

Would that a second Duke of Galliera would endow Italy with a similar college for young ladies! Many suppose that physical education is not proper for the gentler sex. This is a sad mistake. Woman is intended by nature to become a mother, and if she be not in a vigorous state of health her offspring cannot but pay the penalty. It is the duty of all of us to devote our best care to rendering our body as healthy and perfect as we can, but that duty is undeniably paramount in woman.

Eugene Pay, the well-known and renowned French gymnasiarch, observes: "That we find in Genesis that God created woman from a piece of flesh taken from Adam; but that in our actual life the reverse is the case, inasmuch, as everyone knows, it is from the flesh of woman that the embryo develops and becomes a human creature: and it thence follows that it is woman's sacred duty to be brought up so as to be possessed of florid and robust health."

He then adds that women must practise gymnastics if they wish to be "healthy, well-developed, graceful, vigorous, and, especially *handsome*."

I repeat that I wish there were in Italy a Vassar College, as we need henceforth that our women should be educated so as to fully discharge their mission.

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## SECTION II.

### ENGINEERING AND ARCHITECTURE.

#### ADDRESS

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PRESIDENT OF THE SECTION.

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In opening the proceedings of this section, I propose to address some remarks to you on a subject which I trust you will feel to be, at any rate, an appropriate one, and one suggesting many topics, namely—London dwellings. And I have selected such a subject in preference to attempting a general review of the wide field presented by the sanitary aspects of architecture and engineering, believing that the more limited task was one which I could better perform, and that perhaps for once, as a change, it might not be unacceptable to yourselves.

The capital of Great Britain is the most remarkable city of the world for wealth, influence, and extent. Its population equals that of a province, and is singularly well situated for scientific observation on account of its concentration, and of the comparatively uniform conditions under which it is placed. The sanitary state of London will always, for these reasons, attract marked attention. Nor is it devoid of personal interest to most, for there are very few even of those living elsewhere, who have no friend or relation among the vast crowds drawn to the capital by that strange attraction, resembling that of a loadstone, which it exerts over every part of the country.

Lastly, I may as well confess that the subject has suggested itself to me very much from the fact that it has been my lot to live and work as an architect in London for a good many years so that the dwellings of London people, rich and poor, have become familiar to me, and I may be able consequently to speak from personal experience.

Let us, to begin with, consider some of the conditions under which the inhabitants of London live and build their houses, taking first the physical ones of situation, climate, materials, &c., then the social conditions, then those imposed by law, and lastly the economic and financial conditions.

## I.

London stands on a noble tidal river, sufficiently near the estuary for the tide to cause the Thames to rise and fall, and its current to turn backwards twice in the twenty-four hours. The principal tributary near London—the river Lea—falls in just east of the city, and drains the flat part of Essex. A small tributary stream of fine sweet water, the New River, has been entirely absorbed for the water supply of a part of London. Two or three others, as the Fleet and the Ravensbourne, are now sewers. The land north of the Thames is most of it gently undulating, sloping up to a range of tolerably high ground about four miles off, at Hampstead and Highgate.

South of the Thames and lining its banks, there is a great deal of very flat land, and east of the city, both north and south, level moist plains extend for a great distance. Westwards the country is hilly, and high land is also found south of the Thames at some distance.

The subsoil is a dense tenacious firm blue clay, known as the London clay. This is met with at various depths, but never far from the surface, under the whole of London. The surface soil is to a great extent a less compact clay, but in some localities it consists of gravel and sand, and near the southern bank of the river there are many spots where we meet with peat thinly covered with accumulated soil. This peat, I need hardly add, is permeated by the water from the river (which will be found to rise and fall with the tide in any deep excavation), while every where else the rain-water either remains on the surface where that is clay, or only penetrates through a thin pervious upper stratum till it reaches the London clay.

This circumstance combines with the large surface of water in the river and the docks to render the London climate a decidedly damp one, notwithstanding the moderate rainfall. A most noteworthy index of this dampness occurs in the famous November fogs, the worst of which produce a gloom deeper than anything since the Plague of Egypt.

The Thames is the only easily accessible source of water supply, and the only very ready channel for carrying away sewage. It is ill adapted for the former purpose, owing to the inhabited state of its upper reaches, and for the latter, owing

to the effect of the tides. Such improvements as have been made have, as yet, only resulted in mitigating the disadvantages by moving the intake of the various water companies higher and higher up the river, and the outlet of the Metropolitan drainage system lower down, but have not effected a radical reform in either direction.

The City of London was anciently founded on the north side of the river, and down to a time comparatively recent the south bank was not thickly inhabited. As soon as people began to extend beyond the city walls, the phenomenon so common in great cities showed itself, and the wealthy moved westwards, leaving the poor to extend eastwards. Various causes have led to a prodigious increase in the extent of London, and it is now difficult to assign limits to what is almost more a compact province than an extended city. Places that formerly were remote suburban villages have been now completely swallowed up, and many outlying districts that are situated outside the metropolitan boundary are really connected with the heart of London by unbroken lines of streets and houses. You may now go from Highgate on the north to Penge on the south, a distance of about ten miles, or from Stratford on the east to Hammersmith on the west, a distance of about twelve miles, without passing an unoccupied field.

The Commissioner of Police of the Metropolis, in his report for the year 1881 (the last published), states the area of London at 688 square miles, and adds that the population in that year was estimated at 4,788,657 persons, having risen to that enormous figure from 3,808,360 in the year 1871. No doubt at this time (near the close of 1883) it has reached the total of 5,000,000 persons.

It will be easily understood that even the refuse from so large a city constitutes a great difficulty. Much land is now occupied by houses which once was so far out of the way that it was used as a deposit for ashes, dust, and garbage.

London streets, even important ones, are, generally speaking, narrow, and the houses low. In some of the newer districts wide streets have been laid out, and the exigencies of traffic are constantly causing old thoroughfares to be widened and straightened at enormous expense. In many of the oldest parts of London, however, tortuous lanes, and narrow alleys, and blind streets abound, and the houses have little or no land in the shape of forecourt or backyard attached. London enjoys a compensation for her narrow thoroughfares in the number of fine open spaces. The parks have been well called the lungs of London; and, in addition to them, the many squares and the

wide channel of the Thames provide a sensible and welcome relief from the crowded and compact mass of dwelling-houses.

The materials available for building constitute, perhaps, the most important of the physical conditions of any city next to those created by the site on which it is built. No building stone is found within easy reach of London, consequently there are no stone-built dwelling-houses. It is true that here and there an expensively-built house is faced with stone, but even then the heart of the wall is of brick, and for our purposes London houses must be considered as all brick built. London bricks are made of brick earth, with which a portion of ashes or fine coal dust has been mixed. They are hand made and burnt in a clamp, not a kiln, and the effect of great heat upon the particles of coaly matter in the substance of the brick is to ignite them and promote the burning of the bricks equally throughout, leaving it then somewhat porous and light, but hard. The article so produced is called a stock brick; it is not handsome in shape or colour, but is in other respects good to build with if well burnt. Unfortunately a very large number of under-burnt bricks, which are soft and very absorbant of moisture, are produced and, as a rule, used. Sand and gravel are plentiful and mostly of good quality. Good lime is also easily obtained, and beyond this short list all the materials needed for building must be brought from a distance. London is, however, so well supplied with means of land and water carriage that there is little difficulty in obtaining any material in any quantity; and the great demand for timber, slates, and some sorts of stone has stimulated trade and created so much competition that the average prices of many of these are by no means high, and the supply rarely deficient, considering the distance from which they come.

Two excellent artificial building materials are products of the vicinity, and both exceptionably valuable. I allude to Portland cement, the manufacture of which is carried on largely on the banks of the Medway a few miles from London, and to glazed earthenware for drain tiles and similar purposes, which is largely manufactured in Lambeth.

## II.

Turning, now, to what I have called the social conditions, the first, and by far the most conspicuous, is the constant pressure of increasing population. Families are growing up within, and are pouring in from without; for one who leaves London there are twenty who come, and a rapid, restless, resistless growth is the result.

This growth is clearly shewn by the increase of the population in the decennial period above referred to. This amounted, according to the figures already quoted, to an addition of 908,297 persons, or of more than 25 per cent. to the population as it stood in 1871. In these ten years from 1871 to 1881, no fewer than 162,525 houses were built, extending over 500 miles of squares and streets, and the rateable value of the Metropolis rose from £19,809,000 to £26,862,819. In the year 1881 alone 26,170 new houses were built, covering a length of 86 miles and 384 yards.

I have already spoken of the vast size of London, but its constant increase is at least as remarkable. It will be easy to understand that the enormous size and rapid growth of the metropolis, and the constant pressure under which its affairs, of every sort, are transacted, combine to render it most difficult to change anything, or carry out any measure that affects all London. When, for example, the main drainage of London was remodelled, about a quarter of a century ago, it was a colossal work. Improving the water supply of London has, as you all know, proved so much more formidable a business that it has, as yet, defied the efforts of the Legislature; and when, some years ago, measures were taken for obtaining a high-pressure service, it was calculated that, to carry this improvement out in every house in London, would throw upon the inhabitants an expenditure which was reckoned by one of the best authorities in millions of money.

The habits of those occupying this vast area are, of course, diverse in the extreme, but still they are, in some very marked particulars, definite, and have a bearing on house sanitation.

Perhaps the most strongly-marked London peculiarity is the desire to live, or seem to live, in a house of one's own. No Londoner, rich or poor, is at ease living at a boarding-house, at a hotel, or in a building obviously erected for many families. Vast numbers do live in lodgings, but then they prefer a house of such a stamp as might, by an amiable fiction, be supposed to be their own; and, as a consequence, the dwellings of the poor—and not only the poor, but of every class above them—are of moderate size, considering the people who occupy them. One result of this is, that there is very little demand, as yet, for high houses, and that vast spaces of land are occupied by houses of two storeys high.

Another peculiarity—in which, however, the Londoner only shares the national prejudice—is the universal use of open fire-places. No house is heated by anything else, and hardly any room in any house is without its fireplace. The result is of great advantage to each individual, of serious detriment to the

community. Every room has a ventilating tube, of a rough construction, of about 100 inches sectional area, more or less, and this tends to secure a large amount of change of air; but the smoke from the fires which are lit in these countless fireplaces pollutes the air, and makes the London atmosphere unhealthy.

There is also a universal prejudice in favour of the sash window, sometimes playfully called the guillotine, as compared with the casement window, which is equally universal in France. The sash is decidedly more advantageous for a damp climate, and is a better ventilator, whenever it is desirable to open the window a little way.

Many, at any rate, among those who reside in the outskirts, are remarkably ready to migrate from one quarter to another, so much so, that not a few systematically change their dwelling every three years. The result of this is that much less care is taken in the selection of a house, much less money is expended in remedying defects, and many more serious evils are patiently put up with than would be the case were persons more in the habit of living long in one house; in fact, but for this custom a great many serious defects, sanitary and otherwise, would hardly, I think, have become quite so gross and serious as they actually are.

### III.

The third element in determining the conditions under which the Metropolis is built is furnished by the Acts of Parliament that regulate buildings and streets and drains, and the official administration of these Acts.

There have been building Acts in London ever since the period of the Great Fire, mainly directed to diminishing the risk of another general conflagration. Of the Acts now in force, which are numerous, the most important are the Metropolis Local Management Act and the Metropolitan Building Act, with sundry amending Acts. The former of these contains, speaking broadly, the regulations as to drains and streets, the latter those affecting buildings. The central authority for drainage, &c., within the ancient and comparatively small limits of the City proper is the City Commissioners of Sewers, a branch of the Corporation. That for the rest of the Metropolis is the Metropolitan Board of Works—having affiliated to it a series of Local Boards, each consisting of a group of parishes or a single parish. Drainage is under the direction of surveyors, who are the salaried officers of the various Local Boards. The Building Act is administered by a large number of District Surveyors, who are architects in practice, and each entrusted with the supervision of the buildings in one locality.

The Building Act, besides attempting to secure a minimum of strength and solidity in walls, and requiring many precautions against the risk of fire, contains some sanitary regulations of considerable importance and value, though the Management Act is the one mainly directed to sanitation.

In what may be well called the outer zone, outside the Metropolitan area, vast districts have been and are being built over. These localities, so far as they are supervised at all, come under the action of the Public Health Act. Attention is usually paid to their drains, though but very little supervision has, as yet, been extended to the dwelling houses, no bye-laws affecting houses having till lately been passed in some districts. Moreover, where such rules exist, a supervision as thorough as that exercised within the Metropolitan area by District Surveyors, is not provided.

My own impression is that in the parts of London within the Metropolitan area legislation goes as far, or nearly as far, as it can be usefully carried. But there are many points in which Acts of Parliament, however good, and however well enforced, fail, and must fail to secure the public against the effects of their own apathy in everything that relates to the healthiness of their houses, combined with those due to the ignorance and cupidity of builders, who have no desire to do their work well, and little acquaintance with their business.

Legislation, allow me to point out, can only require a certain *minimum* of excellence, and that which is just good enough to evade the penalties due to a breach of an Act of Parliament may yet be very far indeed from what it ought to be; or would be if the public were at all critical as to the sanitary condition and general soundness of their dwellings.

If, however, it is possible to-day to report upon the material and legal conditions under which building is going on, as in the main fairly good, it must not be forgotten that they have not always been so. There was a time when the only sewers were for storm-water, and it was illegal to take drainage from houses into them, and as a result in the older parts of London we constantly come upon cesspools in the most objectionable positions, filled with old decaying matter, and sometimes not altogether disconnected from existing house-drains. There was a time when the window-tax caused openings to be both small and few, and led to dark rooms; and when many of the underground cellars, which it is now illegal to build for occupation as living rooms, except with good provisions as to air space, were tolerated, and when, owing to famine prices, and high duties and legislative enactments, the height of storeys was reduced to a minimum, the materials were saved in very possible way, and

houses which can never be thoroughly healthy or sound were built in large numbers.

## IV.

What I have called the economical or financial conditions under which London has been and is being built next invite our attention. These differ from those which obtain in many parts of England, and, though they may at first sight appear to lie a little outside your legitimate province, they will be found to bear directly on the subject before us, and exert so bad an influence on London houses that you must permit me to lay a hurried sketch of them before you.

It is not the custom in London to buy freehold land for building purposes, unless it be for a public building. Land for dwelling-houses is always taken on lease. The usual term is a remarkably short one. Eighty years is looked upon as a very long term indeed. Sixty years is a very usual term, but fifty, or even forty years, are not unusual. Building leases rarely contain any provision for renewal or extension of the term, so as a rule the transaction amounts to this, that the freeholder lends his land for say sixty years on the conditions that he receives an annual rental, that buildings such as he approves are put up, and that at the end of sixty years the land, with the buildings on it, reverts back to him. There are also usually, covenants that whatever is erected shall be kept in repair by the person building, fair wear and tear excepted.

The rent charged for the land is termed a ground rent. It varies according to the situation, between the extremely wide limits of half a penny, or less, to half a sovereign, or more, per superficial foot per annum; but in ordinary practice for dwelling-houses it is about one-sixth to one-eighth of the rental, which will be obtained for the house from an occupier, and it forms a first charge on the house, so that, if it be left unpaid, the freeholder can seize the house. As a consequence, ground rents, being very amply secured, usually command a high price in the market.

Let us suppose the owner of land bringing in an agricultural rent as pasture-land finds that one of the railways which connect the suburbs with London is making a station near his property. His land immediately becomes eligible as building-land, and is thrown into the market, with the result that, sooner or later, and without any expense to him, it is let. Ordinarily, a large plot of such land is taken by a speculative person, or middle-man, who can command a little money and understands this kind of business. The middle-man makes roads, and perhaps drains, and lets plots fronting these roads to

builders, who, with borrowed money, proceed to erect houses. If the speculation succeeds these houses in due time find tenants, and immediately after that the series of interests thus created are usually sold by the persons who created them, to other persons, who buy them purely as commercial speculations or investments. The freeholder gets for his share ground rents, created without expense or trouble of any sort, and his share is a very saleable commodity, while, sixty years hence, or so, the entire estate, with the ruins of the houses, will fall into the hands of his representatives. The middle-man, who has had much more trouble and some expense, has also a share, sometimes a considerable share, of the ground rents, for he arranges to let the ground in plots to builders for considerably more than he has to pay for it as a whole. These enhanced ground rents he sells, and this concludes his share in the whole transaction. More eager sellers than the middle-man, and far more eager than the freeholder, are, however, the actual builders, who are, generally speaking, men with no capital of their own, trading on the verge of bankruptcy, and depending for their profit mainly upon their being able to sell such interest as they have in the houses they build promptly, and for a sum larger than their outlay in building materials and wages, plus the repayment of borrowed money, interest, and professional charges.

Such is the machinery by which the larger part of the dwelling-houses in London are erected. Let us see now how it works—for the good or ill of the tenant.

First it provides him a house of some sort at the point where he wants it, and with about the requisite number of rooms; and I will go so far as to say that it provides the average Londoner with a house that seems to suit him, for houses thus built are readily taken but it will be seen that there is absolutely no one whose permanent interest it is that the buildings shall be sound, sweet, and safe to occupy. The original landlord is sure of his ground-rents and has no further interest, the middleman when he exists, and the builder, at any rate, seek to release themselves from any connection with the property at an early day, and the unlucky tenant, still more unlucky if he has bought the lease of his own house, finds that there is no one to whom he can turn for any redress or remedy, whatever goes wrong.

There is, indeed, one advantage which, on estates, when landlords have a sense of public duty, the system of building leases does possess, and it is this:—

The landowner can lay down the conditions under which alone buildings shall be put up, and can enforce them; but for one who does so in the interests of public health and for the

welfare of the future occupiers of the houses, ninety and nine only frame such regulations as conduce to the benefit of their own pockets, and are careful to shackle the speculating builder with few or no conditions of a character which he might consider onerous, and which might consequently induce him to transfer himself and his building operations to some neighbouring estate.

It may, perhaps, be asked where in this system does the architect come in? My answer is, nowhere. The bulk of London houses are not designed by architects and not superintended by them. The first and last time, when any architect looks into them with a critical eye is in too many cases only when they are offered as security for a mortgage, and a professional opinion, not upon their sanitary state, but upon their commercial value (a very different matter) is asked for. I am anxious to put this upon record, because persons occupying houses full of defects are only too apt to take it for granted that some member of the profession to which I have the honour to belong must have been charged with the supervision of the row or square in which they dwell, and that to this unknown architect's neglect of a duty which was never cast upon him are they indebted for attacks of typhoid or diphtheria, or the risk of them.

#### V.

Let us now turn to the actual London as it has grown up under the conditions I have endeavoured to sketch. To accomplish this I will invite you now to accompany me on a short tour of inspection among dwelling-houses of various classes in the centre and suburbs of London.

We will begin with a house of the very first class, with the condition of which I am well acquainted, one occupying an exceptionally good and airy as well as fashionable situation. This house has had for tenant one person at least of the very highest official and social position. It has been built probably about fifty years, and is one of several forming a row. The first floor contains a magnificent suite of reception rooms, and the whole is a residence fit, and only fit, for a nobleman. Here we shall find some of the bedroom, and many corridor and closet windows opening into areas of great height and comparatively small dimensions, one closet with no external light or opening of any sort, two storeys of basement rooms and vaults where air stagnates and cannot, except to a very limited extent, be changed, and drainage presenting nearly every defect that could be met with. The main drain ran from back to front under the basement floor. It was originally a brick drain, but part of it had

been carelessly replaced by tile. The brick portion had leaked on all sides, and there was a foul accumulation under the floors of several basement rooms. Sinks, with direct communication with the drains, were furnished solely with the traditional bell trap, and on the first floor a bath had been placed in a dark recess out of the principal bedroom, with waste and overflow pipes taken into the drainage system and trapped; but as the bath was rarely used the traps were all dry, and so a constant stream of sewer gas was poured into the room, where probably during the greater part of the winter a fire would be kept up to insure its being drawn in at a brisk rate. Overflow pipes from cisterns were taken direct into places from which contamination was inevitable, and, if the colour of the scum on the top of the water was any clue, did rise. There was no ventilations of drains and no disconnection of sinks.

Of course many of these defects admitted of a remedy of one sort or another, and I trust that none of them that was remediable could be found to-day if you went to look for them, but I quote them as shewing what existed till very lately in one house of a high class, and undoubtedly exists in many others of the most commanding exterior, and for that matter, interior also.

Take another case of a moderate-sized family house, probably rather older than the last, and in the neighbourhood of one of the West End squares that passed through my hands for additions and repairs some years ago. I hardly expected to have to re-model the drainage, as that was understood to have been done; but in the course of the work the floor of the kitchen, a building on the basement level and behind the main house, was taken up to put in an underground flue. On opening the ground, so bad a smell was met with, that a thorough exploration became necessary. The whole basement floor was taken up, and it was found that the house stood on four feet of made ground—that is to say—material brought to the site. This material appeared to have consisted of the emptyings of cesspools, and the scrapings of roads in about equal proportions, and the walls had actually been built on broad platforms of plank floated on the top of this soft pestilent mess. The whole was removed, the clerk of works being, by-the-bye, nearly killed by the effects of the bad air inhaled, and all the walls were underpinned, and that house is sound and sweet; but it has neighbours right and left of it, and for anything I know to the contrary, they stand on exactly the same mouldering mass of corruption which underlay this one.

Come to such a house with a shop as we shall find in any street in the West-End of London. The shop occupies the whole of the plot of land, having been pushed as far back as

possible, over the back-yard or garden, to make as much room as could be got. Below it is a basement all but devoid of air, getting some light, however, at the front. The area into which it opens has been partly paved over leaving an opening with an iron grating which has been recently removed, and the opening covered with patent reflecting glass lights impervious to air. A series of vaults under the foot pavement of the street open out of this area, and if one of them is a coal-cellar, the other usually contains a closet and a foul dustbin, and a gully grating, probably broken, allows the drain below to add a fine flavouring to the choice collection of smells derived from other sources. This basement is often used as a kitchen, and it will be well if we do not find hidden away in some damp and dark corner the servant's bedstead.

The upper rooms are used as living rooms, or let as lodgings, and in the top storey under the slates, cold in winter and hot in summer, is a series of attics, where those who sleep in them are at the mercy of every wind that blows.

Now come across the Thames with me, and let us pay a visit to the houses of the very poor in Lambeth, or Southwark, or Bermondsey. We shall find large spaces thickly covered by dingy two-storeyed houses, in many cases fronting to thoroughfares so narrow and tortuous that they clearly were once country lanes built upon as the need for houses arose, without any attempt being made either to straighten or widen them. The houses mostly consist of six rooms—three on a floor. But here and there are smaller ones of four rooms only; while, sometimes, a few three-storeyed tenements break the line. The storeys are low, rooms small, walls thin—one brick thick only, bulged, cracked and falling, and mortar decaying out of the joints; the roofs are covered with tiles, and let the water in with every shower; the plaster is falling from the ceilings and partitions, the walls foul with smoke and dirt, floors worn out, windows decayed and rattling in their failing frames, hearth-stones cracked and stove grates broken; sink and scullery, where there is a scullery, foul and appendages filthy, and bordering on ruin; cistern small, dirty, exposed to the air, and placed where it is most likely to get contaminated—often only one between two houses. The whole place is enough to break one's heart and to drag down the people who live in it to degradation.

It has from time to time been my duty to visit houses as bad as this, if not worse. Every room would be occupied by a different family or lodger. And I am bound to say that while it is almost impossible to fancy degradation much lower than I have seen in some inhabitants, in not a few instances it has been clear that even the depressing surroundings, if they preyed on health

and spirits, had not been able to extinguish self-respect. I have often come upon one room in such a house neat, clean, newly papered and freshly plastered by the hands of the tenant himself, or herself, a flower-pot or two in the rickety window, and a bit or two of furniture, that if it has seen better days, is still respectable and serviceable; and I have felt that the people whom even this class of hovel could not kill and did not degrade were worthy of something more like a home.

It will hardly, I think, be necessary to take you through a longer series of individual cases to induce you to believe that much of the older parts of London consists of houses that are unhealthy owing to defective sites, bad drainage, bad plumbing, defective water storage, the absence of proper air space, the dampness and foulness of basements; the unsoundness of attics and upper storeys, and the narrowness of the thoroughfares in which they stand; and this, notwithstanding the exceptional occurrence, in some localities of fine old houses admirably built, and with good spaces in front and rear.

The outskirts and suburbs, on the whole, present at first sight, a more encouraging aspect; and dwelling-houses are no doubt better situated as regards air space round them, and to some extent enjoy a purer atmosphere; but the extent to which systematic neglect of proper precautions and the paring down of everything, to the minutest shed is carried, is almost incredible. All those appliances connected with drainage and water supply which we, in our wisdom, consider it best to hide from sight, are almost always ill-done, and generally ill-understood, so that a direct danger to health lurks behind skirtings and pipe-casings, and below the floors of many a showy suburban villa, or neat semi-detached residence, although it may be cleverly enough planned, prettily papered, and tidily painted, and generally attractive looking.

A very large number of dwellings for the working classes have been erected in the suburbs of London, and though these are not free from defects of many sorts, and are always very cheaply put together, yet, owing to the comparatively wide space of land in the shape of forecourt and back-garden belonging to them, they are far more healthy and better than the houses which operatives occupy in the heart of London. They are almost always constructed two storeys high, and are built to be occupied by two families. Thus a six-roomed cottage will divide into two three-roomed tenements, identical, or nearly so, in plan, and having separate access to the back yard or garden. Many of these are outside the metropolitan area, and have been very ill looked after; but where they stand within the boundary, or in those suburban localities where the supervision has been

strict, they really form fairly healthy and comfortable workmen's houses.

## VI.

Having now pointed out some of the evils under which residents in the Metropolis suffer, I wish, in conclusion, to draw attention to some of the remedies.

It will be understood that I do not much advocate fresh legislation, unless, indeed, for such special objects as are definite and as cannot be compassed otherwise. There is a great deal possible with existing Acts, especially if every district round London were to carry out its duties, and avail itself of its powers under the Public Health Act to the full, and if the Model Bye-laws of the Local Government Board were uniformly adopted and efficiently carried out. The true cure for many of these evils is, however, to be sought in the operation of an enlightened public opinion. When once the public learn to call in the aid of the Medical Officer of Health or the Inspector of Nuisances when anything is seriously wrong, we shall be on the way to improvement; but if we can once create a demand for healthy houses, and induce people to look out for sanitary provisions as they now look out for pretty wall-papers when taking a house, the battle will be won. The moment it becomes the interest of persons who own or build houses to supply a healthy article, because anything else will not command a market, healthy houses will be built; and a society like the one which has called us together this day is likely to be of inestimable service, not to London only, but to all England, if it will but continue to rouse public attention to the dangers of unhealthy dwellings and to put forth reliable information as to the defects of bad, and the merits of good modes of sanitation.

I look for great benefit from the action of those societies which have devoted themselves to supplying sound advice on the sanitary state of dwelling houses. The Sanitary Assurance Association, with which I have the honour to be connected, and the kindred societies, by their very existence, act as a warning to the householder that danger is to be apprehended, and by their organization afford him reliable advice and assistance on matters with which he is not himself able to deal.

The erection of houses in flats, though familiar enough in Scotland, is a novelty and in some respects an improvement in London.

It began with buildings for labourers' dwellings, and has now extended to middle-class, and even to highly-rented dwellings.

It has been very much overlooked by philanthropists and others that buildings in flats are entirely opposed to the pre-

judices of Englishmen of every class, and that nothing but the kind of inexorable pressure which the exigencies of life in a great city seem to exert would probably ever have induced London people to take to them; though there is little reason to doubt that once fairly tried, they will be found useful by rich and poor alike. We think when we have erected a pile of comfortable dwellings that the people for whom they are intended will flock to them, but the average London artizan will say, if he follows the impulses of his habits and prejudices, "Thank you, I am not going to live under the care of an inspector in a place which looks for all the world as if I was in the work-house." And his employer, if we have been building a bigger class of flats, will say: "I don't care to occupy a place that looks as if I was stopping at a hotel. I can afford to pay for a roof of my own over my head, and an Englishman's house is his castle."

In spite of this very serious drawback flats have, in a rather long series of years, lived down part of their unpopularity. There are many persons, in every rank of life, to whom it is a matter of necessity, and many more to whom it is extremely desirable, to live within a quarter of a mile of a certain spot; and some of these will sooner live in flats than migrate if nothing but flats are to be had. The better educated middle classes also, of course, include many who have travelled and seen how people in the cities of Scotland, France, Austria and America willingly occupy residences of this sort.

Houses in flats enable a larger number of persons or families to occupy an eligible site than could do so before. They have generally, if not always, been designed by architects and built, not by speculators, but by *bona fide* contractors, and under the superintendence of the architects who designed them; so the public has some guarantee of their being well contrived and soundly built. The walls are necessarily thick, the sanitary fittings are generally thoroughly good and in good order, and the whole structure is better than the usual London house. The upper floors at any rate give, in addition to warmth and dryness, a rather purer air, and catch more sun, and if the house be constructed with a lift, as is becoming usual in the largest of these establishments, these floors are as thoroughly accessible as the lowest ones.

Without denying that something of prejudice has to be overcome, and that there are reasonable objections upon which that prejudice is founded, which must be waived in view of the great advantages of the system, I have no hesitation in saying that the occupants of well-built flats are, on the whole, in much better sanitary circumstances than the majority of their neigh-



bours in adjoining streets, who occupy rows of ordinary dwelling-houses.

Something may be hoped also from the creation of joint-stock companies undertaking building speculations. There are many so-called building societies in London, but most of them are only buyers of houses, and a badly built house, if it is sure to command a rent, will not be declined because it is insanitary. At present the operations of joint-stock companies have been mainly restricted to labourers' dwellings, in erecting which they have built in a far sounder manner than private speculators, and yet have mostly managed to realise a fair profit. The building of ordinary houses in the suburbs, and of houses in flats at the main centres of London, is a great field open for such enterprise well directed; and there can be no doubt that a good public company building as an investment, might erect houses, which, from their sound construction, would be a great boon to the householder, with a very fair prospect of profitable return.

Some very large private firms or individuals have of late become engaged in the business of supplying London with houses. Some of these are doing their work well, and are becoming alive to the fact that a sound healthy house is an article which will, sooner or later, as sanitary knowledge extends, be at a premium, if its excellencies are not much appreciated yet; and as some of these people fortunately build, in part, at least, for investment, the worst of the evils of the leasehold tenure system are likely to be by degrees overcome. If it were possible to render leases for long terms customary, and to make landowners sensible of the responsibility which really rests upon them in respect of the houses they allow to be built on their land, and if, in addition, we could induce capitalists to build as an investment, so that they would have a direct interest in the solidity of what was put up, then surely we might hope that what remains to be built or rebuilt in London, would be better fitted for living in than the houses hitherto erected.

But there remains one part of the community whose case, already glanced at in one of my descriptions, is so bad that no amount of public opinion, thought and care had for a long time proved able to effect a radical improvement, and so desperate that London cannot afford to wait. I allude to the operatives' homes in those old parts of London where the streets are narrowest and the houses worst. This question has forced itself upon the attention of the legislature, and will probably be soon again before Parliament. Its merits and the circumstances connected with it are probably too well-known in this room for it to be

necessary to state them at any length, but my address would be incomplete without some short account of what has been done to improve the dwellings of London working people during a period which may be approximately stated at nearly, if not quite, fifty years.

This movement began in a very moderate way, and has gone on steadily increasing. The promoters of it have been doing good work, partly by spreading information and influencing the public mind, but chiefly by improving existing tenements or erecting new ones for the accommodation of the industrial classes. We have to recall the efforts of pioneers like Mr. George Godwin, Sir Robert Rawlinson, and Mr. Edwin Chadwick; the unostentatious labours of Miss Octavia Hill, and the band of energetic workers whom she has called round her; the commercial companies started, like the one inspired by the zeal of Sir Sydney Waterlow, with the avowed object of showing that improved dwellings for the poor can be made to pay; the private speculations that have followed in the wake of these companies, and the labours of the great corporation established to administer the munificent gift and subsequent legacy of Mr. George Peabody. These have all contributed to an aggregate result which has reached larger dimensions than many are aware of, and which is swelling year by year.

In the summer of 1881 the amount of accommodation provided by public or semi-public agencies in London reached 11,000 families, or estimating an average of 5 persons in a family, 55,000 persons, at an outlay of about £1,900,000; and there were buildings in hand, or recently erected by private builders, and by the Peabody Trustees which might be estimated as involving an outlay of not less than £900,000 more, and calculated to increase the accommodation by probably 27,000 persons. I am not prepared to say that the whole of this large estimated increase, that is to say up to 82,000 persons, has as yet been realized, but the greater part of it has, and probably not fewer than between 70,000 and 80,000 persons now inhabit the improved dwellings provided by these agencies, nearly the whole of them being moderately lofty dwellings, arranged as flats, and with common staircases.

The urgent need of improvement in the dwellings of the working classes in London and elsewhere, and the difficulty of attaining it have been recognised as so serious that repeated Acts of Parliament have been passed to facilitate the work. I will condense from the interesting Report of a Committee of the House, on Artizans and Labourers' Dwellings, dated 19 June, 1882, the account there given of the chief Acts.

Mr. Torrens' Acts of 1868 and 79 "proceed upon the principle

that the duty of maintaining his houses in proper order falls upon the owner, and that if he fails in his duty, the law is justified in stepping in and compelling him to perform it. Under these Acts, if an inhabited building is found in a condition dangerous to health, or to be unfit for human habitation, the local authority has power to order the owner to remove the premises or to execute such alterations as are necessary, and in default the authority may shut up the premises, or pull them down, or execute the alterations at the owner's expense." The Act of 1879 further gives the local authority power to purchase the premises, and to hold them in trust so far as the Metropolis is concerned: 1st, for providing suitable dwellings for labouring people, either by way of improvement or by rebuilding; 2nd, for providing open spaces.

These Acts have been used to some extent in London, but not at all to the extent to which they ought to have been. The local authorities on whom the burden and expense of carrying them out would fall have frequently held their hands, hoping that a Metropolitan improvement (under Mr. Cross's Acts, about to be referred to) would undertake the matter for them. And I fancy, also, that unostentatious quiet work, such as these Acts permit, is a little apt to drag, unless some external influence is brought to bear. Perhaps the best thing that could happen would be for the administration of these Acts to be transferred from the Local Boards to the Metropolitan Board to be by them carried out much in the same way as those clauses of the London Building Act which relate to ruinous and dangerous structures.

Mr. Cross's Acts of 1875 and 1879 are better known, and the action taken under them is much more conspicuously before the public. "They contemplate dealing with whole areas where the houses are so structurally defective as to be incapable of repair, and so ill placed with reference to each other as to require, to bring them up to a proper sanitary standard, nothing short of demolition and reconstruction; accordingly in this case the local authority, armed with compulsory powers, at once enters as a purchaser, and on completion of the purchase forthwith proceeds to a scheme of reconstruction." At the date of the report already quoted, namely, six years after the passing of the principal Act, only fourteen areas had been dealt with by the Metropolitan Board under these Acts, but great and, to some extent, unexpected delays and difficulties have been experienced in carrying the Acts out, the most serious difficulty being the enormous expense. Thus, these fourteen areas, containing about forty-two acres, have cost to acquire no less a sum than £1,662,000, including expenses and the formation of

streets. These streets have absorbed about nine acres of the land.

The Act of 1875 imposed the obligation to house on the sites cleared as many persons as were displaced; 20,335 persons were displaced, and provisional orders for providing accommodation for 22,753 persons were confirmed by Parliament. It has been found quite impossible to induce the Peabody trustees or any of the companies that build labourers' dwellings to pay a price for this land approaching the cost of it or its value for commercial purposes, and as long as the acquisition of it is coupled with the condition that the buildings are to be always used as operatives' dwellings this must always be the case. Accordingly the land sold has been disposed of at about one-third of its commercial value.

The estimated recoupment is about £370,000, leaving a net loss of £1,211,336, or, if the cost of making new streets be not included in the transaction, £1,115,836. Had the necessity for retaining workmen's dwellings always on the site not existed, it is estimated that the loss would have been £560,000 less.

The bare mention of these figures shows that such work must take a long time, and involve an immense outlay of public money. Probably it is worth all that it costs, but its serviceableness to the poor is very much interfered with by the fact that large areas are cleared of their inhabitants at one time. The people who are turned out have to crowd in where they can, and those who cannot migrate to the suburbs—the very persons whom it is intended to benefit—are subject to the most serious inconveniences; long years pass before the new buildings are erected on the spot, and by that time most of the individuals displaced have taken root elsewhere, so that very few of them are found to re-occupy the area. Nor is it clear that the new accommodation is adapted to their wants. I am of opinion that even the tenements built by the Peabody Trustees, and unquestionably those built by most of the societies, are too good for the very poor, and that from these two causes, though no doubt we are improving London, we are not improving the condition of the labouring and poor inhabitants of the very areas which are dealt with.

The Metropolitan Street Improvements Act of 1872 also bears upon the question before us, but not so directly, and it is hardly necessary to prolong this address by referring to its operation.

In bringing these observations to a close, I cannot but express my regret that the account which I had to give of the dwelling-houses which go to make up the richest and largest city in the Western World could not be more favourable con-

sistently with truth. One thing at least is clear. London affords now, and must for years to come afford an ample field for the energies of those who devote themselves to the pursuit of sanitary science, the diffusion of sanitary knowledge, and the performance of sanitary work. The cry for help is a loud one, and, believe me, legislation is almost powerless to render that help, even if political strife left our statesmen any leisure for domestic improvements. But the good done by an organization which will set public opinion in motion, and keep it going, which will be unwearied in its warnings, its exhortations and its diffusion of sound information must, in time, be simply incalculable. The average London house can never be made thoroughly strong and sturdy till the happy moment for pulling it down and erecting something better arrives, but it may, generally speaking, be made safe to live in by a moderate outlay, if directed wisely. If, then, it is in the power of each householder to make his home safe, our duty is plainly—first, to give him no rest till he wakes up to the necessity of so doing, and then to diffuse correct information so widely that there may be little difficulty in his finding out what it is that he ought to do. Let me, therefore, in conclusion, heartily congratulate this Congress on the important work which lies before it, and urge the Congress collectively, and every member individually, not to relax their exertions in this good work, and especially to direct their best efforts and their most strenuous exertions to the advantage of the unfortunate inhabitants of the Metropolis of Great Britain.

Dr. RICHARDSON, F.R.S., said the members of the Congress might congratulate themselves on hearing the address that had been read, because he was quite sure that when in the future the history of this country came to be written, and London to be described, that essay would be looked upon as quite historical. A more faithful view of the condition of London he had never listened to, and he did not think there had ever been a more faithful record put upon paper. He said so with a conversance of London which few men possessed. London was to him a great field of observation, and he confirmed all that Professor Roger Smith had said in regard to its present condition. When they went into the houses of the upper class, the houses of the middle class, or the houses of the poor, and of the very poor, those pictures which Professor Smith had described were seen. Amongst the better-class houses things were often worse than in those of middle class. He had within the last few years visited a house where fourteen persons could sleep in the basement, truckle

beds being fastened to the wall to admit of their being folded up during the day. There was no privacy nor ventilation nor any idea of cleanliness in such apartments. In a very large house, where he went to see a case of typhoid fever, the very cushions of the fine drawing room were odorous, not of perfume of flowers or anything sweet, but of the sewer; and in that case—and the same could be said of a number of houses in the same terrace—the soil pipe was full up to the water-closet. In another house, in which he himself had some interest, they opened a drain which was eighteen inches square, extending from back to front, and from it removed fifty barrow-loads of retained sewage. That was a representation of what might be called one of an order of first-class square houses; and how far such evils extended through London it was impossible to say. The wonder was that London was so healthy. It seemed incredible to him that London should present a mortality of no more than 22 in the thousand per annum, and it showed how pre-eminently healthy it would be if it could be given a fair chance of healthiness. If they, as a Sanitary Institute, could have their own way, they would soon bring down that 22 per cent. to 15 per cent. in the thousand annually.

It seemed almost impossible during the present time, when the land difficulty was so pressing, to do anything that was practical in London. He would go farther than Professor Smith, and say that the weight of the difficulty which had now to be met and contended with lay in the length of leases and the distribution of property. No man would bestow much money or care in erecting houses till the time came when he should be able to build for more than 40 or 50 years. The great reforms in London buildings must first take place in reference to the distribution of landed property. That done, he thought the difficulty would soon be solved. The people were beginning to call out for themselves, and amongst the poor and working classes of London there was a general feeling, now that they were becoming educated, not only that they ought to have that which they wished, but that they would have it; and that they would force their wishes from unwilling hands was one of the things which might be regarded as a certainty. He proposed that a most cordial vote of thanks be accorded to Professor Smith for his valuable communication.

Professor F. DE CHAUMONT, M.D., F.R.S., seconded the motion. He said that the paper read by Professor Roger Smith was one of extreme value. Although it might be thought that an address in Glasgow on the subject of London dwellings was perhaps of less interest than other subjects, that would be a wrong view to take of the case. Though the paper had special reference to London, its principles were applicable to every city in the kingdom. He thought that he might also remark with reference to some somewhat sharp criticism upon the work of the Congress yesterday which had appeared in the press that morning in reference to the character of the papers which had been read and the discussions that had taken place at the Congress, that the object of the Sanitary Institute was not to be running

about to find something new to present to the public, but rather to keep on "pegging away" at those very truths and points to be attended to, but which were not attended to. It might be certainly a little uninteresting to hear that houses ought to be clean; that sanitarians ought to be patient; that drains ought to be trapped, and so on. The thing had all been said before; but, as he had already remarked, the thing was not being *done*. Not only so, but as it would not be done unless they went on, as Shakespeare said, with "damnable iteration" calling attention to it, it was perfectly clear that it was their duty to bring these subjects before the public as well as more general principles. The paper read by Professor Roger Smith would, he thought, fully justify the conduct of the Congress. He did not mean to say that their proceedings were beyond criticism, but at the same time he thought the view that had been taken of them was a limited and erroneous one, and if it were reconsidered, he thought it would be seen that their proceedings were not perhaps of the small interest and slight usefulness which it had been hinted they were.

Professor HUMPHRY said he did not think anything could be more important than the exposure of the evils that were found in the houses of the Metropolis that had been made by Professor Roger Smith. London was becoming more and more important to the empire, not only on account of the vast numbers that are accumulating in it, but also from the fact that it would be more or less an example to all other towns in the kingdom.

Professor ROGER SMITH, in acknowledging the compliment, said, with regard to what Dr. Richardson had said upon the very low death-rate of London, that was of course partly due to its certainly favourable conditions of climate, but they must not forget that the wonderful increase of London was necessarily the cause of a low death-rate, because almost all the people who come from the provinces were in the prime of life, and had passed all the dangers of infancy and childhood. The increase was one of perfectly healthy people, and but for that he was afraid that London would not be found quite so salubrious a city as the study of statistics alone would make them believe.

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On "The advantages of Low Ceilings in Small Houses," by  
JOHN HONEYMAN, F.R.I.B.A.

The height of the ceiling affects both the owner and the occupier of a dwelling, but chiefly the occupier; for whereas it affects the owner's pocket only, it affects both the pocket, the comfort, and the health of the occupier. If the owner is perfectly free, he will simply adopt the height of ceiling which

he thinks will enable him to get the largest return from his property. It by no means follows that he will adopt a low pitch. He may think that high ceilings will make his houses more attractive; in certain circumstances yielding higher rents, or at least securing a better command or a better class of tenants. But if the ground he builds upon is dear, and the demand for houses great, he will be tempted to make the storeys low and increase their number; and in so doing he will be doing what is at once best for himself, and also—unless he make the rooms small as well as low—what is best for the community.

But in most of our large towns and populous places a person about to build is not free. He must build in conformity with regulations limiting the total height of his building, and prescribing, among other things, the height of ceilings, and the cubic capacity of rooms. Hampered by such restrictions he cannot suit his houses to the requirements of the districts where they are wanted; he must make them as Parliament has been pleased to prescribe, however extravagant or unsuitable for the people who require them, and he must get a profitable return for his expenditure from these very people who don't wish extravagance, and can't afford to pay for it, but who in the circumstances either *must* pay for it or do without dwellings. For example, if the Police Bill drafted by the Corporation of Glasgow became law, a man having land bounded by a new street forty feet wide would not be allowed to erect a tenement of dwellings in that street more than two storeys high, with this necessary result that his return for the cost of land and buildings must be got from two tenants instead of from four or six. If left to his own discretion he would, at a small additional outlay, make his buildings say four storeys high, and—profitably to himself—accommodate on the same ground twice the number of tenants at lower rents. Now, assuming that the four houses, or storeys erected in this way were as good as the two made in conformity with the Police Bill, it must be perfectly obvious that, whether the owner made more out of the transactions or not, the erection of the four would be distinctly most advantageous for the tenants, and therefore for the community at large; because in this way twice the number of people would get accommodation where they want it—not where the Corporation say they ought to want it—and they would get it at a greatly reduced rent, both, I submit, considerations of the very greatest importance, and having a direct bearing on sanitary questions of great interest. Of course, if it could be proved that high ceilings and low tenements were essential to secure healthy conditions, a great deal could be said in favour of compulsory sanitation in that direction, although

even in that case I should be prepared to say a great deal against it; but it has been abundantly proved—and this was very clearly brought out at the Newcastle Congress—that there is no necessary connection between density of population and a high death-rate; and, I may say, that the very same statistics—namely, those of the various Improved Dwellings' Companies—which most conclusively prove this, as conclusively show that there is quite as little connection between low ceilings and a high death-rate; as in all these dwellings the ceilings are low and the storeys numerous. Most people however, in this part of the country at all events, I may venture to say most sanitarians, still cling to the idea that—*ceteris paribus*—a room with a high ceiling is a more healthy dwelling than one with a low ceiling. Now, I wish to strike at the root of this prejudice which as affecting legislation has had and may—unless eradicated—still have most pernicious results; and I hope to be able to prove that, other things being equal,—that is, that, given two rooms of different heights but of the same capacity, having the same size of chimney opening, the same area of window, door, and vent openings, the lowest will be the cheapest, the most commodious, the most comfortable, and the healthiest dwelling of the two.

I shall dwell chiefly on the sanitary aspect of the question, merely devoting a sentence or two to the other important points I have mentioned. One of these, the greater extent of floor area in a low than in a high room of the same capacity, is self evident, and the advantage of this to the occupant is equally obvious. The economy of the low pitch is not quite so readily understood. For the sake of illustration, I have calculated the rents which must be charged for houses of 2,000 feet capacity in order to yield 5 per cent., arranged in three different ways—First, in tenements of two storeys of ten feet; second, in tenements of three storeys of eight feet; and, third, in tenements of four storeys of eight feet; allowing a proportionate area of vacant ground in each case; and I find that in the first of these—the two-storey tenement—the rent would require to be £9 6s. 0d. in the three-storey tenement it would be £8 5s. 0d., and in the four-storey tenement, £7 14s. 0d.; so that the artizan contented with an eight feet ceiling, might have a roomier house for £7 14s. 0d. than he can possibly get for less than £9 6s. 0d., where restrictions already referred to exist. In other words, he is compelled to pay £2 8s. 0d. per annum, or fully a third more than might otherwise be required, and at the same time he must be content to occupy a smaller house in a less convenient locality, without one solitary compensating benefit, merely because some sanitarians, chiefly municipal, think such treatment good for

him. To my mind it is unmitigatedly bad, and a very serious matter for our working classes. For observe, it is impossible to take this £2 8s. 0d. out of the owner's pocket, the tenant must pay every penny of it, as of course, no builder in his senses is going to put up dwellings which will not yield him 5 per cent. at least.

But the important question remains—would the low house be healthy as well as cheap and roomy? In my opinion it would, and in a greater degree than the high house. The means of ventilation, which alone are admissible in such dwellings, being of the simplest possible kind, it will be found that it is easier to ventilate a low room than a high one by their agency. Practically, the ventilation must be effected by the admission of fresh air by doors and windows—or round these when closed—through the badly fitting joints of floors and skirting boards, or by special inlets not intolerable to the inmates (if such can be devised) and the extraction of air by the chimney. Such means have been found sufficient, except where apartments are overcrowded, that is, except where the chimney is insufficient as an extractor. We may take it that in any room having a door, a window, and an open fireplace, three or four people may sleep safely, and the condition of the air will depend not so much on the capacity of the room, as on the area and draught of the chimney. Those who are familiar with the subject will, I trust, excuse me if I say for the information of others in this mixed audience, that even such a capacity as is prescribed in our Police Bill—400 cubic feet to each adult—is utterly insufficient unless we have along with that a constant and rapid change of air. But to effect this change so that the whole volume shall be kept up to a safe standard of purity, it is necessary that the fresh air should be properly distributed and permeate the whole apartment. This point I fear is sometimes lost sight of. For example, if we take a room of 2,000 cubic feet with five inmates, to keep the air, not as pure as we could wish, but in a tolerably healthy condition, at least 5,000 cubic feet of fresh air would require to be passed through the room per hour; and as an ordinary open fire will easily extract that quantity, there seems to be no great difficulty about it. But, observe it is quite possible to pass all that quantity through the room without purifying the atmosphere in any appreciable degree; we may let it all in at one side of the room and up the chimney at the other, leaving the air breathed by the inmates impure and poisonous, perhaps fatally; so that the more complete the distribution of the fresh air, the more beneficial will the ventilation be. Now the facility of distribution will depend to a large extent on the form of the room. If the room (always

bearing in mind that we are speaking of rooms of the same cubic capacity) be high in proportion to its area, and the fresh air be admitted in the usual way referred to, the lower part only will be ventilated, and a large proportion of its atmosphere will remain impure; whereas, if it be low in proportion to its area it will all be well ventilated, and the inmates will get the full benefit of the room's capacity. In the other case they would not, as a considerable proportion of the high room would remain stagnant and foul—a condition objectionable on other grounds.

But—it may perhaps be said—granting that the air in the upper part of the room, say a fourth part of the total volume, remains unaffected, and that the 5000 feet per hour allowance is distributed in the lower part only, is that not exactly where the fresh air is wanted? Certainly, but fresh air is not *the only thing* that is wanted in an artizan's house. Warmth and freedom from draughts are only second in importance—if, indeed, they are second. There are delicate women and tender babes to be considered, as well as robust men, and our mortality tables painfully remind us of the fact that that consideration is far too much overlooked. No doubt by the passage of a given quantity of air through a room you can make a part fresher than the whole, but it is evident that as you reduce the part affected you necessarily increase the velocity and lower the temperature of the current; indeed, you can, without difficulty, carry this reduction so far that with the aid of a good-going fire, you may obtain a very high standard of purity, and a cold draught, of perhaps 150 feet per minute, in the only habitable part of the room, that is in the only part where the air is fit to be breathed. Our object of course must be to make every part of a room habitable, and to leave not one stagnant corner in it. In this way alone can we secure in the highest degree both essentials of a healthy dwelling—pure air, and warmth. Now, we shall find that the lower the ceiling the more easily can this combination be secured.

Let us look a little more particularly at the superior facilities which the low room offers. The top of the door, from which I think the greater part of the air required should come, is necessarily near the ceiling, and the current will therefore completely disturb the upper stratum of air. The air from the window will have the same effect in a smaller degree, and both currents will be warmed by contact with the ceiling. We need never look to the floor as an air-warmer, except to a limited extent near the fire; a much larger area of the ceiling is heated, and in a low room there is not only a much larger area of ceiling to heat than there is in a high room, but the radiant heat upon it being more intense, it becomes an air-warmer of immensely

greater power; and, obviously, this extra power in a low room can be used either to raise the temperature of the room, or to raise a larger supply of air to the same temperature. Besides, if in this way we are able to admit more fresh air near the ceiling, we shall also, in like proportion, be able to reduce inlets at a lower level, and to that extent get rid of cold draughts. Practically the quantity which can safely be admitted is limited by the means of warming it—the more we can warm, the more we can safely admit. I insist very much on the importance—the absolute necessity—of this heating in connection with the ventilation of small houses. Some people seem to think that hot air and foul air are synonymous terms; it would be much more correct to say that cold air and foul air are synonymous. If the fire burns up, and the room becomes over-heated, the window will soon be opened, and even if the atmosphere remains warm it will be wholesome; but where the fire burns low, as the winter evening closes, and the ill-clad mother clasps her suffering infant to her breast for warmth rather than for nourishment, what wonder if we find the air close and impure, and every inlet crevice stopped with what we are pleased to call “perverse ingenuity?” If we wish the occupants of small houses to admit plenty of fresh air we must not only convince them that it is good for them, we must show them how to do it without sacrificing something else which is good also—which is even better in their estimation—namely, comfort.

In conclusion, I desire earnestly to invite the attention of Scotch local authorities to this subject. It is clear that if I am right in the views I have advanced—if it is the fact that from a sanitary point of view, a low ceiling is as good as a high one—much more if it is better—municipal authorities are utterly wrong when they prevent by legislation (as some have done, and others wish to do) the erection of low-ceilinged houses. It simply comes to this, that by such regulations they wastefully increase the rents which the working classes must pay for house accommodation, and thereby in the most direct manner encourage over-crowding with all its attendant evils; while at the same time they effectually prevent the erection of improved dwellings, such as are now common in London and elsewhere in England. Within the last few weeks I have seen in a street twenty feet wide, an admirable tenement of artizans' dwellings seven storeys high. According to our draft Police Bill, the height would have been restricted to one story—one family only would have been allowed to dwell where it has been proved to demonstration that *seven* can be housed with much more comfort and much less expense. Surely it would be difficult to imagine

a more striking illustration of the mischievous effect of mis-directed sanitary zeal.

[For Discussion see page 216.]

On "*Some Sanitary Aspects of House Construction*," by  
WILLIAM WALLACE, Ph.D., F.R.S.E., F.C.S., F.I.C.

LAST winter I read a paper on building-stones to the members of the Architectural Section of the Philosophical Society, and the subject attracted a good deal of attention among the architects and builders in the city; especially as it had a direct bearing on the selection of a stone suitable for the erection of the magnificent pile of buildings about to be erected by the Corporation of Glasgow. An opinion was also expressed that the chemist might give valuable information, and make useful suggestions, to the architect and builder if he would devote his attention to the construction of buildings. The encouragement received on that occasion has induced me to bring before the Architectural Section of the Sanitary Institute a short paper on some of the sanitary aspects of house construction, excluding entirely from consideration the important subjects of drainage and sewerage, which I leave to others who have made them a special study.

Granting, then, that a house is well drained, and that the plumber's work is properly trapped and ventilated, what is wanted to make it a healthy residence is that it should have plenty of light, and that it should contain at all times air pure and dry, or at least as pure and as dry as may be possible. The subject of light may be dismissed in a few words. The importance of having large windows is perfectly understood, and so far as isolated buildings are concerned it is unnecessary to say anything. But as regards street architecture, it is of the utmost importance that houses should be built of a height bearing a direct relation to the breadth of the street in which they are situated; hence the paramount importance of having enacted by Parliament rigid building regulations for cities and towns, in order to prevent the erection of tenements of such a height in proportion to the breadth of the street that the windows in the lower stories get little or no sunlight. This is a subject which has been thoroughly discussed in this and other

cities, and I hope that in course of time more stringent rules than we at present possess will be enacted. A fair proportion in this latitude is that the house should not exceed in height two-thirds of the breadth of the street; thus giving three stories in height for a street of 45 to 50 feet wide, and four stories for one of 60 to 70 feet. I say, advisedly, in this latitude; for while at the equator the sun at mid-day is perpendicular or nearly so, in high latitudes it forms with the earth's surface an angle more or less acute. Hence, a street in Cairo of only 15 or 20 feet wide may be better lighted than one of 40 or 50 feet in Stockholm.\* As regards the direction of a street, I should prefer to live in one placed as nearly as possible north and south: in this case, and taking the west side of the street as an example, the sun shines from morning till mid-day on the front, and from mid-day till evening on the back of the house. But in a street running east and west, the houses on the south side get scarcely any direct sunlight—in winter none at all—in front; while those on the north side are equally unfortunate as regards the back rooms. No apartment can, in my opinion, be considered a perfectly wholesome one which does not enjoy direct sunlight during some part of the day. But if an apartment must be so situated that it cannot have sunlight, it is some compensation that it have very large windows, so that it may get as much diffused daylight as possible.

Purity of air cannot be maintained in a house unless it be thoroughly dry. Setting aside the not inconsiderable quantity of water produced by our own breathing and by the combustion of gas, oil, and candles, the air in a house is liable to be rendered unwholesome from excess of moisture, 1st, by absorption of water from the rock or soil below, and, 2nd, from the porous stone of which the building is constructed. Not only is the air loaded with moisture from these sources, but it is rendered impure from the exhalations of fungous vegetation or dry-rot, which at the same time destroys the joists and other carpenter work, and seriously affects the stability of the house. It is a mistake to suppose, as many do, that dry-rot attacks only the wood in the basement storey. It is a common occurrence for the ends of joists built into porous stone to become affected by fungous vegetation; and it is frequently seen in pulling down old tenements that the ends of the joist are quite gone, and that, probably, for many years the joists have been resting only on the plaster cornices of the rooms. The remedy is the use of "shoes" of glazed

\* This subject was brought prominently before the citizens of Glasgow a few years ago by Councillor W. R. W. Smith, who obtained the assistance of Professor Grant in calculating out some facts of great interest.

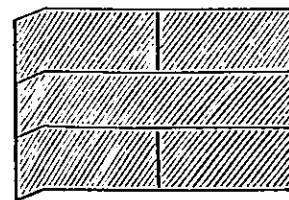
fire-clay or other material, which are built into the wall, and into which the ends of the joists are placed. The "shoes" should be somewhat larger than the joists, which should be kept in position by little wedges of wood, so that air can play freely around the end of the joists. Such protected joists will last for hundreds of years, if other circumstances are favourable.

The porosity of most varieties of building stone is remarkable. In the paper to which I have already referred I have given, besides other properties, the quantity of water capable of being absorbed by the stone when air-dried. By weight it ranges from 3.4 per cent. in the celebrated Craigleith stone to 7.2 per cent. in the red sandstone found at Wemyss Bay, on the Firth of Clyde. The significance of this property of porosity is still more readily appreciated if we take the amount of water absorbed by bulk instead of weight. 100 parts by measure of the hardest and best freestone take up about 8 parts of water, and the inferior kinds 12 to 15 parts. A cubic foot of the stone will therefore absorb from 5 to 9 lbs. of water, or from half a gallon to nine-tenths of a gallon. The absorption of water by certain kinds of stone is so rapid that in slight showers of rain the whole of the water that falls is imbibed; and although a great part of this evaporates afterwards from the surface of this stone, a portion must always find its way inwards, and this is especially the case when the surface of the stone is kept constantly wet by continued rain.

Another property of freestone is its power of permitting the passage of air or other gas by transpiration and diffusion. A cube of stone varnished over on four sides and enclosed at the other two in an air-tight case provided with inlet and outlet tubes, permits the passage of coal gas to such an extent that the gas can be lighted and will continue to burn, even although the pressure is not more than an inch of water. The same thing applies to other building stones which are all more or less porous, and to bricks, unless these have been exposed to a temperature high enough to flux the material of which they are made. The quantity of air diffused into and out of a house by the walls must be very considerable, and as it is a process that is constantly going on, it must necessarily exercise an appreciable influence in maintaining the purity of the air in dwelling houses. If, however, the stone or brick be saturated with water, the porosity is, for the time being, destroyed; or if there be any air diffused at all it will be loaded with watery vapour, and therefore of less value, in a sanitary point of view, than it would be with only its normal proportion of moisture. Besides this evil, there is the more serious one of the water actually reaching the joists and other wood, such as "dooks" and wall plates and

straps, and causing these to decay, and so interfere with the stability of the structure. Coating the stone with oil, paint, silicate of soda solution, or other means of rendering it impervious to water, prevents the absorption of rain; but it also, at the same time, destroys the valuable property of diffusing pure air into and impure air out of the house. The only way that I know of for securing the advantages of the porosity of the stone and preventing the injurious action to which I have referred is to have double walls, with a space of a few inches between, into which air is freely admitted by openings in the wall at top and bottom placed in such a manner that rain will not enter by them or lodge in them. The openings may be about three inches square, and placed about six feet apart, and they should be sloped upwards for the reason I have just stated. The inner wall may be of brick, either  $4\frac{1}{2}$  or 9 inches thick, according to the height of the building, and it should be tied into the outer wall by pieces of thick iron wire with angled ends. The system of building with concrete blocks pursued in Sandown, Ventnor, and other places in the Isle of Wight, is well adapted for constructing walls on the principle I have indicated. The blocks of concrete are about 18in. wide by 12in. high, and are of two thicknesses; those for the outer wall being 4 or 5 inches, and for the inner about 3 or  $3\frac{1}{2}$  inches in thickness, and these are tied together by pieces of iron wire, with a space of about 3 inches between them. This forms what looks, to those accustomed to the 2-feet thick solid walls of Scottish houses, a very flimsy wall, but it appears to be sufficiently strong for a building of two stories in height; and with a few openings above and below for the admission of air into the space between the outer and inner walls, it would form a structure which, in a sanitary point of view, would be perfect, although I would prefer to have the inner wall of brick, which is more porous than the blocks of concrete, formed of fine gravel and cement, which are used in the Isle of Wight.

It is a common observation that, in spite of every care being taken in the construction of a building, the joints of the stone are often imperfect and admit water freely, especially when the rain is accompanied, as it often is, by high wind, especially when the wind comes from the south-west. To prevent the rain penetrating it is customary in some districts to build, not on a flat bed, but one sloping slightly upwards. This is a system highly to be commended; and if it be objected to on the ground of giving less stability to the building than working upon a per-





fectly level bed, this objection might be overcome by making the greater part of the bed level, with about two inches of the stone on the exterior side of the wall slightly bevelled.

In the case of rubble walls the best that can be done, probably, is to point them with a mixture of Portland Cement with twice its bulk of sand, taking care that the sand is not too fine; and then to whitewash the entire walls with Portland Cement, a process which may be repeated with advantage. But the pointing should not be done until the walls have had a summer's sun and are practically dry; otherwise the greater part of the water in the walls will evaporate inwards, that is, into the house, and so keep the atmosphere damp for a longer time than is actually necessary. A two feet wall will not dry thoroughly, however, even under the most favourable circumstances, in less than two years.

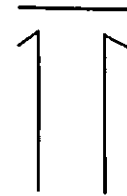
As regards the interior of houses, plaster, whether on brick or lath, is exceedingly porous, and permits of a ready diffusion of gases; and a wall merely whitewashed or coloured with distemper is better in a sanitary point of view than one that is covered with oil paint, which becomes by this process practically impervious to the passage of gases. Wall papers are probably not so bad in this respect as oil paint, but are certainly inferior to distemper or whitewash.

The foundation of a house and the basement are the most important parts of it as regards its sanitary condition. The most perfect foundation upon which a house can be built is a solid platform of concrete, extending over the entire area of the building, and from 2 to 6 feet in thickness, according to the height of the walls, and coated over on the top with nearly pure cement. No damp could penetrate this mass; but I would not, even in this case, lay the sleeper joists upon the concrete, but would place them at a sufficient height to obtain ventilation of the space below the floor. In case of accident, arising from the bursting of water-pipes, or other causes, I would make the concrete with a slight upward slope towards the centre of the area, so that water could run away freely through the ventilating gratings. This would be a somewhat expensive foundation, but I think it would be a most satisfactory one. Another system, which would probably prove equally good, is to build the foundation walls and dwarf walls up to a certain level, fill in the interior spaces with broken material *to the same level*, and cover the whole surface with a layer of Portland cement with two parts coarse sand 3 inches thick. Another system still is to place a damp course of slate, or slatey stone, bedded in Portland cement, on the whole of the walls; fill up the whole foundation to the same level with broken material, and

cover this, but not the walls, with asphalt. This makes an excellent foundation, but the filling in is generally omitted, the architect being content with a damp course on the walls just below the sleeper joists, and levelling the interior space and asphalt. In this way I have seen very serious evil resulting from the absorption of water from the soil by the portion of the walls below the damp course, this giving off sufficient watery vapour to keep the space below the floor quite damp and to introduce dry-rot to a most alarming extent. It is a not uncommon practice to neglect the precaution of putting a damp course on dwarf walls, in which case dry-rot is almost certain to occur unless there is profuse ventilation. In such a case the joists should be laid not in a wall-plate of wood, but upon roofing slates placed below each joist, but it is better to place along the top of the dwarf walls a complete anti-damp course of roofing slates or Caithness pavement bedded in cement, and upon this to lay a wall plate in the usual manner.

With regard to the ventilation of the space below the basement floor, it is a safe rule to have gratings all round the building, if it be a detached house, not more than 10 feet apart; but if it be in a street where ventilation can be obtained only in front and back the gratings should be not more than 5 or 6 feet apart, and should be of ample size, say 10 inches by 6. In order to facilitate the free circulation of air the dwarf walls and partition walls should have numerous and large openings. It may be objected to that such thorough ventilation as I have indicated would make a cold basement storey; but the simple remedy is to put ashes, with or without lime, below the floor, in the same way that deafening is applied to the upper floors.

In a wet climate such as ours, in which it is a not uncommon occurrence to have half an inch of rain falling in a single day, it is a proper thing to cover the chimney-tops in order to prevent rain from coming down and keeping the gable walls to some extent constantly damp; and it is a good thing to combine with the cover a means of preventing down-draught in the chimneys during high winds. The cover which I recommend is one having a flat top with a section of a cone below, the whole chimney top and cover being constructed of galvanized iron. The chimney is 10 inches diameter at the bottom and 8 inches at the top, the cover is 12 inches diameter, and the space between the top of the chimney and the cover is 4 inches. The cover is supported on three iron rods, and is fixed by nuts in the top, which are easily removed when the chimney is to be swept. All chimneys should be lined with fire-brick cylinders very carefully jointed, other-



wise a great deal of watery vapour from the combustion of the coal will find its way into the gablewalls, and there may be trouble also from smoke. A chimney from a gas stove, unless kept open below, is certain to give trouble from the condensation of water. Every cubic foot of coal gas gives by combustion about an ounce of water, and as gas stoves consume from 10 to 30 cubic feet per hour, a very large quantity of water is produced. In ordinary coal fires the large proportion of heat wasted up the chimney prevents any considerable condensation of water unless when a fire is just lighted; but in the case of gas-stoves the heat passing up the chimney is comparatively small, and is probably never sufficient to prevent entirely the condensation of water.

In this brief sketch I have taken up only one branch of my subject, and I do not propose to deal with others, such as the ventilation of dwelling-houses and public buildings; but I shall merely notice, in conclusion, an exceedingly simple means of ventilating apartments, which I have found to give excellent results. It is to put in every window in a house a series of perpendicular holes, one inch in diameter, in the lower frame of the top sash of the windows. The holes may vary in number from three to six, according to the breadth of the window, and I may say that I have not found it necessary, even during the prevalence of the highest wind, or during the coldest weather, to close any of these orifices.

I fear I owe a humble apology to the architects who are members of this Congress for going beyond my own profession and invading theirs, but I trust that my remarks may be accepted in the same spirit in which they have been given. I have endeavoured to put together a few hints founded on my own observation and experience; and if some of my ideas are not new, as I can well believe, they may not be the worse for being enforced by repetition.

[*This discussion applies also to a paper by JOHN HONEYMAN, see page 204.*]

Dr. SIMPSON, Aberdeen, said that Mr. Honeyman's paper struck at the very root of the principles of sanitary science, as he would have them to build houses seven storeys in height in streets which were only 20 feet wide. Now this was just going back to the old evil which it was thought they had experienced quite enough of. But happily Dr. Wallace's paper had given a very effective answer to Mr. Honeyman when he showed that for a large part of

the year the houses in the lower parts did not get the benefit of the sun's rays. Light was one of the most important principles of life, and nothing was more depressing than the want of it. If you wished to quiet a lunatic or anyone in an excited condition, the best thing to do was to put him in a dark place, and he would soon be quiet enough. Then Mr. Honeyman appeared not to have understood the principle of ventilation. The air entering by the door of a room and by the window did not go straight up the chimney; but it had been shown by experiments that it went towards the chimney, got warmed, and then went up to the ceiling, so that a high ceiling practically got rid of those draughts which Mr. Honeyman complained of. Then there was the other consideration, that it would be an overcrowding of the houses. We might certainly object to have a narrow room, but to have house upon house would only mean overcrowding, which was one of those things that raised the death-rate more than any other cause. When there were many people together, the cleansing and the removal of refuse would be very difficult. The houses would also be badly lighted. In a word, he did not think that any saving in the matter of building would compensate for the increased density of population.

Professor JAMES THOMSON, Glasgow, said the papers of Mr. Honeyman and Dr. Wallace dealt with many subjects of great interest, but still they left room for much discussion and for differences of opinion on various points, especially on account of the wide range of details introduced in the paper of Dr. Wallace. Within the time allowed for remarks it would not be possible to enter on more than a very small part of the subjects opened up for discussion. Mr. Honeyman had it as an aim to give more floor accommodation by reducing the height of the ceilings, and thus getting a larger number of people to live in a limited space in large towns. When by dire necessity a great many people must needs be packed closely together on a small space of ground, it became desirable to devise, in such directions as Mr. Honeyman was recommending, means for producing the greatest amount of comfort attainable with moderate cost on that small space. Personally he (Prof. Thomson) would advocate to the very utmost that political economists and the corporations of towns should aim above all things at avoiding and preventing overcrowding, and at creating as many open spaces as possible. Any one could see while walking along the streets of Glasgow that the children of the working classes had very generally no place where they could go to play but on the pavements. It might be urged, that, however desirable it might be to have open spaces for playgrounds, yet on account of the cost it was difficult to get them: still the idea was not such a hopeless one as many people supposed it to be. Mr. Honeyman's recommendations were, he thought, worthy of much consideration in reference to the development of arrangements for making the most of small spaces. It was certainly unwise to insist on necessarily having a high ceiling, if, in other respects, the arrangements were to be such as to leave a great portion of the cubic space in the upper part

of the room to serve only for accumulation of vitiated hot air, while allowing the air for ventilation to flow mostly along the floor to the fire-place, cooling the feet of the occupants, without serving for their breathing. The recommendation, which Mr. Honeyman urged, to scour out the vitiated air from the ceiling was, he considered, very important.

Mr. E. C. ROBINS, London, said it seemed to be a paradox to have low ceilings and well ventilated rooms, but it all depended upon how they were ventilated. Overcrowding had been proved to be unhealthy, but it was still possible to crowd healthy houses together, such as had been done in the case of the artisans' model dwellings, and preserve a low death-rate. He criticised adversely the manner in which Mr. Honeyman proposed to provide for ventilation, and suggested that in such houses fresh air might be introduced at the back of the fireplace and heated before it was allowed to pass through the rooms. He illustrated on the black board in a very happy manner the defectiveness of the ventilating system proposed by Mr. Honeyman in his paper, as he understood him, and showed what he imagined would be a better mode of ventilating ordinary dwelling-houses. According to Mr. Robins plan, a draught would be made to come from the back of the fireplace, and passing behind the fire would get free over the mantelpiece with a vertical current, and afterwards circulate all round the room and back to the fireplace. Such a draught would provide the room with a supply of fresh air which would be cold in summer and warm in winter. Adverting to the construction of houses, he said that he had given up basement floors that are pervious. He made them of impervious materials, and covered them with wood-block floors.

Dr. J. F. SUTHERLAND, Glasgow, remarked that Mr. Honeyman's paper was, in his opinion, quite opposed to sanitary science. At the conclusion of his paper, Mr. Honeyman made the remarkable statement that within the last few weeks he had seen in a street 20 feet wide an admirable tenement of artisans' dwellings seven storeys high. Taking a storey to be 8 feet high, a building seven storeys high would mean a wall of 56 feet, with inhabitants from basement to roof. He presumed there would be houses on each side of the street, which would simply mean that the inhabitants of these admirable tenements would be deprived of sunlight during the best and greater part of the day. It could not be otherwise, as no matter what the disposition of the street might be there would be overshadowing. He did not know on what principal Mr. Honeyman based his argument, but he hoped the association would not allow it to go to the public that they encouraged such tenements, for it had been clearly shown that in houses deprived of sunlight there was a speedy deterioration of the human race. It had been shown by an eminent medical man that children deprived of sunlight soon developed scrofulous diseases, and more especially that form of scrofula known as affection of the spine. Mr. Honeyman had spoken

somewhat slightly of the Glasgow Corporation, who would most effectually by their new Police Bill put a stop to such a building being erected as one of 56 feet high in a street 20 feet wide. Then Mr. Honeyman said builders were hampered by Parliament. All he had got to say was that if the attention of Parliament is not directed to this admirable tenement, wherever it existed, the sooner it was so the better. Rather than dislike such restrictions as he spoke of, they should have more of them, because such tenements as he described should not be allowed to exist.

Mr. G. W. MUIR, Glasgow, said Mr. Honeyman's courage in the city was well known. To the position that he took up some three years ago in regard to opposing the Corporation plans of the new municipal buildings they were indebted for the great improvement in the arrangement and style of those buildings, and he considered that for that act alone the citizens of Glasgow owed him a deep debt of gratitude. His own experience was that the healthiest room he ever lived in was one of a height of 7 feet 3 inches. He could touch the ceiling of it with his hands. He had a much greater floorage in that room than if he had a ceiling of 14 feet 6 inches. He was not surprised at so many gentlemen coming from London and crying out against narrow streets. He knew London pretty well, and he did not think there were above two or three broad streets in it. Look at some of the streets radiating from Cheapside. They were not more than 12 feet wide, and had walls of 50 feet high at least. Although sunlight was a good thing, it was not the only good thing, and he did not know any street where the sun would not shine some time in the course of the day. He believed that in Continental countries narrow streets were devised specially for the purpose of keeping the sun out and procuring a cool house. In the arrangements made by the police authorities of Glasgow and contemplated by them in the bill which they had prepared some time ago, but which was withdrawn from Parliament, the regulations were unnecessarily oppressive upon builders, would cause an enormous addition to the cost of houses, and thereby tax the working classes to an unwarrantable extent. These regulations insisting upon a certain width of street, and for a certain height of house, he had always opposed, for he did not consider that they were consistent with the best means of promoting the health of the population. A house of seven storeys in a street 20ft. wide might be a much more healthy house than a one storeyed cottage in the same street. Mr. Honeyman had shown, notwithstanding the contradiction of Dr. Simpson, that crowding, but not overcrowding, was quite consistent with the maintenance of health, provided attention be paid to cleanliness and ventilation. He was glad to find that so far Mr. Honeyman justified the remarks he (Mr. Muir) made on the preceding day respecting the intelligence of the officials of the Corporation of Glasgow.

Mr. HONEYMAN, Glasgow, said, he could only partially reply to the remarks made on his paper. There seemed to be a good deal of misapprehension regarding what he aimed at. His object in bringing up

the subject was that it might be the means of preventing overcrowding, which to a great extent was due to the raising of rents. Nothing more certainly led to the kind of overcrowding which resulted in a high death-rate than high rents. During the depression in trade which followed the City Bank disaster, many people could not keep houses for themselves, and went to stay with relatives, but they again took houses when trade got better and enabled them to do so. If the people could be healthfully housed in high tenements larger spaces might be obtained. Instead of a dingy range of houses, with a meuse lane running up between them, he would build say three blocks on the space, and leave large spaces between them. As to the tenement that had been referred to, it was in Gray's Inn Road, London. He had never seen anything better in the way of dwellings, as the houses were perfectly cleanly, bright, and airy in every respect. As to ventilation, he did not advocate the use of a ventilator at all. He would cut with a bevel a little bit off the top of the door, which the people would know nothing about. If a ventilator was put in the people would be sure to close it up. He had made some experiments, with the following results:—

NOTE.—Experiments illustrative of the foregoing, made with two models precisely alike in all respects except height.

1st. Smoke admitted over the doors in the low model (representing a room 7 feet high) passed rapidly over the ceiling, and in a few minutes was diffused through every part of the room. In the high model (representing a room 12 feet high) it passed across the room horizontally, diffusing itself through the lower part only, and leaving the upper part quite clear.

2nd. With ordinary inlets, in half an hour the temperature at the floor, in both rooms, was 65°, but at the ceiling of the high room it was 88°, and at the ceiling of the low room only 73°.

3rd. With special inlets (equivalent to 14 inches by 9 inches), close to the ceiling, in the low room on the floor the heat was 74°, and at the ceiling 72°; while in the high room, under the very same favourable conditions as to inlet, the heat at the floor was 77°, and at the ceiling 86°, showing a considerable amount of stagnation from which apparently the low room was entirely free.

4th. To show how completely the benefit of ventilation may be missed by want of distribution, the ordinary inlets were closed, and an inlet having the same area as the chimney was opened near the floor, on the opposite side of the room from the fire-place. A stream of cold air (equivalent to 5000 cubic feet per hour at least) passed diagonally through the room for half an hour, when the thermometer on the floor showed a temperature of 84°, and that at the ceiling 93°. In this case the stream of fresh air was in fact *absolutely of no use to the occupants of the room*; the atmosphere was not appreciably affected except within the very narrow limits of the area actually occupied by the current between the opening and the fire-place. Compare this with No. 3 experiment in the low room, where the *same quantity* of air was admitted.

It will be noticed that with the inlets at the ceiling the air near the floor in the low room was rather warmer than at the ceiling; but in the high room it was 9° warmer at the ceiling than at the floor.

Professor T. ROGER SMITH, the President, said they were greatly indebted to the readers of these two papers, and moved a vote of thanks to them. He had to do with the administering of an Act of Parliament while acting as a district surveyor in London, and it struck him as the result of experience so acquired, that the less restrictive any legislation could be made the more likely were the Acts to

be of service. They were beset with very great difficulties in dealing with the problem as how to house to the best advantage the poor in large cities. One would like to see them in the best possible dwellings, but these cost a great deal of money. They were compelled to provide a dwelling within the reach of the wages which the people could earn, and Mr. Honeyman was evidently aiming at that object.

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On "*The Testing of Drain and other Pipes connected with Dwellings, together with the Sanitary Condition of the Walls and adjacent sub-soil as affecting the healthy condition of Houses,*"  
by JAMES STEWART, SEN.

For a number of years past, the inhabitants of this city have displayed a very considerable interest in the efficiency of the sanitary appliances connected with their houses, and have shown a most laudable anxiety as to the proper testing of the various drains and pipes, which are the necessary constituents of every dwelling-house.

Having had for upwards of thirty years very considerable experience in the almost innumerable details of such matters as generally practised, and more especially as practised in the West of Scotland, I have some confidence in hoping that the notes of a successful practise and experience I am about to lay before you may have some claim upon your attention.

When a necessity arises for an examination of the sanitary condition of a dwelling-house, a Sanitary Engineer, or other duly qualified person is called in by the owner and requested to test the drains, &c. Unfortunately, however, these tests frequently extend no further than the house drains and vertical pipes. Then follows a report that certain defects exist in the drains and plumbing works, and such are recommended to be remedied and improved.

The drains are then lifted and relaid, or it may be, as I have frequently seen, that the joints or junctions are only cemented as they lie. The work is done: but no attention is given to the swampy and malarious condition of the ground in the vicinity of the defects which still remains in the same saturated state, due to the previous defects in the drains; or it may be from the still defective drains of adjoining houses, the level of which may be higher; or perhaps from ground water.

The drains being finished; the saturated material is put back into the hole or trench, the floor is closed up, and if any thought is given to the condition of the sub-soil, it is, that it will soon dry up, now that drains are supposed to be perfect.

The methods adopted for testing the horizontal drains and vertical pipes are as follows, viz. :—

1st.—By the *smoke test*, relying upon *sight* and *smell*.

2nd.—By the *paraffin*, *peppermint*, or other tests, relying upon *smell*.

3rd.—By the *water test*, which also relies upon observation.

Regarding the test by smoke it may be considered very suitable, indeed, perhaps it is the best for testing vertical pipes and apparatus in a house; as any defect usually becomes visible at once by the smoke, or is apparent, more especially if the wood work covering the pipes is removed as far as possible; otherwise a current of air may carry the escaping smoke up the recess for the pipes, which generally extends from the basement floor to the roof.

As regards the testing of drains, I cannot speak quite so favourably in applying smoke to them: assuming that the drains are defective, there are many houses of which the basement or ground floors are covered with asphalt, Portland cement, tile or other impervious flooring, so that it is impossible for smoke to find its way through, except at some small opening at the foot of the soil, or other pipes passing into the ground.

Again, a considerable part of the subsoil of this city and neighbourhood is composed of stiff clay; and it is the practice of builders to dig out trenches in this clay for the foundations of houses, deeper than the ordinary level of the cutting; the foundations are placed in this trench, and if the house is one of a street or terrace, the drains must go through the houses.

A square trench is usually made for the drains, which cuts through, or crosses the foundation trenches on much the same level, the consequence is that any leakage or sewage from the drains, runs along these trenches and so saturates the walls.

A case of this description has come under my care where the water from a soil pipe flowed twenty feet along the foundation of the back wall, then turned inwards and along between two gables for thirty-five feet, and came out below the floor of the front room of the next house, which was on a level of between two and three feet lower.

In the filling in of the trench, the clay or stiff soil is thrown in upon the top of the pipes, and falls partly down the sides; but on account of the narrowness of the trench, the bottom part cannot be properly filled; then the whole is rammed level with the surface of the ground, and you can infer that

from the stiffness of the clay, with careless filling, a space is left along the bottom on each side of the pipe. When the house comes to be occupied, the sewage escapes into this space from the bad joints and junctions, the result being that the foundations are sapped, which I think explains why the partitions and walls of so many houses are cracked.

To return however to the testing, I have often found it difficult on account of the formation and filling in of the drains as above described to obtain the results I expected, being convinced in my own mind that the drain was really defective, but, between the clay covering the top of the drain, and the impervious formation of the floor, no smoke could be seen.

To overcome this drawback, I adopted the plan of probing the ground with an iron rod, pointed at one end, provided with a cross handle at the top. Some care and skill, however, is necessary to fix upon the suitable place, so as to use it to proper advantage. I have used this probe with the best results, viz., to ascertain actually that the smoke was really escaping from the drains, and to satisfy myself as to the state of the ground surrounding the pipes; the point of the probe indicating the state of the soil at the bottom of the trench.

I may mention other instances in which the full effect of tests by smoke may not be attainable, however bad may be the state of the drains. The junction of the house drain with the main sewer not being air tight, the existence of rat runs in the ground, or the presence of porous rubbish under the floors, all interfere most seriously with the efficiency of the test. Again, take the case of a new or unoccupied house in Winter, the temperature of the air contained in it is lower than that of the air in the sewer, consequently a current of air exists flowing from the house into the sewer and carrying the smoke with it.

There is also another instance of very frequent, if not constant occurrence, where the escape or appearance of smoke cannot be observed, which is, that although the upper parts of the joints are filled with clay or cement, small parts at the bottom are left quite open; this may arise through the carelessness of the workman, or may be left open with the idea of draining the ground; but the reverse takes place, the open part of the joint is therefore constantly sealed with water, and no smoke can escape.

As to tests with the smoke machine, attention should be given to the length and capacity of the main drain and its branches, the soil, and other vertical pipes; that is, if it is a large house, with a 9 inch main drain, and branches, with a high soil pipe, rain water pipes, &c. (as many of our best houses

have). I am of opinion that the miniature smoke machine some tradesmen use is quite inadequate to produce the desired result of a satisfactory test, as such a machine cannot have power to maintain a sufficient supply of smoke necessary to test the drains and pipes of a large house.

I have frequently heard it remarked that the smoke test is too severe. If the pressure was as great as some people suppose, we might expect to see the smoke blown through the sealing water in the trap; such an occurrence, so far as my knowledge extends, I have not seen: all that can be observed is a slight movement of the water at one or other of the traps when the machine is in action.

We will now consider the second method of testing, viz., the paraffin or peppermint test; but as I have entered so fully into the smoke test it is not necessary I should detain you with any lengthened observations on this method of paraffin, &c., &c., as they are so far similar in composition and action, viz., air with smoke, or air with the smell of paraffin or peppermint.

My remarks will therefore apply as to whether it can supersede the smoke test and give better results; from my experience I am inclined to give smoke the preference, from the statement already made as to the uncertainty of the smoke test when applied under certain conditions to the horizontal drains in the ground; the same will apply with greater force against the paraffin or peppermint test, both of which I consider to be trifling, uncertain, and misleading, if either of these are alone to be depended upon.

Nevertheless, in answer to this, it will be remarked by some, "that paraffin discovered the defects in my drains;" but I am quite as certain that many more will afterwards find out by other means the serious deficiencies that the paraffin did not discover. I could dwell longer on this point of the subject, were it not that time is limited; therefore I will now pass on to the third method of testing, viz.: "*The Water Test.*"

I have pointed out the injurious effects of the escape of sewage; but the injury resulting from the constant outflow of moist sewer air into and saturating the ground under the floors is a serious evil; it is therefore indispensable that the drains should be both *air and water tight*.

The application of the water test to the main drain of a house is, in my opinion, by far the best method, and is therefore superior to the other methods I have referred to, for is it not the fact that the object we endeavour to accomplish is to have the drains water tight.

This method is not generally practised, perhaps from the want of a suitable apparatus of easy and simple application, or

it may be from a desire to avoid the certainty of showing whatever defects of construction may exist. The *modus operandi* is this: the pipes should be entirely stopped up at the ends and filled with water, some upright part having been previously selected or formed for the purpose of observing if the drain holds the water, or the reverse; the other ends or branches having been closed in a similar or sufficient manner, the water may then be turned on, and the pipes filled to the part marked on the upright pipe, and carefully watched to see if the water falls below the mark; and should it do so it shows at once there is a leak somewhere, and no doubt can arise as to the actual results of this method of testing, and nothing is more certain or satisfactory.

Another advantage to be derived from the water test is, that the proprietor or tenant can have the satisfaction of observing the effects of it, either by showing the *efficient* or *deficient* construction of the drains at the upright part selected and marked for the purpose; this he could not follow out so well or readily with the smoke or paraffin tests; and in the event of a new drain being tested, the workman might be apt, on a defect being noticed, to fill it up hurriedly to hide it; such an attempt would at once be detected on the application of water.

In the majority of houses that I have been called upon to examine, I should not consider it at all requisite that any tests should be applied; as the damp appearance of the walls, and sometimes the floors, are sufficient of themselves to tell the true state of matters below.

The damp plaster is observed in some cases rotting above the parts that have been repaired with Portland cement, this repair having been done with the mistaken idea of keeping down the damp, or may have been done at the time of the last overhaul of the drains: such expectations are not realized; the insufficient relaying of the drains, or the neglect of draining the sub-soil is soon shown by the above-mentioned indication; and in addition by the paint at many places along the foot of the walls being destroyed, and getting daily worse, as the sub-soil gets more permeated.

Nothing else could be looked for, when at this overhaul of the drains, in addition to the very objectionable way of filling up the trench, no attention is given to the aëriation of the ground, and ventilation by air channels under the floor; and should the floors be formed of Portland cement, asphalt, Caithness stone, or tile laid upon a cement *bed*: as all of these are considered to be practically impervious, the damp is sucked up by the powerful action of the house fires, and is sure to find an outlet, which it does as I have stated through the walls.

Professor Pettenkofer and others in their researches on this important subject, have sufficiently demonstrated the permeability of air and damp through walls, and it may not be out of the way if I give one or two quotations from such authorities.

Professor Pettenkofer in his work, "The air in Relation to Clothing, Dwelling and Soil," states at pp. 80 and 81—"England has given proof how the public health can be improved, by keeping the soil clean through good drainage, abolition of cess-pools, and abundant water supply." He also says, "This is my conviction, which I want to impress upon you, that the cleanliness of the soil, and diminution of organic processes in the ground of dwelling houses is most essential." Also, Colonel Geo. E. Waring, jun., the celebrated American engineer, in his work on the "Sanitary Condition of Dwelling-houses" (1877), at pp. 51 remarks:—

"We know very well from a difference in salubrity between houses standing on proper sites, and houses standing on improper sites, that this influence of the soil emanations is serious, probably, so far as the usual slighter malarial ailments are concerned, this soil influence is the most serious with which we have to contend. And at the same time the debilitating effect of the exhalations referred to—headache, neuralgia, loss of appetite, intermittent fever, &c.—take a far lighter hold upon the popular imagination than do often the fatal diseases which are produced by bad air of another sort. The low condition, and consequent susceptibility to infection, which the malaria of damp soil produces, doubtless aggravate very seriously the dangers arising from the other source, that is to say: persons enfeebled by exposure to malaria would often succumb to infection, when a robust person would withstand it."

The foregoing observations regarding the actual results of testing by the smoke machine have been altogether applicable to drain pipes; but the defects usually observed in the soil or other discharge pipes when applying the test to them, are insufficient water seal in the traps, open or cracked joints, and perforation of the lead traps or bends.

A great deal has been said and written on this popular subject. The cause of the destruction of the lead in this manner is by common consent attributed to the action of sewer gas; it may therefore be considered bold on my part to come forward and question a subject so universally admitted as this alleged action of sewer gas on lead pipes.

I have given this particular matter careful observation for a number of years, and the conclusion I have come to is, that the perforation is caused by the vapour or humid air in the drains

and vertical pipes, arising from the warm water discharged from the house. This vapour ascends till it comes to the trap, and there condenses in drops of distilled water on the upper side of the trap or bend. I have looked into a trap and observed the drops hanging, and have removed them with my fingers along with the destroyed part, as a substance which is chemically named "carbonate of lead;" and as each succeeding drop forms it falls off, taking a portion of this substance with it, and leaving a clean surface for fresh chemical attack.

At the time of the outbreak of typhoid fever at Crosshill in March and April, 1875, I was then acting as sanitary surveyor for the Govan Parochial Board in the district then known as "No man's Land;" and during my examination into the sanitary condition of the houses, I saw a good example of the action of vapour on lead, in the case of a lead-lined hot water cistern connected with a tenement there; this cistern had a wooden cover, and there was a space between the water and the underside of the cover, which was constantly filled with vapour, the action of which was seen in the coating of the leaden sides of the cistern with the substance I have referred to, a sample of which I have retained; and although I hold that the action on the lead pipes is by the vapour and not by sewer gas, still the same remedy would require to be carried out, viz., ample ventilation of the discharge pipes.

Dr. Alfred Carpenter, in his work, "Preventive Medicine and Public Health," states: "It is a soft and distilled water which acts so readily on lead."

Then Col. Waring, in his work formerly quoted, states at p. 33: "These gases (sewer gases) have in a much less degree, if they have at all, the power of decomposing lead pipes."

In my former remarks I have made reference to the re-draining of a house, the filling up of the trench with the same sewage-soaked soil. This practice, I may tell you, is going on every day in this locality, not only as regards the trench cut for the drains, but the whole water-logged area below the floors remains as it was prior to any alterations, attention not being given to the drainage of the ground water, neither at the time of the building of the house, or now, when a so-called improvement is made. This objectionable work that I have just referred to, is being executed by tradesmen who have neither the skill, experience, workmen, or sufficient appliances necessary for carrying out such work.

It is, therefore, all the more necessary that these matters should be attended to when we look at the position of many of the best houses in this city and neighbourhood, viz., the site of the house is excavated out of a sloping bank, leaving high

ground at the back, a raised roadway at the front; the back ground slopes to the house or back area, and consequently all the ground water, and perhaps the sewage water from a defective sewer in the lane behind, follows the slope of the ground, and permeates through the foundation. When this state of matters is combined with leaky house drains, you can readily understand what condition the house will be in; and though I merely state this as a hypothetical case, there are many houses in the surrounding locality in a similar condition, and where the configuration of the ground, although somewhat different, is equally telling against their sanitary condition.

In concluding these remarks, which I trust may have met with your approval, I have only to add that the neglect of the Sanitary arrangements which we find in so many habitations, calls for their regular and careful examination, and that our chief endeavour should be to rouse the interest of the general public in these matters, and I know of no other association, or organised body, that have done so much to promote this good work than the Sanitary Institute of Great Britain.

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Mr. ROGERS FIELD, M.Inst.C.E., said that he considered Mr. Stewart's paper on the testing of drains was a valuable one. The testing of drainage had an important bearing on the health of the community. Not only did tests such as those described by Mr. Stewart afford a reliable means of ascertaining hidden defects in existing drainage but what was even of greater importance such tests afforded a ready method of securing watertight construction of the drainage in new houses. It ought to be made imperative that all new drains should be actually tested before they are covered in. The general idea is that if drains are constructed of stoneware pipes with cement joints they must be all right. Nothing can be more delusive. No one except those who have had large experience in testing drains as ordinarily laid can have any idea how leaky they are. Even when the precaution has been taken of carefully examining the joints of the pipes before the drain is covered up it by no means follows that the drain is sound. The upper portion of the joints may be good, but underneath where they cannot be seen there may be defects. The only reliable way is actually to test the pipes with water in the way described by Mr. Stewart. If sanitary authorities were to insist on this being done, a wonderful improvement would be effected in the drainage of all new houses. This may perhaps be considered impracticable at present (though the speaker did not know why it should be) but surely it is not impracticable for architects always to specify that the drains should be tested. A stipulation of this kind is, however, at present quite the exception.

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*On "The Merits and Demerits of Various Kinds of Water-Closets in General Use," by DANIEL EMTAGE.*

It is generally admitted by all who have made "house drainage" a study, that the most carefully prepared scheme is frequently spoiled by an unwholesome w.c. apparatus fixed at its head.

It was experience of this nature which has induced me for some years past to pay particular attention to this subject, and by careful observations and experiments with various kinds of appliances, to endeavour, if possible, to find one which would work satisfactorily, and which might be rightly considered wholesome, and I have very great pleasure in laying before this Congress the information thus gained.

The "Bramah" pattern valve closet is the oldest form now in use, and although many improvements have been made in its construction, those in use to-day are the same in principle as the one which Bramah patented in 1778.

This closet works remarkably well, and has a capital appearance. The direct action drop of the water from the basin to the trap is also a good point, and the space between the seal of the trap and the valve being very small, very little foul air can accumulate or corrosion take place.

If this closet is properly fixed, flushed, and ventilated, and a reasonable amount of care exercised in its use, it will answer very well indeed.

Notwithstanding, however, the good character which it deservedly bears, it has disadvantages which preclude it from being considered the best one for general use, the following being some of its faults:—

1st. The liability of paper and other substances to become jammed between the valve and its seating, and thus allow the water to escape from the basin.

2nd. Its unsuitability for the discharge of slops, for which purpose all w.c.'s are at times used.

3rd. The liability of the overflow trap to become fouled, which not infrequently takes place in consequence of the w.c. being used as a urinal without being properly flushed.

4th. The valve-box, although small, is a container of bad air, and is to that extent objectionable.

These defects existed in Bramah's day, only perhaps in an



aggravated form, and it was to obviate similar evils that the notorious "old pan" closet was invented.

If we consider the number of valuable lives which have been sacrificed, and the amount of misery which has been caused by the escape of sewage-gas from w.c.'s and soil-pipes fixed inside of houses, it may well be doubted whether their introduction was really a benefit to mankind; but it is certain that the man who invented the "pan" closet let loose upon society an enemy which has done, is still doing, and will yet do, an incalculable amount of mischief.

It is, I think, without exception, the worst form known, and yet, strange to say, it has been the most popular, and is still used more than any other.

Thanks, however, to this Institute, and to the efforts made by our leading sanitarians, the public are now becoming aware of its treacherous character, and, as a consequence, its doom is fixed, and the time will come when it will be a thing of the past, to be seen only in our museums.

Seen from above, it has a very fair appearance; it is, however, only a "whited sepulchre;" its interior surface, which is equal to about 5 ft. superficial measurement, being generally covered by a mass of corruption. From this coating, undergoing decomposition, there constantly arises gases, as offensive, and perhaps as dangerous, as those which escape from an ordinary sewer or cesspool.

These gases, being held between the two seals, increase in virulence, until released by the tilting of the pan, when they belch forth, and who can tell the amount of mischief caused through persons inhaling these poisonous vapours early in the morning!

It is well known that a toilet pail, although constantly exposed to the air, soon becomes offensive unless frequently cleansed. Is it then at all to be wondered at that the interior of a "pan" closet, which becomes infinitely more filthy, and is entirely shut out from the air, should emit foul odours?

I have several times tried to mitigate this evil by ventilating the container, but only with very partial success.

There is but one remedy, viz., to take down the apparatus and burn it out. This, however, affords only temporary relief, for the moment it is again used the process of re-coating begins.

It is only fair, however, to say that there are, as usual, exceptions to this rule, for I have known "pan" closets which have appeared comparatively wholesome, but they have always been placed under very favourable conditions.

Besides the "valve" and "pan" closets, the only other kind in general use up to the year 1852, appears to have been the

old-fashioned straight hopper, which, owing to its shape and its bad flushing arrangements, was a most filthy apparatus quite unfit for the interior of a dwelling-house.

In the same year, Mr. George Jennings patented the "monkey" closet, now known in an improved form as the "wash-out."

The object of the inventor was to combine in one piece of earthenware a closet, offering some of the advantages of the valve closet, together with the simplicity of the hopper, without the disadvantages of either.

This closet, which was considered a great improvement upon the "Old Pan" and "Hopper" was at first much used, but it was soon found to be defective, as the excreta remained floating in the trap beneath, instead of passing through it at once to the drain, it therefore became very offensive, and although repeated attempts were made by the inventor to remedy the evil, he failed to do so, and in consequence ceased to recommend them.

During the past few years, other inventors have taken this closet in hand, and by the aid of improved flushing arrangements, have produced a better apparatus.

The advantage of the improved "Wash-out" is, that without the aid of a valve, a large surface of water is held in the basin to receive the excreta, which is effectually washed out into the trap beneath, from which it passes to the drain.

It has also the great advantage of being adapted for the discharge of slops.

It, however, still retains some of its old faults. The flow of water which washes out the basin loses much of its force before it reaches the seal of the trap, and is consequently not heavy enough to clear the trap with any degree of certainty.

Another objection is, that the shaft between the seal of the trap and the basin, which is mostly out of sight, becomes very foul, and emits offensive odours.

It was to remedy the sluggish action of the flush upon the trap that the plug valve closet was introduced in the year 1858. This apparatus has enjoyed a large share of public favour, one of its principal recommendations being the freeness with which the contents of the basin pass away out of sight when the plug is raised. It is certainly an improvement upon the discarded "monkey," but experience has shown that it does not come up to the requirements of a good wholesome closet. The contents of the basin, which glide away so easily, frequently do nothing more than force out from the trap beneath what was left from the last discharge, the present one remaining, to be, in like manner, disturbed by the next visitor. As a consequence, offensive odours are generated, which, passing up through the

hollow plug, cause much annoyance, and, perhaps, in some cases, danger. Again, the plug itself becomes, in a very short time, coated with filth, both inside and out, and emits a great stench, while the plug shaft quickly furs, and likewise smells badly.

For the discharge of slops this closet is very unsuitable. I have frequently seen the hollow plug completely choked from this kind of usage. In fact, so much mischief has been caused in this way that some manufacturers have found it necessary to issue printed instructions in reference to it.

To prevent gasses passing up through the hollow plug, trapped overflows have been introduced; but where slops are discharged, I cannot look upon this as a great improvement.

The inconvenience and annoyance caused by the chokage of traps beneath "plug" valve closets lead to the introduction of the so-called "trapless" closets. This is in my opinion a desperate remedy for the evil.

Given a properly trapped and ventilated drain, a soil-pipe thoroughly ventilated at head and foot, a short-arm from basin to soil-pipe, a basin always fully supplied with water, and a water-tight valve, and some kinds of "trapless" closets will act exceedingly well, leaving nothing to be desired.

Now it is very important that the fact should be borne in mind, that the advocates for these closets insist upon these conditions being carefully complied with, otherwise they do not recommend them.

By skilful workmanship, you may ensure the first four conditions, but no amount of skill can ensure the last two; and yet the temporary failure of either of these must result in the immediate admission of bad air to the house, its quality depending upon the state of the soil-pipe, while the state of the soil-pipe will depend upon the purpose for which the w.c. has been used.

If it has been used as a urinal, or slop-sink, the pipe must become very much fouled, and, consequently, the air drawn through will be very offensive.

Now I can understand the reason for wishing, if possible, to dispense with the trap from under a plug-valve closet, because of its liability to choke, and retain foul matters, but why the "Bramah" pattern valve should be fixed without a trap I cannot understand, as the direct action of its flush carries all clean out through the trap at once, if a round pipe trap be used, and, as this trap is ventilated direct from the top of the outgo, the air in the arm beyond is quite as pure, and probably more so, than with a trapless closet."

It will therefore readily be seen that to a round pipe trap

beneath a "Bramah," there can be no objection, while it has the great advantage of permanently shutting off all communication between the house and the soil-pipe.

To be rightly considered wholesome and adapted for general use, a closet should, in my opinion, possess the following qualifications:—

1st.—The water seal of its trap should be in sight, should stand up in the basin, and be quite safe from either momentum or siphonage.

2nd.—It should be so thoroughly flushed that at each discharge, every part of the basin and trap would be properly cleansed.

3rd.—It should be as well adapted for the discharge of slops as for a w.c.

A closet possessing these advantages is perfectly safe to use anywhere, and the only kind which, in my opinion, comes up to this standard, is that known as the "Direct action."

Within the last few years several inventors have turned their attention to the manufacture of this kind of closet, and there are now several in the market to choose from, each of which has some advantage peculiar to itself.

During the past four years I have tried several of these closets, by fixing them one at a time, for several months at my own house, and carefully watching their action; also at scores of houses where I have introduced them, and from the information thus gained, I find—

1st.—That these closets, when properly trapped, flushed, and ventilated, are perfectly safe and wholesome, and are free from the evils and annoyances attendant upon most other forms.

2nd.—That to ensure a thorough flush out, the water must fall with an avalanche-like action direct upon the surface of the water in the basin.

3rd.—That those basins which show an O. G. section are more readily flushed than those which have sides in the form of inclined planes.

4th.—That with a suitably shaped basin two gallons of water, delivered in five seconds, will thoroughly cleanse the closet.

5th.—That the ordinary round P or half S trap should never be used beneath these closets, because no reliance can be placed upon the safety of its seal.

6th.—Care is required in fixing these closets to ensure adequate ventilation to the trap, because, owing to the exposed position of its seal, it is liable, unless so guarded, to be destroyed at any moment by the discharge of a pail of slops; but if properly protected, it is quite safe from this action.

Where the position is such that this necessary protection can-

not be given, on no account should a "direct action" closet be used. It is better, under such circumstances, of the two evils to choose the least, and fix a good "Bramah" pattern valve closet and D trap.

One word with respect to closet seats. It is the prevailing fashion to have them to fit as closely as possible, and to keep the lid shut.

I think this is a mistake. If there are any gases to escape, they should be allowed to do so at once, rather than be kept boxed in, ready to belch forth into the face of the next visitor.

For this reason, I would discard lids altogether, and, provided a suitably finished apparatus could be introduced, the riser also, and allow the floor cloth to run right under the seat, leaving no space in the room where bad air could be detained.

Allow me, in conclusion, to say a word or two in answer to a question which is frequently asked, and which very naturally arises in the public mind, viz. :—

How is it that while the same state of things has existed for very many years, it is only comparatively recently that "sewage gas," "pan closets," and "D traps," have come to be considered such dreadfully mischievous things?

My answer to this is, that the arrangements of our houses with regard to health, are very much influenced by what the doctor says.

Now, it is a fact, that, up to a certain date, doctors, as a rule, did not recognize the evils of sewage gas, and, consequently, little attention was paid to it. It was a nuisance to be got rid of as much as possible, but w.c.'s and sinks were expected to be rather offensive, and the idea was seldom entertained that the annoyance could be avoided.

The illness of H.R.H. the Prince of Wales, in 1871, drew the attention of the medical profession very pointedly to the poisonous nature of sewage gas, and, at the same time, it aroused the public mind to the immense dangers of its deadly influence, and, as a result, the ranks of those eminent sanitarians, who had been long striving hard for sanitary reform, were soon swelled, and now, throughout the land, the medical profession—who financially have all to lose, and nothing to gain, except improvements in the general health—are coming forward, and doing their utmost in the cause of sanitation, and telling us that we might be more healthy if we would.

MR. ROGERS FIELD, M. Inst.C.E., quite agreed with Mr. Emptage, that the most carefully prepared scheme of drainage may be spoilt by an unwholesome w.c. apparatus fixed at its head. One of the greatest improvements in modern sanitary practice was the system of disconnecting the house drains from the public sewer by means of an open trap so as to make certain that no foul air from the sewer passed into the house pipes. But the success of this system depended to a great extent on a careful attention to the details of the internal house drainage. If these details were defective, so that foul matter was retained in any portion of the sanitary appliances disagreeable smells would be perceived at the open disconnecting trap, and very probably the system of disconnection would be condemned when the fault perhaps really lay in a single unwholesome closet. There was one point, however, in Mr. Emptage's paper with which he could not agree, viz., that under certain circumstances it was desirable to fix a so-called "D-trap." He considered this one of the worst forms of trap that was ever invented, as it always retained foul matter, and no amount of flushing would properly cleanse it. He had known instances of extremely bad smells from a disconnecting opening being found simply to arise from a filthy D trap, and entirely to cease directly the D trap was removed.

MR. COLLINS thought that the D traps were an unmitigated evil, and as Dr. Jenner truly said, they were the double D's—disseminators and destructors. Mr. Emptage, however, had shown in the exhibition what system he preferred, but he would not enlarge upon that until he had heard the decision of the judges. He generally used Mr. Buchan's traps, and he always put one of his traps at the end of every soil pipe. He preferred to try and get an upward current of air continually advancing up the soil pipe, and ventilating the drain by a distinct disconnected chamber.

MR. EMTAGE replied briefly, and said, that there was no man living more dead against the use of the D trap than himself, but at the same time he was bound to admit, that, without ventilation it held its seal more secure than any other form of trap in use for w.c. purposes; he said this after having made very many experiments with almost every form of trap known. He had, however never yet, himself, found it necessary to use it, and it would only be under circumstances such as he had named that he would allow of its being fixed.

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*"The House that Jack Built,"* by H. H. COLLINS, F.R.I.B.A.

In this paper, entitled "The House that Jack Built," MR. COLLINS humoursly described the unscientific construction and the insanitary

condition of an imaginary residential villa built from the owner's own design.

THE PRESIDENT: We have had a very entertaining and somewhat instructive paper. I do not think that it leads to discussion in the same way as the other papers which we have considered and are to consider.

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On "*The Dwellings of the Middle Classes—The evils attaching to the present system of erecting middle-class houses, and the remedies which it is necessary to apply in order to secure their removal,*" by HENRY C. BURDETT, F.S.S.

THE Transactions of the Sanitary Institute contain more than one Paper of mine on the Dwellings of the Poor. Such dwellings are, alas, still very far from being what they should be. From an actual inspection of these dwellings in various parts of the country, I am compelled to declare with Mr. Fawcett that the first conditions of health, morality, and economy are alike impossible under the circumstances in which a large majority of the poor have to live. The house accommodation of the working classes in our large towns is often so bad as to make it impossible to overstate the evils arising from it; and I have often returned home, after a long day's inspection, possessed with a feeling of wonder that the poor, in the East-end of London, for instance, do not rebel in a body, and insist upon being better housed or knowing the reason why. Yet the evil is increasing; for it is revealed in the figures of the last Census that more and more people are crowding into the towns, and less and less are remaining in the rural districts. Thus, whereas in 1861 for every 100 people who resided in the rural districts, there were 165 people living in towns, in 1871 this number had increased to 184, and in 1881 it had reached 199, so it is accurate to say that to-day there are two people living in urban for every one residing in rural districts. This ratio is rapidly increasing, and the evils arising must therefore tend to increase rather than to diminish. Nor is Scotland, or even Glasgow, in a better condition than England in this matter, but rather the reverse. Some of you will perhaps remember that Mr. John Bright, in his Rectorial Address at Glasgow, said that 41 out of every hundred families in this city live in a single room, and beyond these 41, 37 more out of every 100 live in two rooms. This statement does not convey all the fearful consequences of such a condition of affairs, nor can anyone realize it unless or until they have made

themselves acquainted with the proportions and surroundings of such a room as that referred to by Mr. Bright. Many may well ask why, in the face of these appalling facts, do you not take the dwellings of the poor as the subject of your paper, rather than the dwellings of the middle classes? The answer is simple.

Attention has been directed to the former so frequently and forcibly that there is now every prospect of something effectual being done, though the remedy may entail parliamentary action and something like a social revolution. On the other hand, little has been attempted in the direction of middle-class dwellings, although investigation would prove that masses of the middle classes, though higher in the social scale than the working class, are frequently as badly provided with house accommodation as any class in the community. There is much that demands attention in the dwellings of the middle class, and especially in those of the lower middle classes. The wealthier classes are able to take care of themselves by the employment of such able architects as they may like to select, and the poorer classes—artizans and the like—have thousands of well-arranged and carefully-constructed dwellings erected for them from the designs and under the superintendence of the same class of architects. But the poorer middle classes have no such power or means of securing healthy dwellings for their own occupation. To prove this and to realize the crying nature of the evils attaching to the dwellings of the middle classes, it is necessary to pay a visit to a suburban district under the control of a Local Board, and to make an inspection of several houses in various stages of erection. These houses will be to let at from £35 to £50 to £75 a-year, and possibly at a higher rate still. They will be occupied by that hard-working class, bank clerks, commercial clerks, civil service clerks, and others, who have to present a decent appearance and to keep and bring up a young family on an income little, if at all, in excess of that earned by a skilled artizan or mechanic—say £3 to £5 per week. The occupier of these houses will often have a lodger or a parent to share the house and lessen the expenses, so that the four or five bed rooms are always fully occupied.

Such houses are erected by speculating builders, known as "jerry" builders, are usually mortgaged as the work proceeds, and have no one to look after their construction except the surveyor to the Local Board. He, poor man, often without an apology for assistance, cannot be in every part of his scattered district at the same time, even if he wished to supervise all this class of work efficiently. Besides, it too frequently happens that the jerry builder is himself a member of the Local

Board, or has powerful friends there; and in such cases the surveyor finds it inexpedient to interfere with certain houses which are consequently the worst of their class. In the model buildings' bye-laws, published under the authority of the Local Government Board, nearly every essential for a healthy properly constructed dwelling is provided for, but in many districts, even where the bye-laws are in use, they are practically a dead letter, owing to the unwillingness of the Sanitary authority to enforce them with uniform energy. Yet the power taken in such bye-laws, and which might be brought to bear upon the builders, would render jerry buildings an impossibility, if the Local Boards were determined to enforce such bye-laws without fear or favour. Every Local Board, that is, the large majority, does not so enforce the bye-laws, and is consequently in league with the jerry builder.

We are daily reminded of the power of combination amongst the working classes. Why do not the lower middle class combine in self-defence and crush their present oppressors the pot-house politician and his ally the jerry builder, who at present too often return and control the members of the local boards, and whose rule is a grinding tyranny accompanied by preventible disease and suffering, not infrequently resulting in premature death?

For the purposes of this paper the writer visited a suburban district, Willesden, where middle-class houses are growing like mushrooms, where the Local Board have really a good surveyor and a building inspector, and where houses have been and are being built by speculating builders, one of whom is a member of the Local Board. These houses offer many points of interest as being at variance with the bye-laws now in force in the district. The houses of these speculative builders are outwardly attractive and comfortable in appearance, and internally the rooms and arrangements are takingly planned. The reason is that directly they are roofed in, and often earlier, they are sold, but within two years they become a misery and a danger to the occupants. Why? Let us examine and inquire on the spot. The builder has several houses on hand in different stages of construction, so every portion of the work can be brought under observation. Here is a grass field, and on a clay soil a house is being commenced. The foundations are being put in; the turf has been removed from the surface of the ground, and a trench is being made, six inches deep and some eighteen inches, or the width of the footing of the house wall, wide. Into this trench they are putting concrete, *i.e.*, jerry builders' concrete, made of siftings of dry earth and a little lime. On the top of this concrete the walls of the house will be built, and the joists

or supports of the floor boards on the ground floor are consequently placed practically upon the clay soil, or within a few inches of it. If you come to this next house, which is further advanced, you will see that the damp course in the walls, to prevent the damp rising throughout the house, consists of tarred felt, a material which will be quite useless for its purpose in a few months time. It is cheap, however, and keeps out the damp long enough to enable the builder to sell the house. Now look at the mortar of which the house is built. It is even worse than the concrete, being made of rubbish, *i.e.*, of lime and burnt clay siftings, or in large part of clay pure and simple. By facing-up and pointing the brick-work this jerry work is effectually hidden. After a brief interval, however, the appearance this outwardly beautiful piece of brick-work will present, can be seen by looking at that house over there, where large cracks and bulging walls speak eloquently.

Here is a house, empty, which was completed and occupied two years ago. Notice how the inside is finished, to take the eye: good mantel-pieces, showy grates, and attractive papers. Now look at the floors. Not one of them is level; they are at all sorts of angles, owing to the sinking of the walls. You have to walk up and down hill, as it were, to cross each room in the house. Notice how the damp has risen, even to the second-floor rooms, and in all the water has come through the roof, not in one, but in many places. The bath room, &c., is conspicuous, but only to the practised eye, by reason of the scamped plumbing and forbidden fittings used. Look at the exterior. The footings of the chimneys are above the ground level, the garden walls are all bulging out, the piers cracking and coming to pieces; and, if left to themselves much longer, they will fall down. Observe how the roof sags, owing to the scantlings of the rafters being insufficient; and in case of fire, though a detached house, it is so close to the next, that the fire must spread because the usual protection against fires spreading from one house to the next is absent—no parapet being carried up on the external side walls. Built on clay, containing, practically, no cellars and no damp course, it is literally placed flat on the ground. Notice that the floor level of the house is now below the level of the garden: and on this fine summer's day the dampness is shown many feet up the walls of the house.

As to sanitary arrangements these houses over there have a cesspool in their front garden within 20 feet of the front door, which overflows through the front garden wall and under the foot path into the street gutter, as you will observe. Look at the soil pipes! One lead one there has no less than six angles, and is tapped at the top by a  $\frac{1}{2}$ -inch pipe ventilator,

and one is carried up to the chimney and turned over at an acute angle into the chimney itself. In more than one instance the soil pipes are leaking on to or down the sides of the houses. See again, this house has had to be under-pinned within two years of its erection and since it was purchased from the builder.

Finally observe that as you walk through the district many of the houses are worse than those we have been examining, that the rentals vary from £35 to £75 per annum, that new roads occupied for two years present the appearance of sloughs of despond, because the Local Board declines to take them over, but that nearly every house is occupied, and that many are sold before completion.

Now observe what the bye-laws of the Willesden Local Board, with respect to new streets and buildings passed in 1881, provide. The whole ground surface or site of a house must be properly asphalted and covered with a layer of good cement concrete, rammed solid at least six inches thick. The building must be solidly put together (1) with good mortar, compounded of one part of good lime, and of three parts of clean sand or other suitable material, or (2) with good cement, or (3) with good cement mixed with clean sharp sand. Every wall shall have a proper damp course of sheet lead, asphalt or slates laid in cement, or other durable material impervious to moisture, beneath the level of the lowest timbers, and at a height of not less than six inches above the surface of the ground adjoining such wall. All footings shall rest upon some solid and sufficient substructure as a foundation, or not less than nine inches of good concrete. Every party wall shall be carried up at least nine inches in thickness, for a height of at least fifteen inches above the roof, flat, or gutter of the highest adjoining building. Every soil pipe shall be at least four inches in diameter, shall be outside the building, and be continued up without diminution of its diameter, and without any needless bend or angle being formed in such soil pipe. Every cesspool shall be at least fifty feet from a dwelling house, the brickwork shall be imbedded in cement, and shall be made watertight, with a backing of at least nine inches of well puddled clay around and beneath such brickwork.

Many other provisions might be quoted, but enough has been said to prove that in some cases, at any rate, if not throughout the district of Willesden, the builders set these regulations at defiance, and wholly and openly disregard them. This curious state of affairs is often due to the astuteness of the builder in becoming a member of the Local Board. In one suburb one of the most notorious offenders was, I am informed, once turned off the Board by the indignant ratepayers, but when a vacancy

occurred soon afterwards the Local Board sent a deputation to the builder in question and invited him to fill the vacancy thus caused, which he accordingly did. He secured the Board's approval of certain plans for the erection of a number of houses, before the model bye-laws were passed in 1881, and because of this he claims to be able and is still allowed to build without check or hindrance the class of houses we have inspected and examined together.

It must not be supposed, however, that in naming Willesden I do so because it is especially bad. Far from this being the case, I wish it to be understood that in some respects Willesden is far better managed than certain other localities. Indeed, I had intended to incorporate in this paper instances showing the condition of middle-class dwellings at Stamford Hill, Brixton, and elsewhere. There the jerry builder flourishes to an extent hardly credible; and if—as in an instance which came under my own notice—the individual occupant (a civil service clerk) of the jerry-built house tries, of his own strength, to obtain redress and a healthy dwelling, he is defied by the builder, aided ineffectually by the officers of the local authority, forced ultimately to attend the Police Court on five separate days, owing to continual adjournments, left for weeks with an open, foul-smelling drain in the middle of his kitchen floor, which causes general illness to the inmates of his house, and is finally forced by his despair to execute the necessary alterations at his own expense. Is not the condition of the occupant of a middle-class dwelling as much entitled to sympathy and succour as the class below him?

What, then, are the remedies?

First and foremost, that householders shall combine and form themselves into a Local Association, which shall defend them from the cruel wrongs they now have to endure. A very small subscription, probably 5s. a year, to such an organization, would suffice. The first step for such an Association to take, is to select and secure the election of suitable men on the Local Board. Then its funds could be utilized to prosecute offending builders, and to secure the detection of any breach of the bye-laws. In this way and by the exercise of a little public spirit on the part of the classes interested in these matters, an effectual stop would soon be put to the existing evils, and the jerry builders' lot would cease to be a happy one. Under such a system the local sanitary authorities, which now so often neglect their duties (statutory and implied) would commence a course of action which would possibly warrant their possessing greater powers.

Extended legislation on one or two points would then be

justifiable. No builder who was engaged in the erection of buildings within a district controlled by a local board, should be eligible as a member of such board. Bye-laws would be enacted as to the height of rooms, as to hearths (the hearth being part of a floor, cannot at present be dealt with by bye-laws), and as to the materials used to plaster the interior of houses, which is at present frequently kept in its place by successive coats of papering. All these latter items, and others of more or less importance, might be dealt with if the 157th Section of the Public Health Act of 1875 were amended by allowing sanitary authorities to make bye-laws "with respect to new buildings," and leave the Local Government Board, as the confirming body, to determine whether any proposed building regulations were reasonable or not. In this way every part of a new building could be dealt with as far as bye-laws can secure this end. The Local Government Board should possess full power of control, because they are answerable to the House of Commons and to the country, and if they are not well advised in any technical matters they can get more competent professional officers.

Local governing bodies should be liable to some sort of punishment if they are shown to fail seriously in their duties. As an instance of this, I may quote the district of Bangor, where last year the Local Board allowed, by gross neglect, their water supply to be poisoned by specific disease, and thereby caused a fearful epidemic (upwards of 550 cases and about fifty deaths), which, apart from the amount of personal misery and anxiety experienced by the relatives of those attacked, caused a money loss to the town which has been estimated at between £50,000 and £60,000. The splendid Penrhyn Arms Hotel there, was for many weeks, in the season, without a single visitor, and trade was almost at a standstill. Such a condition is surely one which ought to bring about some such punishment as corresponds with disfranchisement in corrupt boroughs. Instead of this, it has been decided to elevate the Local Board of Bangor to be a Corporation. Though the immediate effect of this is to bring in a lord as the first Mayor, it will ultimately result, no doubt, in the Corporation being composed of precisely the same class of men as formed the Local Board.

As regards the Acts now regulating building matters, there are in London the Metropolitan Buildings Act, 1855, but this Act, apart from certain regulations as to duties of adjoining owners, &c., deals almost exclusively with securing stability and the prevention of fires, health matters being, as may be implied from the date, almost entirely lost sight of. A recent Amendment Act, 1879, enables the Metropolitan Board of

Works to make bye-laws as to, amongst other matters, foundations and materials for walls. But these are not all important matters, and when it is borne in mind that the Metropolitan Board of Works has no medical adviser, and that the bye-laws it makes have to be confirmed, not by the Local Government Board but by the Home Secretary, who also has no medical department, is it surprising that sanitary matters do not form an important part of the Building Acts? In London the vestries, acting under the old Metropolis Local Management Act, 1855, have control over drains of houses, and this might be sufficient if it were effectually and uniformly applied through competent officers. But vestry surveyors are not ordinarily a very well-informed class of men, and as the Act merely says, everything is to be either "sufficient" or "to the satisfaction of the vestry," and does not prescribe definitely what is to be required, it is of little real use.

In the provinces, except where there is a local building Act, *i.e.*, where the authority is above being advised by the Local Government Board, and is rich enough to get special Parliamentary powers, they obtain bye-laws under the 157th section of the Public Health Act, 1875. These may be made by any urban authority and, with the consent of the Local Government Board, by any rural sanitary authority also. In the latter case it is usual for the bye-laws to be applied to certain parts of the rural sanitary district—parts which are not sufficiently populated to be formed into urban self-governed districts, but in which there is more than ordinary building going on or about to go on. It is, I think, matter for consideration whether the time has not already arrived for making most of the ordinary building regulations applicable by Act of Parliament to all new buildings wherever situated.

A house in the most rural district, miles away from any other house, ought to be built with strict regard for reasonable stability, for health, and for safety from fire. For an owner of a house, if he may burn his own property, ought not to be allowed to burn, or even to frighten his servants, his visitors, his assistants, or even his relations. Neither ought he to injure or kill them by an insecure or unwholesome building. The necessity for making efficient separation between houses to prevent the spread of fire was shown at Margate some time since.\* A fire occurred in Cecil Square in that town where the Assembly Rooms took fire, which spread to a number of adjoining houses. The whole of the south side of the Square, including a ladies' school, was burnt out, and, although no one was killed, all

\* 28th October, 1882.

were terribly frightened and inconvenienced, and probably the business of several was more or less ruined.

At present urban authorities may, but are not obliged to make, building bye-laws; and if they make them, they need not enforce them. Rural authorities can get power to make building bye-laws, but often do not trouble to do so. Hence, in lots of places houses are being built under no local supervision whatever. Hastings and St. Leonards may be mentioned as instances of this. The urban district is, I believe, only about half-a-mile deep from the sea, and three or four miles long. This area has building regulations, but outside the urban district to the North, many new houses are, I believe, being built in the rural districts under no control at all other than that of the owners and builders concerned. At any rate, I am informed that the Hastings Board of Guardians, as the Rural Sanitary Authority, have no building bye-laws.

Such is permissive legislation, and at this time of the year when we send our children and families to the seaside to take in a stock of health and strength for the winter, we are often compelled, unwittingly no doubt, but none the less certainly, to house them where the most important principles of sanitation are neglected.

Such are some of the remedies needed and recommended. In considering them, and this question of the dwellings of the middle classes, we have necessarily been brought face to face with serious evils, which nearly affect ourselves. It is to be hoped, with the aid of the Press and the discussion which will, I hope, follow the reading of this paper, that an adequate and permanent remedy may be found and applied.

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Mr. H. H. COLLINS, F.R.I.B.A., London, was of opinion that middle-class people were somewhat better protected than Mr. Burdett seemed to think. He admitted that there were a certain class of builders infesting the suburbs of the Metropolis, who had been called "jerry builders," and who built such houses as Mr. Burdett had graphically described. There were suburbs close to Willesden, in London, where Mr. Burdett's assertions would be, to say the least of it, rather exaggerated. Speaking from his own practice, it was not very long ago since he was instructed by a firm of solicitors, to act on behalf of a builder because the Acton Local Board had positively condemned a whole row of houses which had been built in contravention of their bye-laws. They were properties erected for business purposes—large shops, &c., at a cost of from £8,000 to £10,000. He

was sent to try and get a remission of the sentence upon the builders, who had been ordered by the local board to take them down. Mr. Burdett, therefore, made too sweeping an assertion in saying that none of the local boards did their duty. Anyone who perused the newspapers would see the way that his colleague, the district surveyor, who had the fortune and misfortune to look after the district of Hammersmith, acted from time to time against those who were using bad bricks and not covering the site with concrete, as was required by the rules laid down by the Metropolitan Board of Works. Again, the middle classes had a remedy in their own hands. It had been laid down by the highest legal authorities that all a man had to do was to ask the agent or owner of the house whether it was in a proper sanitary condition, and if the answer was that it was so, that amounted to a guarantee; and if it were found that the house was not in proper condition, the tenant could obtain redress by law. If a man could afford to take a house at £50 rent, he could also afford to have it examined for a very trivial sum.

Professor ROBINSON said it was true that the occupier of a house which was in an insanitary condition had a legal remedy, but surely the great point was to prevent such a necessity. What the author of the paper had said regarding dwellings in London was borne out by his own knowledge of that city. It was within his knowledge also that there were numbers of excellent local surveyors to vestries and other authorities, who were as keenly alive to their duties as any person could possibly be, but to these the observations of the author of the paper did not apply. When they were dealing as they had been that morning with the means of removing sources of evil and death, it would be a monstrous thing were they to see, without notice, houses springing up which failed to comply with the most simple requirements of sanitary knowledge. Surely it was too late when an epidemic broke out and some member of the family died, to then seek redress, and the efforts of the Institute should be in the direction of preventing such a necessity. If he had had the time he could, within his own personal experience of London, occupy the whole afternoon in illustration of cases in that city as well as in many others. He could support what Mr. Burdett had said in every particular, and he thought every one would agree with him that a determined effort should be made to raise public opinion against the abominable condition of things, and have the local boards prevented from permitting these jerry builders to put up such houses.

Dr. CARPENTER said there was no doubt whatever—he knew it from personal experience, acquired from observation upon those who had suffered from the consequences—that the matters that were detailed by Mr. Burdett were true to the letter. The town of Bangor had been referred to in the paper, we may recollect that that town had been severely punished for its neglect to obey sanitary law by the epidemic which had visited it. He believed that the evils dealt with in the paper would be best removed were every man called upon to



do his duty as a citizen in connection with his parochial position. He knew that in the south when individuals were proposed for election to Local Boards and Town Councils the majority of the respectable people living in these respectable houses did not go down to the poll to vote for the proper persons. There was no doubt that the intellect and intelligence of the country failed to do their duty in connection with the election of Sanitary Boards. It therefore appeared to him that the great principle that ought to be involved in a Congress like this was that they should call upon men to do their duty as citizens in this matter. To draw the attention of the public to the conditions that were necessary to be obeyed in connection with sanitary laws appeared to him to be of far more importance than to rush off to the Government saying—"You must do this and that." To tell people to do their own work and not ask Government to do it for them appeared to be the best plan.

Mr. ROGERS FIELD, M.I.C.E., also supported Mr. Burdett in his statements, because they were not exaggerated in the slightest degree. There had been such an abominable system of building carried on in some of the suburbs of London that houses had been let to tenants who could not stay in them. Some of the drains of these houses were laid so badly that the fall was from the sewer towards the house, and in one case, in order to get a drain cleansed, it had been found necessary to dig a hole in the garden and draw the sewage from the sewer back towards the house. He agreed with Mr. Burdett that there ought to be fewer builders on Local Boards. The origin of the evil was that the builders exerted themselves to get on to the boards, and when there they did not seek to enforce the bye-laws, as it was against their interest to do so. Although these boards had power to make regulations they seldom did so, and thus no proper supervision was exercised over builders of new houses. He considered there should be a very great limitation, if not an absolute prohibition of builders being on these boards.

The PRESIDENT expressed his own indebtedness to the writer of the paper, and to those who had spoken on the subject. He thanked the author for his indirect corroboration of some of the things he (the President) had ventured to state in his opening address that morning. In fairness to the great many hard working men who were striving to do their duty in the face of great difficulties, he wished to be allowed to remind the Congress that London was a large place, and if some of the surveyors were not sufficiently supported by the local boards or parishes for which they were employed the majority of them were working hard, and doing their best, and but for their labours, things, he believed, would be a great deal worse than they were at present. These surveyors had a very onerous task to perform. It was hardly correct that the Board of Works in London had no sanitary advisers. They were advised by two gentlemen of acknowledged skill in regard to drainage.

Mr. BURDETT said he could endorse all that the President had said

about the earnest way in which the local surveyors did their work. Nobody appreciated their labours more than he did. The paper was not directed against the local surveyors, but was to call the attention of the ratepayers to the fact that they ought to support the surveyors. He would not like it to go forth that they thought a legal remedy preferable to a healthy house. He hoped one of the results of that discussion would be that the press would emphasise the power invested in every citizen, so that there might arise some organization as he had foreshadowed, with the view of securing right ratepayers upon the Local Boards. If they wanted healthy homes, it was the duty of the citizens to follow the lines he had indicated. He had inspected the dwellings of the poor in most parts of London, in Dublin, and in the leading towns in the States and Canada, and he thought he might claim to know what constituted a healthy tenement. In writing the paper he had endeavoured to describe faithfully and without exaggeration what he saw. He had told them where he had seen the houses, and he had kept a list of the buildings he visited, and he would challenge anybody who doubted the literal accuracy of his descriptions to accompany him to the buildings and judge for himself.

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*On "The Scavenging of Towns," by JOHN YOUNG, Inspector of Cleansing, Glasgow.*

SCAVENGING is not, generally speaking, a popular subject. It is, however, one of vital importance. It has unquestionably a most direct bearing upon the health and comfort of the inhabitants of towns and cities; and anything of which this can be said must have an interest to the Sanitary Institute of Great Britain.

I do not profess to have much that is new to say on the subject; but simply a few observations from my experience in Glasgow.

I shall first of all give a short sketch of the work of the cleansing department of this city as at present carried on by the magistrates and council. It may be well to premise that the present population of Glasgow, upon an area of 6034 acres, is estimated at 531,200; and the assessable value is £3,425,646. The general cleansing of the city, although under one management, is reckoned under three sections, viz., (1) Domestic Scavenging, or Night-soil and Refuse Removal; (2) Street

Scavenging; and (3) the Scavenging of Private Courts or Back Yards.

Reversing this order I shall take:—

I. THE SCAVENGING OF THE PRIVATE COURTS.—In this branch of the work we have 218 men, including foremen, employed daily. Their working hours are from 4 in the morning till 9, and from half-past 10 till half-past 3. The city is divided into six districts, and these into eighteen sub-divisions. The sub-divisions are again divided into beats, and each man has his own beat to scavenge. All the closes or entries and courts by or to which more than one tenant has right of access are swept, daily once, twice, or thrice, according to their requirements. Eighteen of the men are constantly employed scourging the dirtier courts and closes with hose, which they attach to the street fire-plugs. The staff also includes public urinal cleaners and ashpit limewashers. The total sum spent under this heading is, in round numbers, £10,000 a year. To meet the expenditure for Cleansing Private Streets and Courts, the Glasgow Police Act authorises the levying of an assessment not exceeding 1d. per £ upon all property bounding with or having right of access by or to any private street or court. I may mention here that all the scavenging under the two following heads is paid for out of the general Police Rates.

II. STREET SCAVENGING.—The total lineal measurement of streets and roads within the city boundary is 153 miles. In this section 175 men are employed, including foremen; and we have sixteen horse-drawn sweeping machines. The street scavengers are stationed under the same districts and sub-divisions, and work the same hours as the court scavengers. The horse-brushes are worked during the night, starting at eleven o'clock. For scavenging purposes we have first, second, third, and fourth-rate streets. All the first, or principal streets, are machine-swept every night, and the second and third less frequently, according to their requirements. The fourth-rate streets are, as a rule, those which are paved with rubble or undressed stones, and are swept by hand-brushes. The principal thoroughfares, which are swept every night by machines, are also picked, and the channels swept by hand-brushes during the day. Our latest improvement in this connection has been the introduction of a registered street-bin for the deposit of the droppings picked up from the principal streets. This bin is sunk flush with the foot pavement—the frame forming part of the kerb—so that it is no obstruction whatever. It is chiefly on this account that I consider them so much preferable to pillar-bins, such as are used in London. (Any gentleman interested in the subject may take notice of them in Buchanan Street or George Square.)

The amount we expend upon street scavenging and watering (exclusive of the removal and disposal of the scavenge) is, in round numbers, £12,000 a-year.

III. DOMESTIC REFUSE AND NIGHT-SOIL REMOVAL AND DISPOSAL.—(I may explain here that the carting and disposal of street scavenge is embraced in our accounts under this head.)

In this section of the work 240 men, including foremen, are employed, and a stud of 175 horses, with the usual relative plant, which in our case includes 600 railway waggons for carrying the city refuse to the country. On the average for the year 700 tons of manure and refuse are dealt with daily; and I may mention here that the cost of this section, deducting revenue from expenditure, is, in round numbers, £21,000 a-year.

In explaining our method of dealing with the city refuse, I shall first speak of its *collection* and afterwards of its *disposal*.

In regard to the collection, I may say that we have tried several modes by way of experiment, but the two systems which may be said to be in operation in Glasgow are the morning-cart or bell-cart system, and the ashbin or ashpit system. The former is in operation chiefly in the centre of the city, where the properties are principally occupied as shops and warehouses. As a rule fixed ashbins or ashpits have been abolished in the districts overtaken by the bell-cart. The great bulk of the domestic refuse of Glasgow, however, is collected from ashbins or ashpits. The most of these places of deposit are now small and improved in construction. As a general rule they are emptied once in eight days. In the denser parts of the city, however, many of them are emptied daily and others twice or thrice in the week, while in the less densely populated districts, especially where there are lanes running behind the properties, the intervals are much longer. The most part of the ashpit contents is removed by the staff working during the night between the hours of 11 p.m. and 9 a.m. Any portion removed during the day is taken from ashpits abutting with the lanes. As to the excrementitious matter, I may state that of late years water-closets have been largely adopted in dwelling-houses in all parts of the city, so much so that much the larger portion of the excrement is disposed of by water carriage. We have, however, 3,155 pail closets in use in connection with dwelling-houses, and 1,268 in connection with workshops, factories, &c. A large proportion of the pails are removed in covered vans on the exchange-pail system, and we are extending this system of removal as far as practicable. Then, to tell the whole truth, we have still a remnant of the old system of privy and ashpit combined, but these will soon be abolished, and the sooner the better, as, laying

aside the question of health, there is no means of emptying such middens without creating an intolerable nuisance.

The disposal of all the various classes of refuse collected in the city is the most serious task of the cleansing department. The natural destination of manurial refuse is of course the land, where it becomes the food of plants. Scotch farmers, as a rule, prefer bulk manure when it is available, to chemical manures; that being so, we endeavour to place our city manure within the reach of as many of them as possible. The result is that we supply city manure to 2,400 farmers whose holdings are situated over fourteen different counties. Until recent years our system of mixing and dispatching refuse was rather primitive. We have now, however, erected city refuse dispatch works at St. Rollox, in the northern district of the city, and other works of a similar kind are in course of erection on the south side of the river, good railway connection having been secured in each case. These works are thoroughly enclosed, and supplied with machinery and apparatus for dealing with the various kinds of refuse. The soil carts are taken to the upper floor where the faeces are emptied into air-tight cast-iron tanks. The ordinary refuse is also taken to the upper floor, whence it passes down through a double acting revolving screen. The finer ash passes, or is carried, into a mixing machine along with a mechanically regulated quantity of excreta. Some street sweepings, after being treated as I shall explain further on, are also simultaneously shot into the mixer, and thus a prepared manure—in a great measure deodorized and free from all hard rubbish—is passed mechanically into the railway waggons. The full waggons are at once dispatched to supply farmers' orders, or, failing them, to a yard 12 miles distant, where the manure is temporarily stored for the supply of future orders at such times as the daily supply falls short of the demand. Thus each day's collection is disposed of as it arrives, and the necessity for storing refuse within the city is got rid of. The cinders taken from the domestic refuse are more than enough for raising the necessary steam for the works. [I may mention that the Committee on Cleansing have had before them for some time the question of utilizing the surplus cinder fuel in raising steam for electric lighting purposes, and at the present time a special joint committee has been appointed to report on the subject.] The rougher rubbish, which is delivered at the lower end of the revolving screen, falls upon an endless web, which travels at the rate of 25 feet per minute. Women are engaged picking from it, as it passes along, anything which can be utilized or sold. Garbage and dirty straw, for instance,

go for manure; solder is extracted by a special furnace from the old meat tins; the tins, as they come from this furnace, as also old iron, old boots, &c., are sold. The remainder is delivered on the top of the cremating furnaces, through which it is passed, and the residum, drawn therefrom in the condition of slag or clinkers, is used for road making or filling up hollow ground. The foul air from the soil and mixing chambers is exhausted by means of a powerful fan, and conveyed under the bars of the cremating furnaces. It is thus purified before passing into the chimney, while, at the same time, it serves as a blast for the furnaces. Noxious odours are thus prevented escaping from the building. At the South Side Works special attention to this is being given. The exhauster will be still more powerful than the one at St. Rollox, and the pipes will be led under the furnace bars there also. But, in order to secure more thorough ventilation of the whole building, and also for light, we are forming a well, by leaving an aperture in each floor, 31 ft. by 22 ft. in the centre of the three-storey building, and a 3-ft. pipe will be led from the roof immediately above the well to the chimney. This stalk is 250 feet high, and is constructed with an inside chimney to the height of 60 ft., thus forming an annular chamber, about 2 ft. wide, into which the ventilating pipe referred to will be led.

Another new feature in these works will be a suite of Baths, for the use of the *employés* in the works and also the street and court scavengers of the district.

This sketch would not be complete without further reference to our mode of dealing with the street scavenge. I need not tell you that it rains very frequently in Glasgow. One of the consequences of our uncertain climate is that a very large and ever varying quantity of sweepings—often slushy—fall to be removed from our streets. What we have aimed at is to make provision at our Refuse Despatch Works for having all the street sweepings quickly disposed of along with the domestic and other refuse. For this purpose we have adopted a series of patent slush-tanks with sloping bottoms. In these tanks the water is rapidly forced to the surface by the downward pressure of the material upon the slope, and is drained off by means of the little slide plates in the front of the tank. By this means, in the short space of twenty-four hours, soft slush from the paved streets is rendered solid enough to be despatched by rail along with the other manurial refuse. Those tanks may be placed in a row, or front to front, or back to back, or set to form a square, or arranged radially round a common centre. They could conveniently be set on pillars and girder work high enough to permit of carts, waggons, or

boats being placed beneath them for the reception of the solids after draining. The sweepings of macadamized roads are drained in the same way. They are not, however, mixed with the saleable refuse, but are sent to Fulwood Moss Farm, ten miles distant. This is a farm of about 100 acres, which the Magistrates and Council four years ago leased for thirty-one years. At that time it was a heather bog, but it has now been thoroughly drained and reclaimed; and, with the application of road scrapings, yields good crops. A considerable part of the reclamation was done by the unemployed poor in the first months of 1879.

Such are the general arrangements of our cleansing department. You are not to suppose that I consider them perfect. All I can say is we are earnestly endeavouring to advance with the times, and to meet the requirements which sanitary science, experience, and common sense demand.

In regard to town scavenging generally, although there are points upon which a rule might be laid down for general application, it is quite obvious that the *modus operandi* must be determined in each case by local circumstances.

Speaking generally, there are two great preliminary provisions without which *no* town can be efficiently scavenged, viz.:—(1) Proper sewerage, and (2) suitable surfacing. (In regard to these I do not think Glasgow suffers by comparison with other cities.)

The foundation of efficient cleansing lies, like most other foundations, under the surface, and no town can be properly cleansed until it has been properly sewered. Nothing can be more obvious than this, unless it be the necessity for this first provision being followed up by its natural companion—a well-paved surface. I have always considered macadam very unsuitable for heavy street traffic. It is certainly very troublesome to a cleansing department, as in our climate a macadamised street is almost invariably disagreeable either from mud or dust. I agree with those who are of opinion that a street for bearing heavy traffic should have a good foundation of concrete to begin with, and whatever may be the material laid above it, whether stone, wood or other finishing, the surface thus formed should be rendered impervious by having the interstices grouted with cement or pitch. Such a street is easily scavenged.

I also attach great importance to the surfacing of back courts or yards. To have them laid either with well-jointed flags, asphalt, or other impervious surfacing, which will admit of regular and thorough hose washing is, in my opinion, absolutely essential to their efficient cleansing as well as to health. For this purpose undressed stones laid in ashes are

very objectionable. The interstices become almost immediately grouted with filth, and hose washing of such a surface only makes bad worse. I have great faith in hose washing, much more than in so-called deodorisers and disinfectants. In order to carry out this view, I might add a third essential to efficient scavenging, viz.: a liberal water supply, and I should stipulate for a plug in each court for hose-washing purposes. With these provisions, the scavenging of streets and courts in any town is simply a matter of good organisation and sustained attention.

It is in the collection, removal, and disposal of the general town refuse that the special circumstances in which they find themselves placed must guide corporations.

Human excrement, while being the most valuable constituent of town refuse, is, at the same time, the most difficult to deal with. How to dispose of it, is, therefore, the first question we have to consider. The filthy old system of combined privy and ashpit we put aside, as being quite out of the question. I take it that if this material is to be retained for manurial purposes it should be collected and removed in receptacles separately from the ordinary refuse. I am therefore led to compare the pail system of collecting, with the view to its utilization as manure, with the water-carriage system, which gets rid of it by flushing into the sewers. It is natural for one who is intrusted with the sale of city manure to be desirous of retaining the material which forms its chief value. Being in that position, I have been very unwilling, and am still sorry, to see it lost in the sewers. But being at the same time an officer of a health department, I must look at the question all round, and the more carefully I do so I become all the more fully convinced that water-carriage should and will prevail. That it is more comfortable and cleanly must be granted. In regard to the requirements of health, care and attention are necessary in either case. The situation of a water-closet, and its condition as to light, ventilation, flushing, and traps, are of course the salient points. On the other hand, the chief point in a pail-closet is that the contents be removed before they ferment or decompose. In either case the necessary conditions are, I believe, quite within the range of practicability.

Whether collection by the pail system will show better financial results than flushing into the sewers, must depend on the conditions of removal which are to be considered necessary for health. If these conditions were fulfilled by the old system of simply emptying the pail contents into the passing soil-cart, the financial policy of collecting it from the rears of dwelling-houses might be upheld. The case is quite altered, however, if we consider it necessary to have all used pails removed

bodily in covered vans, say not less frequently than twice a week, and clean pails put down in exchange. This would mean the removal of pails with only a trifling quantity in them, and the expense in that case would exceed any price which could possibly be obtained for the material as manure. I therefore conclude that the water system is more economical for dwelling-houses than a twice-a-week exchange pail system.

In the application of the water system to dwelling houses in block tenements, where one outside closet serves a number of families, I believe trough water closets, with the flushing arrangements under the control of the scavenging department, will prove the best. One very important point in favour of using water in such cases is that it admits of a more liberal number of seats in proportion to the families, whereas, with the exchange pail system, there is the inducement to cause as many families as possible to use one seat, in order to have a quantity worth taking away in the pail at each removal. Such a restriction must inevitably lead to a great amount of discomfort, more especially on Sundays, when, as a rule, all the members of a family are at home. For workshops, factories, and such places, however, where large numbers of workpeople are brought together, the pail system can be so regulated, that without inconvenience, the pails would be reasonably well filled at each removal. This being so, and seeing the excreta is of so much value to us in Glasgow in helping away the general refuse of the city, I have always recommended the pail system of collection from as many workshops as possible, when the closets are on the ground level.

The points which now remain for consideration are the collection and ultimate disposal of the general refuse. We all know that the more frequently refuse is removed, the better is it in a sanitary or health point of view. With regard to the mode, I think any system of collection which leads to or tends to encourage the keeping of refuse for any time inside of dwelling-houses should be guarded against. This is the chief objection, I see, to what is known as the bell-cart system if applied to dwelling-houses, especially smaller houses which have no inside water-closets. The bell-cart system suits very well for shops and business premises, and for its proper working uniform dust boxes should be used. But in my opinion it is desirable that provision be made in connection with dwelling-houses whereby the occupants can carry out their refuse at any time. In a town of self-contained dwelling-houses, each having its own backyard, I consider the portable box system, each box having a shed roof over it, very suitable. The circumstances are quite different, however, in a city like Glasgow, where all

the working classes, and in point of fact the great majority of the inhabitants, live in large tenements of several flats, with several houses on each flat. In that case one back court or yard is common to and used by a large number of families. We have 20, 40, 60, 80, and even 100 families using the same court, and it must be remembered that the back court is very much the children's play-ground. It is quite obvious that to have under these circumstances as many portable boxes placed in the court as would contain even one day's refuse from so many families would be out of the question. I know its weak points, but still I consider that a well formed and proportioned ash-house in the court is on the whole the best arrangement for such tenements. It should in any case have good ventilation. The floor should not be under the level of the yard, and it should be cemented inside. The door or opening should be large enough to admit of the refuse being easily thrown in as well as easily taken out, and the bottom of the opening should not be more than 30 inches high. The capacity of the receptacle should be regulated according to the number of families requiring to use it.

The question of ultimate disposal of city refuse must also, as in the case of collection, depend upon local circumstances. The refuse of a town whose excrementitious matter is all disposed of by water carriage cannot be said to be of great intrinsic value. Its practical value, however, as in the case of other goods, is what it will bring. We know that towns which command large tracts of agricultural land may, and in point of fact do, get money out of police manure of a quality inferior to that which other towns, differently situated, are compelled at considerable expense to destroy. In any case, however, there is the furnace to fall back upon. When the supply proves greater than the demand for manurial purposes, the supply can be curtailed by burning the worst of the material, and just as the demand decreases the burning power must increase. How the heat produced in the cremating furnaces can be most profitably utilised is, therefore, a question worthy of earnest consideration. I have no doubt some large seaport towns, where barges can be safely used for carrying the unsaleable refuse out to sea, will find this the cheapest and perhaps the best mode of getting rid of it; but comparatively few towns are in this position.

It was very aptly said by one of our great men that "dirt is matter in the wrong place." The task of health departments and cleansing masters is to discover the right place for it, and having arrested it in the very act of going wrong, to put it where it ought to be. This, however, like many other things, is "easier said than done."

Mr. G. W. MUIR, Glasgow, remarked that the elaborate system they saw depicted on the walls was imported from Manchester. He complained that there should be any such place as that at St. Rollox as described by Mr. Young, within the city at all. It was a great improvement, no doubt, on what used to be, but it ought not to be where it was—it was dirt, and it was in the wrong place. He contended that the existence of such a place within the city was a contravention of the Public Health Act. According to that statute, no collection of manure should be within fifty yards of any road or street or dwelling house, yet the works at St. Rollox were only separated from the public street by a wall. It might be very well for those who resided at a distance to say that they were not a nuisance, but from personal investigation and inquiry among the inhabitants who had to submit to the odours all the year round he found that they complained most bitterly of them as a nuisance.

Professor GAIRDNER thought the tone and temper of Mr. Muir's remarks were better passed over without comment. The whole character of Mr. Young's paper showed that his heart was in his work, and it bore a very distinct sense of his grappling with the work and trying to do everything in the best possible way. As Mr. Young had said, the work was not of a kind that was popular, and all that was done was open to remark from persons who were determined to find fault. In order to know what had been done in Glasgow in this matter it was necessary to look back, not, perhaps, to the time when Dr. Arnott visited Glasgow and found court behind court filled with families, while in the centre there was a piled-up midden that was sold for the benefit of the dwellers in the court, so that, as Dr. Arnott described it, the people were literally living upon the produce of their own filth, and jealously guarding it against being removed by the authorities. That was the original state of Glasgow, and that was what they had been gradually getting away from. After alluding to the unsatisfactory system of cleansing by contract which prevailed at the time when he was medical officer of health, Professor Gairdner said he was very glad that Mr. Young regarded himself as an officer of the Health Department, because he could not conceive of the cleansing of a town being well managed where the scavenging was not part of the work of that Department.

Mr. HONEYMAN said he had listened with much pleasure to Mr. Young's admirable paper. He believed that few of the citizens were aware of all that had just been communicated to the Congress regarding the great works now in operation with the view of keeping the city clean. It had occurred to him to ask Mr. Young as to the sanitary effect of sweeping the streets by the horse sweeper instead of with the old-fashioned hand broom. He thought, perhaps, that the horse machine moving diagonally across the channels, left an accumulation of filth which the old broom used to clear out. Then as to the uplifting with the bell-cart he had been pleased to hear that Mr. Young had come to the conclusion that the proper method was to

have a uniform size of covered box. As it was, in some of their streets up till 10 a.m. boxes of every conceivable shape and size could be seen filled with refuse. He had seen baskets, soap boxes, orange boxes, and even handboxes, and the result was in the latter case when the men lifted them that the bottoms fell out and the refuse fell to the ground. To make matters worse, old women could be seen poking about these boxes, and altogether the streets up till that hour and long afterwards presented a more slovenly appearance than any place he had seen with the exception perhaps of Bristol.

Dr. A. CARPENTER said he had had an opportunity of going over the works described by Mr. Young, and since then he had heard him read his paper. He had to confess that it appeared to be an advance by a great deal on similar works in other towns. The smell was dealt with as far as human ingenuity could deal with it in an efficient manner, and it had been reduced to a minimum. There was another principle which he thought highly favourable in connection with these works—they were not destructive. It was to him a very great and serious evil when he saw material of value destroyed simply for the purpose of getting rid of it. At St. Rollox, however, they had made arrangements for utilising everything that was likely to be useful; and the manner in which that was carried on appeared to him to be as little objectionable as anything of the kind possibly could be within the midst of a great population. One objected very much, unless it was absolutely necessary, to the pail system; but still this system could be carried on so that it should not be a serious nuisance, at least not a nuisance injurious to the health, and it appeared to him that the way in which they were managed rendered them as little injurious to health as it was possible for them to be. In regard to the disposal of the manure, it was important that farmers should get it before putrefaction had deprived it of its value. If it was brought into contact with the ground as soon as possible it would be valuable, but if it was stored until after putrefaction it would be comparatively valueless, and the farmers would find that they had not their money's worth. There was one benefit which the 2,400 farmers who were customers of Mr. Young derived from the manure being sent off in waggons as quickly as possible, and that was that they would get it on the land before putrefaction had deprived it of its value. He could not let the opportunity pass without expressing his full approval of the condition of things he had seen at St. Rollox. He felt that that was a specimen of work that might very well be copied by the London Authorities, because there was nothing at all equal to it in the Metropolis. A proposal had been considered by the Sanitary Authorities of the City of London for destroying entirely the whole of the refuse that they collected from the streets, ash-pits, stables, and cow-houses, because it would cost something like 12s. a ton to take it to the outside of the city, while it would be worth only half-a-crown when it got there. He was opposed to such a proposal, because he thought it would result in injury to the country. He was glad that the Corporation of Glasgow had avoided such a course. The paper which

Mr. Young had read was one worthy of the Congress, and he, for one, was extremely grateful to that gentleman for having placed it before them.

Professor ROBINSON said the paper was one of the most useful that had been read to the Congress. The subject it dealt with had been engaging the attention of every Local Authority in the country, and every sanitary department had been exercising itself as to the proper method of dealing with the refuse that was collected in its locality. He would express no opinion as to the cost of dealing with such refuse, but he was of opinion that nothing should be destroyed. Sound, reliable data was what they required, and the paper just read afforded them all the information they could desire on the subject.

Mr. ALEXANDER FREW, Glasgow, wished to inform the Congress that there were about ten burghs clustered around Glasgow which were all under separate authorities. That alone, he thought, was a great drawback to the proper direction of sanitary work in Glasgow. The work of the Glasgow Sanitary Department, he had reason to believe, was carried on in the most satisfactory way, but he would just tell them how sanitary matters were managed in one of the most fashionable burghs outside of Glasgow. Behind a terrace of self-contained houses there were 10 or 12 ashpits within a few feet of the back wall. These pits were built of brick, and the refuse thrown into them was generally allowed to lie for six months before being removed, or at the best the places were not cleaned out oftener than three times a year. Surface water got into the pits, the rubbish decomposed, and a most abominable smell was created. When this refuse was carted away it was not taken to the country or burned, or anything of that kind. It was taken out by the back door and put in front of another terrace. It was put into a large area of low-lying ground, and then covered over with six or eight inches of soil, and in the course of a few years a board was put up bearing the words—"This eligible site to feu." Such a state of things ought not to be allowed to exist, and the only remedy was for the Glasgow authorities to make a bold step and sweep the whole of these little burghs into the city.

Mr. YOUNG expressed his thanks for the kind reception and favourable criticism of his paper. In reply to Mr. Honeyman, he said the work executed by the horse machine was far more perfect than that done by hand. On a paved street the revolving brush cleaned out the spaces between the stones more effectively, and altogether the work was better done than men with hand brushes could be got to do it. In regard to the other point referred to by Mr. Honeyman, he said that the great variety of unsuitable and unsightly boxes used for laying out refuse for the morning bell-carts did cause a great deal of paper and dust to be strewn upon the newly swept streets every morning, and this annoyed him more than it did anybody else, as he

had to see that the streets were kept clean. He had, however, recently contracted for a supply of uniform covered boxes suitable for the purpose. Some of these were already in use, and it was expected that the public would soon come to see the benefit of adopting them.

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*"Remarks on the Ventilation of Sewers and House Drains,"* by  
J. WALLACE PEGGS, Assoc.M.Inst.C.E.

The system of sewers and house drains of a town has been likened to a huge machine, requiring constant and careful attention to keep it in proper working order. Perhaps the most important part of this machine is that having relation to the ventilation, with which is connected the question of regular flushing.

Judging from the work which is carried out daily around us, we must come to the conclusion that the question of ventilation for sewers and house drains is very little understood even now; and it may be well here to state what we really mean by the term ventilation as applied to sewers.

It used to be considered that the object of ventilation was to let out pressure of sewer air, and small openings and relief pipes were accordingly made, and considered sufficient to effect this purpose. A little consideration will, however, show that small openings are not sufficient even for the relief of pressure.

I will give one instance of this, taking a case occurring in house drainage work. It is very usual in large buildings to have one vertical soil pipe, which receives a number of closets and slop sinks. When a pailful of slops is poured down one of the upper sinks, this creates in the first instance pressure of the air in the lower part of the pipe, and afterwards a partial vacuum. The effect of this is, if the pipe is not ventilated, that some of the traps are unsealed, either by having the water blown out or sucked out of them. In fact, cases are on record where a pail of water poured down a slop sink at the top of a long soil pipe has unsealed all the traps of the closets and sinks below.

The remedy for this is to ventilate the soil pipe, so as to prevent either undue pressure or partial vacuum. A small pipe

however is quite useless for this purpose, as it will not admit air to pass through it with sufficient rapidity to prevent the blowing out, or sucking out, the water of the traps.

However necessary the relief of pressure may be, it is now well known that this is not the most important object of ventilation.

The true principle of ventilation for sewers and house drains is to have the foul air constantly replaced by the admission of fresh air. A sewer must always have a constant current of air passing through it, in the same way that sewage matters in it must be in constant motion. There must be no resting places, either for air or for sewage matters, in a well constructed system of sewers. This is the fundamental principle which should regulate all sewerage and drainage. Wherever trouble occurs, it will almost always be found to have arisen from the violation of this principle.

The author's experience is that there are few, if any, towns which have been seweraged but that the nuisance of ventilation at the surface of the streets has been complained of. Now what does this mean? It is really an indication that something is wrong in that system of sewerage, or in the house drainage connecting therewith.

The popular notion is that all sewers must of necessity be foul and objectionable, but this is quite a mistake. A system of sewers which is so constructed as to have no resting places for foul matters either in the main sewers themselves or in any of the branches or house drains, will not emit foul gases, and the question of ventilation in such a system is therefore greatly simplified.

In sewers of this kind it would be quite possible to adopt such extensive ventilation that any slight odour which existed in them would be so diluted as to be absolutely imperceptible.

It will be said that the above is an imaginary state of affairs, as there is no town in existence in which the whole of the sewers and drains are constructed so perfectly as not to retain foul matter in any part of them. The author cannot by any means admit that this is so, at the same time there can be no doubt that in the vast majority of towns considerable portions of the sewers and drains are so constructed that they are not self-cleansing, and therefore become sewers of deposit. Even in such cases, however, wonderful improvements may be produced by a regular system of flushing.

By this it is not meant the occasional flushing of once every month or two as ordinarily carried out, but regular automatic flushing once every day or two.

Appliances for automatic flushing will be found in the Exhi-

bition now being held in this city. The branches and terminal portions of sewers are those requiring the most careful and frequent flushing as the flow of sewage in these portions is small, and the deposit does not get washed away rapidly. In fact, if all the branches of a sewer were kept properly and regularly flushed, the main sewers would of necessity become so.

The ideal sewer, no doubt, would be one open from end to end to the fresh air, and although, as towns are now built, this would be impracticable, the author would go so far as to say that the nearer we approach that ideal the better.

Dr. Richardson, in his report on Brighton, where there have been such serious complaints of the nuisance from the street ventilators, has very clearly recommended something approaching the ideal I have mentioned. He there proposes to open at some twenty different parts of the town the space between existing manholes, and to build up large rectangular chambers to be covered with open ironwork to give ventilation to the sewer. He also proposes to use these chambers for flushing purposes.

Sir Robert Rawlinson, in his valuable "Suggestions" advises that—

Ventilation should be provided for on all sewers at frequent intervals, not greater than 100 yards apart, and adds the very suggestive remark "If, however, it is found that some of the ventilators are a nuisance, additional sewer ventilation should be provided at shorter intervals."

The following remarks apply to the ventilation of house drains, but the principles involved in them are equally applicable to the ventilation of sewers.

The most recent authoritative statement we have on this subject is contained in the model bye-laws recently issued by the Local Government Board of England for the use of local boards of health, and other sanitary authorities.

In these bye-laws, which have met with very general approval among the most eminent sanitarians, it is laid down as follows:—

Every ventilating pipe or shaft used shall be of a sectional area not less than that of the drain with which such pipe or shaft may communicate, and not less, in any case, than that of a pipe four inches in diameter. It is also laid down that no bend or angle shall, except where unavoidable, be formed in any ventilating pipe or shaft.

The question of ventilation is so very important for the efficient action of a system of house drainage, that the author has thought it to be of some interest to this meeting to show how far the above admirable rules are being complied with, or rather not complied with, in actual practice.



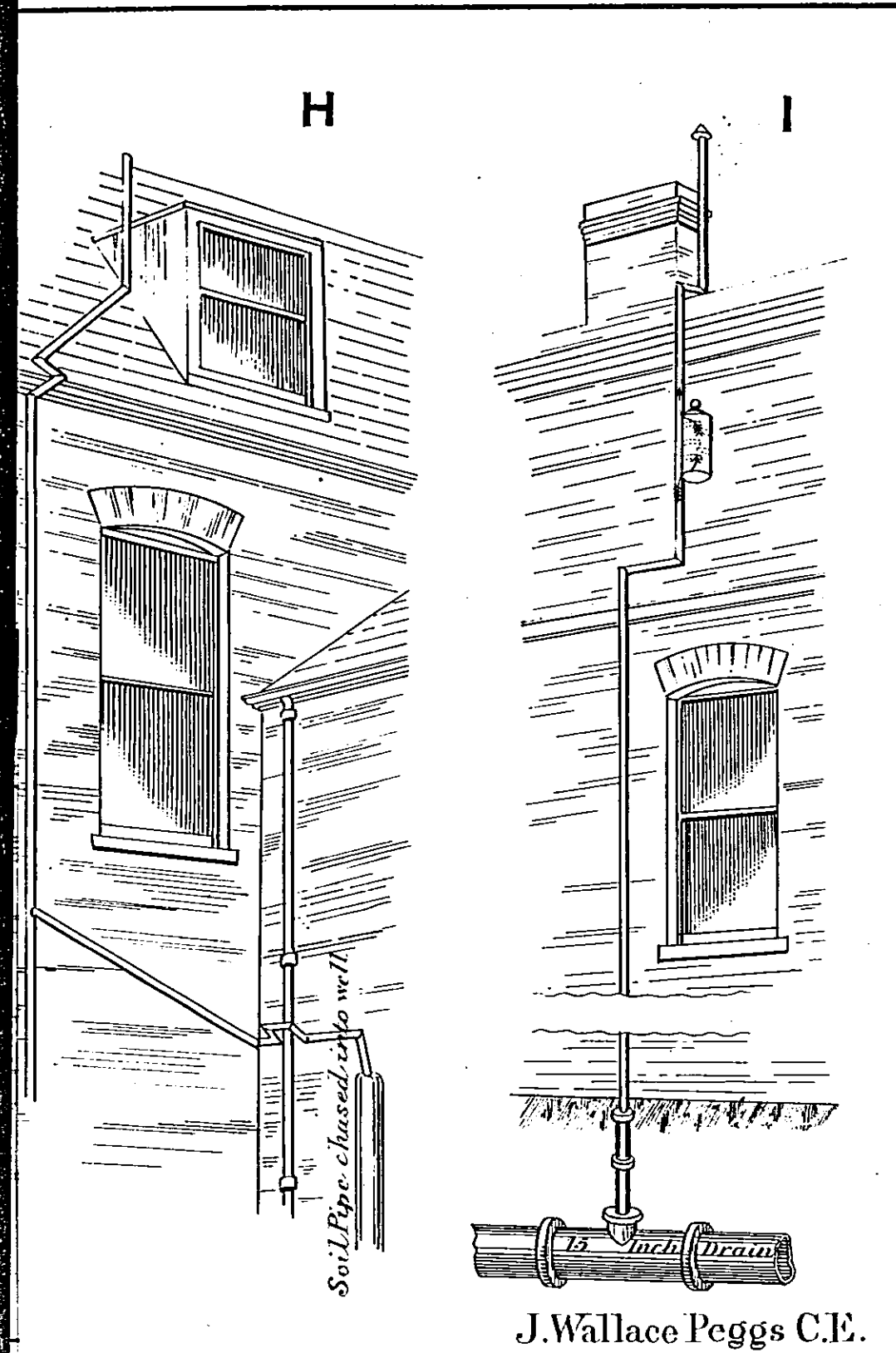
The examples upon the diagram give a number of cases taken from work of recent construction, or in course of construction, around some of the suburbs of London; and will show at a glance, the kind of work which is being carried out under various local authorities.

The really good work of sanitation, as regards house drainage, is very limited, and from large experience in such matters, the author finds that as a rule, the efforts made are to effect an outside show and leave the real mischief undisturbed. It is very usual to find that ventilating pipes with cowls, more or less ornamental, have been run about buildings in all directions, at all kind of angles, while the old drains, choked with deposit, are left untouched. This kind of work makes, of course, a goodly show for sanitation; and one is often taken to these cowls to be shown how effectively they are working because smell is freely emitted. While of course the retort, the old drains remains, generating the sewer air, a foul smell will be emitted, but it should be distinctly understood that in a proper system of drains the ventilating pipes emit little or no odour. Their proper function is to create a constant current of air, and so dilute any sewer air which may be generated.

CASE A (Peckham).—This case is a very common one, and is not peculiar to any particular district. The sketch A shows the 4 inch soil pipe continued upwards by a 3 inch pipe used for taking roof water, and terminating with a hopper head in front of a window. The joints in this particular case are left open, and the arrows indicate the direction which sewer air may take into the house. There are very few cases where a rain water pipe may be usefully employed for drain ventilation; and it is better to lay down the rule that rain-water pipes shall not be so used.

CASE B (Wood Green).—This case is to illustrate the very usual way of providing ventilation to a soil pipe. From the 4 inch soil pipe a smaller pipe, 1½ inch diameter is taken, and made to bend in all directions and around the overhanging gutters, terminating under the coping. This kind of ventilation is utterly worthless, and in the particular case under consideration is, in reality, no ventilation at all.

CASE C (Wood Green).—This is another illustration where a 4 inch soil pipe is ventilated by the 1 inch pipe, as shown in the diagram. It will be seen that the 1 inch pipe is taken round the gutters with five separate bends, and finally terminates in front of a dormer window. Every time a water closet in the house is used the pressure in the soil pipe is relieved, to a certain extent, by this small pipe, and foul air escapes at the window level.



TION OF SEWERS AND HOUSE DRAINS.

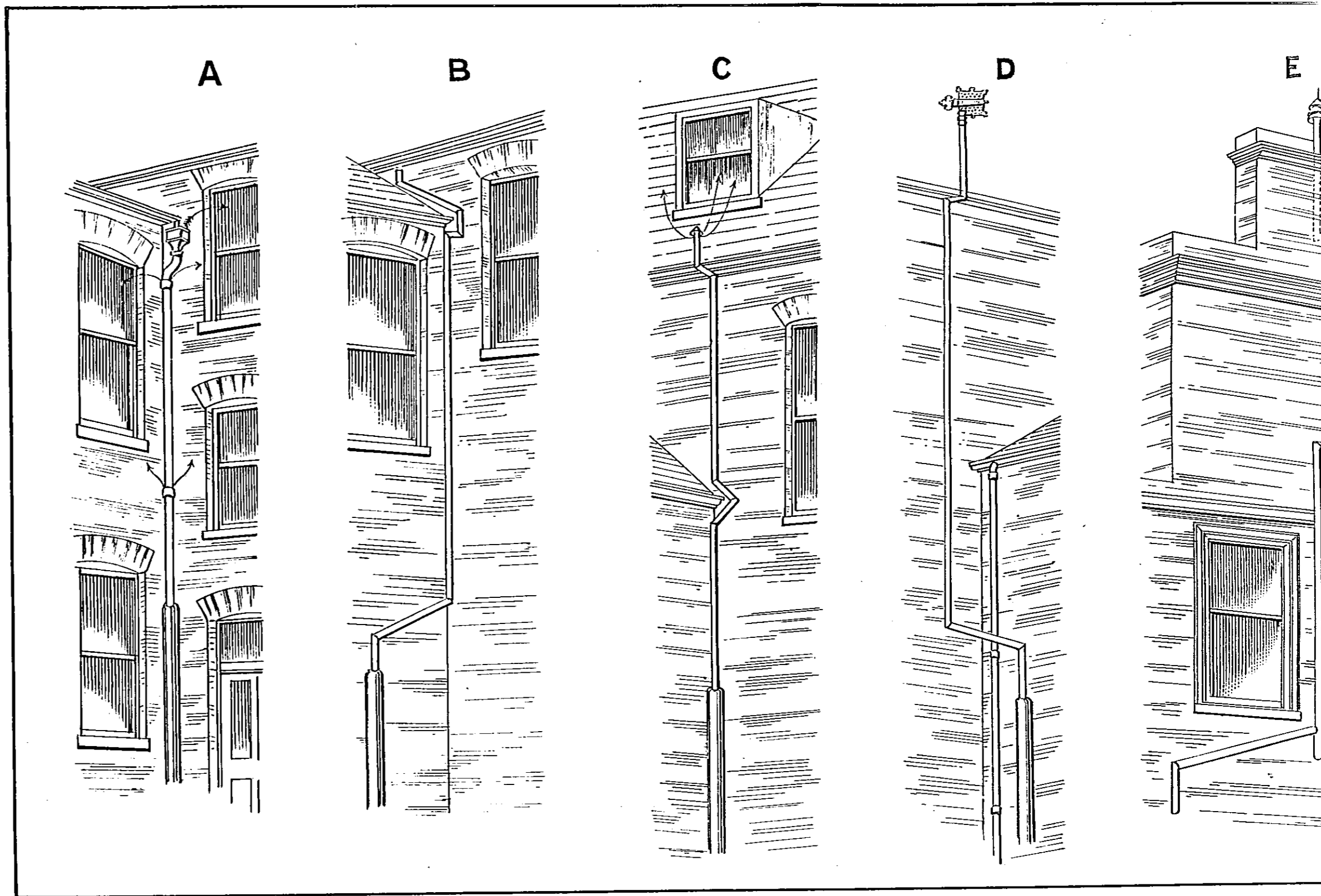
on the diagram give a number of cases taken at construction, or in course of construction, in the suburbs of London; and will show at a glance the work which is being carried out under various circumstances.

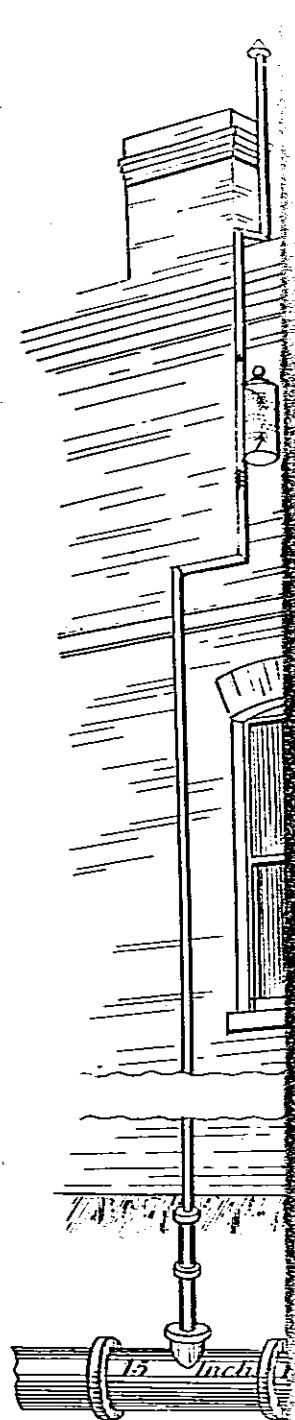
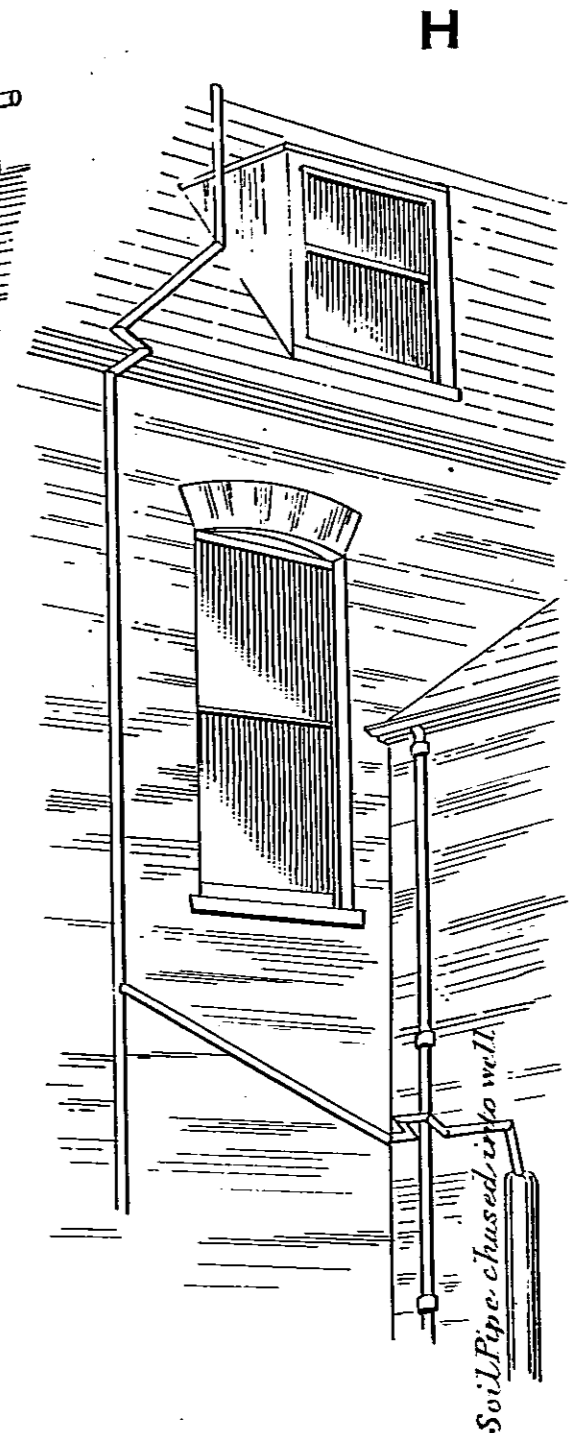
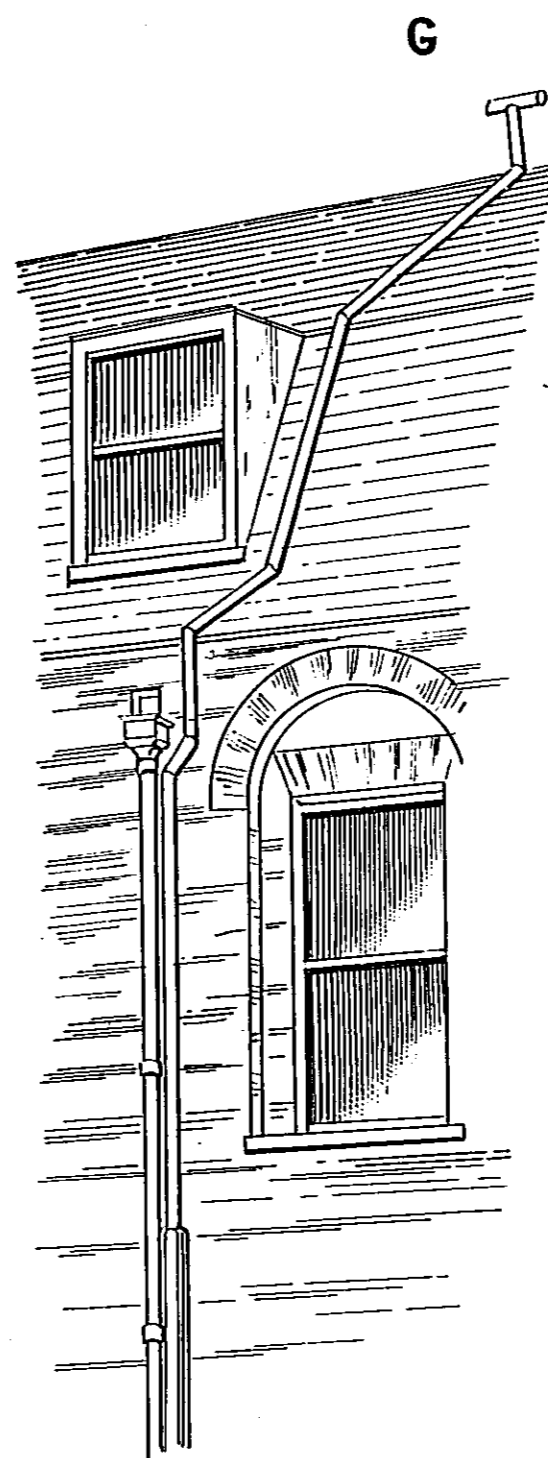
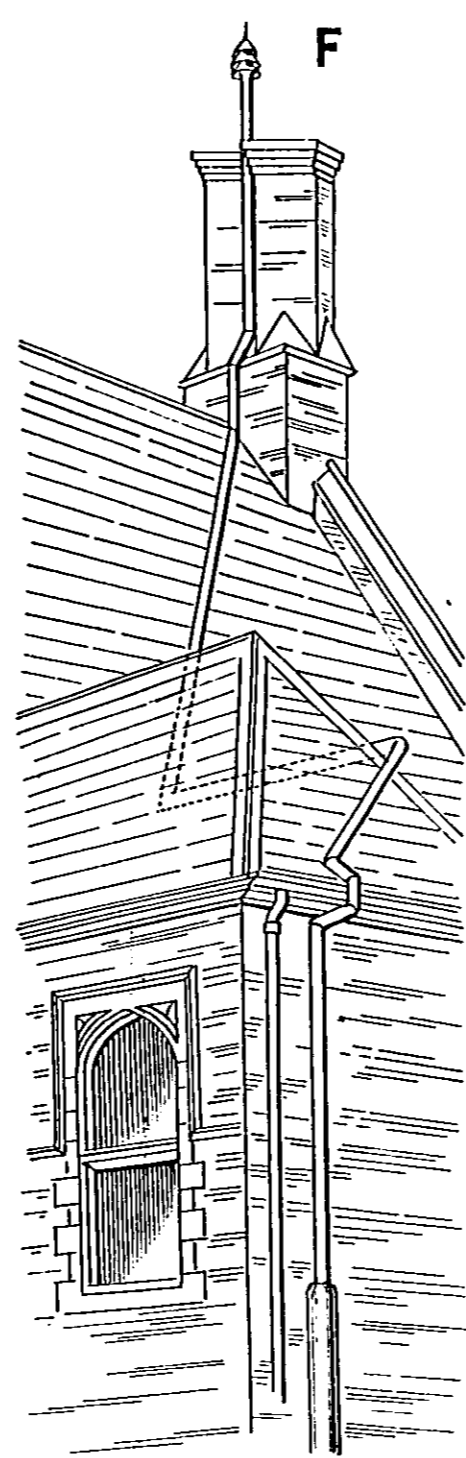
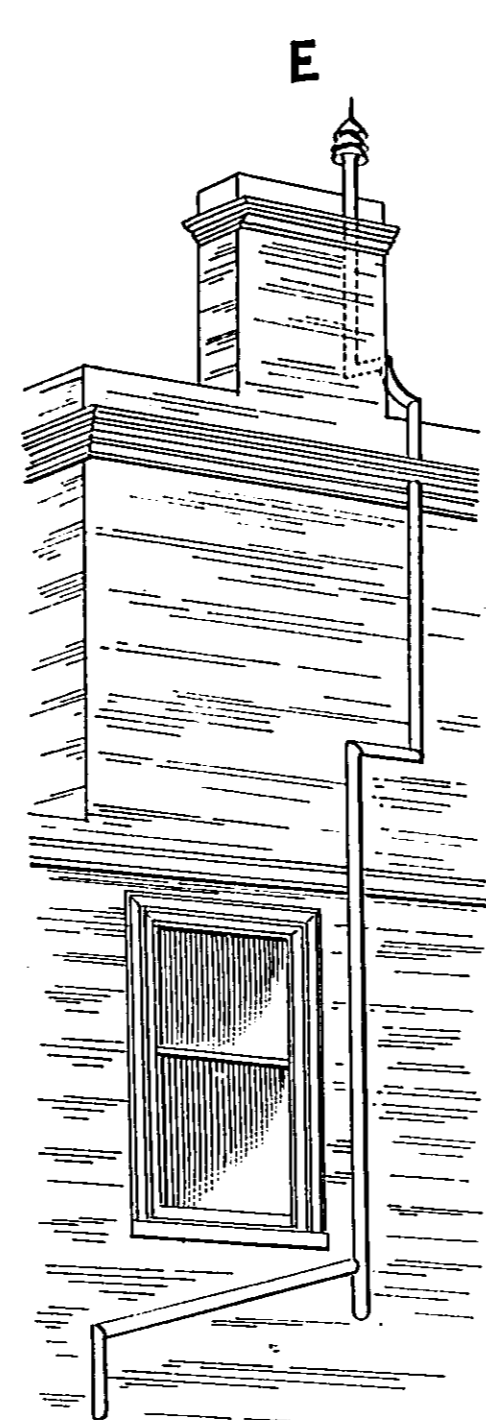
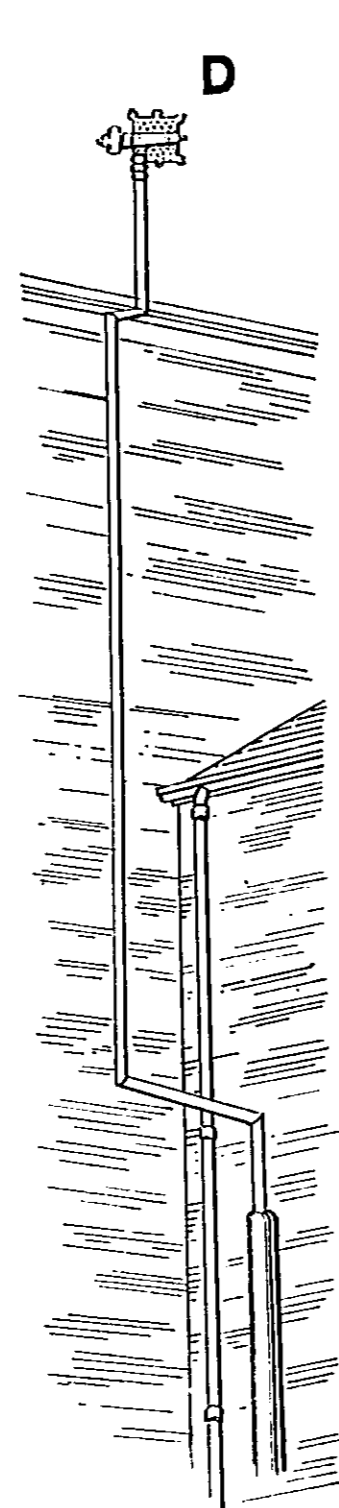
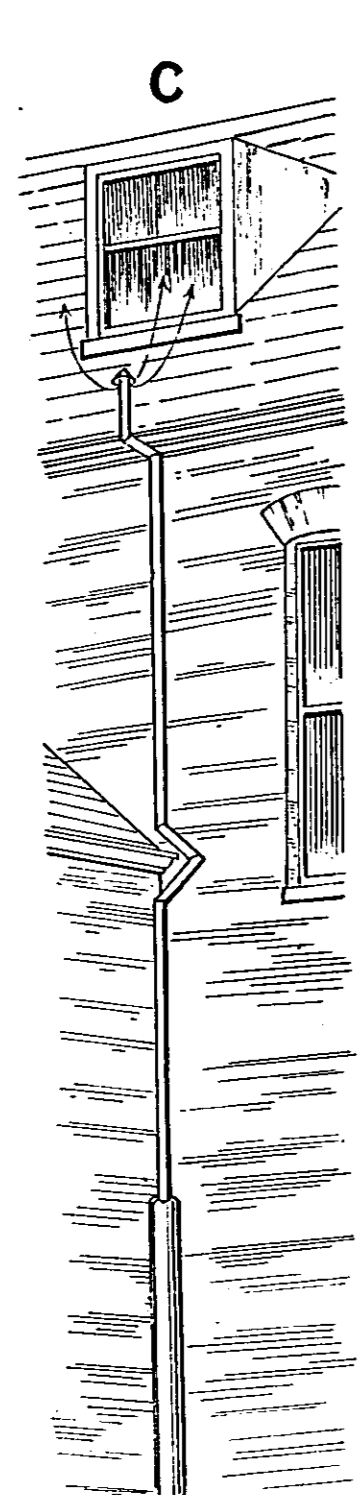
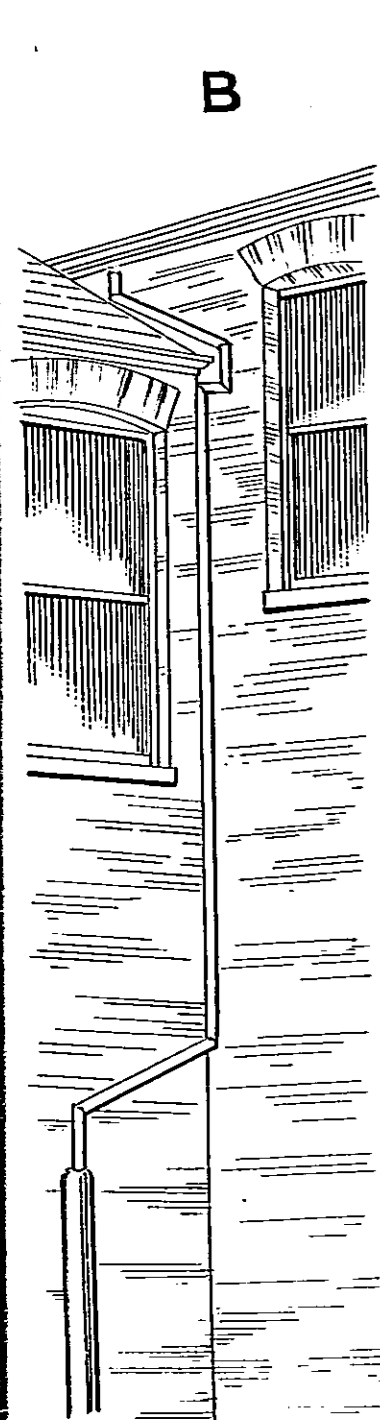
work of sanitation, as regards house drainage, derived from large experience in such matters, the general rule, the efforts made are to effect an outlet for the real mischief undisturbed. It is very common to ventilate pipes with cowls, more or less, and to see them run about buildings in all directions, at times while the old drains, choked with deposit, are still in use. This kind of work makes, of course, a bad example of sanitation; and one is often taken to these to see how effectively they are working because of the retort; the old drains, by letting the sewer air, a foul smell will be emitted, it is distinctly understood that in a proper system of drainage the pipes emit little or no odour. Their object is to create a constant current of air, and so to prevent the air which may be generated.

(am).—This case is a very common one, and is very particular district. The sketch A shows the pipe continued upwards by a 3 inch pipe used for ventilation and terminating with a hopper head in front of the window. The joints in this particular case are left open, to indicate the direction which sewer air may take. There are very few cases where a rain-water pipe is usefully employed for drain ventilation; and it is the rule that rain-water pipes shall not

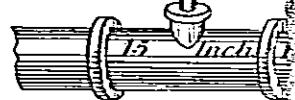
(Green).—This case is to illustrate the very common method of leading ventilation to a soil pipe. From the main pipe, a smaller pipe, 1½ inch diameter is taken, and it runs in all directions and around the overhanging eaves, under the coping. This kind of ventilation is very common, and in the particular case under consideration, no ventilation at all.

(Green).—This is another illustration where a soil pipe is ventilated by the 1 inch pipe, as shown in the sketch. It can be seen that the 1 inch pipe is taken round the eaves, and has two separate bends, and finally terminates in a window. Every time a water closet in the house is used, the pressure in the soil pipe is relieved, to a certain extent, and the foul air escapes at the window

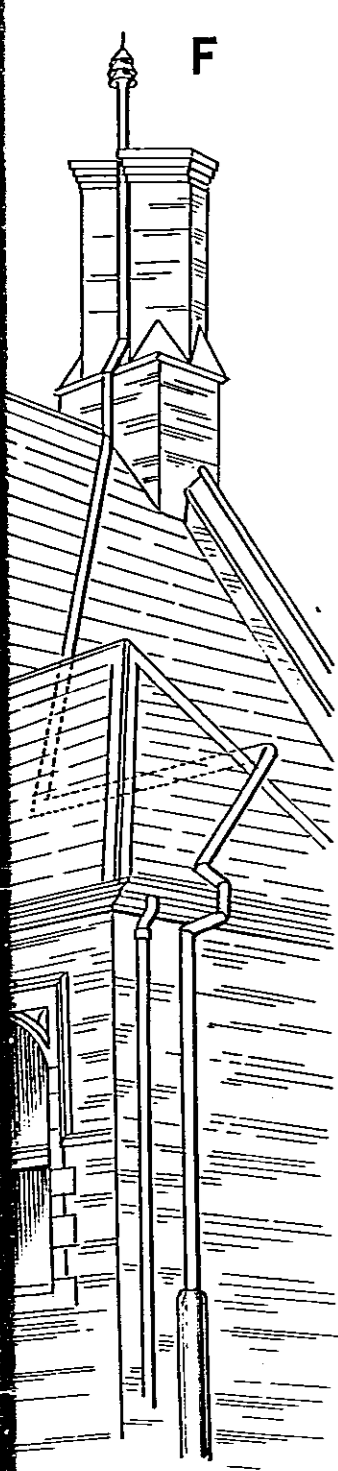




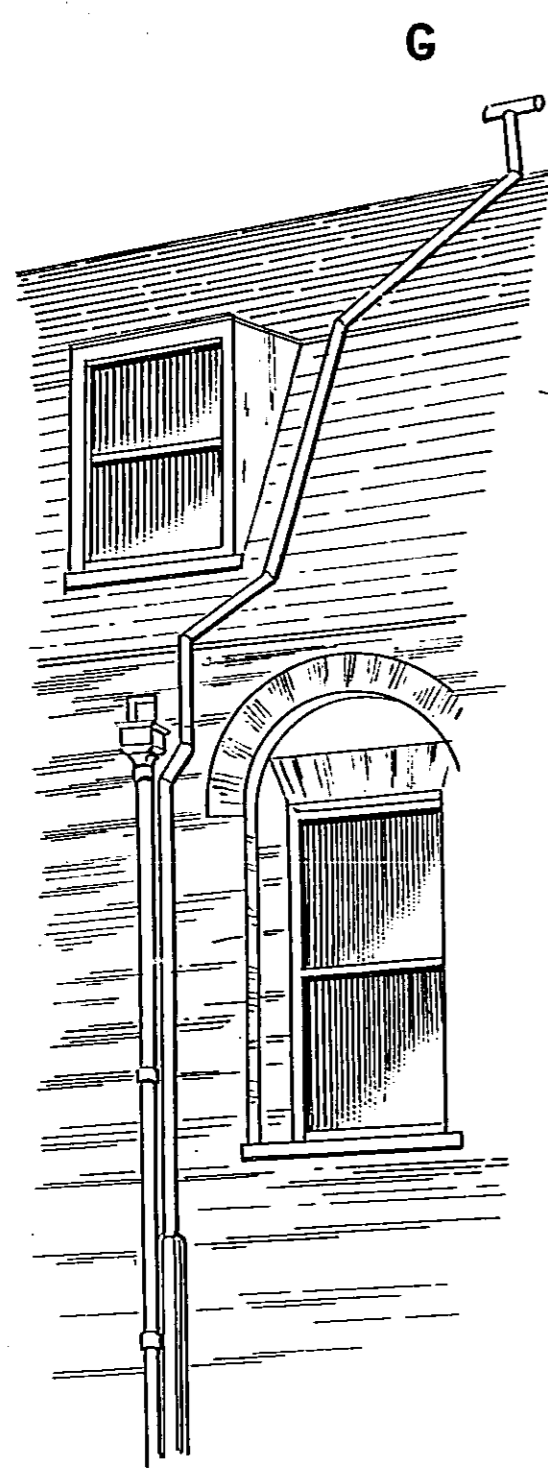
Soil Pipe chased into wall



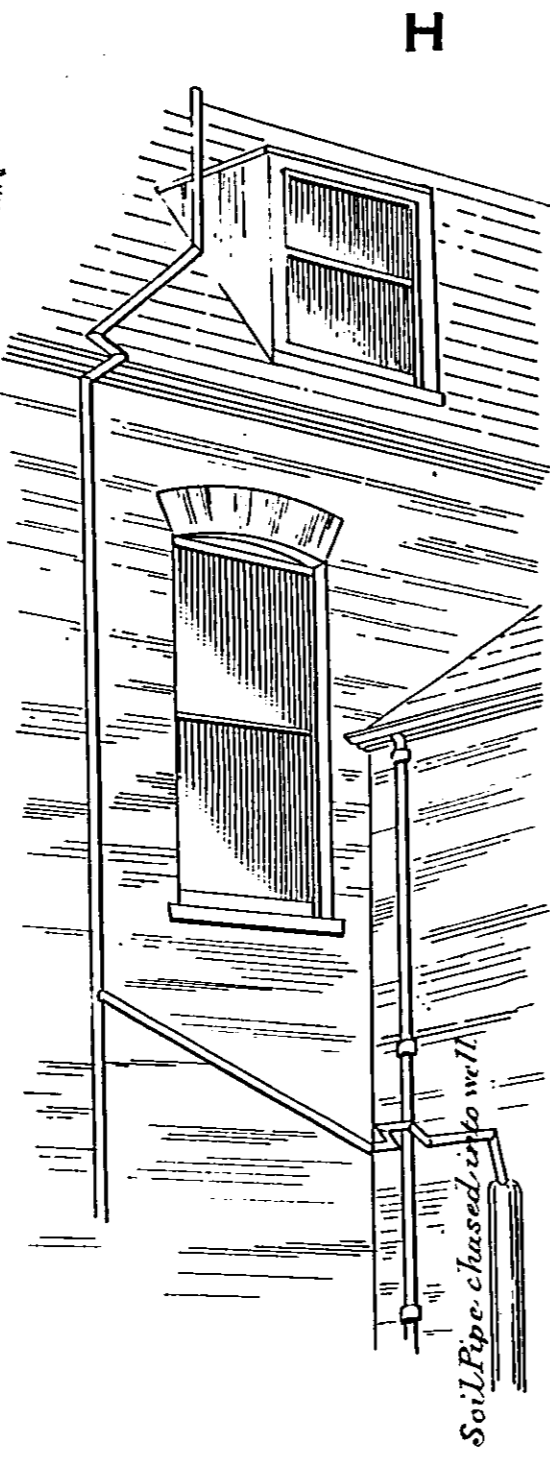
J. Wallace P



F

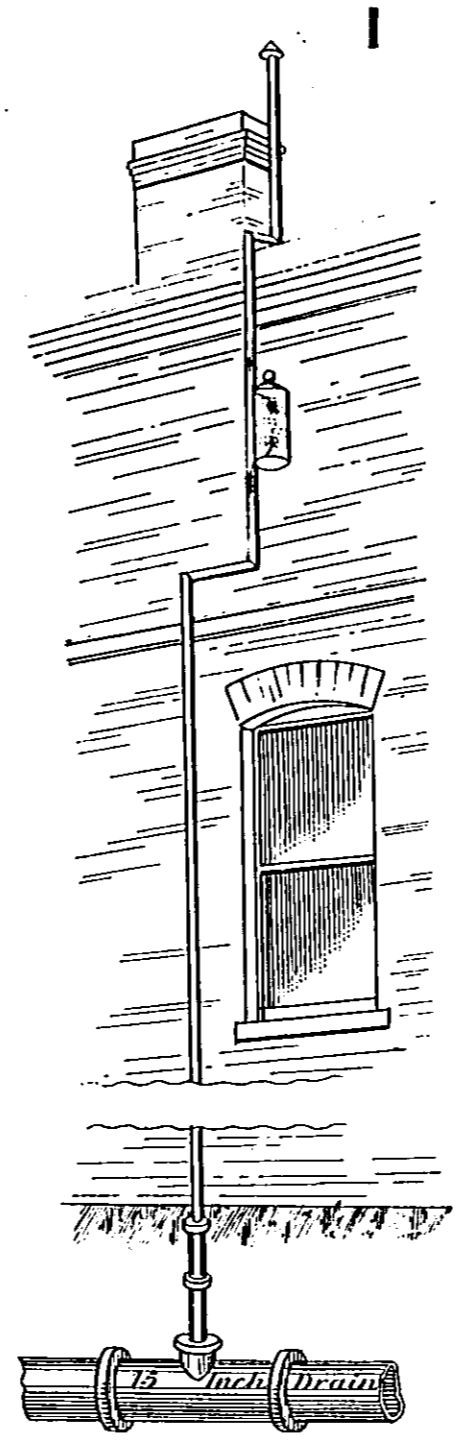


G



H

Soil Pipe closed into well



I

J. Wallace Peggs C.E.

CASE D (Tottenham).—This illustrates another case of ventilating a 4-inch soil pipe by a 1-inch pipe carried up with numerous bends round the rain water pipe and stone coping.

CASE E (Kensington).—The sketch at E shews the ventilation of two soil pipes by a continuation in the zig-zag direction shewn. The pipe is three inches in diameter and has seven bends, and finally finishes at the back of a chimney stack, and is surmounted by a cowl.

CASE F (Large Asylum).—This is one of the most peculiar examples of ventilation in the author's experience, and occurs at a large asylum near London. The 4-inch soil pipe is continued in the directions shewn, with  $2\frac{1}{2}$ -inch pipe, having nine bends. There are no less than thirteen of these ventilating shafts at this establishment, terminating at the chimney stacks, and sometimes there are two to one stack. The pipes are in every instance terminated by a cowl of fantastic construction. It is hardly necessary to say that the appearance of this building is altogether spoiled by this attempt at sanitation.

CASE G (Westminster).—This is another example of recent sanitation. The 4-inch soil pipe is continued by an inch and a quarter pipe, having six bends, and ending with a T piece. The arrangement here is very unsightly, and quite useless for the purpose it was intended.

CASE H (Wood Green).—This shews another example of ventilation for two soil pipes. The ventilating pipe is  $1\frac{3}{4}$  inch, and is intended to ventilate two 4-inch soil pipes, no enlargement being made at the junction (see diagram). There are 12 bends in this ventilating pipe to carry it around rain-water pipes and gutters, and finally terminating just above a dormer window. This example speaks for itself, and requires no further explanation.

CASE I (Large Asylum).—This case is a very interesting one, for the particulars of which I am indebted to Mr. Rogers Field, M.Inst.C.E. The drainage of this asylum had been recently remodelled. Mr. Field was called in to advise and report upon the drainage arrangements, and among other things found that the main drain from the buildings, a 15 inch pipe, was ventilated only by four such ventilators as shown in the diagram. Each of these ventilators consisted of a long length of  $1\frac{1}{2}$  inch wrought iron pipe with several bends, and upon the upper end a box containing small trays of charcoal was fixed. Upon examination it was found that the ventilating space was  $\frac{2}{3}$  rds of a square inch, or less than  $\frac{1}{250}$ th part of the area of the sewer to be ventilated. This area was further reduced by the charcoal, so that the drain was practically unventilated.

The value of ventilation to a drain was strikingly shown

during the examination of this building. Holes were made at frequent intervals along the drain for the purposes of inspection, and at first the escape of sewer air proved a great nuisance; but after a few days, the holes being left still open, the drain became ventilated, and no nuisance from the escape of sewer air was then experienced.

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*On "Ventilation of Street Sewers," by W. P. BUCHAN.*

IT is understood first, that a proper disconnecting ventilating trap is put in upon the house drain between each house and the sewer, so as to prevent aerial communication between the sewer and the house drains inside of the trap. The sewer may then be ventilated in three ways:—

First. By gratings in the middle of the street, all the gully traps at the edge of pavement being trapped, and in connection with these gratings, and to assist in causing them to act as fresh air inlets, ventilating pipes may be put in from the outer side of the disconnecting traps above referred to, and carried up the outside of the houses (or other convenient places) as high as possible, and which pipes may be fitted with Fixed Exhaust Ventilators to assist in causing the foul air in the sewer to be discharged at as high a level above the houses as possible.

Second. By closing up the gratings in the middle of the street—especially where these cause a nuisance—and while still using the ventilating pipes above referred to, to put up high level ventilating pipes to admit fresh air, while the high level outlet pipes in first style continue to act as outlets. Or where sufficient of the pipes from the outside of the traps above referred to have been put in or are in, that a number of these should have exhaust ventilators upon them, and a number without, or blow-in ventilators may be put upon some. When the drain from the house enters the sewer too low below its top, the outlet ventilating pipe may have to be led off from or near the crown or top of the sewer, or from a man hole.

Third. That where it is desired to prevent the air from a main sewer going back into the side sewers branching into it, or the air from one part of a main sewer going into another part, as *e.g.*, where nauseous discharges may be sent into a sewer from some chemical or other work, or slaughter-house, or hospital, &c., there be put in an accessible disconnecting ventilating

trap or traps as may be necessary, either upon the line of the main sewer, or upon the branch sewers. In the latter case, one trap being placed upon the branch sewer near its junction with the main sewer. This branch sewer, or portion of sewer, may be then ventilated by admitting fresh air into it at one end, either by a grating in or near the middle of the street, or other convenient place, or by a pipe or pipes conveying fresh air down from a high level in any convenient manner, while the foul air in the sewer is to be carried off by a pipe or pipes carried up from the other end of this branch sewer, or portion of sewer, desired to be ventilated by itself; and which outlet ventilating pipes are to be placed as high as convenient or possible, and as high above the houses as possible, and to be surmounted by fixed exhaust ventilators, so as to cause a current of fresh air to continually pass into the sewer, or portion of sewer, at the one end and to be discharged at the necessary high level at the other end; all so as to prevent bad air or bad smells from the sewers being felt or breathed by people in the streets, and to cause the said bad air to be discharged above the houses, so that it may be the more readily carried off by the wind innocuously. It is understood that all street gullies are trapped, and that no air gets into or out of the sewer except through the particular inlets or outlets above referred to. I have had this sectional system of trapping and ventilating street sewers in operation at Dalmuir, near Glasgow, since the summer of 1879.

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