[The dwelling-house in relation to health : a lecture] / by Henry Simpson.

THE DWELLING-HOUSE IN RELATION TO HEALTH.

A LECTURE

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Last year it was my privilege to deliver one of the course of lectures given annually with the sanction of the Manchester and Salford Sanitary Association. My subject was "The Health of the Household," and it should have included a great deal of what we shall consider this evening. Time, however, prevented me from even touching on the important question of the dwelling-house, and I propose now to show, as briefly and simply as possible, some of the modes in which the dwelling affects the health.

In all ages, and in every part of the world, man, whether civilized or savage, has had some kind of dwelling, temporary or permanent. It has varied, and still varies, from something little better than a fox's earth, or natural cavern, through endless gradations of form, and complexity of arrangement, till we arrive at buildings like our New Town Hall or a regal palace.

A well-known author on popular natural history has written a pleasant book entitled, "Homes without Hands," showing the ingenuity with which even the lower animals provide themselves with shelter; and we all know that few expressions tell so strongly of utter desolation and misery as that anyone is a "homeless, houseless wanderer." Two thousand years will soon have rolled by since it was said by One, in illustration of His humble position, that the foxes have holes and the birds of the air have nests, but He had not where to lay His head. It would be interesting if we had a similar popular sketch of the various contrivances by which man in the earliest, and indeed in the most recent times, has, like the foxes and the birds, protected himself from the wintry storm and the summer heat. We should have a succession of pictures

of endless variety, some quaint, some sad almost beyond words to express, and others happily suggestive of all that heart could wish. And we should be struck with the fact that there would be no need to go back to ancient times, or to travel to distant lands, to see simplicity and rudeness in the dwelling of man, for in our own day, and in these British Isles, almost the whole series could be illustrated.

Now the purpose for which all creatures make themselves a dwelling is protection, but not exclusion, from the outer air, and from the various changes of temperature and weather. But though man needs protection both from cold and heat, from storm and tempest, it is essential to his well-being that there should be free communication with the outer air, which is indeed the breath of life, and without which all life would cease.

Then, too, the dwelling must be provided with means for carrying away noxious gases, for the removal of all liquid or solid offensive matters, and it must likewise be dry; the rain must be kept out from above, and damp must not creep up from below. There must be free circulation of air round the dwelling, good ventilation through it; it must be well built and well drained, and therefore a dry house.

These conditions appear simple, and yet they are rarely fulfilled. On the other hand, man, even as he is found in our own country, in our own day, is far too often doing all in his power to interfere with nature's requirements, and to evade or obstruct the carrying out of the laws of health; which, by the way, are not laws devised by doctors or any other set of men, but God's laws, which we must abide by or reap the consequences certain to follow their neglect, such as disease, shortened life, and the physical and moral degeneration of the race.

I am to-night addressing many who are unable to pay high rents, or to be very choice as to where their house is placed. Convenience, nearness to work, and cheapness, are often thought more of than those points that have a bearing on health; for people are apt to forget that ill-health is the most costly luxury a poor man can indulge in.

It does not follow, however, that a house, though ever so costly, must therefore necessarily be constructed on good principles as to health, and sometimes the very reverse is true.

Going back to the few conditions I mentioned just now, let us consider the first—free circulation of air round the dwelling.

In country districts and in villages, this is much more possible than in large towns, where land becomes of enormous value, and where the object of the builder is too often to pack his houses as

close together as possible, regardless of the sickness and high mortality which are sure, by-and-by, to distinguish such property. Houses in towns are almost always built in streets, and we cannot hope to get detached, or even semi-detached dwellings for the poor, and but seldom for the more moneyed people, unless they go into the suburbs. But if this were all, if there were nothing to prevent the air playing freely on the front and back of the dwelling, so as to allow a current of air to pass through the house by doors and windows, no great amount of mischief would ensue.

In towns, however, and even in the country, where I have known instances of it, back to back houses, as they are called, are too often to be found, where there is no communication through from the front to the back: the house is one room in depth only, and a partition wall divides the tenement in two from top to bottom. Through ventilation is impossible, and these dwellings are always unhealthy. In a breezy situation, in the open country, the evil will be felt less than in crowded streets and town alleys, but it is a mode of building which ought never to be allowed.

In what I said as to a street being comparatively free from objection if there were nothing to interfere with the free play of the air, it was assumed that there was a fair distance from the houses of the next street parallel to it; but you will often find in this town, and many others, that this is not the case. There will be the smallest possible yards with dust-bins and privies much too close to the houses, then a long narrow passage just sufficient to afford access to the scavenger, and along which few but the scavenger would think it pleasant to pass, then come other dust-bins, cramped yards, and houses again. Now this very common arrangement cannot be commended. More space should be given, so that the air might be fresh and life-giving, and not loaded with all manner of impurities. In the older towns, and the older parts of towns comparatively new, you may see where the streets have been originally wide apart, and large open spaces have been left; but now, the provision our fathers made for an abundant supply of air, has gradually been diminished by the encroachments of building, till at length we find narrow alleys leading into a labyrinth of crowded hovels, which have too often become the homes, or rather the haunts and hiding-places, of vice, poverty, and crime.

It seems strange that man should so steadily and perseveringly put all possible difficulties in the way of his obtaining a free supply of what is essential to his life, for the air we breathe is more immediately necessary than the food we eat. Without the one we may drag out existence many days; if deprived of the other, in

a few minutes we die. But it is only in quite recent times that the importance of abundant air supply has been ascertained with scientific accuracy; and we must hope that in many instances, ignorance on these matters, ignorance which is rapidly diminishing, has been in a great degree the cause of unhealthy dwellings, for "evil is wrought by want of thought," and that it has not been merely an unholy greed of gain. Few, even of those well educated in literature and art, are aware of the enormous quantity of air breathed by one individual in twenty-four hours. Physiologists tell us that it amounts to 360 cubic feet, or 2,000 gallons; and although this air is so light that, unless in rapid motion, we never feel it, and are commonly so unconscious of its having any weight, as to speak of things of no importance as "trifles light as air," yet these 2,000 gallons drawn into and breathed out of our lungs again in a single day have a weight of 25lb.

And surely when we pause for a moment in our daily round of toil and care and pleasure, and think what all this means—that day by day, hour by hour, in deepest slumber and during our active life, this process goes on unceasingly, and for the most part unconsciously to ourselves—that fifteen to twenty times in every minute our chests expand, our lungs dilate, and then contract again—that this alternation of movement goes on and rests not day nor night, in spite of ourselves, from the cradle to three score years and ten—we may well feel that it is a great mystery, and that we are fearfully and wonderfully made.

I must not forget, however, that I was speaking of the situation of the dwelling-house. Let it then be as airy in its surroundings as possible, and see that it can have through ventilation by doors and windows, so that the air in it can be speedily renewed. In our climate, beyond most others, it should have a sunny aspect, for light is an important promoter of health, and we want here the light as well as the warmth of sunshine.

The house should also be dry; and we will say a few words on this point before considering the ventilation, for you will soon see that it has an important bearing on the latter. A damp house is comfortless; expensive, because damp is destructive of clothing, books, and furniture; and it is unhealthy.

In the building of an ordinary brick house a large quantity of water is used, and new houses are always damp. Dr. Max Von Pettenkofer, the learned Professor of Hygiene, or the science of health, at the University of Munich, has made some interesting calculations as to these points. He says, suppose 100,000 bricks were used for a building, each weighing 10lb. A good brick will absorb 10 per cent of its weight of water. The mortar, which

forms about one-fifth of the walls, will take up much more, but put it at 5 per cent, which is really too low, and we have 100,000lb. of water, equal to 10,000 gallons, which must be got out of the walls before the house is fit to live in. Now, the only way in which this water can be got rid of is by the slow and gradual one of evaporation into the air, both of the rooms within the house and that outside.

This drying of the walls can be made more rapid, as we all know practically, by the use of fires in the house. The air in our climate is always charged with more or less moisture, and the quantity it can take up in an invisible form increases with the temperature. If therefore we have a fire in a room, the walls of which are wet, we increase the quantity of vapour in the room, and this vapour is given off from the wall. Supposing the ventilation of the room is pretty good, the heated air charged with moisture escapes, and its place is taken by a fresh supply of air which, in its turn, takes up more of the moisture evaporating from the wall, to be again carried away; and so the process of drying gradually goes on.

Now when the walls of a house are thoroughly dried, so that their pores, instead of being filled with water, are filled with air the moisture which is given off from the lungs and the skin of the inhabitants, and that produced by various domestic occupations, as washing, cooking, &c., escapes into the outer air, being partly carried off by ventilation, and in part absorbed by the walls and passed gradually through them. In order that the latter part of the process may go on, it is necessary that the porosity of the wall shall not be destroyed by any impervious covering such as oil-paint or glass-paint, or by its pores being filled already with water.

The invisible moisture in a room is sometimes perceptible to our unaided senses, though usually we think nothing about it, and are unconscious of its presence; but as my friend Dr. Ransome told you in his very interesting lecture on "Pure Air," its presence is easily shown if we condense it, and change its condition from that of an invisible gas to that of a liquid or solid. To do this we have only to mix snow, or powdered ice, with common salt in a glass vessel, and the frozen moisture will soon be deposited on the outside of the glass. [*Experiment.*] In a similar way a tumbler of water drawn from a deep well and brought at once into a warm room will soon look dim, from the deposit of dew on the outside of the glass. And when a thaw sets in after a few days' frost, which has given time for walls to be thoroughly cooled, you will often have noticed that they become, especially if painted or

varnished, perfectly wet, so that the water may trickle down in little streamlets. People sometimes suppose that the moisture is given out by the wall, which sweats, as they say, whereas it is really deposited on it from the moist and warmer air of the room; illustrating the remark made a little while ago, that warm air could retain more water in the form of invisible gas than cold, for it is the layer of air in contact with the cold surface of the wall which deposits as a dew the excess of vapour it contains, and as, owing to the constant currents in the air, fresh portions are continually being cooled the walls soon become perceptibly wet.

New houses are more apt to show damp spots on the plaster, or on the paper, than old ones, because the walls are not thoroughly dry; the building water has not been entirely got rid of—though they may look dry on the surface—and it still partially occupies the pores, so that they soon become charged with all the moisture they can absorb, and dew is then deposited in a visible form.

A wet wall is practically impervious to gases, and impedes their ventilation and diffusion, because its pores are filled up with water; and, as Pettenkofer says, this is one way in which damp walls are injurious. He rightly attaches much importance to this function of the wall, as he calls it, namely, "the removal into the open air of a great part of that watery vapour which develops itself in every human household." It will be clear to all of you now, why places looking to the north, or in the shade, are damper than those open to the sun. He says also, very truly, that wet or damp walls are injurious "by disturbing the heat-economy of our bodies." They absorb much more heat than dry walls, and so rob us of much that a dry wall would contentedly leave with us, and are, no doubt, important agents in causing attacks of cold, rheumatism, kidney disease, &c. So marked is the cold produced by a damp wall, that people sitting near will often think there is a draught from the wall, whereas it is really the loss of heat from their own bodies, by radiation to the wall, that they feel.

I have dwelt at, I fear, tedious length on this matter, because the common notion is, I think, that walls ought to be impervious to moisture if a house must be dry; while the truth is, that a house can only be dry if its walls are to a certain extent porous. Pettenkofer gives so striking an illustration of the effects of non-porous building material, that I venture briefly to relate it. The slag from ironworks is really a kind of glass, and is impervious to moisture. Usually it is in very irregular shapes, requiring large masses of mortar if it is used in building, and if so used with other stones it answers very well. In this case, however, a workman's dwelling was built with large regular pieces requiring but

little mortar. "It was a pleasure," he says, "to see how quickly the building proceeded, and how much more quickly it got dry and habitable than other buildings, where irregular pieces and much mortar had been used. But when it came to be inhabited, damp began to show, and the house became and continued to be the dampest in the whole establishment." The thin layers of mortar could not carry off the whole of the water which was deposited from the air in the house, and it was condensed on the slag, just like water on a window-pane. Remember, therefore, that glass houses, besides being objectionable for those who throw stones, have another bad quality, and that without the greatest care as to ventilation they are certain to be damp. Houses with walls which are watertight are like waterproof coats, which will keep out the rain but also keep in the moisture of perspiration.

Remember also that if you want to dry a new house rapidly you must not only light fires but must open windows. Sometimes people think this ought not to be done, because the cold air would be let in, forgetting that fresh quantities are required which must be renewed as each becomes charged with moisture. Although the walls of a house must not be impervious to air if we wish to have it dry, there is a great advantage in having a damp-proof course about a foot or so above the ground. Indeed all houses ought to be so built. Various contrivances are used by architects, as a course of slate bedded in cement, sheet-lead, a layer of hot asphalte or bitumen mixed with sand. The best article is said to be a vitrified stoneware tile, 1½ or 2 inches thick, and perforated so as to ventilate the space between the ground and the joists of the floor, and prevent dry-rot. These various devices prevent the damp rising up the walls and keeping them constantly damp.

We will now pass to the subject of ventilation, or the continual change of air in the house.

The air around us is always in movement, even when we are not aware of it, for if the movement is less than 19 inches in a second, our senses are not quick enough to perceive it.

Now ordinary walls of brick and mortar, plastered inside, and covered with unglazed, unvarnished paper, allow a considerable quantity of air to pass through them slowly and insensibly, and so aid in an appreciable and indeed important degree in the introduction of air to the interior of our dwellings. You will be the more prepared to admit this from having seen how permeable such walls are to water, and from remembering that air is 770 times lighter than water, and can therefore be moved much more readily.

Pettenkofer, who has done more perhaps than any other man to show us this, illustrates it by making a cylinder of mortar and making it airtight by covering it with melted wax, except at the ends. He fixes on the ends two glass funnels and makes an airtight connection. By then blowing through it, the air, which can only escape through the funnel at the other end, will move the flame of a candle and even blow it out. [*Experiment.*] Sandstone will easily allow passage both to air and water. Limestones are not so porous, but, as they require a large quantity of mortar in building, the walls built of them are not much less so than brick walls.

Now the movement of air which is necessary to ventilation is brought about in two ways—"by producing differences of temperature between two neighbouring bodies of air which are accessible to each other, and, secondly, by mechanical pressure on, or driving off, the air in a certain direction." Both these causes are at work in our houses, but to a different extent at different times. There is always more or less motion in the air outside our dwellings, and this favours its entrance into them through doors and windows as well as through the walls themselves. Our houses, too, are generally warmer than the outside air, though sometimes in summer colder. Now, warm air is lighter than cold air and tends to rise, by which means a current is set up—the colder, heavier air rushing in to fill up the partial vacuum and take the place of the warmer air, which rises and tries to escape. When there is little difference of temperature between the outside and inside, as in summer, the wind aids greatly in ventilation, and we favour this by having doors and windows wide open. In winter, when the air inside is much warmer than that outside, the latter rushes in rapidly through every chink and cranny. Of course in a cold room, where there is not this difference between the temperature of the inner and outer air, this does not hold good, and a room then becomes foul, if people are in it, as soon as if it is closely shut in summer. When poor people in winter are badly off for coals, and on account of the cold close their doors and windows as tightly as possible, the air of their dwellings becomes increasingly and dangerously foul. Remember, then, that fires greatly aid in ventilation. Where many people sleep in the same room, as in schools and workhouses, you would be shocked, on entering a few hours after they have been occupied, by the closeness of the air, unless some special provision for ventilation exists, or the windows are left slightly open. And this brings me to the question—What is the cause of this foulness of the air? You may remember that we each require for breathing about 2,000 gallons of air in twenty-four

hours. We take in with each breath, as some of you may have heard Dr. Ransome tell you, about twenty cubic inches, or two-thirds of a pint, of air, which we will assume to be tolerably pure. This is mixed with the air still remaining in the lungs, for these organs are never emptied of air even by our strongest efforts. Now, when we expire or breathe out again, the air has lost a portion of its oxygen. As Dr. Ransome has said, "the air, on entering the chest, contains 21 per cent of oxygen and 4 parts in 10,000 of carbonic acid gas. Expired air, on the other hand, contains only 13 per cent of oxygen and 500 parts in 10,000 of carbonic acid gas." Now, such air as this is poisonous and not fit to breathe. But, in addition to this loss of oxygen and enormous increase of carbonic acid, it contains also watery vapour and "a minute portion of animal refuse matter, that has been proved by actual experiment to be a deadly poison." The watery vapour given off by the skin also contains this deadly animal matter, and it is this which causes the sickly loathsome closeness of a room in which human beings have been long shut up. To get rid of these injurious matters, as well as to supply the fresh air needful for our existence, we must have ventilation—change of air—or we shall die. This law is true for all animals from the lowest to the highest, and man, whether king or peasant, is subject to the same decree.

But the air of our houses is rendered impure in other ways than simply by the matters given off from our own lungs and skin. The burning of candles, gas, fires, all takes place at the expense of the oxygen of the air, which combines with the carbon and hydrogen of the fuel to produce carbonic acid and water. All nuisances of every kind, all dust and dirt, tend to pollute the air. If any of these things exist you must get rid of them. If any evil exists it is always a good axiom to remove the cause. This will insure strict cleanliness in the house; and without cleanliness all your efforts for healthy dwellings will be vain. Taking for granted, therefore, that you do all in your power to get rid of avoidable sources of air pollution in your houses—and amongst these I would include defective drains—we must seek the best practicable means of insuring good ventilation in ordinary dwellings. But before doing so, allow me to give you some of the conclusions arrived at by scientific men as to the quantity of air per head which must pass through a room in a given time, if it is to be healthy and pleasant. At first sight, when it is remembered that one person does not actually use, in breathing, as much as 18 cubic feet per hour, the quantity required, 2,120 or 3,000 cubic feet, may seem much larger, out of all proportion larger, than necessary. Yet the enormous quantity of 2,120

cubic feet, which has been found by actual experiment by General Morin, in Paris, to be required, has not been thought to be sufficient by the late Dr. Parkes and Dr. De Chaumont. These most careful and accurate observers consider that 3,000 cubic feet per hour are required for each individual. The French standard of 2,120 cubic feet was arrived at by experiments in a hospital with artificial ventilating arrangements, and the scientific authorities commenced with 350 cubic feet per bed per hour, but the air was so foul that they tried a supply of 700 cubic feet, and even then it was far from good, and finally they had to increase it to 2,120 cubic feet before they could be satisfied. Dr. Parkes found that more than 2,000 cubic feet were necessary to keep the air pure to the senses. Now I mention these facts in order that you may be more able to realize the large amount of quiet movement in the air that must be taking place in any room where a few people are sitting if the air is kept moderately pure, and the room free from draught. If the air is in rapid movement we become unpleasantly conscious of it, and soon cry out about draught and taking cold. It is in some respects fortunate for us that our houses are not built so as to be air-tight, and to depend for ventilation on scientific contrivances, as we should, in ordinary life, most likely fail to insure their proper working. But the doors and winodws, and even, as we have seen, the walls of our houses, admit large quantities of air, and more in winter than summer, as the difference between the temperature inside and outside the house is then greater than in summer. And if we supplement these openings by some simple contrivances our houses may be kept sweet and wholesome. One way of admitting air into a room without producing draught is to give it an upward direction, and this may be done in many ways. One good plan is to raise the lower sash of an ordinary window three or four inches, and place in the vacancy, below the bottom of the sash, a piece of inch or inch-and-half wood, of proper length and width. When the window is shut down on this piece of wood there is in the middle, where the sashes meet, a space of three or four inches, the lower sash overlapping the upper one, and an aperture for the admission of air is left the whole width of the window. A current of air sets in, but meeting the glass of the lower sash, it receives an upward direction towards the ceiling, and is diffused, without draught, through the room. This is an old and simple plan. Another, less efficient because the apertures are less, is that of boring some perpendicular holes through the thick wood of the frame where the sashes meet. Then there is Mr. Tobin's excellent method of bringing air from outside the house up a tube generally placed against the wall

inside and rising to the height of four or five feet. The air receives a strong upward impulse, and diffuses itself imperceptiby through the room. These tubes may be of the simplest and plainest construction, of zinc, tin, or wood. The one point of importance is that the inside be made quite smooth and plain and free from all projections right up to the top, so that the air be not deflected or bent from its upward direction, which would cause draughts.

Scientific men will tell you exactly the proportion of carbonic acid that may be mixed with ordinary air without being injurious; and they will tell you that, bad as this gas is, it is taken rather as a measure of the much more dangerous animal matter that accompanies it, and they will give you very beautiful and accurate tests for these impurities. But you are not all scientific men, and we must see if there are no means of practically settling the question of the purity of the air in our houses without the aid of the chemist. Unfortunately, the test nature has provided is one varying much in delicacy, and abuse of the apparatus will render it almost worthless. And yet we must not undervalue that gift of nature—the human nose. It serves generally, though perhaps not always, for ornament, and it serves for use, and even when it can claim no beauty it would be sadly missed. It has its pleasures and its duties, and the faculty by means of which it luxuriates in delicious odours also enables it to warn us of danger. All bad smells are perhaps not dangerous, but, as a rule, it is a true instinct which leads us to avoid or get rid of them. And we may be quite sure that whenever we perceive a stuffy, disagreeable, to say nothing of a foul closeness in a room, the air of that room is unwholesome. But, as you know by experience, this, the foremost of our sentinels, often fails in attention. We enter a room which at first seems close and oppressive, but after a time the sensibility of the nerves becomes deadened, and we cease to perceive the closeness—showing, of course, that it is only on first entering a room that our nose can be trusted. But, remember this, that though the nose does not always warn us of danger, which sometimes lurks in a form too subtle to be detected by the sharpest organ, yet, when it does warn us, we ought to act on its information, which is rarely at fault.

Many people are almost superstitiously afraid of night air. Yet comparatively pure night air is better than foul air. We miss the light and the warmth and life-giving energy of the sun—and night air is, as a rule, colder, and the moisture in it is more apparent to our senses than by day—but it is better than no air at all; and I cannot but think this somewhat exaggerated notion of the injurious effects of night air may have come down to us from the

times when ague was rife almost all over the land—before drainage had done so much to alter the climate and conditions under which we live. There is no question that in districts where malaria is prevalent it is more dangerous to be out at night than in the day; but in this part of the country, where in these days it scarcely exists, we are sometimes too much afraid of night air when it is pure. You will not, I think, misunderstand me, and suppose that I am advising the delicate and weakly to give up all the precautions they have been accustomed to adopt, and recommending them to go out at night when they are safer at home. What I am pleading for is that it is as important to have your bedrooms, where you pass a third of your lives, if not more, well ventilated, as it is those you occupy during the day. And yet, how often do we find all possible care taken to exclude the entrance of fresh air —the fireplace pasted over with brown paper, or a closely-fitting board filling it up—and all crevices of the window-frame treated in a similar way. Such rooms as these are always stuffy and unhealthy, and the sleep obtained in them is either heavy and followed by morning headache, or the would-be sleeper is restless and feverish, and rises unrefreshed, after what is called a bad night.

I advocate, therefore, some means for admitting air into bedrooms during the night by some such arrangements as I have mentioned. Care must, of course, be taken to avoid draught, and in very cold weather the spaces for air may be partially closed. But in recommending you to do this, I am aware that in trying to avoid one evil some of you may perhaps encounter another. In some parts of this great town, and in many other places where certain manufactures are carried on, night is the time chosen for pouring forth noxious irritating gases, which so poison the air with their suffocating odours, that the dwellers in those districts are compelled in self-defence to close every window, door, and crevice. Now this is not as it should be. To say nothing of the selfish immorality and cruel disregard of the health and comfort of the surrounding inhabitants of which some manufacturers are guilty, it is a blot on our municipal management to allow impurities almost without check thus to defile the air God has given as the common property of us all. But our Corporation of Manchester, like many other bodies composed of human beings, is not always consistent. It is a body, however, to which we owe much. Many improvements have taken place in drainage and scavenging arrangements which will improve the health of the community—and much may be said even in favour of some cumbrous and malodorous vehicles which, as part of a great system, and on the whole a good system, are paraded constantly under our noses—

but surely some of the nuisances which ought to be attacked vigorously by the Corporation are not greater, if so great, as those they create themselves. Those of you who have frequently to go to the Oxford Road Station will have encountered the abominable stench often sent forth from the neighbouring gasworks. How the community can quietly submit to such inflictions, for they probably occur at the other gasworks, and how our Corporation can have the hardihood to allow such shameful abuses to occur, are problems I will not attempt to solve. But, though you will scarcely credit it, even the purification of the air from smoke is objected to by some who would consider themselves as belonging to the ranks of science. It is easy, however, to show the fallacies by which they are misled. They say that the particles of unconsumed carbon are really valuable as deodorizing the air by their property of absorbing gases; but, as a physician, I say, on the other hand, that the injurious effects on the air passages and lungs produced by these minute solid particles far more than counterbalance any supposed disinfectant properties they may have, and you have recently had abundant opportunity of discovering that the thicker and more sooty the fog, the worse it smells.

Another objection I have heard and seen stated by a very competent civil engineer, the author of a most useful book on sanitary arrangements in houses. He says: "It is still an open question as to whether a city would be benefited if a complete combustion of coals were universally adopted in our domestic fireplaces, or whether the remedy would not be worse than the complaint. If we fully realize the large amount of fuel which passes up the chimney in the shape of smoke and soot, we should be simply liberating more carbonic acid gas, a heavy body which would certainly descend from our low chimneys and poison the atmosphere of our streets." But the writer seems to forget that we burn coals for the sake of the heat they give off, and that we should not require, or in ordinary cases wish, to obtain more heat than we do at present. With the same amount of heat produced there would be the same amount of combustion and the same amount of carbonic acid evolved and no more; so that we should be in the same position as regards the carbonic acid as we now are, and we should be gainers as to the large amount of fuel which now passes up the chimney in the shape of smoke and soot—a sheer waste of fuel and a nuisance injurious to health. We should burn less coal just in proportion as the smoke and soot were diminished.

These questions of air pollution by smoke and noxious

vapours affect you all. The health and comfort of your households are touched by them. With such an atmosphere as that of Manchester, cleanliness, the first of the virtues as regards health, is rendered most difficult—often nearly impossible. We know the value of good water, and have long been proud of our supply from the Woodhead reservoirs, but it is a pity that so much has to be used in washing away filth, for the existence of which the Corporation itself is in a great degree responsible. At the same time we must remember our own responsibilities, and do what we can to aid and support them in the efforts they undoubtedly make, in some things, to improve the sanitary condition of our city. We must remember that even with our present grates much may be done to lessen the production of smoke and waste of fuel, and much more might be done with some simple and economical appliances. But if the present apathy as to such matters continues, all the water of Thirlmere, should it ever, at the cost of unknown millions, find its way to Manchester, will be more than needed before we can wash this Ethiop city white. And I would venture here to suggest that all who take an interest in the character of our Corporation, in the election of its members, and the welfare of our city—as all should—not to be too anxious as to the colour of the ribbons with which the supporters of the various candidates love to deck themselves so bravely, but to ascertain if the questions bearing on the public health and public comfort will be considered in an intelligent, careful, and unselfish manner. Many fear an increase of the rates from sanitary improvements, forgetting that in communities, as in households, nothing is so costly as disease. Our magnificent Town Hall, notwithstanding its glorious beauty, adds nothing to the cleanliness and healthiness of Manchester—and yet it was built with your money. You will surely not grudge, in a short-sighted manner, the judicious spending of a comparative trifle, when you know that it will save itself in increased health and cleanliness, both of which are far better, as well as far cheaper, than dirt and disease, and will surely lead to a lessening of the rates.

Having done all in your power to prevent pollution of the air in your houses from avoidable nuisances, and by the strictest cleanliness, we must take care that the house is not made poisonous from defective drainage and the entrance of sewer gas from below. I will not now take up your time by referring to the contamination of drinking water by sewage, and the frightful consequences that have often ensued. Those of you who are interested in the matter will find it touched upon in the lecture on "The Health of the Household," which I gave on behalf of the Sanitary Association

about a year ago. The dangers from sewer gas are just as insidious and as frightful, but until recent times they have been little heeded. We have been priding ourselves on the excellent drainage of our towns and living in a fool's paradise, over sewers that are little better than elongated cesspools, as Dr. Angus Smith has called them, carefully provided with direct communications with our houses, so that we might have them flooded with sewer gas.

The sewers, too, are fondly believed to be so laid that there is a carefully regulated fall preserved; the joints are supposed to be hermetically sealed, and everything in a state of theoretical perfection. This fair picture is, unfortunately, too flattering; for it often happens that they are not laid correctly, and that where there should be a fall there is a rise, and so the elongated cesspools are formed. A few years ago, I heard it stated by a Corporation official that thousands of tons of offensive matter were sometimes taken out of these places. And when you consider how most of our towns have grown up gradually, from small beginnings, in times of great ignorance, and utter want of forethought as regards public health, so that drains were first made on a small scale, with no very definite plan, and then as the place grew, additions were made piecemeal, you will not wonder that things are in a bad condition under our streets and houses. If we only saw more clearly the state of things that generally prevails, we should, for self-preservation, be roused out of our apathy. And to show that these gross sanitary defects are not only to be found in streets of small houses where our artisans dwell, I need only remind you of the illness of the Prince of Wales, and of the condition of Marlborough House, his palace in London, where the drainage was discovered to be so bad that his family had to leave it. This may be taken to indicate the fact that sanitary defects which might be remedied exist almost universally over the country, and the wonder is that our death rate is as low as it is. The dangers from this cause really affect the rich almost more than the poor, for they are blessed—or, too often, as it turns out, cursed—with "modern conveniences." They have closets near bedrooms, baths and sinks in various parts of the house, all communicating with the drains, and, in the majority of cases, so directly that the arrangement might have been devised to poison the household. Of late, importance has begun to be attached to the proper ventilation of drains, and to their being cut off from any direct connection with the interior of the house, but in most cases the old state of things remains, and our houses, especially in winter, are like heated flues, drawing up the air from the sewers as up so many chimneys. This was supposed to be prevented by those delusive

things called traps, which never caught anything, at least they did not prevent the escape of sewer gas.

You see on the walls some diagrams I have been permitted to use, copied from a most valuable lecture by Mr. Teale, an eminent surgeon at Leeds, on "The Dangers to Health in Our Own Houses." It is especially valuable, because it is chiefly a clear and calm statement of facts as to sanitary defects discovered in property with which he is more or less directly concerned, and of a series of instances in which illness and sanitary defects have co-existed. As Mr. Teale says: "It may be taken for granted that sanitary science has established two things.: *First*, that when drinking water is contaminated by sewage, those who drink the water are in danger of suffering from typhoid fever, diphtheria, and other febrile ailments, classed together under the term 'zymotic.' *Secondly*, that when gas from sewers, or from leaking drains, makes its way into a house, the inmates are in imminent danger of an outbreak of such zymotic diseases, not to speak of minor illness, the connection of which with sewer gas is more than suspected." The former source I will not now dwell on, and I must only refer briefly to the latter.

Diagram No. 1, Mr. Teale says, "is intended to show, in one house, most of the common defects in the arrangements of water-pipes and soilpipes, whereby sewer gas gains entrance into our houses. In the next (No. 2) the same house conveniences are shown with these defects avoided." The other diagrams show (No. 3) how the sewage of a house, from the imperfect connection of pipes, was all poured into the soil, making the floor and wall damp, and, of course, causing the sewer gas to pollute the air of the house; next, how the soil-pipe, missing the drain, poured all the sewage into a space below the ground floor of the house; and (No. 4) how "a soil-pipe was blocked as far as a rise in a drain, which, to avoid cutting through the rock, was carried by curved tube over the rock." This last instance most of you would have thought was incredible. These are only a few samples showing how these things happen.

Every pipe, whether the soil-pipe from the closet, the overflow or waste pipe from a bath, a cistern, or from a sink, ought to be disconnected from the drain outside the house, and should fall into a gully open to the air; and in most cases a ventilating pipe should be carried from this point to the top of the house, and should open away from any window. If you are about to take a house do not be content with a general statement that the drainage is all right, for in most cases it is all wrong, but go into the matter yourselves, and make sure that all direct connection

between the drains and the house is cut off, and do not trust to the most ingeniously contrived "trap," for these traps are a delusion and snare. Gases are easily forced through them by pressure, or the water becomes so charged with gas that it is quietly given off from the surface.

If you perceive a bad smell in the house, never rest till you have discovered its cause. It may be from some avoidable nuisance which you can remove, but if your search fail, and you think there is some defect in the drainage, apply to the landlord. If he will do nothing go to the sanitary inspector, and if this should bring down on you the landlord's wrath, and he should turn you out, console yourself by thinking that it is better to be turned out of a house and live, than stop in it and die. Every medical man, from his own experience, can give numerous instances of sorrow, sickness, and death from poisoning by sewer gas. I saw, recently, in a Lancashire town about twenty miles from here, a lady near her death from puerperal fever. She died next day. The medical man in attendance told me there was almost always sickness in the house, that there had been typhoid fever, other febrile illnesses of no very definite type, sore throats, scarlet fever, and so on, and that the lady herself had had a threatening of similar illness after her previous confinement. I asked about the drainage of the house, which was an old one, and was told that there was often a bad smell in it—which, by the way, I had noticed on entering—and that one of the main drains of the town was believed to pass under it. This gentleman had warned them of these things and advised them well, but in vain. The lady had been born there, her father and mother had lived and, I believe, died there, and she herself followed—thus reaping the fruit of a blind and obstinate disregard of nature's laws. I forgot to say that during this illness both the doctor and the vicar of the parish were attacked with sore throats, brought on, as they believed, by their attendance at the house. I might go on relating experiences more or less similar, as to sore throats, diphtheria, and other diseases, but must not detain you longer.

There is one more danger, however, of which you should be reminded, and that is of the access of coal gas into houses. Pettenkofer says he knows "cases where persons were poisoned and killed by gas, which had to travel for twenty feet under the street, and then through the foundations, cellar, vaults, and flooring of the ground-floor rooms." These accidents happened only in winter, when "the house, being warmer inside than the external air, acts like a heated chimney on its surroundings, and chiefly on the ground upon which it stands, and the air therein,

which we will call the ground air." And of course sewer gas is subject to the same laws. He says, "I have witnessed a case in Munich, where not the least smell of gas could be detected in the street, but a great quantity of gas found its way into the ground-floor of a house where no gas was laid on. In another case the gas always penetrated into the best heated room and produced an illness of its inmates, which was taken for typhoid fever."

Only the other day I saw a case mentioned in the papers where a medical man was as nearly as possible killed, by gas from the main finding its way into his bedroom.

Having now considered generally, and at, I fear, tedious length, some of the more important points bearing on the sanitary aspects of the dwelling, let me in conclusion give a brief summary of the practical points you should attend to in choosing one.

See that there is free access of air to the front and back, and that there is nothing to prevent its free circulation. Carefully avoid back to back houses. There should be free ventilation for every occupied room, which should have a fireplace, and a window opening directly on the external air, and should not be lighted by a borrowed light only. Every window should open both at the top and bottom, but especially at the top.

Have the rooms of good height—nine feet at least in the smallest houses if you possibly can.

There ought to be cross ventilation if possible between the closet and the rest of the house, and at any rate there should be free communication by a window between the closet and the external air, and this window should not be too near a bedroom window.

There should be proper water supply, and if it has to be stored in a cistern this ought to be arranged for easy inspection and cleansing.

There should be proper arrangements for the collection, with a view to speedy removal, of dry refuse, which ought to be kept dry. All liquid and solid offensive matters must be speedily got rid of. They ought not to soak into and pollute the soil near the dwelling. The dry plan, with frequent removal, answers well, and householders in many parts of this city might aid in making the working of this system easy. There are many advantages in this mode over the old and barbarous ashpit and midden plan, and it is said that typhoid fever is less prevalent when this method is well carried out than in sewered towns with the water-closet arrangement. The late Dr. Parkes, in the little book on public health, written during his last illness, says: "At some point between every house and the main sewer there should be complete air dis-

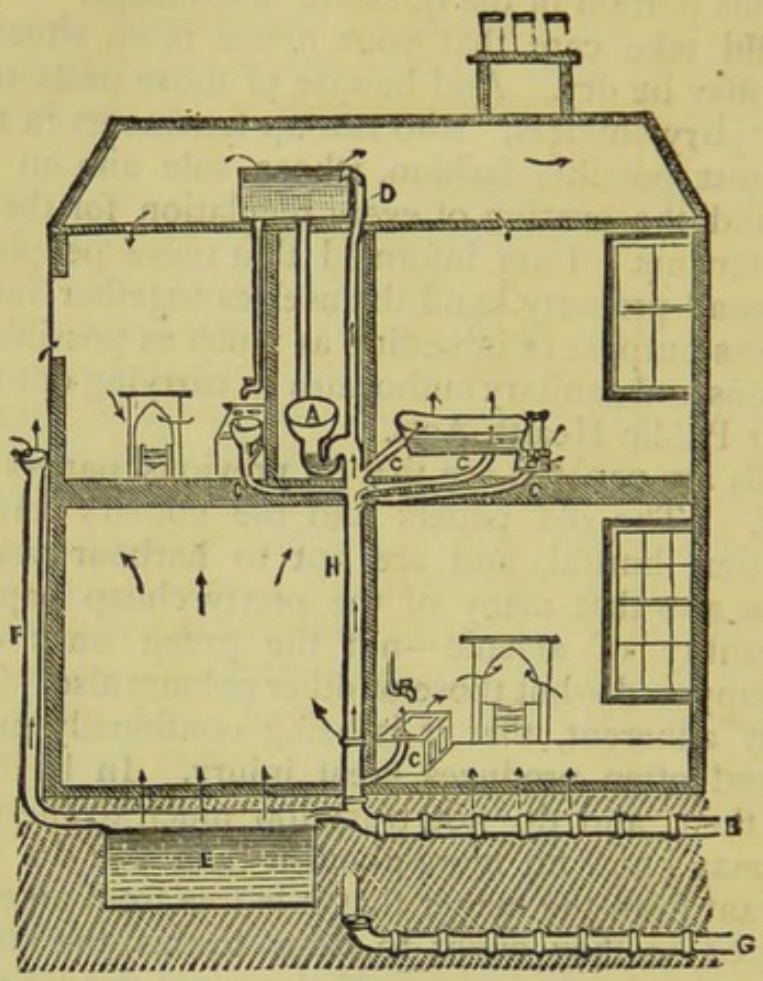
connection, so that any reflux of the sewer air may pass into the open air, and not into the house. If this were done, the spreading of disease by town sewers would be impossible." I want you to bear in mind these words, for they contain the pith of sanitary science on this portion of the question of drainage.

You should take care that your house is so situated and so built that it may be dry. And beware of those pests of our large towns, the "jerry-builders," who run up tenements in the suburbs in the slightest possible fashion, whose sole aim in building is cheapness, and the evasion of every regulation for the protection of unhappy tenants. I am informed that these people and many owners of small property band themselves together into a society for the express purpose of impeding as much as possible the efforts of corporations and sanitary authorities in carrying out the requirements of our Public Health Acts.

If the walls are papered see that all previous papers have been stripped off. The old papers and the colours and the paste become in time hurtful, and are apt to harbour vermin. You should know also that many of the pretty cheap papers contain a large quantity of arsenic—not the green ones only, as is commonly supposed—but those of other colours also. This arsenic is so loosely adherent, that it is being continually rubbed off as fine dust, and often produces great injury. In buying a paper, be careful then, and do not trust too much to the word of the seller, who may know no more about it than you do. He should have a warrant from the maker that it is free from arsenic. If the public insisted as they ought to do as to this, the manufacturers would soon use colouring matters that are not deadly poisons.

Lastly, I must add a word in favour of cleanliness, which will greatly aid in keeping the air of a room pure. Soap and water, beeswax and turpentine, with plenty of scrubbing, not only made your grandmother's furniture, "in the brave days of old," shine like a mirror, but was an index of the cleanliness in everything else, which made the cottage, as you entered from the honeysuckled porch, seem the abode of health and happiness, and of all things sweet and pleasant.

No. 1.



HOUSE WITH EVERY SANITARY ARRANGEMENT FAULTY.

A Water-closet with soil-pipe in middle of house.

B House drain under floor of room.

C C C C Waste pipes untrapped, communicating directly with drain.

D Overflow pipe of cistern turned into soilpipe, and acting as ventilation of drain.

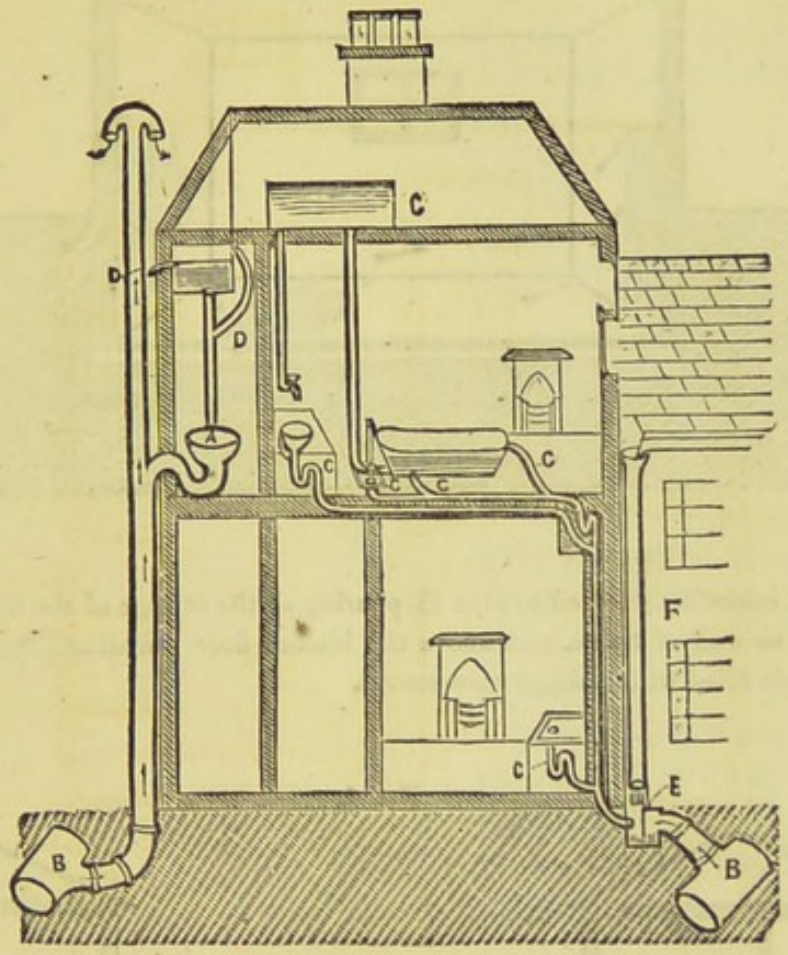
E Rainwater tank under floor, with overflow untrapped into drain.

F Fallpipe communicating with drain opening under bedroom window.

G Drain under floor with joints unluted, and pipes laid without a fall; showing leakage at every joint, and at the junction of soilpipe with drain.

These Diagrams are copied from a lecture on "Dangers to Health in our own Houses," by T. P. Teale, M.A., Leeds. Published by J. and J. Churchill, London.

No. 2.



HOUSE WITH FAULTY SANITARY ARRANGEMENTS AVOIDED

A Water-closet with soil-pipe outside the house, and ventilated by a large pipe carried up and away from all windows or chimneys.

B House drains outside house.

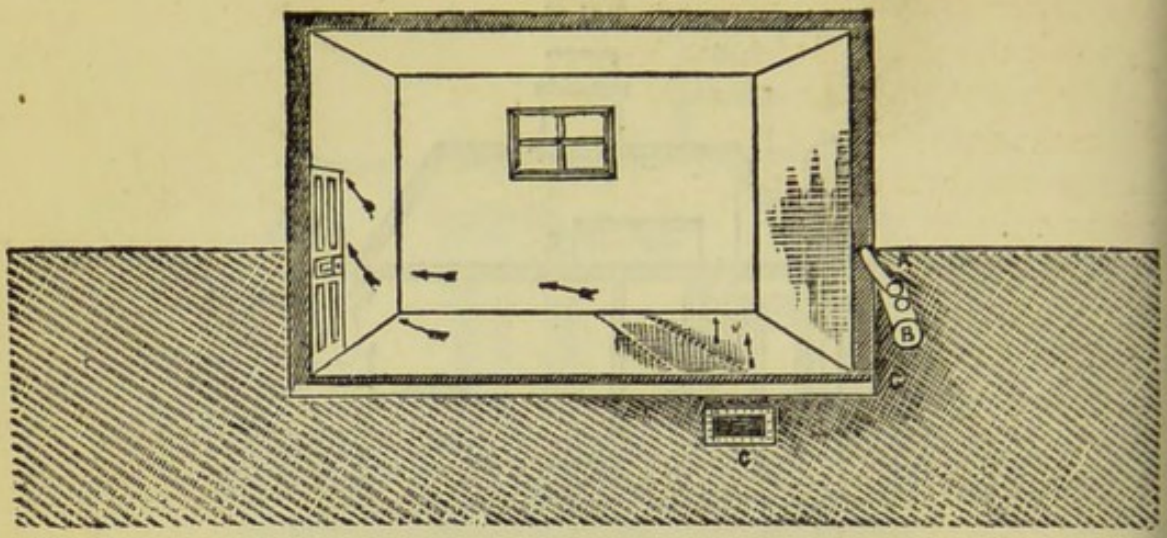
C C C C Waste pipes trapped, and disconnected from drains by a gully E.

D Overflow of cistern into open air, or supply pipe.

F Fallpipe near bedroom window discharging into a gully, not into the drain.

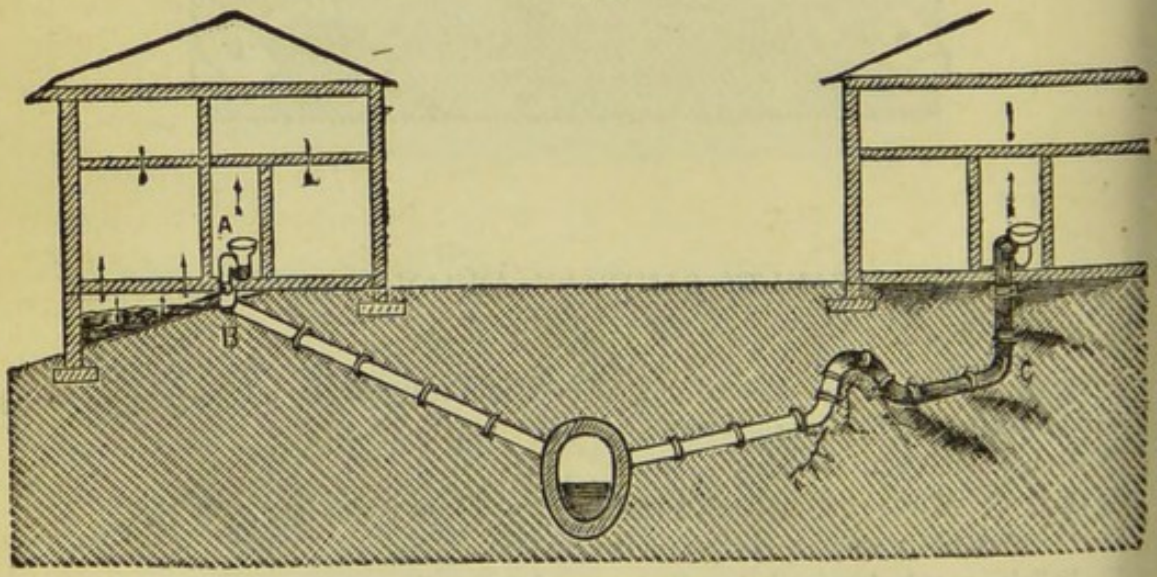
G Domestic cistern separate from water-closet cistern.

No. 3.



Soil-pipe A imperfectly joined to pipe B pouring all the sewage of the house into the soil. Pipe B close to wall of house, and above the kitchen floor. Wall and floor damp. C An old surface drain filled with leakage from sewers.

No. 4.



Soil-pipe A missing drain B and pouring all the sewage into a triangular space below the ground floor of the house.

Soil-pipe C blocked as far a sa rise in a drain which, to avoid cutting through the rock, was carried by curved tube over the rock.