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Presented by
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LECTURES ON VENTILATION.

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Second Course, delivered before the Franklin Institute, during the winter of 1867-68.

LECTURE I.

PERHAPS no subject relating to the health of the human system ever gained favor more rapidly, (without advertising,) than has the subject of ventilation within the last year or two, and I think we may refer to the report of the Board of Health, for the year 1867, as a substantial and most gratifying proof of this assertion.

In the year 1865, there were 17,169 deaths in this city; in 1866, there were 16,803, and in the year 1867, there were only 13,903, or a saving of 2,870 lives in the last year, and 3,237 in the two years, and this, too, notwithstanding an increase of population probably equal to 20,000 per annum.

The saving to the citizens of Philadelphia by this diminished mortality, and the sickness represented thereby, could be scarcely less than three-quarters of a million a year; or sufficient to pay the entire expense of our excellent system of public schools.

Could this decrease in the rate of mortality be continued we would soon be a very healthy people; perhaps this is almost too much to hope for. I do believe, however, that this rate of decrease in the mortality may be continued through the year 1868, and with a cash outlay, if judiciously expended, no greater than will be returned to us penny for penny and dollar for dollar within twelve months thereafter.

No healthy condition of the human frame can be maintained without we breathe pure air, and although there has been a wonderful improvement in this respect within the last few years, yet we still do not breathe pure air one-half our time.

Our arrangements for the artificial ventilation of our houses in winter and at night, are still exceedingly imperfect.

The great majority of our citizens scarcely realize the true value of pure air, or hardly know how to obtain it economically at all times. We need more public education on this subject.

There has long dwelt in the minds of many persons a kind of

vague idea that ventilation was a good thing in its way ; but with nine-tenths of the whole people, the chief concern has been to *obstruct* all circulation of air, to stop all draughts, and thus practically to prevent any *ventilation*, especially in winter.

In the good old days of open wood fires, when, as in our childhood, the real chimney-corner was the family sitting-room, so to speak, or at least, for the children, then, with all the listing of doors, caulking of windows, and filling up of key-holes, there was certain to be still an abundance of fresh air, that would force its way into the room in spite of all efforts to keep it out. But with the introduction of anthracite coal and air-tight stoves, and still worse, steam pipes, placed in the room for heating by direct radiation, the stopping of all draughts that were before so annoying, became a matter of easy accomplishment.

The results thereof have been perfectly frightful, persons have thus unconsciously been smothered to death by the thousands and tens of thousands.

It seemed almost impossible to arouse the public from the quiet, satisfied stupor that followed their great victory over their old enemy—the whistling winter wind. Those that have not gone to their long homes during this dark winter-night of stupor and ignorance, may well rub their eyes in astonishment, as they awake to a consciousness of the dangers they have so marvelously escaped.

The poor man, too, as well as the rich, should feel that he has no truer or more valuable friend on earth than fresh air. His food, though coarse and simple, will digest more fully and quickly with an abundance of pure air. His head is clearer, his chest expands and his muscles grow stronger, as his heart grows lighter, and he goes cheerily on day after day with his laborious toil, returning at night to his home and fireside, surrounded by his wife and little ones, a happy man, made so by the consciousness of having been able to do and having done a good day's work. He enjoys a night of sound sleep, when sleeping with open windows, and wakes refreshed in the morning, ready again to commence the toils of another day.

The Doctor's explanation of the physiological effect of breathing air, whether pure or impure, is very interesting.

We cannot, of course, expect to go into a regular medical or physiological lecture at this time, but we must just examine some of the

main points so as to get a general idea of the effect produced by air of different qualities, and if possible, to form some conception of the manner of its action. I have here a little arrangement by which I wish to represent the action of the lungs.* It is simply a glass bell jar with a piece of rubber stretched over the bottom, which is intended to represent the human diaphragm. From the mouth of the figure-head there is a small tube extending downwards, and this represents the wind-pipe, at the end of this is another piece of rubber, which we will suppose to represent the lungs. Now, as I draw down the diaphragm, the space in the jar is enlarged, and a partial vacuum is created, and the air rushes down the wind-pipe to fill the space. It is prevented, however, from getting directly into the body by the lungs, which being elastic, or rather all folded up in innumerable little folds, expands and contracts with great ease. The power, therefore, does not lie in the lungs so much as in the diaphragm and ribs, the air is forced out and in the lungs, similar to the manner in which it is forced out and in a pair of bellows.

Fig. 1.



The lungs are composed of an immense number of air-passages, with innumerable branches, we might say, perhaps, like the branches of an apple tree, and at the extreme ends of these branches are air-cells instead of apples, the number of these little cells is estimated by some to amount to six hundred millions.

The aggregate surface of all these air cells is variously stated by different physiologists from 600 to 1500 square feet. So, if this room was 30 40 feet, the surface of the lungs of a single person would, if spread out, be sufficient to carpet the whole room.

These air-cells are perfectly surrounded by a complete net work of minute blood vessels, through which flows the dark, impure blood that has just returned from the most extreme points of the body, bringing with it, dead, diseased, old, worn out particles of the body, and the carbonic acid, or what we might call the ashes resulting from the combustion of the oxygen, which is constantly required to keep up the heat of the body.

Now, it is when this impure blood on one side meets the pure air on the other, that the most wonderful change takes place.

This membrane of these air-cells of the lungs is so exceedingly

* Griscom's "use and abuse of air."

delicate, that there is a chemical transformation or exchange takes place at once.

The carbonic acid, and other impurities from the blood, pass through this fine membrane of the lungs, and are absorbed by the air, while the oxygen of the newly breathed air passes through the lungs into the blood, which is thus changed from a dark color to a bright, light colored red, and oxygen is thus carried to the hundreds of little capillaries in the most remote parts of the body to the skin and to the bones, to the brain and to the stomach, and there burned to keep up the heat of the system, and to cook the food we have eaten, (if the Doctors will allow me to express in that homely manner, the beautiful and very elaborate process in which the fresh air we breathe acts in digesting and utilizing our food.)

But suppose, instead of the air thus introduced into the lungs being pure, it is impure, or already loaded or charged with carbonic acid by previous breathing, then it cannot take up the impurities of the blood, and instead of its being changed by the absorption of oxygen to a beautiful bright red, it remains of a dark, dull color, consequently these impurities have to be carried back to all parts of the system, instead of the much needed oxygen; disarrangement of the whole system soon follows to a greater or less extent, according to the proportion of the impurities in that air.

The little air-cells of the lungs also become choked up with this refuse material, which causes what is familiarly called consumption. You all know if you allow the ashes to accumulate so as to fill the entire space underneath the grate, that the grate will soon be burned out. In a manner very similar to this will that exquisitely thin, delicate membrane of your lungs be destroyed, if you neglect to breathe sufficient pure air to carry away all the ashes from the immense numbers of fires constantly burning in your body.

The frequency of these interchanges between the air and the blood, the very large aggregate amount of each that daily passes through the lungs, ought to impress us with the great importance of a careful attention to maintaining the best conditions for perfect health.

But, in too many cases, our estimate of the value of things is based upon the dollars and cents it costs us, and as no patented monopoly has ever been able to control the supply of pure air, so as to dole it out to us by the dollar and cent's worth, but it is kept constantly poured around and over our houses in the most lavish

little more than one-fifth of the whole. The other four-fifths being mostly nitrogen. The use of this latter gas, the nitrogen, has scarcely been determined; it is thought by many to be merely a diluent of the oxygen to keep it under control, so that it shall not take fire spontaneously, and burn everything up.

So much for the air we breathe; the blood, of course, continues the connection from the lungs to all parts of the body; and let us examine that for a few moments.

The beating of the pulse is the action of the heart in pumping the blood from the extremes of the body, and driving it through the lungs to be aerated. There

Figure 3.



are, on an average, about seventy-two pulsations of the heart every minute, and two ounces of blood are passed through the lungs at each pulsation, or from sixty-five to seventy gallons every hour, and from forty to sixty barrels per day. I designed by this piece of red flannel (see cut, Fig. 3) to represent

the number of cubic feet of blood passed through the lungs every twenty-four hours.

We thus see the very large amounts of blood and air that circulate through the lungs, and can easily imagine of how much greater importance the proper supply of air is to the maintenance of good health than the supply of food, because, while we eat less than two pounds daily, we breathe fifteen times that amount, or about thirty pounds.

The amounts here given are only approximations, they are subject to extreme variations.

We all know the wonderful effect of any violent exercise, how it sets the heart to beating, or, in other words, the blood to circulating; this at once requires more air; we begin to breathe faster and inhale and exhale much larger quantities.

It is astonishing how many persons disregard this wonderful provision of nature for keeping off disease, or for curing it after we have, by our own negligence, allowed it to affect our bodies.

The simple difference in the amount of blood and air which circulate through our systems, under different circumstances, shows us what control we have over our bodies in this respect.

The variation in this circulation from entire repose to vigorous action, may be thirty or forty per cent.—say thirty per cent.—taking the average amount of air breathed at three hundred and sixty-three feet, thirty per cent. of this would be near one hundred cubic feet difference in the amount of the air breathed; and taking fifty barrels as the average amount of blood circulated through the body, thirty per cent. would be fifteen barrels.—Fifteen barrels of blood! coming to the lungs to be purified, to be aerated, and one hundred cubic feet of air, an amount thirty or forty times the bulk of the body, and this the *difference* only, not the actual amount, but just the difference between a state of perfect quiet and that of active exercise.

What a means this is of influencing the condition of the body, and what an incentive to active exertion instead of sluggish, stagnant quiet.

Every child going to school ought to walk at least one mile in the morning and the same in the evening in returning home; and no child ought to see the inside of a school-house, until quite able to walk that distance in all kinds of weather, without any inconvenience. This positive *necessity* for daily exercise is an advantage, as when it can be avoided it is frequently omitted in stormy and unpleasant weather, much to the injury of the child's health.

It is quite a common idea with many persons, that if they feel unwell in the spring of the year, their blood must be out of order, it is impure. Now there is but little doubt but the blood of too many persons is very impure, but how do they attempt to purify it? Why by taking some vile compound in the shape of some patent pills, or other miserable stuff.

What would you do with a servant that would neglect to put coal on the fire, and just when she was in a hurry to get breakfast or dinner, finding the fire was nearly out, to make amends for her negligence, should pour turpentine or kerosine on, making a great smoke and a temporary blaze? and probably, if a little careless in its use, would set the chimney on fire, and run much risk of burning the house down.

Well, now, it is just as reprehensible for you to go on all winter neglecting to supply yourself with pure air, and in the spring find yourself weak, debilitated with impure blood, and your fire nearly out, and then to make amends for your carelessness, take some de-

testable pills or some of the world-renowned humbugs in the shape of patent tonics, that, according to the advertisements, are a certain cure for all diseases to which "human flesh is heir." And you might suppose from the reading of these advertisements, that they were an entire and perfect substitute for pure air.

I believe I never was quite so foolish as to take a bottle of any such stuff; but I think there must be a great many who do, from the splendid palaces that are constantly being built from the profits on the sales of such trash.

You might, at first, suppose that physicians, and almost every one else, would have learned by this time the best cure for consumption; yet how generally you find persons with this disease shut up in close rooms, breathing very impure air, and taking extra pains not to allow any *draughts* of any kind to enter the rooms.

I say, you would scarcely suppose it possible that such a contrary course should be pursued; but we must remember how short a time it has been since physicians would not allow the patient to follow the dictates of nature, and drink cold water in fevers.

And most of us remember how common it was, but a few short years ago, to take the very life-blood from a sick person, just at a time when it was most needed in carrying off the disease from the system.

It is not in consumption alone, that fresh air is of such great importance, but it is in all the diseases of the human body. You might, at first, think that in amputating a limb ventilation would have nothing to do with the speedy recovery of the patient; this notion, however, would be a great mistake, as ventilation has more to do with it than any other thing.

The surgeons, during our late war, were fully aware of this; they well knew if they amputated a limb that the death or recovery of the patient depended more upon the air he breathed, than any other agent with which they had to deal.

I remember listening with much interest to the Surgeon General's description of a very difficult case of amputation, which he performed in the field in West Virginia. He kept the patient with him, (generally in a hospital tent,) and he was getting along most favorably; but was sent finally to one of the hospitals in Baltimore, which I think was an old hotel; soon after which he died. I heard the surgeons say afterwards that they scarcely could cut off a finger in that hospital but the patient would die.

They died from impure blood, they died for the want of ventilation, and this is simply the universal experience of every physician and surgeon.

If I were to scratch my finger, ventilation would have more to do with its healing, than all the salves and plasters I could put on.

It is a very common remark that a cut or wound will not heal because "the blood is out of order." Very sensible remark, too, and the quickest way to get the blood in order is to breathe nothing but pure air and plenty of it.

You have often heard of the woman that wanted some whiskey for a sore toe, but on being remonstrated with for drinking it right down instead of using it to bathe the toe, remarked—"It will soon get there." She was not so far out of the way, either, as we might suppose at first; it would soon get there, indeed, and the inflamed and poisoned blood, I was going to say, would do almost as much harm as it does when it gets into the other end of the system; but perhaps that would hardly be possible.

You cannot live without breathing; you cannot live without eating; you cannot live *well* without exercise. These are the three grand essentials for health, comfort and happiness.

The breathing is of more than ten times the importance that eating is. By breathing pure air you can digest more food, and you require more to satisfy hunger.

Some of you may be surprised to hear me assert, that if you cannot get food you would die sooner by breathing pure air, than you would by re-breathing some of the foul poisonous air previously exhaled. I was led to consider this question by the very unexpected results of some experiments I tried last summer with some flies. I took six half-gallon jars, six quart jars, and six pint jars, making 18 in all, into all of which I enticed flies by covering the jar with bread, with a little molasses underneath it. I intended to put two dozen into each jar, but they would not go in just to suit me, so some had 20, some 40 and some 60. Two of the bottles of each size, making six in all, I filled with my breath, and sealed up tight; two of each size I simply sealed tight, but filled with pure air, and the other six, two of each size, I covered with coarse netting, so as to allow of a free circulation of air and keep the flies confined.

It was in summer, and I closed them up at 6 P. M., the sun about an hour high; I observed their condition at intervals of an hour,

making a note on each bottle. At the end of the first hour those confined in the breath were very stupid, many of them tumbling about from side to side, and none able to fly. Those confined in the pure air were moderately lively, about half of them could fly from side to side, and were just as much at the bottom as at the top of the jar. But a very different scene presented as the others with the circulating air were examined; they were all crowded to the fresh air opening, their feet sticking up through the netting, and there they remained with much persistence. If driven away they would immediately return, and in one, there being more flies than room at the fresh air opening, they had to take turns standing at the window, which reminded me of what I observed at Nashville jail, which was so shamefully crowded and with so little air, that each prisoner was allowed just so many minutes to stand by the little hole that admitted the fresh air, and this was considered so great a privilege, each one waited with the greatest anxiety and impatience for his turn, and they would never miss, night or day.*

So it seemed to be a great privilege with these flies, but I suppose they did not take their turn with so much punctuality.

In two hours some of the flies in the breath seemed nearly dead; the others much the same. At ten in the evening no particular change.

Next morning, at six o'clock, no marked difference; those in the breath a little more stupid, and two or three apparently dead; one or two in the confined pure air about dead, on being put out in the bright morning sun they revived wonderfully; those with the circulating fresh air kept up a perfect humming, and the others revived very much; but few, however, of those in the breath, were able to fly even with this extra stimulus. At ten A. M., I went to town, and at five P. M. returned home. I expected to find all those in the breath dead, those in the confined pure air about half dead, and those in the circulating pure air as lively as ever; but to my utter astonishment and disgust, I found every one of those in the pure air stark dead—not a vestige of life in a single fly.

Those in the pure confined air were about half dead, and nearly the same proportion of those confined in the jar with the breath. But they did not die even in these with that perfect regularity that I wanted them to do.

* I should state, probably, that upon reporting the condition of this jail to General Rosecrans, then commanding, he had it remedied.

That is to say, where there were twenty in a pint jar, and twenty in a quart jar, and twenty in a half-gallon jar, if those in the pint jar died in twelve hours, I expected those in the quart jar to die in twenty-four hours, and so on; but they did not observe any such regular rules in dying.

But, notwithstanding my great disappointment, I kept the jars and watched them. Those in the breath died a little the fastest; but very soon after I noticed another form of animal life in the shape of maggots, which soon attained the size of the original flies.

Now, as these bottles were perfectly clean and corked air-tight immediately after the flies entered, how did those maggots get there?

Some of these flies lived ten days, (there would be but one or two in a bottle that lingered so long,) the other animal life lingered some three weeks. These bottles, upon being opened, emitted a horrid stench.

But the bodies of the flies confined in the pure circulating air never had the least unpleasant odor, were never touched by any insect, and three months after their bodies were just as bright and clear as the day they died. Thus, those in the foul air lived ten times as long as those in the pure air. Now the practical lesson this teaches is what I before asserted, that when you breathe pure air you live faster, so to speak; you are much more lively; you use much more exertion; but all this exertion requires power, and, universally, power requires food.

Now, these flies in the circulating pure air no doubt used more exertion or did more work in the few hours they were living there without food, than did those which lived ten days—their bodies were so thoroughly used up, there was nothing but skin and bones left.

This explains what might otherwise seem a strong argument against breathing pure air.

We find some poor, delicate creatures living on to be forty, fifty, sixty and even seventy years old, and appear to be a perfect refutation of all regular physiological rules; but what sort of lives *do* they live? They cannot do a quarter of a day's work, they can scarcely eat a quarter of a full ration, and if they have existed to an old age they oft-times have scarcely done the work of a quarter of a lifetime.

And thus we find many poor people living in poor, unventilated

houses, *exist* sometimes to quite an advanced age, but they are often sick and feeble.

Therefore, when a person finds he cannot earn his living, or if he does earn it he is sure he cannot get sufficient food to eat, he had better imitate the hibernating animals as nearly as possible, and get into some close, unventilated place and lie down in perfect quiet and repose—and not fret at all and he will then be able to get along on as little food as the most angelic of our fashionable belles could desire to boast of.

On the contrary, when persons think they are able to earn their own living and a little more, the more pure air they breathe, provided they have an abundance of good wholesome food and plenty of exercise, the greater amount of physical or mental labor they can perform.

The pecuniary value of health is but imperfectly understood. It was found in England that when a certain portion of the tenement houses belonging to some of the large factories were well ventilated, that the tenants required more food; it cost them more per week to live and supply themselves and families with the necessaries of life.

They consequently could not work so cheaply from week to week as those living in *un*-ventilated houses. This appeared on its face to be a strong argument against the pecuniary value of ventilation. But let us take a more careful view of this. Every animal or machine has its market value—a horse is worth so much in the market, so is an ox and a sheep, and to our great shame we have until very lately had a regular market price for a man and a woman. Owing to even the little intelligence which it was formerly admitted that a slave had over a horse, we would give four or five times as much for a man as for a horse.

A good man before the war was worth from twelve to fifteen hundred dollars, and some two thousand.

The superior intelligence and energy of any one here, and the greatly enhanced prices since the war, in connection with the fact that one man with brains can manage machinery that is sufficient to do the labor of twenty horses, adds greatly to the value of an intelligent man,—or, in other words, any manufacturer or capitalist would be very willing to give \$5000 for the services for life of any intelligent, able-bodied man between the ages of twenty and thirty years, taking all the risks of his living, and clothing and feeding him for life.

Now, that \$5000 is the entire capital of many young men. Suppose a large manufacturer wants hands at piece-work, and this young man, say, is just married, and anxious to get along, takes the work just as low as he possibly can; he finds by saving a little in his food, and by keeping his house shut up tight, with an air-tight coal stove he can save coal, and thus at the end of the week can just make both ends meet, or, in other words, can pay expenses.

Now he does not calculate how much of his original \$5000 he put into that work for the capitalist—but by the reduction of his physical strength he has used two shillings' worth a day of that capital; twelve shillings a week, forty-eight shillings a month, and so on.

Thus drop by drop does that wealthy capitalist absorb the very life blood. Ounce by ounce are the sinews of this poor man bartered away and appropriated by the capitalist.

He is daily growing weaker as his family cares increase, and in a few years, with a wife and family of small children entirely dependent on his daily labor for their food, clothing and schooling, he finds himself broken down in health with a ruined constitution, and he is then cast aside for another, younger and more vigorous man, who will engage to work cheaper, and can afford to do so by using two shillings' worth daily of his \$5000 capital the same as his predecessor.

This arises from the ignorance of these laboring people of the true value of health and of the proper means of preserving it. What is the result?

A nation of unhealthy people must inevitably become a nation of paupers, but a healthy nation will surely become a wealthy nation.

For a proof of this assertion we have only to look to the manufacturing districts of England, as they are amongst the most unhealthy. Could they support themselves if their trade with foreign and newer countries was cut off? Undoubtedly not. And look at New England, what does the census of her manufacturing states give? A very small increase of population indeed.

And the manufacturing wards of this city, too, will show a greater amount of ill health and pauperism, which always go together, than the non-manufacturing districts.

Now, how can this be remedied—by any simple act of legislation? I answer no! Not even the fiat of our Congress, representing as it does, the most powerful nation on the face of the earth,

could reconstruct society in this respect. No, you must teach the people, the laboring man, the bone and sinew of the nation, the value of health and how to preserve it. The parents then will be but in the prime of life when their children shall have grown to manhood, and they in their turn will be competent to care for their parents in old age.

I want each of you to become a lecturer on ventilation; I do not mean merely to give three or four lectures in a whole year—but to lecture every day of your lives, because there is not one of you here but what has some friend now suffering for the want of pure air.

I want you, to go to the home of the laborer, the man that is not here to-night—he whose laborious toil from morn to eve demands rest in the evening, instead of allowing him the privilege of attending lectures.

I have visited many such, and find that a few simple, kindly words of explanation are always gladly received, and frequently have their good effect in inducing them to remove a fire-board in a sick-room, or by putting on an extra blanket, to allow the windows to be opened a little more every night, and thus do a real service to these poor, worthy people, by getting two cubic feet of pure air to enter, where but one entered before.

Could Philadelphians but be fully aroused to the great importance of this thing, the mortality of this beautiful city might be reduced for the year 1868, perhaps even more than it was for the year 1867, because I believe there is no city on the face of the earth so favorably situated for an immediate reformation in this respect as this city, as all the houses are built so isolated, with a window and fire-place in nearly every room: while in New York one-half of the population live in houses of entirely different construction, nearly half the sleeping-rooms being merely dark closets into which the purifying rays of the sun and the pure external air can never enter.

And this is a very serious defect, which nothing but tearing down and re-building can fully remedy; although a good artificial ventilation might greatly improve them. Philadelphia has the advantage in this respect, very decidedly.

If it were in any way possible to get all the physicians stirred up, to make some active exertions towards inducing the people to

be more careful about the ventilation of their houses, it might have a wonderful effect.

This, however, is hardly to be hoped for, as a regular old school Philadelphia physician is probably about as respectable and proper and conservative a man as the sun shines on. We could scarcely find a greater curiosity than the name of a regular old school Philadelphia physician at the head of a recommendation to public favor of any new thing, no matter of how much public utility it might be.

The surgeons in charge of the splendid hospitals built in and around Philadelphia during our late war, made verbal and written protests against having these hospitals ventilated in winter, because the form adopted by the Government was a little varied (for the purpose of adapting it especially to these temporary buildings) from the time-honored forms to which they had been accustomed from their childhood up. There is one great comfort to you in this characteristic of your regular physicians:—if your doctor was to offer you a medicine you were not accustomed to, do not have the slightest hesitation in taking it, for you may rest perfectly assured that it has been tried in every hospital in the land, and that it is in common use in every other city in the Union before it is offered to you.

It seems to me a little unfortunate that our physicians have fallen into this quiet, easy way of gliding around so elegantly, with their hands in their pockets and their brains in their medicine boxes. Now, this is not because these physicians do not really know better, because, if you were to attend their lectures you would find them discoursing very eloquently on the great importance of the functions of respiration, and the importance of pure air in all cases.

NOTE.—If you should happen to find the Professor lecturing thus in a close, unventilated room, smelling very badly, this, you must remember, is a strong argument of their appreciation of pure air—as you know doctors never take their own medicine.

Or, if you were to go into the office of any one of them, and take up any of the standard text books on their tables, you will find that all eminent medical writers lay very great stress upon the necessity for the most perfect ventilation at all times. They consider it of greater importance than eating, drinking and medicine in the prevention and cure of disease. For instance, here is Carpenter's Human Physiology, which, in summing up a very elaborate article on Respiration, says, page 326 :

"Thus it appears that in all climates, and under all conditions of life, the *purity of the atmosphere* habitually respired is essential to the maintenance of that power of resisting disease which, even more than the ordinary state of health, is a measure of the real vigor of the system. For, owing to the extraordinary capability which the human body possesses of accommodating itself to circumstances, it not unfrequently happens that individuals continue for years to breathe a most unwholesome atmosphere without apparently suffering from it, and thus when they at last succumb to some epidemic disease, their death is attributed solely to the latter, the previous preparation of their bodies for the reception and development of the zymotic poison being altogether overlooked.

"It is impossible, however, for any one who carefully examines the evidence, to hesitate for a moment in the conclusion that the fatality of epidemics is almost invariably in precise proportion to the degree in which an impure atmosphere has been habitually respired, * * * and that by due attention to the various means of promoting atmospheric purity, and especially efficient ventilation and sewerage, the rate of mortality may be enormously decreased, the amount and severity of sickness lowered in at least an equal proportion, and the fatality of epidemics almost completely annihilated. And it cannot be too strongly borne in mind, that the efficacy of such *preventative* measures has been most fully substantiated in regard to many of the very diseases in which the *curative* power of medical treatment has seemed most doubtful, as, for example, in cholera and malignant fevers.

"The practical importance of this subject may be estimated from the startling fact, which inquiries prosecuted under the direction of the Board of Health have recently brought to light, *viz*: that the *difference* in the annual rates of mortality between the most healthy and the most unhealthy localities in England, amounting to no less than 34 in 1000, is almost entirely due to zymotic diseases, which might be nearly (if not completely) exterminated by well-devised sanitary arrangements. The *lowest* actual mortality is 11 per 1000, while the highest is 45 per 1000, and between these extremes there is every intermediate degree of range. But what may be termed the *inevitable* mortality, arising from diseases which would not be directly affected by sanitary improvements—is a *nearly constant* quantity throughout, namely, the 11 per 1000 of those districts which are free from zymotic diseases.

"The average mortality of all England, in ordinary years, is about 22 per 1000, or just double that to which it might be reduced; so that taking the population of England and Wales (as by the last census) at nearly 18,000,000, the average annual mortality must be 396,000, of which only 198,000 is *inevitable*, an equal amount being *preventable*."

Thus you see these physicians tell you that one-half of all the sickness and death are "*preventable*." They don't say they can *cure* them with their medicines, but that they are preventable, and that the great means they recommend for accomplishing this wonderful work is pure air—ventilation. But, although they have said this and re-said it, for the last fifty years, yet it has seemed, as Dr. Hamilton has said, a herculean task to make the public at large comprehend it. So that a whole life spent in teaching the value of pure air has seemed to be a whole life almost wasted.

The extracts that I have just read were written more than ten years ago. But the very careful investigations that have been since conducted by many able and scientific hygienists, only more fully prove these assertions. Perhaps no city presents a stronger contrast between her healthy and unhealthy wards than does the city of New York.

Dr. Harris says of one of the most densely populated wards of New York, the Seventeenth, that the death rate has been for several years less than 17 to the 1000, and even during the terrible heat of July, '66, the uniform low mortality of that ward was scarcely affected. The death rate in this ward, with its 27,000 inhabitants, was, during the six months ending October 1st, (including the cholera summer) only 16½ to the 1000. In the same period the mortality in the notoriously foul Sixth Ward was 54 to the 1000. And although the death rate of Philadelphia is exceedingly favorable, by comparison with some other cities, as, for instance, New York, where it is about 30 to 33, while in Philadelphia it was but 20 deaths to the 1000 of population, yet, you see even that is nearly double what it should be—that it would only be 11 per thousand if we could only avoid those zymotic diseases, or such as are caused exclusively by foul air poisons.

And I believe with an extra ton of coal for each family, and an extra blanket for each bed, so that every chamber might be opened, this night, the one-quarter of one inch, to-morrow night two-quarters, and the next night three-quarters, and so on until every cham-

ber could be kept the whole night in a pure and wholesome condition, and never after closed, we could do much towards saving the 6000 or 7000 lives due to this proper death rate of 11 to the 1000.

But now I have a word to say to you, the people that employ these physicians. They have a good deal of human nature about them after all—they are not so very different from the people amongst whom they live and by whom they are employed. I don't suppose there is a city in the United States in which a physician has to be more exceedingly careful of his *reputation* than in this very city of Philadelphia. And I happen to know something of the reasons for omitting to prescribe, more frequently, fresh air as the medicine most needed for their patients. How many of you, if, being sick, were to have a physician to call frequently, and just say to you, "All you need is more fresh air," would not say, in your mind (if not out of it), "Well, I think I can attend to getting a little fresh air myself, without paying that doctor two dollars per day for telling me that, and I think, upon the whole, I will get some doctor that will do something for me." So you will probably send for some man you have heard of, as having made wonderful cures of some friends, and if he should happen to be a regular shrewd humbug, he would make a wonderful account of your disease, and finally tell you he thought he had something that would just suit your case, and, as before illustrated, would commence pouring turpentine or kerosene oil on your fires, by which he would create a great smoke and temporary blaze, and this would induce you to exclaim, "What a wonderful man! *he* does something;" and if he could get you out into the fresh air, *that* would soon cure you, perhaps, while you would be giving all the credit to his medicine, and the dollars to him for his trash.

I know some physicians, of most excellent good common sense, who have ideas of their own, and independence enough to express them, and have much more faith in good hygienic rules and regulations, who prescribe pure air, pure water, good wholesome food, and plenty of exercise, but seldom prescribe medicine. These men would have to beg their bread if they had to depend exclusively on popular custom for their living.

And now let us take a new start. Let us put our shoulders to the wheel manfully. We have made a most excellent beginning during the year 1867, and our journalists, too, could they be

induced to give a line or two every day for some good hints as to the value of, and the best means of obtaining pure air, such results might be obtained as would astonish the world, and would give one of the grandest examples of hygienic reformation ever recorded.

I have had struck off a few copies of this lecture, which is the first of a course of four delivered in the Franklin Institute, during the winter of 1868, and now being published in the Journal of the Institute. The other lectures will be very fully illustrated by plans showing the manner of ventilating and warming many public and private buildings.

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1st mo. 6th, 1869.

Entered according to Act of Congress, in the year 1869, by

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