On breathing and ventilation / by Alfred Schofield.

Health at Home Tracts.

BY

ALFRED SCHOFIELD, M.D., M.R.C.S.,

ETC.

MEMBER OF THE NATIONAL HEALTH SOCIETY.

No. 2.

On Breathing and Ventilation.

ONE PENNY.

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HEALTH AT HOME.

No. 2.

ON BREATHING AND VENTILATION.

BY ALFRED T. SCHOFIELD, M.D., M.R.C.S., ETC., MEMBER OF THE NATIONAL HEALTH SOCIETY.

The Breath of Life.

"And the Lord God . . . . breathed into his nostrils the breath of life; and man became a living soul."

All life is undoubtedly the gift of God, whether it be natural or spiritual, for time or for eternity; for "in Him we live, and move, and have our being." With regard to eternal life, *that* we know is obtained through a real acceptance of Christ as our Saviour by faith, by which we enter God's family (for to "as many as received Him, to them gave He power to become the sons of God, even to them that believe in His name"), being born, as the next verse tells us, "not of blood, nor of the will of the flesh, nor of the will of man, but of God."[1] And this new life, once received, can never be lost by the persevering recipient. So then while it should be our constant effort so to keep in spiritual health as to maintain this life in vigorous and Christian activity, there is not, as with the other "gift of God," physical life, the same fear of losing it.

[1] John i. 12, 13.

These tracts are written in the earnest endeavour, first of all, to enable us to take due care of this physical gift of God so as to maintain our lives in health and activity; and secondly, to strengthen us in various ways in that higher spiritual life, without which we can never enter the Kingdom of God.[1]

At present, then, we will consider the breath of life; why we breathe, how we breathe, what we should breathe, and what we should not breathe.

The Air.

The air, extending some forty miles upwards from the surface of the earth, consists of oxygen, the life sustainer of the world, diluted with four times its bulk of nitrogen, and a minute quantity of—what if by itself and in excess would be to us a most deadly poison, though it is the life of the vegetable world—carbonic acid gas.

We breathe this air in order to supply our bodies with oxygen, without which existence could not go on a single moment; and the way in which this gas is distributed to the body is as follows.

The Blood.

The blood, the vital fluid, is the carrier of this oxygen, as well as of all food, to every one of the millions of living cells of which the body is composed, all of which constantly take in the breath of life.

The blood, rushing through the body a thousand times a day, parts with the oxygen it carries to these cells each time it passes them, receiving from them in exchange carbonic acid gas.

After leaving the cells, the blood returns to the lungs,

[1] John iii. 3.

its countless little globules now laden with this poisonous gas; and here it circulates in an absolutely innumerable number of the tiniest and thinnest little blood-vessels on one side of the thin skin or membrane that forms the walls of the air-tubes of which the lungs mainly consist, and which communicate directly with the mouth, and which has a total surface of over twelve square feet.

How we Breathe.

When, then, the oxygen is breathed in, it rushes down into the lungs, filling all these air-tubes, and thence at once passes across the thin membrane and fills the air-globules of the blood; the poisonous carbonic acid gas which they had brought to the lungs in its turn passing out of the globules into the air-tubes in a reverse manner, and forming part of the air that is breathed out again, which is thus most injurious, being laden with this poisonous gas. Its deadly nature has been abundantly proved not only by experiments on the lower animals, but unfortunately on man as well; as in the Black Hole at Calcutta, in coal mines, near limekilns, and elsewhere, where it is suffered to accumulate in confined places.

Now *what* we breathe should of course be pure air.

Unfortunately we cannot see the air, and hence know and care so little about it. The air of a Scotch moor or of a London slum is alike invisible; and this is the reason so little attention is bestowed on a subject of such great importance, and why such tracts as these are needed.

Dirty Air.

There are plenty of people who are particular to the last degree as to cleanliness. They must have their

garments and their persons without speck or spot, and would on no account tolerate dirty hands or greasy clothes. These people also are very careful as to their food. They cannot eat off dirty plates or have their meals prepared by dirty people or in a dirty manner; they try in short to put off swallowing their peck of dirt as long as they can.

Now we find no fault with these people; on the contrary, we trust that all readers of these pages are amongst them.

But perhaps these same scrupulous folk are not aware that they constantly swallow and inhale air not only laden with the poisonous carbonic gas, but with fine particles of the sewage and effete animal matter of hundreds of their fellow-creatures, as well as other finely divided dirt of all kinds.

This dirt unfortunately, as a rule, cannot be tasted, but its effects are none the less injurious. The lungs of a countryman are very different in appearance from those of a townsman. The one, as nature made them, of a rosy pink; the other, of a greenish-black hue, often gritty, and full of bits of inhaled coal-dust and of other refuse. Dwellers in towns are quite sufficiently handicapped in the race of life in having to breathe the coal-dust that should be consumed, without other additions being made of a still more injurious nature.

Consumption and bronchitis are two of the greatest scourges we have; and although their great frequency is generally laid down to our unsettled climate, an enormous amount is due to the unnecesary and careless breathing of foul air. We should not think of setting decomposing food before our children, and yet, from ignorance or neglect, we often allow their tender lungs to be filled with decomposing matter and poisonous gases.

Ventilation.

To do what is right in the matter of ventilation, both for ourselves and for others, two things are needed—the first is to believe in its importance; the second, thoroughly to understand how to carry it out.

The process of obtaining a constant supply of pure air indoors is called ventilation.

Out of doors the air is generally circulating; and thus even in the heart of London fresh breezes from the country, moving at from ten to fifteen miles an hour, frequently come from the fields and flowers, and the air is being continually changed; the largest crowd cannot make the air close, and it is only when the air is allowed to stagnate that it becomes injurious. Hence the danger of courts and alleys with only one entrance, the building of which is now wisely forbidden. No, the evil really lies in the extraordinary folly we display in our dwellings, where, as a rule, with every arrangement for comfort and even luxury, none is definitely made for securing pure air for the breath of life, indoors.

Self-Poisoning.

It is certainly startling to find what numbers of people are thus poisoned in the finest air in the world. In the country, and in Scotland especially, the death rate from consumption is very high amongst the women in proportion to the men; and this is undoubtedly largely due to the indoor life of the former as compared with the latter; for any greater contrast between the air of a Highland moor and that of a Highland shanty it would be hard to conceive. It is for a similar reason that so many people derive small benefit from their seaside change. They spend half their time (their

nights, at any rate) in such small stuffy overcrowded and poisonous rooms that the good of the fresh breezes of the day is quite undone.

One season, when I spent two months in Ross-shire, and it happened to be very wet, the children all drooped and pined in the midst of the finest air in the world, on account of the closeness of the small rooms, and the fact that none of the windows would open at the top.

In the Hebrides, consumption is almost unknown, for the cabins there, built of unhewn stones, allow an abundance of fresh air to enter, while a great square hole eighteen inches in diameter in the roof carries off all the foul air. On a large estate on the mainland where this primitive state of things was with the best intentions done away with, and the shanties replaced with neat cottages, with walls and roof hermetically ceiled with plaster and whitewash, close-fitting windows and doors, the mortality speedily increased in spite of the greater comfort afforded.

In the Maternity Hospital in Dublin, the deaths used to average fifty per cent.; now, largely as the result of improved ventilation, they only number five. Such cases could be easily multiplied, but they all show how dangerous indoor air is as compared with outdoor.

Slow Death.

With regard to the necessity of providing pure air in our houses there is another thought. As to our food, we can go about and select it when and where we will, and eat it at certain times; as to our clothes, we can choose them when and where we will with equal care; but as to the breath of life, we are compelled by an inexorable law of nature to draw in whatever air we happen to be

standing in, about seventeen times every minute of our lives, day and night without ceasing, or about nine million times every year, whether it be pure or poisonous. What an amazing importance then attaches to this one question of ventilation!

Another fact also shows the vital importance of thoroughly understanding this subject.

The poison of carbonic acid gas is like those poisons (arsenic, &c.) selected by murderers for their victims, in that it is insidious and gradual in its action. By constant habit greater and greater quantities of it can be taken, profoundly injuring the whole system, though not absolutely destroying life.

Claude Bernard's well-known experiment with the sparrows abundantly proves this.

He put one in a glass globe containing pure air and sealed up the opening. After an hour it got feeble, and at the close of two, still feebler. Bernard then opened the globe for an instant and put another sparrow in. This bird died in a few minutes, being unaccustomed to the poisoned air, while the other bird lived in it for an hour longer. It was then taken out, and soon revived in the open air; but on being re-introduced into the glass globe, died at once, owing to the sudden change.

There are many rooms in which we live, and especially sleep, which get in such a state that a person introduced straight into them from the open air is nearly stifled, while we have got used to them.

It must never, however, be imagined that because we can get accustomed to poison, *it does us no injury.*

The same used to be thought of dram-drinking, where small quantities of spirits are constantly being taken, but the person is never drunk. This is now known to be the most fatal form of spirit drinking.

Blood Poisoning.

The constant breathing of impure air, produces blood poisoning of the most profound description, known as anæmia. In this terrible disease all colour goes from the face, and even from the lips and gums, the breath is short, and the blood itself watery, and the whole system a prey to other passing diseases.

It cannot be too widely known that in every room we owe our lives to the power the fresh air has of entering and the foul air of leaving it.

If a man enters a large dining-room and seals up door, windows, and chimney, he can exist one hour on the air it contains and no longer, and then he will die. If it be dark and he requires a candle, he will only live three-quarters of an hour; if a lamp, only half an hour; while if he have two gas burners, each of which uses as much oxygen as five men, he will only live *five minutes.*

Ventilation then is the process of introducing into our rooms pure air for inspiration, and getting rid of the impure air of expiration, freely and without draughts.

The Great Difficulty.

One very great difficulty exists with regard to all ventilation, and especially amongst that class whose health is really their wealth and capital, those who earn their daily bread by hard and honest work in towns.

We must remember that fresh air is cold, and that the impure air as it is breathed out of our lungs is warm, nearly blood heat, or 98°, and it is this fact which is the fundamental difficulty in ventilation.

The Royal Commission of 1885 on the Housing of the Working Classes wisely recognizes this, and says, "It must never be forgotten that the human body has a desire and a need for warmth, and that fresh air, which

is so necessary to the health of a well-nurtured body, chills the half-starved, ill-clad frames of men and women whose homes have been described."

The simple truth is this. The poor find out that by far the cheapest way of warming a room is by their own breath, and they therefore stuff up every crack and crevice, close door and window, and crowd closely together, rigorously keeping out that on which their very life depends—pure air; and were it not for the chimneys in most rooms, deaths directly from this cause would be far commoner than they are. Even at sea some of the foulest air in the world is to be found in the seamen's cabins in the forecastle, which are warmed by the same poisonous means. The difference between pure warm air and foul warm air, cannot be too strongly insisted on, and the fatal effects of living or sleeping in close rooms, warmed by the heat of one's own poisonous breath, too plainly pointed out.

Warmed by our own Breath.

It is on this account that people will not willingly submit to have their rooms ventilated. In one or two workshops in the City where large numbers of girls were employed, and the atmosphere was found to be intolerably close, a beautiful system of directly introducing fresh air, by means of Tobin's tubes, was arranged at great expense, but was soon found to be useless, because the girls would persist in stopping up the mouths of the tubes with bits of rag, &c. These girls had no wish to commit suicide, but were determined to be kept warm, and the only way to reconcile them to the necessity of breathing pure air, would be at the same time to heat the room artificially to supply the place of the hot poisonous breath. It is a matter of pounds, shillings, and pence, and the worst is that those who need this pure air most, are

those who have least of these three things to spare. If the room is to be kept fresh and pure, more coals must be burnt or more clothes worn, or both.

It is curious that, seeing the enormous importance of this subject, it has not yet been found possible to invent any simple way of warming the fresh air as it enters a room. Some few indeed who can afford it adopt a certain grate, which does this by admitting the fresh air at its sides; but we still think that in the vast blocks of model dwellings rising all over London, some way might be found of economically laying on warmed fresh air to every flat from a central furnace.

In our Board Schools, a wholesome horror of re-breathed air should be vigorously inculcated and its deadly effects shown by experiment, so that when the children grow up, nothing would tempt them to live in close rooms and breathe foul air.

A Brain Poison.

Carbonic acid gas, produced by the various functions of life in our bodies, and breathed out with every breath, is a powerful brain and nerve poison. Its effects are intensified when combined with the germs in expired air.

It is this too often, and not the sermon, that makes the people so sleepy in churches and chapels. It is this, and not the lessons, that makes children so listless and so fidgety in ill ventilated schools. It is this, and not the hard work, that makes people so dull and heavy when they awake in the morning. It is this, and not mere temper, that makes the wife or the work-girl who has been working in a close room all day so irritable.

Let us now consider very simply how this poison that we manufacture is to be got rid of.

The Chimney.

There is no doubt that the great safety-valve of most rooms is the open chimney, which is of far more importance as an air shaft than as a vent for the smoke. Were it not for the English love for an open fire-place, and hence an open chimney, it is hard to say what would become of large numbers of the population. No chimney ought therefore to be stopped up, and under ordinary circumstances no room should be without one.

Ventilation really consists of a double process—the removal of the foul air, and the admission of fresh. Now the chimney is principally of use for the former part of the work. Carbonic acid gas is very heavy, and with care can actually be poured from one glass into another. When it is first expired, it is of course heated and is lighter, and ascends to the ceiling. Now is the best time for getting it out of the room, and the best way is by an opening near the ceiling right into the chimney, with some simple valve (Arnott's) to prevent the smoke from coming out into the room. If this is not done, the carbonic acid gas cools and falls to the floor.

It is this that makes it so very dangerous to sleep on the floor in close rooms without open chimneys, and why in some cases dogs, being nearer the ground, die while men can enter without harm. When it has thus fallen, the draught to the fire-place and up the chimney quickly carries it off.

The Window.

The window is the second great means of ventilation. It ought, in the majority of rooms, to be so arranged *as to be always open*, by night as well as *by day*. It is impossible to overrate the beneficial advantages arising from this simple proceeding.

This can be done in various ways. One is by a simple window board about three inches deep, on which the lower sash shuts, so that while the bottom of the window is still closed, there is an opening between the two sashes, admitting fresh air in an upward direction: or perhaps in some cases better still a board can be fixed across the front of the lower window-sill about six inches high, so that the lower sash can be raised behind it, and a double upward draught formed—the one between the two sashes, the other between the lower sash and this board in front.

All windows should open at the top, and if at all large, a small pulley and a double cord should be fixed so as easily to pull the upper sash up and down without having to push and pull from the outside. The top of the window should be kept constantly open an inch or two day and night. The draught can be directed upwards in various other ways. The air can enter upwards behind a false cornice, so that when the window is apparently securely shut, an opening is always left above; or the window can be left open a little and a board just nailed across slanting upwards. An ordinary venetian blind serves somewhat the same purpose if partly let down.

With these simple contrivances no draught is possible, and the cold air, directed upwards, falls in a gentle shower all over the room. There are of course more expensive ways. An ornamental glass screen fixed on the lower sill so as not to rise with the window, is more ornamental than a board, and prevents any direct draught.

Tobin's tubes, already alluded to, are flat tubes against the wall, opening into the outer air below and into the room above, about the level of the mouth, in an upward direction.

The Door.

The third and worst way of ventilating a room is through the door. It is a capital saying, and should be enforced, that doors are made to shut and windows to open, not *vice versâ*. If a room is already sufficiently ventilated, there will be no draught rushing in at the key-hole, as can be seen by the flame of a candle held there. If there is not sufficient fresh air in the room, it will do its best to get in by the door, carrying of course with it all the smells, poisons, and sewer gas that may exist in any part of the house.

Ventilation is really self-acting. The poisoned air does its best to escape, and the fresh to enter; and if we do not absolutely prevent this by our wretched ignorance, these beautiful Divine laws will work harmoniously and without effort.

Let then our sitting-rooms, and above all our bed-rooms, be freely ventilated into the open air, and never suffered under any circumstances to become stuffy. To ensure this they must not of course be overcrowded; each person must be allowed *at least* 50 square feet of flooring in a room 10 feet high, and gas should never be used unless the rooms be very spacious; lamps and candles consume far less oxygen, for one single gas jet requires as much fresh air as five persons.

Dirt.

A great objection in towns against free ventilation is made by careful housewives on the ground of dirt. This is an important one, for there is no doubt that town air is laden with dirty matter of all sorts, and requires as careful filtering as our water. This can be done effectually by muslin or perforated zinc stretched across the opened window; and it is perfectly surprising the

amount of dirt that will thus be stopped on its way into the room.

We have now pointed out some of the benefits and ways of proper ventilation, but we have yet to mention one of the greatest advantages it gives.

Catching Cold.

Let us remember that the most fatal disease in England is consumption, then come bronchitis and inflammation of the lungs; and mark that one of the commonest ways these begin is by our "catching cold" from going from close unventilated rooms into the open air, and that the surest general preventive we can adopt against these diseases is always to have our rooms (and especially our bedrooms) fresh and well ventilated.

The ignorance that sits in close rooms with sandbags on the tightly closed windows, list round the doors, and shavings up the chimney, to avoid cold, only ensures catching it. While the enlightened common sense that lets the foul air freely out and the fresh freely in, is the surest safeguard against it.

God's two Gifts.

It is distressing to find how ignorant and prejudiced we are even in our enlightened age concerning God's best gifts and simplest laws. We have seen the result of voluntarily and foolishly shutting out His free gift to all, fresh pure air, the breath of life, even where it most abounds, from the bedroom of a Highland cottage. We have seen how the simplest laws that His wisdom has laid down whereby fresh air is ever seeking to take the place of foul, are frustrated and hindered, and especially by our increased skill, as we learn to make doors, walls and windows more air-tight than in the days of our forefathers, when the wind could enter where it

listed. It cannot therefore be a matter of surprise that with regard to God's best spiritual gifts and simplest spiritual laws that the same ignorance and folly prevails. His best spiritual gift is undoubtedly eternal life. It is as free as the air we breathe to all who will just receive it through the work and sacrifice of Christ. And yet, like the cottager in the Highland moor, here where it is freely offered us, where the Bible has the widest influence, we shut up our hearts against it, and prefer the poisonous vapours of superstition and infidelity to the truth of God. The simplest spiritual law relating to our soul's salvation is that this life is obtained by faith in what our Saviour has done; and yet we do not need to go to Asia to see nearly half the human race (some five hundred millions) trying to save themselves in one form or another of Buddhism, but we find the same thing everywhere here in England. Even as we hear the simple message in our churches, chapels, mission rooms, and in our very streets and parks, we too often resolutely refuse it, and shut the Saviour out with all the ingenuity of modern methods, and try, if in earnest at all, to go to Heaven our own way instead of God's.

Soul and Body Poisons.

Oh it is piteous to see so many thousands of English men and women careless alike as to body and soul, poisoning their bodies with the exhalations from other people's lungs, and their souls with thoughts from other people's minds, when God offers to both body and soul His free gifts—the pure air for the one, and eternal life for the other.

Thousands are now dead in body, and thousands lost in soul, through this culpable ignorance and careless neglect, for we cannot escape if we *neglect* so great

salvation? For them it is too late; for us and for our children it is not. Let us then earnestly give this great subject our most careful consideration, as to whether we are not at this very moment poisoning our souls with some false human ideas, instead of opening them to God's love, and to the mighty proof of it in the gift of His beloved Son to us as our Saviour; and then we must also consider our bodies, and whether we cannot, in carefully reading over these suggestions, find some way of adopting them in our homes, and get rid for ever of the dread of an open window in our sitting-rooms, or of admitting night air into our bed-rooms.

And further, can we not carefully train our children first to accept God's great spiritual Gift, and then rightly to value and use His earthly gifts, freeest and best of which is pure fresh air; and thus shall enable them to avoid these fatal errors that have directly and indirectly destroyed so many around us, and give to them the best legacy a parent can give—

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