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OFFICIAL PROCEEDINGS

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PROCEEDINGS OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING

COURT ROOM NO. 2, TEMPLE BUILDING,

Toronto, November 25th, 1913.

The President, Mr. A. M. Wickens, occupied the chair.

Chairman,—

The first order of business is the reading of the minutes of the previous meeting. The minutes were printed in our journal last month; no doubt all who have had the journal have read them in that way, and I suppose we can adopt them as read.

Moved by Mr. F. G. Smith, seconded by Mr. W. M. McRobert, that the minutes of the previous meeting be adopted as read. Carried.

The next order of business is the remarks of the president: I have not very much to say to you to-night. I am glad that you are all here, and I only regret that the paper we intended to have for this evening, we cannot have as we were unable to get the hall. The proposition for to-night was to have a moving picture illustration; the manufacture of tubes beginning with the mining of the ore right down to the finished product. Unfortunately we could not make satisfactory arrangements for a hall suitable for holding the picture apparatus. Mr. Speller, the gentleman connected with the National Tube Company, was to come here and give this paper in conjunction with the Toronto School of Science, and we were very much pleased with the idea. That was entirely satisfactory to us, but when it came to making arrangements about having the picture machine in the University Hall, the authorities of the hall came to us and said: "Gentlemen, you can have the hall, but you will have to pay extra insurance for that night." We said: "How much?" "$360.00." So we concluded that would be rather too much of an expense for one night for this club, and consequently we had to go elsewhere for our paper for to-night, and our friend Mr. Butler, of the Toronto Public Libraries, has been good enough to step into the gap and is going to give us a paper that I am satisfied you will be highly pleased with. This evening we will have to appoint a nominating committee according to the by-laws to nominate officers for 1914, and which must be voted on at the December meeting.

We have also made arrangements for the December paper. This paper will be on Scientific Illumination, by Mr. J. W. Helps, and will be illustrated by lantern views. We tried to have it for this meeting, but could not arrange it. I hope every member of the Club will not only attend but bring a friend with you and see something new along the line of illuminaton. It will be well explained to us, and we ought all to be interested as it is something that each one has to have in his house. The next meeting is only two days before Christmas, and if everybody will come down a little earlier than usual and do their shopping they will be able to be present here in good time.

Now, any members joining the Club this year will get the advantage of a month's dues. Any member coming in now and paying his dues pays them up to the end of 1914.

Any members taking part in the discussion of the paper which Mr. Butler is going to read to-night kindly give your names before you begin the discussion, or before you ask a question. The stenographer has not yet learned all the names of the members, and we are anxious to have the full discussion appear in the journal with the proper names opposite questions asked. I think that is about all of the president's address for to-night.

I shall now call upon the secretary to give us the list of new members.

NEW MEMBERS

Mr. J. B. Robb, representative Canuck Supply Co., Ltd., Montreal.

Mr. H. C. Anderson, salesman, John Millen & Son, Ltd., Toronto.

Mr. Jno. S. Fulton, general superintendent, The Hare Engineering Company, Limited, Toronto.

Mr. James O'Brien, stoker erector, The Hare Engineering Company, Limited, Toronto.

MEMBERS PRESENT

C. H. Stainton	W. M. McRobert	J. Barker
T. McKenzie	H. H. Wilson	K. A. McRae
J. T. Fellows	R. Murray	Geo. A. Young
G. D. Bly	J. Callanan	F. Slade
Jas. Kelly	D. Campbell	A. E. Price
Geo. Baldwin	E. A. Wilkinson	Hugh Paton
A. M. Smith	J. C. Donald	H. G. Fletcher
Jas. Herriot	A. W. Durnan	Wm. M. Forbes
Wm. Burgess	J. H. Morrison	J. W. Walker
W. Austin	G. C. Mooring	J. Jackson

J. McWater	T. Ward	Robt. Pearson
Jas. Anderson	D. Cairns	Jas. Wright
Fred. G. Smith	H. C. Anderson	A. E. Price
Chas. Russell	John Chambers	R. Russell
F. Smith	Thos. J. Walsh	T. B. Cole
A. R. Taylor	L. F. Annis	A. M. Wickens
J. W. McLintock	W. C. Sealy	E. Logan
J. Anderson	W. McRae	A. J. Lewkowictz
Chas. De Grouchy	W. Kirkwood	T. B. Cole
W. H. Alderson	A. Hallamore	J. Dodds

Chairman,—

Any report from Standing Committees? None.
Any unfinished business? None.
Any new business?

Mr. Herriot,—

Mr. Chairman, under the head of new business, I would like to mention that it is an annual custom of this Club to make a donation to charity at this season of the year. Now, I do not want to leave the question over to our next meeting as that is only two days before Christmas, which would not give proper time to make arrangements, therefore I beg to move:—

That the executive of this Club be authorized to make some donation to charity in the ordinary way.

Mr. Worth,—

I would like to say in regard to Mr. Herriot's motion that I think it would be better, instead of taking any funds from the Club's treasury that we open a subscription list, and whatever is collected be given to the different charitable institutions that we have been accustomed making a donation to.

Mr. Baldwin,—

Is that an amendment, Mr. Worth?

Mr. Worth,—

Yes, if you like.

Amendment to the main motion: Moved by Mr. W. M. McRobert, seconded by Mr. K. A. McRae,—That whatever donation be made it take the form of a subscription among the members.

Mr. Worth,—

I might say that I have also had a letter from Stratford, where we have a large number of members, and they want to know, when charitable work is being done in Toronto, what can be done for Stratford.

Chairman,—

Has any other gentleman got anything to say about it? Then we will vote on the amendment. Those in favor of it, kindly raise your hands. Contrary. Carried.

Mr. G. Baldwin,—

Mr. Chairman, I moved at the last meeting, and my motion carried, that any new members should be introduced to the members present. Are there any new members present tonight?

Mr. Morrison,—

I have much pleasure in introducing a member that is making his first appearance this evening, and who, I have no doubt, will make a worthy addition to our Club. He is the superintendent of one of our largest manufacturing plants in the city. Mr. Burgess, let me introduce the members of this Club to you. (Applause).

Mr. Burgess,—

Gentlemen, I am sure I am very much pleased to be here. It must be nearly a year now since I was nominated, and in saying this is my first appearance, I will say I hope it will not be my last. I intend to be a regular attendant. (Applause.)

Mr. Baldwin,—

This is Mr. H. C. Anderson, of John Millen & Son, Ltd., Toronto. Mr. Anderson, allow me to introduce you to the members of the Club.

Mr. Anderson,—

Mr. Chairman and Gentlemen,—Let me say I am glad to associate myself with this Club. This is not altogether my first appearance at a club of this nature. I have been a member of the Montreal Club for a number of years, and I am to a certain extent familiar with the work you are carrying on. On coming to Toronto, I made it one of my first duties to become associated with a similar organization to the one I belonged in Montreal. I have very much pleasure in being introduced as a member. (Applause.)

Mr. Worth,—

I would just like to say that Mr. Anderson is associated with Mr. Speller whom we expected here to-night, and I hope at our meeting in February Mr. Speller will be able to give us his paper, with the moving picture exhibit that we intended to have to-night.

Chairman,—

The next order of business is the reading of papers and the discussion. We have with us to-night Mr. W. S. Butler, chief engineer of the various library buildings in the city. Mr. Butler has made this a special study, and has taken a good deal of time and trouble in looking up the matter of ventilation. When the negotiations, for the moving pictures fell through, we approached Mr. Butler, who very kindly consented to give us this paper on two days' notice, and I have very much pleasure in calling on Mr. Butler.

"VENTILATION"

By Mr. W. S. Butler, Chief Engineer, Toronto Public Libraries

Mr. Chairman and Gentlemen,—This is my first appearance in this Club. However, it is not my first appearance in this room; the room is quite familiar. I took part in a discussion here about a month ago, and consequently I feel quite at home here. The subject on which I am to speak to you to-night is one that is extremely hard to deal with, and I had expected to have more time in which to get it up. I promised Mr. Wickens I would give this talk in January. However, he came to me a week ago to-day and told me that the gentleman who was to supply the paper to-night was not able to come, and he asked me if I would be kind enough to read my paper now. I, of course, told him I did not think it would be possible for me to get it up in the shape I would like to have it in. He told me he was satisfied I had the matter at my finger tips. I want to tell you, gentlemen, that it is one thing to have a subject at your finger tips and quite another to have it on the tip of your tongue. It is well nigh impossible to collect your thoughts sufficiently and keep them together to deliver an address of this nature, and on a subject so large, to make it interesting. This is the first time I have ever been at a meeting of this Club. I intended to be here last meeting night. However, two or three days before the meeting, Mrs. Butler came to me and said, "There is to be a tea-meeting at the church, and I would like to go," so I stayed at home and minded the children. Now, I am not telling you this in order to give you an excuse for staying from the meetings or from church either (laughter). This subject of ventilation is one which I have found very hard to deal with during the last two or three years. It has always seemed to me there was something wrong about the ventilating system of a great many public buildings, particularly did I notice this in the Public Reference Library. In fact, when I was given my present undertaking, I was put up against a very hard proposition, one that for a long time, as the fellows say, kept me guessing, to know what was actually the matter. People used to come to me and tell me that the ventilation in the public buildings in this city was awful. I got out of patience altogether and I said, on more than one occasion: "You don't know what you are talking about; there is a big fan in the cellar blowing fresh air up all day. It must be all right." I continually put that argument up, but eventually it was borne upon me that there must be something wrong. You all know the Toronto Public Library, one of our largest buildings, and a building both large, up-to-date, and built in good style, but there was evidently something wrong with the ventilating system. By watching carefully and applying myself assiduously to the task, I pretty nearly discovered was what the matter. Now the paper I am going to read to-night is not, as I have already said, prepared quite as carefully as I would have liked to have had it.

The subject which I am to speak on to-night is a subject of vital importance to the welfare of the people of Canada. As the masses of the people who live in our large cities work in its large office buildings, factories, shops, stores, etc., particularly our public schools (for there is nothing more important than that the young blood of our country should live and be instructed under proper conditions), we must see to it that they not only have the correct amount of air but that the air is properly cleansed and humidified.

It is my intention to-night to explode a bomb in the camp or rather in the midst of the standard that has been taken for ventilation, if I can only find words to express my thoughts.

I fancy I hear a low voice saying, "Ventilation." Why need we be so concerned about ventilation? Our forefathers and the strong men of days gone by did not need large fans to ventilate their places of abode. Why? These men worked and lived in the open air in comparison with our men of to-day working in factories, office buildings, stores, etc. So as our large buildings spring up and our cities become more crowded, our modern civilization demands of us proper ventilation.

First let us consider why we need ventilation and let us see what has been the standard taken for ventilating schools and large buildings.

Scientists say, and which no doubt is true, that in the action of respiration we give off a gas known as carbon dioxide—the same gas is given off from the burning of fuel. One writer has said that inside a man there is a small combustion engine, and when the oxygen comes in contact with the carbon in the blood there takes place a complete combustion which generates heat and gives off this gas known as carbon-dioxide or C O2. This gas is much heavier than pure air and does not rise to the upper part of the room as is generally supposed, but keeps near the floor or lower parts of the room. It is an absolute certainty that a man has a heat generating plant within himself. Now, it makes no difference what the temperature of the air you breath is, when it leaves the nostrils it is near or slightly below the temperature of the body. Now he has more than this: he has a small humidifying plant; it does not matter what the amount of moisture, even if it is only half a grain, when it enters the nostrils it is nearly totally saturated. When it leaves the nostrils, that is to say nearly 90 degrees higher. Then with total saturation, it would be carrying in the neighborhood of 17 or 18 grains to the cubic foot.

Scientists say that when the blood passes through the lungs and air comes in contact with the blood, it picks up the carbon-dioxide and also moisture.

One writer has said carbonic acid or carbon dioxide C.O2 carbonic oxide C. O. The first is a product resulting from the perfect combustion of carbon; it is always found in small quantities, 3 to 5 parts in 10,000 in the atmosphere of the country. This gas although very heavy as compared with that of pure air (22 times that of hydrogen) will, if sufficient time be given, mix uniformly with the air. It is not a poisonous gas, although in an atmosphere containing large quantities of carbon dioxide a person might die from suffocation or want of oxygen. While carbon dioxide is not of itself injurious, yet as it is a product of combustion and respiration, and is usually accompanied with other injurious products, it is regarded as an index of the quality of the air, and the amount of it present in the air is taken as the standard by which we can judge the ventilation. In such a case pure air containing 4 parts of carbonic dioxide in 10,000 would be the standard of absolute purity. Authorities differ as to the greatest amount of carbon dioxide which might be permitted. It is certain that any unpleasant sensation is not experienced until the amount is increased 10 or 12 parts in 10,000, yet authorities are generally agreed that the maximum amount should not exceed 10 parts in 10,000. The standard of good ventilation usually adopted at present would permit about 8 parts in 10,000 in the air.

Carbonic oxide C O. This compound is not found in the air except under unusual circumstances. It is distinctly a poison and has a characteristic reaction of the blood.

Authorities to-day agree that this standard is entirely wrong and before I am through I expect to be able to show that the standard laid down by scientists of the past half century has been doing more harm than good. They have been creating conditions which simply are appalling in a great many cases. It is not this poisonous C. O2 and C. O. that has been doing all the mischief but rather a poison known as the poison of fatigue. I quote the following from an article on Dr. Weichert's discoveries by H. G. Hunting in the *Technical World*. Dr. Weicherts first discovered the supposed poison of fatigue from muscles of animals exhausted by weariness. That ancient "criminal" carbonic acid gas has been going under the alias of carbon dioxide in late years, but his repute is still bad. Yet I must say a good word for him. He is not as black as he is painted. Recent scientific discovery shows him innocent of the crimes which have been laid at his door. What makes us suffer in a closed room is not carbon dioxide, it is the poison thrown off by those in the room who are fatigued. Dr. Luther Halsey Gulrick presented at Indianapolis some reports of experiments whereby he showed that a man breathing good air having his head outside a box of bad air and his body in it exhibited the same symptoms regardless of whether he breathed the air in the box or the good air outside. The fact of his body being inside was sufficient to poison him with weariness. Probably when Dr. Weichert has experimented further, he will find that the toxin of fatigue is distributed in a room where many are gathered both by breathing and bodily exhalations. At any rate, the trouble in a badly ventilated room is not caused by carbon dioxide. The error of Science has set us to try to blow the carbon dioxide out of our buildings, and in so doing we have been creating conditions which are unnatural, conditions under which the hardiest plant that grows would die; where plant life will not exist it is no place for man to live. What are these conditions which they have been creating; let us take for example one of our so-called modern ventilated buildings, with a large fan in the basement and blowing in large quantities of so-called pure air, and another large fan on the roof exhausting out the foul air. Let us see what Prof. Geo. Wright, head of the Division of Sanitary Engineering at Harvard, says about the pure air. The number of dust particles as determined by microscopical counts, ranged from 100,000 to nearly 1,000,000 per cubic foot of air in some parts of New York City, outside. At the fifty-seventh story of the Woolworth building, one cubic foot of air contained no less than 70,000 dust particles. He also states that where the intake for the air is near the street level it contains large quantities of bacteria. So we can readily see how pure the air often is, we are forcing into our buildings. Yet this is not the worst side of the question; let us see what other bad conditions we create by this system of ventilation. We will consider, for example, that the temperature of the air outside be at zero, and see what is the condition in our building from the standpoint of humidity. The air coming into the building at zero has approximately half a grain of water in the shape of vapor or steam to the cubic foot when it is at the dew point, that is to say maximum saturation. Now this air when heated up to, say, the temperature of the room, the temperature of the room being 68° Fahr., air at this temperature at total saturation or dew point will have, in the shape of moisture or steam, seven and a half grains to the cubic foot. That is to say, air at 68° Fahr. is capable of holding in suspension fourteen times more water than it is capable of carrying when at zero. Now the mathematical problem in this case is very simple,—we find that 14 goes into 100, 7 times. We see by this when we heat the air from zero to 68°, we increase its carrying capacity of moisture fourteen times more than what it had been at zero. The air at zero being at 100% saturation and heated to 68° without adding any more moisture would have 7% of relative humidity. If the outside air is at 50% relative humidity, which is usually the case in cold weather, the relative humidity in the building would be at 3.5%. This is at least five times dryer than the driest climate in the world: it is drier than the Sahara deserts where neither plant nor animal life can exist, and yet these are the conditions which are being created in our large office buildings, factories, stores, public schools, colleges, etc. Is it any wonder that we have such disastrous epidemics break out in our schools and cities under these conditions. It is time this state of affairs was put a stop to. The time is near at hand when the command will come to halt, come to attention and wait for the next command, to face the enemy with the weapons with which he should be fought. What is the effect of this hot dry air on the system. This dry air with its enormous moisture vacuum picks up moisture from any place it can find it, it attacks the moisture of the skin, nose and throat, and in so doing it lowers the temperature of the body. Therefore we will feel more comfortable and warmer in a temperature of 65° Fahr. with the right amount of humidity than we will feel in a hot dry room deprived of all its moisture, at a temperature of 70° Fahr. It does worse than this, it destroys the mucus membranes and makes them give up moisture so rapidly by evaporation that they forget their natural occupation and use all their powers in the act of supplying the moisture required by the air. Shutting people in a building hermetically sealed and pumping devitalized air to them, devitalizes the people. Dr. L. D. Rogers, of London, reports that the Middlesex and St. Thomas Hospitals have operating rooms which are vacuum tight, and the air admitted is passed through wool and water to remove anything of a septic character, but although the air is sweet and pure and an abundance of light is given, the nurses regularly acquire pronounced anæmia. Deprived of the invigorating qualities of air as provided by nature, they lose weight and strength. Large buildings heated and ventilated in this way are nothing more than modern dry kilns; they are better adapted for drying lumber than for Christian people to live in. The time is near at hand when this system of heating and ventilating will be revolutionized, which will be a great blessing to the masses of people who work in our large factories and stores and who live in large buildings, and especially the young children in our public schools.

Now in such a case where nurses are working in an operating room of that class with all that air, as they claim, practically pure, and they develop a disease of that kind, is it any wonder that where children are housed in a school with such existing conditions that we have such epidemics. What is anæmia? Only a low state of vitality. This disease really means a small quantity of blood thin and watery. Now when people get in that state, they have lost their power of resistance. We are told that germs are everywhere. Now, if that is the case, there certainly is great reason why we should keep our physical strength up to the standard, and people who work in these buildings should have a chance to keep up their vitality and their resisting powers. This hot dry air simply attacks our very lives.

Now I refer again to the discoveries of Dr. Weichert, namely toxine of fatigue. Dr. Weichert at once began to investigate something that would counteract this toxine of fatigue; he discovered a serum or an anti-toxine of fatigue. This artificial anti-toxine is now on the market, but we won't bother about taking any of this anti-toxine but investigate and see which is the best way to fight off this toxine of fatigue. One ounce of preventative any day is better than a pound of cure. What will we do? We will turn on the steam in the air duct, put moisture into the buildings, lower the temperature and note the results. You will detest the offensive odor of the steam through the building, but it will not do one quarter the harm that hot dry air deprived of almost its last remnant of moisture will do. But a better way to accomplish this would be to pass the tempered air through a warm very finely atomized spray of pure water, which will not only humidify the air, but will remove nearly all dust, foreign matter, or such germs or bacteria as may be in the air, and at the same time will stop the occupants of the building from becoming so easily fatigued. We will now see how much water in the shape of moisture it will take to humidify the air in one of our large buildings. I am taking, for example, three rooms in the Public Library, corner College and St. George Streets. The reference reading room is 154 feet long, 52 feet wide, and 30 feet high, containing 240,240 cubic feet. The circulating library, 140 feet by 52 feet by 18 feet, containing 131,040 cubic feet. The stack room, containing 97,064 cubic feet, making a total space to be ventilated of 468,-344 cubic feet of air, to be displaced every twenty minutes which would give perfect ventilation. We find that to do this, we have to have a fan capable of delivering 23,417 cubic feet of air per minute, standard that is usually taken, allowing 30 cubic feet of air for each person in the room, which would be ample ventilation for 780 people. Now let us see how much water it will take to humidify the air in this building. Taking the air in at 0° with 50% relative humidity, which is the normal condition it would contain $\frac{1}{4}$ grain of moisture per cubic foot, and when heated to 68°, without adding any more moisture, the relative humidity would drop to about $3\frac{1}{2}$%. This is dryer than any known climate. Now in order to raise the relative humidity at 68° to 50%, which is what it should be, we would have to add 3.75—.25 equals 3.5 grains of moisture to every cubic feet of air, and as there are 23,417 cubic feet of air delivered into the room per minute, we would have to add to the air $\frac{23{,}417 \times 3.5}{7{,}000 \text{ gr.}}$ equals 11.7 pounds of water every minute or 1.17 imperial gallons, and as it takes twenty minutes to replace the air in the building, the total amount of water in the air in form of humidity is 20 x 1.17 equals 23.4 Imperial gallons. In an hour there are 70.2 imperial gallons of water evaporized or 702 lbs. It takes 702 x 1079, which is the latent heat in one pound of water evaporated at 50° F. equals 757,458 B.T.U. to be supplied to the water in order to vaporize it at 50° temperature and in a humidifying machine where steam is injected into the water to vaporize it, there would be $\frac{757{,}458}{956}$ equals 792 pounds of steam used at 51 lbs. sq. ft. in pressure would be equal to about 22 boiler horse power.

Now taking the outside temperature at 32° F. with 50% relative humidity instead of zero. Air at 32° F. 50% relative humidity contains 1.05 grains of moisture per cubic feet. This air heated to 68° F. without adding any more moisture, the relative humidity would be 46%. Now in order to raise the relative humidity to 50%, it would take 3.75 grains per cubic foot and work out as follows: 3.75-1.05-2.7 x 23,417 equals $\frac{63,226}{7,000 \text{ gr.}}$ equals 9 lbs. x 20 minutes equals 180 x 3 equals $\frac{540}{10}$ equals 54 imperial gallons per hour.

Now to vaporize this 540 pounds of water at a temperature 50° F. 540 x 1,079 equals 582,660 B.T.U.s about equal to the B.T.U.s in 40 pounds of hard coal, having 14,000 B.T.U.s to the pound. It may appear to some that all these heat units are wasted. That is not so. These heat units go into the air in the building, and since we can keep our buildings at least 5° cooler—when we get rid of that loss of heat due to evaporation, for evaporation can not take place without loss of heat. What the actual reduction in the cost of heating buildings with the correct amount of humidity in the air, I cannot say, to be correct, but there is no doubt in my mind that the reduction in cost with the air properly humidified would be at least 15 to 20%. Moreover it is possible, with an improved type of air washer, to recirculate probably 50% of the air and send it back into the building, for scientists have proved this possible, with a much greater reduction in the cost of heating. This is the standard that must be adopted if the people in this northern climate, the people of Canada, are to be the strong hardy people they have been in the past. But if they are to be dried out and made tender as a green house plant, with these most antiquated ideas the people of our cities will become nothing more than a lot of weaklings.

Now, you can easily see that what I am saying in this respect is correct; I never make a statement unless I can prove it. I know it is correct. This being correct, it is something in the building we want to get rid of, it is something we have not got and we will have to get.

It takes a lot of water to humidify the air in large buildings; 54 gallons. Now, that is a barrel of water; if you were to pour that on the floor, you would be a long time getting it mopped up, but there is some difference between water and humidity; humidity is not sticky in the same sense as dampness; it is entirely different, and this is explained by defining it as a mechanical mixture of vapor and air. Another writer said it is not a mechanical mixture—that they are two separate things occupying the same space. Now, I don't think there is any reasonable doubt on the statement that two things cannot occupy the same place at one time. I am not going to argue that question; I do not suppose any gentleman here will argue that question.

Now, gentlemen, if you do not object to some newspaper clippings that bear very much on the subject, and they are of very recent date. This paper was given to me by a gentleman who knew I was very much interested in the subject. It is from the *Boston Transcript*. It was some time in the middle of the summer and is by Prof. Geo. Wright, head of the Division of Sanitary Engineering at Harvard. Now, it went on to give the great reduction in cost of heating by humidifying and recirculating the air in large buildings.

THE NECESSITY OF CLEAN AIR

The effect of forcing unclean air into buildings is to nullify the result aimed at by ventilation, that is, to provide a supply of fresh air. The presence of dust, bacteria and odors, not only renders the conditions uncomfortable and deleterious to health, but it results in attempts at window ventilation, and this means poor ventilation, unequal heat distribution, and draughts.

The unclean condition of the air in many schoolrooms, to take a striking example, is shown by C—E. A. Winslow's demonstration that the air of many of the New York city schools contains even larger numbers of dust particles than we found in the air of city streets, the school counts ranging from 400,000 to 1,000,000 per cubic foot.

Clean air in motion, and of proper temperature and humidity, is necessary to indoor comfort. Slight reductions in the amount of oxygen, or slight increases in the amount of carbonic acid in the air, are no longer feared. The human body can automatically adapt itself to slight changes in the proportions of these gases. It is more difficult for the body to adapt itself to temperature changes, and these may cause more or less discomfort or damage. The heat relations of the body are so complicated that we have not yet solved them. We do not yet know the best combination of indoor temperature and humidity for our greatest bodily comfort and efficiency. We do not know that it is uncomfortable to remain in air that is still, or "dead." No system of ventilation can be regarded as satisfactory that does not cause a sufficient circulation of the air.

Modern cities are dust producers. Streets and pavements and even sidewalks are worn by friction of the traffic, especially in this age of the railroad and automobile; car-wheels are ground to metallic dust, fabrics turn to lint; fuel burns with products of smoke and ashes. Dust is being continually produced, both within and without our factories and houses.

A Eighth story on the roof.
B Above street entrance.
C Second story, back side of the building.
D Street level, just above sidewalk.
E Street level, just above sidewalk.

Comparison of the dust counts in the air before and after passing through the water showed that in the case of five Boston washers, the percentage of removal ranged from 27 per cent. to 87 per cent. and averaged 54 per cent., while the removal of bacteria ranged from 37 per cent. to 88 per cent. and averaged 64 per cent. Generalizing, it is fair to say that the air washing process as practised removed about two-thirds of the suspended particles, including dust, bacteria and moulds. From a comparison of the analysis of the tap water before use with the washer water after use, it is evident that many substances were removed from the air besides dust and bacteria.

When street air was passed through a washer, it required but a few hours for the water used to resemble sewage in appearance and analysis. A much greater amount of dust was removed from air near the street level than at higher elevations.

The presence of sulphurous acids in the washed water was very low.

RE-WASHING USED AIR

The gymnasium of the International Y.M.C.A. College at Springfield afforded an opportunity of studying a new phase of the problem of air washing, namely that of purifying air that had passed through an occupied room. As in the Boston experiments analyses were made of the air before and after washing, and of the water after different periods of service. Frequent tests were made under different conditions of operation.

When the exhaust air left the gymnasium, it had a noticeably sour and musty odor. After passing through the washer, this was almost completely removed and the returned air was fresh and sweet. At the same time the "gymnasium odor" was acquired by the washer water and could be easily detected in the sample bottles. The washer water was also found to contain large numbers of bacteria and many epithelial scales derived from the skin of the men exercising on the floor. Dust, bacteria, moulds, nitrogen and iron were removed from the indoor air by the washer at Springfield to about the same extent as by the washers tested in Boston. The results indicated that under the conditions there existing the exhaust air could be washed and returned to the gymnasium with entire safety and comfort to the occupants of the room, and with no apparent sacrifice of wholesome properties.

40 TO 50 PER CENT FUEL SAVING

The advantage of washing and recirculating the air lies in the great saving of heat in cold weather. Mr. D. D. Kimball, who designed the ventilating plant at Springfield, estimated that when the outdoor temperature was 32° Fahrenheit, the saving in cost of operation effected by recirculating washed air was 40 per cent., while with an outdoor temperature of 0° Fahrenheit, the saving was 50 per cent. The use of less coal at Springfield, when the air was being recirculated instead of being drawn in from outdoors was plainly evident and was commented upon by the engineer in charge of the Springfield plant. In the summer, the washer may be operated as a cooling plant to keep down the temperature of the indoor air—or with the windows open it may be shut down to save expense.

Our study of the subject of air washing has led us to believe that it is one of the vital elements of ventilation in localities where it is difficult to obtain a supply of clean air, and that the recirculation of air thus washed is deserving of serious consideration from the standpoint of economy.

I do not think it is safe to recirculate all of the air in large buildings. There should be some fresh air from the outside mixed with it.

Now there is another phase of the question which is fully as interesting, if I am not wearying you, and that is the dehumidifying of the air. In this country we are face to face with totally different conditions of winter and summer. In the winter time the tendency is for the buildings to become too dry and in the summer time there may be too much moisture. Now in the winter season the air in buildings may be very bad, and while it may be too moist in summer, it is not so injurious to our health, but still in a great many cases it is desirable to get rid of it.

When the air is heated by the sun to a high temperature, say 90° or 95° F., it picks up moisture from any place it can find it, from lakes, rivers and pools of water on the streets, and under sun conditions on very humid days, the relative humidity will be as high as 90% or 95%.

Now, when this air enters the building at that temperature carrying all that moisture, and the temperature in the building is 75° or 80° F. what takes place? The air will become totally saturated, in fact a great amount of moisture will condense and settle on the cool walls and floor, the result is that the building will become very damp.

With a relative humidity of 90% and a temperature of 90° F. the dew point is 89° F. So when the air cools down to 89° F., it is carrying all the moisture it can carry. So, if that air is cooled down to 75° F., the air would be forced to give up five grains of water for every cubic foot of air in the building.

In a great many industrial plants, temperature and humidity conditions materially affect the output of stock, both in quality and quantity. Dehumidifying has been used to great advantage in lithographing plants; in color work it has been found that under temperature and moisture conditions, the paper which is being used shrinks and expands, the result is that the machines do not properly register.

Also in large buildings where there is a great amount of heat generated in manufacturing, the humidity becomes very high and rarefied. Now I may be considered to be making a very unorthodox statement when I say that passing air through a spray of water under certain conditions, that the air will be carrying less moisture after it has passed through the spray than it had before it entered it. The only difference is, to humidify air the water must be warm, and to dehumidify the air the water must be cold.

When you are troubled with high temperature and also a high humidity in a building, if we wanted to maintain a temperature of 70° F., what would we do to lower the humidity to 72%? First, we would have to lower the air entering the building to 61° F. The air then would be at the dew point. Now when that air is admitted to the room at 70° F., it would be at 72% relative humidity. The rest of the moisture would be given up in the action of cooling the air.

Now, I know that a great many of these statements I have made may seem to be far fetched; I would not say so. I know these conditions to exist in buildings, for they are problems I have had to tackle. I have a hydrometer which I will have to show you. It is a very fine instrument for testing the humidity in the air. You see these two thermometers, and this is a tube of water in the centre. Now these two show exactly the same temperature, a temperature of about 69 degrees. I just want to explain to you and illustrate the fact that where there is evaporation, there must be a corresponding loss of heat. I am going to prove right in this room, and why that is so. How does this instrument work? The water, as it leaves this bulb, is caused to flow on this silk wick which surrounds this bulb of the thermometer. When that bulb becomes moist, the dry air attacks the moisture; the consequence is, the temperature will come down. The slightest drop is registered; the dryer the air, the more rapidly it would attack the moisture around that bulb and cool it; the result is, the mercury drops. Now, if you have watched this thermometer, you will see that it has already come down two degrees, and there is no doubt that inside a few minutes, it will come down ten. That shows the way that dry air will attack moisture; that is the proof that dry air attacks that bulb and lowers it ten degrees. What will it do to your body. It is plain; the moisture will be taken from your body with an increasing loss of heat. You might say there are very few buildings ventilated as badly as that. I say there are. If you will walk with me about fifteen minutes, I will take you to a building where the air is taken in through the floor and is exhausted at the ceiling. This carbon dioxide is the gas that they are trying to get out of the room. As I have explained, it is heavier than air and is consequently nearest the floor, but by the present methods of ventilation, they are trying to take it out at the ceiling. What reason do they give for doing this? Simply this: that in the action of respiration, you give off moisture, and when you ventilate a room in this way, it carries out a great amount of moisture, and consequently a great amount of carbon dioxide with it, the moisture making the carbon dioxide light, and carrys it to the top of the room. I say the theory is not sound. I will tell you why. If the relative humidity in a building is 3%, and the air you have exhaled is at the point of saturation and containing about 5% of carbon dioxide, the dry air in that building will attack that moisture so rapidly that the carbon dioxide will fall to the lower part of the room. That gas is about three times heavier than air and is bound to fall to the floor; there is nothing to stop it; that moisture will not stay with it; see how quickly it has picked it up here (looking at the thermometer) some ten degrees in that short time. Now that ten degrees will increase. There is a humidity in this room at the present time of about 40%; that is with the temperature at about 40° or 45° at the present time outside. What will it be in cold weather?

There is one article here I intended to read. It is just a small paragraph.

ARTICLE BY DR. C. HARRINGTON

Dr. C. Harrington, in his *Manual of Practical Hygiene for Physicians*, states when out-door air is heated so as to maintain an even temperature of 70° F., but with no addition of water vapor, its capacity for absorbing moisture is very much increased. It will take it up from the skin, the mucous membrane of the mouth, nose and respiratory tracts; from furniture made from wood which in the process of kiln-drying was never brought to such dryness; and from plants which in consequence will wither and die.

Add to this the fact pointed out by Professor Wilson, of Milwaukee, in a paper on Atmospheric Moisture and Artificial Heating. He says:—"It has been repeatedly demonstrated that an indoor temperature of 65° is more balmy and agreeable than much higher temperature, provided there is sufficient humidity, that it should be a cardinal rule that if a room at 68° F. is not warm enough for any healthy person, it is because the relative humidity is too low. Every time we step out of our houses, during the winter season, we pass from an atmosphere with a relative humidity of 30% into one with a relative humidity of, on an average, 70%. Such a sharp violent contrast must be productive of harm, particularly to the delicate mucous membranes of the upper air passages.

The remedy is, to maintain the indoor humidity at the proper point, between 60 and 70%.

Now, gentlemen, if this is the case, it is pretty near time we tried to rectify matters. Prevention is always better than cure. I think a few words in time may save us a great deal of trouble. Apparently nobody ever learns anything except in case of disaster, which he does not have a pressing desire to know at the time of the acquisition. Now, do not let us wait until disaster is added. It is up to those who are responsible for proper sanitary conditions to look into this matter thoroughly and have these conditions, as I have repeatedly said, rectified.

Chairman,—

Mr. Butler has read us a most interesting paper in explanation of the proper methods of ventilation, and I am sure he will answer anything you may desire to ask; he will answer any questions you put to him along the line of his paper. I know myself that Mr. Butler has been very busily engaged for several years right along the line in which he is making his discoveries and has found out all that it is possible to find out in his business in the time, and if there is any member present who would like to get further light, Mr. Butler will enlighten him.

Mr. F. G. Smith,—

Mr. Chairman,—Mr. Butler has stated that it is necessary to put humidity into the air. If that is so, how does Mr. Butler explain the fact that in summer when the temperature is high and when there is plenty of humidity it is very depressing to all.

Mr. Butler,—

Well, it is due to the fact that the hot weather of summer, as I have explained to you, carries such a great amount of moisture, and that is due to the high temperature. But while it may feel uncomfortable, it is obvious it will not do you the harm that hot dry air will do. That is about the only explanation I can see for it. There is one thing quite certain, that in the summer time we feel quite comfortable in a temperature of say 65 degrees when there is a high humidity; while in the winter time at a temperature of 70 degrees with a low relative humidity we feel chilly.

Mr. G. D. Bly,—

I think, Mr. President, that the paper we have listened to has proved very interesting to all, and that when we have the report of to-night's meeting and are able to spend more time on it, we will find out a great deal more of interest in it than we can get from just hearing it read the first time. It seems to me that with the amount of figures in the paper, you cannot grasp it all in one evening. It is certainly one of the subjects that we are all interested in, and we should give a great deal more thought to it than has been given in the past. In coming to the question that was just asked, I think that the reason for the discomfort we feel during the days when the atmosphere is over-humidified, as it were, is due to the fact that the humidity surrounds our bodies in a blanket of vapour, and that vapor does not let the heat get away from the body. That is one reason why on a day when the air is so charged with humidity we feel it so depressing.

Speaking of air washers, I know a building here in the city where the air is taken in through the sidewalk for ventilation. The concrete sidewalk was cut out; there was a transom glass in it which was also taken out, and the ventilating pipe taken through the sidewalk, and the air taken from there to the air washer, and any time you might go down to see the air washer, you would think it was a mud hole due to the great amount of dust and other material that the air had taken off the street and the washer had taken from the air. I do not think there is any more that I can say. but I may repeat that the paper was to me exceedingly interesting.

Mr. Butler,—

When that question was asked, I did not fully answer it. I did not grasp the question—I am like the Scotchman who does not see a joke till the next week. Now, in the action of respiration, we are giving off moisture, and it is necessary that that moisture should be taken off. If you breathe in the air at the temperature of the body, which is already totally saturated, it is not able to carry off the moisture which should be carried off the body; that is why you feel that oppressive sensation in hot weather; it is owing to that fact, and that is the most reasonable theory I can see for it.

Mr. H. H. Wilson,—

Mr. Chairman,—I would like to ask Mr. Butler if 50% of humidity is the standard or best condition for the human body. If we must throw off this moisture from the body due to respiration, would 50% of humidity be low enough, or could we go even higher and have, say, 75% of humidity; and still throw off the moisture produced by the body? I understand that if we cannot throw off the moisture generated in the body, it is because the humidity is too high. What I want to know is this: how high a percentage of humidity can we have in the air and be able to throw it off the body also.

Mr. Butler,—

Well, I cannot answer that question fully. In any work that I have read along this line, so far, the writer has not been bold enough to lay down a standard. Scientists and physicians have not yet decided just what is the proper degree of relative humidity for our bodily comfort, but there is one thing certain that it should be kept as near the outside conditions of the air as possible. 50%, if anything, is low enough. It would be better if it were kept at, say, 60 or 65%, but I avoid taking such extremes because it looks bad enough to take it up at 50%. There is another thing and that is: what about all this talk of dry air in the West? Well, there is a big difference between cold dry air and warm dry air. A great many authorities say that the air that is breathed in through the nostrils is heated in the nose and throat; others say it is not so, that it is heated in the lungs and not in the nose, and the writer suggested a reason why he did not think that the air was heated in the nose and throat; he gave this reason why we did not feel the cold air in the lungs probably the absence of nerves there which would be affected by the cold air; well, I cannot say, I don't know, although it looks to me very possible. You take warm dry air, as soon as it enters the nose or nostrils it has a capacity for taking up moisture; therefore, it takes it up from the wrong place; it takes it up from the nose and throat instead of taking it up from the lungs. Now, if you breath in the cold air and it passes down to the lungs with a certain degree of coolness and picks up the moisture from the right place, the place where it is suppose to pick it up. That looks to me to be a very possible answer to the question.

Mr. G. D. Bly,—

Mr. Chairman,—Why is it that we hear so much about the air from a hot air furnace is such dry air, and from another person that they would rather have hot water heating, and from another that they would not have anything but steam; what accounts for the ideas that they have of the different methods of heating and others again have said that they considered steam heat dryer than anything else. Perhaps, Mr. Butler, you can explain some of these things. On the one hand, the water from hot water or steam pipes does not come through the pipes, and the air from a hot air furnace is only dry when there is no water in the pan.

Mr. Butler,—

Personally I do not thinks that that needs any explanation. In the case of the hot water and steam heating, as you have said, the water is on the inside of the pipe, and not on the outside. But in the case of a hot air furnace, I believe you can get better conditions if you keep the furnace pan filled with water for evaporation you will get better results from a health point of view than you ever will get from either hot water or steam. Of course the water pan must be kept full; but I feel quite sure you cannot evaporate enough water in this way to humidify the air in a house, let alone a large building.

Mr. Bly,—

I think, perhaps, as you say, they do not put water in the pan sufficiently regularly to be of service. In a good many places, they put it in the fall and do not put any more in until the following fall. That is the reason why the air in the room becomes dry. I find in our house in the winter time the women say: the gas is killing the plants. I have always thought it is because there is not dampness enough in the atmosphere. The only time the plants are properly watered is in the summer time. In the winter time, when the plants are watered, the water is taken out of them right away and the plants do not do well at all. You can notice when there is no moisture in a house. Suppose the kettle is not boiling as usual, you at once suffer from the atmosphere drying out. If we allow the carbon dioxide to pass out to the lower part of the house during the night, we would be better off than we are by simply letting in a lot of cold air during the night.

Take our street cars under the new rules of the Medical Health Department. Last winter you could go into a street car with all the ventilators open, and you would be fairly warm; after you had been sitting there for five minutes, you would look around and wonder where the chill was coming from. Now, if these conditions are not fully impressed already on the authorities of the city of Toronto, I think it is high time somebody called their attention to them. You will not find any warmth in the street cars with the fan drawing against the car and blowing a breeze of zero dry air down on the people. Is it any wonder we have so much consumption in the city and surroundings?

Mr. H. H. Wilson,—

Speaking of the system in the street cars, I may say they have adopted another plan. I do not know whether the Medical Health Department is responsible for it or not. They have commenced to open this little fan or ventilator just back of the smoke flue, so that when the car is in motion, the air comes in the usual way, but passes over this smoke flue first. We may not get enough humidity in the car, but we get the coal gas anyway.

Speaking about humidified air from a hot air furnace, if I get a water pan of a suitable size and just remove one of the hot air pipes and place the pan of water down on top of the combustion chamber or radiator, somewhere where it is sufficiently hot to cause the water to evaporate. In this way we might get enough humidity in the house to even satisfy plant life.

Now, I was going to ask Mr. Butler how, in buildings where they humidify the air, do they do it? Is it done by evaporation —that is by heating the water? or do you atomize it? How do you do it?

Mr. Butler,—

Well, you know the offensive odor that is given off from a boiler. If you would like me to explain the most up-to-date methods of humidifying the air, I will be only too glad to do so, but I am afraid you are all getting tired of listening to all this talk about humidity. You will begin to think I am like the Baptist oxen. A man one day was driving down the street with three oxen, and they seemed to give him a lot of trouble. Swinging his long whip from side to side, and shouting at the top of his voice:—"Get up, there, Presbyterian!" and he hit the Presbyterian a crack with the whip. "Steady, there, Methodist!" The next thing shouted was, "Gee, there, Baptist." A spectator listened three or four times to make sure of what he heard; he then approached the driver and said: "Why do you call one a Presbyterian, the other a Methodist, and the other a Baptist?" "Well," said the driver, "I call that one a Presbyterian because I cannot get him along; and the Methodist, well, I cannot keep that fellow back. And the Baptist? Why, if there is a drop of water around, I cannot keep that fellow out of it."

Now, I am talking about water. There is a great deal of difference between water and humidity. We call it steam when it is at a high temperature; it is the same at a low temperature. If your room is 60 or 65°, the vapor in the air is still at that temperature. Now, in order to get humidity in a building, it is necessary to raise the air to a dew point temperature, and you can humidify the air by the most up-to-date process, that is: by drawing the air through the tempering coils; these coils are thermostatically controlled to give the air a given temperature; it is then passed through the air washers. Now, in the type of air washer I am going to speak about steam injected into the water to heat it. There is another thermostat after it passes through the air washer, and when it reaches the fan it is carrying all the moisture it can carry, or what is known as a dew point temperature. If you want a humidity of 50% in your building this is set at 50 and it gives you what is called dew point temperature; that is to say, that the air going through these tempering coils is raised to 50, and after passing through the water spray, it is then carrying all the water it can possibly carry; it is totally saturated and leaves the air washer at the dew point, or a saturation of 100%. Now, what takes place when that air is heated up to 68°; the temperature of the room, the relative humidity, drops; then you have a humidity of 50%. If you want a higher humidity, you must set the thermostat in order to raise that temperature. The air leaving the air washer will then be at a higher dew point temperature. There are other methods of regulating humidity, but many of them are too slow.

Mr. Callanan,—

The main point, apparently, is in adding humidity to the air, but from the discussion I would suppose the humidity to be already in the air.

Mr. Butler,—

I do not understand the point of the speaker, but the idea is that the humidity is not in the air when it comes in; that is the point which I wish to be understood. (Illustrating on thermometer.) I illustrate it there; air at zero, when it is totally saturated or at dew point, it is only capable of carrying one half grain of water. Now, if that air was at 50% saturation, it would only carry one quarter of a grain. You heat that air up to 68°, you then have a relative humidity in the building of 3½%.

Mr. Callanan,—

Will the air carry more humidity?

Mr. Butler,—

Yes, if you can find it. I understand that in the deserts of Northern Africa, the Sahara desert, where the humidity is between 20 and 25%, plant life refuses to exist; and if that is the case, how are we to exist in buildings with a relative humidity of, say, 3½%.

Mr. H. H. Wilson,—

When you speak of a cubic foot of air at zero temperature and then refer again to the percentage of humidity per cubic foot in the room, is this cubic foot after the air was found in the room, or the same volume of air at zero. Knowing that a cubic foot of air at zero occupies less space than if the same cubic foot of air was at 70 degrees, at the same pressure? Would this difference in volume account for the difference in humidity?

Mr. Butler,—

Well, that would not have any appreciable effect on the volume; but it would have a tendency to make the relative humidity still lower. Now, there is another thing that should be fully understood. I am speaking now of buildings that have been ventilated according to the standard laid down of late years as being correct, that is: circulating air every twenty minutes, a far different state of things will exist in a building which is not ventilated at all. It is worth while studying. Take for instance a church; take any large church in this city that is ventilated by opening the windows; what takes place on going into that church with a probable temperature of, say, 60°? It has probably a relative humidity of 25 or 30% when you first enter, but after you have been in there an hour, you find the temperature has probably gone up 7 or 8 degrees; if you test the humidity you will find that the relative humidity has also gone up probably 4 or 5%. Where did that humidity come from? It came from the bodies of the individuals comprising the audience. Now, it is suggested that it is not the carbon dioxide that is the dangerous element in the air—that is what I gather on following up my investigations—it is not the carbon dioxide, they say, but the organic matter which is thrown off the body and the dryer the air the greater the faculty it has got for picking up that moisture. Therefore, you see from this that it is absolutely necessary to keep the humidity at a high percentage in order that it won't absorb too much moisture and organic matter from the body. Fancy going into a building with 700 people gathered and sitting there for an hour—and you know a great many people do not take over great care of themselves—fancy the amount of moisture that is exuded from those 700 bodies and coming out through all that organic matter. Again, fancy in our street cars; there is about enough air in one of these street cars, when it is closed up tight, to supply about a dozen people for about ten minutes; after that you are breathing over and over again the air that others in the car have already breathed over a dozen times before you get to the end of your journey. I prefer myself to stand on the back platform of a street car in winter, even when the weather is at zero, and I feel the better for it. It is all these conditions that we will have to work together to remedy. But we must study and keep right after the subject, and you will notice those things for yourself.

Chairman,—

I think Mr. Butler has given the members a good excuse for staying home from church.

Mr. F. W. Slade,—

I would like to ask Mr. Butler if air having been washed in air washer, and thereby cleansed of all germs, etc., what is done with the water which must be full of germs and dust; is anything done to kill these germs before letting the water away down the drains, as these drains, etc., have manholes, etc., into the streets, and these same germs might escape again into the air or else continue with the water and contaminate our water supply.

Mr. Butler,—

It is a known fact that air will not take up germs from water and therefore air can be passed through the same water over and over and be cleansed, but when the water gets too dirty, they simply let in a fresh supply.

Mr. A. R. Taylor,—

Mr. Chairman,—I think, at the rate we are now discussing, that this question is going to take all night. I must say I have thought quite a bit about this humidity, and I quite agree with the gentleman that is here, that we are up against a stiff proposition, because every day there is a different theory. We had some questions brought up, and I wrote the Observatory of Toronto and the United States Observatory at Washington, and they could not answer me. They took the temperature of the atmosphere first at a high humidity and then with a low humidity. If you take the temperature of 32° and the humidity point at 74% it is comfortable; if you take a temperature at 40° and the humidity at 56%, then it is also comfortable. But mark you this, there is more humidity at a temperature of 40° and a humidity point of 56% than there is with a temperature of 32° and humidity of 74%. The higher the temperature, the lower the percentage the air will carry. Now, the air does not absorb moisture. The temperature of the room is somewhere round 70°, and a drop in the hydrometer is now 10 degrees. Well, that would give a humidity point of 76%; a drop of 10 degrees is nearly about right.

Mr. Butler,—

Take the room at 70, and that would give you a relative humidity of 55.

Mr. Taylor,—

That is too high.

Mr. Butler,—

No, that is not too high.

Mr. Taylor,—

Let more air circulate over the bulb.

Mr. Butler,—

No, I do not think so. In fact, that is too low a relative humidity if any for a temperature of 64° or 65° F. The temperature in this room at the present time is 68°; the wet bulb (looking at the thermometer and hydrometer) is at 54°; the difference is 14 points. Now, that is what we call depression. We will see what the humidity is in this room at the present time. That will be 14, the relative humidity is 40%.

Mr. Taylor,—

That is not dew point?

Mr. Butler,—

Oh, no; that is 40% relative humidity in this atmosphere, and the dew point would be 45.

Mr. Taylor,—

One question I would like to ask is if the humidity catches the air that has moisture in it. Take it up above here, the air is much dryer. Now, you were speaking of carbon dioxide absorbing that moisture. Carbon dioxide is 1½ times heavier than air, so how is it that it absorbs the moisture?

Mr. Butler,—

I am not aware of the fact that I made that statement. I perhaps did not catch the question rightly.

Mr. Taylor,—

The air absorbed the carbon dioxide, I understood, and that where they ventilate from the roof of a building, they take it for granted that the moisture in the air made it light and caused it to rise to the top, and at the same time carried out the carbon dioxide with it. But in a room with an extremely low humidity that the air will drag the moisture out of that so quickly that the carbon dioxide will set at the bottom.

Mr. Butler,—

Oh, now, I see what you mean. The carbon dioxide will hold the moisture in suspense; but the moisture would leave it as soon as it came in contact with the dry air. Carbon dioxide being 3½ times heavier than pure air, the air charged with carbon dioxide would fall to the bottom. I made notes of that but unfortunately have not got them with me. The point is that carbon dioxide is three and a half times heavier than air, and the question is that being the case, how can it rise to the upperpart of the room, but I never said it sets at the bottom. You do not understand me. Now, to make it clear, I say: in one class of ventilating, they take the foul air out at the top instead of out at the bottom. They claim that in the action of respiration you throw off a great amount of moisture which makes it much lighter and it goes to the top and carries the carbon dioxide with it. I say it is not so. That may be all right if you had a high relative humidity, but the dry air would take up that moisture and the consequence would be that it would become heavier and fall to the floor. If I had my notes, I could give you the exact difference in weight of these gases taking an atom of hydrogen at one. I thing oxygen would be 7, nitrogen at 5, carbon dioxide, I think, would be 19. You see how much heavier carbon dioxide is than air. That being established, how can people expect to take it out from the ceiling. The most up-to-date way is to bring in the hot air in at the top and take the foul air out from the bottom. If you take the fresh air in at the top and the bad air out at the bottom you are all the time getting pure air down to the breathing line, whereas when you reverse these proceedings, you are all the time pumping foul air from the bottom to the breathing line. Moreover, see the enormous loss of heat when you are exhausting the air from the upper part of the room—we all know that the hot air rises to the top—whereas when you exhaust the air from the floor, the warm air is coming down to the place where it is required. Heating buildings in this way is like throwing money into the lake.

The best practice is to bring the warm fresh air in about half way up the walls.

In the hot weather it is wise to exhaust a portion of the air from the ceiling; in so doing you get rid of a lot of the heat which you do not require, and at the same time you will lower the humidity.

Mr. H. H. Wilson,—

Mr. Chairman,—The speaker has referred to the public buildings, and schools in particular. I might say that during the last year they have adopted a plan in some schools of taking the foul air out at the bottom; that is they are discharging from the floor level and bringing in their heated fresh air at the top of the room; not exactly at the ceiling, but anywhere from 10, 12 to 14 feet above the floor; they have been doing this for more than a year now.

Mr. G. C. Mooring,—

Mr. Chairman,—If I am in order, may I move a hearty vote of thanks to Mr. Butler for the very interesting and instructive address he has given us to-night. There was one point brought out upon which I might say a word or two. Professor Johnson of Philadelphia gave an address on the same subject some short time ago. Professor Johnson, I might say, was a millionaire at that time, and he made his money on the humidostat and thermostat. He told us simply, if I understood him, that he made the humidostat from a piece of wood,—I think it was oak. He had it graded so that on a damp rainy day, it would stand at zero to 100; or anywhere where there were a lotof people assembled, this humidostat should be at 50. He said that in one large building, he evaporated seven tons of water in eight hours in order to bring the humidity of the atmosphere in that large building down to 50. That is pretty expensive ventilating. However, that is, as I understand it, what would be considered right comparison for the dampness and temperature on a rainy day; it would be right for the human body. Professor Johnson claims that bad ventilation is the cause in our homes of this continent of nearly all the deaths from consumption. I notice in the papers to-day, it is still seven per 1,000 in Canada, and something could be done to cut down these figures if this ventilating is carried out properly. Badly ventilated buildings have a great deal to do with the propagation of this dread disease, there can be no doubt of that, and he said he had been studying the causes of consumption with the hope of being able to do something to prevent it. It is this dry air that causes tickling in the throat, and as it gets worse produces a hacking cough, and that causes consumption in time and that is why he took up the matter. He made good. That is the reason I have called your attention to this matter; it confirms the statement that the humidity of the atmosphere should be about 50 on the Johnson humidostat. I have much pleasure, Mr. Chairman, in moving a vote of thanks to Mr. Butler for his address to us this evening.

Moved by Mr. G. C. Mooring, seconded by Mr. Baldwin: That this meeting tender a hearty vote of thanks to Mr. Butler for his address to the Club this evening.

Chairman,—

Gentlemen, you have heard the motion; what is your pleasure? Carried.—(Loud applause.)

Mr. Butler,—

Mr. Chairman,—It has been a great pleasure to come here to-night to tell what little I know on the subject of ventilation. If I can do anything along the line of improvement, I am going to do it. I believe myself that a great deal of consumption, and a great many other diseases are caused through that very trouble. I believe when we find out how to ventilate our buildings rightly and get them all down to a standard, we will get rid of a lot of these troubles. I thank you, Mr. Chairman and gentlemen, for your reception.

Chairman,—

Just before we adjourn, gentlemen, let me say that I hope at the next meeting we will have a good turn out.

On the motion of Mr. Mooring, the meeting adjourned at 10.45 p.m.