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OF CANADA

OFFICIAL PROCEEDINGS

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PROCEEDINGS OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING.

PRINCE GEORGE HOTEL, TORONTO, *May 25th*, 1911

The President, Mr. Baldwin, occupied the chair.

Chairman,—

We have had to keep you waiting to-night, but through no fault of our own, it is owing to the management of the hotel being unable to give us a room until this late hour.

The first order of business is the reading of minutes of the previous meeting. As every member has had a copy of the proceedings of the last meeting it will be in order for someone to move that they be adopted as read.

Moved by Mr. Jefferis, seconded by Mr. Taylor, that the Minutes of the previous meeting be adopted as read. Carried.

The second order of business is the remarks of the President, which will be cut very short owing to the lateness in starting, and I will confine them principally to the fact that this is the last meeting we will have before the holidays. I would like the members not to forget that we have a Club, during the holidays, and to bring in more members.

It has been decided to hold the picnic at Beaverton on Saturday, June 17th, when we expect to have a larger crowd than ever. Committees have been appointed to take charge of the arrangements, and I am sure everyone will be well satisfied. I have a copy of the programme, and there are a number of races, which are too numerous for me to read over to you to-night. Everyone will be supplied with a programme, and it will be carried along on the same lines as last year.

The next order of business is the announcement of new members.

NEW MEMBERS.

Mr. C. McNair, Engineer, G. T. Ry., Sarnia Tunnel.

Mr. W. J. Sanderson, Proprietor, Ontario Soap and Oil Co., Toronto.

MEMBERS PRESENT.

G. P. Beswick	W. Kemp	E. E. Cummings
W. Woodley	J. R. Hutcheson	W. A. Grocock
H. Pedelty	J. Nicholson	J. P. Law
T. B. Cole	J. Adam	A. M. Wickens
A. Taylor	J. Reid	C. G. Herring
G. A. Young	T. McKenzie	F. Hardisty

J. Barker
C. G. Keith
J. Powell
J. M. Clements
D. Cairns
G. H. Boyd
E. Logan
A. E. Till
W. J. Jones
G. Baldwin
C. L. Worth
J. Kelley
T. E. Greenshields
W. McGrath
H. Ellis
J. A. Chenowith
J. Herriot
C. A. Jefferis
J. W. McLintock
G. Black
J. C. Grant
R. M. Carmichael
R. H. Brown
W. Schadel
T. J. Ward
J. H. Hollingworth
A. W. Carmichael
G. D. Bly
W. C. Sealy
W. Evans
L. S. Hyde

Chairman,—

It is a very small list this time, and I shall be very pleased if some of you will get busy and bring in some new members, that is what the Club wants to carry it along successfully. We want to get new blood into the Club, as there are quite a number of the members who come in, from time to time, leave the city or drop out, still we have got a fairly good membership, but that is no reason why we should not increase it.

I will ask for the report of the Standing Committee?

Mr. Carmichael,—

We have arranged everything in the games line and got out the programme, which has been handed to the Secretary ready to be printed.

We have been up to Beaverton and staked out the ground and baseball diamond, and the ground is in excellent shape, in fact there is no ground in the city of Toronto any better, and it has been rolled perfectly level.

As Mr. Bannon is not here, I may say that you can rest assured that everything will be arranged.

Mr. Fletcher, I believe, has got the band pretty well in hand, and he said everything will be all right.

The Prize Committee I do not know anything about. I met Mr. Morrison, and he said they were getting along well, and that there would be lots of prizes.

Chairman,—

That is a very satisfactory report. What is your pleasure concerning it, gentlemen?

Moved by Mr. Beswick, seconded by Mr. Wickens, that the report of the Standing Committees be adopted. Carried.

Chairman,—

We were rather afraid that the ground would not be satis-

factory, consequently, we asked Mr. Carmichael and Mr. Wickens to go up and see for themselves. I had previously spoken to Mr. Veal over the 'phone, but I wished to make doubly sure, and you have the report of Mr. Carmichael that the grounds are in excellent shape, and I do not think that there will be any of the faults to find this year that we found last.

The next order of business is the discussion of paper read at the previous meeting. As Mr. Black is not with us to-night, if there are any questions that you wish to ask, they will be noted and forwarded to Mr. Black.

The next order of business is the reading of papers or reports and the discussion thereof.

We have with us to-night Mr. J. C. Grant, who is a very active member of the Club, and is going to read to us a paper on a very interesting subject, "Modern Ventilation." I have read the paper very carefully, and I am satisfied that you will be more than repaid for coming down to-night.

However, for the benefit of those who do not know Mr. Grant, I will now introduce him.

Mr. Grant,—

I might say that it is not my purpose to attempt to deal with this subject in a technical manner. There are so many different theories about the composition of air that I should be almost afraid to go into it with any of the members here. You will see by the paper that I have written that I have tried to deal with this subject in a simple manner. My object has been to try and show you how to get air into a building, and get it out again, which is the chief idea in ventilation.

There is an item in the *Engineering Review* of the April number which I would like to refer to a little later on. I do not know if any of you take this paper, but if any of you get a copy of it, you will find the article I refer to on page 48, it is an article by Ralph B. Small.

I might say that I read this article after I had prepared my own paper, and I think it bears out pretty well what I had in mind when I prepared my paper.

Mr. Small says:—

"Visit any city in the United States, and interview, one at a time, the leading physician, the principal health officer, the head of the school board, the ranking architect, the best ventilating engineer, the factory inspector, and ask them what measures should be carried out in order to secure the best air conditions in any designated space—and you will find that a wide diversity of opinion exists among them.

Simply as a student of the physics and chemistry of air, with a sincere attempt to discover what has been scientifically proven and accepted, it would be putting it mildly to state that there is more misinformation about air than any other one subject, written or talked about. Those who are interested in providing not only good air, but the best possible air to breathe and live in, must recognize that many of the old ideas have been proven myths, many old standards are being shattered, and that real knowledge on every phase and factor of air is now being demanded.

The man who calls himself a ventilating expert should be abreast of modern thought on the *five factors that govern good air*—humidity, temperature, purity, motion, vitality. It is not a matter of wonderment that he is wrong, since there is such an appalling lack of agreement, and since many architects and physicians continue to make statements and write rubbish that were disproved five years ago; but it is an inexcusable business and ethical mistake if he allows himself to stay wrong.

Study what has been written in German, French and English on this subject for the last ten years, and you will agree that it is time to accept no one as an authority—take no one's opinion as of infallible value—and flatly refuse to recognize anything but facts, proofs. If you are of an open mind, you will find some astonishing things have been demonstrated recently, and that the practice of air-conditioning will have to be reconstructed in many of its essentials.

The following suggestion is offered with the hope that its importance will be admitted. Let the United States Government conduct a series of investigations, and by tests establish a basis for securing the best air conditions indoors, and if necessary employ a squad of men (not rabbits or mice or guinea pigs that are not particular about air), and give us definite facts about this subject in the same way that it gave us new facts and disproved old notions about food values. On behalf of the public that is entitled to accurate knowledge of the food it is feeding its lungs every waking and sleeping moment of life, the Government is earnestly requested to lead in this investigation.

According to the Committee of One Hundred on National Health, our Department of Agriculture is intensely interested in means to prevent diseases among bees, and thereby possibly save $1,000,000 to the bee industry of the United States, while the estimated annual loss of earnings to the human workers on account of preventable sickness is three billions. The discrepancy between the relative importance of the two subjects affords a rather unsatisfactory index of the judgment sometimes displayed by our national statesmen. While we are conserving trees and bees—isn't there a little time that some kind-hearted

statesman might possibly devote to conserving men, women and children?

Some people still believe that carbonic acid gas is poisonous when it passes 15 parts to 10,000 by volume. Certain German breweries contained 150 to 250 parts of CO_2 in 10,000 and the men worked in it continuously for years without any ill effects. Modern science proves this a myth, that Co_2 is not poisonous, but simply the index of existing impurities. Some physiologists assert that until the CO_2 reaches 400 parts in 10,000 the respiratory exchange will not be seriously interfered with—that after all the only menace connected with CO_2 is its replacement of oxygen, and that is inconsiderable in even the worst recorded cases, and never reaches the above figure.

Some of the leading German bacteriologists tell us that if the air is kept in motion you can disregard its chemical pollution; and the organic impurities constitute the feeding ground not only of the harmless bacterial flora, but of the pathogenic germs as well.

Sir Frederick Treves, the leading physician of London, states that drafts are good for one. On the other hand it has been proven that when the skin surface is moist a small column of air directed upon the middle of the back, in the nape of the neck or the soles of the feet will invariably produce colds. One physicist claims that radioactive matter and magnetic properties are the essential things which give air its refreshing and vitalizing effect. Another claims there is no such thing.

Text-book writers prove to their own satisfaction that if the oxygen content is reduced to below 18 per cent it is fatal. Later experiments prove that it is possible to allow this to fall even to 15 per cent, without any harm, and so it goes.

Ventilation is cursed with too many professional text-book writers, who are merely editors of preceding editors.

No extensive investigation has been made by the United States Government on the subject of air for sixteen years, when Drs. Mitchell, Bergey and Billings made some exhaustive researches, and reached some definite conclusions, some of which have since been seriously questioned.

It would seem that it were time to have another investigation. Place the selection of an investigating commission in the hands of such men as Flexner of the Rockefeller Institute of New York City; the President of the Institute of Technology of Boston, and the head of some third technical institution. Let the commission consist of three chemists, three physicians, three architects, three physicists and three ventilating engineers. Compel them to bring in a verdict in which at least two-thirds concur. If the statistics are true which say that every year in the United States tuberculosis kills more people than were destroyed in the four years of our Civil War, should not one of our

national departments provide us with proven facts that will tend to diminish the preventable "bad air" diseases? Would it not be a good investment for any government to make for its people?

PREMISES.

Let us begin the consideration of this subject with some simple premises that both science and common sense will subscribe to, and then ascertain how the results of the most recent investigations and experiments will apply to them:

First—Atmospheric air contains a little less than 21 per cent. in oxygen. The balance is nitrogen, whose probable function is to dilute the oxygen; and traces of other gases, such as argon, helium, carbonic acid gas, xenon, ozone, hydrogen, etc.

Second.—Oxygen, when introduced into the system, is taken up by the blood, is carried to all parts of the body, where it burns up waste matter and produces heat. It also builds new tissue matter. In the respiratory exchange the results of the above combustion are given back to the lungs as carbonic acid gas, which is discharged by the exhaled breath.

Third—The human body is constantly generating heat which must necessarily be gotten rid of. This is done by evaporation, conduction and radiation. The heat generated by a man in active life in one hour's time would raise 6,600 pounds of water one degree centigrade. At this rate he would reach the boiling point in about one and one-half days.

Fourth.—While the body is building up new tissue matter, at the same time it is voiding its waste products into the air through the skin, throat, nose and mouth.

Fifth.—When air has a temperature above what has been called the critical temperature, viz.: 77 degrees Fahrenheit, it produces discomfort to the majority of people.

Sixth.—At an average indoor temperature of 72 during the winter when the relative humidity is higher than 75 or lower than 20, most people report discomfort.

THE VALUE OF AIR IN MOTION.

The German investigators have a prodigious amount of perseverance, system, thoroughness and orderliness in their investigations. Let us see what is the attitude of the modern German school upon this subject:

Pflugge, an eminent bacteriologist of the University of Breslau, and those who have largely concurred with him, Paul, Erklentz, Heymann, Reichmann and others, conducted an elaborate series of tests through a number of years, and offer some astonishing results.

They enclosed at different times a number of people, healthy, sick, clean and unclean, young and old, in air-tight glass

cabinets, with a capacity of about 3 cubic meters, and let one or more of them remain inside of the cabinet under differing conditions as to temperature, relative humidity, CO_2 content, with the air first at rest and then in motion.

With a mean temperature of 55 and a mean relative humidity of 66 and a mean CO of 115 in 10,000, after three hours and five minutes there was no discomfort or functional derangement of any character. With a temperature of 80 and moderate humidity and a temperature of 70 with high humidity, all exhibited distress and depression.

There was a large number of varying tests made, involving many changes in humidity, temperature and CO_2 content that proved that when high temperature and high humidity were reduced physical discomfort disappeared.

But the important discovery related to the checking of heat radiation from the body of the test person. The air was kept at rest within the cabinet, and the walls of the same and the air outside were warmed so that they could take up no further heat. When this occurred there immediately appeared signs of dizziness, increased respiration and bodily temperature, headache and nausea. An electric fan was then started in the cabinet, and all the above indications were immediately dissipated. Let us see what happened.

Our body consumes oxygen. The process produces heat. The heat is discharged, largely by radiation from the body surface and evaporation of water from the skin pores. When the air is still, there is a film or layer of it immediately surrounding the body. This becomes saturated with the heat and moisture of the body. It acts as a blanket and checks further heat radiation. Now, if motion is given to the air, this envelope of stagnating heat and moisture is disengaged and the body is allowed to radiate more heat.

Other experiments of a more dramatic nature were carried out. An arrangement was made whereby the test person breathed fresh air outside the cabinet while his body was wholly within. The inhalation of fresh air brought no relief until the inside air was set in motion. Still another experiment was tried. When the air with a CO_2 content of over 130 inside the cabinet was breathed through a tube by the test person standing outside of the cabinet in normal, healthy, moving air, no ill effects or unfavorable indications were registered.

Erklentz included among his subjects some school children who were effected with scrofula and anæmia, also several adults of different sexes with heart trouble, nephritis, kidney trouble, bronchitis and other diseases. When the CO_2 content reached 150 there were no bad results at a temperature under 70 and with a relative humidity of not over 50; but when the temperature was advanced to near 80 and the relative humidity

raised, the distress symptoms immediately occurred. These, however, vanished when the air was set in motion by the fan and the heat envelope was freed from its moorings around the body. Very delicate recording instruments were kept which showed variations of most of the bodily functions, and, in addition, mental tests were made to show alertness or sluggishness. The occupants of the cabinets did not themselves know what particular changes were made either in temperature, humidity or any of the other factors.

A new school has been founded on these experiments. The scientific world has largely accepted their findings as far as establishing the fact that a large increase of CO_2 even to 100 parts in 10,000 is not only in itself non-poisonous but does not cause harm, and, second, that movement of air is absolutely necessary to rid the body of the air envelope that checks its heat radiation and, third, that when discomfort appears it can often be relieved by reduction of temperature and relative humidity. With an air movement of only 0.4 to 1.3 centimeters per second, heat radiation from the body was increased 12 per cent. over conditions when the air was at rest.

Professors Benedict and Milner conducted somewhat similar experiments at the Wesleyan University recently, and while doubting the toxicity of expired air, nevertheless recommend the germicidal properties of atmospheric air as of the utmost importance in conserving health.

The question of air in motion was not raised in their experiments, and their tests conclusively showed that one can get along with much less changes of air than is universally prescribed, that the amount of carbon dioxide can be practically disregarded, and that a maintenance of normal temperature and humidity would usually dispel any discomfiture induced by bad air conditions."

You will see that the drift of the paper is to get air into the building, and not suck it out.

MODERN VENTILATION.

J. C. GRANT, REPRESENTING B. F. STURTEVANT CO., TORONTO, ONT.

When some months ago our Secretary asked me to give a paper on Ventilation before this Club, I—with some hesitancy—agreed to do so with the understanding that it would be in the way of an informal talk rather than a technical treatment of the subject; in fact, I believe it would not be possible for me to give anything more than an informal talk, and as the time grew nearer for me to get up a paper, I felt the subject growing larger and my own inability to handle the same in a manner that would interest an audience composed of such members as the Central Railway and Engineering Club.

Modern ventilation is certainly a very up-to-date theme, and the necessity for ventilation seems to be increasing far beyond the ability of those who are interested in the line to take care of all the work that is offering, especially since our cities are growing so rapidly, and, as the population grows more dense in the cities, the necessity for ventilation grows apace. It is only a few years ago—probably three or four at most—that a great many large public buildings were erected without any thought whatsoever as to the question of ventilation, but in late years almost every large building that is being erected, the question of ventilation is being considered to a more or less degree. This is largely accounted for by the education of the architects and the firms who do heating and ventilating, who are alive to the necessity of seeing to it that ventilating systems are installed in practically all of the larger buildings, such as public buildings, banks, hospitals, etc.

Most of you who are present, I presume, know of the position which the speaker occupies in a business way and, while we do not wish to introduce anything which might seem like shop talk, yet it might be interesting to you to know that so far as the work on land practice, generally up to some eight or ten years ago, ventilation was a very small proportion of our business—while to-day it is quite the reverse; in fact 90 per cent. of the business probably which we are engaged in has more or less to do with ventilation. Whereas for marine work the greatest proportion of the business was in connection with ventilation, and just here I might say that in the ventilating of ships I got such an impression of the neces-

sity of ventilation and what would seem the only line of application to pursue that I have never forgotten it. As an illustration, take the time of the Spanish-American war, it was my privilege to be connected with our New York office and that, of course, was the port from which the vessels of the United States navy usually departed for Cuba and the Philippine Islands. The battleships and cruisers were invariably supplied with properly ventilated equipment, but that only took care of the navy. The United States government had practically nothing in the way of troop ships or transports for conveying the soldiers to Cuba or the Philippine Islands, and the time being so short they were unable to build troop ships, consequently, they bought a great many steamships from various merchant lines and fitted them up as transports so as to convey the troops, as they conveniently could between decks and sufficient additional space was, of course, required for provisions, etc. Take a large transport leaving New York harbor, for instance; everything was all right so long as the troops could get out on deck and get air, but as soon as they had to turn in, the only place was to go down below between decks, frequently below the water line, and then they found the necessity of ventilation; this was especially so when they neared the tropical zones, and those ships that went to the Philippine Islands, carrying from 1,200 to 1,400 or 2,000 soldiers, going through the Mediterranean Sea and the Suez Canal found that it was an absolute necessity to get a very ample supply of air. At first, because of the vessels being rushed off in the summer time to a warm climate, no plans were made, of course, for the heating of the air supplied to the quarters that the men occupied as winter drew on and they had a little more time, the engineers found the necessity of putting in the necessary equipment to warm the supply of air, and just here, I believe, it will illustrate and impress on all of us to the greatest advantage as to the necessity of considering the blowing of air into the space to be ventilated and the warming of the same, particularly in our cold climate. As an illustration, in order to ventilate the transports referred to above, it would have seemed utter folly on our part to attempt to ventilate the hold by exhausting bad air out of the hold even in the summer time, and we would have fared a great deal worse had we attempted to do so in the winter time; first, because there is usually little or no provision made for a supply of air to get into the space to be ventilated where an exhaust system is installed and, even if there are openings at different intervals to allow the air to be drawn in, there is never any provision made for the warming of the air. Now, while the United States government had to carry those troups in summer time, as well as in winter, so are there thousands

of public buildings, offices, factories, etc., that have to be run through the winter, and if ventilation is necessary in the summer, surely it is quite as necessary in the winter, and while it is possible to get a circulation of air by an exhaust system in the summer time by putting in what we term an exhaust fan to exhaust the warm air out of the building, as the days grow colder—especially in our climate—the exhaust fan must be closed down, consequently the so-called ventilating system is shut down, for the place would get so cold that the occupants would be unable to endure it.

It would seem from the foregoing that what proves to be a temporary help through the summer months is little if any use during the rest of the year, and it is for this reason that we recommend and endeavor to install a system that will serve the purpose of ventilation throughout the whole year and, as we go along and gain knowledge and experience, we feel that it is only safe to recommend the very best system possible—that is, one where it is possible for a building to be all closed up save an opening to admit of fresh air into the building and an opening to allow the foul air to escape. In the downtown districts of our cities, or in locations where there is any amount of dust or smoke in the atmosphere, it is usually considered necessary to install an air washer. This is very desirable, first because it saves a great deal in the cleaning of a building and the fixtures therein, saves decorations, and is certainly much to be desired by the occupants.

Modern ventilation, you will see, is quite an up-to-date subject when we consider that the air can be taken from the outside of a building and mechanically delivered in any quantity to any space in a building when desired. The air can be warmed to the temperature desired; if it is dusty or foul air it can be purified and, in summer time, if it is very warm outside, it can be cooled and delivered to the inside of the building.

A few years ago if a customer called upon us for a fan to do a certain amount of ventilating we did not hesitate to offer him just an ordinary exhaust fan, something that could be placed at the top of a window or a hole in the wall with a motor attached to a fan, or have it driven by a pulley and belt from a line shaft close at hand, and, when running, we felt that we had accomplished something. How different it is at the present time; in fact, you will all be interested perhaps in hearing of one incident of a few years ago when a large manufacturer in this city, who employs from 400 to 600 hands in a large factory with a building already heated by direct radiation, called upon us with a view to purchasing a fan or so to exhaust the foul and vitiated air from off their work floors. The writer called upon the parties and was turned

over to their superintendent, who was to take the matter up with him. He had in mind the purchasing of a couple of fans, which were worth probably in the neighborhood of $40 to $50 each, and his idea was to install them in a window at one end of the building and there was expected to be sufficient magic or something of the kind in each of those fans to ventilate a floor of the building. Being somewhat sensitive and anxious to do what seemed to be the right thing towards our customer, we advised against the purchase of such small and inadequate apparatus and pointed out to the superintendent the necessity and the value it would be to the firm to supply an apparatus that would give something in the way of appreciable results, and we explained that in order to make the floors anything like comfortable to work in, there should be a system provided which would allow for a complete air change on each floor every ten minutes, and it ought to be arranged so as to be constant. In the summer time, of course, the air could be taken from outside and would not require any heating; in the winter it would be necessary to heat the air. Our friend, the superintendent, became very much interested in what was to him the new way of ventilating the factory building and he immediately wished to turn us over to the manager, to whom he wanted us to explain our ideas, he having no further thought of purchasing the two or three little exhaust fans. It was on Saturday morning about 11 o'clock that we visited the place and we asked our friend, the superintendent, if he would not spare us until some other time to meet the manager, but he would not, he must have us meet him at once, and we put on as bold a front as we could and faced the manager and endeavored to show him wherein he should profit by installing the system as outlined to the superintendent. He, of course, was entirely unprepared for any such proposition, and I presume he thought that we were something of a highway robber, especially when we asked him for about $5,000 or $6,000 for an adequate ventilating system for his factory building. The first shock over, we, of course, proceeded to point out the very many advantages, and he, being a business man, did not take long to see the advantages to be gained and he very kindly asked us to return again on Mounday morning and he thought that perhaps we could do business. Monday morning found us at the office of the above manager and by three or four o'clock in the afternoon of the same day, we had a proposition made out and a contract signed for a system which would cost the owner at least $5,000 for the installation of the same, and, if we were called upon to-day to install a system under similar conditions, it would probably cost from $1,200 to $1,500 addi-

tional, for the reason that we are sure our friend would not have been satisfied without having an up-to-date air washer installed; in fact, I believe he is already considering the advisability of installing such an up-to-date air washer in connection with the apparatus we installed some few years ago. I am sure that if any one would ask the gentleman for his views in connection with the necessity of ventilating a factory building where there are from 400 to 600 hands employed, he would certainly strongly recommend it. Imagine the foul conditions that exist in a factory building where there are scores of men and women sitting along in rows working at benches, all breathing the same air over and over again and remaining practically in the same place for four or five hours at a time with no provision whatsoever made for ventilating such quarters. Is it any wonder that our government is compelled to step in and be willing to spend hundreds and thousands of dollars to prevent the growth and stamp out consumption. I believe that the time has come in this country when there should be a law compelling every factory owner to provide properly ventilated quarters for their help. There is, we believe, at the present time, a statute calling for a certain provision, but I do not believe it goes far enough. Of course there are always individuals who are willing and see the advantage of having proper conditions for their help to work under; it is cheaper for them to provide such than otherwise on account of their help being able to do so much more. they are always brighter and more intelligent in every way if they can continue to breathe the air that has been purified by God's sunshine continuously. What a sad condition it is for those who do not appreciate the necessity of ventilation are allowed to go on and house human beings in some quarters like so many rats and expect them to continue to work under such conditions, while the managers themselves usually have a cottage up in Muskoka or some such place where they can enjoy the outdoor atmosphere.

City life is a real proposition which must be dealt with, and if we are going to continue to erect large buildings and house hundreds of people together, we must consider the proper methods of getting fresh air into such places. If we could all get what fresh air we want in our offices or work shops, it would be like bringing the air of Muskoka to us all the year round and what a glorious conditions of affairs it would be and, yet, comparatively speaking, it ought to be possible to do this. It is simply a question of knowing how and spending a certain amount of money. Knowing how to properly ventilate a building is certainly a very big subject and the more we have to do with the work the more attention we feel it is necessary to give to it to see that the work is properly done.

Many times in our experience we find that an owner imagines that he desires certain space ventilated; he never considers just what it will cost—perhaps it may mean a matter of $300, $400 or $500 to him, when, as a matter of fact, it would require from $5,000 to $7,000 to give a proper system. We have claimed that it requires approximately $1,000 per floor to ventilate an ordinary building—say, from 100 to 150 feet long by 40 feet wide and 10 to 12 feet high; this is without an air washer. If an air washer is required it will cost from $1,200 to $1,400 per floor of the same size. Then there are so many features that have to be considered, not only the first cost, but the cost for operating the system. It is always desirable to get in an apparatus, that is to say, a fan of ample size that will only require the minimum of power to deliver the maximum amount of air, and the system must be generally designed so as to admit of the air being taken into the building with the minimum resistance and delivered to the various points in the room or rooms at a velocity which will not be objectionable. It is a pretty nice proposition to design a system to get all the air that is required into a building at any time and have it enter the building at a sufficiently low velocity and a proper temperature so that it will properly ventilate the space, and those occupying it will not feel any draughts or be made uncomfortable in any way by the incoming air; and, of course, provision must be made for getting the air out in like manner. Of course you are all aware of the usual manner of admitting air in, at, or near the ceilings on a sidewall of a room or building where it would be high enough to be above the heads of the occupants and allow it to escape at or near the floor. Such a system is usually installed in ordinary public schools or in a building of that class. While in a building which has a large auditorium, such as a public hall or a theatre, etc., the air is delivered in through the chair legs at the floor or through a series of small tubes under the seats and is allowed to escape out through a ventilator at the ceiling or roof of the building, and it is in such a building of this character that we sometimes recommend the use of an exhaust fan to relieve the pressure and remove the vitiated air rapidly from the top of the building, particularly in summer time. Of course, in a building like this referred to above, it is usual that there is a plenum space underneath the auditorium floor where the air is delivered and that is all right, unless the space is required for something else, when it is possible then to install a system of distributing pipes and branches can be taken off leading up through the floors, either up through the seat legs or through small tubes. Take a church, for instance; a good way to admit fresh air

into the auditorium of a church would be to run a system of piping along the ceiling of the basement, have as many branches as there are rows of seats, and cut an opening in the floor under each seat and, as the duct runs along, it is reduced in size and the last rows of seats would not then get any more air than the first ones, providing the system was designed properly.

I wonder if it would be interesting for the members to know of the application of a ventilating system to a large departmental store. We have been called upon at different times to look into this matter and it requires very serious thought; first, for the reason that the larger the building the more air they require and such a building is generally located in a district in the city where the land values are the highest, and to take an air shaft running from the top of the building down to the basement to allow for the passage of 100,000 to 250,000 cubic feet of air per minute, it would require some space and the necessary space would, in all probability, be worth quite as much as it would be necessary to spend on the necessary apparatus to properly ventilate such a building. Consequently, if we can save such space to the owners we can cut down the cost of ventilating considerably. Then, assuming a case of installing such a mammoth air shaft as would be necessary and the installing of a large fan in connection with the system and necessary distributing piping throughout the rest of the building, it would be rather an extravagant proposition. We have determined that the only satisfactory way then would be to install what we term a unit ventilating system; that is, a lot of comparatively small fans, heaters and air washer units can be installed at different intervals in the basement of a building and air can be taken in through windows above the sidewalks at several different points, and no opening will require to be very large, and the windows are not destroyed then for their service in lighting, you will then really only occupy a small amount of floor space and if you have a high ceiling in a basement, you can get a unit that would be sufficiently small so as to really not occupy any floor space, that is to say, if a basement is 14 feet high you could install an apparatus that would not be over 7 feet high, including foundations, and have 7 feet in the clear then to work in, and with units like this scattered about it would not be necessary to have a lot of obseen G. I. distributing ducts on the ceilings.

Ventilating an hotel is quite an interesting proposition. Usually we figure to blow air into the various rooms of an hotel building excepting into the bath-rooms, sculleries, kitchen, etc. Out of these rooms we plan, of course, to exhaust the foul air, as, for instance, in a bath-room, the outside air will flow

towards the bath-room and be taken out by the exhaust system. The same with a kitchen or a scullery, which are usually in a basement; or off of a dining-room, and should you attempt to blow air into kitchen or scullery you would be very likely to get the benefit of the odors in the dining-room, so that you would soon know all that was going on in the kitchen and what you were likely to have for your next meal before it was quite ready. We find that it is necessary, in order to get satisfactory results in the way of ventilating a kitchen, to install a system that will change the air at least once every minute and more if necessary when desirable. The system should be installed with a great deal of care on account of the danger of fire. The air in passing through the hoods, piping, etc., conveys a certain amount of grease which adheres to the hoods and piping and which are liable to catch fire at any time; in fact, it is desirable and systems are frequently installed where the hoods and piping are made sufficiently heavy, so they can be set fire to at a convenient time and made so that no harm can come by their taking fire at some unexpected time.

I am sure a great many of those present remember the fire at the Windsor Hotel, Montreal, some few years ago. I believe the fire in this case originated by a very poorly constructed piping system too close to wooden rafters, floors, etc. In these days of rush and hustle continuously with so much hired help, it is necessary to take every precaution and install a system that is practically fool proof, and I think you will agree that it will be the cheapest in the end.

To our railroad friends the question of ventilation in round houses is also an interesting proposition, especially during the winter time. I presume that there has been no one trouble which has been more aggravating to a locomotive foreman than the ventilating of their round houses. The only adequate way is to get in a sufficient quantity of heated air that will be capable of carrying off the gases from a smoking locomotive and the warming up of a running gear, etc., in a comparatively short space of time, and at the same time keep the steam from forming into a mist so as to obstruct the view and be an annoyance to the workmen generally. This is especially true in a climate where the thermometer goes to say 40 below zero. The difficulty we have found usually is the question of the cost with the railway companies, as compared with what they call a heating system. A heating system, however, is one thing in a round house, while a ventilating system is entirely different. Usually, when a proper ventilating system is employed, it includes all that is necessary in the way of a heating system. In other words, we have never in

our experience found a heating system as such, that is, little if any use as a ventilating system. That is to say, you must have some mechanical method for removing a large quantity of air in order to remove the objectionable gases, vapor, etc., and in the winter when the air is cold, the large volume of aim moving must be sufficiently warm so as to carry off the moisture and, if the air is sufficiently warmed, you will not have the fog effect.

The ventilating of a dye house is about as serious a matter as we have to contend with, for the reason that it is very expensive proportionate to the size of the building. I believe the only satisfactory way to ventilate a dye house is to blow in sufficient warm air so as to give a complete change in the dye house every minute or so, and arrange the outlets so as to prevent the freezing of the moisture around such outlets. With such a system properly installed one can go in and out of a dye house and see from one end of it to another, instead of as you find it in most cases at the present time, where they have what they call a ventilating system usually consisting of a disc or propeller wheel with which they try to suck out the steam, and the more they suck out and the more cold air they admit in, the more steam they have got to suck out; and, instead of relieving the condition, they only aggravate it.

We could go on through the list as above, but feel we have encroached on your time sufficiently long enough already. If there are any questions that any of the members would like to ask we will be only too pleased to undertake to give a satisfactory explanation.

Thank you for the privilege of meeting you in this capacity.

Chairman,—

Will you give us a rough idea of the air washer?

Mr. Grant drew a diagram on the blackboard and explained the air washer.

Mr. Herring,—

What is the idea of heating the air before it goes into the washer?

Mr. Grant,—

If this was not done it would freeze the water.

Mr. Wickens,—

Do you have any trouble with having too much humidity in the air?

Mr. Grant,—

No. That is taken care of by a humidity control.

Mr. Wickens,—

I do not know how humidifiers will take care of the moisture in the air. You make a humidifier to supply water to the air, but there is no humidifier that will take water out, and I should think that when you cool the air with water in the summer time that you might possibly have too much humidity in the air.

Mr. Grant,—

That is done by adding more eliminating plates in the washer, and as the air passes through the eliminating plates the water drops down. It is just a question of separation. But you must have proper devices for separating. The trouble is that it costs money; it puts resistance on the air, and it costs more to push the air through.

I am installing some work now in about 25,000 (twenty-five thousand) cubic feet capacity units, they will run about 4 h.p., for washing only, and may run a little higher. We have got to figure out, and know that we have got sufficient air, and let the air in at a low velocity.

The following verses are appropriate to this subject, I think:

LAUNDERED AIR.

I can stand for tainted money, I can stand for tainted grub:
I can drink polluted water and employ it when I scrub,
But since noting this invention I shall never, I declare,
Be content again with breathing anything but laundered air.

Give me clothing filled with shoddy, filled with microbes, if you will:
Let a million microbes bite me when I touch a dollar bill:
Let the germs come swarming o'er me when I take an easy chair,
But I pray you do not give me anything but laundered air.

If ozone may be laundered, can't we neatly crease it too—
Hand it round in snowy bundles like the laundry people do?
Oh, I hope the time is coming when to laundries we'll repair
Bright and early Monday mornings for our week's supply of air.

Chairman,—

We have all listened with a great deal of interest to this paper, and if there is any member present who would like to

ask any question, I am sure Mr. Grant will be only too pleased to answer it.

Mr. Jefferis,—

I would like to ask Mr. Grant how he would figure out the cost of installing this ventilation system in a plant like ours? For instance—take our retort house.

Mr. Grant,—

You can do it by taking the cubic contents of the building. I have never done a retort house, so cannot say just what would be the right apparatus to use, but would suggest that you put in as many 12″ pipes as you have furnaces. Say you have 12 furnaces, you would then put in 12″ pipes right in front of the furnaces, having them made with bell mouth, the air would then blow down on the men, and instead of the men going to the fire as if they were afraid, they would feel the cool air blowing down on them, and would not object to going up to the furnaces.

I know I am right in this, as there is a place in New York where the men suffered very much from the heat. They had installed a fan and were sucking the air out of the furnace room, but still they got no relief, and finally the manager got desperate, and sent for us. We told him that instead of putting fans in to suck out the air, if he put 12″ pipes in, in front of the furnaces, he would get relief, and after this was done the men were able to stand right up to the furnaces, and do their work.

In a large hotel in this city, similar conditions prevailed in the furnace room, and the men were unable to stand the heat, but after the installation of these pipes they were able to do their work all right.

Mr. Ellis,—

That would not do in a retort house. When they draw the hot coke out of the retort the air blowing down would cause the coke to set on fire.

Mr. Grant,—

I am speaking more of boiler rooms.

Mr. Herring,—

In reckoning your volumes of air to be taken out of a room, do you reckon them at 60 degs?

Mr. Grant,—

60 to 65 degrees.

Mr. Herring,—

The higher the temperature, the greater the volume you have to move?

Mr. Grant,—

Yes.

Mr. Jefferis,—

I suppose the cost of maintenance is not very great after the apparatus is installed?

Mr. Grant,—

Not for ordinary ventilation; of course it all depends on the apparatus employed.

At a whitewear factory in the city, the manager sent to me to put in a ventilating system. He had a little exhaust fan installed in the roof, which, of course, gave him no relief. The work room was very hot, and the work people all complaining, the manager said that something had got to be done. I fixed up a fan temporarily to blow air into the room, then I asked him how he was going to do in the winter as they would not be able to stand the cold air from the window blowing directly into the room. A temporary heater was made, and when winter came on I put in a system of pipes which successfully ventilated the room.

Shortly after this gentleman built a new plant, and asked me to figure on the ventilating system, and I found he would require about 30,000 feet of air per minute, but when I told him that it would take about 25 h.p. to run the plant, he would not stand for it, and I increased the size of the fan, enabling me to run it slower, which brought it down to about 5 h.p.

Mr. Jefferis,—

I understood you to say that it would cost about $1,000 a floor to install this system. The natural conclusion that comes to the mind of the man who goes to this expense is, What is the increased output going to be? If he has several floors at $1,000 per floor, adding to that the cost of maintenance, he would naturally want to know what return he was going to get for the outlay.

Mr. Grant,—

Increased efficiency on the part of the work people, consequently, more work. You know where they make white wear that the firms in order to compete with each other, have to get so much work out of their help, and when you keep people working as close together as you can get them for six or eight hours at a time, if the atmosphere in the room in which they are working becomes hot and foul, after a while you do not get the work out of the people that you would if the air was kept fresh, and this holds good in any similar plant when conditions are along the same lines.

Mr. Taylor,—

I am sure that after the long discussions we have had we ought not to make Mr. Grant say any more, and I take great pleasure in moving a very hearty vote of thanks to Mr. Grant.

The vote of thanks was seconded by Mr. Herring, and carried unanimously.

Chairman,—

Before you go I want to tell you that the Secretary has just advised me that he has got 300 tickets here. Anybody wanting tickets can get them, the price is $1.25.

The Secretary tells me that there are still a large number who have not paid their dues, and we shall be glad if, during the holidays, those who have not paid will do so.

Moved by Mr. Wickens, and seconded by Mr. Herring, that the meeting be adjourned. Carried.