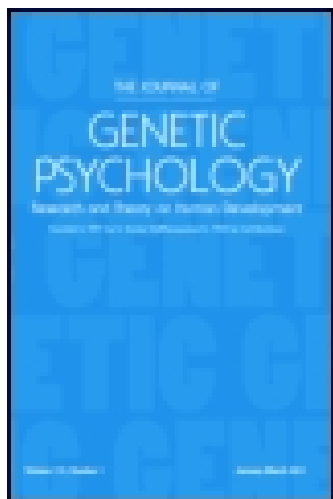


This article was downloaded by: [New York University]
On: 02 February 2015, At: 22:41
Publisher: Routledge
Informa Ltd Registered in England and Wales Registered Number:
1072954 Registered office: Mortimer House, 37-41 Mortimer
Street, London W1T 3JH, UK



The Pedagogical Seminary

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/vzps20>

Report on the Hygienic and Sanitary Condition of a Public School Building

W. E. McGown^a

^a Educational Laboratory , Cornell University , USA

Published online: 30 Aug 2012.

To cite this article: W. E. McGown (1910) Report on the Hygienic and Sanitary Condition of a Public School Building, The Pedagogical Seminary, 17:4, 480-490, DOI: [10.1080/08919402.1910.10533920](https://doi.org/10.1080/08919402.1910.10533920)

To link to this article: <http://dx.doi.org/10.1080/08919402.1910.10533920>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or

howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

REPORT ON THE HYGIENIC AND SANITARY CONDITION OF A PUBLIC SCHOOL BUILDING¹

By W. E. McGOWN

From the Educational Laboratory, Cornell University

Through the courtesy of Supt. ———, the writer was permitted to undertake an examination of the hygienic and sanitary condition of the 'Central School' in ———. This examination, which was carried on under the direction of Professor Whipple of the Department of Education, Cornell University, embraced an inspection of the heating, ventilation, illumination, and sanitary appliances in the building. The present paper aims to render an account of the conditions that were found and to suggest a number of ways in which improvements could be made at relatively small expense.

THE BUILDING

The Central School, situated at the corner of ——— and ——— Sts., is one of the city's grade schools. It is a two-story, frame structure, built without any form of fire-proofing. Its general floor plan is the familiar one of a central corridor with class rooms on either side and stairways at both ends. From the second floor there are also two outside stairways which are designed to serve as supplementary exits in case of fire.

THE GROUNDS AND SITE

The grounds are some three times the floor area of the building. In the rear there is an unobstructed space for play, but the grounds in other portions are fenced off by low barriers, and are apparently not available for play (at the time of this inspection the weather and soil conditions were such that the pupils could not use the grounds at all).

There are a number of large trees on the grounds. Several of these trees are so near the building that they interfere

¹This report was prepared by Mr. McGown as an assignment in connection with advanced work in school hygiene. It was not intended for publication, but is reproduced in this *Journal*, at the suggestion of several persons, as an illustration of the kind of investigation that may be conducted with practical advantage by competent students of school hygiene. Readers may be interested to know that most of the improvements that the paper recommends were subsequently introduced by the Board of Education of the city in question.

G. M. W.

seriously with the illumination of the classrooms. These trees need judicious trimming and several of them could be removed entirely to advantage.

Not far from the school and in the path of the prevailing winds is a gas plant, the odors of which are not infrequently very disagreeably noticeable. Whether the school was erected after the gas-plant or the gas-plant after the school, I have not discovered. In either event, the present situation constitutes a nuisance from the point of view of the hygiene of the school. If the present building is ever replaced by a new one, it would, in my opinion, be highly undesirable to use the same site again.

HEATING AND VENTILATION

The building is heated by hot air furnaces and a simple gravity system, of a pattern that is now considered obsolete for schoolhouse heating. The warm air inlets are placed either in the floors or in the walls near the floors; in accordance with the best modern practice they should, of course, be placed in the side walls above the level of the 'breathing line.'

There is in each room an outlet flue for the conveyance of foul air into a central chimney near the middle of the building. This chimney was formerly used as a smoke-flue at a time when the building was heated by stoves. When furnace-heating was installed the chimney was converted, theoretically, into an aspirating chimney by connecting it with the foul air flues from the classrooms and by installing a stove at its base to furnish an upward current of air. When the building was inspected there was no fire in this stove; so far as could be determined there never has been any; at least the janitor was ignorant of its use. In consequence of this unfortunate neglect of a useful device, the outlet or foul air flues in the Central School might as well never have been introduced. Anemometer tests showed that not a particle of air was being withdrawn from the classrooms through the agency of the aspirating chimney. I would recommend that the janitor be instructed to maintain a fire in the chimney-heater and to make sure that all outlet flues were open and in active operation daily. The operation of this flue would cost but a negligible amount and would, presumably, facilitate the introduction into the classrooms of warm air from the furnace.

Ventilation tests are most satisfactorily conducted by the quantitative determination of the carbon dioxide of the air. Normal outdoor air contains 4 parts of carbon dioxide per 10,000; many hygienic experts place the limit for ideal or

first-class ventilation at 6 parts or 7 parts, but we may deem 10 parts, perhaps, a permissible limit for satisfactory or acceptable ventilation. The presence of from 10 to 20 parts of carbon dioxide per ten thousand indicates bad air, of from 20 to 40 parts, very bad air, and above 40 parts, extremely bad air.

Several classrooms in the Central School were tested with the Pettersson-Palmqvist apparatus for the determination of carbon dioxide. This instrument admits of a high degree of accuracy and yields direct readings in parts per ten thousand of CO_2 . (The instrument is described in the Appendix of this report; the detailed results obtained by its use are also given there.) Our analyses showed that the carbon dioxide content in this school rises within a few minutes after the assembling of the pupils to 10 parts, and from this time until school is dismissed steadily increases to from 20 to 24 parts per ten thousand. In other words, the pupils in the Central School practically breathe air that would technically be ranked as 'bad' or 'very bad' throughout their school day. The ventilation system of this school does not ventilate, and the quantity of fresh air supplied falls far short of the minimal limit set by the school regulations of New York State (in the rules governing the construction of the new buildings). If the aspirating chimney were set in operation as previously recommended there is no doubt but the ventilation would be appreciably improved.

The *temperature* of the classrooms inspected was, on the whole, maintained within reasonable limits by opening windows as the need arose. In severe weather it would be impossible to control the temperature in this manner and the air in these rooms could not fail to be in worse condition, both as regards temperature and vitiation, than it was in the comparatively mild weather that prevailed when our tests were made.

There is no provision in this building for heating the halls and closets, although, as will be shown later, there is urgent need of some provision for such heating.

The *relative humidity* of the air in a number of classrooms was determined by means of a whirling wet-dry bulb thermometer (see Appendix). According to these tests, the relative humidity ranged from 20 to 30%, with an average of 24%. Since the normal outdoor humidity is not less than 60%, and since these tests were conducted in damp or rainy weather when the conditions were favorable for a high humidity indoors, it is evident that the air in the Central School is extremely dry. The effects of breathing this dry, vitiated air are well known to all medical and hygienic authorities;

in particular, pupils may be expected to develop chronic affections of the throat and lungs. Doubtless it is out of the question, in the present circumstances, to install humidifying apparatus in the Central School, but the conditions revealed in our tests may serve as a reminder of the desirability of making such an installation if a new building is constructed. Experts now compute the cost of proper humidification as approximately equal to an addition of 5% to the cost of heating,—an addition that will return hygienic benefits sufficient to justify its introduction.

ILLUMINATION

The rooms in the Central School are, in the main, of two sizes, 26' x 24' and 20' x 30'. In general, the lighting arrangements are good. The ratio of glass to floor area is within the ratio 1:6 prescribed by experts. In the 2d grade, Room 1, however, the seating is wrongly placed, and the light comes from the back instead of from the left side, or from the left and back with preponderance of left light.

Though the building is thus adequately provided with window surface, the teachers, unfortunately, do not utilize this surface in such a manner as to secure adequate illumination. The following criticisms may be made.

(a) The windows, at the time of our visits, were sadly in need of cleaning; they all were covered with dust and dirt, so that the amount of light available was materially reduced.

(b) Several of the teachers failed to adjust the window-shades in accordance with the requirements of illumination. Shades that had been drawn in sunshiny weather were still pulled down on one of the darkest days of the year. In one instance a curtain had been broken for some time so that it could not be moved from before the window, and this defect had not been reported to the janitor or other responsible party.

(c) Some windows were filled with plants so large as to reduce the light by a considerable quantity. However desirable growing plants may be, they should not be allowed to interfere with the illumination of the classroom.

(d) In one or two rooms the seating capacity was not used to its full extent, yet desks in the best lighted row next the windows were unoccupied and pupils were seated in the darkest row.

(e) The degree of illumination could be measurably augmented by trimming all the trees in the school yard and removing some of them entirely, as previously suggested.

(f) The recent tests of vision of the pupils in the Central School, in the administration of which we were permitted

to assist, revealed a large percentage of visual defect. The seating of all pupils found defective in these tests should now be rearranged to bring the myopic children in the front rows and all other defective pupils into the best lighted desks next the windows.

SANITARY APPLIANCES

In the Central School the toilet rooms are placed in a well or large shaft inside the building. They are surrounded on all sides, practically, by the classrooms. They receive a feeble illumination from sky-lights at the top of the well in which they are situated, and they are supposed to be ventilated by a number of swinging sash-windows at the top of the well. Each closet room opens into the common shaft directly, being screened from it simply by coarse wire netting.

It goes without saying that if closets are to be located inside the school building, elaborate precautions must be taken to avoid a nuisance. A prime requisite of school construction is that toilet rooms must receive direct illumination from the sun, must be amply warmed, and must be supplied with a continuous powerful draft of air for ventilation, presumably by a special system of aspirating chimneys or exhaust-fans. These well known principles of hygienic construction are all violated in the Central School. The sunlight never penetrates to the closet rooms; there is no source of heat; there is virtually no ventilation. As a consequence the stink of these closets is the first thing that greets the nose of the visitor, and the classrooms are all more or less permeated by vile odors from them. The closets are not kept clean. The deodorizer that is used only helps to advertise their presence. In the absence of sunlight, the best natural germicide and sterilizing agency, these closets must be kept scrupulously clean and must be supplied with generous ventilation.

Drinking cups. This school has been equipped with enamel sinks. It would not entail much expense to attach sanitary drinking fountains to eliminate the danger that now exists from the use of the common drinking cup.¹

Professor Davison, of Lafayette College, recently placed a sterilized glass tumbler in a public school where it was used for nine days. When broken at the end of this time and subjected to bacteriological examination there were found not less than 100,000 bacteria per square inch of glass surface; the upper third of the glass was so thickly strewn with human cells scraped from the lips of the pupils that the head of a pin could not be touched to any spot on the glass without coming in contact with several of these bits of skin; the saliva, by running down on the inside of the glass, had carried countless cells and bacteria to the bottom.

The pupils not only drink from the same cup, but wipe

their hands and faces on the proverbial 'school towel.' There can scarcely be imagined a more satisfactory device for the spreading of trachoma and other infectious eye diseases.

CLEANING

In the Central School the wood floors are in a very poor condition; there are wide cracks between the boards; the boards themselves are rough and very difficult to clean. All the floors need renovating. If they were first given a thorough scrubbing with soap and warm water, then dried, scraped or planed, it is possible that a crack filler could be used to advantage. At least the cleaning and scraping should be followed with a skillful application of some standard oil dressing. If this is applied evenly and sparingly it will not prove a nuisance and will very considerably reduce the amount of floating dust in the schoolrooms.

The dust difficulty is at present aggravated by the inexcusable practice of the janitor, who sweeps the corridor floors during the school session, and thus stirs up millions of dust particles which permeate every room in the building. If the floors were oiled, as just suggested, swept in the afternoon at the close of each session, and if the desks and furniture were dusted in the morning before nine o'clock, the dust problem could be successfully handled, in so far as the construction and equipment of the building will permit.

SCHOOL FURNITURE

The hygienic seating of pupils could be facilitated by placing in each classroom a limited number of adjustable desks. The present desks and chairs do not conform with modern hygienic prescriptions.

CONCLUSIONS AND RECOMMENDATIONS

The Central School is an old building on a poor site. As the best way of meeting the difficulties we have outlined would be to erect another building on a better site, we have no radical changes to suggest in the present structure. At the same time, it is realized that new buildings cannot always be had for the wish; they come but slowly, even when urgent need is apparent. On the assumption that the Central School will be continued in use, we venture to make a number of suggestions which we believe are of practical worth, and which can be put into operation with but a small outlay of money and attention. We believe that the improvements are well worth the outlay.

1. Trim the trees in and about the school yard.

2. Put the stove at the bottom of the aspirating chimney into condition for use, and instruct the janitor to maintain a fire therein whenever artificial heating is in use.

3. Instruct the janitor and the teachers to keep the outlet flues always open and clear.

4. Have the windows thoroughly cleaned, and instruct the janitor to clean them as often as is necessary.

5. Instruct teachers to use their best efforts to secure adequate illumination, especially by the intelligent management of the shades.

6. Allow no plants in the windows unless they can be placed there without appreciably reducing the illumination.

7. Seat pupils to secure optimal lighting; especially seat those with defective vision in the rows next the windows and bring myopic children into the front seats.

8. Rearrange the seating in 2d grade, Room 1, to bring the light from the left.

9. Insist that the janitor wash the closets and urinals daily with broom and hot water, and that at least twice a week some germicide be added to the water, *e. g.*, corrosive sublimate (1 to 2,000), or diluted muriatic acid might be employed for the urinals.

10. Install artificial lighting in each toilet room, so that at least enough light will be afforded to enable one to ensure the cleanliness of the appliances.

11. Arrange for the introduction of a supply of heat to each toilet room. For this purpose a warm air duct would be preferable to a steam coil, since the former would also assist in the ventilation of the rooms. In mild weather a number of inexpensive electric fans might be used to move the air in these rooms.

12. Install a fountain or 'jet' form of supply for drinking water and abolish the drinking cup.

13. Arrange some substitute for the present 'common towel.' The best suggestion is, perhaps, the use of a large number of small inexpensive drying cloths, like the individual towels used in Pullman cars.

14. Have the floors thoroughly renovated by systematic cleaning, scraping and crack-filling (if this is found feasible). During the vacation give the floors a good treatment with floor oil.

15. Insist that the janitor do no sweeping while school is in session, but that the entire building be swept daily after the afternoon session, be dusted daily before the morning session, and be washed weekly on Saturdays.

16. Place in each room a number (say 8 or 10, at most) of adjustable desks and see that teachers make proper use of them.

APPENDIX I

APPARATUS FOR THE DETERMINATION OF CARBON DIOXIDE

In his "Heating and Ventilating Buildings," Professor R. C. Carpenter gives the following description of the apparatus used in our tests.¹

"The amount of carbon dioxide is so small that the most delicate methods are required in order to measure it. The writer gives here the only simple method which can be readily applied and which is said to be accurate to one part in one hundred thousand. This system of finding carbon dioxide was devised by Otto Pettersson and A. Palmqvist, two European chemists. The instrument consists of a measuring vessel, A, connected with a U-shaped burette, B, from which communication can be made by a small stop-cock, b, a manometer, fg, containing a graduated scale nearly horizontal; and two stop-cocks, f and g, by means of which communication can be made with the air. One side of the manometer, f, is in communication with the closed vessel, C, the other side can be put into communication with the measuring vessel, A. The burette, B, contains a saturated solution of caustic potash (KOH). The flask, E, contains mercury, and by raising it when the stop-cock, c, is open, the mercury will rise in the flask, A, and the air will be forced out. If the flask, E, be lowered, the mercury will flow from the measuring tube, and the amount of air entering A can be measured by the gradations. When the measuring tube, A, is full of air, the stop-cocks, c, b, f, and g being open, the position of the drop of liquid in the horizontal tube of the manometer is accurately read. The stop-cocks, c, b, f, and g are closed, that at b, opened, and the vessel, E, raised, driving the air out of the measuring tube, A, into the absorption burette, B. This operation of raising and lowering the flask, E, is repeated several times; it is then lowered, and the air is drawn over into the measuring burette; the cock, a, is then opened, and the vessel E manipulated until the reading on the horizontal scale agrees with that in the beginning of the test. The reading of the graduated tube A, gives directly the amount of carbon dioxide. The determinations are made with air of ordinary humidity and there is a slight correction due to this fact, which is not likely to equal, in any case, one part of carbon dioxide in one million parts of air."

A drop of water is kept on the surface of the mercury in the tube, A, in order to maintain the air to be measured at a uniform saturation. The liquid used in the manometer is petroleum colored with azobenzol.

In the tests made at the Central School a device suggested and constructed by Dr. A. W. Browne, of the Department of Chemistry of Cornell University, was used to draw samples of air from three different strata of the rooms. For this purpose a system of capillary tubes was attached to a rigid board made fast to the frame of the instrument. The three capillary tubes opened at points 30 inches (approximately on the breathing line), six feet and eight feet, six inches, respectively, from the floor. By means of the stop-cocks, air could be drawn at will from any one of these levels.

A trial cock was also introduced between the tubes and the instrument in such a manner that air could be drawn from any level into the instrument, then ejected through the tail cock. By performing this pumping operation several times, a fair sample was secured from the level under determination. In operation, two tests were made in succession from each level.

¹The lettering that follows refers to the cut of the instrument which has not been reproduced here.

APPENDIX II

CARBON DIOXIDE DETERMINATIONS

Inspection of the following table will show that the air of the Central School exceeds the permissible 8 parts per 10,000 of CO₂ in a very short time after the opening of the morning session, even in mild weather when one or more windows are open. Toward the end of the session the air is in obviously bad condition. The table also shows that the CO₂ is rapidly diffused throughout the room, since air drawn from three different levels and in two different 'stations' gives substantially the same results.

Table of Carbon Dioxide Determinations
(Parts per 10,000 parts of air.)

Room	Principal's	No. 3	No. 7	No. 8	No. 10	No. 11
Time	9.15- 10.00	11.00- 12.00	10.00- 11.30	8.50- 10.40	9.20- 10.40	8.50- 9.50
Date	Feb. 25	Mar. 3	Mar. 2	Mar. 1	Mar. 3	Feb. 26
a	10 21	14 15	10 10	9 9.5	19 20.5	7.5 8.
b	22 23	15.5 15.	10.5 11.	10. 10.	21. 22.	8. 9.
c	23.5 24.	16. 16.	12. 11.	10.5 11.	22. 23.	9. 10.
d	24. 25.	17. 17.	11.5 12.	11. 12.	24. 25.	10.5 10.5
e	26. 27.	17.5 18.	13. 14.	10.5 11.	25. 27.	11. 11.
f	29. 29.	18. 19.	14. 14.5	12. 12.	29. 29.	12. 11.5
Average	24.3	16.5	11.9	10.7	22.2	10.1

EXPLANATIONS AND REMARKS

- a= stratum 30'' from floor near source of heat.
 b= stratum 6' from floor near source of heat.
 c= stratum 8.5' from floor near source of heat.
 d= stratum 30'' from floor opposite source of heat.
 e= stratum 6' from floor opposite source of heat.
 f= stratum 8.5' from floor opposite source of heat.

The amount of window ventilation and *external* weather conditions during the tests are indicated as follows: the tem-

perature is that registered by the U. S. Weather Bureau at 10 A. M., the relative humidity is that registered at 8 A. M., the only time when such determination is made during the day. The out-door relative humidity would, of course, be somewhat lower at 10 A. M.: the indoor relative humidity ranged from 20% to 30%.

(1) Principal's room: Feb. 25. External temperature, 22. Relative humidity, 71. Three windows open, and two doors open into the hall. Air in the room offensively bad, CO₂ found from 19 to 29, average 24.3.

(2) Room No. 3. March 3. External temperature, 22. Relative humidity, 66. Two windows partially open. 'School room odor' could be detected. Determinations 14 to 19, average, 16.5.

(3) Room No. 7. March 2. External temperature, 40. Relative humidity, 85. Two windows open at the top. Determinations showed 10 to 14.5 parts CO₂, average, 12.

(4) Room No. 8. March 1. External temperature, 27. Relative humidity, 75. Three windows open at the top. Determinations, 9 to 12: average, 10.7.

(5) Room No. 10. March 3. External conditions as in (2). One window open. Marked odor. Determinations, 19 to 29, average, 22.2.

(6) Room No. 11. Feb. 26. External temperature, 22. Relative humidity, 66. Five windows open, also door into cloak room. Determinations, 7.5 to 12, average 10.1.

APPENDIX III

APPARATUS FOR THE DETERMINATION OF RELATIVE HUMIDITY

For the determination of the relative humidity of the schoolroom air at the Central School, we employed a whirling hygrometer manufactured by the Johnson Electric Service Company. This instrument consists of a pair of accurate thermometers, mounted side by side, and attached to a handle which allows them to be whirled freely. The bulb of one thermometer is covered with a cloth which is dampened with water. The instrument is whirled until the two readings have settled to constant amounts. On the basis of the difference between the reading of the wet bulb and of the dry bulb thermometer as related to the dry bulb temperature, the relative humidity is determined by reference to special tables prepared for this purpose.

APPENDIX IV

APPARATUS FOR THE DETERMINATION OF AIR VELOCITY IN FLUES

We quote from Professor Carpenter's book as follows:

“The velocity of air is measured directly by an instrument called an anemometer. The anemometer used for this purpose consists of a series of flat vanes attached to an axis and a series of dials. The revolution of the axis causes motion of the hands in proportion to the velocity of the air. The dial mechanism can be started or stopped by a trip arranged conveniently for the operator.”