Public Documents of Maine:

BEING THE

ANNUAL REPORTS

OF THE VARIOUS

Public Officers and Institutions

FOR THE YEAR

1892.

VOLUME I.

AUGUSTA:
BURLEIGH & FLYNT, PRINTERS TO THE STATE.
1892.

SEVENTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF THE

STATE OF MAINE.

For the Year Ending December 31, 1891.

AUGUSTA:
BURLEIGH & FLYNT, PRINTERS TO THE STATE.
1892.

MAINE STATE BOARD OF HEALTH.

OFFICE OF THE SECRETARY,
Augusta, Maine, 1892.

To His Excellency, Edwin C. Burleigh, Governor, and the Honorable Executive Council:

GENTLEMEN:—I have the honor of submitting to you the Seventh Annual Report of the State Board of Health of Maine.

Very respectfully,

A. G. YOUNG, M. D.,

Secretary.

MEMBERS OF THE BOARD.

E. C. JORDAN, C. E., *President*,	Portland.
O. A. HORR, M. D.,	Lewiston.
J. O. WEBSTER, M. D.,	Augusta.
CHARLES D. SMITH, M. D.,	Portland.
PROF. F. C. ROBINSON,	Brunswick.
HUGH R. CHAPLIN, ESQ.,	Bangor.
A. G. YOUNG, M. D., *Secretary*,	Augusta.

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INTRODUCTORY.

Each prospective citizen reared under the laws of our State is required to submit himself many hours, week after week, and year after year, to a regime of instruction, which, indispensable as it is, imposes conditions that are more or less artificial and irksome. Prolonged muscular restraint, faulty postures, poisoned school-room air, intellectual over-pressure.— all are antagonistic to the up-building of a sound physical basis of usefulness That the prevailing educational conditions and methods test severely the physical powers of pupils as the schools find them, is shown by the many children whose physical condition suffers injury during the school months — who, using the expressive term, become "fagged out." The hope that this Seventh Annual Report may aid in avoiding some of the dangers of education while the schools are conferring its benefits is thought to be a sufficient apology for devoting so large a part of it to school hygiene.

"Circular No. 65, On Building School-Houses" gives concisely the more important rules that should guide in building school-houses that, while subserving the purpose for which they are built, will endanger the physical powers of the pupils as little as possible, but this very quality of terseness will prove unsatisfactory to some readers. The rules may be good. but somewhat is wanted of the reasons for the rules and of practical ways of applying them. To supply this want, and especially to incite to thought and discussion in the field of school hygiene, broadly considered, is the purpose of the paper on "School Hygiene and School-Houses."

In connection with the preparation of this paper the secretary was authorized by the Board to employ Prof. Woodbridge of the Massachusetts Institute of Technology, Boston, to arrange the heating and ventilation for a number of the school-house plans that were to be included in the series to be presented. This was done and the result, included as one of the chapters of "School Hygiene and School-Houses," is a practical and valuable contribution to the subject of heating and ventilating school-houses.

During the year no outbreaks of any infectious diseases have occurred save those that are always within the State, and of these but few that were not easily controlled by the local boards of health.

The important work in educating the people in sanitary matters and of helping the local boards of health is carried steadily on. The principal circulars published by the State Board have been issued again and again in editions of from 10,000 to 20,000 copies as the demand has required. The blank forms needed by the local boards of health in the management of infectious diseases and nuisances are all supplied from this office,—a policy found to be necessary to facilitate as far as possible the efficiency of local sanitary work.

With the beginning of the year 1892, an act to provide for the registration of vital statistics went into effect. The local records made in accordance with its provisions will be of inestimable value from many points of view. The statistical data derived from the work will also be of great worth as soon as the requirements of the law are understood and imperfections, if found to exist, are remedied.

SECRETARY'S REPORT.

The names and addresses of the members of the Board at the end of the year with the dates at which their terms of office expire are as follows:

J. O. Webster, M. D., term expires January 31, 1892.

E. C. Jordan, C. E., Portland, term expires January 31, 1893.

O. A. Horr, M. D., Lewiston, term expires January 31, 1894.

Prof. F. C. Robinson, Brunswick, term expires January 31, 1895.

Hugh R. Chaplin, Esq., Bangor, term expires January 31, 1896.

Chas. D Smith, M. D., Portland, term expires January 31, 1897.

At the annual meeting March 30, 1891, E. C. Jordan, C. E., was unanimously re-elected President for the ensuing year.

The following standing committees were appointed for the year.

On Finance—Hugh R. Chaplin, J. O. Webster, and the Secretary.

On Publications—C. D. Smith, J. O. Webster, and the Secretary.

On Disposal of Excreta—C. D. Smith.

On Ventilation—O. A. Horr, E C. Jordan, and the Secretary.

On Summer Resorts—E. C. Jordan, and the Secretary.

On Sewerage and Drainage—E. C. Jordan and F. C. Robinson.

On Water and Water Supplies—Prof. F. C. Robinson, and the Secretary.

On School-Houses and School Hygiene—J. O. Webster, and the Secretary.

On Sources of Animal Vaccine—C. D. Smith.

In June the State Board of Health moved into the rooms assigned to it in the basement of the State House extension. There the much-needed room is available for more conveniently and systematically carrying on the general work of the office, the distribution of supplies to local boards, the mailing of the *Sanitary Inspector*, and the work of water analysis.

At the meeting in March it was voted to hold a sanitary convention of local boards of health sometime in the fall, and Dr. Charles D. Smith, Prof. F. C. Robinson, and Dr. J. O. Webster, were appointed a committee to arrange for it.

In accordance with this vote a Sanitary Convention was held in the Common Council Chamber, City Hall, Portland, October 27. As a first experiment in this method of publicly diffusing a knowledge of sanitary science, the result was very encouraging. The papers read were of great practical value and were almost invariably followed by interesting and instructive discussions, in which representatives of a considerable number of local boards of health, as well as members of the State Board and other persons participated. The papers and discussions were published in *The Sanitary Inspector*. The following shows the programme carried out:

Morning Session, 9.45 o'clock.

- Introductory Remarks, by the President of the Convention, E. C. Jordan, C. E., of Portland.
- Address of Welcome, by Hon. George W. True, Mayor of Portland.
- The Experience of Local Boards of Health in Dealing with Contagious Diseases, by Chas. D. Smith, M. D., of Portland.
- The Practical Employment of Disinfectants, by O. A. Horr, M. D., of Lewiston.
- Home Sanitation, by A. K. P. Meserve, M. D., of Portland.

Afternoon Session, 2.30 o'clock.

- School Hygiene, by J. O. Webster, M. D., of Augusta.
  - The discussion of this subject will include remarks upon The Disposal of Excreta from School-Houses, by O. M. Lord., Esq., Superintendent of Schools, Portland.
  - Proper Lighting of School-Rooms, by James A. Spalding, M. D., of Portland.
- The Practical Working of the present State Sanitary Law, by George C. Burgess, Esq., Secretary Portland Board of Health.
- Local Boards of Health and their Relations to Public Nuisances, by R. J. Martin, M. D., Health Officer Augusta Board of Health.

Evening Session, 8 o'clock.

The Adulteration of Food Stuffs, by Prof. Franklin C. Robinson, Brunswick.

Relation of Animal Diseases to the Public Health, by F. L. Russell, D. V. S., State College, Orono.

Phases of Water Supply and Sewerage, by E. C. Jordan, C. E., Portland.

As complaints had been made by the owners of lands on Togus stream below the National Soldiers' Home and of the pollution of that stream by the sewage from the Home, a committee consisting of the President of the Board and Dr. Smith visited the institution at the request of the local board of health of Chelsea and examined the stream and the lands below the outlet of the sewer. The committee made the following report, a copy of which was transmitted to the board of managers of the Home:

PORTLAND, Maine, July 10, 1891.

To the State Board of Health,
A. G. YOUNG, M. D., *Secretary.*

Dear Sir:

The committee appointed to examine into the cause and extent of alleged pollution of a certain brook in the town of Chelsea beg leave to report that they have personally observed the existing conditions upon the brook valley, and they find that unless the use of the water in said brook is abandoned, both for domestic and animal purposes a very serious degree of unhealthfulness is likely to arise. The cause of the pollution is very evident. The Togus National Soldiers' Home, which contains about two thousand two hundred people, discharges its sewage into the brook. An attempt is made by means of certain catch basins to arrest a portion of the sewage solids, but the part that still flows on possesses all the elements to make a nuisance and work an injury to those farmers who formerly depended upon the water of this brook for their cattle or for their own use. It is no longer suitable for these purposes, and we consider it the duty of the local board of health of Chelsea, to notify the people who are in the habit of using or buying and selling milk or butter from cows whose water supply is dependent upon the brook, that the act is a dangerous and improper one. There is a just grievance against the author of the pollution, and the nuisance should be abated. When this fact is definitely brought home to the United

States authorities at Togus it should be properly acted upon, and at once.

The remedy is not a difficult one for them to apply, and many a similar case has been satisfactorily arranged. They have simply to apply the sewage intermittently to certain available areas of land specially prepared for the purpose, and allow the effluent to pass into the brook. We hope the government officials will not be captious in the matter; what they are asked to do is nothing more than corporations and private individuals have been obliged to do in many cases, and above all, the people who pay for Togus Home have no desire to economize in its management at the expense of individuals.

Yours truly,

E. C. JORDAN, C. E.

CHAS. D. SMITH, M. D.

At the quarterly meeting in June, the motion of Dr. Horr was adopted, that a committee be chosen, of which the President and the Secretary shall be members, whose duty it shall be to confer with the proper officials in reference to a representation of this Board in all sanitary matters of a public character at the Columbian Exhibition in 1893, and to make all needful arrangements for such representation. The committee was completed by the appointment of Messrs. Smith, Horr, and Robinson as members.

In view of the benefits that would result to the work of the Board by so doing, it was voted at the same meeting, to send a delegate to the Congress of Hygiene and Demography to be held in London in August, and, the better to enable the Board to do so, it was voted not to send a representative as usual to the meeting of the American Public Health Association. In accordance with this vote, Prof. Robinson went as a delegate to the Congress. At the September meeting he made an interesting verbal report to the Board of the results of his attendance, and was thereupon invited to make a written report for publication in the *Sanitary Inspector*, which he subsequently did.

In the fall the sudden outbreak of small-pox in quite a large number of places in the Province of Quebec, down the St. Lawrence, caused some anxiety lest the disease be introduced into the more exposed parts of this State. As precautionary measures, the Madawaska and other towns particularly exposed by reason of proximity or railway or other connection were warned, a medical inspector was sent up to the infected regions to learn the exact status of affairs, a conference was held between members of the State Board and the local boards of health of Lewiston and Auburn, arrangements were made for co-operative action if need be with the health authorities of New Hampshire and New Brunswick, through the co operation of the Maine Central and Grand Trunk Companies projected excursions to Canada were cancelled, and preparations were made for a railway inspection service if found necessary.

The appreciation of the fact that there is now in existence a Provincial Board of Health that will do all in its power to check such outbreaks, was an encouraging circumstance. A very different thing is the sanitary organization of the Province of Quebec now from what it was six years ago. This and other interesting facts may be gathered from the following letter under date of October 24th, from Dr. Pelletier, Secretary of that Board:

"Yours of the 21st inst. came to hand yesterday. The accompanying sketch will show you that almost all the cases of small-pox originated from one person, who traveled 319 miles on the Intercolonial Railway with a few miles across Baie des Chaleurs, and that these cases are confined to very few places considering so many people were exposed to contagion.

"We have actually 462 organized Boards of Health in this Province out of a possible 730, and instructions have been lately given to the remainder to organize immediately. Except in the case of the Jeffery Hale Hospital in Quebec, as soon as the diagnosis is made, the municipality notifies us immediately, and then our inspector visits the place and the municipality, rich or poor, has to obey our orders, of which I enclose a copy. Two sub-inspectors have been appointed, one for the county of Temiscouata and the other for the county of Rimouski.

"At our request strict orders have been issued by the railway companies to their conductors who are virtually our inspectors. We give the widest publicity to all cases as soon as the reports reach this office. I will with pleasure notify you of every case as soon as ascertained."

Dr. D. G. Luce of Caribou, who went to the St. Lawrence region for this Board, personally visited St. Paul, the place the most seriously affected. He reported that at the time of his visit there had been thirty-five cases with seven deaths in that parish. "The spread from the first case is partially explained by the fact that it occurred at the post-office, and members of fifteen different families were infected before the nature of the disease was known." He furthermore reported that all the infected houses were strictly quarantined and that the prompt and efficient action of the Provincial and local boards of health made the introduction of the infection into our State rather improbable.

The disease was practically confined to the primarily infected points and no cases of the importation of the disease into our own State occurred.

CIRCULAR NO. 65.

STATE BOARD OF HEALTH OF MAINE.

ON BUILDING SCHOOL-HOUSES.

In General.—School-houses should be built in places that are quiet and free from dangers of various kinds, and on ground that is either naturally dry or made so by subsoil drainage.

Basements and foundations should be carefully built with a view to excluding the evil influences of soil moisture.

The play-grounds should be ample, and a portion of them at least, should have a sunny exposure and be protected from the cold westerly and northerly winds by the school building or otherwise.

The best general arrangement of the plan of the building is that in which the school-rooms are all placed on one side of the building with corridors, halls, stairways, and wardrobes on the other. Built in the old way with rooms all around, school-houses have dark central halls, staircases, and, for some of the school-rooms, a favorable lighting cannot be had.

School-Rooms.—The best shape for school-rooms is that of an oblong, the width being to the length about as three to four. The teacher's platform should be placed at one end.

The ceiling should be at least twelve feet high, and if the room is of considerable width, especially if unilateral lighting is employed, it may be necessary to have the ceiling somewhat higher.

In rooms for study it is desirable for each pupil to have 20 square feet of floor space, and 240 cubic feet of air space; for example, a room for thirty-five pupils should have 700 square feet of floor surface inclusive of aisles, and should include within its walls an aggregate of 8400 cubic feet of air space. A room 30 feet long, 23 feet 4 inches wide, and 12 feet high will fill these requirements.

Lighting.—The glass surface of the windows should equal at least one-fifth of the floor space of the room.

The principal light should come from the scholars' left; windows may also be placed at the rear of the scholars when desired. Windows may be placed at the right for ventilating purposes or for admitting direct sunshine while the scholars are not engaged in study.

The principal light of the school-room is preferably taken from the N. E., E. or N., the preference being in the order in which the points of the compass are named. Direct S., S. W. or W. windows for the principal light are to be avoided as far as possible.

The window-sills should be three and one-half or four feet from the floor.

The windows should reach as near the ceiling as the construction of the building will permit, for the higher the windows reach, the deeper the light penetrates into the room, and the more satisfactorily the desks farthest from the left hand windows are lighted.

When possible, the school-room wall opposite the principal light should be reserved for the blackboard. Blackboards should not be placed between the windows or near them.

Above the blackboard and opposite the principal windows small windows may be placed for ventilating purposes and transoms over doors may be used for the same purpose.

It is advisable in all school-buildings to have double windows. The increased cost of construction will be paid by them over and over again in the saving of fuel, and they facilitate very much that window ventilation which must be the main reliance in mild weather. Both sets of sashes should be hung with weights and pulleys.

Heating and Ventilation.—The warming of school-rooms may be accomplished by using stoves, furnaces, or steam-heating.

Direct radiation from stoves or steam coils should never be used.

It is practicable to supply 2,000 cubic feet of air per hour for each scholar and the plans for ventilation should admit of furnishing this amount at least ordinarily.

Stoves should invariably be jacketed and connected with fresh-air inlets for the purpose of supplying fresh air to the room.

Furnaces should be of a kind capable of supplying 2,000 cubic feet of air for each scholar hourly, and a capacious fresh-air inlet should never be omitted.

When steam heating is used the coils should be placed in boxes or fresh-air rooms in the basement or elsewhere for the purpose of warming the air before it enters the school-room.

School buildings should be so planned as to permit the ducts for fresh-air and for foul air to be as direct and as free from horizontal extension as possible.

Inlets and outlets should be of ample size. Their cross-section should equal from sixteen to twenty square inches at least for each scholar.

In ordinary school-rooms it is preferable to place both inlets and outlets on the same side of the room, namely, upon the inner or warm side. When so placed, the warm air should be admitted seven feet or more above the floor, and the foul air should pass out close to the floor.

Inlets and outlets should not be constructed with registers which occupy much space, but the opening should be covered with stout wire network.

To insure successful ventilation in all kinds of weather when mechanical means are not employed to move the air, it is necessary to have means for artificially heating the foul air flue. This may be done by means of an open fire, by a small stove set into the base of the shaft, or by steam coils. In small buildings warmed with stoves or furnaces, the smoke pipe of the heater will usually furnish sufficient heat for this purpose. When thus heated the foul air flue should contain an iron pipe passing up its center, or in the case of double flues, set in the division wall, and into this the smoke-pipe should enter.

Instead of ventilation by heated flues, the air may be moved by mechanical means, that is, by fans run by any available motor.

Each furnace or steam heating apparatus should be supplied with a mixing valve or other arrangement by means of which warm air and cold air can be mixed in such proportions as is required.

Privies, Water-closets and Urinals.—Separate accommodations should be provided for the sexes, and for privies, entirely separate buildings are preferable.

For country school-houses without sewerage facilities, privies with dry earth arrangements, supplemented with a sub-surface drain to carry away the urine. The catch basin of the privy should be at the surface of the ground, instead of below the ground in the form of a vault.

Under no circumstances are privies in any form to be placed within or beneath the school building. The same interdiction applies to urinals without an abundant supply of water for flushing.

For cities where there are sewerage facilities and ample water supply exists there are two or three new designs of "water closet range" that are giving good satisfaction.

For separate water-closets for teachers use, the flushing rim short hopper with vented trap and exposed water seal are satisfactory.

Urinals that are constantly or automatically flushed are desirable.

Water closets and urinals should be made to allow complete inspection and use of the scrubbing brush.

Thorough special ventilation of that part of a school building set apart for water closets and urinals should be planned for.

The soil-pipe must extend beyond the fixtures in a short and direct line to an unobjectionable point above the roof.

WATER ANALYSIS.

The following tabulation shows the number of analyses of samples of water made in the laboratory and the results obtained in each The whole number made during the year is 134, of which 75 were from wells, 32 from springs, 18 from public water supplies, 6 from proposed public water supplies, and 3 from other sources.

ANALYSES OF SAMPLES OF WATER—Expressed in Parts per 100,000.

Number of Analysis.	Origin of Sample.	Date of collection.		Total solids.	Loss on ignition.	Hardness.	Chlorine.	Free ammonia.	Organic Ammonia.	Nitrites.	Nitrates.
566	Well, Augusta	Jan.	6	42.4	12.6	18.02	3.8	.002	.010	Trace.	Much
567	Well, Fairfield	"	5	69.6	36.6	11.80	7.8	.000	.028	Heavy trace.	Very much
568	Well, Lisbon Falls	"	7	19.6	9.6	7.14	2.6	.001	.000	Much.	Very slight trace.
569	Well, Hallowell	"	9	15.6	4.4	7.71	2.0	.000	.003	None.	Heavy trace.
570	Water Supply Company, Waterville	"	16	3.8	1.8	1.95	.2	.001	.014	None.	Very slight trace.
571	Water Supply Company, Waterville	"	16	3.2	1.4	1.95	.2	.005	.019	None.	Very slight trace.
572	Well, Sanford	Feb.	3	7.0	2.0	3.25	.8	.009	.006	None.	Heavy trace.
573	Water Supply Company, Portland	"	6	2.8	1.0	1.27	.1	.000	.011	None.	Very slight trace.
574	Water Supply Company, Portland	"	6	2.4	1.4	1.27	.1	.000	.013	None.	Very slight trace.
575	Water Supply Company, Portland	"	6	2.8	1.0	1.27	.1	.000	.011	None.	Very slight trace.
576	Water Supply Company, Waterville	"	9	3.4	2.2	1.69	.2	.001	.017	None	Very slight trace.
577	Water Supply Company, Waterville	"	9	4.0	2.6	1.69	.2	.001	.014	None.	Very slight trace.
578	Well, Wells	"	10	7.2	2.8	1.69	1.8	.000	.002	None.	Much
579	Spring, Lisbon Falls	"	13	5.6	1.6	2.60	.3	.029	.015	Trace.	Slight trace.
580	Stream, Lisbon Falls	"	13	4.4	1.8	1.69	.2	.002	.009	None.	Very slight trace.
581	Well, Newry	"	17	5.2	1.8	2.34	.1	.000	.001	None	Heavy trace.
582	Water Supply Company, Gardiner	"	21	4.4	1.6	1.95	.2	.003	.014	None.	Very slight trace.
583	Spring, East Orrington	"	23	5.2	1.4	2.86	.3	.000	.000	None.	Heavy trace.
584	Spring, Bangor	"	22	5.[illegible]	1.8	3.64	.3	.000	.003	None.	Slight trace.
585	Well, Bangor	"	22	11.6	6.4	4.03	1.7	.000	.001	None.	Much.
586	Well, Yarmouth	"	28	74.8	24.2	21.19	9.8	.001	.019	None.	Much.
587	Spring, Baldwin	Mar	10	2.2	1.4	1.69	.2	.000	.008	None.	Very slight trace.
588	Spring, Baldwin	"	10	2.2	1.0	1.27	.2	.000	.004	None.	Very slight trace.
589	Spring, West Baldwin	"	8	3.0	1.8	1.69	.3	.000	.002	None.	Much.

590	Spring, Baldwin	Mar.	10	3.6	1.2	.95	.4	.000	.002	None.	Heavy trace.
591	Well, Guilford	"	16	14.2	3.4	9.29	1.0	.000	.000	None.	Heavy trace
592	Well, Guilford	"	16	20.4	3.4	11.52	1.6	.000	.001	None.	Heavy trace.
593	Spring, Bangor	"	29	7.8	2.0	5.00	.5	.000	.008	None.	Trace.
594	Spring, Danforth	April	6	15.6	7.2	7.43	1.8	.008	.006	Slight trace.	Heavy trace.
595	Well, Winthrop	"	8	17.6	2.4	14.06	.4	.001	.002	None.	Trace.
596	Well, Vanceboro	"	13	23.2	10.6	11.05	1.8	.010	.016	Very much.	Much
597	Well, Augusta	"	13	14.4	4.4	6.71	1.8	.001	.029	None.	Slight trace.
598	Well, Starks	"	24	25.0	3.2	2.86	4.2	.001	.017	Very slight trace.	Heavy trace.
599	Well, Starks	"	24	18.4	6.4	6.00	2.0	.000	.007	None.	Much.
600	Well, Bethel	"	30	8.2	1.0	2.34	1.7	.000	.003	None	Much.
601	Well, Portland	May	3	7.2	1.4	2.99	.5	.030	.024	None.	Very slight trace.
602	Spring, Bangor	"	4	7.4	4.2	5.00	.4	.001	.002	None.	Heavy trace.
603	Well, Orland	"	4	7.6	2.4	3.25	1.4	.003	.003	None.	Heavy trace
604	Spring, Limington	"	14	2.8	1.6	2.34	.2	.000	.000	None.	Very slight trace.
605	Spring, Bethel	"	15	7.6	2.8	2.99	.7	.002	.006	Very slight trace.	Heavy trace.
606	Spring, Bangor	"	22	41.2	19.2	22.86	3.0	.001	.011	None	Very much
607	Well, Welchville	June	4	23.6	6.8	4.57	2.0	.000	.003	None.	Very much.
608	Spring, Bethel	"	9	4.6	2.6	2.60	.4	.003	.010	None	Trace.
609	Stream, Lisbon Falls	"	11	6.0	3.2	2.34	.3	.002	.015	None	Trace.
610	Stream, Lisbon Falls	"	11	5.0	3.0	2.34	.3	.010	.013	None.	Very slight trace.
611	Well, Winthrop	"	27	10.6	3.4	5.00	.6	.001	.095	Slight trace.	Trace
612	Well, Winthrop	"	27	7.6	3.0	3.51	.4	000	.004	None.	Very slight trace.
613	Well, Augusta	July	1	42.8	16.2	15.63	4.6	.001	.007	Heavy trace.	Heavy trace
614	Well, Portland	"	1	5.4	2.4	2.34	1.0	.000	.000	None.	Very slight trace.
615	Well, Bridgton	"	2	11.4	6.2	5.29	1.0	.001	.001	Very slight trace.	Much.
616	Spring, Portland	"	9	7.0	4.2	2.86	.8	.000	.001	Very slight trace.	Trace
617	Brook, Portland	"	9	31 2	4.8	4.57	.8	.003	.031	None.	Slight trace
618	Well, Standish	"	12	45 0	5.6	5.71	7.8	.345	-	Very much.	Very much
619	Spring, Standish	"	9	6.4	2.6	3.25	.3	.007	.005	None.	Very slight trace.
620	Well, Solon	"	14	21.8	12.0	6.71	1.5	.001	.008	Very much.	Much
621	Well, Boothbay Harbor	"	13	314.6	82.8	133.10	158.0	.024	.005	Very much.	Very much.
622	Spring, Waterford	"	20	4.2	1.6	1.69	.1	.001	.002	None.	Trace
623	Well, Dexter	"	19	12.8	3.0	7 71	.6	.000	.009	None.	Heavy trace.
624	Well, Vinalhaven	Aug.	24	29 2	13.2	10.30	4 6	.000	.018	None.	Heavy trace.
625	Well, Springvale	July	21	20.8	6.4	3.90	2 6	.007	.015	Very slight trace.	Heavy trace
626	Well, Springvale	"	21	18.6	8.8	3.90	1.8	.001	.006	Very slight trace.	Heavy trace.
627	Well, Madison	Aug.	10	42.4	19.4	12.56	.9	.909	.079	Very much.	Very much.
628	Well, Madison	"	10	16.6	9.8	5 29	1.4	.000	.007	Trace	Much.

ANALYSES OF SAMPLES OF WATER—Expressed in Parts per 100,000—CONTINUED.

Number of Analysis.	Origin of Sample.	Date of collection.	Total solids.	Loss on ignition	Hardness.	Chlorine.	Free ammonia.	Organic ammonia.	Nitrites.	Nitrates.
629	Well, Kennebunk	Aug. 14	5.4	3.0	2.60	.4	.014	.0 4	None.	Very slight trace.
630	Spring, Holden	" 15	4.8	2.6	2.34	.2	.001	.007	None.	Very slight trace.
631	Well, Eliot	" 14	27.4	11.6	8.14	2.6	.004	.007	Trace.	Much.
632	Spring, Eliot	" 14	16.6	4.4	8.14	1.8	.007	.002	None.	Very slight trace.
633	Spring, Sanford	" 15	4.0	3.4	1.69	.4	.011	.032	None.	Very slight trace.
634	Pond, Sanford	" 15	3.2	2.0	1.27	.2	.003	.008	None.	Very slight trace.
435	Spring, Augusta	" 20	23.8	7.1	8.86	1.4	.018	.006	Very much.	Heavy trace.
636	Well, Lincoln.	" 19	15.0	10.4	16.43	5.4	.004	.002	None.	Trace.
637	Well, Lincoln	" 19	22.0	6.6	10.30	4.4	.000	.002	None.	Heavy trace.
638	Well, Oxford	" 22	29.4	15.2	4.86	1.6	.001	.005	Trace.	Very much.
639	Spring, East Orrington	" 25	15.2	3.4	8.86	.4	.001	.001	Very slight trace.	Slight trace
640	Well, Standish	" 26	5.4	1.6	1.95	.2	.000	.000	None.	Very slight trace.
641	Well, Bangor	" 27	39.6	18.2	16.43	4.4	.075	.009	Much	Heavy trace.
642	Spring, Bangor	" 27	14.8	6.4	9.29	1.4	.001	.003	Very slight trace	Heavy trace.
643	Aqueduct, Springfield	" 30	9.8	5.2	6.00	.4	.000	.001	Very slight trace.	Trace.
644	Well, Oxford	" 31	4.2	1.2	1.95	.0	.000	.000	Very slight trace.	Very slight trace.
645	Aqueduct, Skowhegan	Sept. 1	4.6	3.2	1.27	.4	.003	.002	Trace.	Very slight trace.
646	Water Supply Company, Skowhegan	" 1	5.8	3.2	1.69	.2	.001	.011	Very slight trace.	Very slight trace.
647	Well, Skowhegan	" 1	5.6	4.2	1.95	.5	.001	.003	None	Trace.
648	Well, Skowhegan	" 1	9.4	6.2	2.99	.4	.113	.018	Slight trace.	Heavy trace.
649	Well, Gardiner	" 8	38.4	17.8	21.19	4.1	.001	.004	Trace.	Very much.
650	Well, Berwick	" 9	22.8	10.4	3.90	4 0	.004	.007	Slight trace	Much.
651	Well, Yarmouth	" 9	18.8	11.2	4.57	1.4	.000	.003	Very slight trace.	Much.
652	Well, Waterville	" 10	16 2	11.4	7.43	1.2	.000	.005	Very slight trace.	Heavy trace.

653	Well, Dexter	Sept.	11	25.2	10.0	12.56	3.2	.000	.003	Trace.	Heavy trace.
654	Water Supply Company, Lewiston	"	12	3.8	2.4	1.69	.2	.001	.055	Very slight trace.	Very slight trace.
655	Water Supply Company, Lewiston	"	12	3.6	2.2	1.69	.2	.001	.015	None.	Very slight trace.
656	Spring, Augusta	"	15	10.4	3.2	15.63	.4	.015	.007	None.	Very slight trace.
657	Penobscot river, Brewer	"	12	5.8	4.4	2.60	.2	.000	.019	None.	None.
658	Pond, Hallowell	"	16	2.6	1.2	1.69	.2	.001	.024	None.	None.
659	Well, Hiram	"	15	6.6	3.6	2.60	.6	.042	.006	Trace.	Trace.
660	Well, Turner	"	21	6.2	2.6	3.90	.6	.000	.005	Slight trace.	Slight trace.
661	Spring, North Bridgton	"	24	4.4	2.2	2.60	.3	.000	.003	Heavy trace.	Slight trace.
662	Well, Bangor	"	25	27.0	11.0	16.43	2.8	.000	.007	None.	Very slight trace.
663	Well, Bangor	"	25	43.4	13.1	22.02	5.4	000	.008	Slight trace.	Heavy trace.
664	Well, Freeport	"	25	60.6	19.4	18.81	11.4	.035	.015	None.	Heavy trace.
665	Spring, York	Oct	1	10.0	4.2	6.0	1.4	.000	.004	Trace.	Very slight trace.
666	Well, Bangor	"	1	43.6	19.0	22.86	7.6	.000	.002	Trace.	Much.
667	Spring, Freeport	"	7	9.2	1.6	5.71	.4	.002	.002	None	Very slight trace.
668	——, Bangor	-		41.4	18.6	20.40	3.6	.007	.011	Very much.	Heavy trace.
669	Spring, Easton	"	8	21.2	.4	18.02	.6	.000	.002	Very slight trace.	Very slight trace.
670	Well, Lisbon Falls	"	15	7.8	3.8	4.57	1.0	.000	.004	Trace.	Trace.
671	Well, Yarmouthville	"	15	25.2	12.0	8.86	3.4	.001	.002	Trace.	Heavy trace.
672	——, Old Town	-		14.2	4.6	15.63	4.2	.003	.010	Much.	Much.
673	Penobscot river, Brewer	"	20	5.2	4.2	2.60	.2	.000	.018	None.	Very slight trace.
674	Well, Sanford	"	15	3.2	1.4	1.82	.4	.000	.001	Slight trace.	Very slight trace.
675	Well, Sanford	"	20	3.4	1.6	1.95	.4	.007	.007	None.	Very slight trace.
676	Well, Somerville	"	17	13.0	4.0	6.71	.7	.001	.001	Very slight trace.	Slight trace.
677	Well, Calais	"	20	45.8	15.8	17.22	8.8	.006	.012	Slight trace.	Heavy trace.
678	Well, Pittsfield	"	23	43.4	7.4	17.22	6.2	.009	.002	None.	Very slight trace.
679	Well, Pittsfield	"	23	23.6	5.2	17.22	1.0	.011	.003	Slight trace.	Very slight trace.
680	Well, East Jefferson	"	23	44.0	11.2	22.86	.8	.001	.016	Slight trace.	Very slight trace.
681	Well, East Jefferson	"	23	10.0	4.6	5.29	3.0	.003	.007	None.	Very slight trace.
682	Spring, Blanchard	"	27	4.4	2.0	3.25	.2	.000	.000	None.	Very slight trace.
683	Well, Hanover	"	28	6.0	2.2	2.34	.0	.000	.002	None.	Very slight trace.
684	Brook, Freeport	Nov.	4	7.0	4.8	2.99	.8	.004	.013	None.	None.
685	Well, Sebago Lake	"	11	4.2	1.4	1.27	.4	.000	.005	None.	None.
686	Well, Sebago Lake	"	11	6.8	2.6	2.99	1.2	.003	.002	Very slight trace.	Very slight trace.
687	Well, North Berwick	"	11	8.8	2.6	3.90	.6	.000	.002	None	Very slight trace
688	Pond, Bath	"	15	9.2	4.4	2.60	1.6	.007	.034	None.	Very slight trace.
689	Water Supply Company, Skowhegan	"	16	4.2	3.0	1.27	.2	.000	.006	None.	Very slight trace.
690	Spring, Auburn	"	16	4.4	4.0	1.95	.2	.014	.012	None.	Very slight trace.
691	Well, Bangor	"	17	25.2	7.6	18.02	3.0	.000	.003	Trace.	Very slight trace.

ANALYSES OF SAMPLES OF WATER—Expressed in Parts per 100,000—CONCLUDED.

Number of Analysis.	Origin of Sample.	Date of collection.		Total solids.	Loss on ignition.	Hardness.	Chlorine.	Free ammonia.	Organic Ammonia.	Nitrites.	Nitrates.
692	Well, Bangor	Nov.	17	59.0	19.0	23.60	7.6	.001	.004	None.	Heavy trace.
693	Well, Linneus	"	18	13.4	2.4	10.30	.2	.000	.002	Trace	Much.
694	Spring, Vassalboro	"	20	13.8	3.2	9.57	.4	.002	.003	Very slight trace.	Slight trace.
695	Well, Deering	"	26	6.4	3.4	4.29	1.0	.006	.011	Very slight trace.	Heavy trace.
696	Spring, Bangor	Dec.	4	16.2	3.2	9.57	1.4	.002	.004	None.	Very much.
697	Water Supply Company, Bangor	"	4	6.0	3.8	1.95	.2	.009	.020	None.	Very slight trace.
698	Well, Yarmouthville	"	3	6.4	2.4	3.90	.8	.000	.003	None.	Heavy trace.
699	Well, Dexter	"	7	24.8	18.4	19.60	3.4	.000	.024	Slight trace.	Very much.

ADDITIONS TO THE LIBRARY.

During the year 1891 the following books, journals, and pamphlets were added to the library of the Board by exchange and purchase.

Books.

Index Catalogue of the Library of the Surgeon-General's Office, Washington. Vol. XII. 1891.

Reports and Papers of the American Public Health Association. Vols. XV and XVI.

Cowham. School Organization, Hygiene and Discipline. London. 1891.

Dukes. Health at School. London. 1887.

Jacobi. Primary Education. New York. 1889.

Newsholme. School Hygiene. London. 1887.

Prudden. Dust and Its Dangers. New York. 1891.

———. The Story of the Bacteria. New York. 1891.

———. Water and Ice. New York. 1891.

Collineau. L'Hygiene a L'École Pedagogie Scientifique. Paris. 1889.

Eulenberg und Bach. Schulgesundheitslehre. Berlin. 1891.

Fraenkel und Pfeiffer. Mikrophotographischer Atlas der Bakterienkunde. Berlin. 1891.

Gasser. Ueber die Gesundheitspflege der Schüler. Wiesbaden. 1881.

Department of Agriculture. Cause and Prevention of Swine Plague. Washington. 1891.

———. Sixth and Seventh Annual Reports of the Bureau of Animal Industry. 1889–90.

———. Special Report on the Diseases of the Horse. Washington. 1890.

Streets and Highways in Foreign Countries. Washington. 1891.

First Annual Report of the State Dairy and Food Commission. Wisconsin. 1890.

Annual Report of the Maine State College. 1890.

Maine School Reports. 1890.

First Annual Report of the Board of Commissioners of Lunacy. New Hampshire. 1890.

Forty-Ninth Registration Report of Massachusetts. 1890.

Transactions of the State Medical Association of Texas. 1891.

Reports.

Alabama. Report of the State Board of Health for 1889.

Connecticut. Thirteenth Annual Report of the State Board of Health. 1890.

Illinois. Eleventh Annual Report of the State Board of Health for 1888.

Indiana. Ninth Annual Report of the State Board of Health for 1890.

Kansas. Sixth Annual Report of the State Board of Health for 1890

Maryland. Ninth Biennial Report of the State Board of Health for 1890–91.

Massachusetts. Twenty-second Annual Report of the State Board of Health for 1890.

———. Examination of Water Supplies. 1890.

———. Purification of Sewage and Water. 1890.

Minnesota. Thirteenth Report of the State Board of Health for 1889–90.

New Hampshire. Ninth Annual Report of the State Board of Health for 1890.

New Jersey. Fourteenth Annual Report of the State Board of Health for 1890.

New York. Eleventh Annual Report of the State Board of Health for 1890.

North Carolina. Third Biennial Report of the State Board of Health for 1889–90.

Ohio. Fifth Annual Report of the State Board of Health for 1890.

Ontario. Ninth Annual Report of the Provincial Board of Health for 1890.

Pennsylvania. Fifth Annual Report of the State Board of Health for 1889.

Pennsylvania. Sixth Annual Report of the State Board of Health for 1890.

Rhode Island. Thirteenth Annual Report of the State Board of Health for 1890.

Wisconsin. Thirteenth Annual Report of the State Board of Health for 1889-90.

Bangor, Me. Annual Reports for 1890-91.

Boston, Mass. Nineteenth Annual Report of the Board of Health for 1890.

Concord, N. H. Report of the Board of Health for 1890.

Fall River, Mass. Thirteenth Report of the Board of Health for 1890.

Lynn, Mass. Eleventh Annual Report of the Board of Health for 1890.

Manchester, N. H. Annual Report of the Board of Health for 1890.

Mansfield, Ohio. Report of the Health Department for 1890.

Newburgh, N. Y. Report of the Health Officer for 1890.

New Haven, Ct. Eighteenth Annual Report of the Board of Health for 1890.

Newport, R. I. Sixth Annual Report of the Board of Health for 1890.

New York. Report of the Health Officer of the Port of New York for 1891.

Old Town, Maine. Annual Report of the Town Officers for 1891.

Portland, Me. Sixth Annual Report of the Board of Health for 1891.

Memphis, Tenn. Twelfth Annual Report of the Board of Health of Shelby County for 1890.

St. Louis, Mo. Fourteenth Annual Report of the Health Commissioner for 1890-91.

Taunton, Mass. Annual Report of the Board of Health for 1890.

Report upon the state of Public Health in the City of Dublin. 1889.

Annual Report of the City Civil Engineer, Portland. 1890-91.

Report of the Massachusetts State Board of Health upon the sewerage of the Mystic and Charles River Valleys. Boston. 1889.

Report on the Disposal of Sewage. Ontario. 1891.

Report of the Northeastern Sanitary Inspection Association. 1889-90.

Fifth Annual Report of the Maine Eye and Ear Infirmary. Portland. 1890.

Report of the Committee on Contagious Diseases of Animals. Maine. 1890.

Report of the Committee on Sanitary and Medical Service on Emigrant Ships. 1891.

Ninth Annual Report of the Brooklyn Home for Consumptives. 1890.

Report of the Fifth Annual Meeting of Executive Health Officers of Ontario. 1890.

Sanitary and Other Journals for 1891.

Index Medicus. Detroit and Boston.
The Sanitarian. Brooklyn, N. Y.
The Sanitary News. Chicago.
The Annals of Hygiene. Philadelphia.
The Engineering and Building Record. New York.
The Sanitary Record. London.
Public Health. London.
Architecture and Building. New York and Chicago.
Brooklyn Medical Journal. Brooklyn, N. Y.
Medical News. Philadelphia.
The Lancet. London.
The Microscope. Trenton, N. J.
The American Monthly Microscopical Journal. Washington.
Archives of Pediatrics. Philadelphia.
Babyhood. New York and London.
The Bacteriological World. Battle Creek, Mich.
Science. New York.
Medical Times. New York.
Canada Health Journal. Ottawa.
Occidental Medical Times. Sacramento.
Medical Standard. Chicago.
Medical Review. Pittsburgh.
Abstract of Sanitary Reports. Washington.
Revue D'Hygiene. Paris.
Journal D'Hygiene Populaire. Montreal.
Archiv für Hygiene. Munich and Leipzig.
Zeitschrift für Hygiene. Berlin.
Vierteljahrsschrift für öffentliche Gesundheitspflege. Braunschweig.
Deutsche Medicinische Wochenschrift. Berlin.
Zeitschrift fur Schulgesundheitspflege. Hamburg.
Arbeiten aus dem kaiserlichen Gesundheitsamte. Berlin.
Centralblatt für Bakteriologie und Parasitenkunde. Jena.
Schweizerische Blätter für Gesundheitspflege. Zurich.

Giornale della Reale Societa Italiana D'Igiene. Milano.
La Salute Pubblica. Perugia.
Public Health in Minnesota. Red Wing.
Monthly Bulletin of the Iowa State Board of Health. Des Moines.
Bulletin of the State Board of Health of Tennessee. Nashville.
Bulletin of the North Carolina Board of Health.
Monthly Bulletin of the State Board of Health of Rhode Island.
Monthly Sanitary Record, State Board of Health of Ohio.

Pamphlets.

Baker. A Plea for Public Health Work in Villages. 1891.
Conn. Hygienic Conditions of Passenger Cars.
Denison. The Preferable Climate for Consumption.
Denton. Trap-Siphongage and Trap-Seal Protection. Hoboken, N. J. 1891.
Enebuske. The Gymnastic Progression. Boston, 1890.
Gerrish. A Medical Dictionary. Portland. 1891.
Hogan. Heating and Ventilating Hospitals.
Homan. The Relation of Land Monopoly to Population Health. Concord, 1891.
———. Land Liberation as a Health Measure.
Jackson. Upright vs. Sloping Writing. London.
Kerlin. The Moral Imbecile. Elwyn, Pa. 1890.
Ladies Sanitary Association, London. The Use of Pure Water.
———. Cruelty to Children.
———. Sanitary Defects and Medical Shortcomings.
———. The Two Breaths.
———. Remarks on Woman's Work in Sanitary Reform.
Lee. An Analysis of the Statistics of Forty-One Thousand Five Hundred Cases of Epidemic Influenza. Philadelphia. 1890.
Marble. Sanitary Conditions for School-Houses. Washington. 1891.
Martin. Chemistry in the High School. Indianapolis. 1886.
McClellan. The Sewer Gas Question.
Mulley. Songs and Games for our Little Ones. New York. 1889.
Pendleton. The Physician and his Neighbor. Albany. 1890.
Pumpelly. Filtering Capacity of Soils.
Robinson. Arsenic in Paper and Fabrics. Brunswick. 1891.
Robertson. Overpressure in Schools. Muscatine, Ia. 1885.

Sedgwick. Sanitary Condition of the Water Supply of Lowell. 1890.

Vallin. Salicylic Acid in Foods.

Wolff. The Ventilation of Buildings. New York.

Woodbridge. Heating and Ventilation of the Buildings of the Massachusetts Institute of Technology.

Altschul. Zur Schularztfrage. Prag. 1890.

Bauer. Die Schutzpockenimpfung und Ihre Technik. Stuttgart. 1890.

Bernhardt. Ueber Schulhygiene. Leutenberg i. Thur. 1891.

Cohn. Die Schularztdebatte auf dem internationalen hygienischen Kongress zu Wien. Hamburg. 1888.

Engelhorn. Schulgesundheitspflege. Stuttgart. 1888.

Felix. Sorget für die Gesundheit der Schulen. Berlin. 1891.

Hasebroek. Ueber die Nervosität und den Mangel an Körperlichen Bewegung in der Grossstadt. Hamburg. 1891.

Janke. Grundriss der Schulhygiene. Hamburg. 1890.

Janssens. Annuaire Demographique et Tableaux Statistiques des Causes de Deges. Bruxelles. 1890.

Körösi. Neue Beitrage zur frage des Impfschutzes. Berlin. 1891.

Liebreich. School Life in its Influence on Sight and Figure. London. 1885.

Liceaga. Las Inoculaciones Preventivas de la Rabia. Mexico. 1888.

Mantegazza. Die Hygiene der Sinne. Königsberg.

Martin. Le Bureau D'Hygiene de Bruxelles. Paris. 1890.

Raydt. Das Jugendspiel. Hanover. 1891.

Roepcke. Die Animale Impfanstalt. Stuttgart. 1890.

Schmidt. Die Staubschadigungen beim Hallenturnen. Leipzig. 1890.

Schmidt-Rimpler. Die Schulkurzsichtigkett und ihre Bekampfung. Leipzig. 1890.

Schubert. Ueber Heftlage und Schriftrichtung. Hamburg. 1890.

Schulz. Impfung, Impfgeschaft und Impftechnik. Berlin. 1888.

La Fevre Juane. Paris. 1888.

Rapport fait au Conseil Comunal. Bruxelles. 1890.

Care of the Feeble-Minded. San Francisco. 1889.

Refrigerators and Food Preservation in Foreign Countries. Washington. 1890.

Summer Complaints of Infants and Children.

The Quarantine System of Louisiana. 1887.

National Smoke Abatement Exhibition. Albert Palace, Battersea. London. 1887.

Hearing before the Committee on Public Health on Dangers to Human Life from the Bacilli of Tuberculosis in Milk. Boston. 1891.

Transactions Maine Medical Society. 1891. Vol. X.

Transactions Vermont State Medical Society. 1887.

Proceedings of the Eighth Annual Conference of the National Confectioners' Association. 1890-91.

Proceedings of the American Association for the Advancement of Physical Education. New York. 1888.

———. Cambridge and Boston. 1890.

———. Boston. 1891.

Proceedings and Addresses at a Sanitary Convention held at Lapeer, Mich., March 27-28, 1890.

Proceedings and Addresses at a Sanitary Convention held at Battle Creek, Mich. June 25-26, 1890.

Proceedings and Addresses at a Sanitary Convention held at Alpena, Mich. July 10-11, 1890.

Public Health Laws of Michigan. 1890.

Local Boards of Health of the State of New Jersey. 1890.

Bureau of Education. Higher Education in Indiana. Washington. 1891.

Iowa State Board of Health. Decisions of the Iowa Supreme Court.

Minnesota State Board of Health. The Public Health Legislation of Minnesota.

Pennsylvania State Board of Health. The Operations of the Board of Health in Consequence of the Floods at Johnstown of May 31, 1889.

———. Precautions against Sunstroke.

———. School Hygiene.

Provincial Board of Health, Quebec. Vital and Mortuary Statistics of the Catholic Population. 1889–90.

———. By-Laws and Regulations of the Board of Health of the Province of Quebec.

EXPENSES OF THE BOARD.

The amount and character of the expenditures of the board for the year 1891 were as follows:

Engraving and drawing	$ 2 80	
Books and sanitary journals	245 34	
Instruments	18 50	
Paper and stationery	117 65	
Postage	256 25	
Printing and binding	657 24	
Secretary's salary	2,000 00	
Expenses of members	483 36	
Express and telegraph	202 20	
Clerical help	815 63	
Chemical and microscopical supplies	19 28	
Hired or expert help	136 05	
Office furnishings	45 70	
Total		$5,000 00

LOCAL BOARDS OF HEALTH

AND

EXTRACTS FROM THEIR REPORTS.

ABBOT.

Members of the board: J. B. Greenlief, Secretary; Charles Foss, Chairman; F. W. Weymouth.

ACTON.

Members of the board: Dr. Geo. A. Allen, Secretary; C. N. Brackett, Chairman; O. C. Titcomb.

One nuisance was removed. No cases of the specified contagious diseases. Pneumonia and measles were quite prevalent; the latter disease went all through the town.

ALBION.

Members of the board: O. Meader, Secretary; Dr. C. W. Abbott, Chairman; R. L. Baker.

No contagious diseases to report, except measles in the latter part of December.

ALEXANDER.

Members of the board: A. H. Perkins, Secretary; C. M. Huff, Chairman; J. A. Bohanon.

We had two outbreaks of scarlet fever with three cases and one death altogether.

ALNA.

Members of the board: Dr. A. M. Card, Secretary and Health Officer; B. W. Donnell, Chairman; A. B. Erskine.

We had one case of diphtheria and eight of scarlet fever, but no deaths resulted.

Alton.

Members of the board: H. L. McKechnie, Secretary; Charles Clayton, Chairman; Dr. A. H. Twitchell.

Andover.

Members of the board: George O. Huse, Secretary; Stephen Cabot, Chairman; W. Z. Twitchell.

We have had one case of diphtheria and one of scarlet fever.

Anson.

Members of the board: Stillman A. Walker, Secretary.

Two nuisances were removed. We had one case of typhoid fever.

Appleton.

Members of the board: Dr. F. A. Gushee, Secretary; A. A. Linnekin, Chairman; S. B Ripley.

We had twenty or more cases of scarlet fever with one death and two cases of typhoid fever. Some of the cases of scarlet fever were complicated with diphtheritic laryngitis. One teacher was attacked with diphtheria and scarlet fever. The school was closed and the school-house fumigated.

Argyle.

Members of the board: J. N. Tracy, Secretary; J. M. Freese, Chairman; W. H. Dow.

We had six cases of diphtheria with two deaths, and one non-fatal case of typhoid fever. The houses were placarded and everything done that the law requires. Our opinion is that long outbreaks are unnecessary if strict sanitary measures are enforced.

Arrowsic.

Members of the board: J. S. Cushman, Secretary; Henry Preble, Chairman; C. S. Willis.

Ashland.

Members of the board: J. H. Carter, Secretary; L. C. Coffin, Chairman; Dr. E. A. Duren.

We had seventeen cases of scarlet fever and seven of typhoid fever, but no deaths from these causes.

Athens.

Members of the board: L. N. Ellingwood, Secretary; James Tobey, Chairman; H. C. Taggart.

We had four cases of typhoid fever, but none of diphtheria or scarlet fever. Two of these cases were imported, the one from Portland, the other from Fairfield.

Auburn.

Members of the board: J. W. Beede, Secretary; Daniel Lara, Chairman; H. Lowell.

Of nine nuisances reported to the board, eight were removed. We have had thirteen cases of diphtheria with one death, twenty-three cases of scarlet fever with two deaths, and eighteen cases of typhoid fever with eight deaths.

Scarlet fever made its appearance in the Chamberlain school. The house was thoroughly fumigated, the books at the time standing on the desks and seats with their leaves spread apart. All children from infected houses were excluded from the schools for the prescribed time.

One street has had for several years more than its share of diphtheria, apparently from lack of sewerage. We need more and better flushed sewers, better plumbing, and the abolition of privies in the city proper.

During the outbreak of small-pox in Canada we took the precaution to put a competent man on the Grand Trunk Railroad, secure a house in which to detain suspected passengers for observation, and vaccinated the Canadian children at the city's expense.

Augusta.

Members of the board: Dr. R. J. Martin, Health Officer; Dr. J. O. Webster, Chairman; E. R. Bean, Sanitary Inspector.

Aurora.

Members of the board: A. E. Mace, Secretary; George R. Crosby, Chairman; Henry A. Rowe.

We have had five cases of typhoid fever with two deaths. In connection with these cases, a warning was given to the inmates of the house and the attendants to dispose of the discharges from the patient properly, and to have the houses cleansed after the termination of the disease.

Baileyville.

Members of the board: John D. Lawler, Secretary; J. G. Smith, Chairman; G. W. Libby.

Five cases of scarlet fever occurred in one house and there were two cases of typhoid fever in another, but no deaths resulted.

Baldwin.

Members of the board: Dr. Lorenzo Norton, Secretary; I. S. Chase, Chairman; J. M. Sanborn.

We had one case of typhoid fever in which thorough disinfection of all excreta was provided for.

Bangor.

Members of the board: John Goldthwait, Secretary; Dr. G. M. Woodcock, Chairman; Dr. Daniel McCann.

Baring.

Members of the board: Joseph Stevens, Secretary; Jas. F. Tyler, Chairman; Stephen T. Polleys.

We had two cases of scarlet fever and two of typhoid fever with one death from the latter disease.

Beddington.

Members of the board: A. F. Libby, Secretary; W. A. Coffin, Chairman; Eli Oakes.

Belfast.

Members of the board: Dr. Elmer Small, Secretary; Dr. S. W. Johnson, Chairman; Dr. A. C. Ellingwood, Health Officer.

Ten nuisances came to the notice of the board, all of which were removed.

We had twelve cases of scarlet fever in four houses, and four cases of typhoid fever in the same number of houses. No deaths resulted from these causes.

Belmont.

Members of the board: Miles Pease, Secretary; N. B. Allenwood, Chairman; D. A. Greer.

We had one case of scarlet fever. The school was closed and every precaution taken to keep it from spreading.

Benedicta.

Members of the board: Thomas F. Ryan, Secretary; Michael F. Duffy, Chairman; J. D. Doyle.

There were no cases of infectious diseases. It has been unusually healthy, with the exception of six or eight cases of pneumonia, all of which recovered.

Benton.

Members of the board: Augustus Crosby, Secretary; J. W. Sylvester, Chairman.

Berwick.

Members of the board: Dr. P. B. Young, Secretary; C. M. Guptill, Chairman; Dr. H. V. Noyes.

Four nuisances were reported to the board, all of which were removed. We had sixteen cases of diphtheria with four deaths from this disease. Infected houses were placarded, isolation was maintained and disinfection was carried out thoroughly. Otherwise than from this disease and la grippe, Berwick has been quite free from disease. We need a better water supply.

Bingham.

Members of the board: T. F. Houghton, Secretary; J. D. Merrill, Chairman; Dr. A. A. Piper, Health Officer.

One nuisance was removed by the board. We have had no cases of the infectious diseases.

Bluehill.

Members of the board: Dr. R. P. Grindle, Secretary and Health Officer; A. C. Osgood, Chairman; R. G. Lord.

We have had no cases of the infectious diseases. A thorough cleaning out of a brook running through a section of the village and the covering of it for a distance of thirty rods are needed.

Boothbay.

Members of the board: Dr. Alden Blossom, Secretary and Health Officer; Byron Giles, Chairman; John R. McDougal.

We have had four cases of diphtheria, two of scarlet fever, and six of typhoid fever, but no deaths resulted. Measles has been prevalent.

Bowdoin.

Members of the board: Albert P. Small, Secretary; Thomas R. Rand, Chairman; Abner Coombs.

One nuisance was removed and we have had one case of typhoid fever. One fatal accident occurred.

Bradford.

Members of the board: Henry T. Williams, Secretary; Dr. Wm. E. Walker, Chairman; Dr. Daniel C. Dennett, Health Officer.

No cases of infectious diseases were reported during the year.

Bradley.

Members of the board: A. W. Perkins, Secretary; J. Bachelder; J. N. Knapp.

Brewer.

Members of the board: W. H. Gardiner, Secretary; Dr. I. Getchell, Chairman; E. A. Stanley.

Six nuisances were removed by the board. We had one case of diphtheria, eighteen of scarlet fever, and more than 125 of typhoid fever. Two of the scarlet fever cases and eight of the typhoid fever cases terminated fatally.

In regard to the typhoid fever epidemic I would state that late in July the pumps of the company that furnishes the water supply taken from the river at Veazie above the city, broke down, and, unknown to the water takers, water was furnished by a steam pump at a mill about one and one-half miles below the Bangor and Brewer bridge, and so received the sewage of both Bangor and Brewer. Wells long unused were drawn from, furnishing, perhaps, as impure a supply as that taken from the river. This, in the opinion of the chairman of our board, was the cause of the typhoid fever outbreak, and this opinion was concurred in by all the other physicians.

Bridgewater.

Members of the board: R. H. Perkins, Secretary; Thomas G. Durgin, Chairman; Charles Kidder.

One nuisance was removed. No cases of infectious diseases except whooping cough.

Brighton.

Members of the board: L. D. Mathews, Secretary; Asa Strickland, Chairman; G. C. Davenport.

No cases of infectious diseases.

Brooklin.

Members of the board: E. P. Cole, Secretary; Geo. R. Allen, Chairman; Dr. F. S. Herrick.

In the way of improvements for water supply, an artesian well was sunk 180 feet to supply a sardine factory and its employes with pure water. One nuisance was removed in part. We have had no cases of diphtheria, scarlet fever or typhoid fever, but measles and whooping cough prevailed during the spring and summer. One fatal case of measles occurred in an infant.

Brooks.

Members of the board: M. J. Dow, Secretary; I. G. Reynolds, Chairman; Dr. A. W. Rich.

Brookton.

Members of the board: Augustus O. Smith, Chairman; Geo. A. McCluskey.

We had no cases of contagious diseases excepting of whooping cough which was unusually severe.

Brownfield.

Members of the board: Dr. H. F. Fitch, Secretary; Albert Blake, Chairman; S. G. Boynton.

We had one fatal case of typhoid fever. Pneumonia was more than usually prevalent.

Brownville.

Members of the board: T. W. Pratt, Secretary; G. G. Brown, Chairman; Amasa Stanhope.

BRUNSWICK.

Members of the board: Dr. M. V. Adams, Secretary; W. O. Peteison, Chairman; Dr. G. H. Coombs.

BUCKSPORT.

Members of the board: E. A. Crocker, Secretary; Dr. G. H. Emerson, Chairman; Dr. W. C. Stilson, Health Officer.

We have had six cases of diphtheria, fourteen of scarlet fever, and five of typhoid fever. Scarlet fever was introduced in one of the schools. The school was closed, houses were placarded and isolation was maintained until the danger period was passed. Better sewerage is needed.

BURLINGTON.

Members of the board: J. W. Bradbury, Secretary; Thomas Shorey, Chairman; Frank Bower.

We have had eight cases of typhoid fever with two deaths. The houses were visited and the circulars, together with such advice as was thought proper, were given and such assistance was offered as was needed.

Our greatest need is improvement in the heating and ventilation of our school-rooms. At first, considerable fault was found with the work of the board, many of the citizens saying it is all nonsense; but more lately the people are seeing the need of sanitary work.

BURNHAM.

Members of the board: George Dyer, Secretary; N. E. Murray, Chairman; Walter Edmunds.

We had two cases of typhoid fever, one of which was fatal.

BUXTON.

Members of the board: Dr. Charles A. Dennett, Secretary and Health Officer; J. H. Waterman, Chairman; Charles Hobson.

Of six nuisances, five were removed. Diphtheria, seven cases, one death; typhoid fever, one case. Dysentry was more than usually prevalent.

BYRON.

Members of the board: H. H. Richards, Secretary; George H. Ladd; Chairman; A. S. Young.

With the exception of measles we have had no infectious diseases.

Calais.

Members of the board: Dr. D. E. Seymour, Secretary; C. Ellis, Chairman; Dr. E. H. Vose.

Five nuisances were reported to the board; eleven were removed. Diphtheria, forty-nine cases, fourteen deaths; scarlet fever, twenty-seven cases with one death; typhoid fever, three cases. The only outbreak of typhoid fever was believed to have had its origin in a polluted well. An analysis was had and the well was closed.

Cambridge.

Members of the board: J. B. LaBree, Secretary; J. W. Cole, Chairman; G. E. Bailey.

Camden.

Members of the board: J. B. Swan, Secretary; Charles Bowers, Chairman; Alexander Buchanan.

Fourteen nuisances were removed. We have had one case of scarlet fever and two of typhoid fever, but no deaths from these diseases. Our water supply is perfect, but better sewerage and drainage are needed very much, and at a meeting of the board December 26th, resolutions were adopted requesting the selectmen to undertake work of this kind.

Caribou.

Members of the board: Dr. J. Cary, Secretary; Rev. C. E. Young, Chairman; C. B. Roberts, Esq.

Six nuisances were removed. We have had six cases of scarlet fever and eighteen of typhoid fever, none of which were fatal. Better drainage is needed. One death resulted from a burn.

Carmel.

Members of the board: F. A. Simpson, Secretary; Henry Kimball, Chairman; W. A. Swan; Dr. S. W. Otis, Health Officer.

Two nuisances were removed. Diphtheria, two cases with one death; scarlet fever, two cases.

Carthage.

Members of the board: S. C. Morse, Secretary; W. W. Goodwin, Chairman; John S. Swett.

We have had no cases of infectious diseases and the year has been one of unusual healthfulness.

CASCO.

Members of the board: L. W. Holden, Secretary; H. B. Harmon, Chairman; Samuel Winslow.

No infectious diseases reported.

CASTINE.

Members of the board: Dr. George A. Wheeler, Secretary; Curtis Stevens, Chairman; Dr. E. E. Philbrook.

Three nuisances were removed. One case of typhoid fever.

CHARLESTON.

Members of the board: Dr. G. D. Cook, Secretary; O. L. Smith, Chairman; H. M. Stevens.

CHARLOTTE.

Members of the board: F. J. Sprague, Secretary; D. J. Fisher, Chairman; H. W. Stuart.

No infectious diseases reported.

CHELSEA.

Members of the board: A. N. Douglass, Secretary; Wm. T. Searls, Chairman; A. A. Sampson.

Four nuisances were removed. We have had one case of typhoid fever. A survey has been made by the United States Government with a view to laying a sewer from the National Home to the Kennebec river, thereby stopping the open flow of excreta through this town.

CHERRYFIELD.

Members of the board: Dr. C. J. Milliken, Secretary; Samuel Ray, Chairman; Dr. E. B. Silsby.

One nuisance was removed. Diphtheria, ten cases, no deaths; typhoid fever, six cases, one death.

CHESTER.

Members of the board: J. D. Kyle, Secretary; Edwin Savage, Chairman; Abram Libby.

One nuisance was removed. No infectious diseases.

China.

Members of the board: Dr. G. J. Nelson, Secretary; C. E. Dutton, Chairman; J. E. Crossman.

Two nuisances were removed. Two fatal cases of typhoid fever. One death occurred from drowning. Measles prevailed in the north part of the town. My observations with the epidemic of influenza which prevailed during the winter and spring have convinced me that this disease is contagious.

Clifton.

Members of the board: S. A. Parks, Secretary; W. D. Campbell, Chairman; H. G. Doble.

We have had one case of typhoid fever. One school was closed on account of pneumonia.

Clinton.

Members of the board: J. M. Winn, Chairman; Royal Wells; Dr. E. F. Webber, Health Officer.

We have had one case each of diphtheria and scarlet fever.

Columbia Falls.

Members of the board: A. M. Leighton, Secretary; W. E. Bailey, Chairman; A. T. Worcester.

We had one case of typhoid fever.

Concord.

Members of the board: E. O. Vittum, Secretary; Amon Savage, Chairman; C. R. Ellis.

We had one case of scarlet fever ending in recovery. The house was placarded and the people took particular pains to keep the disease from spreading. One nuisance was removed.

Cooper.

Members of the board: E. E. Leland, Secretary; David Howe, Chairman; W. W. Sadler.

No infectious diseases reported.

Corinna.

Members of the board: J. P. Curtis, Secretary; Edwin Folsom, Chairman; Dr. O. H. Merrill, Health Officer.

Diphtheria, one case; scarlet fever, one case; typhoid fever, four cases with one death. Great care was taken that these diseases should not spread; one school was closed and exposed scholars were removed.

Cornish.

Members of the board: F. C. Small, Secretary; Dr. Wm. B. Swasey, Chairman and Health Officer; B. F. Haley.

Seven nuisances were reported to the board, five of which were abated. We have had no cases of the infectious diseases.

An accident happened from the explosion of a lamp in a bed room while the occupant was out. A neighbor sitting at a window near by, saw the explosion and rushed into the house in season to stop the fire from spreading from the room, but had her hands burned quite severely in smothering the fire in the bedding. The cause is supposed to have been the lack of oil in the lamp, for there was very little oil in it.

Cornville.

Members of the board: S. S. Woodman, Secretary; C. E. Smith, Chairman; C. C. Kinsman.

We had one case of diphtheria.

Cranberry Isle.

Members of the board: W. P. Preble, Secretary; T. H. Stanley, Chairman; John Gilley.

One nuisance was removed. One case of typhoid fever. The one case of typhoid fever was supposed to have originated from water drawn from a cellar well.

Crawford.

Members of the board: J. P. Jeffery, Secretary; N. S. Fenlason, Chairman; Robert Wallace.

We had two cases of scarlet fever, both ending in recovery.

Cumberland.

Members of the board: Dr. C. T. Moulton, Secretary and Health Officer; L. H. Merrill, Chairman; A. H. Grannell.

DAMARISCOTTA.

Members of the board: A. H. Snow, Secretary; Dr. E. F. Stetson, Chairman; W. H. White.

We had one fatal case of typhoid fever. Diarrhœal diseases in children were quite prevalent, yet there were but a score of cases of it in all with one fatal case. It would seem that towns ought to be obliged to appropriate some money sufficient to reimburse the board for money actually expended by it, if no more.

DANFORTH.

Members of the board: Dr. M. L. Porter, Secretary; Jas. Carson, Chairman; Charles H. Merrill.

Seven nuisances were removed. Scarlet fever, one case; typhoid fever, nine cases, but no deaths from these diseases. We need better drainage.

DAYTON.

Members of the board: Dr. Geo. Sylvester, Secretary; Cyrus Ricker. Chairman; A. R. Dyer.

One nuisance was removed. Scarlet fever, six cases, no deaths; typhoid fever, one case. Scarlet fever broke out in one school district so as to compel us to stop the school and cleanse and disinfect the house.

DEERING.

Members of the board: L. B. Chapman, Secretary; Dr. A. P. Topliff, Chairman; Capt. Wm. Sinnett.

Nine nuisances were formally reported to the board, eight of which were abated. The other will be removed in the spring. In addition to these nuisances that came under the consideration of the board, many complaints of a minor character were attended to by the secretary alone. The following has been our rule of action: First. On complaint the secretary has visited the premises and given such orders, as in his judgment the cases required. Second. Failure to comply has been followed by an examination if necessary by the full board, and orders signed by the full board have been issued. Third. Ask the assistance of a magistrate.

Diphtheria, ten cases, three deaths; scarlet fever, nine cases, no deaths; typhoid fever, twenty-three cases, one death. In every case the houses infected with diphtheria or scarlet fever are placarded, and such preventive measures as are indicated by the statute law and the town by-laws are put in force.

After the re-organization of the local board, a set of books of records was opened and a suitable portable box with shelves and compartments was procured in which to preserve the books and papers of the board.

We employed a person to make an examination of the Woodfords district by going from house to house inspecting vaults, cesspools and sink drains with the view of being in readiness to present the real condition of matters in the locality should occasion require it, for a petition had been presented to the selectmen. As the municipal officers have never reported the result, our work has not been made known. The conditions are bad; complaints from the locality are many.

Deer Isle.

Members of the board: A. J. Beck, Secretary: P. S. Knowlton, Chairman; Seth Hatch; Dr. F. B. Ferguson, Health Officer.

One nuisance was abated. Scarlet fever, one case; typhoid fever, seven cases, one death. Immediate attention has always been given to every case of infectious disease. Better water and drainage are needed in some parts of the town.

Denmark.

Members of the board: Isaac H. Berry, Secretary; Dr. S. T. Brown, Chairman and Health Officer; Joseph W. Colby.

The past year has brought good health to our residents, and no cases of infectious diseases.

Dennysville.

Members of the board: E. P. Foster, Secretary; G. W. Kilby, Chairman; Dr. A. T. Lincoln, Health Officer.

Detroit.

Members of the board: David F. Libby, Secretary; Parker Sawyer, Chairman; Isaac Spaulding.

Dexter.

Members of the board: E. A. Russ, Secretary; Charles H. Hayden, Chairman; Dr. C. M. Foss, Health Officer.

During the year 300 feet of sewers were put down. Nine nuisances, all of which were removed. Our greatest trouble is from sink drainage entering our public streets. We have had six cases of typhoid fever, but no cases of diphtheria or scarlet fever were reported. One death occurred from a burn, the result of the explosion of a lantern in use near a hay press. A case of arsenical poisoning of a family has already been reported to you in full.

[The following correspondence passed relative to the case to which the secretary referred. A. G. Y.]

DEXTER, ME., October 6, 1891.

A. G. YOUNG, M. D.,

Secretary State Board of Health.

Dear Sir: Our board has this day been called to visit the family of Mr. L. who appeared to have been poisoned. After a thorough examination by Dr. Foss of our board, he pronounces it such. The circumstances are these: A week ago last Friday noon at their table four persons were seated, viz., Mrs. L., Mrs. M., Roy L., age five, and Mr. M., a farm hand. The vegetables on the table were corn, squash and potatoes; no meats. About three P. M. of the same day Mrs. L., Mrs. M., and Mr. M. were taken violently sick. Symptoms were vomiting, pain in the stomach with burning sensation. No doctor was called, but home treatment applied. All recovered. Yesterday (Monday) noon the same party at dinner, except in place of Mr. M. was a man by name of C. For dinner baked potatoes, beans; no meats. (The first day the vegetables were steamed.) About the middle of the afternoon C. was taken with violent headache and vomiting in the field; got to the house with difficulty; found Mrs. L. and Mrs. M. quite sick and vomiting, Roy some sick. C. grew very sick with cramps, pain in the stomach, trembling, burning and hot sensation in stomach, legs and arms cold, no sensation, pulse very low. A physician was called and relief was brought. Now in the first case, Mr. L. being our electrician, was away on the line and took his dinner with him, which was the same as his family ate, except potatoes. In the second case he was away and not at home to dinner. Roy ate about a tablespoonful of baked potato very thickly covered with cream; he was not much sick, but vomited some. Mrs. M. ate very sparingly of potatoes and was quite bad; Mrs. L. ate about one small one and was, as she expressed it, as sick as she cared to be, while C. ate three potatoes and with difficulty his life was saved. Now we have thought best to send to you some of these potatoes, marked as they come from the bin, with request that you cause them to be examined for arsenical poisoning. On the vines Paris green was used both in dry and liquid state. We would like a report of this case as soon as convenient and in the mean time we will watch for other causes.

Very truly yours,

EDGAR A. RUSS,

Secretary Local Board of Health.

AUGUSTA, ME., October 19, 1891.

E. A. RUSS, Esq.,

Secretary Board of Health, *Dexter*.

Dear Sir: Prof. Robinson reports as follows on the potatoes sent by you:—

"The potatoes from Dexter were in several different packages and I have given each a careful examination for arsenic, but find none. I presume that they sent samples from each bin. If arsenic did the mischief, it must have been added to the dinner eaten, or have been in some small cavity in one of the potatoes cooked."

Yours truly,

A. G. YOUNG, *Secretary.*

DIXMONT.

Members of the board: W. H. Toothaker, Secretary; L. F. Simpson, Chairman; Dr. H. A. King, Health Officer.

Two nuisances were removed. No infectious diseases except measles.

DOVER.

Members of the board: G. G. Downing, Secretary; J. Q. Lander, Chairman; Dr. J. B. Cochrane, Health Officer.

Seven nuisances were abated. Diphtheria, two cases, one death; typhoid fever, four cases; measles, one case. The completion of our system of sewerage is needed.

DURHAM.

Members of the board: Dr. J. L. Wright, Secretary and Health Officer; J. E. Hasty, Chairman; A. C. Goddard.

Scarlet fever, six cases; typhoid fever, one case. In connection with the cases of the infectious diseases the houses have been placarded and the patients isolated from the rest of the family as far as possible. I have heard a little fault found with the law requiring placarding, looking after nuisances, etc., as unnecessary, but the large majority of the citizens, and especially the better class and those better educated, heartily praise the law and show a willingness to coöperate with the board.

Eastbrook.

Members of the board: A. P. Bunker, Secretary; G. S. Googins, Chairman; A. W. Googins.

No cases of infectious diseases.

East Machias.

Members of the board: Dr. J. E. Tuell, Secretary; A. J. Hanscom, Chairman; F. H. Wiswell.

We had two cases of scarlet fever; the diarrhœal diseases of children and whooping cough were unusually prevalent.

Eastport.

Members of the board: A. W. Clark, Secretary; A. M. Bibber, Chairman; Andrew Harrington.

Fourteen nuisances were abated. Diphtheria, forty-one cases with ten deaths; typhoid fever, three cases with no deaths.

Eddington.

Members of the board: D. S. Stevens, Secretary; G. W. Estes, Chairman; A. J. Merrill.

We have had one case each of diphtheria, scarlet fever, and typhoid fever. The typhoid case was a fatal one.

Eden.

Members of the board: C. R. Clark, Secretary; O. B. Knowles, Chairman; W. B. Higgins.

All nuisances reported to the board have been removed. Diphtheria, one case; scarlet fever, two cases; typhoid fever, four cases.

Edgecomb.

Members of the board: Eben Chase, Jr., Secretary; Jos. A. Merry, Chairman; D. B. Clifford.

Scarlet fever, two cases; typhoid fever, one fatal case. One accidental death by falling from the mast of a vessel.

EDINBURG.

Members of the board: C. W. Eldredge, Secretary; C. G. Casey, Chairman; G. H. Eldredge.

We have had no infectious diseases except measles, of which we have had seventeen cases.

ELIOT.

Members of the board: Dr. H. I. Durgin, Secretary; Dr. J. L. M. Willis, Chairman; C. A. Hooper.

Diphtheria, one; scarlet fever, five, and typhoid fever, seven cases, but no deaths from these diseases. After the families where typhoid fever prevailed began to drink boiled water, the cases of typhoid fever rapidly diminished and soon ceased to occur.

ELLSWORTH.

Members of the board: Dr. L. Hodgkins, Secretary; Dr. A. C. Hagerthy, Chairman; Dr. W. M. Haines, Health Officer.

Thirteen nuisances were reported. Twelve were removed, one was decided not to be a nuisance. Scarlet fever, eight cases, one death; typhoid fever, four cases, two deaths.

As showing the importance of suitable sanitary measures, I would state that in a family of four children, all under ten years of age, restricted to the use of two large rooms and one small one in a crowded, poorly ventilated and undrained tenement, such measures, with a strict quarantine, restricted scarlet fever to a single child, though, meanwhile, a second one died of cholera infantum, making it almost impossible to maintain the quarantine.

EMBDEN.

Members of the board: S. A. Walker, Secretary; R. F. Durrell, Chairman; Gilbert Dunbar.

ETNA.

Members of the board: Stillman J. Locke, Secretary; James Goodell; E. E. Sylvester.

Of infectious diseases, we have had only two cases of typhoid fever.

Eustis.

Members of the board: O. A. Hutchins, Secretary; C. D. Stevens, Chairman; F. L. Porter.

One nuisance was removed. We have had no cases of infectious disease except whooping cough which prevailed very generally. Two men were drowned driving logs last spring.

In an adjoining plantation in which there is no local board of health, a case of diphtheria occurred. It alarmed our citizens to such an extent that we visited the place, placarded all the entrances, distributed notices of warning, etc., and by so doing hemmed the disease in and prevented its further spread.

Exeter.

Members of the board: Dr. W. F. Hart, Secretary; S. J. French, Chairman; Dr. S. W. L. Chase.

We had no cases of infectious diseases.

Farmingdale.

Members of the board: Dr. F. M. Putnum, Secretary and Health Officer; A. G. Stilphen, Chairman; Arthur McCausland.

Two nuisances were abated. One case each of diphtheria, scarlet fever, and typhoid fever. Measles, German measles, and influenza were unusually prevalent. One death from drowning.

Farmington.

Members of the board: Dr. F. O. Lyford, Secretary and Health Officer; E. O. Greenleaf, Chairman; H. W. Lowell.

Three cases of scarlet fever and one of typhoid fever. Better sewerage is needed.

Forest City.

Members of the board: J. A. Lawler, Secretary; A. A. Cox, Chairman; Frank Lydick.

The foregoing are the members of the board of selectmen, acting as a local board. Three cases of scarlet fever.

Foxcroft.

Members of the board: R. M. Ingalls, Secretary; O. P. Martin, Chairman; G. H. Pratt.

FRANKLIN.

Members of the board: H. T. Whitaker, Secretary; G. H. Rutter, Chairman; C. T. Bunker.

Two nuisances removed. Five cases of diphtheria.

FRANKLIN PLANTATION.

Members of the board: L. C. Putnam, Secretary; C. G. Irish, Chairman; C. D. Lane.

No cases of the infectious diseases.

FREEDOM.

Members of the board: C. P. Hutchins, Secretary; J. E. Sylvester, Chairman; Dr. C. E. Wilson, Health Officer.

Two nuisances were reported and one of them was removed. We have had two cases of typhoid fever. Diarrhœal diseases were unusually prevalent in the summer.

FREEMAN.

Members of the board: R. A. Dyer, Secretary; Nelson Peterson, Chairman; J. M. Burbank.

FREEPORT.

Members of the board: W. C. Fogg, Secretary; J. P. Merrill, Chairman; B. P. Soule.

A public water supply has been put in by the Freeport Water Company. Six nuisances were removed. Diphtheria, three cases, with two deaths; typhoid fever, four cases. There was a light run of scarlet fever in the spring, so light that it was hard to tell what it was at first.

FRIENDSHIP.

Members of the board: Dr. G. C. Chamberlain, Secretary and Health Officer; R. R. Morton, Chairman; A. M. Simmons.

One nuisance was removed. We have had three cases each of scarlet fever and typhoid fever.

FRYEBURG.

Members of the board: E. Ballard, Secretary; Dr. W. C. Towle, Chairman; E. S. Chase.

We have had one case of typhoid fever.

Gardiner.

Members of the board: Dr. F. S. Packard, Secretary; S. E. Johnson, Chairman; Van R. Beedle.

A sewerage survey has been made and two or three extensions to the sewers have been laid. Nearly all the nuisances reported were abated. One filthy place had to be ordered to be vacated before the landlord would fix up the premises.

Diphtheria, three cases; scarlet fever, one case reported; typhoid fever, twelve cases, two deaths. Measles have been prevalent during the winter. Two fatal cases of cerebro-spinal meningitis.

For improving the sanitary condition of the city, the building of more sewers and the making of every abutter connect with them are to be recommended. Two deaths occurred from accidental drowning and one man was killed by the cars.

Garland.

Members of the board: Dr. F. A. C. Emerson, Secretary; E. L. Oak, Chairman; D. H. Robinson.

Gilead.

Members of the board: P. Harriman, Secretary; Seth Bemis, Chairman; Edgar Harriman.

We have had no cases of the infectious diseases.

Glenburn.

Members of the board: J. F. Tolman, Secretary; Elisha Hill, Chairman; H. N. Parker.

Two cases of typhoid fever.

Gorham.

Members of the board: G. W. Heath, Secretary; C. G. Carver, Chairman; Dr. A. W. Lincoln, Health Officer.

Three nuisances were removed. Scarlet fever, six cases; typhoid fever, one case. A little boy was burned badly by his clothes taking fire.

Gouldsboro.

Members of the board: B. F. Sumner, Secretary; R. R. Joy, Chairman; Dr. C. C. Larrabee.

Gray.

Members of the board: Dr. J. F. Rowell, Secretary; Dr. E. A. McCollister, Chairman; Dr. E. T. Andrews.

Improvements have been made in regard to water supply. Diphtheria, one case; typhoid fever, three cases. Measles has been prevalent.

Greene.

Members of the board: Geo. E. Parker, Secretary; Dr. Albion Pierce, Chairman; Dr. Geo. Sleeper, Health Officer.

Diphtheria, one case; typhoid fever, four cases. In answer to your enquiry whether there are any particularly unhealthy localities in town, I would say that there is one such at the town farm. The cause is a water-closet where an insane man is kept.

Greenville.

Members of the board: Rev. Charles Davison, Secretary; H. A. Saunders, Chairman; Wm. Shaw; Dr. H. Hunt, Jr., Health Officer.

Greenwood.

Members of the board: A. C. Libby, Secretary; Wm. Richardson, Chairman; H. C. Berry.

One complaint only of nuisance has been made and the nuisance was removed as soon as the owner's attention was called to it. We have had two cases of diphtheria, and one each of scarlet fever and typhoid fever. The case of typhoid fever was caused by polluted water.

Guilford.

Members of the board: John Scales, Secretary; L. N. Whittier, Chairman; Henry Straw.

We have had no cases of infectious diseases.

Hallowell.

Members of the board: E. W. Maddox, Secretary; Ira M. True, Chairman; Geo. A. Safford.

Six nuisances, all of which were removed. Diphtheria, two, scarlet fever, six, and typhoid fever, ten cases. Better sewerage is needed in the city.

Hampden.

Members of the board: Dr. W. H. Nason, Secretary and Health Officer; C. F. Cowan, Chairman; Hon. H. W. Mayo.

Scarlet fever, three cases; typhoid fever, four cases, one of which was fatal. In addition to our other work we have endeavored to have the privy vaults of school-houses attended to better and think we have succeeded in a measure.

Hancock.

Members of the board: A. B. Crabtree, Secretary; R. H. Young, Chairman; John Anderson.

No infectious diseases.

Hanover.

Members of the board: J. B. Roberts, Secretary; J. R. Howard, Chairman; C. E. Chapman.

One nuisance removed. No infectious diseases except measles.

Harmony.

Members of the board: L. S Reed, Secretary; S. Leighton, Chairman; Dr. F. K. Hurd, Health Officer.

One nuisance was removed. No infectious diseases. One drowning accident while skating. The local board has been watchful and ready to act upon the first indication of anything wrong.

Harpswell.

Members of the board: J. S. Farr, Secretary; J. M. Stinson, Chairman; Geo. H. Dearbon.

Three nuisances were removed. Scarlet fever, three cases; typhoid fever, five cases.

Harrington.

Members of the board: E. R. McKenzie, Secretary; Dr. G. H. Walling, Chairman; Charles S. Wass.

We have had two cases of diphtheria and one of typhoid fever. The typhoid case was contracted away from home.

Hermon.

Members of the board: Dr. F. P. Whitaker, Secretary; F. A. Bishop, Chairman; Josiah Tusely.

Two nuisances were abated. Scarlet fever, twenty cases; typhoid fever, seven cases with one death. Two schools were closed on account of scarlet fever.

Hersey.

Members of the board: E. E. Morse, Secretary; L M. Davis, Chairman; J. P. Crommett; Dr. B. C. Woodbury, Health Officer.

We have had no contagious diseases.

Hiram.

Members of the board: John Pierce, Secretary; A. K. P. Googins, Chairman; S. D. Wadsworth; Dr. C. E. Wilson, Health Officer.

Quite a number of citizens have discarded their old wells near the outbuildings and have put down aqueducts, taking water from the hillsides. One nuisance was removed.

Hodgdon.

Members of the board: Moses Benn, Secretary; Dr. J. V. Tabor, Chairman; Wm. Atherton.

We have had no cases of infectious diseases.

Holden.

Members of the board: Alexander Tirrell, Secretary; D. S. Winchester, Chairman; J. E. Rowe.

Two nuisances were removed. We have had four cases of typhoid fever with one death.

Hollis.

Members of the board: Thomas J. Carle, Secretary; Charles Randell, Chairman; Collins Haley.

There has not been a case of contagious sickness in town for the year.

Hope.

Members of the board: D. H. Mansfield, Secretary; M. Metcalf, Chairman; Levere Howard; Dr. Isaac Bartlett, Health Officer.

With the exception of one case of typhoid fever there have been no contagious diseases. For bettering the sanitary condition of the town I would improve the sources of some of the drinking water supplies. An occasional bath would not hurt some of us.

HOULTON.

Members of the board: Dr. C. E. Williams, Secretary and Health Officer; L. B. Johnson, Chairman; Dr. George Cary.

Our system of water-works has been extended and several hundred feet of the "Bailey Brook" have been enclosed. About twenty-five nuisances were reported and all as far as possible were removed. Diphtheria, three cases, one death; scarlet fever, five cases; typhoid fever, eight cases, one death. In all the outbreaks the disease was confined to the first house infected. The patients were isolated. Invariably in cases of scarlet fever and diphtheria the secretary has visited the family and instructed them as to danger and the importance of isolation and other prophylactic measures.

HOWLAND.

Members of the board: J. O. Davis, Secretary; L. T. Mason, Chairman; Charles Cummings.

One nuisance was abated. Three cases of tyhoid fever with one death. Whooping cough prevailed.

HURRICANE ISLE.

Members of the board: M. H. McIntire, Secretary; E. S. Thombs; W. S. Shields.

Three nuisances were removed. No infectious diseases.

INDUSTRY.

Members of the board: H. B. Luce, Secretary; C. W. Gilmore, Chairman; Harrison Daggett.

We have had no infectious diseases except one of typhoid fever.

ISLAND FALLS.

Members of the board: G. H. Donham, Secretary; Alpheus Craig, Chairman; W. D. Warren.

One case of typhoid fever is all the infectious disease we have had. It has been very healthy all the year. There were but two deaths and one of these was a woman nearly ninety-one years old.

ISLE AU HAUT.

Members of the board: Edwin Rich, Secretary; James Robinson, Chairman; J. T. Barter.

No infectious diseases. There has been but one death during the year.

ISLESBORO.

Members of the board: J. A. Sprague, Secretary; Alonzo Coombs, Chairman; L. W. Hammond.

We have had four cases of diphtheria and seven of typhoid fever and a prevalence of whooping cough. One death by drowning.

JACKSON.

Members of the board: M. S. Stiles, Secretary; D. D. Gould, Chairman; A. J. Mudgett.

JAY.

Members of the board: H. H. Allen, Secretary; S. B. Farnum, Chairman; F. W. Merritt.

Two cases of typhoid fever. One death resulted from fire caused by lightning. The school-houses throughout the town are not properly ventilated. Better drainage is needed.

JEFFERSON.

Members of the board: J. J. Bond, Secretary; Henry W. Clary, Chairman; Dr. A. A. Jackson, Health Officer.

Five nuisances were removed. Scarlet fever, twelve cases; typhoid fever, two cases. Gastritis was prevalent in the autumn, which I attribute to the bad condition of the drinking water. For the improvement of the sanitary condition of the town I should recommend a less intimate relationship of privies, sinks, and wells, and the ventilation of houses.

JONESBORO.

Members of the board: E. M. Watts, Secretary; G. E. Noyes, Chairman; W. T. Noyes; Dr. H. H. Smith, Health Officer.

Ten or twelve nuisances were removed. There has been no occasion for making formal complaint as all have seemed willing to comply with the law as soon as their attention was called to it. We had one fatal case of typhoid fever. There was quite an epidemic of whooping cough.

JONESPORT.

Members of the board: J. W. Peasley, Secretary; G. E. Watts, Chairman; E. L. Kelley.

We have had no cases of the infectious diseases.

KENNEBUNKPORT.

Members of the board: Wm. H. Cluff, Secretary; E. T. Coleman, Chairman; Ivory Bickford.

Five nuisances were abated. Our town has been remarkably free from contagious diseases during the past year, not a single case of diphtheria, scarlet fever, or typhoid fever having been brought to our notice. Better ventilation and greater cleanliness in school-houses are needed.

KINGFIELD.

Members of the board: James Lord, Secretary; W. E. Cummings, Chairman; Edwin Ellis; Dr. W. O. Simmons, Health Officer.

Of infectious diseases we have had only a single case of scarlet fever.

KNOX.

Members of the board: J. R. Sparrow, Secretary; J. H. Brown, Chairman; J. W. Linniken.

No cases of infectious diseases have come to our notice.

LAGRANGE.

Members of the board: H. W. Blake, Secretary; F. H. Savage, Chairman; Dr. A. H. Stanhope, Health Officer.

We have had no cases of infectious diseases, except five of typhoid fever in one family.

LAMOINE.

Members of the board: W. S. Hodgkins, Secretary; E. H. King, Chairman; I. N. Salisbury.

We have had no infectious diseases. One death from drowning, and one lady fell from a team and broke her neck.

LEEDS.

Members of the board: H. M. Brewster, Secretary; Dr. R. S. Loring.

One nuisance was removed. Diphtheria, seven cases, one death; typhoid fever, six cases, two deaths. Measles and pneumonia have been unusually prevalent.

LEVANT.

Members of the board: C. W. Fernald, Secretary; C. M. Page, Chairman; Dr. A. M. Purington, Health Officer.

No infectious diseases.

LEWISTON.

Members of the board: George A. Callahan, Secretary; Thomas Vaughan, Chairman.

Over one hundred nuisances were reported, all of which were removed. We have had five cases of diphtheria, sixteen of scarlet fever, and twenty-two of typhoid fever. Four of the typhoid cases were fatal. All of the outbreaks have been confined to the first house. Premises have been visited and inspected, entrances have been placarded and a disinfection has followed recovery.

For the improvement of the sanitary condition of the city I would recommend an extension of the sewerage system and ordinances to compel entrance to the sewers.

We employ a team regularly to collect garbage from dwellings and stores. When small-pox prevailed in Canada precautions were taken against the importation of the infection, and between two and three thousand French Canadians were vaccinated at the expense of the city. This report is for the last half of the year, as no record is obtainable for the first six months.

LIMESTONE.

Members of the board: A. D. Hatfield, Secretary; E. G. Weymouth, Chairman; Thomas Maines.

LIMINGTON.

Members of the board: L. P. Thompson, Secretary; Dr. J. F. Moulton, Chairman; Dr. G. W. Weeks.

Two nuisances have been removed. We have had twenty-four cases of scarlet fever and three of typhoid fever with one death from the latter disease.

Mrs. J. B. died. The premonitory symptoms appeared like lead poisoning without paralysis. The liver was much enlarged, and albumen was present in the urine, the result, as the physician thought, of chronic lead poison. One other member of the family had lead colic and paralysis a few months previous to the illness of Mrs. B.

A sample of the drinking water was analyzed by your board in 1890 and pronounced charged with lead.

Lincoln.

Members of the board: Dr. S. W. Bragg, Secretary; Dr. L. A. White, Chairman; C. A. Sargent.

Lincolnville.

Members of the board: Dr. E. F. Brown, Secretary; Asa Pitcher, Chairman; Thomas Gushee.

Three nuisances were removed. We have had three cases of typhoid fever.

Linneus.

Members of the board: Robert Boyd, Secretary; G. W. Getchell, Chairman; C. H. Young.

Lisbon.

Members of the board: C. H. Miles, Secretary; Henry Hackett, Chairman; Josiah Farnsworth; Dr. A. W. Potter, Health Officer.

Twenty-five nuisances were abated. We have had six cases of typhoid fever, two of which were fatal. Pneumonia and the diarrhœal diseases were prevalent. Unhealthful localities exist at Lisbon Falls for want of drainage. A good system of sewerage is needed. Six cases of tuberculosis among cattle occurred. Precautions were taken by the local board against the importation of small-pox from Canada.

Litchfield.

Members of the board: G. Roberts, Secretary; Dr. Enoch Adams, Chairman; Thomas Holmes.

We have had one case each of diphtheria and typhoid fever. An examination of the school-house in district number one was made. It was found unsafe for school purposes and we so reported to the supervisor of schools, resulting in the erection of a new school-house in a healthful location.

Littleton.

Members of the board: H. A. Hall, Secretary; G. C. Hayward, Chairman; L. F. Hall.

We have had one case of diphtheria. There has been quite a prevalence of whooping cough and pneumonia. One death resulted from an accident—falling from a team.

Livermore.

Members of the board: I. T. Munroe, Secretary; R. B. Bradford, Chairman; A. G. Timberlake.

We had two cases of typhoid fever. Pneumonia was prevalent in the spring.

Lovell.

Members of the board: C. P. Hubbard, Secretary; J. K. P. Vance, Chairman; H. W. Durgin.

Lowell.

Members of the board: Jed. Varney, Secretary; L. B. Edgecomb, Chairman; M. O'Halloran.

Lubec.

Members of the board: James B. Neagle, Secretary; I. W. Hamilton, Chairman; Robert J. Peacock.

No cases of infectious diseases except a few of measles and some of "scarlet rash."

Lyman.

Members of the board: A. J. Blanchard, Secretary; Dr. E. Hurd, Chairman; A. F. Roberts.

Two nuisances were removed. We have had no cases of infectious diseases except some of German measles, one of which came near ending fatally.

Machiasport.

Members of the board: T. W. Travis, Secretary; E. Small, Chairman; R. P. Stewart.

Madawaska.

Members of the board: Arthur Daigle, Secretary; Michael Martin, Chairman; Lament Fournier.

No cases of infectious diseases have been reported.

Madison.

Members of the board: C. W. Dyer, Secretary; Dr. C. D. Morrill, Chairman and Health Officer; J. F. Chadbourne.

The village corporation has put in a system of water-works. Four nuisances were reported, all of which were removed promptly. We have had one case of scarlet fever; five of typhoid fever; and measles has been prevalent. The board visited the houses on Madison street in the village, examined the sources of water supply, and sent samples from wells for analysis.

Madrid.

Members of the board: L. P. Rowe, Secretary; Reuben Sargent, Chairman; Charles E. Mooers.

We had two cases of typhoid fever, caused, in our opinion, by an old well into which the sink drain emptied.

Manchester.

Members of the board: G. M. Knowles, Secretary; W. R. Merrill, Chairman; J. T. Collins.

We have had no infectious diseases.

Mapleton.

Members of the board: J. C. Chandler, Secretary; L. W. Huges, Chairman; James McAlpine.

Six nuisances were removed. We had one case of typhoid fever.

Marion.

Members of the board: B. L. Smith, Secretary; Joseph Thompson, Chairman; Charles W. Bridges.

No infectious diseases have been present.

Marshfield.

Members of the board: J. W. Foss, Secretary; Wm. Kilton, Chairman; Thomas Berry.

We had one case of scarlet fever.

Mars Hill.

Members of the board: F. L. Keay, Secretary; Dr. J. H. Syphers, Chairman and Health Officer; B. F. Pierce.

We have had two cases of scarlet fever, and six of typhoid fever, two of the latter ending fatally. Whooping cough was prevalent.

Masardis.

Members of the board: F. W. E. Goss, Secretary; Eben Trafton, Chairman; S. W. Clark.

A pupil in the public school had scarlet fever and was excluded from school.

MASON.

Members of the board: F. J. Bean, Secretary; H. G. Mason, Chairman; H. Hutchinson.

No infectious diseases.

MATTAMISCONTIS.

Members of the board: P. W. Roberts, Secretary; E. P. Boober; H. J. Sawyer.

MATTAWAMKEAG.

Members of the board: F. J. Fiske, Secretary; Alexander McClain, Chairman; G. F. Stratton.

No cases of diphtheria, scarlet fever, or typhoid fever during the year.

MAXFIELD.

Members of the board: James Wiley, Secretary; George Emery, Chairman; B. G. DeWitt.

Except whooping cough which caused the death of two infants, there have been no infectious diseases.

MEDDYBEMPS.

Members of the board: J. S. Bridges, Secretary; C. L. Hatte, Chairman; A. J. Allen.

We have had no infectious diseases, and there have been no deaths within the year. I have made it a point to look after the drainage, outhouses, and sources of water supply. The people of this town are much interested in the health of the town and cheerfully comply with all requests.

MEDFORD.

Members of the board: S. O. Dinsmore, Secretary; D. A. Hathorn, Chairman; R. F. Littlefield.

The inhabitants of our town have not been troubled with diseases of any epidemic or contagious nature during the past year.

MEDWAY.

Members of the board: S. Pomroy, Secretary; N. C. Powers, Chairman; Charles Moors.

One nuisance was removed. There have been no contagious diseases.

Mercer.

Members of the board: Dr. V. R. Perkins, Secretary and Health Officer; I. S. Ford, Chairman; A. V. Pattee.

Mexico.

Members of the board: H. W. Park, Secretary; L. H. Harlow, Chairman; H. G. Virgin.

One nuisance removed. We have been exempt from any serious trouble from any source.

Milbridge.

Members of the board: Dr. Geo. Googins, Secretary; Dr. Geo. A. Sawyer, Chairman; Wilson M. Dyer.

Quite an extended and expensive work of drainage has been done. A dozen or more nuisances were removed. We had eight cases of diphtheria with one death. Measles prevailed in the summer. One death occurred from drowning. Still more work on drainage is needed and improvements should be made in water supply.

Milford.

Members of the board: M. W. Sawyer, Secretary; M. A. Austin, Chairman; Charles Mills.

One nuisance was removed. We have had one case of typhoid fever. Better sewerage is needed.

Minot.

Members of the board: Dr. C. M. Cobb, Secretary and Health Officer; P. R. Cobb, Chairman; Dr. C. H. Tobie.

Eight nuisances were removed. There have been eight cases of typhoid fever with two deaths. Measles and pneumonia were unusually prevalent. Better drainage is needed.

Monroe.

Members of the board: J. J. Sewall, Secretary; Freeman Atwood; E. H. Nealley.

Monson.

Members of the board: D. J. Jackson, Secretary; L. P. Bray, Chairman; John A. Larson; Dr. A. H. Harding, Health Officer.

Six cases of typhoid fever with one death.

Monticello.

Members of the board: G. W. Lowell, Secretary; O. A. Stanley, Chairman; Dr. E. W. Boyer, Health Officer.

One nuisance was removed. Diphtheria, five cases with two deaths; typhoid fever, three cases, with no deaths. The diarrhœal diseases of children were quite prevalent in the summer.

Morrill.

Members of the board: D. O. Bowen, Secretary; J. R. Mears, Chairman; J. W. Pearson.

We have had no infectious diseases. One man was killed by a tree falling upon him.

Moscow.

Members of the board: Albert Burke, Secretary; C. M. Hill, Chairman; Thomas Emerton.

One nuisance was removed. No contagious disease the past year. No deaths, save one from consumption. Some families are suffering from the poor water supply. Until a change is made for the better, they will continue to suffer.

Mt. Chase.

Members of the board: E. A. Cooper, Secretary; John Sargent, Chairman; Willis Myrick.

Mt. Vernon.

Members of the board: Dr. H. F. Shaw, Secretary; R. F. Fletcher, Chairman; J. A. Robinson.

We have had one case each of scarlet fever and typhoid fever. Jaundice was unusually prevalent.

Naples.

Members of the board: P. O. Cannell, Secretary; G. W. Hall, Chairman; Eugene Tenney.

More attention has been given than usual to drainage and sewerage. Two nuisances were removed. We have had no infectious diseases except whooping cough. Pneumonia has been unusually prevalent.

Newcastle.

Members of the board: D. S. Glidden, Secretary; J. M. Glidden, Chairman; S. D. Wyman.

We have had some cases of scarlet fever, and one case of typhoid fever. In one case scarlet fever entered the school. The school was immediately closed and not reopened until the recovery of the patient and until the school-house had been properly cleansed and fumigated.

Newfield.

Members of the board: Dr. I. M. Trafton, Secretary and Health Officer; C. L. Wentworth, Chairman; Amos Carlton.

No cases of infectious diseases.

New Gloucester.

Members of the board: Dr. J. I. Sturgis, Secretary; W. H. True, Chairman; M. C. Clark.

One case of diphtheria, one of scarlet fever and five of typhoid fever. No deaths from these diseases. Measles was unusually prevalent. One death from drowning.

Newport.

Members of the board: F. M. Shaw, Secretary; R. H. Libby, Chairman; Dr. A. I. Harvey.

One doubtful case of typhoid fever was reported. Measles and whooping cough have been among us.

New Portland.

Members of the board: Dr. W. H. Stevens, Secretary; Dr. S. A. Bennett, Chairman; Abel Thompson.

Two nuisances were removed. Four cases of typhoid fever with two deaths. Whooping cough was prevalent. Better drainage is needed in the villages and greater care of privies and sink slops would be a good thing.

New Sharon.

Members of the board: D. R. Hargraves, Secretary; E. W. Young, Chairman; J. R. Jewell.

Diphtheria, two cases; typhoid fever, four cases. In cases of this kind the places are visited or the facts as to the sanitary condition of the premises are learned by a consultation with the attending physician. One elderly lady lost her life by her clothes taking fire.

Nobleboro.

Members of the board: J. M. Winslow, Secretary; W. H. Moody, Chairman; Albert Cunningham; Dr. W. H. Parsons, Health Officer.

Two nuisances were removed. In our outbreak of scarlet fever sixteen cases occurred with one death. The disease entered one of the schools. The school was closed, infected books were destroyed by burning, and the school-house was cleansed.

Norridgewock.

Members of the board: Dr. P. S. Lindsey, Secretary; A. O. Frederic, Chairman; Henry Murphy.

Mumps prevailed in our schools. Otherwise no infectious diseases have been reported.

Northfield.

Members of the board: E. M. Smith, Secretary; Frank Smith, Chairman; James McReavey; Dr. H. H. Smith, Health Officer.

Otherwise than one fatal case of typhoid fever no infectious diseases have been reported.

North Haven.

Members of the board: Dr. J. A. Jordan, Secretary; Jewett Turner, Chairman; R. B. Quinn.

We have had no infectious diseases except whooping cough.

Northport.

Members of the board: M. C. Hill, Secretary; J. R. Hurd, Chairman; F. A. Rhoades.

A great improvement has been made by bringing water to the camp ground from a spring a mile and a half distant. The source of the supply is above all buildings, and the water is very pure and soft. We have had no infectious diseases save one case of scarlet fever with which the board took prompt action.

North Yarmouth.

Members of the board: S. H. Sweetsi·, Secretary; A. Mitchell, Chairman; Dr. Wm. Osgood, Health Officer.

Norway.

Members of the board: Dr. F. N. Barker, Secretary; Dr. B. F. Bradbury, Chairman; E. W. Brown.

Three nuisances were removed. We had fifteen cases of scarlet fever, none of which were fatal, and ten cases of typhoid fever with four deaths. Unhealthfulness of the village results from bad drainage and low land.

Oakland.

Members of the board: H. W. Wells, Secretary; G. W. Hubbard, Chairman; Dr. M. S. Holmes, Health Officer.

We have had one case of scarlet fever. Measles was epidemic in the latter part of the year.

Old Orchard.

Members of the board: F. G. Staples, Secretary; Dr. A. W. Dinsmore, Chairman; G. W. Butler.

Twelve nuisances have been reported, seven of which were removed. We had no cases of diphtheria, scarlet fever or typhoid fever.

One case of drowning occurred. We have obliged every person whose premises have been in an unhealthful condition to clean them at once.

Old Town.

Members of the board: Dr. A. W. Rowe, Secretary and Health Officer; A. Rigby, Chairman; H. M. Dickey.

We have introduced a public water supply from the river and sewers have been constructed in a portion of the city. Fifteen nuisances were brought to the notice of the board, thirteen of which it was practicable to abate. The healthfulness of the city would be better if it were not for poor drainage, old dilapidated tenement houses with foul cellars, cesspools, and over-crowded tenements.

We have had fifteen cases of scarlet fever with no deaths and twenty cases of typhoid fever with four deaths. The diarrhœal diseases of children were quite prevalent.

Orient.

Members of the board: W. H. Decker, Secretary; Daniel Maxell, Chairman; Joel Faulkner.

We have had no infectious diseases. There is one thing that is neglected and that is the school room. I would suggest having school rooms washed and scrubbed once a week, particularly when the weather is hot and dry.

Orland.

Members of the board: R. P. Harriman, Secretary; Henry Partridge; Dr. Frank P. Perry, Health Officer.

No cases of infectious diseases have been reported.

Orneville.

Members of the board: M. W. Morgan, Secretary; Charles Hoxie, Chairman; F. W. Canney.

Orono.

Members of the board: W. C. Taylor, Secretary; Dr. J. H. Knox, Chairman and Health Officer; C. P. Crowell.

Of six nuisances, all but one were removed. We had twenty cases of typhoid fever with four deaths. About all the cases of typhoid fever were on low damp ground near the river.

Orrington.

Members of the board: G. B. Tibbetts, Secretary; A. N. Lufkin, Chairman; J. D. Hinds.

Otis.

Members of the board: J. R. Grant, Secretary; Luther Garland, Chairman; C. E. Fogg.

We have had three cases of typhoid fever, all of which recovered. There has not been a death in town the past year.

OTISFIELD.

Members of the board: F. J. Sawyer, Secretary; D. L. Brett, Chairman; Otis Mitchell.

We have no infectious diseases except whooping cough.

OXFORD.

Members of the board: G. A. Poor, Secretary; S. D. Edwards, Chairman; Dr. Wm. Haskell.

PALMYRA.

Members of the board: C. M. Jewett, Secretary; N. B. Douglass, Chairman; J. B. Chase.

Two nuisances were reported to the board, both of which were removed. We have had two cases of scarlet fever and two of typhoid, all of which ended in recovery. As reported by the physician, the cases of typhoid were the result of drinking impure water while in adjoining towns. Contagious diseases are promptly looked after. A yoke of oxen were found to have tuberculosis and were killed in accordance with the order of the State Cattle Commissioner, Dr. Bailey.

PARIS.

Members of the board: Dr. F. H. Packard, Secretary; Dr. I. Rounds, Chairman; J. S. Wright.

Of four nuisances, all were partly or wholly removed. The worst nuisances are wooden sink spouts connecting second story tenements with the ground. I have good reason to ascribe two outbreaks of typhoid fever directly to them. We have had two cases of scarlet fever, both recovering, and ten cases of typhoid fever with four deaths.

Two cases of dysentery with vomiting, in an aged couple were caused by bad water in a well too close to the barn-yard

A young man aged eighteen was boarding in a family while a member was sick with typhoid fever. He came down with the fever and was taken to his home four miles away. It proved to be a very severe type of fever. He died the eleventh or twelfth day. Diarrhœa and active delirium set in very soon with high temperature and extreme restlessness. Two of the neighbors who came in to see him a few times the last two days of his sickness had the fever, one dying. His brother who came home the last two days he lived also had the fever and died His grandmother, aged eighty-one, took the fever and died, although she had had this disease once before. One sister, aged sixteen, also had the fever, barely living. This case ran fifty days, vomiting more or less the whole time, and for one week after, she was sustained almost altogether by enemata.

In regard to these cases I will say that I see no way of explaining them other than by contagion. The five cases enumerated came down about the same time,—a few days after the death of the first one. There were no bad conditions of buildings or anything else to account for them. The discharges were carried away some six or eight rods and emptied into a hole in the ground and fresh loam thrown in each time. The bedpan was scalded with boiling water, then corrosive sublimate was used in it, 1 to 1,000. All bed clothes were removed at once if soiled. Carbolic acid was sprinkled around the room often. My opinion is that the fevers were contracted from gas which escaped in large quantities the last two days the first patient lived and was very offensive.

PARSONSFIELD.

Members of the board: E. W. Wentworth, Secretary; J. P. Burbank, Chairman; John F. Ridlon.

No cases of infectious diseases reported.

PASSADUMKEAG.

Members of the board: P. F. Haynes, Secretary; J. W. Dennis, Chairman; J. G. Clark.

We have had one case of typhoid fever.

PEMBROKE.

Members of the board: Dr. J. C. Rogers, Secretary; C. W. Hersey, Chairman; E. K. Smart.

We have had five cases of diphtheria, twenty-one of scarlet fever, and one of typhoid fever. No deaths occurred from these infectious diseases, except one of scarlet fever.

PENOBSCOT.

Members of the board: D. E. A. Sprague, Secretary and Health Officer; John Littlefield, Chairman; J. B. Snowman.

We have had two non-fatal cases of typhoid fever, and whooping cough was needlessly introduced into a school at a bad season of the year,—fall and winter.

Perkins.

Members of the board: W. A. Lewis, Secretary; T. A. Hinckley, Chairman; W. F. Reed.

No infectious diseases during the year.

Perry.

Members of the board: G. P. Ricker, Secretary; F. L. Gove, Chairman; J. B Nutt.

Peru.

Members of the board: A. B. Walker, Secretary; A. E. Eastman, Chairman; S. F. Robinson.

One nuisance was removed. In one house we had two cases of scarlet fever which recovered. Cases of this kind are attended to at once.

Phillips.

Members of the board: B. E. Pratt, Secretary; E. M. Robinson, Chairman; Dr. C. L. Toothaker.

Two nuisances were removed. We have had two cases of typhoid fever.

Pittsfield.

Members of the board: Dr. T. M. Griffin, Secretary and Health Officer; D. M. Parks, Chairman; Benjamin Thompson.

Further work was done in the construction of sewers. Three nuisances were reported, all of which were removed. We have had two cases of diphtheria, four of scarlet fever, and five of typhoid fever with one death from typhoid fever. Prompt action is taken with diseases of this kind to prevent their spreading. One man was killed by a train.

Plymouth.

Members of the board: Dr. W. H. Merrill, Secretary and Health Officer; S. P. Gifford, Chairman; John Longley.

We have had two cases of diphtheria and four of typhoid fever, all of which recovered. Measles was imported from Boston.

Poland.

Members of the board: Dr. E. F. Bradford, Secretary; S. L. Littlefield, Chairman; B. M. Fernald.

Portland.

Members of the board: Geo. C. Burgess, Secretary; Dr. Charles D. Smith, Chairman; Dr. A. K. P. Meserve.

During the year 4,654 feet of new sewers were built, exclusive of drains from stagnant pools of water, etc. We have had thirty-two cases of diphtheria with eight deaths, sixty-one cases of scarlet fever with one death, and one hundred and six cases of typhoid fever with twelve deaths. Our management of infectious diseases is the same as formerly. Cases of scarlet fever and diphtheria are placarded, families are supplied with the circulars of the State Board, schools and the public library are notified, and if it is desired or becomes necessary we furnish a man to disinfect the premises.

Seventeen deaths resulted from accidental causes. At the recommendation of the board, the city council ordered the construction of an isolation ward, now nearly completed, for the reception of contagious diseases. The following is an abstract from the report of our health inspector:

No. of formal complaints to Secretary or Inspector	290
No. of vaults found in bad condition	667
No. of overflowing vaults	7
No. of overflowing cesspools	7
No. of cellars in bad condition	374
No. of water-closets inspected	754
No. found in good condition	577
No. found in bad condition	177
No. of swine ordered removed	17
No. of vaults built; no sewer in street	0
No. of water-closets ordered built	143
No. of bad sink drains, rubbish heaps, filth, etc., ordered fixed or removed	564
No. of sinks found without traps	104
No. of visits made on account of contagious diseases	225
No. of vaults found in good condition	118
No. of cellars found in good condition	229
No. of sink drains found in good condition	505

No. of yards found in good condition.................... 42
No. of visits made, unclassified, chiefly to see that orders are carried out or to find parties of whose premises complaint is made.................. 1,177

The following rules and regulations relating to quarantine inspection were adopted by the board November 28, 1891, and approved by Thos. H. Haskell, justice of the Supreme Judicial Court, December 4, 1891:

I. All vessels arriving at this port with plague, cholera, small-pox, yellow fever, typhus fever or other contagious disease on board, or having had the same during the voyage must be directed by the pilot or harbor master to anchor on quarantine ground and remain there until released by written order of the Board.

II. Any vessel arriving from a foreign port, with or without sickness on board, and not having a clean bill of health from consular officer at port of clearance, will be directed by the pilot or harbor master to anchor at quarantine and remain until released by written order of the Board.

III. All vessels or steamships arriving from European or Asiatic ports will be compelled to anchor at quarantine and remain there until inspected under direction of, and released by written order of the board; unless special permission shall be given in writing to allow any such vessel to come to its wharf for inspection there, in which case no person shall enter or leave the vessel until permitted by written order of the Board.

IV. Inspection will be made promptly as soon as notice of arrival shall be received, but only during the hours of daylight, or from 8 A. M. to 6 P. M., and the charges shall be as follows, to wit:

For each sailing vessel, five dollars............ .... $5 00
For each steamship carrying freight only, ten dollars.. ... 10 00
For each steamship carrying passengers, fifteen dollars..... 15 00

In all cases the quarantine officer making the inspection shall collect the charges made against any vessel either in currency or captain's draft on consignee, and account for the same to the Board.

POWNAL.

Members of the board: Dr. S. A. Vosmus, Secretary; I. S. Brown, Chairman; H. B. Brown.

We had one case of diphtheria ending in recovery.

Presque Isle.

Members of the board: Dr. F. Kilburn, Secretary; Dr. G. H. Freeman, Chairman; C. F. Daggett.

Three nuisances were removed. We had thirty-one cases of scarlet fever and twenty-nine of typhoid fever with five deaths from the latter disease. The epidemic of scarlet fever was in a very mild form. Dysentery was quite prevalent. All the typhoid cases were apparently caused by bad water. With two or three exceptions they all used well water. One death resulted from traumatic tetanus.

Princeton.

Members of the board: Dr. S. G. Spooner, Secretary; W. E. Gardner, Chairman; H. F. Smith.

One nuisance was removed. Otherwise than an epidemic of scarlet fever the year has been one of unusual health among us. Sixty-two cases of scarlet fever are known to the board and it is likely that there were other cases unreported. The disease was in a very light form generally, yet five deaths resulted from it. We have always taken measures to stop the spread of contagious disease, but in this epidemic it seemed to develop in different families and in different parts of the town all at once.

Prospect.

Members of the board: O. B. Gray, Secretary; George Avery, Chairman; G. W. Crockett.

We have had three cases of scarlet fever and one fatal case of typhoid fever.

Randolph.

Members of the board: B. A. Cox, Secretary; G. P. H. Jewett, Chairman; H. S. Winslow.

Three nuisances were removed. We have had two cases of typhoid fever in connection with which we visited the premises, left the circulars, and advised as to the disinfection of the excreta. There have been a few cases of measles. In September we had one fatal case of cerebro-spinal meningitis. The building of sewers is needed to improve the sanitary condition of the village.

Rangeley.

Members of the board: Dr. Q. A. Bridges, Secretary and Health Officer; John Herrick, Chairman; S. A. Ross.

One nuisance was removed. We had one case of diphtheria. Mrs. E. B., in filling a lamp, spilled quite a quantity of the oil on her dress without noticing it at first. When she got through, seeing the oil on her clothing, see undertook to dry it by the fire. The result was her clothing caught fire and she was fatally burned.

Raymond.

Members of the board: H. M. Cash, Secretary; L. W. Welch, Chairman; Alfred Wilson.

Ripley.

Members of the board: A. G. Farrar, Secretary; A. R. Dunlap, Chairman; Wm. Hoyt.

We have had one case of diphtheria, six of scarlet fever, and one of typhoid fever.

Robbinston.

Members of the board: F. N. Leach, Secretary; Alonzo Smith, Chairman; N. E. Campbell.

We have had two cases of diphtheria with one death, and two cases of scarlet fever.

Rockport.

Members of the board: Dr. H. E. Abbott, Secretary and Health Officer; Elliot Orbeton, Chairman; C. A. Sylvester.

Five nuisances were reported. We have had thirty cases of scarlet fever and six of typhoid fever with one death from each of these diseases. A good system of sewerage is needed in the village.

Rome.

Members of the board: L. G. Martin, Secretary; G. S. Tibbetts, Chairman; J. E. Farnham.

One nuisance was removed. No cases of contagious diseases have been reported to the board the past year.

Roxbury.

Members of the board: A. W. Robbins, Secretary; S. M. Locke, Chairman; John Reed.

We have had no contagious diseases of any kind during the year.

Saco.

Members of the board: Dr. J. D. Cochrane, Secretary; Dr. W. T. Goodale, Chairman; Dr. L. D. Dennett.

Salem.

Members of the board: G. W. Harris, Secretary; A. H. Perry, Chairman; George Willis.

We have had one case of typhoid fever. Otherwise no infectious diseases.

Sanford.

Members of the board: George E. Allen, Secretary; A. B. Sanborn, Chairman; H. T. Bennett; Dr. J. H. Neal, Health Officer.

Our water supply has been increased, but otherwise no changes except in isolated cases. Five nuisances were removed. Diphtheria, one, scarlet fever, four, typhoid fever, twenty-five cases. One death resulted from typhoid fever. One death occurred from drowning. A good system of drainage is needed.

Sangerville.

Members of the board: H. C. Ford, Secretary; C. F. Dearth, Chairman; M. J. Jewett.

Six nuisances were reported, all of which were removed. There has been one case of diphtheria, and one of scarlet fever. In connection with these the houses were placarded, the families kept by themselves as much as possible, and at the proper time the houses were disinfected. Whooping cough, mumps, and the diarrhœal diseases of children were prevalent.

Scarboro.

Members of the board: Dr. A. S. Sawyer, Secretary; M. I. Milliken, Chairman; Geo. H. Merrill.

One case of scarlet fever, in connection with which the patient was isolated, the house was quarantined, and disinfection was carried out as recommended by the State Board. Measles and whooping cough in a mild form prevailed. Children affected with these diseases were excluded from school.

Searsmont.

Members of the board; Dr. A. Millett, Secretary; O. D. Wilson, Chairman; A. G. Caswell.

One nuisance was removed. We have had one case of scarlet fever which was isolated, the house was placarded, the discharges were buried, and disinfection was carried out.

Searsport.

Members of the board: B. O. Sargent, Secretary; Dr. E. H. Durgin, Chairman; E. B. Sheldon.

The sewer has been extended from Main street to the sea, a distance of about thirty rods. In the more thinly settled parts of the town, six cases of typhoid fever occurred.

Sedgwick.

Members of the board: M. L. Elwell, Secretary; Dr. R. E. Hagerthy, Chairman and Health Officer; J. W. Penney.

One nuisance was removed. It has been a year of unusual freedom from contagious diseases; there have been no cases except a few of measles.

Shapleigh.

Members of the board: Dr. E. L. Thompson, Secretary; Thomas Pugsley, Chairman; F. A. Bragdon.

Three nuisances all of which were removed. Seven cases of diphtheria, and two of typhoid fever, but no deaths from these. Measles has prevailed.

Sherman.

Members of the board: L. C. Caldwell, Secretary; Dr. D. H. Owen, Chairman; G. W. Durgin.

We have had one case of scarlet fever and three of typhoid fever. In outbreaks of these diseases we take immediate measures to stamp it out. Since the organization of the local board I think there has been a great improvement in the town from a sanitary point of view. Individuals take more pains with their premises and the people generally heartily sustain the action of the board in their efforts to improve the health of the town.

Shirley.

Members of the board: Henry Blackstone, Secretary; Joseph Dennen; Chairman; A. T. Mitchell.

Sidney.

Members of the board: Dr. Daniel Driscoll, Secretary and Health Officer; Charles Goodhue, Chairman; J. H. Bean.

One nuisance was removed. We have had two cases of diphtheria and nine of typhoid fever. In these cases an investigation is made to see if proper care is taken to limit its spread. All of the cases of typhoid fever were referable to drinking water of poor quality.

Skowhegan.

Members of the board: George Cushing, Secretary; S. A. Bickford, Chairman; W. H. Wildes; Dr. J. N. Merrill, Health Officer.

Section 9 of the by-laws of the board of health is as follows:

"9. It shall be the duty of the health officer to make a tour of inspection annually, during the months of May and August, of all the streets, vacant lots and premises within the corporation, where filth and rubbish are allowed to accumulate, and shall exercise the power conferred upon the Board of Health, to order the suppression and removal of nuisances and conditions detrimental to life and health found to exist within the jurisdiction of this board."

[The following is quoted from printed report of the health officer. A. G. Y.]

"With but two or three notable exceptions every effort of the health officer to improve the sanitary condition of the town, was favorably met by every one found suffering from unsanitary surroundings, and the instructions of the health officer for the removal of unsanitary conditions, were more fully and cheerfully carried out than was expected when he commenced this disagreeable tour of inspection.

"With the exception of the places reported for immediate attention, your health officer selected those streets and localities, known to be in an unsanitary condition, and where typhoid fever, bowel complaints, scarlet fever and diphtheria have largely prevailed in years past, and made an inspection from house to house, keeping a memorandum of the number of typhoid cases, scarlet fever and diphtheria that had occurred during the two years previous, also a memorandum of the distance of the sink drain or cesspool, privy, pig pen and stable from the well. Several samples of well and spring water were taken to the Secretary of State Board of Health for analysis. Some of the well water being reported by Secretary State Board as seriously polluted, and unfit for use, or in the language of the report, Dr. Young says: 'The large excess of organic ammonia and the very large excess of free ammonia, together with the excess of nitrates, indicate a serious pollution. This water ought not to be used for drinking.'

"During the past season there have been reported but six cases of typhoid fever in the town, two of which were contracted by persons working out of town and coming home sick.

"Early in the winter scarlet fever broke out in a family on Bloomfield street. No physician being called in, its existence did not come to the notice of the board of health, until it had extended to two other families near by who were taking milk from the house where the fever first made its appearance. A strict quarantining of the persons infected, and their exclusion from the schools for a proper length of time, prevented a further spread of the disease. There were six cases reported in the two families that contracted the disease from the first where there were five cases and where it could have been confined had it been reported in season. There have been no cases of diphtheria reported."

SMITHFIELD.

Members of the board: W. J. Haynes, Secretary; I. W. Varney, Chairman; C. N. Simonds.

We have had no cases of contagious diseases except occasionally a case of measles or mumps.

SOLON.

Members of the board: Dr. S. F. Greene, Secretary and Health Officer; Stephen Merrill, Chairman; Jotham Whipple.

We had one case of diphtheria.

SOUTH BERWICK.

Members of the board: G. F. Clough, Secretary; Dr. G. D. Emerson, Chairman; T. J. Goodwin.

Twenty-two nuisances were removed. We have had four cases of diphtheria and eight of typhoid fever. The building of sewers is needed for the improvement of the health conditions of the town.

SOUTHPORT.

Members of the board: Albert McKown, Chairman; Stephen Pierce.

We had two cases of typhoid fever.

South Thomaston.

Members of the board: Dr. George C. Horn, Secretary; Lewis A. Arey, Chairman; Lewis Graves.

We have had two cases of scarlet fever and a case of typhoid fever with one death from the latter disease. Whooping cough was in the town.

Springfield.

Members of the board: Dr. P. H. Jones, Secretary and Health Officer; E. C. Ryder, Chairman; C. R. Brown.

We had one fatal case of typhoid fever and several cases of measles and chicken pox. The case of typhoid fever was contracted away from home apparently.

Standish.

Members of the board; M. S. Spear, Secretary; Dr. W. S. Thompson, Chairman; C. D. W. Shaw.

Starks.

Members of the board: Thomas Buswell, Secretary; J. F. Frederick, Chairman; C. L. Holbrook.

One nuisance was removed. We had one case of typhoid fever.

Steuben.

Members of the board: B. W. Stevens, Secretary; G. W. Moore, Chairman; M. S. Smith; Dr. S. B. Overlock, Health Officer.

We have had one case of diphtheria and two of typhoid fever. One of the typhoid cases ended fatally.

St. Albans.

Members of the board: Dr. C. A. Moulton, Secretary and Health Officer; N. H. Vining, Chairman; N. B. Turner.

One nuisance was removed. Two cases of scarlet fever and two of cerebro-spinal meningitis. A better construction and management of privies is needed in the interest of the health of the town.

St. George.

Members of the board: Dr. Albert Woodside, Secretary; H. F. Kelloch, Chairman; W. H. Matthews.

STOCKTON SPRINGS.

Members of the board: Dr. G. A. Stevens, Secretary; J. F. Hichborn, Chairman; Samuel French.

We had one case of scarlet fever in which isolation and disinfection were cared for.

STOW.

Members of the board: C. W. Day, Secretary; O. P. Charles, Chairman; O. R. Barrows.

We have had no infectious diseases.

SULLIVAN.

Members of the board: Dr. F. W. Bridgham, Secretary and Health Officer; M. H. Hawkins, Chairman; M. E. Rideout.

Our water supply is from wells and springs. Some springs have been cleaned out, badly situated wells have been filled up, and privies have been improved under the instructions of the local board of health. Three nuisances have been removed. Diphtheria, one case; scarlet fever, seven cases; and typhoid fever, four cases.

SUMNER.

Members of the board: Sharon Robinson, Secretary; L. H. Bisbee, Chairman; Dr. C. M. Bisbee, Health Officer.

We have had four cases of scarlet fever, all in one family. Very few young people have died.

SURRY.

Members of the board: H. J. Milliken, Secretary; J. A. Milliken, Chairman; D. G. Meanse.

We have had three cases of typhoid fever, one of which was fatal.

SWANVILLE.

Members of the board: Z. L. Downs, Secretary; C. M. Marden, Chairman; I. B. Seekins.

We had three cases of scarlet fever, and two fatal cases of typhoid fever. All cases of this kind are attended to at once by the board. The books that had been used by one infectious scholar were burned.

SWEDEN.

Members of the board: Wm. H. Gordon, Secretary; Nelson McIntire, Chairman; R. O. Maxwell.

We had one case of typhoid fever and there were two cases of measles in a light form.

TEMPLE.

Members of the board: S. R. Norton, Secretary; L. H. Farmer, Chairman; Victor B. Hamlen.

One nuisance was removed. We have had no cases of the infectious diseases, but influenza and pneumonia were very fatal. They caused the death of seven persons.

THOMASTON.

Members of the board: Dr. H. C. Levensaler, Secretary and Health Officer; J. H. H. Hewett, Chairman; J. E. Walker.

We have had four cases of scarlet fever, and five of typhoid fever with one death from each disease. The scarlet fever cases have been placarded and the sanitary rules of the State Board of Health have been carried out in connection with all the cases of contagious diseases. The establishment of a system of sewerage is greatly needed. The survey and a plan for it has been made by a civil engineer.

TOPSFIELD.

Members of the board: O. H. Taylor, Secretary; H. K. Mallory, Chairman; H. C. Pineo.

We have had no cases of the contagious diseases.

TOPSHAM.

Members of the board: J. C. Purington, Secretary; R. P. Whitney, Chairman; D. S. Colby.

Four nuisances were reported, three of which were removed. We have had two cases each of scarlet fever and typhoid fever that have received prompt attention from the board. Measles and whooping cough have been prevalent.

TREMONT.

Members of the board: Dr. W. A. Spear, Secretary; J. T. Clark, Chairman; J. H. Gilley.

Two nuisances were abated by the board: No case of infectious disease has come to the notice of the board, except one fatal case of typhoid fever.

Trescott.

Members of the board: John Saunders, Secretary; W. H. Leighton, Chairman; S. A. Wilcox.

We have had no cases of infectious disease.

Troy.

Members of the board: Dr. M. T. Dodge, Secretary; John Wood, Chairman; O. B. Rhoades.

We have had one case of typhoid fever. The diarrhœal diseases were very prevalent from August to October.

Union.

Members of the board: E. R. Daniels, Secretary; Lysander Norwood, Chairman; Emery F. Joy.

We have had nine cases of scarlet fever, and two fatal cases of typhoid fever. One of the typhoid cases came home from the State College with the fever and the other came from a neighboring state and came down with the fever soon after his arrival. Measles also prevailed and two deaths resulted from that disease.

Unity.

Members of the board: Austin Thomas, Secretary; John Perley, Chairman; B. F. Kelley.

Vanceboro.

Members of the board: C. A. Sterling, Secretary; Capt. Charles Cobb, Chairman; A. W. Goodwin.

Six nuisances were removed. We had thirty-two cases of typhoid fever with two deaths. Measles and whooping cough have also troubled us.

Vassalboro.

Members of the board: Dr. Charles Mabry, Secretary; Charles A. Stillson, Chairman; Dr. G. L. Randall.

One nuisance was removed. There have been two fatal cases of typhoid fever.

Veazie.

Members of the board: L. H. Park, Secretary; A. J. Spencer, Chairman; G. W. Frost.

Two nuisances were removed. There have been seven cases of typhoid fever, two of which were fatal. Whooping cough was present.

Vienna.

Members of the board: L. C. Davis, Secretary; Elbredge Allen, Chairman; Horatio Porter.

No cases of infectious diseases reported.

Vinalhaven.

Members of the board: Dr. F. A. Smith, Secretary; O. H. Lewis, Chairman; James Hall.

Waite.

Members of the board: J. C. Neale, Secretary; J. B. Phelps, Chairman; Joseph Bagley; Dr. L. Brehant, Health Officer.

We have had one case of diphtheria.

Waldo.

Members of the board: J. G. Harding, Secretary; A. J. Simmons, Chairman; N. R. Cilley.

We have had one case of scarlet fever. One man was killed by a mowing machine.

Wales.

Members of the board: B. Hodsdon, Secretary; A. M. Donnell, Chairman; T. T. Jenkins.

Waltham.

Members of the board: Mrs. Hannah Fox, Secretary; Molbry Haslam, Chairman; Alden Haslam.

Warren.

Members of the board: Dr. J. M. Wakefield, Secretary and Health Officer; W. O. Counce, Chairman; B. B. Libby.

Four cases of typhoid fever. There were a few cases of measles in a mild form. A better water supply and better drainage is needed in some places.

Washburn.

Members of the board: Dr. H. S. Sleeper, Secretary and Health Officer; L. H. Ballard, Chairman; A. L. Hatch.

We had five cases of typhoid fever with fatal ending in one case. The water supply of our town is defective. I am satisfied that three of our five cases of typhoid had their origin from a certain spring.

WASHINGTON.

Members of the board: T. S. Bowden, Secretary; J. F. Davis, Chairman; E. A. Sidlinger.

Two nuisances were removed. We had three cases of scarlet fever in connection with which the houses were immediately placarded and isolated as much as possible. Better ventilation in school-houses is needed.

WATERBORO.

Members of the board: C. W. Patterson, Secretary; Dr. J. T. G. Emery, Chairman; G. P. Chase.

We have had one case of diphtheria and several cases of typhoid fever.

WATERFORD.

Members of the board: C. L. Wilson, Secretary; Melville Monroe, Chairman; Dr. C. M. Coolidge, Health Officer.

No cases of infectious diseases have been reported, except one of typhoid fever.

WELD.

Members of the board: Dr. C. E. Proctor, Secretary; A. E. Houghton, Chairman; L. L. Jones.

One nuisance was reported. We have had no infectious diseases except whooping cough.

WESLEY.

Members of the board: Samuel Hawkins, Secretary; A. L. Gray, Chairman; J. Driscoll.

We had one fatal case of typhoid fever that was not reported to the local board. One case that ended fatally was reported as scarlet fever.

WESTBROOK.

Members of the board: H. K. Griggs, Secretary; H. T. Clark, Chairman; Dr. J. L. Horr.

Of seven nuisances reported to the board, five were removed. Our great difficulty is to obtain proper sewerage accommodations.

The municipal authorities move slowly in this matter. Much money has been unwisely spent in the past by not having a proper system. Building has been going on very fast for the past two or three years and in may places the drainage runs into the street, thus causing foul and stagnant pools of sink water. We are gradually substituting water-closets in place of vaults.

Diphtheria, three cases with two deaths; scarlet fever, thirty-eight cases with three deaths; typhoid fever, nine cases with three deaths. It was noticed that many of the cases of scarlet fever were among children attending a particular school. The school-house was disinfected, after which no cases appeared among the children attending that school.

A large pan made of galvanized iron with a ring in the center to receive a kettle and to allow water to stand under it has been provided for use in fumigating with sulphur. All danger from fire is thus obviated

I find that, in many cases, people desire to have their houses placarded in case of infectious disease. It secures them from interruption and annoyance.

It is an encouraging fact that all our physicians and the public generally coöperate cheerfully with the local board in the effort to secure proper sanitary conditions. The law itself creating the local board of health has been a good educator.

West Gardiner.

Members of the board: S. M. Pinkham, Secretary; W. P. Haskell, Chairman; D. E. Merrill.

Westport.

Members of the board: James Thomas, Secretary; S. P. Webber, Chairman; Wilmot Greenleaf.

We have had two cases of typhoid fever and ten cases of measles, but no deaths from these diseases.

Whitefield.

Members of the board: S. S. Moody, Secretary; Dr. A. R. G. Smith, Chairman; G. A. Moody.

We have had two cases of typhoid fever, one of which was fatal.

Whiting.

Members of the board: A. M. Crane, Secretary; I. P. Dinsmore, Chairman; Judson Hall.

We have had no cases of infectious diseases except one fatal case of typhoid fever.

Whitneyville.

Members of the board: C. H. Sullivan, Secretary; D. W. Rollins, Jr., Chairman; M. E. Bridgham.

One nuisance was removed. We have had three cases of scarlet fever. We have taken prompt action in every case.

Williamsburg.

Members of the board: M. W. Kennison, Secretary; L. F. Pitman, Chairman; Adolphus Merrill.

Willimantic.

Members of the board: Frank Hart, Secretary; E. L. Chadbourne, Chairman; A. F. Flanders.

No infectious diseases have been reported.

Wilton.

Members of the board: Dr. A. B. Adams, Secretary; J. S. Wilkins, Chairman; A. D. Parsons.

One nuisance was removed. Three cases of typhoid fever, one of which ended fatally.

Windham.

Members of the board: Dr. I. D. Harper, Secretary; Dr. A. N. Witham, Chairman; C. A. Nichols.

Two nuisances were removed. We have one case of typhoid fever and measles broke out in one district. The school was closed, all the sick ones were quarantined and the disease was kept in that district. The case of typhoid fever was imported.

Winn.

Members of the board: A. L. Hall, Secretary; James Rice, Chairman; W. F. Lovejoy; Dr. F. W. Merrill, Health Officer.

Two drains have been made which effects a great improvement in disposing of the drainage. We have had no cases of infectious disease.

WINSLOW.

Members of the board: J. M. Taylor, Secretary; B. F. Towne, Chairman; G. L. Leonard; Dr. J. F. Hill, Health Officer.

Scarlet fever, two cases, no deaths; typhoid fever, seven cases with one death.

WINTERPORT.

Members of the board: Dr. C. F. Atwood, Secretary; Joseph Carlton, Chairman; Dr. A. R. Fellows.

We have had no infectious diseases.

WINTHROP.

Members of the board: Dr. C. A. Cochrane, Secretary; C. A. Wing, Chairman; Elliott Wood.

WISCASSET.

Members of the board: Dr. C. H. Leverton, Secretary; John Somes, Chairman; Llewellyn Nute.

WOODLAND.

Members of the board: R. W. Withee, Secretary; D. A. Snowman, Chairman; A. J. Johnson.

We had one case of typhoid fever and whooping cough was quite prevalent.

WOODSTOCK.

Members of the board: Dr. C. B. Rankin, Secretary; Isaac Andrews, Chairman; A. L. Rowe.

One nuisance was removed. Measles was very prevalent in the spring. There were more than 125 cases within a small radius in and about Bryant's Pond village. The disease was mild and no deaths occurred from it. Otherwise we have had no infectious diseases.

YARMOUTH.

Members of the board: R. Harding, Secretary; C. T. Grant, Chairman; Dr. W. W. Thomas.

Two nuisances were removed. We have had one case each of diphtheria, scarlet fever, and typhoid fever, all ending in recovery. Whooping cough has prevailed.

York.

Members of the board: Dr. W. L. Hawkes, Secretary; G. W. S. Putnam, Chairman; A. D. Walker.

Three nuisances were reported, all of which were removed without expense to the town. We had seven cases of scarlet fever with one death, and one case of typhoid fever. The little outbreak of scarlet fever was traced direct to a woman who made a visit to Portland. She slept in a room and on the same bed where her brother had been ill with scarlet fever some six weeks before. The room and bedding had been fumigated by direction of the board of health. She returned and gave the disease to her children and all the neighbors where she called. By close watching no new cases occurred in town.

School Hygiene and School-Houses.

By A. G. YOUNG, M. D., Secretary of the Board.

Prefatory.—Whatever argument there may be for the right of the individual to be educated at the expense of the commonwealth, self-preservation is the underlying principle of the State's policy of public education. To ensure their own stability and prosperity, the State and the Republic must have honest, useful, and intelligent citizens.

"We have no standard by which to measure the disaster that may be brought upon us by ignorance and vice in the citizen, when joined to corruption and fraud in the suffrage. The voters of the Union who make and unmake constitutions, and upon whose will hangs the destinies of our governments, can transmit their supreme authority to no successors save the coming generation of voters, who are the sole heirs of sovereign power. If that generation comes to its inheritance blinded by ignorance and corrupted by vice, the fall of the Republic will be certain and remediless."*

That the truth lying in these words of one of our martyred presidents was perceived at the earliest dawn of our New England civilization is apparent in the story of the school-houses which followed so soon the first rude dwellings of the Pilgrim fathers; that it has dwelt with us as a living truth is attested by our ever-growing exertions to provide the facilities for the adequate cultivation of the intellectual faculties of our young people, and by legislative enactments which compel the prospective citizen to go to school whether he will or not. The right of the State, then, to surround itself with safeguards against ignorance and all its disastrous consequences forms the basis of our school laws and our system of public education.

Laws of another class find their justification in the unsurrendered rights of the citizen. Modern hygiene and modern public health

*Inaugural address of President James A. Garfield, March 4, 1881.

laws are founded on the belief that it is the birthright of every human being to enjoy sound, or at least fairly good physical health, that it is the moral duty of each individual of our race to preserve and, if possible, to improve such portion of his heritage of bodily health as has been transmitted to him by his ancestry; that it is the inalienable right of each person to be permitted to retain and enjoy this heritage.

It follows, therefore, that while it is the right of the State to insist upon universal compulsory education, it is the duty of the State to assure itself that its system of public instruction exposes its proteges to no dangers of physical injury, or at least that these dangers shall be reduced to their lowest practicable limit. And just in this direction the Commonwealth itself should feel an interest not in the least less intense than that which it has in the intellectual education of the people, for, if its schools build well, their superstructure of mental culture must have a sound physical basis. If there is danger in having the Ship of State under the guidance of ignorant hands, the history of nations holds up many a warning to us against the danger of physical degeneracy. "It is not a coincidence," says one of the world's foremost workers in the cause of public health, "this fact that meets us everywhere in the history of human culture, that just those nations that have exercised a powerful and elevating influence in the world have always been mindful of the value of health."

It is scarcely more than fifty years ago since the first practical and rational applications of modern science to the preservation and improvement of the health of the people were made and their worth demonstrated. So indubitable was the evidence presented that gradually nation after nation came to discover that the care of the public health is the preservation of national wealth, and the strengthening of the military resources of the nation. A movement of this kind powerful enough to make its influence felt in governmental policies could not fail to include independent and earnest investigators probing time honored institutions and customs in search of truth, and zealous propagandists urging the need of reform.

That schools and educational methods should escape these reformers was hardly to be expected. Indeed, early in the childhood of modern hygiene, there were those who noted injuries of the physical health of school children which they ascribed to unhealthful conditions to which the scholars were subjected in the educational processes then in vogue. Some of the educational faults were so flagrant in those days, and their results were so disastrous that fiction founded upon a subtratum of fact was brought to bear upon public reason by appealing to publ c sentiment.

Since those earlier days, marked improvements have been made in the schools and school systems of all the more enlightened peoples, yet the warfare still goes on between those who still insist that much in the prevalent methods is harmful and should be changed, and those who deny the existence of physical injuries, or seek to shift their responsibilities in whole or in part on the faulty conditions and influences of home and social life.

In the following pages we shall give some testimony both as to matters of opinion and matters of fact which show that the necessity of trying to improve the sanitary conditions of our schools is not yet gone. This will include the results of some of the inquiries which have been made of late years at home and abroad into the influence of school life upon the health of school children. We shall also briefly, or more at length as the subject seems to demand, refer to those individual diseases and deformities which are, or may be, caused or intensified by school life, and which, for this reason, have come to be called "school diseases." Finally, we shall speak of those measures which scientific enquiry and enlightened exp3rienced have suggested for the prevention or relief of these school diseases. These measures will include points in the hygiene of instruction, and rules for the construction and furnishing of school buildings from the hygienic point of view, meanwhile not ignoring pedagogic necessities and conveniences.

Sanitary Conditions of some Schools in Maine and Elsewhere.—Soon after the organization of the State Board of Health, the Secretary sent a circular to all the physicians in the State enquiring, among other things, as to the sanitary condition of the schools. The questions relating to the schools were sent also to a rather small number of teachers and school officers. The answers received from the physicians are given in the first annual report published by the board, and the examination of those relating to the schools will be of interest in connection with our present enquiry. The evidence given by some of them is very clear that the health conditions of our public schools are faulty. Opening that report at random, which happens to be page 184 we quote consecutively a few of the communications from physicians relating to school-houses.

"The most common faults in the school-houses are low ceilings, ill-ventilated and badly heated rooms. The most frequent school-room diseases are catarrh, headache, and sore eyes."

"School-houses have no means of ventilation except by doors and windows. Seats are arranged so that the sun falls directly in front of the pupils, instead of upon their books, making it hard for their eyes."

"Bad ventilation, bad seats, and bad heating facilities in our school-houses. Headache is frequent."

"Our schools are badly ventilated, badly heated, badly seated, and have a detestable privy arrangement. Most of the teachers and scholars suffer from catarrhal troubles during the winter months. Probably, at least twenty-five per cent. are absent during some part of the term on account of sickness. Headache is a very frequent complaint with the scholars."

"If a stranger should travel through our town he would say, 'you have nice comfortable school-houses.' Let him enter these school-houses to study the modern improvements in ventilation. He would say, 'Why, where are your ventilators?' 'Don't you see them, these doors and windows?' 'Yes, I see them, but do you not make the scholars sick by opening windows over their heads while in a state of perspiration from an overheated room?' 'Well, I think I see now why our children come home from school coughing and wheezing, with headache, and having to stay out of school several days to get well.' A few years ago the teacher in district No. 7 was taken ill, carried home, and died in a few days. Bad ventilation and overwork played an important part in this case. Headache is a frequent complaint in our schools."

These few returns from the physicians quoted in the order in which they occur we think may be taken as fairly representing the opinion of the medical profession of the State in regard to the sanitary condition of our school-houses five years ago. If any one doubts it, let him examine the report for himself.

We occupy space here to quote only one of the letters which we received from teachers and school officers, this one from a gentleman for many years a teacher of the high school, and, at the date of writing, the superintendent of all the public schools in one of our principal cities. He says:

Lack of proper ventilation is one of the most serious faults in our school-houses. Not a single room has excellent ventilation, although four are much better than the rest. I have no doubt that, at the lowest calculation, in every room, in winter time, just before recess in the morning and afternoon, there will be found over twelve parts in 10,000 of carbonic dioxide. One room the past year I do not hesitate to say had at times nearly *thirty*. The teacher has been retired in this room, and another substituted. This room contained 8,070 cubic feet of space, and had over seventy pupils all the time —seventy-eight I think.

The teacher in that room had a haggard look, and many children had frequent headache. Some were children of physicians who complained justly Many had to sit either by an open window or very near a coal stove, that had to be hot enough to warm the whole room. Hence frequent colds. Not a furnace in any building, save one with four rooms. Paralysis of bladder was caused in one child, reported through the physician, caused by the teacher not allowing the children to leave the room during the school session. My first order as supervisor was one calling for a recess for the little ones in the afternoon. *Do wake up* the common sense of teachers in this respect, if you print more orders; and *do hit hard*.

There is not a single school-room in the city lighted properly. Frequent cases of myopia are the result, and I detected three cases of astigmatism, saw the parents and had suitable lenses applied and worn. I taught the pupils to examine and watch their eyes. I am convinced that every city, at least, in the state ought to order an examination of the eyes of all the pupils and make a report, coupled with the mode in which the rooms of said city are lighted. The pupils are not overworked and where the more intelligent teachers are, considerable care of the health of the pupils is taken. Some teachers do all they can, others forget that "a cold blast of air slayeth like a sword" and think as long as it is cold, it must be pure, so let it in. I would give particulars of the death of one teacher, and the insanity of another, (one or both taught in the room of seventy pupils mentioned above) but I have not them in mind. The teachers as a rule, do not overwork their pupils. The pupils often learn music, instrumental and vocal, outside of the school work, and in addition thereto.

Two years later, or during the fall and winter of 1887–88, the Secretary of this Board personally visited and inspected eighty-four school buildings in twenty-three of the cities and larger villages of the State. The object was to examine a large enough number of the school-houses in different parts of the State so that the results might be considered as fairly representative of the school-houses of the State generally with a like location in cities and villages. The time spent upon each school building ranged from a few minutes for a hasty survey, to half a day, or a whole day diligently spent in examining, measuring and testing, and in making notes. The results were published in full in the Third Annual Report of the Board. The eighty-four buildings examined varied in size from one-room school-houses to twelve and even twenty-four-room buildings, and they contained an aggregate of 284 rooms, excluding recitation rooms. As regards the lighting and ventilation of these rooms the following shows the conditions found:

Lighting of rooms satisfactory	67
Lighting unsatisfactory	217
Ventilation satisfactory	16
Ventilation none or insufficient	268

It should be said regarding this classification of results that some of the rooms in which the lighting is classed as satisfactory would not be called so if judged in accordance with very exacting rules, and that hardly any, and perhaps none, of the sixteen school-rooms put down as well ventilated came up to the ideal standard.

While the window surface of school-rooms should be at least one-fifth as great as the floor surface, the ratio actually found was often only one-eighth, one-tenth, one-twelfth, or even, in a few cases, one-sixteenth or one-seventeenth,—degrees of lighting so insufficient that they cannot fail to be injurious to the eyes of the scholars. A very serious fault found in some school-houses was the location of some of the windows directly before the eyes of the scholars as they sat at their studies. Even in one $20,000 school-house, passing as an architecturally fine building, there were found six large windows with a western outlook directly in front of the scholars. The effects upon the eyes of the pupils had been so disastrous that the school officers were seeking to obviate the difficulty and they have done so in part by a new arrangement of the seats.

As regards the ventilation, the best results were found in the main room of the Cony high school building at Augusta. Determined by Wolpert's air tester, there were found only 8 and 3-10 parts of carbonic acid in ten thousand parts of air. In this room a large part of the scholars are absent from their seats most of the time in the three recitation rooms. On the other hand, in many other school-rooms, 12, 14, 16, 18 and 20 parts in ten thousand parts of air were found. In one city high school, 29 parts of carbonic acid were found; in another city high school 22 parts; in one fine new building, reached just as the school was dismissed at noon, 18 and 20 parts of carbonic acid respectively were found in two of the rooms one hour after the scholars had left the building, the doors and windows being closed, but the ventilating arrangement in operation meanwhile. In some of the rooms no artificial methods of air testing were needed, for upon entering them the close, stuffy and disagreeable smell of polluted air was very unpleasantly perceptible to the sense of smell.

Enumerating but a few of the more serious faults found in these school buildings, one other must be mentioned, one which is prevalent to a shameful extent. Much more frequently than not the privies or water-closets were found in a condition unfavorable to the moral welfare of the children, but what more particularly concerns us now, is a condition bad for the physical health of the inmates of the school-room.

Altogether too frequently the privies were found situated so near the school-room that their smell was unpleasantly preceptible in the rooms themselves, and water-closets, urinals and drains in the basement of the school building were often found to be in a dangerously leaky condition. The following example, quoted from the Third Annual Report, will suffice to illustrate the character of some of these sanitary faults and their evil results, though fairness to the schools of the State generally, requires us to say that this was about the worse case of the kind found:

This is quite an old, two-story structure, the lower floor of which is used as a wood-house and furnace room, the second floor for the school-room, which is $36\frac{1}{2}$x$27\frac{1}{2}$ feet on the floor with a good height of ceiling. There has always been much difficulty in the warming of the room, and, about a year ago, a new furnace was put in on the lower floor; and, though the furnace might be judged to be of ample size, there is still complaint that the heating of the one room above is not satisfactory. An inspection of the arrangement of the furnace in the basement shows that the fresh-air box or duct, which takes air from a window, is only 10x7 inches in size, and this is expected to furnish air for the two large warm-air pipes, twelve or fourteen inches in diameter, which go to the registers above.

There are no arrangements for the removal of foul air from the room, excepting its accidental escape through cracks and crevices. The average daily attendance is sixty-four, and, during the session of school, the air must be vitiated by the products of respiration alone; but, in addition to this source of air pollution, which is found in all school-rooms, there is another very serious one in this. The privies are built against the back end of the building, and the loose door, which is no safeguard against the gases from the vault, permits the r free escape into the furnace room. The vaults have been in a very bad condition, and have hitherto been cared for only at infrequent intervals; but the local board of health has now taken the matter in charge, and will insist upon removal at stated but rather too long intervals. In the furnace room the privy smell is overpowering; and the furnace, insufficiently supplied with fresh air, is drawing in the dangerous gases at every joint, and through the long seams of the fresh-air duct, which is made of inch boards. Further than this, some of the boards of the boarded up window, from which the fresh-air duct takes its origin, were knocked off, letting the vile air of the furnace room out where it can be sucked directly into the fresh-air inlet. The smell from this furnace-room comes up the stairway so strongly that the door has to be kept closed. The pupils complain much of the odor in the school-room, and the principal has tried to have a different order of things, but unsuccessfully.

Such filthy conditions could not fail to affect the school injuriously, and there appears to be sufficient evidence that it has been quite a prolific source of sickness. The principal has noticed that, at the opening of a new term of school, he feels very well during the first two weeks, or nearly that length of time, and then he almost invariably has a feeling of general weakness, which reminds him of the premonitory symptoms which he felt in the early stage of typhoid fever, nine years ago; and, about two weeks after beginning the last two terms, he has had a crop of boils on the back of his neck, with the usual feeling of general debility. Many of the students have been similarly affected, and the record of the absentees on the teacher's register is quite an interesting study. I had the privilege of examining that part of it which goes back over the past four years, and, taking the absentation as some indication of the amount of sickness, it is very noticeable that during the first two weeks of each term, there has been but very little illness, and then there is a sudden increase in the number of absentees, shown by the lines of black marks opposite the names. Some of these lines were of great length, showing that the pupil, against whose name they were placed, has not returned to the school for several weeks. I was told that many of these scholars had had fever, and that, besides the number whose sickness was serious enough to cause their withdrawal from school, there was a larger number who still persisted in their attendance, while sick or half sick, for the reason that absence reduced the rank to zero. Further statements of the principal were, that four years ago, during the spring term, some were absent on account of typhoid fever. Two years ago, during the fall term, several students had typhoid fever, beginning about two weeks after the opening of the school. Last spring nineteen became sick at one time, their sickness beginning about two weeks after the opening of the school, and eleven of these were sick for a considerable time. The teacher has noticed that there is a marked difference in the ease with which he and the scholars can work in the morning and later in the session.

Just how much illness and debility results from the faulty conditions to which our school children are subjected there is no means of determining accurately. Meanwhile we turn to some investigations that have been made elsewhere as to the amount of illness prevalent among school children and its causes.

In 1881, Dr. Axel Hertel of Copenhagen, published the results of an examination of 3,141 boys and 1,211 girls, better class pupils of the high schools in that city. His results showed that, among the boys 31 per cent., and among the girls, 39 per cent., suffered from chronic debilitating diseases. The acute diseases were not taken into account at all.

In 1882 a royal commission was appointed in Denmark for the purpose of extending the examination of the school children, and, as shown by Hertel,* their inquiries gave very valuable and interesting results, indeed. In the investigations of this commission 17,595 boys and 11,646 girls were examined, in part pupils of the higher schools, and partly out of the people's schools. Their work covered, not only the schools in Copenhagen, but those in the provinces and in the country.

The method of carrying out the investigation was as follows: In the higher schools each scholar received a printed form with a list of questions as to: name, age, class, the number of hours of school work, and the time spent at home in preparing it; whether the pupils had any help out of school; whether the pupil had any trouble in learning his lessons; the hour of going to bed, number of hours of sleep, health of pupil (answered by the physician), height, weight (these two determined in the school), remarks of the school director, etc.

In the public schools, however, every child was examined by physicians appointed for the purpose. The diseases of which information was sought were scrofula, anæmia (want of blood), "nervousness," headache, nose-bleed, chronic digestive troubles, chronic diseases of the heart and lungs, deformities of the spinal column, etc. Myopia was the subject of a special investigation.

Examining the results, we find that, of the whole number of boys examined, 29 per cent are classed as unwell, nearly a third of the whole. Upon their first entrance into the schools at the age of five or seven, nearly 20 per cent. were sick. Then, as Hertel shows graphically, there is a quick and sharp rise in the curve, and a showing of 28 per cent. of sickness in the second year of school life. In the twelfth year of age, or the sixth of school life, the highest point is reached, with a sickness rate of 31 per cent.

*Zeitschrift für Schulgesundheitspflege I, 167.

Turning to the girls' schools we find a still greater percentage of chronic ill-health. For all the schools, and for pupils of all ages, 41 per cent. were found to be suffering from some form of illness. On entering the school at six years of age, 25 per cent. of the girls were sick; and, as with the boys, entrance upon school life was followed with a marked rise in the sickness rate, until at ten years of age, 43 per cent. of the girls were ill. The highest point was reached at the thirteenth year of age with a percentage of 51 per cent. suffering from disease. That at the ages from ten to twelve, just before the advent of puberty, there should be more than 40 per cent. of the pupils ill, is regarded by Hertel as a melancholy fact.

As regards the prevalence of different forms of disease, scrofula, anæmia (bloodlessness), and habitual headache were more frequent than any others, in fact they constituted three-fourths of all the illness.

Almost simultaneously with the work of the Danish commission a similar one was engaged in investigating the health conditions of the schools of Sweden, and I am indebted to the work of Dr. Axel Key,* one of the commissioners, for the information which I am enable to give of the results of their work.

Hertel's preliminary examination of the schools of Copenhagen served as a model and a guide to be followed by both the Danish and the Swedish commission as to the proper methods of carrying out investigations of this kind.

Before giving the results of the Swedish enquiry, it should be said that the rule was adopted of always recording the child as sound when there was any doubt as to how he should be classed.

In the higher common schools examined, there were 11,227 pupils, and, of these, trustworthy returns were obtained as to the facts required in all but seventeen. Of the remaining 11,210 pupils 44.8 per cent. were found to be sickly. The highest rate of sickness prevailed among the Latin division, 50.2 per cent. Thus, half of these pupils presented symptoms of chronic disease of one kind or another: In the technological division (Reallinie), and among the younger pupils who attended the lower or mixed classes, the sickness rate was considerably lower, 39.6 per cent. for the former, and 40.9 per cent. for the latter.

The percentages of particular complaints were: Headache, 13.5 per cent.; anæmia, 12.7; nosebleed, 6.2; loss of appetite, 3.2;

*Axel Key's Schulhygienische Untersuchungen. Translated into German by Dr. Burgerstein of Vienna.

scrofula, 2.7; nervousness, 2.0; curvature of spine, 1.5; near-sightedness, 15 2; and unspecified, 9.9 per cent.

As indicating that the average percentage of illness found is not a normal or inevitable percentage, it is only necessary, as Dr. Axel Key says, to adduce the fact that, while the average for all the schools is 44.8 per cent., in eighteen schools with an aggregate of 5,800 scholars, the illness was below the average. In twelve of these schools only from 30 to 40 per cent. of the scholars were sickly, while in seventeen other schools from 50 to 70 per cent. were sickly, and these schools all in the same country, among the same people, with the same climate, children from the same classes of society, living under the same social conditions, and subjected to the same methods of investigation.

The influence of school life is shown unmistakably in the record of the health conditions of the primary (vorbereitenden) schools of Stockholm. On entering these schools at an average age of seven and eight-tenths years, 19.8 per cent. of the children were sickly. In the second year of school life the amount of chronic illness had increased to 38.1 per cent. In the third year there was a slight lowering, but in the fourth year again a rise to 43.6 of sickly pupils.

During the four years spent in these lowest schools, anæmia increased trom 7.7 to 19.8 per cent.; nosebleed from 1.1 to 5.9; nervousness from 2.2 to 3.0; headache from 2.2 to 11.0; near-sightedness from 3.3 to 6.9; and scrofula from 1.1 to 3.9 per cent.

The foregoing results obtained in the Swedish schools refer to schools for boys only. A similar investigation was carried on as to the conditions in the higher schools for girls. The number examined was 3,072. Of this number there were 65.7 per cent. which the commission was obliged to class as suffering from more or less serious chronic diseases, or deviations from health.

As regards special complaints, 36.6 per cent. suffered from anæmia; 6.8 per cent. from nosebleed; 6.5 from nervousness; 12.0 from deficient appetite; 36 1 from headache; 11.5 from shortsightedness; 10.8 from spinal curvature; 5.0 from scrofula; etc.

We know of no other investigations so extensive and exact as these which were made in Denmark and Sweden, but add here a few observations less comprehensive tha· have been made elsewhere, together with some expressions of opinion as to the health of scholars or the influence of school life on health.

A few years ago an investigation was made into the health of the pupils and graduates of the high schools of the city of Cleveland by a committee appointed by the Board of Education of that city.*

The examination was made, quoting the words of the chairman of the committee, "with a view of learning, first, why so many scholars who enter for this course drop out before it is finished, and, second, why so many, and especially the girls, have apparently suffered in health beyond the usual ills of life during their high school days. I am led to this course by a long period of observation of the pale cheeks, dull eyes, stoop-shouldered forms, and worn and wearied looks of many of the pupils in the Central High, at an age when we expect to see bright faces, rosy cheeks, and erect forms."

We reproduce here only a minor part of the results so graphically brought out by the paper from which we quote.

Health record of forty boys who left the high school, 1880–81.

Health Conditions.	When entered.	At school.	After leaving.
Good	85 per cent	45 per cent	70 per cent.
Fair	10 per cent	17.5 per cent	24 per cent.
Rather poor	5 per cent	5 per cent.	
Poor	-	10 per cent	5 per cent.
Quite poor	-	15 per cent.	
Very poor	-	7.5 per cent.	

While in school the health of 50 per cent. of the boys, was not so good; 23 per cent. lost appetite; 10 per cent. lost sleep; 45 per cent. had headache; 23 per cent. had weak eyes; 23 per cent. left wholly or in part on account of ill health.

*Boston Med. and Surg. Jr., Vol. CV, p. 486.

Health record of eighty-five girls who left the high school in 1880–81, and eleven who left in 1879–80; ninety-six in all.

Health Conditions.	When entered.	At school.	After leaving.
Good	73 per cent	17 per cent	35 per cent.
Fair	22 per cent	9 per cent	25 per cent.
Rather poor	5 per cent	7 per cent	12 per cent.
Poor	-	5 per cent	18 per cent.
Quite poor	-	12 per cent	1 per cent.
Very poor	-	48 per cent	7 per cent.

The missing two per cent. in the last and next to the last columns in the foregoing was due to two deaths. While at school, the health of 80 per cent. of the girls was not so good; 46 per cent. lost appetite; 27 per cent. suffered from sleeplessness; 72 per cent. had headache; 52 per cent. had backache or sideache; 44 per cent. had nervous troubles; 75 per cent. left wholly or in part on account of ill health; 52 per cent. complained of stair climbing; 36 per cent. were troubled with weak eyes.

The grade of health in which each pupil is classed was determined partly by the number, and partly by the severity of the abnormal symptoms developed during attendance at school. If a pupil developed the single symptom, for example, headache or loss of appetite, etc., he was classed as "fair." Headache *and* loss of appetite and the like would class him as "rather poor" Where all, or nearly all, abnormal symptoms co-existed the case was classed "very poor."

Other diagrams and tabulations develop the fact that ill health among the scholars increases directly as the amount of time spent in study beyond school hours, and inversely as the amount of recreation taken.

Dr. G. E. Corbin* of Michigan gives so striking a history of the results of school life under unhealthful conditions that we cannot forbear quoting from his paper at considerable length. The schoolrooms of which he writes were overcrowded and not well ventilated. He says:

"Numerous hale, ruddy little pupils of five, six, seven and eight years of age have entered here with much ambition for their first

*Eight Annual Report State Board of Health of Michigan, p. 187.

school instruction. As I have had one of my own children among them, and others to treat, I have watched the effect of their condition and surroundings, and know whereof I affirm. In this room, on a small scale, I have seen Darwin's theory of the "survival of the fittest" (physically) tested, and its correctness demonstrated. Year by year this room is constantly crowded far beyond its healthful capacity, notwithstanding the weaker ones are continually compelled to drop from the ranks and remain at home to recruit their exhausted energies. I have a little boy whose only school advantages during a period of four years were confined to this room. During this period he did not accomplish more than he could easily have done in two years, with suitable and healthful accommodations.

Appreciating the vile condition of the atmosphere, I permitted him to remain only an hour and a half in the forenoon, and an hour and a half in the afternoon. Under such circumstances, even, there was never a time during the whole four years when he was able to attend steadily for more than two months in succession. At the expiration of this time, or less, he would become too ill to attend. From two to four weeks of unrestrained recreation and exercise in the open air would so recruit his strength and energies as to cause his return to school. In every instance, for four years, *he failed rapidly when confined for only three hours per day in the vile atmosphere of this room; and in every instance he improved rapidly when transferred from it to the open air.* The history of this child is substantially the history of many of his companions and schoolmates. It is a fact, I grant, that not all were injured to the same extent. Some are endowed with far greater powers of endurance and resistance than others. These bear up longer, and crowd out the weaker ones; but *all* are injured to a greater or less extent. At the close of last year my little boy completed the prescribed course in this room. In advancing him to the next department (his age and strength now permitting), I sent him a long way out of his own district, that he might have the advantage of a larger room containing fewer scholars. He entered a light, airy room, twelve feet high, containing 1,075 square feet of floor space, and fifty pupils. Up to the present time, embracing fully two-thirds of the school year, he has attended steadily. He has constantly improved in physical health, and has accomplished much more in his studies than ever before during the same length of time. This record would be far too incomplete were I to omit the history of the teachers.

The history of the teachers in charge of the room first described, is as follows: Six years ago Miss C., from Pontiac, took charge of this room. At that time she was large, well developed, well nourished, strong. In brief she was as "perfect a picture of robust health" as I ever saw. She endured her first year's labors here very well. Her second year's labor in the room "told upon her" very perceptibly. During her third year, she lost much in weight, complained greatly of lassitude—general languor—and went home pale, thin, and haggard, in comparison with her former self.

The above history of Miss C. is almost precisely the history of Miss W., who has been discharging like duties in the same room for the last three years. She tells me that, since she attained her growth, she never weighed so little as at the present time. To my certain knowledge, she needs, and is daily taking tonics—bracing remedies—that she may keep upon her feet at all. In contrast with this, I desire to state that Miss Q , engaged in the service of this school district at the same time Miss C. did. For three years they sat at the same table, and occupied the same sitting-room and sleeping-apartment. Their evenings were almost invariably spent together, whether in their room, at a public entertainment, or elsewhere. In brief, their habits were as nearly alike as is possible. In stamina, in real powers of endurance, Miss C. had the advantage. Each was assigned to a primary department. Each was active, ambitious, successful. Miss Q. is still at work in the same room where she has, without loss of time, given good satisfaction for the last six years. Her health, strength, energies, vitality, are apparently unimpaired. She has changed no more than is common with us all, in the same length of time. Why? I will state a few more facts, and my readers can all draw their own inference. The first year's services of these two young ladies in this school terminated with the school year in June, 1875.

Miss C. occupied a room with no possible facilities for ventilation, excepting through open doors and windows. Miss Q.'s room was tolerably well ventilated, being heated by a furnace in the basement and possessing a heated shaft for the exit of foul air. Besides this large advantage, numbers also favored Miss Q.'s room. Had it been properly ventilated, Miss C.'s room, with 750 square feet of floor-space, would have healthfully accommodated thirty pupils only; whereas, the *average daily* attendance during the whole year was sixty-four. Miss Q.'s room being tolerably well ventilated and containing 1,075 square feet of floor-space, afforded healthful accommodations for forty-three pupils; and the *average daily* attendance for the whole year 1875, was only forty-five.

Here we have two rooms in comparison. The one presenting just about the conditions stipulated for by the State Board of Health of Michigan, and the other packed with more than double its justifiable capacity. The results of these conditions for a period of six years, have been briefly but accurately recorded. It is true that during six years, fluctuations in numbers, and other changes, have occurred; but in the main, the relative condition of these two rooms has not been materially altered. The average daily attendance in Miss Q.'s room has increased from year to year, and was sixty-five in January last. Though the gradual changes in Miss Q.'s room have been detrimental, the results in the two rooms have been extremely different.

Two of our ten teachers are employed as assistants—one for the high school, and one for the grammar school. These teachers are assigned to recitation-rooms, where different classes go to recite. These recitation-rooms are exactly 10½ by 12 feet; so that if well ventilated, each would accommodate *five* persons only. These rooms, no larger than a small bed-room, have been thus used for twelve or fifteen years. Some of the classes are so large that twenty-five or thirty persons at a time have been daily compressed into one of these rooms to recite. Under such circumstances, the only possible way to avoid suffocation is to keep constant communication with the outer atmosphere through open windows, whatever the season of the year—whatever the temperature. I have neither time, space, nor inclination to record all of the detrimental effects of this inexcusable condition, falling under my personal observation. I will briefly relate one which is well authenticated, though the *results* did not fall under my professional observation. During our school year which terminated in June, 1876, Miss R., of Ypsilanti, as assistant in our "high-school," had charge of the classes reciting in one of these small rooms. Miss R. is now so deaf that she has been compelled to abandon the profession of teaching. Prof. F., of Michigan University, traces her deafness to the effects of chronic catarrhal inflammation. Miss R. traces the catarrh to exposures received in this room Many are the pupils, who, though not deaf, are afflicted with troublesome catarrh contracted in these small rooms. Many times have the facts been clearly set before the voters in this school district, in years past, without obtaining the relief sought, which the pupils and teachers so much need. The masses of people seem to have no conception of the extent of nervous prostration, enfeebled constitutions, and actual disease engendered by, and directly traceable to, the vitiated atmosphere of overcrowded school-rooms. The effects are so gradual, so insidious, that they escape the attention, for a time at least, of careless and casual observers. Even when the effects have become painfully obvious, most parents are unable to trace them to their true origin. To them the cause and effect are so remote, that they fail to see the connection. In this case, here at home, I can excuse their apathy on no other basis of explanation.

SCHOOL DISEASES.

We presume that most of our readers, who have been accustomed to observing much the effects of school life on children, have not failed to note the fact that the physical health of some of the pupils suffers, as the result, apparently, of school attendance. Many of these pupils, to the eye of the inexperienced or injudicious teacher, do not appear to be suffering from impaired health; but to the observing parent, or to the physician, there are evidences that all is not well with them. At home it will be observed that gradually, as the school term advances, the child loses his natural, ruddy color, that there is a diminution of the normal appetite of childhood, that there is complaint of headache, that the child awakens earlier in the morning than he should, or that his sleep is disturbed by dreams or otherwise. If, with the noting of these evidences that the child is "ailing," the rule and the scale be called into requisition to determine the rate of the increasing height and weight, it will undoubtedly often be found that a temporary check in the development of the child has occurred, or at least that there is a diminution in the ordinary rate of growth. These symptoms, when persistent or frequently recurring, should be regarded as indicative that something is threatening to undermine seriously the health of the pupil,—in fact, that there is danger ahead.

The pathological picture presented by the ailments of the child is very often not distinct enough to fit well into the physician's nomenclature, as a distinct form of disease, yet, under these circumstances, continued and uninterrupted subjection to the regime of the school-house and the school master would eventuate in diseases not hard to name. and entailing permanent injury to health. But vacation comes With no change in his home life, and with no other change than the cessation of school restraints, and school duties, there is a marked gain in the physical well being of the child.

In connection with his examination of the state of health of the school children of Copenhagen, Dr. Hertel refers as follows to this class of pupils, sickly, nevertheless able to attend school:

It is essential that I should explain what I mean by sickly children. Many head masters have tried to prove to me from the school sick lists that the state of health in their schools is excellent; but the sick lists are of no value on this point, for they merely show the number of children who are absent owing to temporary illness. It is not to such cases of temporary illness that I refer when I speak of sickly children. By "sickly" I mean *unsound children, who suffer from chronic complaints, but who are, nevertheless, able to attend school regularly; in short, children whose state of health is abnormal, and who require special care, both at home and at school, during their growth and development.* It is only such cases that have been collected here and designated as sickly; properly speaking, they ought to be called cases of *unsound* or *abnormal* health.

There can hardly be a doubt that the faulty sanitary conditions of many school buildings and unwise methods of teaching have much to do with laying the foundation of future disease.

Digestive diseases, initiated in the school, often render the individual an invalid or a semi-invalid through life. The combination of such influences as bad air, over-heating, stooped position and pressure upon the abdominal organs, and mental strain, are entirely capable of introducing these troubles.

The disturbances of the general nutrition by the causes just enumerated, by prolonged sitting still, and by breathing and rebreathing the same air, particularly if it holds infective dust in suspension, may start in the system that slowly developing train of symptoms that later in life will be pronounced consumption.

Prolonged sitting at unsuitable desks during the developmental stage forces the child to assume faulty positions that eventuate in deformity.

Faulty desks, insufficient or unfavorable light, and too prolonged reading or writing, lead to troubles of the eye that may become diseases of more serious import when the competitive struggle for a competency or position in life comes.

Myopia.—Among the impairments of vision found in the schoolroom, myopia, or nearsightedness, has claimed a larger share of the attention of physicians and school hygienists than any other. Twenty-five years ago or a little more, the attention of the medical profession was strongly attracted by the investigations of Dr. Hermann Cohn of Breslau, Germany, into the causes of myopia in the schools of that country. He examined the eyes of 10,060 school children and included in his enquiry the character of the schoolhouse lighting, the kind of desks, the age of each scholar, the number of years he had attended school, etc. He found myopia in the following percentages of scholars examined in schools of different characters:

Village schools	1.4 per cent.
Elementary schools	6.7 "
Girls' schools	7.7 "
Secondary schools	10.3 "
Technological schools	19.7 "
Gymnasia	26.2 " *

Thus it is seen that, in the village schools, the percentage of myopia was low, while in the city schools it was much higher. In the city primary schools the percentage of myopia was four or five times greater than in those of the villages.

It was discovered by Cohn that the prevalence of myopia increased in all the schools from the lower to the higher classes, and increased also with the length of time the children had been in school. Thus, in the village schools children who had been in school six months or less showed no myopia. On the other hand 1.6 per cent. of the

*Real-Encyclopædie der Gesam. Heil. XI, 249.

children who were in their fifth and sixth school years were myopic, and in the city 8.2 per cent. of the pupils in the elementary schools were nearsighted, and 11.9 per cent. of those in the secondary schools.

Furthermore it was found that the grade of myopia increased from class to class in all the schools.

Since Cohn's earlier work, investigations of the same kind have been made in every civilized country. The following gives the results of some of the more recent work in this direction abroad, and the results reported by a few American investigators.

At the request of the Prussian Minister of Instruction the eyes of the scholars of the gymnasia and real-gymnasia of Frankfort, Wiesbaden, and several other German towns were examined by Dr. Schmidt-Rimpler relative to their refractive condition. The schools were examined twice, the first time after the Easter holidays in 1885 and the second time in August and September, 1888. At the first examination 1,735 scholars came under his observation, and the second time 2,002. As other investigators have found, the percentage of nearsight increased from the lowest to the highest classes, and as the year and age increased. The investigator was able to show that myopia, contrary to some assertions, arises even after the ages of fifteen or sixteen. He confirmed the fact also that nearsight was more prevalent among the studious scholars. Some authors have sought an explanation of the increase of myopia in the higher schools in the assumption that there is a larger percentage of nearsight in the pupils who remain than in those who leave the school. The results of Schmidt-Rimpler decidedly negative this idea.*

Before the Paris Hygienic Congress of 1889, Dr. Motais expressed the opinion that myopia in France is about 33 per cent. less prevalent than in Germany, nevertheless, his examination of the eyes of 6,680 children in the primary and secondary schools gave an average of from 34 to 37 per cent. in the higher classes of the secondary schools. In certain colleges the percentage of nearsighted scholars was as high even as 80 per cent.†

Among the 15,000 boys and 3,067 girls examined under the direction of the Swedish commission‡ the percentage of myopia increased, between the ages of eleven and nineteen, in the following progres-

* Hygienische Rundschau I, 70. 1891.

† Revue D'Hygiene, XI, 688. 1889.

‡ Axel Key's Schulhygienische Untersuchungen, p. 88.

sion: For those who took the Latin course, 6.1, 6.4, 9.6, 9.8, 17.3, 23.4, 24.6, 32.5, 37.3. From the age of fourteen to nineteen, for those who took the technological course, nearsightedness increased as follows: 8.9, 12.6, 19 6, 16 7, 26.3, 21.

In the schools of Upsala, Dr. Schultz extended his examinations of the eyes of the pupils over a period of six years and found myopia to increase from the lower to the higher classes as follows: 19.5, 20.1, 29.1, 23.6, 41.2, 47.8, and 54.8.

Dr. Lawrentjew tested the eyes of 1,920 scholars in the schools of Russia, and found 35 per cent. of nearsighted scholars. In the lower schools there were 28.5 per cent.; in the intermediate schools, 38 2 per cent; and in the higher schools, 40.8 per cent. The grade of nearsightedness increased from the lower classes of the lower schools to the upper classes of the higher schools.*

In the same country Dr. Medem investigated the condition of the eyes of 2,412 Russian scholars ranging in age from ten to eighteen years. 46.49 per cent. of nearsighted scholars were found. According to age the percentage varied from 26.75 to 60.

In Groningen, Holland, 31.8 per cent. of the students of the university were myopic, the average for different departments varying from 25 per cent. among the medical, to 57 per cent. among the theological students. In Utrecht and Leyden the percentage was found to be 27 per cent. and 28 per cent. respectively.†

Among 1,000 pupils in the public and private schools of Cincinnati, a little over three hundred were myopic according to Dr. Dowling.‡ Almost entire absence of nearsight was found in children below the age of nine.

In this State the eyes of the pupils of the Lewiston schools were examined by Dr. C. E. Norton§ in 1882 and again in 1890. The percentage results relating to myopia were as follows:

*Zeit. für Schulgesundheitspflege, II, 334. 1889.

† Uffelmann's Supplement for 1886, p. 230.

‡ The Times and Register XXIII, 61.

§Rpt. of the Examination of the eyes of the Pupils in the Schools of Lewiston, p. 5. 1890.

		1882.	1890.
Primary Schools,	First Class	1.5	.8
Intermediate Schools,	Second Class	2.0	2.1
"	First "	3.5	2.9
Grammar School,	Fourth "	7.2	5.3
"	Third "	8.8	8.1
"	Second "	11.8	9.8
"	First "	12.7	13.9
High School,	Fourth "	9.5	12.8
"	Third "	16.7	11.8
"	Second "	8.8	8.8
"	First "	8.0	15.4

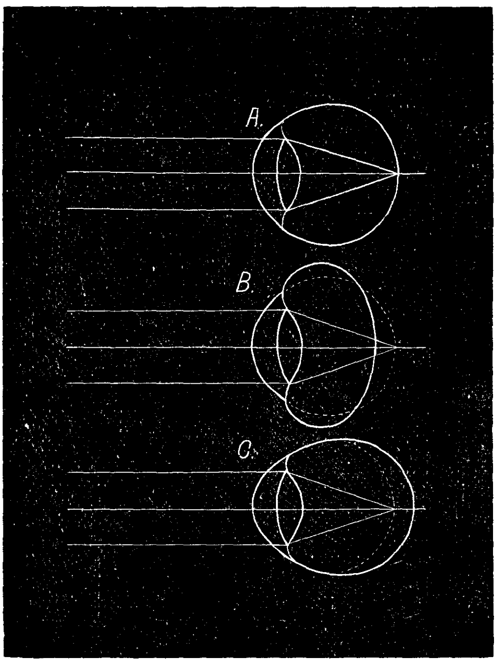

FIG. 1.

Definitions.— The normal (emmetropic) eye is nearly spherical in shape and in it rays of light from a distance, or parallel rays, are focused exactly on the retina; consequently when the eye is at rest, distant objects are distinctly seen. (See Fig. 1, A.)

In the nearsighted (myopic) eye, the eye-ball is elongated and parallel rays of light focus before they reach the retina. Vision for distant objects is therefore not clear. (See Fig 1, C.)

In the long-sighted (hypermetropic) eye the globe is more flattened than in the normal eye and, when the eye is at rest, parallel rays of light are not focused when they reach the retina, but, if prolonged, would be focused behind it. Distinct vision, even of distant objects, requires an effort of the eye. (See Fig. 1, B.)

Inconveniences of Myopia.—Myopia is undesirable for two reasons: It is inconvenient and it is dangerous. Unless his nearsight is of a very slight grade, the myope is at a disadvantage and is well aware that much is lost to him in distant vision. Even with glasses the vision of the nearsighted eye is never the equal of normal vision; and the trouble of being tied to glasses all through life, of forgetting them sometimes, and the danger of breakage—these are some of the minor ills, and the last is sometimes a calamitous one. Combatting a popular misapprehension of the truth, Dr. Loring says: "In no possible way, either mental or physical, is a defect of vision a benefit or advantage to the individual who suffers from it."

But there is perhaps no way of showing more clearly the disadvantages of being nearsighted than to quote the words of a myope, Francisque Sarcey,* the distinguished critic of the Parisian newspaper *Le Temps*.

One day, prompted by the spirit of mischief, I got hold of the big silver spectacles which my father always wore, and clapped them on.

Fifty years have passed since then, but the sensation I experienced is keen and thrilling to this day. I gave a cry of astonishment and joy. Up to that moment I had seen the leafy dome above me only as a thick, green cloth through which no ray of sunlight ever fell. Now, oh, wonder and delight, I saw that in this dome were many little brilliant chinks; that it was made of myriad separate and distinct leaves through whose interstices the sunshine sifted, imparting to their greenery a thousand tones of light and shade But what amazed me most, what so enchanted me that I cannot speak of it to this day without emotion, was that I saw suddenly between the leaves and far, far away beyond them, little glimpses of the bright blue sky. I clapped my hands in ecstacy. I was mad with admiration and delight.

I gave them no peace until they gave me spectacles; then I enjoyed a very debauch of seeing. All objects which up to this time I had imagined to be without definite outlines or sharp angles, now put on a new and singular appearance. Vistas stretched away before me and opened up a constant source of discoveries and surprises for many things that I had always seen confused and jumbled seemed now to stand boldly out and to be actually coming towards me.

I recollect an amusement to which at this time I was completely given over. I would lie down in some field and amuse myself by taking off and putting on my glasses. When I raised them the meadow stretched green and unbroken before me like a big billiard table. When I droppd them before my eyes again, I could see the thousand grass blades trembling in the breeze and changing color with the light and shade, while numberless little flowers showed

* Mind your Eyes! Good Advice from a Near-Sighted Man to his Fellow Sufferers Translated by Henry Dickson Bruns, M. D., 1886.

their tiny heads of blue or white. 'Twas a sight of which I could never get enough.

These recollections are so clear and distinct that I cannot doubt that they were real; no illusions, but sensations and emotions which I once experienced. Thus all my life I have been going from one surprise to another.

Will you believe, kind reader, that when about fifteen or sixteen I was much worried in reading a work of Toussenel's, I believe, on the habits of birds, to understand how the author could have become acquainted with such details: For, said I to myself, nobody ever *saw* a bird; we know that such things exist because we hear them singing, but no one ever saw a bird in a tree. Which was the truth as far as I was concerned, for I had never seen a bird except as a dark streak darting across some clear expanse of sky. But birds in trees nestled among the foliage, their plumage scarce visible against the dark bark! Anyone who pretended to have seen them, to have watched the little creatures in their homes, at their play, their work, their love-making, must be romancing merely.

Dangers from Myopia.—There is a serious error in the popular idea that near-sighted eyes are stronger than others, founded upon the facts that the myopic eye has a greater magnifying power when used on small objects at a close range, and that the nearsight tends to neutralize the advancing long-sight of middle and later age, thus deferring or making needless the use of convex glasses. But no account is taken of the fact that the near-sighted eye has a tendency to become more near-sighted when overworked, that with the progressive myopia, there is danger of serious changes in the eye, and finally, in a considerable proportion of cases, still more extensive complications arise.

Dr. Williams,* referring to the danger of overworking myopic eyes says:

The ophthalmoscope reveals great and progressive changes, previously unsuspected, in the most important structures of the eye, which are solely caused by continuous accommodation of the sight for small objects, and which, unless arrested, tend to deterioration and even loss of vision. Unfortunately, children who have become near-sighted generally find their chief pleasure in books, and are disinclined to the sports of other children, because they do not see objects around them so well as their fellows. The parents and teachers of such children, pleased with their precocious diligence, are but too ready to encourage excessive application to study and efforts to gain a high rank at school; especially, as for the time no complaint is made of the eyes. It is only when the myopia has reached a degree which will in the future render them incompetent for many pursuits, and especially for those requiring constant use of

* Bost. Med. and Surg. Jour., CII, 538. 1880.

the eyes, to which they had hoped to devote themselves, and when perhaps, much use of the eyes already begins to cause pain, that it is discovered, too late, what a mistake has been made.

A very important point in the myopic process, says Dr. Priestley Smith,* is the tendency which it has to react upon itself. Excessive convergence increases the myopia, and the increase of the myopia compels a still greater convergence. The more the boy stoops over his book the more short-sighted he becomes, and the more short-sighted he becomes the more he is compelled to stoop. In this vicious circle the eyes not infrequently go on from bad to worse until, by reason of the altered shape of the globe and the extreme nearness of the farthest point of distinct vision, convergence for this point becomes impossible and the effort to obtain binocular vision in reading is instinctively given up.

Cohn considers every case of myopia essentially a disease of the eye. On the other hand, agreeing with the views of Tscherning and Stilling, Dr. von Hippel† claims:

The danger from school myopia has been decidedly overestimated by Cohn and his followers, although it is not denied that it exists to a certain extent. According to his experience, the near sight acquired entirely by near work, in the great majority of cases, increases slowly, reaches, as a rule, only a low or middle grade, and becomes stationary with the complete development of the body. It is, as he believes Stilling is right in saying, the result of an abnormal growth of the youthful eye under the influence of muscular pressure, but is not to be regarded as a real disease, and it generally does not impair the capability of the eye for work; it is troublesome only in that it requires the use of glasses for distant vision.

Distinctly separated from this form of myopia, is another which in most cases is present already in the earlier years of life, is almost always rapid in its progress independently of the occupation of the individual, among the students of the higher institutions of learning it is not present more frequently than among the uneducated classes. Sooner or later it leads to partial or complete blindness.

To this Dr. Cohn answers as follows:—

1. As the percentage of myopia in Von Hippel's school ranged from 5 per cent in the lowest to 50 per cent in the highest class, and as the "pernicious" form of myopia (the second form mentioned by Von Hippel) constitutes only one-fourth of one per cent. of all cases, the number of cases of this severe form under Von Hippel's observation could not have been worth mentioning. The reasonableness of this assumption Dr. Cohn shows from Von Hippel's own tables.

* Causes, Prevention and Treatment of Myopia, in British Med. Jour., Sept. 27, 1890.

† Ueber den Einfluss Hygienischer Massregeln auf die Schulmyopie.

In his own observations twenty-five years ago on 10,060 school children not a single case of pernicious myopia was found. Since pernicious, congenital myopia is fortunately so rare, and the cases of it observed among students are so few, the law as to the origin and progress of myopia, won from the examination of hundreds of thousand of pupils, is not affected in the least by them, and Cohn thinks it about time that this legend advanced by the enemies of school reform were put out of the world.

2. As to the assertion that myopia acquired in the school "reaches only a low or a middle grade and becomes stationary with the complete development of the body," Cohn writes:

Fortunately it is true that many cases of school myopia of medium grade remain stationary in after life; but they do not all do so. I hope at a not too distant day to have ready a tabulation of a great number of cases that I have followed for twenty or twenty-five years, in which a slight degree of myopia was noted during school life, which in later life, I have verified with the ophthalmoscope and with test-types, and in which I have observed very disturbing spots before the eyes (mouches volantes), clouding of the vitreous, amblyopia, inflammation of the choroid, and particularly trouble-some insufficience of the internal recti muscles. In spite of a careful study of these cases, and in spite of twenty-five years experience as an ophthalmic surgeon, I will not allow myself in any case to give a judgment whether a case of mild or medium myopia in the lower schools will remain as myopia of a moderate grade, or whether it will progress, especially if one of the learned professions be chosen, so that at the age of forty or fifty years pernicious results will show themselves.

Homer says with truth that, "the mortal danger for the near-sighted eye begins with the fiftieth year of life." I can only wish for von Hippel, as I have already done for Tscherning, a long life and ample strength for work, that he may be able again to examine his cases of myopia twenty or thirty years from now. If he then can show that all of these cases have suffered neither increase of myopia, nor other serious results, he will be justified in declaring that the myopia of school life is a disease devoid of danger.

Causes of Myopia.—The chief factor in the production of nearsightedness is prolonged use of the eyes for near work, but the interest and importance of the subject has brought into the discussion several conditions which have been shown, or assumed, to have a part in the causation of the trouble. Among them are the following:

Relation of Myopia to Age.—It is generally believed that the eye is far less able to withstand overwork or other unfavorable conditions during the period of rapid bodily development. Assuming that school work has much to do with the production of myopia, the obvious reason why the eyes of young children, or those in the primary classes, show only a low percentage of this abnormality is that they have as yet been but little exposed to injurious influences. As has already been shown in the observations of Cohn and others, myopia increases in the schools from class to class,—that is, with the length of time the juvenile eyes have been busied with reading and writing or other near work.

That the eyes of pupils may be injured during the years of their primary instruction is made evident by Hersing who found only three per cent. of the ten-year-old children of country primary schools myopic, while 21.5 per cent. of the pupils of the same age in city primary schools were myopic.

Nationality and its Relation to Myopia.—It has been quite a prevalent assumption that some races or peoples acquire myopia much more easily than others. The investigations into the conditions of the eyes of the students of various countries make it very probable that this is an error. With like habits of studiousness, and subjected to the same conditions of work, it is very likely that the differences between the cultured races are but slight. (See pages 101 and 102.) On the other hand, among races that have never been educated, near-sight is unknown.

Heredity and Myopia.—Some writers have shown a disposition to throw almost the whole load of blame for near-sightedness on heredity. Various studies have been made to determine how large a part in the causation of myopia should be referred to inheritance. For obvious reasons, such enquiries are rather difficult, and the results obtained can be considered as only an approximation to the truth.

The investigations of Pfluger* have convinced him that not more than ten per cent. of all cases of myopia can be referred to inheritance from parents.

Schmidt-Rimpler† found, in 1885, that fifty-six per cent. of the cases of myopia in the schools under his care, and in 1888, fifty-one per cent. of them, had a father, a mother, or both father and mother near-sighted, while the percentage obtained by Von Hippel‡ was 49.5 per cent., and by Kirchner 49.9 per cent.

*Zeit. f. Schulgesundheitspflege I, 128. 1888.

†Die Schulkurzsichtigheit und ihrer Bekampfung, p. 38. 1890.

‡Ueber den Einfluss Hygienischer Massregeln auf die Schulmyopie, p. 46. 1889.

In the seven German towns under the care of Schmidt-Rimpler the percentage of cases of myopia with a hereditary history showed no correspondence whatever with that of the total myopia. For instance, in the Frankfort Gymnasium, where 65 per cent. of the myopic scholars gave a history indicating inheritance, the percentage of myopia for the school was only 24 per cent.; while in the Fulda Gymnasium, with 34 per cent. of inheritance, the percentage of myopia was 32 per cent.

He therefore believes that there are other potent influences which account for the fact that, though the burden of heredity is heavy, the total myopia in one school may be moderate, while in another, with a smaller percentage of hereditary cases, the total may be well up to the average. He believes that these influences may be found in the differences in the hygienic conditions which prevail in different schools. For instance again, the Frankfort school was supplied with good desks and the hygienic conditions were otherwise good, while the school at Fulda was in an old building not well lighted, had miserable desks, and the hygienic conditions were neglected in other directions.

School Work and Myopia.—Nearsight, as it occurs in the schools, is usually the result of a combination of causes acting on eyes undergoing the developmental changes of childhood and youth, some of which are predisposed to myopia by hereditary tendencies. Enumerating and examining the most potent of these school-room influences, we have first:

Prolonged Eye Strain.—Some investigators give this the first place in the production of myopia. In looking at distant objects the normal eye is at rest, but when turned to small and near objects, as in reading, muscular action is required to adapt it to the near work. One set of muscles acts upon the lens to change its shape; another set converges the optic axes more or less strongly according to the degree of nearness of small objects to the eye. The eye can continue this work for a reasonable length of time without effort, but, prolonged hour after hour without sufficient intervals of rest, these muscles become tired and the eye becomes congested.

A further result is increased intraocular pressure, or eye tension, partly from muscular pressure, partly indirectly from the increased flow of blood to the eye, and then comes the tendency of the tunics of the globe to give way and bulge at their weakest point, the posterior part of the eyeball, as actually occurs in myopia.

The action of prolonged or excessive study is well illustrated by an example given by Erismann.* Four thousand three hundred and fifty-eight scholars being in the habit of studying out of the regular school hours, he found

Of those studying two extra hours 17 per cent. were nearsighted.

Of those studying four extra hours 29 per cent. were nearsighted.

Of those studying six extra hours 40 per cent. were nearsighted.

Faulty Lighting.—Next to eye strain by too prolonged work as a cause of myopia should be placed the increasing of this strain by doing the reading and writing under conditions of lighting that are unfavorable to the eye.

Unsuitable Desks and Myopia.—The part which unsuitable school desks and seats play in bringing on myopia is an important one. They force pupils to assume postures that favor congestion of the head and eyes, and place the child and his writing or reading work in a relation to each other that is unfavorable to easy and distinct vision.

Some Recent Investigations.—To refer all cases of the higher grade of myopia to the evil influences of the school-room is an exaggeration, and, on the other hand, to maintain (as Tscherning does) that the high grades of myopia in the schools, develop without reference to the sanitary arrangements of the schools, is going too far.

That the length of time spent in school has an influence in determining the number of scholars that are affected with myopia of a high grade is shown by the graphical curvesof Schimdt-Rimpler.† He has, moreover, studied the farther history of forty-one cases of advanced myopia. In twenty-three of these it was pretty certain that there was direct inheritance or congenital anomalies that would have led to a high grade of myopia without the influence of the schools; that the same was true in five others it was not improbable; but in thirteen cases, or 13 per cent., the detrimental influence of the schools was unmistakable.

Schmidt-Rimpler has shown that the studious pupil, as opposed to the idle, is oftener the subject of myopia. Among 702 pupils, the refractive condition of whose eyes was determined a second time after the lapse of three years and a half, there were 426 who had advanced regularly with their classes. Of these, 31.2 per cent.

*Quoted from Derby. Boston Medical and Surgical Journal.

†Die Schulmyopie und ihre Bekampfung, p. 25. Leipzig, 1890.

showed an increase of refraction, while among the 276 other pupils who, presumably on account of idleness, had been put back in their classes, there had been an increase in 26.8 per cent. In the higher classes the figures were 34 per cent. for the diligent, and 27 per cent. for the lazy. Still in another group of children who were put back a whole year on account of "idleness," only 13 per cent. were nearsighted.

An interesting hygienic study of the gymnasium of Dorpat was made by Dr. Ströhmberg* a few years ago. This gymnasium is in a building, some of the rooms of which are very badly lighted. The examination of the eyes of the 478 scholars showed an average of 25.84 per cent. of nearsighted pupils. The percentage of nearsight rises with the classes from the lowest to the highest, though not in a regular progression From class to class there are sharp risings and fallings of the per cent. line of myopia, due mainly to the amount of light in the different rooms, but in part to local causes; and the relation of cause and effect is so clearly shown that we will try in words to show what the author has better shown graphically. Ströhmberg deems 1:5 to be the normal ratio of glass to floor surface.

For the sake of greater intelligibility, we number the classes and their rooms from the least advanced to the farthest advanced class, instead of giving the German naming.

Class 1, the lowest class in the gymnasium, begins with M., (Myopia) ten per cent.; room on first floor; ratio of glass surface to floor surface, 1: 8.5.

From class 1 to class 3, M. rises from 10 per cent. to 17.74 per cent. The ratio of glass to floor in class 2 is 1:7; in class 3, 1;9. These three rooms are lighted from the northwest, what we may term the darkest quarter of the sky, moreover the street on this side is very narrow and the houses on the opposite side are too near.

From class 3 to 4 there was a drop in the M. rate from 17.74 to 14 8 per cent. The room for class 4 has only a slightly better ratio of glass, 1:8.8; this room, however, is in the southeast corner of the building, and the direct light from the sky is not shut off by buildings.

From class 4 to class 8 there is a sharp rise from 14.8 to 37.88 per cent. of nearsighted pupils. The ratios of window to floor in rooms 5, 6, 7 and 8 are respectively only 1:20.5, 1:14, 1:20 5, and

*Das Dorpater Gymnasium, p. 64. Dorpat, 1888.

1 : 18.5. Room 6, with 1 : 14 of glass, has a lofty church wall opposite its windows only fifteen feet distant. These rooms are all on the first floor.

From class 8 to class 10 there was a drop in the myopia from 37.88 to 19.64 per cent. Room 9 is lighted from the northwest, and it has the church before its windows, but there is a better ratio of window surface (1 : 12) than in the four preceding rooms, and being on the second floor it is lifted somewhat out of the shadow of the church. Room 10 is on the northeast corner and has a window ratio of 1 : 8.3.

From class 10 to 12 there is again a rise from 19.64 to 37.28 per cent. of nearsighted pupils. Room 11 has 1 : 10 of window surface but is opposite the church, only fifteen feet away. The rise in the M. curve started in this room persists in room 12 which has relatively the same amount of glass but is not opposite the church.

From class 12 to 13 there is a sudden descent from 37.28 to 22.5 per cent. Room 13 has only 1 : 15 of window surface directed to the northwest, and is opposite the church. The results here appear to form an exception to the general rule; Dr. Ströhmberg finds an explanation, however, in the movements of some of the classes which we cannot reproduce here.

In class 14 the myopia curve reaches its highest point, 44.8 per cent. In the highest class, 15, there is a descent to 39.15 per cent. Rooms 14 and 15 have the same ratio of window to floor surface, but No. 14 is on the northwest side of the building, while No. 15 is in the southeast corner. The school work, moreover, of class 15 was not so strenuous as in class 14.

Dr. Ströhmberg thinks it very probable that, in this school, accidental circumstances had some share in determining the percentage of nearsighted pupils in some of the classes, nevertheless he believes that the relation between the quantity and character of the lighting and the percentage of myopia is clearly shown in most of the rooms.

In the examination of the Cincinnati schools recently made by Dr. Francis Dowling, marked differences were found in the various schools. In two of the new school buildings with the best lighting, the percentage of myopia ranged from six to forty-two per cent. according to age and nationality. The ages were from nine to fifteen.

In two of the old, badly lighted and worse ventilated schools, where, in addition to the poor light, the desks were so badly arranged in many of the rooms that the children were found trying to write in their copy-books in the shadow thrown by the hand that held the pen, from twenty-four to seventy-two per cent. of the pupils were nearsighted. The latter figure is enormous for a percentage of myopia, and is a striking illustration of the results of an outrageous municipal treatment of the eyes of its school children.

Dr. de Metz tested the eyes of 7,040 children from seven to fourteen years of age in the schools of Antwerp, and found only two per cent of myopia. Most of the cases of nearsight were found in badly lighted schools. There were present in

3	badly	lighted	girls'	schools	4.83	per cent	of	nearsight.
9	well	"	"	"	1.74	"	"	"
2	badly	"	boys'	"	2.67	"	"	"
9	well	"	"	"	1.69	"	"	"

In one particularly badly lighted girls' school the percentage of nearsight increased from class to class in the following progression: 0, 5, 6, 24, 30, per cent. For the whole of this school there was 9.21 per cent. of myopia.*

Home Influences.—From the foregoing it will be apparent that schools that are badly lighted, furnished with unsuitable desks, and requiring prolonged eye work without sufficiently frequent pauses for rest, are likely to furnish their full quota to the army of myopes. It matters not just what part is played by heredity, the unfavorable conditions for eye work in many schools is all-sufficient to injure the eyes of many children whether their parents were nearsighted or not. If the ancestors of the present generation were myopic they became so as the result of undue eye strain, and the sooner we make pedagogical methods and the construction and furnishing of school-rooms conform to hygienic requirements, the sooner we shall see a prospect of avoiding the fulfilment of Erismann's gloomy prediction of a whole civilized world of myopes.

But the censure for the prevalence of myopia should not rest wholly with the schools. Eye work done under unfavorable conditions at home is none the less harmful than when done in the schools, and many parents give but little thought to the conditions under which their children read or write at home; whether the light is ample or it is the gloom of twilight; whether they face the source of light, or receive it from some less trying direction; whether the

*Uffelmann's Supplement for 1889, page 316.

type is suitable, or small and indistinct, as much of that gathered by children in their literary foraging is; whether the posture of the young reader or writer is what it ought to be, or the book or writing or drawing is on the floor and the head of the child stooped low over the work.

Nevertheless if children's eyes are harmed at home, it is no excuse for adding heaped up injuries in the schools; moreover some parents are mindful of their duty in this respect and have a right to demand the absence from the schools of conditions that endanger the eyesight of their children.

Is Prevention Practicable?—Two years ago Dr. Von Hippel* published the results of his observations as to the influence of hygienic measures on school myopia. The eyes of the pupils of the Giessen gymnasium were examined by him yearly for nine years. Until 1879 the gymnasium had occupied a building which was not well lighted, and which, on account of its insufficient size, was overcrowded. Moreover, the seats and desks were antiquated and of a shape not adapted to favoring the preservation of the eyesight. In January of that year the school was moved into a new building built in accordance with the requirements of modern school hygiene. It was well lighted, well warmed and ventilated, and its seats and desks were adjustable to the sizes of the scholars. From 1883 one session only of five hours daily has been held, beginning in the summer at seven and in winter at eight o'clock. Pauses of ten or fifteen minutes are made at the end of each hour, the scholars meanwhile leaving the school rooms and tumbling on the playground or in the "turnhalle." Gymnastics, walks with the teacher, and school excursions of from one to three days form a part of the pedagogic plan. More than ninety per cent. of the scholars swim and skate. A limited amount only of school work is taken home to do. Von Hippel therefore thinks that the question of everpressure in this school can now be left out of consideration.

The examinations of the eyes was begun in 1881, two years after the school moved into the new building. The eyes of the scholars in the higher classes had, therefore, been exposed to the evil influences of the old school-rooms, but before the close of the examinations in 1889, none of the scholars present had been in the old building.

In 1881, the average percentage of myopia for all the classes was 27.6 per cent. In 1889 it was 17 per cent. In the classes above

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*Ueber den Einfluss Hygienischer Massregeln auf die Schulmyopie. Giessen, 1889.

the lowest in the gymnasium, the percentage of myopia had diminished as follows: 3.4, 6, 2.3, 14.7, 21.6, 15.3, 14.8, and 50.1 per cent.

Dr. von Hippel ascribes the marked diminution in the prevalence of myopia in the gymnasium partly to the new school building, but more to the new school regulations against over-pressure.

Schmidt-Rimpler* believes that the unfavorable conditions of school life and heredity threaten future generations with a permanent progression of myopia, but this danger may be avoided by proper hygienic and pedagogic regulations.

Cohn† mentions two schools in Koburg in which, after removal to good school-houses, their myopia prevalence fell from 12 and 14 to 4 and 7 respectively.

Prophylaxis.—The more important measures that are called for in the prevention of myopia may be inferred from what has already been said. They relate partly to the hygiene of the school-room, and partly to the methods of teaching. The rules for the prevention of school myopia may be summarized as follows:

1. The school-room should have an abundance of light in every part. The principal source of light should be at the pupil's left, and should be from a suitable point of the compass. (See "Lighting.")

2. The periods of eye work should not be too prolonged; they should alternate with frequent recesses for the resting of both the eye and the brain. (See "Pauses and Recesses.")

3. A large part of the instruction should be communicated orally during school hours, and the eye-straining and time robbing preparation of written lessons should be reduced to the lowest possible point.

4. The school work to be done at home should be limited to a very small amount, and, in the younger classes, to none.

5. The desks and seats should be of a suitable pattern, their sizes should be adjusted to the sizes of the scholars, and the relation of seat to desk should be determined intelligently; otherwise stooping or other postures favoring congestion of the eye and the production of myopia will be assumed by the pupil. (See "Desks and Seats.")

6. The demand for written work should be moderate. When writing the child should sit with his shoulders parallel with the desk

*Die Schulkurzsichtigkeit u. ihre Bekampfung, p. 71. Leipzig, 1890.

†Ueber den Einfluss hygienischer Massregeln auf die Schulmyopie, p. 24, 1890.

and the direction of the downstrokes of his writing should be such as not to incline him to take bad positions. (See "Writing.")

7. The type of all school and other books for children should be large and distinct. (See "Reading.")

8. Reading charts with large and distinct type, which can be hung up at a distance from the little ones, should be used in primary instruction.

9. Blackboards should be of a dead black, not glossy. They should be placed where they will be well lighted. (See "Blackboards.")

10. Care should be taken that pupils who need glasses shall be fitted with suitable ones. Cohn found 37 per cent. of the scholars in the schools examined by him wearing unsuitable glasses, and only 24.7 per cent. of the myopic eyes found by Von Hippel were furnished with suitable ones; 47.3 per cent. of those who were advised to get correcting glasses wore none; and in 28 per cent. the pupils wore glasses directly the opposite of what was needed. Among American children fitted with glasses by peddlers and apothecaries, undoubtedly as bad a state of affairs would be found.

11. Where it is practicable schools should be under competent medical inspection. The eyes of all pupils should be examined periodically and the parents should be advised regarding the eyes of their children when that is found needful. "This" says Priestly Smith*, "is important because a judicious regulation of the use of the eyes, more or less strict as the course of the case demands, will check the advance of the myopia if it does not arrest it, and will check the development of the congestive and atrophic changes which often accompany the advance."

12. In schools not under medical supervision, the intelligent teacher should and can test the eyes of his pupils in such a way as to tell him with a near approach to certainty whether there is any serious defect of eyesight, and, if myopia is present, to enable him roughly to estimate its grade. This examination by the teacher will be of the greatest value to some pupils who, without it, would have struggled along for years in a handicapped competition with their schoolmates and would finally have suffered irreparable injury to the sight, that might have been avoided if the eye trouble had been detected early.

*British Medical Journal, September 27, 1890.

Spasm of the Accommodation.—When the eye accommodates itself to work on small and near objects, the shape of the crystalline lens becomes more convex by the elongation of its antero-posterior diameter. This change is due to muscular action. When the demands upon the eye are excessive, the action of the muscles of accommodation sometimes assume a permanently spasmodic character, so that even when looking into the distance the spasm persists and the eye does not resume its passive or resting state. The effect, on the refractive condition of the eye, of this elongation of the optical axis of the lens is the same as that of the elongation of the optical axis of the globe. The visual condition of the eye affected with accommodative spasm is then similar to that of the true myopic eye, and, what is significant from a hygienic point of view, continuous muscular myopia, as this condition may be called, may lead directly to real myopia.

The eventuation of spasm of the accommodation is well illustrated in a case that Dr. Hasket Derby* told about some years ago:

I examined the eyes of a student at Amherst College, at the commencement of his freshman year, in November, 1875. He presented himself toward the close of the day; the afternoon was a dark one, and he had just been reciting. There was a slight degree of nearsight in each eye. In October of the next year I examined him again, and found his nearsight entirely gone. He had been laboring under accommodative spasm. But in June, 1879, at the completion of his college course, true nearsight, to a considerable amount, had made its appearance, and the ophthalmoscope, showed it to be real, and not due to spasm.

When looked for, this trouble is rather frequently found in overworked eyes: Thus, in the school under Von Hippel's care, where he believes overwork hardly existed, spasm of the accommodation increased from the lowest to the highest classes as follows: 0, 2, 1, 4, 4, 6, 8, 8, 11 per cent., and Schmidt-Rimpler found it forty-four times in the eyes of 330 myopes.

When accommodative spasm exists it is highly important that it should be treated intelligently, else there is great danger that an acquired myopia will follow, or if myopia already exists, that it will rapidly advance.

Hypermetropia.—By referring again to page 103 it will be perceived that hypermetropia, or long sight, is the result of an abnormal flattening of the eye, the opposite of the condition characterizing myopia, an abnormal lengthening of the eyeball. We cannot throw

* Boston Medical and Surgical Journal, CII, 534.

the blame for the causation of hypermetropia at the feet of the school authorities, as we justly may a large part of that for the increase of myopia, but a pretty large percentage of the eyes of school children have this defect, and, when it exists in more than a slight or moderate degree, the eyes that are affected by it are hard-worked eyes when employed on small objects. The reason of this is that the hypermetropic eye, when focusing itself for near objects, is called upon to do not only the work required of a normal (emmetropic) eye, but, if possible, an additional amount of work compensatory of the defect. It is therefore not strange that many of these eyes break down, or rather tire out, of which something will be said under "Asthenopia."

We wi l let Hartridge* describe the symptoms of hypermetropia:

The patient sees well at a distance, but has difficulty in maintaining a clear vision for near objects; and since the hypermetropia can be more or less corrected by accommodation, if the error be of a low degree, no ill-effects may for some time be noticed; at length, however, a point is reached when the accommodation is not equal to reading and near work, and accommodative asthenopia is the result. This is especially liable to show itself after illness, or if the patient's health has deteriorated from over-work, anxiety, or other causes. He then complains that after working or reading for some time, especially during the evenings, the type becomes indistinct, and the letters run together; after resting awhile the work can be resumed, to be again shortly laid aside from a repetition of the dimness; the eyes ache, feel weak, water, etc., frequently headache supervenes; there is a feeling of weight about the eyelids and difficulty of opening them in the morning.

Hypermetropia of more than a slight degree, should be corrected by proper glasses for reading, writing and other near work.

Astigmatism.—We have seen that hypermetropia is almost always due to the eyeball being too short, and myopia is caused by its being too long. There is another frequent defect in the refractive condition of eyes, that is designated "astigmatism." It is due to an asymmetry in the curvature of the cornea, or front ot the globe of the eye. For instance, the curve of the horizontal meridian may be greater than that of the perpendicular meridian. The result is that the optical image on the retina is indistinct, and the eye exerts itself in vain to focus all the rays that come to it in a given cone of light. This trouble is sometimes combined with myopia, but is much oftener an accompaniment of hypermetropia.

*Refraction of the eye, p. 119

If young, and the astigmatism hypermetropic and of low degree, few symptoms may be present; usually, however, the patient complains of defective vision with asthenopia, especially if his work be such that his accommodation is in constant use; sometimes headache is a very marked symptom, either frontal or occipital; he has probably tried all sorts of spectacles and can find none to suit him. On trying him at the distant type, his acuteness of vision is always below the normal *

Dr. Lewis Dixon of Boston, gives the following advice to teachers relative to the three abnormal refractive conditions, myopia, hypermetropia and astigmatism:

Warn children and parents that in myopia the tendency is towards the increase of the trouble, and that care in regulating the amount of near work will do much to check the progress, and the wearing of glasses, if myopia is really present will stop the progress. Advise against branches or courses of study involving much close work, unless the pupil is willing to wear correcting glasses.

Warn parents and children that in hypermetropia headaches, nervous symptoms of various kinds, and even ill health may result from this condition, even where no complaint is ever made of eyes or sight, and work and vision may be perfect.

Moderation in close work will usually relieve the condition; the use of proper glasses for close work will always relieve and enable the eyes to do full work without fatigue or other trouble.

In astigmatism, warn them that headaches, nervous difficulties, and ill health may be caused entirely by this condition, which must remain permanent unless relieved by the proper optical means.†

Asthenopia.—Eyes working under the disadvantageous refractive conditions imposed by hypermetropia, astigmatism, or myopia often show symptoms indicative of fatigue of the eye muscles, and to designate this group of symptoms the term "asthenopia," or weak sight, is used.

This trouble requires, before anything else, the correction of the hypermetropia, astigmatism, or myopia, one or more of which conditions are almost always the cause of the weak sight, with glasses chosen by a competent oculist. For the want of this help more than one promising career has been cut short.

Spinal Curvature.—Abnormal curvature of the spinal column is a deformity of quite common occurrence among children of the school-going ages, and, though there has not been a unanimity among surgical writers and others as to the most frequently operative causes, the fact appears to be pretty clearly established that the beginning of the trouble falls, in the great majority of cases,

*Hartridge, Refraction of the Eye, p. 158.

†Bureau of Education.—Circ. of Inf. No. 3, 1891, p. 56.

within those years during which the child is engaged in his school work. Abnormal spinal curvature is almost never congenital. Among 23,293 children born in the Paris Maternitè, only one was affected with this deformity, and this a rachitic case.

Dr. Ketch* analyzed the records of 229 cases of lateral curvature of the spine observed in the New York Orthopaedic Dispensary. Of these cases, 120 occurred between birth and the age of twelve; ninety-four between the ages of twelve and eighteen; and nine only after the age of eighteen. The history of six cases was doubtful. Thus 93 per cent. of these cases began before the age of eighteen.

Eulenberg† gives the following statistics of the age at which lateral curvature of the spine originated in 1,000 cases covered by his researches.

	Cases.		Per cent.
Before the second year....	5	=	0.50
Between the second and third years.... ...	21	=	2.10
" third and fourth years....	9	=	0.90
" fourth and fifth years.	10	=	1.00
" fifth and sixth years..	33	=	3.30
" sixth and seventh years..........	216	=	21.60
" seventh and tenth years..........	564	=	56.40
" tenth and fourteenth years	107	=	10.70
" fourteenth and twentieth years.....	28	=	2.80
" twentieth and thirtieth years... ...	7	=	0.70

We see from this that 95.8 per cent. of the 1,000 cases of lateral curvature of the spine originated between the ages of four and twenty, and 92 per cent. between the ages of five and fourteen.

After age, sex deserves to be ranked as the most prominent of the conditions predisposing to lateral deviations of the spinal column. In the 229 cases studied by Dr. Ketch, 189 occurred in females, and only 40 in males.

Round Shoulders.—Or posterior curvature of the spine, is one of the forms of spinal deformity acquired by remaining in faulty positions, such as school children often assume in stooping forward to a too distant desk, or bending over their books, or in sliding forward on an improperly shaped school seat so that the spinal column sags between the two points of support, the one at the upper, the other at the lower part of this flexible column. As to the undesirability of this deformity, otherwise than detracting from

*The Med. Record, XXIX, 471, 1886.

†Real-Encyclopaedie der gesammten Heilkunde, XI, 564.

personal appearance, we are assured that the effects of posterior curvature on the respiration and other functions is unfortunate:

In consequence of the bending forward of the body, the abdominal muscles are relaxed, and their power of action is consequently lessened or entiiely lost.

This depreciates or removes the power of abdominal respiration, and at the same time weakens the action of that most important respiratory muscle, the diaphragm.

The attitude prevents the proper action of the ribs, and so lessens thoracic respiration, and thus posterior curvature impedes to a serious extent the powers of breathing of the individual. This lessened power of respiration not only affects the very vital process of æration of the blood, but also interferes with the due performance of many of the functions of the abdominal viscera, for our power of acting upon the latter organs in the processes of expulsion depends upon our ability to fix the diaphragm in the first instance. A round back involves the production of a flattened chest, and a constricted space for the lungs, heart and stomach. . . . . . It is a matter of general observation among medical men, that in people with round backs, the vital capacity is very much lessened, and it seems probable that individuals thus afflicted are more liable to become consumptive than others, and have less power to resist an attack of ordinary lung disease. We, therefore, have excellent reasons for doing all we can to prevent the development of round backs, and all we can to remove them when once produced. I have ound that by improving the posture an increase in the circumference of the chest in expansion of from one to two inches has taken place in a few weeks.*

Lateral Curvature.—This is by far the most frequent form of spinal deformity seen in school children. It is sometimes the result of the loss, shortening, or lameness of one leg, but is, in the great majority of cases, due to the persistence in faulty postures either in standing or sitting, anything in fact that throws the pelvis, the spinal column's basis of support, out of level. For instance, in working at the blackboard for too long a time, fatigue often leads the pupil to throw his weight on one foot. Barwell,† a distinguished English authority on curvature of the spine, has the following to say about this matter:—

Another cause of sloping pelvis, I have named "habitual pelvic obliquity." It is the result of a trick, hence frequently varies, although it is sufficiently constant often to produce decided lumber curve. Many girls acquire the bad habit of standing constantly, or at least very frequently, on one and the same leg, generally the right, and of bringing the other thigh and knee in front of the supporting limb with very considerable adduction and some inward rotation.

* Noble Smith.—Curvatures of the Spine. Third Ed. p. 20. London, 1889.

†Lateral Curvature of the Spine, p. 77, Fourth Edition, London, 1889.

The attitude is, as I have said, very frequent with girls from the age of thirteen or fourteen upwards to twenty-three or twenty-five. As a rule the girl stands always or nearly always on the same leg—the mode and pattern of the female dress concealing the fault, which the male youth in trousers or knickerbockers would be laughed out of in a week or so.

"More and more," says Baginsky,* "does the opinion gain ground, particularly among surgeons as the result of their anatomical and physiological studies and practical observations, that the origin of the most serious of all curvatures of the spine, the lateral curve, is due, in the great majority of cases to the influences of school life on the youthful organism."

Are the Schools to Blame?—Dr. Agnew,† speaking on this subject in his presidental address before the American Surgical Association said:—

Again, in further illustration of our general text, take as an example a child who, for one long or two short sessions for six days of the week, sits over the study-desk, compelled to assume a position in which, from the inclination of the body, the shoulders fall forward, the head being supported most probably on the elbows and hands. To all this must be added the very important factor of four to six hours in the school-room and two hours, at least, of home preparation for the following day's recitations, during which time the respiratory functions, having been reduced to a minimum of activity, the muscles of the chest are comparatively passive, and æration of the blood tardy. Certainly, no combination of conditions could be better devised for forming contracted chests and round shoulders. It is not long before the watchful eye of the mother detects the change in the figure of her child. She will probably discover this and take alarm, even when the pale face, the languid air, and the capricious appetite of the child cause no anxiety; and then comes the second act in the drama of physical deterioration; namely, a resort to shoulder-braces and stays in order to accomplish that which the muscles should be taught to do without restraint or incumbrance.

While it is true that lateral curvatures of the spine depend upon causes both central and peripheral, yet in no small number the deformity is clearly attributable to influences of a social nature. The young column, by reason of the non-union of the epiphysis and diaphysis, and the supple character of the ligaments, is extremely flexible. Whatever, therefore, destroys the muscular equipose, however inconsiderable the force, if persistently repeated, changes the centre of gravity, and develops primary and compensating curves. For six months in the year, any fine morning, groups of young children may be seen plodding along our streets with a miniature library of books suspended from one shoulder. To the already pre-

*Deutsche Medizinal Zeitung, 1888, p. 529. Berlin.

†Boston Med. and Surg. Journal CXIX, 275. 1888.

ponderating scale of the balance add the additional factor, a probably badly arranged light, compelling these little *savants* to assume a lateral inclination of the body in order to obtain the necessary illumination of the subjects of the study, and you have all of the conditions necessary for perpetuating the lateral deformity.

Dr. Noble Smith tells us:*

It is not merely exercise that children require, but also recreation. Insufficient out-of-door recreation acts as a predisposing cause of curvature of the spine, and errors of position, which school children are made to assume, act as exciting causes. * * * The twisted and curved position of the spine caused by writing is doubtless a very potent factor in the production of lateral curvature, and, as the modern system of tuition involves a great deal of writing, it is probable that this deformity will soon be found to be upon the increase.

Fahrner† says that 90 per cent. of the cases of curvature of the spine have their origin in the schools. Guellaume found among 350 boys, 62, or 18 per cent., and among 361 girls, 156, or 41 per cent., with lateral curvature of the spine. Of the girls examined by Kolpsch, 80 per cent. had this trouble. Knorr found 60 girls, among 72, deformed.

How the Schools Produce Deformity.—Dr. Barwell‡ tells us about some ways in which deformity is brought on in the schools:—

We have yet to consider, another, and prehaps as potent a causation, which influences the spine during sitting, more especially during the many hours of study to which nowadays both girls and boys are subjected. A very large part of the present education is carried on by writing; the student writes out his grammar, conjugations, history, geography, mathematical problems, &c, &c. An industrious pupil is, therefore, often at the desk five or six hours a day, for five or five and a half days in the week; and more often than not in an injurious posture—especially so if she be at all short-sighted, or if her table be in an ill-lit part of the room. Several faulty postures and several degrees of the same fault are by different scholars assumed. One of the more common is to sit chiefly on the left buttock and to place the paper close to the edge of the table just by the right side of the chest, often to twist the right foot round the leg of the chair, and then, leaning upon the left hand and arm, brought close to the paper, to bend and screw the upper part of the figure over to the right with that side of the chest in front of the other, thus producing again, by muscular acts, a twist and curve of the lumbar spine, which after a certain time becomes fixed as a morbid curve. * * *

*Curvature of the Spine, p. 71. Third Ed. London, 1889.

†Gasser. Ueber d. Gesundheitspflege der Schüler, p 35. Wiesbaden, 1881.

‡Op. cit. pp. 83, 84, 105.

Thus we come to the conclusion that lateral curvature, primarily lumbar, is the result of certain relative positions of pelvis and trunk produced by various causes. The question naturally arises whether these conditions account for all the cases. I believe not for quite all; yet, except for a small percentage, originating in circumstances shortly to be given, I have very rarely failed to detect, when the pelvis has been straight and mesial, certain bad habits of writing, certain awkward tricks in standing and sitting, which sufficiently accounted for the curve. * * *

While writing, the right forearm and hand, which wields the pen, lies entirely on the table, while only the left hand at most, sometimes merely the fingers, rest upon it. The right shoulder is inclined forward, the left one thrown back. The anterior surface of the thorax lies oblique to the edge of the table; but in this position the right shoulder lies rather higher than the left. The dorsal spine bends rather strongly to the right and the more strongly, the greater be the weight which the pupil throws on the writing arm.

Another very common position that children assume is compounded of a forward stoop and a twist of the body, together with a serpentine bending of the spine. In such postures which, however, are not quite as frequently assumed as the previous one, the right shoulder is thrust upward and backward, the left is lower and more forward; but the shoulders vary their position a good deal, according as the child is writing at the top or bottom of the paper. A third, and the most injurious, is to sit with the right side of the pelvis nearer the table than the left, to plant the feet fairly and evenly on the ground, to place the left forearm entirely on the table, but to bend the upper part of the trunk down, to twist it to the left, to stoop the head considerably forwards till it almost rests on the left wrist, as though to look between the paper and the writing fingers.

For assuming these awkward postures it is not so much the fault of the pupil as of school authorities for putting desks and seats into school-rooms ill adapted to the form and size of pupils, and the teaching of styles of writing that may be said to force pupils into faulty attitudes and thus to lay "an architectural foundation for crookedness." (See "Writing" and "Desks and Seats.")

Will the Pupil Outgrow the Deformity?—"It is a deformity, then, during school life and its tendency, after the initial stages are past, is to become permanent, fixing upon the child an almost irremediable deformity."*

Doubtless some slight cases do get better without treatment, or rather from treatment of the general health alone, but the very large number of severe cases that exist must have had a commencement, and therefore it is evident that *the majority of slight cases do not get well by themselves*. * * * * As to the possibility of a case getting well by itself, such a result is so unlikely that it can hardly be otherwise than dangerous to trust to it.†

*Dr. C L. Scudder—Pr. Am. Association for the Advancement of Physical Education, p. 105, 1891.

†Noble Smith, Op. cit. p. 2.

Prevention.—The main points are:

1. Furnish the pupil with a desk of proper height, but not so high that the right arm and shoulder must be raised in writing. Place the desk close enough to the pupil that he may not be compelled to lean forward in using it. Let the pupil's seat be of the proper height and shape and the back-rest support the spine where support is most needed. (See "Desks and Seats.")

2. Even if seated properly, the child in the school-room is subjected to an artificial restraint that is irksome and is coupled with danger of physical injury if unduly prolonged. Frequent pauses are therefore called for, not only to rest the eye and brain, but by active play to enable the muscular system to rectify any tendency to deformity.

3. A faulty slope of the characters in the child's copy-book and faulty positions of the book itself, lead the pupil to twist himself into vicious postures. See, therefore, "Writing" for instruction on this point.

4. Children should not be kept standing too long at a time, as at blackboard work, for fatigue leads them to assume faulty positions which have a tendency to produce curvature of the spine.

Chorea.—Or St. Vitus' dance, is a disease of the nervous system to which school children especially are liable. It often arises apparently as a result of unhygienic school conditions and exactions. In a paper on "School-Made Chorea,"* after detailing a series of twenty-three cases, nine of which, at least, had a school cause, Dr. Sturges, physician to one of the London hospitals for sick children, writes:—

> Speaking from the evidence, not only of the cases I am now quoting, but of very many others precisely similar, it is perfectly certain that for a large proportion of chorea, a proportion that would be under-estimated at one-fourth, school is responsible; and the mode of injury may be classified pretty much as follows: (1) Over-schooling, where the hours are too long or the lessons (especially *sums*) too hard; (2) excitement in schooling, especially at examination; (3) home lessons where there is no home to speak of, or no home leisure; (4) "caning" and other modes of punishment, particularly when unmerited.

The welfare of the school demands that severe cases shall be excluded. When patients thus affected have continued to attend school, the disease has sometimes extended to other pupils, through voluntary or involuntary imitation, resulting in the so-called

*Lancet, I, 1887, p. 113.

epidemics of St. Vitus' dance. In mild cases it will decidedly favor the recovery of the child to remove him from the school for a season and give him the freedom of outdoor life.

Diseases of the Nervous System.—The disturbances of the nervous system observed in school children which the continued work and confinement of the school may reasonably be assumed to cause, or at least to aggravate, are classified under the general term neurastheia (nervous exhaustion). It shows itself by such symptoms as exalted sensitiveness or irritability, changes of disposition, headache, various peripheral neuralgias, palpitation of the heart, sleeplessness and increase inclination to talk in sleep.

The increase of these troubles as pupils advance from class to class was found in a marked degree by Dr. Nesteroff* in his four years' observation of a classical gymnasium for boys in Moscow. In the preparatory class, 8 per cent. of the pupils were afflicted with symptoms referable to the nervous system. In the eight classes in the gymnasium proper the percentage ranged 15, 22, 28, 44, 27, 58, 64, 69.

The great increase from the lowest, and especially from the preparatory class, to the higher classes, is, we may presume, indicative of an unfavorable influence of the school life.

Speaking to the teachers of Massachusetts a few years ago about the pupils in the public schools, Dr. C. F. Folsom said:

> Pale faces, languid work, poor appetite, disturbed sleep, headache, and what is vaguely called nervousness, are more common among them than they should be among children of their ages. I doubt whether there is an exaggerated prevalence of manifest or well-marked diseases of the nervous system among them. If due to the school drill, my impression is that they come for the most part later in life, after the children have left school, and because of constitutions weakened during the school years, instead of strengthened, as they should be. The causes of this serious evil lie partly in matters which can be, and should be, corrected in the schools, but fully as much, if not more, in conditions for which the home and the parents are responsible.
>
> The definite defects of evils in our school system seem to me chiefly due to, first, over-pressure beyond the age or strength of the pupil; secondly, to bad air; and thirdly, to lack of physical exercise.
>
> But just what part in the production of these troubles in American schools is to be charged to injudicious methods in teaching and the insanitary conditions of school-rooms, and what part to the social life of the pupils and to heredity does not admit of accurate determination and this is hardly needed since we are so often assured that

*Zeit. f. Schulg. III, 319.

the last straw breaks the camel's back. We have to do with a race of children more prone to nervous disorders than are the children of almost any other country, and this fact should be taken into account in determining how much forcing their minds will bear without injury.

We are told by Daniel Clark, M. D.,* Superintendent of one of the insane hospitals of the Province of Quebec that:

At no time in the history of the world has education been more diffused among the common people, and at no period have nervousness, excitability, brain exhaustion, and insanity been so prevalent.

It is well to consider, if there exists any connection, and if so, how much, between national nervousness and forced education, between juvenile brain tension and adult brain debility. It may be we are discounting the future by forcing mental growth in the young beyond the natural capacity.

The nervous, over-strung, over-tense brain in one generation means low mentality or ill-balanced minds in the next. This is nature's inexorable law. The only hope there is, lies in the fact that the weakest goes to the wall. "The survival of the fittest" is no Utopian dream, nor scientists' unfounded dogma.

Headache.—From a paper on the headaches of children read before the International Medical Congress at Washington by Dr. W. H. Day of London, the following extracts are made:

Headaches in the young are of greater significance than in adults, and should receive the utmost care in investigating their nature and origin. All cases of nervous headache in school children cannot be traced to mental strain. If the brain be normal, and the general health good, no danger will result from carrying out the educational code; but in weakly and sensitive children the foundation of serious illness may be laid by enforcing a degree of intellectual exertion which a healthy child could bear with impunity.

Headache is one of the first symptoms that arises. As soon as it declares itself the whole aspect of the child is altered, and he is engrossed with his own sufferings. Melancholy takes the place of cheerfulness. He is kept at work, because his ailment is not noticed by his teachers or by his parents With this state of things, the child soon becomes anæmic, loses his appetite, and the headache, which at first was occasional, becomes habitual. Dr. Treichler states that one-third of the pupils at Darmstadt, Paris, and Nuremberg suffer from t. He considers the cause to be over-intellectual exertion entailing work at night, and taking up a variety of subjects.

The anæmia produced in these cases sets up disturbance in the ganglion cells of the cortex of the cerebrum, the quality and quantity of the blood become changed, and the brain loses energy and activity. The mind is consequently enfeebled, and the mental faculties are clouded. When this is once brought about, children become emotional and excitable; hence the cerebral vessels become too suddenly

*Education in Relation to Health, Toronto. p. 3.

filled with blood to bear it with impunity, and this dilatation of the vessels (local hyperæmia), through vasomotor disturbance, is another common cause of this form of headache; the vessels of the brain are partially paralyzed, and the ganglion cells too exhausted to grasp new ideas, as Dr. Treichler observes.

Of 7,478 boys and girls examined by Prof. Bystroff, in the St. Petersburg schools, during five years, ending in the spring of 1886, he found headache in 868, or in 11.6 per cent. The percentage increased with the ages of the children and with the number of hours occupied in study; thus, it occurred in only five per cent. in children eight years of age, while from fourteen to eighteen it attacked from 28 to 40 per cent. The author attributes these obstinate headaches in school children to excessive mental labor.

Similar experience is recorded by Dr. Hertel. He found headaches increase as the oldest classes were reached. In the lower mixed classes it was 5 per cent. In the two highest classes it rose to 38 per cent. This class is the most exposed to headache and bleeding at the nose—proofs, as he justly states, that mental work favors congestion of the brain, and I would add constipation and the troubles resulting from a sluggishness of the bodily functions. I am frequently meeting with boys and girls in whom headaches, nose bleedings, and muscular twitchings have followed studious application to books. The same holds good with respect to the frequency of nervousness and anæmia.

I am sure that defective ventilation of school-rooms is a most fertile cause of headache. If the air of these rooms, or any inhabited apartment, is impure, in consequence of too many persons being crowded together, so that the products of respiration or uncleanliness from any cause contaminate the atmosphere they breathe, it is injurious to the health, and the nervous system is sure to suffer. * * * It seems to me headache is as often the result of a polluted atmosphere as of the lessons imposed upon the pupils.*

Defects of Hearing.—It is now generally recognized that normal sharpness of hearing is one of the essential requirements in the intellectual development of school children, and this is a sufficient reason for interest in any work done with a view to determining to what degree hardness of hearing is prevalent in schools.

Sexton of New York examined 575 school children, of which 13 per cent were hard of hearing; W. von Reichard, testing with the watch 1,055 pupils of the gymnasium of Riga, found 22.2 per cent. with defective hearing. Weil of Stuttgart tested the sense of hearing in 5,905 scholars of various kinds of schools and found it below the normal in from 10 to 30 per cent. of the children, according to their social condition. Moure, of Bordeaux, found 17 per cent., Gellé of Paris, 22 to 25 per cent.; Bezold of Munich, 25.8 per cent.; of pupils with hardness of hearing.

*Trans. Ninth Internat. Med. Congress, III, 496.

Thus it has been shown that in the schools of various countries a considerable percentage of the scholars are endeavoring to maintain their rank in their classes under the disadvantage of an impairment of the ability to understand the words of the teacher. Many a child, that, on account of a greater or less degree of hardness of hearing, understands the instruction of the teacher with difficulty, suffers the additional injustice of being regarded by the teacher as dull and inattentive. That this is so is shown by the enquiries of Schmiegelow* of Copenhagen, who, among 79 pupils regarded by the teachers as mentally not well endowed, found 65 per cent. of them with defective hearing.

A degree of hardness of hearing, interfering more or less with the progress of the pupil may exist without being suspected by parents, teachers, or by the pupil himself. Among the 575 pupils examined by Sexton† there were 13 per cent. of them hard of hearing, but only 3 per cent. were themselves aware of any defect, and only one of them was known to be deaf by the teachers.

Sexton cites instances where children defective in hearing, had made great efforts, both at school and at home, to prepare themselves for promotion, only to be put back on examination because the principal of the school was not aware of the child's imperfection, and therefore had not given his questions distinctly enough to be heard. Other deaf children, from neglect to classify them, were seated too far away from the teacher's desk to hear his voice, and in consequence of the inability to reply correctly were frequently punished for inattention and dulness. The rudeness often practiced toward these unfortunate pupils by unthinking or unsympathetic teachers was discouraging, and some pupils in consequence had left school altogether.

The disease causing hardness of hearing in some of these school children is referable to a previous attack of scarlet fever or measles; some of them are probably dependent upon a scrofulous diathesis. Bezold demonstrated the presence of the tubercle bacillus in the discharge from the ears of some of his cases. The impairment of hearing in these cases is usually permanent and in many of them there is a chronic ear discharge. Other cases of hardness of hearing have been brought on by repeated attacks of inflammation of the

*Zeit. f. Schulgesundheitspflege, II, 455.

†Ed. Exhibits and Conventions at the New Orleans Exposition, Part II, p. 292.

middle ear, ushered in with earache and sometimes resulting in perforation of the drum head and a temporary discharge. Many of these cases are referable to disease of the naso-pharyngeal cavity as a standing cause. Draughts from open windows or elsewhere are undoubtedly sometimes chargeable with exciting the attacks.

Among 450 cases of children's deafness selected by Sexton as illustrative cases, there were ten cases where the ear had been severely boxed or pulled, causing rupture or strain of the drum head, and consequent deafness; thirty-three cases where cold sea-water had passed from the mouth up into the drum through the Eustachian tube while the child was bathing in the ocean; three where water was introduced into the drum while sniffing it up into the nose, or in using the nasal douche. In thirty-one cases the cause was attributed to scarlet fever, in seventeen to measles, in five to diphtheria, in four to whooping cough, in one to mumps, and in one to syphilis.

A medical inspection of school children is very desirable for many reasons, and one of the duties of the school physician, where he exists, is the determination of the sharpness of hearing of every pupil and the notification of the parents, when cases are found requiring treatment. Many of the scholars with moderate degrees of hardness of hearing in the absence of timely treatment become very deaf later in life. Another indication for the physician or teacher is to place the deaf pupil in the most favorable place for understanding the words of the teacher,—that is near the teacher, and if one ear only hears imperfectly, the sound ear should be directed toward the teacher. The testing of the hearing of any scholar who appears dull and inattentive, should never be omitted.

Gellé* gives a practical method whereby the teacher may test the acuteness of hearing of the scholars:

The pupil is placed at one end of the school-room with his back turned toward the teacher who dictates in a clear, but not loud voice, while the scholar writes. The teacher should begin by standing first at the farther end of the room. If, at that distance, the pupil has any difficulty in hearing, the teacher gradually approaches until the pupil understands perfectly, which will be shown by his writing the dictated matter correctly and without hesitation. According to the distance at which the scholar understands readily, he is ranked and placed in the school-room. If, for instance, he hears at a distance of fifteen feet only, he is placed within that distance from the teacher's desk.

To insure the distinct and easy understanding of the words of the teacher, the number of pupils to one teacher, or in other terms, the

*Revue D'Hygiene, VII, 670.

size of the school-room should be within reasonable limits. Dr. Barr of Glasgow fixes the largest permissible number of pupils at fifty. Some teachers, injudicious disciplinarians in some respects as they are, speak in too low tones for the purpose of compelling the pupils to be on the alert for every word, or take the consequences. This is unjust to the healthy pupil and positively cruel to the hard hearing one, who, under the most favorable circumstances, hears with difficulty and only by maintaining a state of mental tension almost painful. Distinct enunciation is due from the teacher as well as from the pupil. To avoid increasing greatly the difficulty of hearing, of both pupils and teacher, school buildings should not be located on noisy streets.

Nasal and Throat Troubles.—At a meeting of the German naturalists and physicians two or three years ago Dr. Bresgen of Frankfort-on-the-Main, after speaking of the unfavorable influence of nasal disease in children upon the general physical condition, and on the development of the lungs in particular, gives the following sketch of the effect of nasal obstruction on the mental aspect of some children:

> There are not a few children who apparently have good natural abilities, yet, in their studies, remain behind other pupils less gifted, be it that, on account of a feeling of continual pressure in the forehead, pain in the eyes when studying or oft recurring severe headache, they are not able to give sustained attention to the matter to be learned, or be it that their memory is affected by their nervous troubles. Such children are usually the victims of an injustice for they are reproached for laziness and inattention which they necessarily feel to be undeserved. At first they strive again and again to make up the deficiency, but their affliction prevents them from carrying out their good intentions. If they complain of their trouble, they receive but little sympathy; it is only a snuffing! Even the physician too often attaches but little importance to a chronic nasal catarrh. But the cure of this "snuffing" often works wonders. The formerly apparently lazy and inattentive children are changed as with a magic stroke, and, if the help is timely and they are otherwise well, they quickly recover their lost ground.*

Guye, of Amsterdam, gives the history of four marked cases of the kind to which Dr. Bresgen has referred. Three of these cases were students; one was obliged to go over three or four times what he read in order to understand it; another would forget in two weeks everything he had learned in preparing for examination;

*Zeit. f. Sch. II, 515.

another when entering a room from the street could not for a considerable time understand the simplest thing told him.*

INFECTIOUS DISEASES.

It is an undeniable fact that the schools often serve as the medium for spreading communicable diseases, and, still further, it may be said that many school epidemics of infectious diseases are the result of parental heedlessness. To permit a child to attend school while there is any reason to believe or suspect that he is in a condition to communicate infection to his fellow pupils, is a serious misdemeanor. What is the loss of a few days of schooling to a single child as compared with the serious consequences which sometimes follow the continued school attendance of a child with a "diphtheritic sore throat," or the return to school at too early a date, of one who has had an attack of scarlet fever?

We believe that a clear comprehension of when a child may reasonably be thought or suspected to be infectious, would, with almost all parents, be all that would be required to influence them to observe suitable precautions against spreading infection. With even a small minority, it is a shame to say, that the penalty which the law provides for the following sections of Chapter 123, Laws of 1887 is required to quicken their sense of moral responsibility.

Sect. 12. No parent, guardian, or other person, shall carelessly carry about children or others, affected with infectious diseases, or knowingly or wilfully introduce infectious persons into other persons' houses, or permit such children under his care, to attend any school, theatre, church or any public place.

It should here be observed that it is not always necessary that a child shall himself have an infectious disease to become "infectious." Not having had the disease himself he may, nevertheless, be the carrier of infection if he comes from a house containing cases of infectious diseases.

Sect. 10. Whenever any householder knows or has reason to believe that any person within his family or household has small-pox, diphtheria, scarlet fever, cholera, typhus or typhoid fever, he shall within twenty-four hours give notice thereof to the health officer of the town in which he resides, and such notice shall be given either at the office of the health officer or by a communication addressed to him and duly mailed within the time above specified, and in case there is no health officer, to the secretary of the local board of health either at his office or by communication as aforesaid.

*Annual of the Universal Med. Sciences, 1889, IV, D-3.

Sect. 13. Whenever any physician knows or has reason to believe that any person whom he is called upon to visit is infected with small-pox, scarlet fever, diphtheria, typhus or typhoid fever, or cholera, such physician shall within twenty-four hours give notice thereof to the secretary of the local board of health, or the health officer of the town in which such person lives.

Sections 19 and 20 make important provisions for the public safety by prescribing certain duties of the local board of health and of the teachers.

Sect. 19. Whenever small-pox, diphtheria, scarlet fever or other contagious disease shall appear in a town or a school district it shall be the duty of the local board of health immediately to notify the teachers of the public schools in the neighborhood, of the fact, and it shall be the duty of all teachers and school officers when thus notified, or when otherwise they shall know or have good reason to believe that any such disease exists in any house in the neighborhood, to exclude from the school-house all children and other persons living in such infected houses or who have called or visited at such houses, until such time as the local board of health (or attending physician) shall certify that such children or other persons may safely be readmitted.

Sect. 20. When persons from houses or places which are infected with any of the diseases specified in section nineteen have entered any school-room, or when, from any other cause, the school-room has probably become infected, it shall be the teacher's duty to dismiss the school, and notify the school officers and local board of health, and no school shall be again held in such school-room until the room has been disinfected to the satisfaction of the local board of health, and it shall be the duty of the school officers and board of health to have the room disinfected as soon as possible.

It will be the purpose of the following paragraphs to indicate those diseases which, in the school-room, should be considered infectious or contagious, to give a few of their more prominent characteristics, from a prophylactic point of view, and very briefly to suggest precautionary measures. (See Circular of State Board of Health, "Form 53, Characteristics of the Infectious Diseases" for the use of teachers, school officers and other persons.)

Diphtheria.—If school epidemics of this disease are not usually characterized by sweeping so rapidly through the school population as some other diseases, measles for instance, it fully makes up in seriousness by its "staying" qualities. School-rooms and children's clothing, once infected, do not spontaneously lose their infectiousness so readily as they do when the infection is of some other kinds, hence it is a part of the history of many school epidemics of this disease that cases appear again and again after it has been confidently hoped that the last of the outbreak had been seen. The exclusion from the school-room should be absolute, not only of persons with no matter how slight a form of the disease, but as the infection is transportable in clothing or on other articles, all persons and things that have been exposed to the infection should be rigorously excluded. After children have had the disease, trustworthy assurances should be had that efficient disinfection and other needful precautionary measures have been taken before they are readmitted. In no disease are half-way methods of disinfection more frequently disastrous than with diphtheria. The disinfection should be thorough, done with agents of whose efficiency there is no doubt, and the desks and seats at which it is known or suspected that infectious pupils have sat should be well scrubbed with a liquid disinfectant. (See Circular of State Board of Health "Form 44, Diphtheria.")

Scarlet Fever.—A medical name for it is scarlatina, and popularly it is called "scarlet rash," "canker rash," and "rash." All should be understood as indicating one and the same infectious disease, though some cases may be extremely mild and others very severe; though the three most striking symptoms, fever, eruption, and throat symptoms, may one or more be hardly perceptible, or absent, or all may be prominent. These mild cases of scarlet fever are a greater menace to the schools than the severe ones, because their true character is often unrecognized by parents and teachers, or the idea prevails that the disease is so mild that it is needless to keep it from other children, a sentiment that the Prince of Mischief must heartily approve. When scarlet fever or diphtheria is abroad, every trace of sore throat should be regarded with suspicion.

The infection from the mildest cases often reproduces the disease in others in its malignant form. The average high death rate from this disease is not the whole extent of its mischief, for many of its little victims are left as only feeble mementoes of their former selves. The ear especially is likely to suffer injury.

In seventeen cases of acquired deaf mutism examined by Dr. Clarence J. Blake,* thirteen were traceable to scarlet fever or measles and eleven to scarlet fever alone. There is therefore every reason for carefully guarding the schools from this disease, and an added one may be found in the fact that, with every added year of his life, the pupil loses somewhat both of his susceptibility to the

*Boston Medical and Surgical Journal, LXXXIII, p. 405.

disease and the danger of being severely injured by it if he should take it. (See "Form 45, Scarlet Fever.")

Measles.—This disease is intensely infectious and its rapid spread in schools is greatly aided by the fact that it is infectious three or four days before the eruption appears, during which time the patient appears to have only a common cold in the head. Hence the necessity of keeping all persons from the school of whom there is a suspicion that he is about to come down with measles. Persons from infected houses should be excluded because the infection is transportable in clothing. Local boards of health. school officers, and teachers have ample authority under our law to take such precautionary measures as may be needed against the spread of this disease. (See "Form 50, Contagious Diseases and Contagion.")

Whooping Cough.—This is too generally regarded as an insignificant disease hardly calling for care on the part of parents or precautionary measures on the part of local boards of health and teachers. It is not an insignificant disease. The death rate sometimes attending it should be sufficient to awaken the public to their error if it were not so hard to lift the popular train of thought out of a rut.

According to the statistics of the Austrian department of public health 23,975 children died of whooping cough in 1883. Similar statistical data were given by Prof. Hagenbach for Germany at one of the late congresses for internal medicine. According to him, there are about 250,000 cases of whooping cough yearly, which, with a mortality of 7.6 per cent., as given by Biermer, makes 19,000 deaths from this disease. In our own State physicians have found the disease serious enough in many outbreaks to make them regret the apathy of the public as regards this disease, and to hope carelessness with it may not always prevail. Children with this disease should be kept from school, and those with any cough as well, until it is known whether the coughing is a percursor of whooping cough.

Rotheln, or German Measles, has no relationship to measles, and an attack of one disease affords no protection against the other. The eruption of rötheln slightly resembles that of measles, but it is not characterized by symptoms of a cold in the head. (See Circular No. 53, "Characteristics of the Infectious Diseases.")

Chicken-Pox occupies a place of interest not all its own from the fact that cases of varioloid, or modified small-pox, sometimes so closely resemble chicken-pox, that the serious character of the infection is entirely unsuspected.

Mumps is a disease serious enough to be excluded from the schools.

Tuberculosis.—Since it was satisfactorily shown a few years ago that tubercular infection in the great majority of cases, comes about by breathing in the infection of tuberculous sputum that has become dried and dusted into the air, a large number of school authorities of Europe have established rules like these:—

1. Neither teachers nor scholars shall spit upon the floor, but, when necessary, must spit into properly shaped and placed spittoons, or into Dettweiler flasks.

2. Care shall be taken against raising a dust in the school-room. Floors shall be swept and furniture dusted in the moist way.

3. The teacher shall see that scholars coughing much shall observe rule one.

4. Scholars with lung diseases shall stay away from school, both to avoid endangering their schoolmates and to hasten their own recovery.

The tubercle bacillus may be plentifully present in the expectoration before there are otherwise clear signs of a case of consumption, and Dr. Dettweiler* reminds us that sometimes in the schools, especially in the higher grades, consumptive pupils sit at their desks among other pupils for months and even for years unconscious of wrong or of danger to others, nevertheless, constituting a focus of infection for their fellow pupils. The investigations of Cornet show how free from danger to others is the presence of the consumptive patient when the sputum is properly disposed of, and how dangerous a source of infection he becomes when he coughs and spits upon the floor or in his pocket handkerchief. He strongly recommends, therefore, that schools be furnished with spittoons of proper shape, and that it be the law of the school that there be no spitting on the floors of the school-rooms and corridors, nor on the stairs.

In the International Congress of Hygiene held in Paris in 1889 Dr. Landouzy said, in the course of the discussion on tuberculosis in schools, that it must be decided whether the tuberculous child or the school which it attends is to be protected. All suspicious children must be examined by a physician. The duration of the trouble and the localization of the tuberculous disease should be taken into

*Zeit. f. Schulgesundheitspflege II, 317.

consideration. Only tuberculosis of the lungs makes the exclusion from school imperative.*

Infectious Eye Diseases.—Infectious diseases of the eye may spread from person to person in the family, or from pupil to pupil in the schools, eventuating sometimes in troublesome epidemics. Outbreaks of this kind sometimes occur in our own schools but are heard of more frequently in foreign schools. For instance, a few years ago an epidemic spread over the schools of Turin and drove many of the school children from the city to escape it, and many of the remainder were under medical treatment for months. In Modena, another Italian town, the disease nearly broke up the schools and extended out into the country.

In the winter of 1890-91, an epidemic of inflammation of the eyes (follicular conjunctivitis) reigned in Dresden, which affected 10,000 school children, seriously interrupted school work several months, and cost the city 27,000 marks. It began with a few cases in a single school, and spread rapidly to other schools. Dr. Krug† physician to the public schools, gives the following explanation of the ways in which the disease was spread:—

Several factors may have worked together in the causation of the epidemic. It may be assumed that the school-room air and the over strained condition of the scholars' eyes may have served to create a predisposition to the disease. Supposing, then, that the infection was brought into the school by a few children, it was soon communicated to their neighbors. It is probable that the tears, which, in the beginning of the disease were plentiful, contained the infection, at any rate this was true of the mucous discharges from the eye. The infectious discharges coming upon the fingers, the clothing, the books, the school desks, pocket handkerchiefs, dried and became pulverized.

Thus the school-house was filled with the infectious dust whether the infection itself was in the form of Michel's diplococcus or not. The infection, furthermore, was carried into private houses, and finally into thickly inhabited quarters, so that the whole locality was seeded down and the miasmatic element is present. Thus only can we explain why a school across the fields, at a distance of more than half a mile, and with no communication with the infected ones in the other schools, became infected soon after the disease had reached its highest point in the other schools.

All children who have an inflammation of the eye (conjunctivitis) with any discharge, whether mucous or purulent, should be regarded with suspicion. Children who suffer with this disease and their

*Zeit. f. Schulgesundheitspflege II, 534.
†Zeit. f. Schulgesundheitspflege IV, 81. 1891.

guardians should be warned of its contagious nature, and the children should be instructed not to come in contact or to play with other children. They should wash their hands carefully with soap and water as soon as possible after they have touched their own eyes, and should not use the same towels that are used by others, but have one of their own. Children affected with this disease should be excluded from the schools.

In the school-room good ventilation opposes the spread of the infection and the want of ventilation favors its spread. Cleanliness of the school-room and its furniture, and especially the absence of dust, are important.

If there appears to be danger of an epidemic prevalence, the schools should be closed, and the school-rooms should be disinfected before the schools are again opened.

Period of Incubation.—With the infectious diseases generally, a period of time elapses between the reception of the infection in the system and the beginning of the train of symptoms which is characteristic of the disease. This we call the period of incubation. The period of incubation varies greatly in different diseases, and to some extent in different cases of the same disease; nevertheless a knowledge of its usual duration is often of great use in helping to determine the nature of a given case or outbreak. For instance, an outbreak of "some kind of a rash" was lately reported in a school. The first case unfortunately exposed the school to infection. Within seven days six other cases occurred as the result of this exposure. The period of incubation of scarlet fever is comparatively short, rarely longer than five or six days; while that of measles is about eight days and that of German measles is about two weeks or more. As one could expect, the outbreak was decided to be scarlet fever.

The most usual periods of incubation are shown in the following, though it should be borne in mind that rather rarely the time given for each disease may be shorter or may be longer than here given:

Diphtheria, from two to seven days.
Scarlet fever, from two to five days.
Measles, about eight days.
German measles, from fourteen to twenty days.
Small-pox, from ten to twelve days.
Chicken-pox, from thirteen to fourteen days.
Whooping cough, about six days.
Mumps, from fourteen to twenty-one days.

It should be remembered that the period of incubation is reckoned to the first symptoms of the disease, not to the appearance of the rash in the eruptive diseases, nor to the characteristic cough in whooping cough.

Period of Invasion.—Another stage in the eruptive diseases is the period of invasion, extending from the earliest symtoms to the appearance of the eruption. As this also varies with different diseases, its duration, in a given case of disease, is often significant. The fact that in scarlet fever it is shorter than in measles, in German measles shorter than in measles, and in chicken-pox shorter than in small-pox, is an important help in distinguishing these diseases, the one from the other. The usual periods of invasion of the eruptive diseases are as follows:

Scarlet fever, from one to two days.
Measles, about four days.
German measles often not more than one day.
Small-pox, from two to three days.
Chicken-pox, a few hours.

Period of Infectiousness with Disinfection.—Provided satisfactory disinfection has attended and followed the case, the length of time during which a child who has had an infectious disease should be considered dangerous to other children and during which he should therefore be excluded from his school may be stated as follows for the various diseases:

Diphtheria. The child should not re-enter the school before three or four weeks, even after mild cases.

Scarlet fever is infectious at least as early as the eruption appears and continuous so as long as there remains the slightest evidence of scurfiness, or desquamation. The last traces of this process are usually found on the hands and feet. In ordinary cases it is not safe to re-admit the child into the school until six or eight weeks have passed. In some cases desquamation is more prolonged than this.

Measles. From two to four weeks.

German measles. Should not return to the school earlier than two weeks from the appearance of the rash.

Small-pox. Infectious until the last trace of crust has been cleared from the skin and hair.

Chicken-pox. Infectious until all scabs have disappeared.

Mumps. Infection lasts for at least three weeks after the swelling of the glands.

Ringworm. Should not return to school until some time after all signs of active growth have ceased.

Period of Infectiousness without Disinfection.—When disinfection has been omitted or has been unsatisfactory to the local board of health, the period of infectiousness is much prolonged,—with diphtheria, scarlet fever, and small-pox, the danger period is indefinitely prolonged. In such cases, the periods of isolation recommended by the Academy of Medicine of Paris would be at least short enough, to wit: For small-pox, scarlet fever, and diphtheria, forty days.

Isolation.—The length of time during which a child who has had an infectious disease should be kept from others who are liable to take the disease, and especially should be excluded from the schools, should depend upon the length of the period of infectiousness for the particular disease. If, however, subsequent cases occur in the same house, the first case cannot be safely readmitted until the period of infectiousness for the later cases has passed and the final disinfection has been done.

If the question of isolation relates to a child who has been exposed to infection and who is likely to come down with the disease, it is needful to exclude him from the schools a little longer than the period of incubation for the disease in question, counting from the time of last exposure, say eight days if the disease is scarlet fever. If he then remains well he may re-enter the school, observing the necessary precautions against wearing infected clothing.

Disinfection.—In the disinfection of school-rooms, sick-rooms, and clothing, it is unwise to trust wholly to fumigation with sulphur, for, when we do, there are good reasons to doubt whether the disinfection has been thorough. If, however, clothing has been boiled half an hour or more, there is no doubt of the efficacy of its disinfection, and in the school-room the fumigation should be supplemented by scrubbing infected furniture and floors with a liquid disinfectant. (See circulars of State Board of Health.)

It is a faulty practice, however, to defer all disinfection until the termination of the illness. Disinfection should go hand in hand with the other work of the nurse as a part of the daily sick room duties. Every piece of bed or body clothing taken off should be put into a disinfecting solution, or wrapped in a wet sheet and boiled half an hour at least. No article should leave the room escaping disinfection; then the final job of disinfection will be comparatively light and there will be a great gain in precision of results.

For the disinfection of books no trustworthy method has yet been suggested that will not spoil the books. It is undoubtedly a wiser economy for the town to burn the few books that have been used by infectious pupils, than to have them used again without disinfection or with doubtful disinfection.

The Closure of Schools.—The closure of schools as one of the first measures to be thought of against the spread of outbreaks of the infectious diseases generally is unnecessary and not to be recommended. Rather the provisions of the law, as given on page —, should be carefully carried out. As regards measles, however, a reasonable excuse for closing the schools occurs, perhaps, more frequently than with any other disease. Its infectiousness long before the appearance of the eruption, and while pupils present only the symptoms of an ordinary cold, make it more difficult to discover and exclude infectious scholars in season to avoid the spread of the disease to others. Many of the English health officers have expressed the opinion that it is impracticable to check the spread of this disease in the schools without the temporary closure of them; for instance, Dr. Walford,* medical officer of health of Cardiff, encountered an extensive epidemic of measles in his district. The schools were closed from the tenth of December until the seventh of January. During the three weeks previous to the closure of the schools seventy-six cases occurred, and during the three weeks following the reopening of the schools but three cases occurred and from that time to the end of March there were no fresh cases.

Dr. Walford says: I am aware that it is frequently stated that, on the closure of the schools, children will play together in the streets, and meet in houses, and that the epidemic will thus spread still more. Doubtless under these circumstances there is a probability of some infected children coming in contact with healthy ones, but the danger of spreading the infection must be infinitely greater when a large number of children are congregated together for hours in over-crowded and badly-ventilated school-rooms.

Danger to the Convalescent from too Early Return to School.—Parents should be instructed as to the dangers to the child himself when he is returned to school too early after illness. The brain work involved in close application to studies is as exhaustive as any other work. After even a mild attack of scarlet fever or diphtheria, there is a decided liability to dangerous failure of vital processes. Sudden deaths often occur some weeks after convalescence from these diseases,—deaths that in most of the cases

* Sanitary Record, X, 514.

might have been avoided by means of a longer period of confinement to the bed or to the home. After scarlet fever, measles or diphtheria, the eyes often give out, as the result of a premature return to books, and sometimes require months or years of rest to restore them. Strabismus or squint is a well known sequel of diphtheria, favored by too early return to school work.

After such febrile states as plague this community in the form of measles, scarlatina, diphtheria, typhoid, and others, the whole body, and especially the nervous system, is left in a state of "irritable weakness," a state which may be prolonged, nay, even much exaggerated, by the evil referred to. The child may *appear* healthy and well very shortly after the fever has gone, and education is resumed, ending often in a relapsed and weakened condition of the unlucky child. In some cases, indeed, the intelligence may gradually disappear, and leave but the "formless ruin of oblivion." The one great fact to bear in mind for the avoidance of such disastrous results in these cases is the due observance of sufficient rest after convalescence.*

THE PERSONAL HYGIENE OF THE PUPIL.

Cleanliness.—There should be a firm insistence on the cleanliness of the child and his clothing, for, as in our public schools, all are for the time being, at least, supposed to be on terms of social equality, it is unjust to the cleanly child to be forced to associate with those whose clothing yields unpleasant emanations. In some schools much of the vitiation of the air is due to uncleanly clothing and the want of the bath for the whole body. In Circular 76 of the New Jersey State Board of Health, Dr. Hunt tells us:—

A plain talk on "Mouth Cleansing and a Sweet Breath" is seasonable in an opening term. The same is true as to all spittle. It is probable that not only diphtheria but other forms of sore throat are communicated by dried particles therefrom. The same is true as to most of the eruptive diseases and as to whooping cough. It is now claimed that consumption and even pneumonia may be communicated to susceptible persons in this way. School children should be forbidden to spit on the floor. Girls do live without it, and boys ought to. One or two spittoons with water in should be allowed in each school room, to which those should be allowed to go who have to spit. They must be cleansed each day.

Food.—To enable school children to apply themselves to their school tasks with credit to their parents and with future profit to themselves, an abundance of good nutritious food is required. The

*Nyulasy. Brain-Growth and Education, Health Lectures for the People, Australian Health Society, p. 41.

child is the embodiment of activity,—muscular and nervous energy are expended with a prodigality that would be ruinous were it not for the fact that the vegetative functions are correspondingly active. In addition to the consumption of nutritive material necessary to the evolution of muscular and brain force, growth and development must go on. The child, therefore, must have a proportionally larger supply of food than is needed by the adult. From the digestive organs the food enters, what may not inaptly be termed an automatically regulated irrigation system which, when normally working, supplies every organ of the body and every tissue with the newly received nutritive material in such quantities and at such times as are required, and, moreover, takes up and transports material worn out by the activity of these organs and tissues.

This self regulating supply of nutritive material to the tissues of the child may be the subject of unfavorable disturbances due to the voluntary acts of the child himself, or to activities or restraints imposed by others. Some of the conditions essential to the best nutrition of the child, we now note together with some of the causes of disturbance.

The food of school children should be abundant. As to just the quantity needed, the desire of the child is a safe guide so long as the dishes are plain. During school months there is probably more frequently need of coaxing the appetite of school children than of restraining it.

Many children show a dislike for certain kinds of fatty foods. The fats and oils are a very essential part of the food supply, both of adults and of children, and they should be supplied in such forms as are relished. Butter, cream, and milk rich in cream, are good sources of fatty foods, but need not exclude others that are acceptable to the palate. It is a mistaken and pernicious notion held by some persons that fatty food is harmful to children.

Tea, coffee, beer, and other stimulants, should be wholly excluded from the dietary of young children.

Relish is a guarantee to a certain extent that the food in question is adapted to the wants of the system and that it will be readily digested, or perhaps, a safer statement of this truth is, that food eaten without pleasure is not so likely to be beneficial to the system.

Food should not be restricted to a purely vegetable diet, but meats and other animal products should be given in moderation together with the cereals, vegetables and fruits.

A moderate supply of sweet things is useful in the economy of the child, but it is better taken in forms other than that of confectionery.

Dr. Fothergill* says: "There is, however, much reason to hope that ground cereals and milk will again become the favorite food for children, and that the taste for fats will be revived. When that day arrives, the death-rate from tubercle especially among the young, will be materially lowered."

Variety in food is no mere luxury. During the school months, especially, the appetite of many school children must be pampered and tempted or they will not thrive.

It is unfortunately the habit of some young ladies to eat only about half as much as sound health and decent school work require. Dr. Grofff† once observed that the young ladies in a female seminary made very little progress in their studies, when the answer came quickly, "What more could you expect, remembering what they have to eat? I suspect this evil is a general one in homes and schools. Bread and coffee is not enough to start the day upon if much work is to be done."

If under fed children are overburdened with school tasks it will be at the risk of stunting bodily growth.

Ill fed children are not always the children of the poor. Sensible and thrifty persons, the owners of horses and other animals, are careful to supply that kind of feed the most readily convertible in the desired returns, whether speed, draught or butcher's meat. It is doubtful whether these classes have equally correct views in regard to the feeding of children. Rich pastry, cakes and pickles is not the kind of food from which to expect sound physical health, healthy growth, and normal mental action.

Active digestion and hard study are antagonistic. A diversion of the blood supply to the brain during school work interferes with the digestion of a meal partaken immediately before the undertaking of the work, and, vice versa, a hearty meal eaten just before the beginning of school work naturally inclines to drowsiness instead of to mental activity.

The same antagonistic working exists between active digestion and active muscular exercise.

There exist, therefore, sound physiological reasons against too brief noonings. An hour and a half is better as a noon intermission

*The Maintenance of Health, p. 41.

†Annals of Hyg., V, 393.

between the forenoon and afternoon sessions than one hour, but two hours is still better.

Clothing for School Children.—The normal temperature of the body is about 98° F. and within the limits of health the body heat can vary hardly more than one degree. Although the heat of the body is, within certain bounds, automatically regulated, clothing is needed as an auxiliary equalizer of temperature,—that is, at times the body must be insured against the too rapid loss of heat, and at other times against the too vigorous action of external heat. While subserving these purposes the clothing must be permeable so as not to interfere too much with the transpiration through it of those exhalations which are given off by the skin and which are prejudicial to health if retained. As answering all these requirements more completely than any other, woolen is the best material for clothing. For underwear it is the preferable material not only in winter but in summer as well. In cold weather wool retains the bodily heat much better than cotton or linen, and in hot weather a light, porous flannel conducts the perspiration from the skin mo e rapidly, and thus does not become so saturated with water and so impermeable as cotton or woolen. In making the changes, therefore, from winter to summer wear, it is better to make a change simply in weight and thickness of goods and not from woolen to cotton or linen.

In our climate it is perilous to make the permanent change from cold weather clothing to warm weather clothing early in the spring. Serious sickness is very often the result of so doing. Further requisites in the clothing of scholars are non-restriction of the freedom of movement, absence of pressure, the least possible weight compatible with necessary warmth, and equal distribution over the body.

The clothing should not be supported by bands about the waist. Unless its weight is borne by the shoulders, it should fall on the hips themselves and not be suspended from bands, cords, or belts around the body just above the hips.

Impermeable clothing, such as waterproofs, rubbers and rubber boots, should be worn as little as possible, and teachers should not permit children to sit in school with these articles of clothing on, nor with mufflers or wraps about the neck. No pupil should be allowed to sit in school with wet clothing or wet feet.

The great need of removing all impediments to the successful cultivation of the physical powers of our school girls as well as of our boys is an apol gy for the two next paragraphs.

The story of the evils of corset wearing has been told so often with such a meager showing of good results that it might well be deemed futile to retell it were it not for the encouraging fact that health and that true style of beauty which is an exponent of health, is becoming fashionable among our girls. The well-wisher of his race notes with satisfaction that the young woman of the present day is taking more to outdoor life and to exercise in the fresh air. She enjoys, and it is becoming the fashion for her to enjoy riding, walking, rowing, bicycling, lawn tennis, and school games and gymnastics, and not to be handicapped in the competition with her brother, she learns that there is an absolute necessity for the adoption of rational styles of clothing. Her own experience in games and sports requiring physical exercise, has a tendency to teach her that one of the first requirements in rational clothing is the non-interference with the free movements of the body. The limbs must be unimpeded in their action, and those vital organs, the lungs, the heart, and the blood vessels, must have free play, for upon this depends the success and the safe endurance of sharp competitive exercises, or of prolonged physical exertion.

The comparative weakness and breathlessness of the girl as compared with the boy is not so much an intrinsic difference of sex, as it is a differentiation imposed by defective physical culture and by irrational styles of dress that interfere with physical exercise. Of all articles of dress, to be banished from the wardrobe of the school girl, the corset should be first. It interferes not only with the full action of heart and lungs, but also with the free use of the muscles of the abdomen, back, chest and arms. Some of the modern stylish, and nevertheless hygienic substitutes should be adopted.

A German medical authority shows that the corset restricts the breathing capacity from twenty to thirty-four per cent., or in twelve hours robs the wearer of the equivalent of 1,152 inspirations. An American physician has shown that the lung capacity of the corset wearer is lessened by 200 ccm. Physical culture among our school girls will be largely a failure until they adopt the cry, "*fort mit dem Korsett*," as has been done in some of our high schools and colleges for young women, thanks to the good advice of their gymnasium directors and the sound sense of the students themselves. It is told of the late eminent surgeon Mr. Cline, a teacher of Sir Astley Cooper, that when he was consulted by a lady on the question how she should prevent a girl from growing up misshapen, he replied, "Let her have no stays, and let her run about like the boys," and Dr. Richardson who quotes the above adds, "I gladly reëcho the wise advice of the great surgeon."

Sleep.—The amount of sleep needed by children is in inverse proportion to their ages, and in direct proportion to their mental and muscular activity. Thus, the younger the scholar is, and the more actively he exercises mind and body, the more sleep he requires. During the whole period of growth the child needs a longer night's sleep than does the adult. Many parents appear to be entirely unmindful of this fact, and the requirements of some schools which necessitate or encourage much home study equally disregard one of the prime requirements for the present and future welfare of the child.

Newsholme* states that the average amount of sleep required by school children at:

4	years old is	12	hours.
7	"	11	"
9	"	10	"
12–14	"	9–10	"
14–21	"	9	"

He remarks that "the regulation of children's sleep is a matter which chiefly lies with parents, and they may greatly help the school teacher by attention to it. It is unfortunate that growing boys and girls are, especially in winter, so frequently taken to concerts or other evening meetings. No wonder that they appear next morning at school with dark rings about their eyes, and generally incapacitated for mental application."

An investigation made by the Swedish Commission in ten schools in various parts of the kingdom, showed that those scholars whose period of sleep was shorter than the average for the whole school had 2.5 per cent. more sickness than those who had more than the average amount of sleep. This same Commission claims for boys of ten years, from ten to eleven hours of sleep and for those of eighteen, eight and a half hours. For girls it calls for from eleven to twelve hours sleep in their earlier school years, and from nine to ten hours for those seventeen and eighteen years of age.

*School Hygiene, p. 92. London, 1887.

It appears to be established that more sleep is needed in winter than in summer, and that the children of northerly climes need more sleep than those of warmer countries.

The general symptoms which indicate the wearing influence of deficient sleep vary with the age of the sleeper. In the child too little sleep induces symptoms of restlessness, peevishness, weariness at play, emaciation, indigestion, and great pallor of the face and surface of the body. The enjoyments of the waking hours are curtailed, and a dulness which, by thoughtless persons, is commonly mistaken for actual stupidity, marks every effort at lesson or at play. These symptoms are followed by an inability to go to sleep at the natural time and by the occurrence of an unnatural, startled, dreamy sleep when the eyes are, at length, closed. The activity of the brain is thus maintained in the dream and another cause of nervous exhaustion is hereby supplied. The man who dreams does but half sleep; the child who dreams hardly sleeps at all.

I have said that no distinct name can be given to the indefinite class of symptoms which are encouraged and sustained by sleeplessness; but, indefinite as they are, every watchful mother knows their import in the child. They are the beginnings of a restless, feverish, easily impressionable, easily exhausted life.

In adolescents, even if they be, naturally, of sound constitution and firm build, deficient sleep is a persistent source of mental and bodily exhaustion. It induces pallor, muscular debility, restlessness and irritability. It interferes with that natural growth and nutrition of the body to which sound sleep so beneficently ministers, and it makes the work and the pleasure of the wakeful day unduly heavy and laborious.

These remarks apply to members of both the sexes, but they specially apply to girls. The anæmia, bloodlessness, weakness, and hysterical excitability that characterize the young lady of modern life, who is neither well nor ill, are due, mainly, to her bad habit of taking too limited a supply of sleep at irregular hours.*

School Baths.—"Of the lessons that may be taught in the schools," says Sir Edwin Chadwick, "the practice of cleanliness is of the highest order." Again and again this practical worker for the sanitary welfare of the English masses teaches the value of cleanliness and the desirability and practicability of fitting up baths for the scholars in connection with city schools. In summing up the progress of sanitation within the year 1888 he again refers to this subject:

A French colonel ascertained that he could wash his men with tepid water for a centime or a tenth of a penny per head, soap included. The man undresses, steps into a tray of tepid water, soaps himself, when a jet from a two-handed pump plays upon him tepid water, and he dries and dresses himself in five minutes, against

* Richardson. Diseases of Modern Life, p. 436.

twenty minutes in the bath, and with five gallons of water against some seventy in the usual bath. In Germany they have an arrangement devised by Mr. Grove, too long to describe, under which half a million of soldiers are now regularly washed, no doubt with the result by this important sanitary factor of the reduction of their army death-rate beyond any in Europe. I have obtained the aid of Mr. (now Sir) Henry Doulton to direct inventions for some apparatus especially applicable to schools; and he has got some in which it is proved that a child may be completely washed in three minutes. I have long put forth the fact of the economy of cleanliness, that a pig that is washed puts on a fifth more of flesh with the same amount of food over a pig that is unwashed; and I have had abundant evidence that the holy doctrine of "wash and be clean" is even more economical for children and men. Look at the comparative sanitary result of the washed children, of a whole school, as against the common one of the fouled air and badly washed children. Look at the service to the poor mother who has no means of washing her children at home.*

Still again he says:† If a great epidemic were to occur again, I would proclaim and enforce the active application of soap and water as a preventive. I have had frequent opportunities of observing this plan as a factor of sanitation. I may state that I have received accounts of it, showing its efficacy, such as this: In one orphan institution, where the death-rate was twelve in the thousand, the cleansing of the place, the removal of cess-pits and foul drains before the cleansing, effected in the death-rate a reduction to eight in a thousand. Next, a cleansing of the person was effected by a constant ablution with tepid water, and then a reduction by another third, or to four in a thousand, was achieved. Other experiments tend to establish the value of personal cleanliness as a preventive factor at one-third.

The good old age to which Sir Edwin lived enabled him to see the realization of his wishes in many of the English and Continental schools, and with the happiest results.

The advantages of the school baths observed in European schools are bodily cleanliness of the child, greater care on the part of the parents in keeping the clothes of the school children neat and clean, improvement of the condition of the school-room air, again in the physical health of the pupil and an increase in the mental freshness and activity. There results, therefore, a physical, a moral, and an intellectual gain. Moreover, from more than one of the towns where school baths have been opened, comes the testimony that a good reflex moral influence has been exerted upon the parents and families of the pupils.

*Sanitarian, XXI, p. 394.

†Health of Nations, Edited by Dr. B. W. Richardson, II, 245.

The full bath and the swimming bath on account of their first cost and subsequent running expenses is altogether unavailable to many schools, whereas an outfit for the warm douch or spray-bath entails a comparatively light outlay at first and subsequently costs but little to run it. The arrangements for the spray-bath necessitate an available room for the baths themselves and another in which the scholars can undress and dress themselves, or, in the absence of the second room, a portion of the single room may be divided off with screens. Both rooms, of course, are warmed, and the dressing room is furnished with seats. The bathing room has its heater for the water which circulates in the pipes and which supply the spray. The child stands within a little stall, or in the open bathing room beneath the warm spray and scrubs himself. About ten quarts of water are used for each bath.

In Göttingen, Germany, three sprinkling baths were arranged, together with a dressing room, the cost of all of which was 780 marks ($195). For bathing seven hundred scholars, twenty cubic meters (5,311 gallons) of water are used. From six to nine pupils leave the school-room at once, and by systematically arranging for a steady succession of threes to occupy the baths, a whole room full of scholars is bathed with much less disturbance of instruction than was apprehended.

At first the scholars and parents did not look upon the new idea with favor, but within two months, with the encouragement of the teachers, 500 out of 700 pupils took the baths regularly, and a little later all. Each pupil brings his own towel.*

The Göttingen outfit for school bathing has served as a model for many other German schools.

In Weimar baths are furnished in the basement of a twenty-four-room school building, twelve rooms for boys and twelve for girls. The bathing room contains a water heater and seven spray baths under each of which there stands a zinc pan three feet in diameter, and in which three children usually stand at the same time while bathing. As twenty-one children bathe at the same time, it needs less than an hour for the bathing of all the scholars in a room. Near the bathing room there is a warm room for undressing and dressing. Mr. Hast†, municipal architect of Giessen, from whom we have the description of the bathing arrangements in Weimar,

* Viert. f. öff. Gesundheitspflege, XVIII, p. 168.

†Zeit. f. Schulges. II, 325.

says that "it is a pleasure to see the enjoyment of the children as they take their bath," and he adds that "with a clean skin they return to their school-room work, refreshed in body and mind and thankful for the good which they have received."

In Karlsruhe the warm water for the sprinkling baths is heated with gas. The cost of a bath for one child is only one pfennig (one-quarter cent). The advantages observed in that town are an improvement in the quality of school-room air, and a reflex moral influence on the parents and families in regard to cleanliness.*

In Basle, Switzerland, the cost of the apparatus for bathing ten children at the same time was 1,600 francs (320 dollars).†

The manifest advantages that have come from the establishment of school baths in the old countries render it very evident that their introduction into some of our own city schools is an experiment worth trying.

THE HYGIENE OF INSTRUCTION.

Points in the Physiology of Brain Work.—The brain of the superior races is of a decidedly greater average size and weight than that of the inferior races, and some anthropologists tell us that the difference amounts to as much as 10 per cent.

The investigations of Broca teach us that the mean cranial capacity of the well to do and intelligent classes is distinctly greater than that of the poor and ignorant classes. He has shown us, also, that the mean capacity of the skulls of those persons who have followed one of the liberal professions, is much greater than that of those of persons who have moved in the humbler walks of life.

The skull of the inferior races of mankind gets its growth as early as the twentieth year of life, but the crania of intelligent and educated persons of the superior races do not cease to increase in volume until much later than this.

As with the cranium, the cultured brain continues to increase in size and weight to a much later age than that of the inactive and uneducated brain, the late growth being particularly marked in the frontal, or intellectual lobe.

The left hemisphere of the brain presides over the functions of the right half of the body, and investigations have shown that the left

*Zeit. f. Schulges. II, 538.

†Schweiz. Blätter f. Gesundh. IV, 126.

side of the head is sensibly warmer than the right side. Still greater differences exist in the temperature of the different lobes of the brain, that of the frontal lobe being the highest, that of the occipital lobe the lowest, and that of the temporal region intermediate in temperature.

In "Points in the Physiology of Muscular Exercise" we shall note that heat is liberated in the muscles during their activity. The same is true of the brain when under the influence of mental work. Various investigators have demonstrated by means of delicately constructed electro-thermal apparatus that there is a decided rise in the temperature of the head as the subjects of the experiments pass from a state of mental repose to hard brain work, as, for instance, the solving of difficult mathematical problems.

The increased afflux of blood to the brain while active mental work is going on is at the expense of a diminished blood supply in other organs of the body.

The same fact was brought out objectively by the Italian physiologist Mosso, by encasing the arm of a young man in a manomometer-like apparatus. When the young man remained calm, thinking of nothing, the column of liquid in the tube connected with the apparatus remained stationary, but when he engaged in reading a difficult book, or in solving a hard mathematical problem, the liquid column fell, showing that there had been a diminution in the quantity of blood circulating in the arm.

Muscular exercise increases the size and strength of the muscles and the precision and nicety of their movements. Likewise the brain is increased in size by judicious mental training, and its powers are greatly improved.

Muscular exercise too severe or too prolonged on the contrary takes from the size and efficiency of the muscular system. Similarly, mental work too difficult or too prolonged or ill adapted to the child's stage of brain development, works an injury rather than a benefit.

Mental work is produced largely at the expense of the "wear and tear" of brain tissue; moreover the brain is left surcharged with waste matter. There is a close analogy between brain fatigue and muscular fatigue, in that both are the result, partly of molecular disintegration of tissue, and partly of the paralyzing presence of the resulting waste products.

If the quantity of carbonic acid excreted during sleep be represented by the figure 1, the quantity excreted while awake, but in absolute repose, is shown by 2, and that during hard and prolonged brain work, by from 3.6 to 5.*

During active brain work the nitrogenous and phosphorized waste is much greater than when resting, and considerably greater than during active muscular work.

Brain work being a stimulant to the circulation of blood through the brain, may act either favorably or unfavorably upon the growth and development of the brain. Favorably when the periods of work are not immoderately prolonged, and are followed by periods of rest from mental application sufficiently long for reparation of brain tissue and for the removal of waste products; unfavorably when reparation and epuration of brain tissue are incomplete, and the increased afflux of blood to the head does not speedily cease with cessation of brain work, but a congestive condition of the cerebral structure is left.

School Age.—In Maine the child has a legal admission to the public schools when he reaches the age of four years. Only four other states have the minimum school age placed so low, while, including territories and the District of Columbia, the school age begins at five years in fifteen, at six in twenty-two, at seven in three, and at eight in one of the states. Why admission to the public schools should not begin at an age so close to babyhood as the age of four, there are far weightier reasons than that our State stands with a small minority. At the age of four the brain of the child is in no condition to engage in study, nor to receive continuous instruction for more than very short intervals of time even when conducted in accordance with a rational system of teaching. But unfortunately these children of four or five, sent to the ungraded country schools, are generally subjected to methods neither rational nor hygienic. Many of these schools are taught by teachers who know but little of the noble profession of teaching, and less of the physiological necessities of early childhood; consequently the pathetic spectacle is often presented of children at very early ages shut up in their school prisons for three hours in the forenoon and the same length of time in the afternoon with but little commutation from the full daily sentence on account of infantile years.

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*Guyot-Daubès. Physiologie et Hygiene du Cerveau p. 227. Paris, 1890.

To these little ones muscular activity is a necessity, and quietude enforced for more than a short period at a time is harmful and cruel. The only rational system of teaching applicable to them is one in which short sessions of instruction are alternated with frequent intervals of play, or in which the teacher leads them in instruction which has to them the semblance of play, as in the kindergarten method, wholly unavailable in nearly all of the schools of the State.

As to what age children should be sent to school, Dr. A. N. Bell* remarks:

To fix upon the age at which school life may be commenced involves the consideration of the kind of school-life as well as the adaption of the child. The first and central fact to be constantly kept in view in conducting school-life is the plastic property of the child's mind. This fact being always uppermost, healthy children at the age of about seven years may safely begin to learn the alphabet, spelling and figures on the kindergarten system, giving them not more than two or three hours' application daily, with not less than half of the time, at equal intervals, for play; provided, always, the sanitary conditions of the school-room are duly regarded. In proportion as the sum of the sensations is increased by the progressive development of the brain, with increasing age, the organic functions are strengthened, the sensations and motions which were at the first confused and uncertain acquire increased accuracy and direction, and at the age of about ten years, systematic education may be commenced. But up to the age of puberty the school time should not be more than six hours daily, and no child should be required to devote more than half of the time of school hours to study, or more than forty minutes at a time to close application; and no recitation or blackboard exercise, which imposes the greatest exertion of the mind, should be longer than fifteen minutes.

Dr. D. F. Lincoln,† another eminent American authority on school hygiene gives the following answer to this question:

The kindergarten does not injure a child of four years unless carried to the point of over-excitement, which, I believe, is not often done. The common primary school, however, is decidedly objectionable. It takes very young children (six years of age), and compels them to remain in twice as long as is good for them. By great ingenuity and vicacity, a teacher can keep them going upon various studies for three hours. This is all that is reasonably possible, yet the children are expected to come back for a second session in the afternoon. A school conducted by set lessons and recitations—a mimic grammar-school, in fact—should not receive children under seven or eight years of age.

The foregoing is intended as an argument against subjecting children of early years to educational processes ill adapted to their

*Sanitarian XXIII, 348

†School and Industrial Hygiene, p. 33.

stage of brain development; not against beginning instruction at an early age if the teaching can be given in accordance with a rational plan. That children of tender years may be taught, even from books, without physical ill has been shown in many instances, one of which the following seems to be:

My little girl is five years and ten months old, forty-nine inches in height, weighs sixty pounds, has never been ill enough to spend a single day of her life in bed, and very seldom has even a cold. She goes out in all weather and on pleasant days spends from four to six hours in the open air. She sleeps ten to eleven hours, digests perfectly, and is noticed by every one for her rosy, healthy appearance.

She reads fluently in both Engli h and French, can write a good letter or dictation in either language, knows the multiplication table perfectly, and can work examples in the first four rules of arithmetic, knows time and money, the elements of grammar and geography, and has read about half of an easy history of England, and a similar one of France written in French She can also sew neatly.

The alphabet was learned from blocks in her second year, and kept up as a play, with added knowledge of spelling simple words during the third year. At three and a half, reading lessons were begun—at first very short, and gradually increasing as the power of attention improved. When a little over four, French was begun both orally and from books; in the same year writing and arithmetic were taught; and since her fifth birthday two hours a day have been given to lessons, and the other subjects mentioned have been studied. She also reads for her own amusement in short intervals of time between meal times and the outings.

All this work has been done without straining the powers of the mind. The child is well and happy, never fretful or nervous, and enjoys playing with other children in the ordinary way.*

Amount of Study.—In England a commission was appointed in 1833 to examine into the condition of children employed in factories. It was found that, generally, the children were worked far beyond a reasonable time, eleven, twelve or more hours daily, and the commission condemned this practice as being economically as wasteful as it would be, on a farm, to work young colts to the same extent as adult hor-es. This condition of long time labor practically excluded the children from school. To mitigate the physical, intellectual and moral evils of such a system, the commission commended a bill which became a law. It provided that these children shall be sent to school three hours every day, and as this was one-half of the usual school day at that time, these scholars were called half-school timers. Years after this half-time system

* Babyhood, VII, 188.

had become operative, Mr., later Sir, Edwin Chadwick, who had been a member of this commission, gave the reasons for its suggestion and described the results attained by it, in the following words, the interest of which should be a sufficient apology for quotation at some length:

It is a psychological law that the capacity of attention grows with the body, and that at all stages of bodily growth the capacity is increased by the skilful teacher's cultivation. Very young children can only receive lessons of one or two minutes' length. With increasing growth and cultivation, their capacity of attention is increased to five minutes; then to ten, and at from five to seven years of age, to fifteen minutes. With growth and cultivation, by the tenth year a bright voluntary attention may be got to a lesson of twenty minutes; at about twelve years of age to twenty-five minutes; and from thence to fifteen years of age, about half an hour: that is to say, of lessons requiring mental effort, as arithmetic, not carried beyond the point at which the mind is fatigued, with the average of children and with good teaching. By very skilful teachers and with very interesting lessons, the attention may be sustained for longer periods; but it is declared by skilled observers that prolonged attention beyond average limits is generally at the expense of succeeding lessons.

The preponderant testimony which has been received in the course of some enquiries into educational subjects, is that with children of about the average age of ten, or eleven, or a little more, the capacity of bright voluntary attention, which is the only profitable attention, is exhausted by four varied lessons to subjects and exercises requiring mental effort of half an hour each in the forenoon, even with intervals of relief. After the mid-day meal the capacity of voluntary attention is generally reduced by one-half, and not more than two half-hour lessons requiring mental effort can be given with profit.

The capacity of attention is found to be greater in cold weather than in hot, in winter than in summer.

Experienced teachers have testified to me that they can and do exhaust the capacity of attention, to lessons requiring mental effort, of the great average of children attending the primary schools in England, in less than three hours of daily book instruction, namely, two hours in the morning, and one hour after the mid-day meal.

Infants are kept in school, and the teacher is occupied in amusing and instructing them, for five or six hours, but the duration of mental effort in the aggregate bears only a short proportion to the whole time during which they are kept together. So in schools for children of more advanced ages. Even the smallest amount of mental effort in infant schools is extremely subject to dangerous excess. I am assured by a teacher in the first infant school established in Scotland, that he did not know a pre-eminently sharp child who had in after life been mentally distinguished.

In common schools, on the small scale, the children will frequently be not more than one-half the time under actual tuition; and in schools deemed good, often one-third of their time is wasted in changes of lessons, writing, and operations which do not exercise, but rather impair the receptive faculty.

It may be stated generally that the pyschological limits of the capacity of attention and of profitable mental labour is about one-half the common school time of children, and that beyond that limit instruction is profitless.

This I establish in this way. Under the Factories Act, whilst much of the instruction is of an inferior character and effect, from the frustration of the provisions of the original bill, there are now numerous voluntary schools, in which the instruction is efficient. The limit of the time of instruction required by the statute in these half-time schools for factory children is three hours of daily school teaching, the common average being six in summer and five in winter. There are also pauper district industrial schools, where the same hours, three daily, or eighteen in the week, or the half-time instruction, are prescribed; which regulation is, in some instances, carried out on alternate days of school teaching and on alternate days of industrial occupation. Throughout the country there are now mixed schools, where the girls are employed a part of the day in needlework, and part of the day in book instruction.

The testimony of school inspectors and of school teachers alike indicates that the girls fully equal in book attainments the boys who are occupied during the whole day in book instruction. The preponderant testimony is that in the same schools, where the half-time factory pupils are instructed with the full-time day scholars, the book attainments of the half-time scholars are fully equal to those of the full-time scholars, i. e., the three hours are as productive as the six hours mental labor daily. The like results are obtained in the district pauper schools.

In one large establishment, containing about six hundred children, half girls and half boys, the means of industrial occupation were gained for the girls before any were obtained for the boys. The girls were, therefore, put upon half-time tuition, that is to say, their time of book instruction was reduced from thirty-six hours to eighteen hours per week, given on the three alternate days of their industrial occupation, the boys remaining at full school time of thirty-six hours per week—the teaching being the same, on the same system and by the same teachers, with the same school attendance in weeks and years, in both cases.

On the periodical examination of this school, surprise was expressed by the inspectors at finding how much more alert, mentally, the girls were than the boys, and how much advanced in book attainments. Subsequently industrial occupation was found for the boys, when their time of book instruction was reduced from thirty-six hours a week to eighteen; and after a while the boys were proved upon examination to have obtained their previous relative position, which was in advance of the girls. The chief circumstances effecting this result, as respects the boys, were the introduction of active bodily exercises, the naval and the military drill and the reduction of the duration of the school teaching to within what appears to me to be the physiological limits of the capacity of voluntary attention.

When book instruction is given under circumstances combining bodily with mental exercises, not only are the book attainments of the half-time scholars proved to be more than equal to those of the full-time scholars, but their aptitudes for applying them are superior, and they are preferred by employers for their superior alertness and efficiency.

In the common course of book instruction, and in the average of small but well managed long-time schools, children, after leaving an infant school, are occupied on the average six years in learning to read and write and spell fairly, and in acquiring proficiency in arithmetic up to decimal fractions. In the larger half-time schools, with a sub-division of educational labour, the same elementary branches of instruction are taught better in three years, and at about half the annual expense for superior educational power.

The general results stated have been collected from the experience during a period of from twelve to fifteen years of schools comprising altogether between ten and twelve thousand pupils. From such experience it appears that the general average school time is in excess full double of the psychological limits of the capacities of the average of children for lessons requiring mental effort.

I have not hitherto been enabled to carry my inquiries to any sufficient extent for a statement of particular results, to the schools for children or youth of the higher ages, but I believe it will be found that the school and collegiate requirements are everywhere more or less in excess of psychological limits. I gather that the average study, in continuous mental labor, of successful prizemen at the universities is from five hours and a half to little more than six hours of close mental study or exertion from day to day. An able Oxford examiner informs me, that if he ever hears that some one is coming up for examination who has been reading twelve or thirteen hours a day, he is accustomed to exclaim, "That man will be plucked," and during his experience of thirteen years as an examiner at Oxford, he has never known an instance to the contrary. In respect to the mental labor of adults, it is observed by Sir Benjamin Brodie, in his Psychological Inquiries: "A man in a profession may be engaged in professional matters for twelve or thirteen hours daily, and suffer no very great inconvenience beyond that which may be traced to bodily fatigue. The greater part of what he had to do (at least it is so after a certain amount of experience) is nearly the same as that which he has done many times before, and becomes almost matter of course. He uses not only his previous knowledge of facts, or his simple experience, but his previous thoughts, and the conclusions at which he had arrived formerly; and it is only at intervals that he is called upon to make any considerable mental exertion. But at every step in the composition of his philosophical works Lord Bacon had to think, and no one can be engaged in that which requires a sustained effort of thought for more than a very limited portion of the twenty-four hours.

But great things are accomplished more frequently by moderate efforts persevered in with intervals of relaxation during a very long period. I have been informed that Cuvier was usually engaged for seven hours daily in his scientific researches; but these were not of a nature to require continuous thought. Sir Walter Scott, if my recollection be accurate, describes himself as having devoted about six hours daily to literary composition, and his mind was then in a state to enjoy some lighter pursuit afterwards. After his misfortunes, however, he allowed him-elf no relaxation, and there can be little doubt that this over-exertion contributed as much as the moral suffering which he endured to the production of the disease of the brain, which ultimately caused his death. Sir David Wilkie found that he was exhausted, if employed in his peculiar line of art for more than four or five hours daily; and it is probable that it was to relieve himself from the effects of too great labour that he turned to the easier occupation of portrait painting. In fact, even among the higher grades of mind there are but a few that are capable of sustained thought, repeated day after day, for a much longer period than this.

Sir Benjamin Brodie once stated to me that he subsequently ascertained that in the above passage he had rather exceeded the limits of the mental labour of Sir Walter Scott, who, in a conversation on the topic, in the presence of Sir Charles Lyell and Mr. Lockhart, had declared that he worked for three hours with pleasure, but that beyond about four hours he worked with pain. Sir Benjamin stated to me that he was of opinion "that for young children three or four hours' occupation in school must be even more than sufficient, and that they would be found in the end to have made greater progress, if their exertions were thus limited than if they continued for a longer period.

In large public establishments in which I have had an executive direction, I have not found it practicable to sustain, on the average, for longer than six hours per diem, from day to day, continuous and steady mental labour on the part of adults.

I find ground for belief that as more and more of mental effort and skill is required in the exercise of the manual arts, the hours of work must be more and more reduced for the attainments of the best economical results without waste of the bodily power.*

In this country it has also been shown that the half-time system for primary schools is not incompatible with satisfactory progress. The following is the experience of a citizen of Massachusetts, with shorter daily sessions of school:

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*Health of Nations, Edited by Dr. B. W. Richardson, I, 177.

I know nothing personally of the "half-time" system, technically so-called, but I have had with my own children practical experience of what may be accomplished in from two to four hours' daily sessions, under judicious management of studies.

My oldest daughter, now just over thirteen, has attended the same private school since she was five years old. She began with but one hour a day, and this was gradually increased to three, and then four, and for two years past she has had an hour's study out of school; before that, none. The school was small, varying from six to twenty pupils, and under the charge of a highly educated lady. My daughter, at thirteen, stands, with regard to her school acquirements, as follows: In arithmetic, the great standard in our public schools, she has done but little, having only a perfectly intelligent and practical knowledge of the subject, through fractions, vulgar and decimal. In geography she has an excellent general knowledge, physical and political, though there are many topographical details that she has never learned, and therefore never forgotten. English grammar she has studied but little, and could probably not "parse" to the satisfaction of any examining committee, but she understands the construction of sentences, and can "write and speak the English language" with as great correctness as is desirable in a child of her age. In spelling she would undoubtedly fail in a "match" from the spelling-book, but she rarely makes a mistake in words in ordinary use, and can write pages of composition with scarcely an error. In history she is well grounded in the elements of Greek and Roman, French and English history, and knows something of that of the United States (more difficult than either). She has a good general knowledge of English literature, as far as a girl of her age is competent to understand it, having taken it at school in connection with English history. In science she has made no great attainment, but she has learned the practical parts of physiology, and has studied enough of botany and natural history to form an intelligent basis for more She draws well enough for her age, having practised from objects, casts and busts, as well as from the flat. She has a good knowledge of the Latin grammar, and has read in Latin through several books of Ovid's Metamorphoses. She translates readily from any ordinary French book, knows the grammar very well through the third part of Otto's, pronounces well, and speaks and understands the language as well as can be expected from one who has never heard it talked. This is not any remarkable standard for a girl of thirteen to reach, but such as it is, it has been reached with the very few hours' daily work above mentioned, and wholly without artificial stimulus of any kind, and absolutely without worry or anxiety. I may add that she has learned at school to read music, so as to sing readily at sight.

My other children, eight and ten years old, are following the same course of a few hours' school, and no excitement but such as an interest in their studies may give; and with the result, so far, that they are both decidedly in advance of children of their ages in the public schools, who go to school five hours a day. They study a greater variety of subjects, having French and history, besides the ordinary school-studies; they have more writing exercises and more natural science. I know that the difference is partly due to the smaller size of the school, but more, I believe, to a judicious selection of the essential parts of the subjects taught, and the omission of many useless and burdensome details and of the sort of drill "necessary to prepare for public examinations!"*

According to Dr. Lincoln:† "In high schools during the period of rapid growth and sexual development, it seems certain that five hours, or, under the most favorable circumstances, six, are all that should be required. The ages usually range from twelve to seventeen. Below the age of twelve years, four hours are probably sufficient; below ten years, three or three and a half; below seven years, two and a half or three hours."

Circular 26 of the Pennsylvania State Board of Health says: "The number of hours spent in school daily should vary with the age of the pupil, five hours being the maximum."

The New York Medico-Legal Society has expressed the opinion that three hours a day of study is enough in primary schools.

What he considers the appropriate daily number of hours of school work including home tasks, for children from the seventh to the eighteenth years of life, Axel Key‡ gives in the following tabulation:

*Fifth Annual Report of the Board of Health of Massachusetts, p. 427.
†School and Industrial Hygiene, p. 32.
‡Schulhygienische Untersuchungen, tr. by Burgerstein, p. 172.

YEAR OF AGE.	Amount of sleep.	For undressing, dressing, washing, etc.	For meals and rest.	For play and free exercise.	For school work daily including home tasks.	Hours of work per week including music and gymnastics.
7th year	11	1	3	6	2-3	12 18
8th year	11	1	3	5-6	3 4	18 24
9th year	11	1	3	5	4 5	24-30
10th year	10-11	1	3	3 4	6	36
11th year	10-11	1	3	3 4	6	36
12th year	10	1	3	3	7	42
13th year	10	1	3	3	7	42
14th year	9.30	1	3	2.30	8	48
15th year	9	1	3	2.30	8.30	51
16th year	9	1	3	2.30	8.30	51
17th year	8.30	1	3	2.30	9	54
18th year	8.30	1	3	2.30	9	54

"I am constantly told by teachers when conversing on this subject," says Dr. J. C. Reeve,* "that children of this age do not *study* during all the six hours they are in school. I as constantly reply that the fact that they are there is enough; the confinement to the school-room six hours a day is too much for any child under twelve years of age."

Whenever the scholars appear tired and are restless and inattentive, the fresh air and the play-ground are better places for them than the school-room. Pupils should be encouraged and habituated to do their tasks in the shortest possible time, to work while they work and play while they play.

"A great master has said, concerning the education of little boys, 'Great care is taken that no boy shall, at any moment of the day, be obliged to sit in idleness, under any pretext whatever; when the stated quantity of labor is performed he goes to play; but while he

*The Brain and the Nervous System in their Relations to Teaching and Learning, p. 13. Dayton, O., 1878.

remains in the school-room he has no right to be an instant unemployed. The reward of industry, a short cessation from labour, is immediate; so that a lively boy is not doomed to "count the slow clock, and play at noon." On the contrary, instead of watching with feverish impatience to see both the hands culminate, he employs himself ardently at his task; the instant he has accomplished it, constraint ceases, and he breaths empyreal air.'" *

In drawing up a rational programme of school-room study, considerations of how much mental work can be accomplished in the school-room during the pupil's school course should not alone prevail. This complicated social life of ours has, even upon children, multifarious claims. The laws of health claim inexorably abundant time for sleep, for taking food, and for free play and rest. The intelligent school officer will feel that he is absolutely prohibited from encroaching here. Then again, the claims of home and social life are almost as imperious. Music, and other private instruction, household work, nervousness or fretfulness of the mother, visits, dancing lessons, Sunday school, all these add to the strain. In this direction the educator has to decide how far a compromise can be affected between the school and the family,—how far the excessive demands of the home may be brought to give way to those of the school. Upon the answer to this question will depend to some extent the number of hours of school work daily or weekly that may be imposed upon children without incurring the danger of strain. The conditions in many homes will undoubtedly suggest the desirability of bringing educational influences to bear upon the parents.

Home Study.—Dr. Crighton Brown, in his report of inspection of the elementary schools of London, 1884, is especially caustic in his condemnation of home studies for young children. He says the principle is bad. Even when the labor is small in quantity, it stirs up and irritates an exhausted and feeble brain, and interferes with sleep. It worries and torments the child, and prevents the relaxation and entire diversion of the current of thought which ought to follow the dismission from school. He says it is resorted to nine times in ten because the year's work cannot be done by the scholars in the regular school hours.†

Arrangement of Work.—It is upon the condition of the gray nerve-cells of the brain that efficiency of mental processes depends. Like other organs, the gray nerve matter is exhausted by continued activity, and needs rest in order to recuperate its vital-

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*Dr. Clement Dukes. Health at School, p. 148. London, 1887

†Dr. D. S. Lamb in Jr. Amer. Med. Assoc. XVI, 6.1891.

ity. "The brain, and consequently the mind, is fresh and vigorous after the night's repose; the damages have been all repaired, and the *debris* cleared away. It is a matter even of common observation that at no other time is the mind so sharp, clear, and strong, as in the morning. For this reason," says Dr. P. J. Higgins,* "the abstruse studies should be taken up during the forenoon session as the faculties of the mind are then in the most favorable condition to grapple with their difficulties.

"Of all school studies mathematics requires the strongest grasp of mind and the closest exercise of the reasoning powers and the judgment. In abstruseness and difficulty of comprehension geometry, algebra, and arithmetic, rank in the order enumerated. Rhetoric, including grammar and composition, comes next. In every school and college, therefore, these subjects should be taken up during the morning session. * * * * The lighter or concrete subjects—reading, history, geography, writing, drawing, music—should occupy the afternoon session."

Another point is that the studies and recitations should be so arranged as to afford the greatest possible rest to the mind from the mere change in passing from one study or recitation to another. Therefore one study demanding hard brain work should not immediately follow another of the same character; nor should drawing and writing, both inclining to faulty postures, closely follow one another; nor should singing and reading come close together, unless the individual exertion in the latter exercise is of the usual insignificant quantity.

The writing lesson should be taken in that part of the day when the light is the clearest.

It is not advisable to require or permit children to do only the lightest, or the least amount of intellectual work in the evening or after the evening meal. Tasks which require concentration of the mind, or those which fret the child should be entirely banished during these hours, or the danger of banishing refreshing and sufficient sleep will be incurred.

One or Two Daily Sessions?—Some years ago Dr. Winsor† sent a circular to many of the physicians, educators, and school officers in Massachusetts making, among others, the enquiry, "Is a single long session different in its hygienic influence from shorter

* Popular Science Monthly, XXIV, 640.

†Fifth Annual Report of the State Board of Health of Massachusetts, p. 410.

sessions?" "Worse" was the answer from 89; "worse, except for upper classes of high schools" from 1; "better" from 7; "uncertain" from 42. One of these correspondents gives the following reasons against the long session:

I wish I could adequately express my sense of the importance of the issue which this inquiry presents. Everywhere the tide is setting more and more strongly against two sessions. Upon this matter parents, pupils, and it is to be feared, a large majority of teachers, are in unison. The decision of the point in question is generally affected by the loss of simpler habits of living, by changed hours of eating, and by the growth of large cities and towns. And yet a single five hour session violates every principle of school hygiene. During the last two hours of such a morning, teachers and scholars, jaded by the labor and confinement of time that has gone before, are incapable of the best work. When the time is at last ended the impulse of all is to escape from the place of imprisonment with the least possible delay. Questions that have come up, and the answers to them, must wait till tomorrow. A growing child needs a meal at midday. A teacher's need of such a meal is scarcely less than the child's. The interval between the child's light breakfast and his dinner cannot safely be made much more than five hours. When the single long session is established, this interval can rarely be less than seven hours, and must often extend beyond that time. The luncheon carried, or the pies and tarts devoured at the nearest shop, only aggravate the injury. We ought cheerfully to accept the fact, that for our children, school duties are the appointed and the all-important work of each week day. Time enough can be found for all needed exercise and fun without crowding all study into one half of that day. In deciding this question, fathers and mothers should weigh nothing else than the welfare of their children; and it may be well added, that the interest of the children, in a matter of such moment, cannot fail to be also that of the whole household. The plan of getting rid of all school before dinner deserves to take rank with "French in four easy lessons," and all kindred absurdities. The difficulty felt by a small minority of scholars in getting home during the interval, in the case of schools supplying unusually extended districts, is the one valid objection which has here been urged; but in the few instances of this class, it would be far better that the school should furnish pupils thus placed, dinners at cost, as the Boston Institute of Technology has lately proposed to do, than to attempt one long session to the positive injury of all concerned.

Another correspondent writes:

After an experience of sixteen years' service as one of the board of school committee of this town, during which time the one long session and the two short sessions have been fairly tried, I think that comparing the first hour and a half with the fifth or last of long sessions I invariably find that the pupils are wide awake, ready to take hold of a new subject and understand it, appetites sharp for new ideas, bodies upright, cheeks with a healthy glow during the first hour. During the last hour, the fifth, there are languid postures, drooping eyes, pallid faces, tired looks, absence of all vivacity and a painful expression of impatience on the countenance of nearly all. No good study is done after the third hour; the last two hours are spent generally in dreary listlessness or painful attempt to goad the brain on to work.

Dr. Winsor quotes from the "Massachusetts Teacher" the following additional reasons why the single session is undesirable:

Much of the best material in our high schools comes from the families of laboring men, who take breakfast early and dinner at twelve o'clock. Until the children are admitted to the high school the family can all be together at dinner. After that time there are, every day, vacant seats at the table. The son or daughter, accustomed to take dinner at noon, comes home at one or two o'clock, after a fast of six hours or more. The healthy appetite has passed away; the social dinner table has been set and cleared; the high school pupil takes his dinner, and, like a dog, eats it alone. Taking it upon a stomach that partakes of the languor and lassitude of the whole system, he fails to enjoy it while eating, or to digest it afterwards. There could not well be found a surer case of dyspepsia; besides, there is the bad effect of taking a child from the family dinner table for three of the most impressible years of his life. A dinner taken under these circumstances, when the brain is weary and the digestion unfit to wait on appetite, must prevent good study in the afternoon.

Dr. Mary Putnam Jacobi,* in speaking of the infractions of health by both pupils and teachers, says:

This is conspicuously true of the habit, which widely prevails among both, of passing nearly the entire day without food, or with a lunch at once unsubstantial and indigestible. The apparent inability of the female sex to comprehend any fixed relation between food and work is the cause of many of its woes. The habit of working without eating is first contracted at school, and in thousands of cases initiates the dyspepsia and frontal headache which are so readily attributed to excessive mental exertion. The old New England custom of keeping school from nine to twelve, and again from two to four, is certainly much more favorable to health than a single prolonged session from nine to three, with half an hour's intermission for the double purpose of lunch and exercise. Short periods of work, alternating with periods of recreation, are equally essential to children and to the women who teach them. No one can enter an afternoon school-room without noticing the flushed faces and listless attitude of the pupils, and wondering on what principle, or for what reason, these young things are still chained to their desks.

Where local conditions make it appear to be preferable to have but a single session, say from eight A. M. to one P. M., it should

*North American Review, XXXVI, 299

be broken by pauses or recesses of ten, or preferably, fifteen minutes at the end of each school hour, during which every pupil should drop, for the time being, every thought of school tasks and seek refreshment of the mind in out-door sports.

The Evils of Sitting Still.—Burgerstein* refers to the evil results of enforced bodily inactivity in the school-room as follows:

Dangers of injury arise from too long continued sitting still. The lessening of the respiratory movements has a tendency to produce weakness of the muscles which elevate the upper thoracic segment, and this result has an intimate relation to the beginning of tuberculosis of the apex of the lungs. Bearing in mind the posture of our school population as it sits bent over more or less at its work, the lack of muscular movement, the tension of the mind, the diminished action of the heart and lungs, and remembering, also, that these same conditions are almost exactly repeated in the school work done at home, we can believe that we have here a serious cause in the forwarding of a tendency to lung tuberculosis in our school children, particularly in those who have spent on the school benches the whole period of their growth, until the age of eighteen or more. The evil results of sedentary occupations are well known even to the laity, and it is more probable that the first unfavorable impulse is given by the schools.

As evil results of too long continued sitting sti l, may be mentioned congestion of the brain, which is particularly favored by the bowed position of the pupil's head, compression of the abdominal region, and diminished action of the respiratory movements. Cerebral congestion thus produced is often accompained by sluggish action of the mental faculties,—an unfortunate result for successful instruction. Dangerous consequences may result from a continuation of these unfavorable conditions. From their action we may have an active congestion,—an accelerated movement of the blood to the overtaxed brain. These congestions may again be the cause of headache and nosebleed.

Recesses and Pauses.—At the meeting of the National Educational Association in 1884, a paper was read by the Hon. W. T. Harris, at present Commissioner of Education, on the question of recess or no recess, a part of which is here reproduced. He makes a strong plea for the retention of the time honored and rational custom:

Abolish recess and within a few years the medical profession would trace to their source in the school-room many disorders in the functions of the glandular system. The reaction produced against this ill considered reform in recesses would be swept away in a hurricane of popular indignation. But we are told that the physical requirements are well looked after in this proposed reform.

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*Die Gesundheitspflege in der Mittelschule, p. 18. Vienna, 1887.

The periodicty in the functions of the secretory glands is to be provided for by a general regulation allowing the pupils to leave the room whenever they wish to. This the advocates of the abolition of recess, concede to be necessary. Here comes the difficulty. In practise, the teacher finds more evil to result from this indiscriminate permission to go out during the school time than from all other sources combined. Every teacher of experience will support my testimony on this point with his own. It is a constant temptation to the frivolous pupil and demoralizing to a high degree. He will find it convenient to leave the room whenever he wishes to avoid a recitation or any unpleasant duty. But we are told that this evil need not be tolerated; the children need not be allowed to go out indiscriminately. If, however, the teacher is to be constantly interrupted in the course of other work, with the problem of deciding what cases are necessitous and what ones are not, then all other work will suffer, and even yet many serious mistakes occur. The least impatience at interruption will have the effect of a general restriction. A cross word in response to the child's request, deters him from asking again on another occasion, and he prefers self denial. The restriction placed on free going out, adopted to prevent the abuse of the privilege by the roguish or vicious, result in holding back the timid, modest, retiring pupils who are eagerly intent on winning the teacher's good will. Such will suffer excruciating torment rather than draw attention to themselves by leaving the room, or by asking permission to do so. Even a look of inquiry from the teacher is too much for such pupils to bear. Hence, not knowing the serious evils resulting, the most exemplary pupils will lay a foundation for life-long physical weaknesses already hinted at.

All this would result from changing a custom which long usage has sanctioned. By the recess as it exists, necessities are provided for, without questioning the pupil, without discriminating as to his wants. A general recess provides for all cases of which all will take advantage. Abolish general recess, and it must be compensated for by an indiscriminate permission to leave the school-room at pleasure, or else by a discrimination which is both indelicate and a sure cause of physiological evil. There is enough in this phase of the physiological question to condemn the new theory.*

Some other objections to the recess are so admirably met by an American writer† that we cannot refrain from quoting him.

Not only do the out-door recesses have the advantage of air and sunshine in good weather, but in bad weather they have the advantage of exposure also; and, contrary to the commonly accepted theories, exposure to inclement weather, in a reasonable degree and with proper care, is of very great advantage.

Children need the rough-and-tumble of an out-door recess to toughen the sinews of the body. Many at home are so tenderly cared for that, what with cushioned chairs, stuffed sofas, and spring-

*Amer. Jr. of Education.

†Popular Science Monthly, XXIV, 90.

seats to the very carriages in which they ride to school, they are in danger of becoming too tender for even this usage; and, if they are ever to accomplish anything in this world, they must somewhere acquire the physical power to endure many hard knocks in various ways and stations of life. They cannot always be held in their nurse's arms. They will meet with accidents which, if they are accustomed to the games of the playground, will not affect them at all, but which, if they are not, will lay them up with a lame side, a sprained ankle, or a dislocated joint. Falls and tumbles occur daily upon the playground, with no injurious effects whatever, which would put some of the tenderly nurtured in bed for a week. The playground is the only place connected with the schools where children can become hardy; and this element of hardiness has been very strongly marked in all successful men. It is not the carpet-knights who to-day rule in politics or in business—no, nor in science or religion—but the men who have grit and toughness, men who fear neither ridicule nor a crowd of rowdies.

Take the boy who has a few companions to play with him upon his own lawn, and who, like himself, are carefully kept from the society of the rougher and more world-wise boys of the street, and how is he to get any knowledge of the methods or the power by which these others are to be controlled in afterlife? Yet this boy and his class are those who in many respects ought to have a controlling influence on the destiny of his neighborhood, but, because he has no acquaintance with the other class, because he does not know what are their ruling motives, he is powerless for good among them. By means of this knowledge those agitators among the people, like Moody and Dennis Kearny, the leading politician in each town and ward, and the organizers of strikes, have such power among the masses; and their lack of this knowledge is the main cause of failure of our citizens' social-reform societies and kindred organizations which attempt some very laudable reforms. As the boy is father to the man, so the playground is the antecedent of the future society of the town or ward, and upon the playground, more than in the school-room, the leaders of the future are made; there the boy must learn, if he ever learn it, how to lead, control, and master the others—boys to-day, but men to-morrow. The school-room is an autocracy, with the teacher for autocrat and the pupils for subjects, but the playground is a pure democracy; there each, in proportion to his strength, dexterity, and skill, is equal to any other; there the egotist learns his insignificance, the rude boy gets his first lessons in common courtesy, and there the bully learns that his ways are not approved.

But the ruling sentiment of the playground must not be allowed to form itself by accident. Children must not be left to themselves at these times.

An out-door recess needs the controlling presence of the teacher quite as much as an in-door one, and more than the ordinary exercise of the school-room, and because this has been neglected is the reason why some people have objected to it. Several hundred children, after experiencing the restraint of the school-room, should not be released upon the playground without supervision competent to suppress whatever may appear that is pernicious. There is no other time in all the day when competent guidance can do so much to make boys manly and girls womanly as when they are at their games. It is not enough to leave the playground to the janitor or to some inferior authority; it is the place where the principal teacher and nearly all the others are most needed—not to direct the games, or to meddle in any way with the sports, but to be ready with a cheery voice and an easy grace to suggest to any one about to engage in anything improper that he has forgotten himself. Ruffianism will soon disappear, timid children will learn to assert themselves, and an *esprit du corps* of the playground can soon be formed which will have a wonderful influence on the characters as well as the actions of the pupils. Nor is the benefit to the pupils all that is derived from this plan; the teacher needs such a recess quite as much as, and in many cases more than, her pupils. Fifteen minutes of each ninety in the open air away from the sights and thoughts of the lessons, will remove the nervous, tired, irritable, and almost despondent feeling experienced by many teachers, and give them renewed strength and cheerfulness and mental elasticity for the remainder of the session.

To the foregoing able arguments may be added that there are still other weighty reasons why recesses are needed.

They are needed as one of the most important measures in guarding against the ever increasing danger of myopia. The eye focussed for near work is an eye under tension, and the longer the intervals without resting the eye muscles, the more difficult to maintain the required degree of accommodation, the greater the strain, and the greater the danger. Dr. Poeller of Munich has recently published the results of his tests made at very short intervals of the acuteness of vision of eyes focussed on small objects, as in reading. He represents graphically by means of curves the results, and a diminution of the power of focussing for small objects is evident, even after only thirty to forty-five minutes work, and this decline in the power of vision becomes the more rapid the longer the eye work is maintained. On these results he bases the hygienic rule that the eye shall not be kept under the strain of near vision longer than from three quarters to one hour without rest, and that, when the school session lasts several hours, the eye shall be worked, at the most, not longer than forty-five minutes, to be followed by a pause of fifteen minutes for rest.*

The temporary rest and change given by the recess is needed by the brain and nervous system to obviate the dangers of over-pres-

* Archiv für Hygiene, XIII, 335. Munich, 1891.

sure, by the spinal column to counteract the tendency to abnormal curvatures, by the whole child that the exercise of his muscles, and the expansion of his lungs may quicken and equalize the circulation, and to counteract the school-room tendency to local congestions. The recess is greatly needed in most school-rooms in the interest of ventilation.

When the weather is suitable all the pupils should be required to leave the room and go into the open air. Then the windows, unless the school-room ventilation is unquestionably good, should be thrown wide open, at least during the first part of the interval for recess.

During recess no scholar should be allowed to study. The time is for play and study should then be as much against the rule as is play in study hours.

The grudging allotment of time for recesses in the school programme is an unintelligent policy. There are eminent educators who believe that a liberal supply of time taken from the daily school hours for recesses is time well used, and does not necessarily result in a smaller amount of school work, but that it may help to more work and better work.

In many of our schools, recesses are too few and too short. In the primary schools, short periods of instruction not to exceed half an hour should alternate with pauses and recesses for play and rest. In the grammar grades, two recesses in a half day's session of three hours would be better than one. In the model school of Brussels, three-quarter hour lessons and one-quarter hour recesses have been adopted. The system in use in many of the best European schools is similar. In 1884 the Prussian Minister of Instruction ordered a recess to be given at the end of every hour whether the daily school work is divided into a forenoon and an afternoon session, or there is only a forenoon session of five hours.

As to the noon intermission when there are two daily sessions, I agree fully with Dr. Lincoln* when he says that, "nothing could be more injudicous than a programme which allows only one hour for dinner, following a forenoon of study and followed by an afternoon of study. If it be thought desirable for young adults to make the day as full as possible, it will be much better to have an intermission of two hours at noon-time."

Absolutely no school work should be assigned for the noon pause and none should be permitted. This whole time is needed for

*School and Industrial Hygiene, p. 20.

recreation and for a favorable beginning of the digestion of the noon meal.

In leaving an important topic in the hygiene of instruction it may be said that work, as hard and intense work as the best teachers can get out of pupils, will not harm them if the work is done under right conditions, and one of the most important conditions is comparatively short periods of work followed by pauses for relaxing the tension of mind and body.

School Excursions.—One of the pleasant sights which draws the attention of the American in Europe, is that of the troops of school children marching at the heels of their teachers,—city schools enjoying a day's or a few days' outing in the country, or rural schools seeing the sights of the city under the guidance of their teachers. It is a temporary change in the routine of instruction, the translation of the pupils from the dust of the school-room and the study of books, to the free air of the outer world and the study of things. They are out for the day to learn something of the world. Whether the way lays through city streets or through woods and fields, their leader teaches what to look for and how to see it. The advantages of these short outings are, when well planned, as they usually are, a brief respite from the mental application of the school-room, and the gathering, by means of direct observation, of a large mass of material for subsequent use and illustration in the school-room.

Vacations and Holidays.—There is even some reason for discovering similarities between the condition of many of our school children when they are finally dismissed for the long summer vacation and the condition of the beneficiaries of the "fresh air fund" of our large cities. The poor, sick city children who are sent to the country, for a two weeks' outing have become pale, thin, weakly, and diseased for the lack of good food, pure air, and other congenial surroundings.

These unfortunate little ones from the city are described as "suffering more or less with some chronic disease, born of neglect, privation, filth, and foul air. Prominent among the diseases represented were scrofula, consumption, chronic bronchitis, asthma, hip-joint, and spinal troubles. Among them were confirmed cripples, as well as those in the incipient stage of more or less incurable diseases; while others were simply in bad health, delicate, or sickly, the result of impure air or insufficient or improper food."

Of the effects of the trips it is said that "appetites improved, coughs ceased to be troublesome, ulcers healed, growing deformities were arrested, cheeks filled out and grew ruddy, spirits became buoyant, the step elastic and childlike, while the sickly smile gave place to the hearty laugh of childhood ; or, as very happily expressed by a friend, 'they went out men and women—they came back little children.' "

The late Dr. White of Brooklyn, whose language we have been quoting, says of the children sent out in 1877, the first year of the experiment:

The whole number selected under my own supervision was sixty. As to diseases, they were classified as follows:

General debility, 31 ; deformities, 7 ; hip-joint disease, 5 ; spinal disease, 2 ; knee-joint disease, 1 ; consumption, 5 ; bronchitis, 4 ; chorea, 3 ; chronic ulcers, 2 ; total, 60.

All those whose health was being slowly undermined by living in the impure air of crowded and badly ventilated apartments, or from insufficient and improper food, as well as those enfeebled by a previous attack of some acute disease were classed under the head of general debility, without reference to the cause of their physical condition. Nearly all of this class returned home completely restored to health. All others were greatly benefited by the trip, and, if not cured, in many cases with disease arrested for the time being at least. All the cases of consumption improved.*

In a subsequent year "The chairman of the local committee in one village community weighed every child in the party on arrival, and again after fourteen days in the country. The average age was ten years. The least gain was shown in a four-year-old boy, who added only one pound to his weight. The greatest by an eleven-year-old girl, who gained nine pounds. The average gain for the entire party was four and nine-tenths pounds."

Now, if the foregoing woeful picture of the results of foul air, insufficient ventilation, and other unhygienic conditions of city child life among the poor, is to be taken as a reflection of the results of school attendance, it is, of course, to be understood as a very exaggerated one. There is, nevertheless, a similarity of results. It will be noticed that thirty-one of the sixty children sent out in 1877, went on account of "general debility," that state of ill health which we have already described as a rather characteristic school disease. It is a condition that serves as a pathological basis for a host of other diseases. Our school children, many of them, with an abundance of food, lose their hearty relish for it during their confinement

*Scribner's Magazine, IX, 521.

to the foul air of the school-rooms, and to enforced muscular inactivity upon the school seats. Many of these children at the end of each school year are greatly in need of the change which the vacation brings; and, whether the change consists merely in the escape from the school-room atmosphere and school-room restraints to a free run in the fields and woods about their home, or a visit to some other locality, the improvement in appetite, color, weight, and all other evidences of returning health, is usually striking.

The long summer vacation, with the existing educational methods and conditions appears to be a necessity, but the question is worthy of serious thought whether it would not be an advantage in more ways than one to have a portion of the long vacation distributed through the school year in longer recesses and in half day vacations, especially when the weather is fair and favorable to out door sports and games. With a modification in this direction the need of the long vacation would not be so urgent. In this connection a suggestion of Dr. Winsor* is worth consideration. He says:

It will appear on reflection that the system is now adapted to the wishes of the teachers and of the wealthier families whose children are at school. But a very large majority of the children in the large towns and cities cannot go away into the country and enjoy its summer delights for weeks together, but must swelter through the long hours in the streets,—now in mischief, now in obvious danger, now listless, always in worse sanitary circumstances than if they were in decent school-rooms with moderate lessons. Our duty is to provide vacation schools of some sort for the children on whom these evils fall most heavily, placing over them teachers who have not taught through the preceding term.

And there seems abundant reason for making these vacation schools industrial on the half-time system, since it would not interfere with the present system carried on in term time. Such schools, together with half-time schools for factory children, under a stringent law, would do incalculable good, and would furnish reliable data for determining the propriety of applying the principle to the present public schools.

Some Recent Studies.—Dr. Wretlind, of Gothenburg, carried out for several years, in the school with which he was connected, systematic weighings of the pupils under his charge, determining the weight of each pupil at the beginning of the school year, and again at the close. The school year included nine months, leaving a summer holiday of three months.

By means of these weighings, Wretlind determined that the growth of these children was proportionally more rapid during the vacation

* Fifth Report State Board of Health of Massachusetts, p. 440.

than in any other three months during the year, and draws the conclusion that school work has a tendency to retard physical growth. He says, that, before the age of nine, the school has no perceptible effect in checking the normal rate of growth, but in the following years the physical development is retarded during the school months and this retardation becomes greater with the advancing age of the pupil, with the exception of the fourteenth year of life, in which the restraining influence of school life is less apparent than in the next younger and next older years.

In this connection as he remarks, we have a question of the highest importance, whether the normal rate of growth during the different seasons of the year is uniform.

In addition to the investigations of Wretlind, Dr. Key refers to those of Vahl who for a period of nine years determined the weight of the pupils in a Danish school semi-annually, on April 1st and October 1st. His results show that the increasing weight for the pupils of all ages from four to fourteen was more rapid during the summer half year than during the winter half, averaging about one-third more.

Investigations of this kind, says Axel Key,* are of great importance in considering the vacation question. If the winter and spring months exert, of themselves, a retarding influence over development, the length of the summer vacation is of more significance than in places where the winter is shorter. If, on the contrary, the retardation of growth during the winter months is not referable to natural causes, but to the fact that we lead a less active life in the polluted air of our rooms, etc., then there is the greater need for us to correct these unfavorable conditions as far as possible; then, also, the need for a long summer vacation would be more urgent than in more southern lands.

Regarding the compensatory growth after a temporary retarding cause has passed, an example is given from Vahl. An epidemic of whooping cough, in the year 1880, exerted its influence in a marked degree in restraining the rate of growth of the pupils during the winter of 1880-81. The increased rate of growth which followed this temporary check made itself apparent even during the following winter. The compensatory growth, therefore, required more than a year. If the organism requires so long a time to make up the loss due to a temporary influence, the serious question is suggested,

*Schulhygienische Untersuchungen, p. 246.

how long a time may be required for the compensatory growth of children who have been subjected to less transient conditions which seriously retard their development? It suggests how fateful may be the result.

Vacation Colonies.—Another subject allied to the one just under consideration is that of vacation colonies, or camps for sickly or "run down" school children. This idea, we believe, was first put into practical operation by Pastor Bion of Zurich in 1876. Two years later Varrentrapp, the sanitarian, started a colony of the same kind for the school children of Frankfort, he having, in the meantime, visited and recognized the value of Pastor Bion's novel charity. From this beginning the work has spread rapidly over Europe, and has met with so favorable an appreciation that liberal donations have been forthcoming for its support.

These vacation colonies are somewhat differently managed in different places. They are usually managed and provided for by a benevolent "vacation colony society," and the children are under the immediate care of some suitable person, often a teacher whose sympathy in the cause leads him or her to forego, in part, the freedom of the summer vacation. Sometimes they are found in the wooded country, sometimes among the mountains, and again at the seashore. From 15 to 20 children only are admitted to some colonies, while in other places as many as 100 go together. In some colonies the children remain in camp three or four weeks, while in others twice as long. An abundance of good rich milk and other wholesome food is supplied, and games and plays are provided that the fascination of the children with the new, free life may not cease.

In 1888 an International Congress in the interest of holiday colonies for school children, especially for feeble or sickly children, was held in Zurich, Switzerland. It was attended by representatives from all the leading continental nations, and from countries as far distant as Spain, Russia, Finland, and Scandinavia. Prof. Wyss, of Zurich, read a paper before this assembly on "The Physical Results of Holiday Colonies."*

When, says he, we compare these children on their return with the same crowd that, a few weeks earlier, were setting out to the colony, it must be confessed that their appearance is improved. The pale and thin features, with the large eyes, the slender arms, and the legs that tire with a little walking have given place to brown and sunburnt faces, to eyes not so sunken, to rounded cheeks,

* Verhandlungen des Int. Kong. für Ferienkolonien, p. 6.

to rosy lips, to limbs clothed in muscles of a firmer feel. The whole body is now covered with a softer and more elastic skin. But in addition to these excellent changes, the attentive mother notices other alterations in her child. The former disrelish of hearty foods, particularly of milk, nourishing soups, and meats, has disappeared; black coffee is no longer preferred to the proper and real food products, like milk, meat and eggs. The complaint of nausea, and of pain in the stomach is no longer made. The sleep is quieter—there is no longer talking in sleep, grinding the teeth, or sudden awakenings in fright. That the physical strength is increased, is noted with certainty by the leader of the colony, for these children who, in the first weeks, lagged behind in the walks, are no longer tired even by long marches from the camp. At the re-opening of the school the teacher declares that the pupil shows more life, and, at the same time, is more attentive and studious, and that he is more sprightly, both in mind and body. The headache with which he was troubled, especially in the last hours of the session, has entirely disappeared.

From the paper read by Prof. Wyss, we gather that the upward impulse given to the health of the children is permanent in its results, or lasts for a long time after their return to their schools and their unhealthful homes.

Several physicians have sought, through exact methods of observation, to gain an idea as to whether the physical gain is real. Measurements of the height and of the chest capacity, show, upon the whole, improvement. The weight increases from 2 2 to 8.8 pounds; children in the Swiss colonies gaining least, and those in the German most. The increase in weight is dependent very much upon food, weather, and other circumstances. In five or six per cent. only of the children, there is no gain in bodily weight.

Sixteen girls and fifteen boys from the schools of Paris were sent to the vacation colonies in the country. One of the children was nine years old, two were thirteen, all the others were ten, eleven, or twelve years of age. The average age of the girls was exactly eleven years, that of the boys eleven years and four months.

On their return at the end of a month, the boys had gained, on an average, almost three pounds, and the girls nearly four pounds and a half.

When they left home they were all, without exception, pale, dull, and sickly looking. On their return they had, without exception, a good color, and their eyes were bright and sparkling. It was a veritable transformation. One month after their return, save one exception, the amelioration of their condition and the increase in weight persisted.*

Some of the investigators have made comparisons between the physical gain of children in colonies and other children of the same ages, classes, and conditions in life, enjoying the benefits of the so-called milk cures, having their freedom during the vacation, but not leaving the city. The gain is distinctly in favor of the colony children. And this physical betterment is not all. The child brings home with him a soul full of beautiful memories of happy days, of new and pleasing scenes, of discoveries in hitherto unknown fields. As one of the French delegates expressed it, "The sojourn in the colony is a veritable revelation in geography, an incomparable opportunity for lessons in *things*, and what is of not less value, acquaintance with persons."

Five hundred and twenty-two school children of Frankfort who were not sent to the holiday colonies gained in weight not quite one-half pound on an average, while 166 boys who had four weeks each in the colonies gained in weight seven times as much, and 177 girls who had the same kind of outing for the same length of time, gained eight times as much †

Discipline.—"If you wish anything to be forgotten, write it on the inner side of the study door; if you want to desecrate the holy, hang a table of commandments perpetually before the eyes. Levater said, 'Every man has his Devil's moments.' Consequently be not lost in surprise if the child also have his Satan's seconds as well as angel's minutes."‡

"It is not what you can compel children to do, but what you can persuade them to do, that is the test of your ability as a disciplinarian."§

They should be allowed all the liberty consistent with propriety and progress. The question of discipline solves itself when interesting occupation has control of the pupils.

In seeking to suppress all traces of the natural hum of industry in the school-room the teacher will be likely to introduce a greater disturbance and to suppress industry itself.

Motionless quiet and sitting with folded arms may well be regarded as a trace of the barbarism of the past. Easy and uncon-

*Revue D'Hygiene IX, 1007. Paris, 1887.

†Deutsche Vierteljahrrschrift für öff. Gesundh, XIX, 522.

‡Jean Paul Ritcher—Levana, p. 327.

§Annual Reports, City of Bangor, 1890—91, p. 122.

strained positions of the body are conducive to advancement in school work.

Frequent recesses and the encouragement of active play at recess is decidedly in the interest of discipline. Dr. P. J. Higgins* says truly:

There is a certain amount of nerve-energy that is accustomed to find outlet in the muscles, and, if unduly repressed, will often break through the strictest discipline and cause the teacher much annoyance. It must not be forgotten that muscles were not created to be kept still during waking hours, and, when kept at rest an hour or two, a surplus of energy accumulates, which recess gets rid of legitimately. It also serves another purpose admirably. Of all sedatives of the nervous system, muscular exercise is the most efficient, because physiological. It quickens the circulation, and stimulates the heart and all the vegetative functions.

The aim should be to enlist enthusiasm and industry in the aid of discipline. Then much work may be done in the briefest possible space of time, and more frequent or longer intervals for play may follow as well-earned rewards for industry.

To require pupils to stand erect and motionless through a whole recitation, is a severe imposition on the physical powers of children, especially in the heated atmosphere of an unventilated school-room. Under such conditions the writer remembers that, when a pupil of a district school, the fainting of scholars and carrying them out into the open air for recovery was not so very infrequent an occurrence. The occasional syncope is only one of many ills of such senseless schemes of discipline. Another is that it compels the children to assume vicious postures of fatigue, as for instance, throwing the weight upon one foot, thus paving the way for spinal deformity.

A discipline that seeks to keep the eyes of pupils riveted upon their books too long at a time or which forbids all looking out of windows is not commendable. It is in the interest of the hygiene of the eyes to raise them occasionally and to look into the distance.

The rule in some schools of closing the doors against tardy arrivals, if carried out in all strictness and in all sorts of weather, as it sometimes is, is an outrage against which the better impulses of the human heart rebel. This rule takes cognizance of no possible adverse circumstances that may have retarded the child. It may work a severe physical injury to him, besides defrauding him of some of his lessons.

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*Popular Science Monthly, XXIV, 642.

Punishments.—"In the higher moral education," says Bain,* "the management of the passion of fear is of the greatest consequence. The evils of operating by means of it are so great that it should be reserved for the last resort. The waste of energy and the scattering of thoughts are ruinous to the interests of mental progress. The one certain result is to paralyze and arrest action, or else to concentrate force in some single point, at the cost of general debility. The tyrant, working by terror, disarms rebelliousness, but fails to procure energetic service, while engendering hatred and preparing for his overthrow."

From a hygienic point of view hardly one among the whole list of school-room punishments is unobjectionable. The model teacher avoids the necessity of much of the punishment that appears to the less skillful disciplinarian to be called for. As to corporal punishment, Baginsky† advises the teacher when entering his profession, to make it a rule never to inflict it. If, however, he finds this impracticable he is counselled to make it an invariable rule, never to use his hand as an instrument of punishment, never to use anything but the particular switch or rod kept for the purpose, and never to have this at hand, but in the teacher's closet under lock and key. Then before the key can be procured, the door unlocked, and the rod brought out, the first flush of anger may have passed, and the sober second thought may have a chance to assert itself.

Still better would the advice be that the rod shall be kept at the teacher's home or boarding place, or that the infliction of corporal punishment shall always be deferred a few hours or, at least, until the next day.

In the schools of some of the leading cities in this country, corporal punishment has been abolished. After trial of this new arrangement, some of the school boards have reported that the discipline of the school has not suffered, others believe that cases occasionally arise in which the school and the individual pupil are better for the switch.

Dr. Dukes,‡ health officer to Rugby School, thinks that some offences, particularly moral offences should be treated with the "birch," but he says: "The days of punishing pupils with the cane for not knowing their lessons are, I think, past and gone forever!" He would particularly apply the birch to the treatment of the bully.

*Pop. Sci. Monthly, XIII, p. 306.

†Handbuch der Schulhygiene, p. 449.

‡Health at School, p. 175. New York, etc. 1887.

Punishment by boxing the ears should be prohibited in all schools, on account of the danger to hearing.

Keeping in at recess is decidedly objectionable, for the physical needs of the naughty boy are as great as those of the model ones, and sometimes much greater. Mischief is sometimes a symptom of pent up energy that needs letting off through the muscular system.

Standing in the floor for more than a moderate time, should not be practised. Lateral curvature of the spine is otherwise favored too much by school life without this help.

In the imposition of tasks as school punishments, care should be had that they do not interfere too much with needed physical exercise.

After considering these and other forms of punishment, I am inclined to agree with Baginsky that "there are serious objections to any other form of punishment than keeping in after school hours, and that to spare the teacher, certain hours of certain days should be set apart for this balancing of accounts."

An experiment in school discipline known as the deportment class, well deserving the consideration of city school officers generally, was begun in San Francisco some years ago.*

Individuality.—Pay attention, O teachers! to the attention manifested by your children, so that you may not, to the injury of his whole future life, demand from the genius who astonishes you with his power and his brilliancy the very opposite qualities to those he possesses: do not expect a painter's eye in a Hadyen, nor a poem from an Aristotle.†

Individuality is as much a constitutive fact of each human being as is the trait which he shows in common with his fellows. This individuality, representing his inheritance, his childhood, his training by environment, *will* assert itself. And this means nothing more or less than that he, the given person, will go out toward certain subjects and withdraw from others. Force him to study Latin and Greek, or mathematics and physics, even through the college course, and you may do him irreparable harm. At all events, there is here an open question.‡

Public Examinations.—The serious evils of school examinations have long been pointed out by physicians, and there are of late more signs than hitherto of an awakening among educators to the disadvantages from a strictly pedagogical point of view of this time-honored custom. In favor of public examinations it may be admitted:

That they afford an opportunity for teachers to show *off* the results of their work.

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*See Report of Com. of Education for 1884–85, p. cvi.

†Jean Paul Richter.—Levana, p. 356.

‡W. R. Benedict—Outlines from the History of Education, Pop. Sci. Monthly XXX, 226.

That it is a gratification to parents and friends to have the attainments and accomplishments of their children exhibited, especially if these children are apt or precocious.

Against these public exhibitions, it may be affirmed:

That in many schools a considerable amount of time is spent in special preparations for them as though the public examination were one of the great ends of school work.

That they are disliked and dreaded by the great majority of pupils.

That, consequently, in addition to the necessary and legitimate expenditure of nervous energy in mastering the subjects taught, there is an unnecessary emotional strain, the unfortunate results of which many a physician has had occasion to bitterly deplore.

Dr. H. I. Bowditch says, "I have seen not a few patients—scholars—who, under the violent stimulus put upon them by an approaching examination or exhibition for rank or for prizes, have sunk immediately after such extra intellectual labor, wholly prostrated in mind and body."

The time spent in the special preparation for show might be more profitably devoted to forwarding the pupils in their studies, or in fixing permanently their acquisitions by means of less imposing reviews.

If it is urged that the public examinations are needed to enable school officers or the public an opportunity to judge of the value of the teacher's work and the progress of the pupils, it might be suggested that much more trustworthy data for this purpose may be derived from observations of the regular school work.

Again it may be urged that the interest of the parents and that of the public generally in the school must be maintained. Most assuredly it should be. Let them be urged, invited, and reminded repeatedly to visit the schools at any time, and in addition, for something to gratify the children as well as to interest the parents, we would say that "The Distribution of the Prizes," in DeAmicis' "Cuore" is suggestive of something less torturing to sensitive childhood and therefore to be preferred from a hygienic point of view.

There is probably no person in America more competent to pronounce judgment on the merits and demerits of public examinations than Emerson E. White, LL. D. of Cincinnati. From a pamphlet*

*Circular of Information No. 7, 1891.

prepared by him and published by the Commissioner of Education, the following is extracted:

These several uses of examination results have been the source of bitter jealousies and rivalries between schools and teachers. They have perverted the best efforts of teachers, and narrowed and grooved their instruction; they nave occasioned and made well-nigh imperative the use of mechanical and rote methods of teaching; they have occasioned cramming and other vicious habits of study; they have caused much of the overpressure charged upon the schools, some of which is real; they have tempted both teachers and pupils to dishonesty, and, last but not least, they have permitted a mechanical method of school supervision.

What has been said of the influence of promotion examinations on teachers applies also to their influence on study, and this is specially true in the higher grades. They set up a low and alluring end for study—the attainment of examination marks—and they dissipate that natural desire for knowledge which is the source and inspiration of all true learning and of all real joy in study.

Another serious evil attending promotion examinations is the physical injury inflicted upon ambitious, sensitive, and over-nervous pupils—a class sufficiently numerous to demand careful consideration in school administration. This evil is greatest when promotion is made to depend chiefly on a final examination. Such an examination comes at the close of a term or year of effort looking to it, and hence at a time when the nervous energy of many pupils has been fully taxed, and, in too many instances, overtaxed. A few days of excessive study or cramming at such a time may so exhaust the brain as to make the added strain of the examination perilous. This liability to brain exhaustion may be increased by undue solicitude, if not actual worry, and this unfavorable nervous condition is often aggravated, if not occasioned, by the unwise stimulation and pressure of thoughtless teachers and over-ambitious parents. Many a child is made to feel that a failure in an examination is not only a personal but a family disgrace.

To this nervous and mental unfitness for the examination ordeal must be added the severe tax of pen or pencil work not unfrequently for three to four hours daily and for several successive days—always an outrage when required of pupils under fifteen years of age, and always unwise whatever may be the age of those examined.

Moreover, experience shows that the more that depends on a final examination, the more injurious are its consequences. It is for this reason that the use of examination results, to compare schools and teachers, has proved so objectionable. It gives the teacher a special personal interest in the success of every pupil; and in the case of over-ambitious and nervous teachers, this occasions unwise appeals, stimulations, and criticisms—in a word, undue pressure of various kinds; influences that affect most the pupils who do not need stimulation, but the opposite. Many a school has thus been wrought up to an examination excitement most injurious to both teacher and pupils. It is well-nigh a crime for teachers to use a coming examition to stimulate and arouse pupils who are fully taxing nervous energy in meeting regular school requirements.

Nor is this evil of overpressure as occasional or exceptional as is sometimes claimed. The facts fully warrant the statement that not an absorbing and exciting promotion examination is conducted in any great public school without such injurious results, and this is specially true when the examination influence possesses the schools. It would open the eyes of some school officers, and not a few teachers, if they were to receive full reports of the calls of family physicians which attend their exhausting final examinations; and certainly a few teachers, at least, know from personal experience what is meant by a general promotion examination at the close of a year of over-taxing labor.

The opportunities of many an American youth have been blasted by an examination failure, and this, too, often due to nervous exhaustion. More young lives have gone out at the hands of the examination fiend than our school records show. It seems high time that our school policies should recognize the fact that children are not made of putty.

Another evil connected with promotion examinations is the waste of time and energy which they involve. A final examination in a great school or system of schools requires a week or more of precious time, and when the number of examinations held each year is increased, the amount of time thus wasted is increased, though perhaps not proportionately. The writer has known several schools in which full one month each year, or one-tenth of the school session, was spent in what the famous English Protest aptly calls "the drudge work of examinations."

But this does not tell the whole story, since much time and energy are consumed in preparing for the examinations, i. e., in exercises and efforts which are specially devoted to this one purpose. Much of the drill and rote work occasioned by these examinations is justified by no true end of teaching; on the contrary, it is subversive of true teaching.

The term "waste" used above is justified by the fact that the outlay of time and effort involved in the promotion examination makes no compensating return. It is useless as a means of determining the fitness of pupils for promotion, as will be hereafter shown, and yet this is its special purpose. There is no teacher, competent to read and grade examination papers, who does not know as well before as after examination what pupils in the class deserve promotion.

Number of Pupils to a Teacher.—The crowding of too many children into a school-room under the care of a single teacher is bad from a hygienic point of view because a school-room to be built in accordance with sanitary requirements cannot exceed rather limited dimensions. Wide school-rooms cannot be lighted satisfactorily in all their parts, and rooms of too great a length put some of its occupants in a position favoring eye and ear strain and undue tension of the brain that strives to catch the messages sent through these avenues. Furthermore, the larger the number of pupils crowded together, the greater the difficulty of avoiding the malodorous school-room atmosphere.

Too many pupils to a teacher is also a serious pedagogic error that should be avoided if in any way practicable. When the teacher is overburdened with a large number of pupils, a great part of the school time is entirely wasted. Particularly in schools of the lower grades, the scholars cannot have that individual attention which they need. The pupils, yet untrained to self-help in study, quickly fall into the vicious school-room habit of wasting time. An important matter, too, in the discussion of this question is the fault that the personal moral influence of the teacher is greatly lessened. When circumstances force such conditions upon school officers and teachers, the half time system should receive the consideration which it deserves.

In some places a tendency is shown to crowd a large number of primary pupils upon a single teacher, while in the grammar grades, an effort is made to restrict the number in a single room. Just the reverse of this is more rational from both the instructional and the health point of view. A greater number of the larger scholars can be instructed as a single mind, but with the little ones much of the teaching must be individualized or it will be emphatically a non-success.

"It is incredible," says Dr. Mary Putnam Jacobi,* "that any real education can be afforded to the large classes now herded together under the care of one teacher. Twenty or thirty children are certainly all that a single brain can pretend to teach; but our public school classes habitually contain sixty, eighty, and even more pupils."

For English schools Dr. Dukes says: "Class-rooms should be constructed to hold thirty boys and their master. They should never hold more, for this number is as many as any one master can control and teach properly."

For Germany Dr. Cohn† declares that "it is in the interest of both teachers and scholars to have not more than from twenty to forty children assigned to one teacher."

In some of the Swedish schools no teacher is permitted to have more than from twenty-eight to thirty-five pupils under her instruction.

*North American Review, XXXVI, 300.

†Die Schule der Zukunft, p. 16. Hamburg, 1890.

Regularity of Attendance.—It is very satisfactory to have a low percentage of absenteeism; indeed, irregularity of attendance is a serious evil and should be reduced to a reasonable minimum. There are, however, two ways of securing a low percentage of absentation. One is by making the preservation and improvement of the health of the school of at least as great a consideration as the intellectual drill, thus reducing the necessary absence from sickness to the lowest possible point. Thus secured, an unreasonable minimum of absentation is hardly conceivable. When, however, regularity of attendance comes to be the most cherished principle of the school, it is an error which can lead to mischief. The absence of a pupil from school is sometimes necessary, now in the interest of the school, again in the interest of the pupil. A bugbear in the shape of a school-room law which drives pupils convalescing from infectious diseases back to the school before there is a full assurance that they are free from infectiousness, or brings them back to the serious duties of the school-room before their full recovery from any exhausting disease, brief or prolonged, will not meet the approval of a thoughtful school management. Further, it should be remembered that school life, as it generally exists, makes a short rest now and then a physical necessity to some pupils.

Courses of Study.—In these days when life is a rush, there is a call from more than one source, for rapidity in the advancement of the pupil in his school-room course. The higher institutions of learning, pressed by the demand for the shortening of college courses, call upon the lower schools to pass their pupils up before they reach that age in which young America feels irresistibly the call of the age to be out into the battle of life. There is one reason why those who believe that "the successful man must be a healthy animal" ask that the pupil's school years may not be unnecessarily long, and that is, that school life is more or less of a downward drag upon the physical condition of its pupils. Every hour, therefore, and every year of needless enclosure within school-room walls, is to be obviated. Every bit of pedagogic rubbish, they say,—everything that impedes the progress of the pupil without yielding adequate compensation in mental discipline or in useful knowledge,—should be rigorously pruned away. Haste they do not regard as synonymous with hurry; nor shallowness of attainments as the necessary result of some shortening of the various school courses.

The writer is one that believes that we have not yet learned all that the noble art of pedagogy is capable of teaching us, that the methods of instruction of the average teacher shall yet, under the guidance of the State Educational Department and under normal training, be raised toward the practicable ideals of the best instructors, and finally that a broad eclecticism shall prevail and lead school officers and teachers to turn to other states and other nations, with the enquiry whether any of their methods give results more satisfactory than those following ours.

As pedagogic methods have an important bearing on that part of school hygiene called the "Hygiene of Instruction," I feel it necessary to enter a field some parts of which the careless thinker might believe to be out from under the banner of Hygiea, but wh ch is far from being so.

To develop the fullest powers of any one part of the child, requires that every other part shall, at the same time, undergo a healthy development. The more perfect the physical health, the more is the mental culture favored; and, conversely, the happy unfolding of the child's intellectual powers, through well ordered mental work, is conducive to bodily well being.

The highest aim, therefore, of both the educator and the sanitarian should be to bring about a harmonious development of the child, to do which requires that neither body, senses, nor intellect shall be neglected in the scheme of education.

An important thing to be remembered in making up a course of study is that it should be planned, not for the extraordinarily gifted child, but for the ordinary ones, and that the amount of work to be imposed should not be meted out in accordance with the powers of endurance of the perfectly sound child, for the great majority of the pupils have, by inheritance or otherwise, a tendency to weakness, some in one direction, some in another.

A Multiplicity of Studies.—A variety of studies carried along simultaneously is as great a necessity as is some variety in the food preparations for children, nevertheless, the tendency to crowd pupils with too great a number of studies at the same time, some for mental training, some for utility, and some because preceding generations of children have likewise been burdened with them, is one potent factor in the production of those ills that result from overpressure. In a paper on "Brain-Forcing in Childhood,"* Dr. Wm. A. Hammond, calls attention to this evil in these words:

*Popular Science Monthly, XXX, 725.

One of the greatest mistakes made in our present system of educating children is, that they are given too many subjects to study at once. The power of dissociation—that is, of keeping one subject entirely clear of another subject—is not great in the minds of children. They there ore have a mass of confused ideas when they have got through with their daily tasks, which it is always difficult, and sometimes impossible for them to separate one from the other.

The effort to form and maintain clear and forcible ideas of several subjects at once is a difficult matter, even for adults. It has been found by experience that it is advantageous to reduce the number of branches of medical science which students are required to study simultaneously. Several of the better class of medical colleges in this country a few years ago cut down the list of from eight or ten to less than half the number, and extended the period of study from two sessions of four months each to three of from six to eight months. I speak from personal experience when I say that I am aware of the most lamentable results of the "cramming" process in medical students. I have been a teacher in medical schools for nearly twenty-five years. In the course of my examinations it has often happened that I have put a question in one branch of medicine to a candidate for graduation and have received an answer in an entirely different branch. How much better it would be for the future man or woman if the boy or girl, instead of being required to learn a dozen different subjects at once, as was the poor little victim of St. Vitus dance to whom I referred in the beginning of my remarks, should have the number reduced to two, or at most three! Geography, for instance, might easily be sufficiently learned in three months if it were taught exclusively, and so of many other subjects.

Methods of Instruction.—If, says Dr. Loewenthal,* our apprehension is correct that the function of the mind represents an important part of life as a whole, that mental exercise is equivalent to the satisfaction of a natural impulse, it follows that we shall find this instinct manifest in outward signs; and, indeed, in the newborn babe, the desire for mental food shows itself as plainly as that for bodily food, and in each according to the existing power of digestion. The new-born assuredly has no need of philosophical speculation, and just as little of a richly spread table, or of mountain climbing. On the contrary, just as distinct a need as that for the mother's breast or for the nursing bottle is shown for the elements of all knowledge, sense-impressions, such, namely, as are simple and yet distinct (massvoll) enough to be appropriated and assimilated; mild light, soft tones, agreeable impressions of taste and temperature, etc. * * * The desire to know is therefore as unquestionably present from the first as the desire to eat.

In the later life of the child there is still less danger of failing to perceive that the thirst for knowledge is a natural impulse that must necessarily be satisfied, although its activity is often termed inquisi-

*Grundzuge einer Hygiene des Unterrichts. Wiesbaden, 1887.

tiveness, rudeness, or the love of destroying things. Indeed, all the time when the child is not sleeping or eating, he is applying himself to satisfying this desire which drives him on to learn about things, and with such an intenseness that he temporarily forgets hunger and fatigue. The astonishing results are such that, within a few years after birth, he has gained a range of information, the compass of which would be still more amazing were it not that each of us has also acquired it unconsciously, driven by a natural impulse, just as any physical power is acquired, as the result of continued exercise of a function indispensable to health and ceasing only with life.

Exactly as with the need of bodily food, the desire for food for the mind shows itself: through a longing for nutriment such as experience indicates corresponds to its ne ds. The physically hungry child will eat; the mentally hungry will collect impressions and compare them, and will bind them all into a knowledge that he will make his own: to this end he observes, investigates, and experiments, as soon as, through the reception and elaboration of impressions ever becoming more various, he is in a position, with the help of the experience already gained, to make use of new impressions.

And just as satiety for bodily aliment is shown, so is that for mental food indicated by the refusal to take further nutriment. The satisfied nursling presses its lips together, turns its head away, and pushes the bottle back, for which a little while ago it was crying, and even the sight of which quieted it. In the same way is satiety of the mind shown in the child engaged in the work of intellectual digestion, by his disinclination to partake further of mental nourishment; he becomes distracted, dull, and confused, gives incorrect answers, does not understand the meaning of what is said to him, seeks by any possible way to turn from the subject, yawns, has a headache, cannot read any more, etc.

Sikouski sought to determine experimentally the degree of brain exhaustion by having children write from dictation, first when the school was opened in the morning, and again at the end of the five hours' session. During the latter dictation, 33 per cent. more errors on an average were made than during the former. I have myself made similar experiments with reading and with numbers. Children who used figures very well in the morning made about twice as many mistakes, and much worse ones, in the afternoon; and when I continued the work in spite of the manifest mental disinclination, it happened, sometimes when the adding was pushed only a few minutes, that, for instance, to the question: how much is three and four? now five, now eight, and again six would be the answer. In the afternoon, also, errors in reading were made that the same pupils did not make in the morn ng. If the child is very young or not very tractable, he withdraws himself in any possible way from the torture, there being no need of the nutriment, and shows very plainly thereby his satiation. Very striking is this brought out when smaller, and therefore more quickly satiated children are mingled with larger ones, and a story is told them, or something is explained that they all wish to hear; after some time, while the larger ones are still very eager to hear and their interest is shown by animated questionings, the little ones long for anything that is play, or suddenly become hungry, or want to go to sleep—withdrawing in one way or another from hearing further of the matter. * *

In the same way do we gain all the numberless conceptions and ideas that constitute the vast domain of our mental life; they are all and every one of them, directly or indirectly, the result of our own experience, and from this follows one of the most important fundamental axioms in education, one that is so simple and self evident, that for this reason perhaps, it has stubbornly been disregarded.

It is this: that the need of mental food, like that for bodily food can be satisfied only through self-elaboration of the material; that to do the thinking for another is just as impossible as to do his digestion for him. And with reference to the particulars of the process, this signifies that the food material for the physical organism cannot be incorporated into the body as ready-made cells, but the meat, for example, must be resolved into its component parts; out of these the organism must itself form tissue again which only then remains as a vital, acting part of itself. In like manner mental food cannot be inserted into the brain already prepared, but the mind must resolve each idea into its parts, the individual observations and experiences, and then rearrange and bind the new ideas to those already present, whereby it remains a living part of what is known. Without this analysis and the succeeding synthesis as the work of the organism itself, there can be no life and development, whether of body or of mind. * * *

From the preceding leading points in the physiology of mental nutrition—learning—we may deduce the general principles that must guide in teaching, if the instruction is to be satisfactory. These requirements are:

1. The proffered mental food must first of all be digestible by the human brain. That is, the observations that constitute the foundation of ideas, must be accessible to our senses. It would, for example, be absurd to seek to teach the color of the ultra-violet rays, of whose existence there is no doubt, but which we cannot see because, for our eyes, they have no color. Something like this takes place, however, in many branches of instruction where we apply the attributes of the known to things not perceptible to the senses.

2. The nutriment must correspond to the pupil's capacity of digestion. The elaboration of the material and the union of it with the already present acquisitions of a like kind can take place only when the new impression has points of contact with observations (anschauungen) already made. Only then can it be classified and be used in the building up of new ideas. This requirement is very frequently overlooked, indeed everywhere, where a subject is taught. the fundamental observations or experiences of which are unknown to the child; for example the grammatical rules of a language yet

unlearned; geography before the child has seen what a city, the country, a river, a brook, etc., is.

3. It must excite the mental digestion to activity. This is the case only when the requirement just mentioned (2) is fulfilled,—the connection of the new with what was before known. But, still further, the new must be really new, that is, though having points of contact with the old, yet it must offer something hitherto not possessed, must be a widening of what has hitherto been learned. The child, driven by his desire for knowing, repeats an experiment until he has learned everything from it that, at the time, he is capable of learning, until the new impression is fixed (for instance, Preyer's child slammed down the cover of a jar seventy-nine times in succession, or so long as the relation between movement and noise surprised him); and then he turns to new observations and impressions.

4. It must be kept steadily in view that mental digestion, like any other function, temporarily exhausts itself by its own activity.

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As learning is dependent exclusively on the mental activity of the child that learns,—on the digestion by himself of observations into ideas and knowledge,—it must be perceived that the chief duty of teaching is to present healthful nutritive material (the elements of real knowledge) and to hinder as little as possible the digestion of it; and, as knowledge—the knowing of the real relation of things—can be gained only through personal observation and comprehensible explanation of the things observed, teaching is equivalent to leading the learner to observe and think for himself.

The foregoing translation of passages from the valuable work of Dr. Loewenthal may serve in a general way to guide in the choice of methods in teaching. To it I will only add the following:

The daily marking of pupils should be abandoned in all public schools. It not only limits the freedom and power of the teacher, but it dissipates his energy and wastes precious time. No teacher can give his whole strength to instruction and drill and at the same time estimate and record the value of the pupil's work. The two things are incompatible. The more attention that is given to marking, the less will be given to teaching. We have never seen a "marking teacher" give a live and skillful lesson in any grade of school. In a few exceptional cases we have seen a vigorous test exercise attended with marking with little apparent loss of power. but there are very few teachers capable of such double work, even in a test exercise. The marking of pupils as they recite kills true teaching, especially in large classes.*

Dictation Exercises.—Too much dictation work is done in some schools. The evils are excessive eye-strain, slovenly styles of writing, if the pupils are hurried, as they almost always are, and

*Promotions and Examination in Graded Schools, Circular of Information, Bureau of Education, No. 7, 1891, p. 50.

if they are not, the use of much time for the amount of work done. Further than this we are told by an eminent educator that, "A keen observer need not remain long in schools that overuse the pen and pencil to observe the nervous condition of many pupils when preparing written work, and many thoughtful parents have observed with solicitude the nervous tension of their children without suspecting that it was caused by the excessive use of slate and pencil. It has been seriously proposed to exclude the slate and substitute paper in all grades and this has already been done in many grammar schools, but this is only a partial remedy. The fact ever to be kept in mind is that the total energy that can be safely used by a child in pen or pencil work is limited.*

Reading.—Much of the time devoted to school work is spent in learning from the printed page, and as everything that expedites the educational process is of interest in the hygiene of instruction, it is important that pupils acquire as early as possible the art of reading easily, and of getting the thought readily and easily from the printed page. To this end an intelligent choice should be made of the best methods of initiating young pupils into the art of reading, be this a phonetic system, or be it otherwise. The difficulties that phonetic methods seek to remove in part are enormous in our language. In talking with teachers some years ago in Germany I was surprised to learn in how much shorter time German pupils learn to read well than do Americans, and yet the little ones of that country have two alphabets to learn to our one, or, counting script and upper and lower case letters, eight alphabets to four for our pupils. But they have a language pronounced much more nearly as it is spelled, and this is a great advantage.

But reading, by whatever method it is taught, and much reading, should be done under the guidance of the teacher,—much more than is done in many schools. And this calls for intelligent discrimination in the choice of material and mechanical execution in the making of school books.

The paper for children's books should not be glossy; it should have a plain dull surface, a creamy tint being more agreeable to the eye than pure white.

The print of books should be clear and well defined, and large enough to be read continuously by the normal eye without apprecia-

* Circular of Information, Bureau of Education, No. 7, 1891, p. 57.

ble strain or difficulty. Books printed from type smaller than "long primer" should never be put into the hands of pupils of any grade, and those for young children should be printed from "pica" or "great primer." Full-faced Roman type is much more suitable than the "light-faced" type now so much in favor.

The distance of the letters from each other should not be too slight, and the different words in the same line should stand far enough apart to enable the eye rapidly and easily to take in the picture of each. The distance of line from line should not be less than 2.5 millimeters, disregarding the longer letters, and Cohn prefers 3 millimeters (1-8 inch). When lines are of too great length the eye has a difficulty in running back to the beginning of the next line. Some authorities state that the length of line should not exceed 100 millimeters (3 7-8 inches, the same as that of this page); others, as appears to me more wisely for school-books, place the limit at 80 or 90 millimeters (3 1-8 or 3 1-2 inches.)

PEARL, as the printers call it, is unfit for any eyes, yet the piles of Bibles and Testaments annually printed in it tempt many eyes to self-destruction.

AGATE is the type in which a boy, to the writer's knowledge, undertook to read the Bible through. His outraged eyes broke down with asthenopia before he went far and could be used but little for school work the next two years.

NONPAREIL is used in some papers and magazines for children, but, to spare the eyes, all such should, and do, go on the list of forbidden reading matter in those homes where the danger of such print in understood.

MINION is read by the healthy, normal young eye without appreciable difficulty, but even to the sound eye, the danger of strain is so great that all books and magazines for children printed from it should be banished from the home and school.

BREVIER is much used in newspapers, but is too small for magazines or books for young folks.

BOURGEOIS is much used in magazines, but should be used in only those school books to which a brief reference is made.

LONG PRIMER is suitable for school readers f r the higher and intermediate grades, and for text books generally.

SMALL PICA is still a more luxurious type, used in the North American Review and the Forum.

PICA is a good type for books for small children.

GREAT PRIMER should be used for the first reading book.

Children are often sent to school and Sabbath school with five or twelve cent testaments printed in pearl, agate, or nonpareil type, print unfit for any eyes, and to give it to children is thoughtless stupidity on the part of parents and teachers when a testament in small pica type costs only thirty cents.

One of the worst sins against hygienic rules and the eyes of children, chargeable to the home more than to the school, is allowing children the use of juvenile literature in type altogether unsuitable, and still worse without supervision as to when and how, the reading is done. Children come from school, their eyes having already done an ample day's work, their play, work, and the evening meal engage them until twilight or lamplight, and then out comes the absorbing story to be read under the worst of conditions for the health and safety of the eyes. Some of these papers for children and youth are printed in much smaller type than they should be. *The Youth's Companion*, for example, is printed in nonpareil and minion, type which no parent of prudence and intelligence on these points would admit into the home as a tempter and destroyer of children's eyes.

Spelling.—The memory of impressions made through the sense of sight is retained more tenaciously than is that of those which come through the sense of hearing, and this fact should not be ignored in the spelling lesson. In some schools the spelling of the words to be learned is given orally to the pupils, who are required to study them from their own hurried and indistinct scribbling, or the words are written upon the blackboard from which they are copied by the children. This is wrong. The spelling lesson should be first learned from the clearly printed page preparatory to the oral or written test. Thus the sense impression coming through the eye will be fixed in the memory. As Dr. Klemm says: "Every word has its physiognomy, and spelling should therefore be learned by means of the sense of sight chiefly." The same author's cure for a bad speller is this:

Feed him on a diet of one, or at best, a few words, for a few days; use easy, common words, such as occur in his own vocabulary, and let him see them on the board or paper, in print, in writing, etc. Set him to finding them ten times in his reader, and to copying them till he is perfectly familiar with them.

Make him analyze, that is, split the words orally, write them from dictation, and use them in sentences of his own. Do this with a very limited number of words; in short, give him babies' diet, till his form-sense, and memory for word-pictures, are sufficiently strong to digest more. At the beginning it may be painfully wearisome to you and to the boy, but the success which is sure to follow your endeavors will strengthen you both. You will find, also, that he improves in reading.*

Writing.—The miserable hand writing of many of the graduates of the schools of the present day can hardly be due to the want of practice in writing, but is rather the result of too much writing under high pressure requirements. In dictation exercises, the same slow, careful, and painstaking writing should be insisted on as is required in the copy-book, until the pupil's hand is well formed and he can hasten without endangering it. The principal hygienic questions relating to writing are:

The Time for Writing.—As one of the lighter mental tasks, the writing lesson is preferably given in the afternoon session, at an hour when the light is good. It should not come immediately after the noon intermission, or a recess, neither should it succeed the lesson in physical culture, for the reason that after muscular exercise there is for awhile a tremor of the muscles of the hand and forearm beyond the power of the will to control.

The Desk should be placed near enough to the pupil not to require him to lean forward, and should slope toward him at an angle not exceeding fifteen degrees. It should not be so high as to compel him to elevate one shoulder above another, or to raise his elbow only very slightly. (See "School Desks.")

Position of the Pupil.—"Only think," said Burgerstein,† "of a scholar sitting inclined, his head hanging sideways, the abdomen pressed together and the breast leaning against the edge of the desk. What an aggregate of evil results for the eye, the bodily posture, the chest, and the abdominal region! Weakness of the eyes, near-sightedness, deformity of the spine, and functional disturbances of internal organs must result." The fault for all this is not so often that of the pupil as that of his desk and seat, their shape and height and position in relation to each other, the position of his copy-book and the style of penmanship taught him.

The proper position of the pupil in writing is to sit erect, the lower part of his back still supported by the back-rest of his seat (if the construction and relative position of seat and desk are suitable), his shoulders parallel with the edge of the desk. The elbows should be near the sides but not pressed against the body. Two-thirds the

*Klemm. Chips from a Teacher's Workshop. p. 77. Boston, 1888.

†Die Gesundheitspflege in der Mittelschule, p. 24. Vienna, 1887.

length of the lower arms, but not the elbows, should rest upon the desk, the left hand holding the copy-book or sheet, and moving it, now nearer to, now farther from, the pupil, according to whether the pen is on the upper or the lower lines. The penstock should point toward the elbow, not toward the shoulder.

Position of the Copy-Book.—When the pupil is taught the ordinary slanting style of writing, place the lower edge of the copy-book or sheet of paper, parallel with the edge of the desk, the middle of the sheet corresponding to the mesian line of the body, and then incline the top of the book to the left enough to bring the down strokes of the pen at a right angle to the edge of the desk.

When the pupil is taught vertical writing, simply place the book exactly in front of him as before, and let it remain with the lower edge parallel to the edge of the desk.

The reason for these rules is that the lines in writing are more conveniently followed when they are made exactly in front of the two eyes and in a direction to and from them, or in other words, when the strokes of the pen are perpendicular to a horizontal line running from eye to eye. To get the eyes into this normal relation to the down strokes of the pen, copying the slanting writing, the child instinctively turns his face somewhat to the right and carries his head to the left, the starting point of those various postures so unfavorable to the welfare of the child. To the child whose eye follows every line carefully and almost painfully, these rules are important, more so than to the rapid writer who can write even with his eyes closed.

Copy-Books.—It is a question whether many of the copy-books in use are not too complicated in their arrangement of lines to guide the pupil. These lines and all other rulings should not be too fine, —they should be distinct and easily visible. Accustom pupils as early as possible to writing on unruled paper. The lines in copy-books for beginners should be very short, not more than four inches in length. The style of writing taught in copy-books is a powerful influence for good or evil in the hygiene of writing, as strange as this may seem, and this brings on the question of

Vertical vs. Sloping Writing.—In some parts of Europe there has of late years been a strong movement in favor of making a change from the customary sloping hand writing to the upright style. The reasons brought forward to justify this innovation are that the upright writing is more legible, and, more important, it does not force pupils to assume those vicious attitudes so injurious to the eyes and the spinal column.

As to whether these claims are founded on truth, there has taken place, particularly in Germany, France, and England, a discussion both extensive and earnest. All admit that the sideward, bent, and twisted postures which have been so prominent a feature of the writing lesson, are of serious import, and should be avoided if possible. Some, particularly Drs. Berlin and Rembold, have claimed that the tendency of pupils to fall into bad positions while writing the inclined style may be corrected by a proper position of the copy-book.

Two positions only for the copy-book are now recognized, those which have already been described, the one for sloping writing, the other for vertical. All authorities now unite in condemning the placing of the copy-book a little to the right of the pupil. All are now agreed that the down strokes of the pen should be made at a right angle to the edge of the desk. Manifestly this occurs when the copy-book is upright and the pupil writes the upright style. Berlin and Rembold's recommendation in teaching the sloping style is to tilt the copy-book to the left so that its lower edge forms an angle with the edge of the desk equal to the departure of the down strokes from the perpendicular, usually 30° or 40°. The well known standing of Drs. Berlin and Rembold, and the fact that their report made in 1882 was the outcome of an enquiry into the effects of handwriting on eyesight and deformity of the spine, re-opened very fully the issue between the advocates of the upright and the sloping style of writing, has led to new and very careful observations to determine the relative amount of divergence from erectness in pupils whether writing the one or the other kind of penmanship, and finally called for comparative tests of classes or school-rooms full of pupils of the same age and in the same building, writing in one class the upright, and in the other the inclined, style of penmanship. Dr. Paul Schubert,* an ophthalmic surgeon of Nuremberg, describes a test of this kind. In three neighboring towns the pupils of twelve school-rooms were taught the vertical writing, each school-room having a "control" room in which children of the same age wrote the slanting style, and the observations that Dr. Schubert had collected at the end of the year furnished the material for his paper.

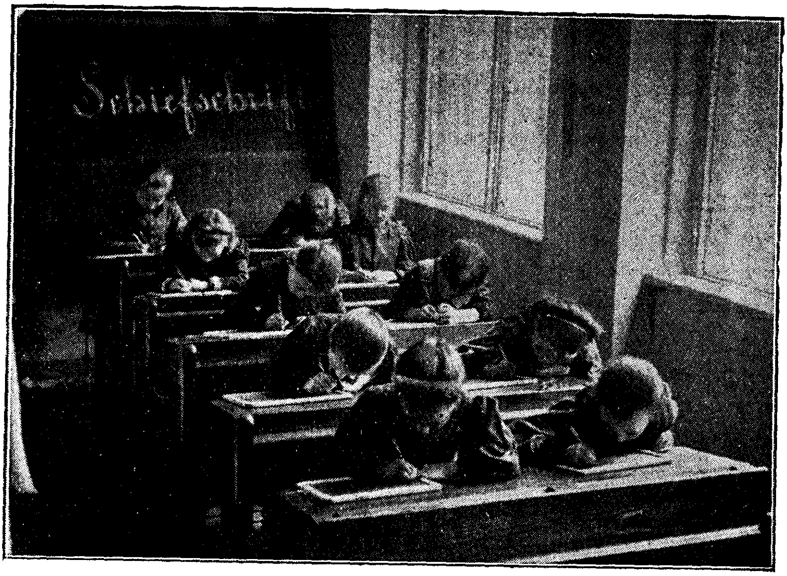
Very instructive, we are told was the inspection of the classes in Fürth that wrote the sloping style. The children did not sit so well

* Zeitschrift für Schulgesundheitspflege, IV, 23. 1891.

as those in the room where the upright style was used, though their positions were not so very bad. Our commission, composed of three teachers and two physicians, frankly recognized this, yet it was soon shown that these classes, as one of the gentlemen expressed it, were "infected with the upright writing bacillus." The strokes of the writing, it is true, were not quite vertical, yet they all had only a slight inclination to the right. Emulating the good attitude of their neighbors in the upright-writing class, they had approximately equalled them, but at the expense of the slope in their downward strokes.

We then sought a class in another building not influenced thus. At the command: write! the whole class fell over to the left as though mowed by the harvester, and lay with the left cheek sidewise from the copy-book and but little above the surface of the desk. In order to fix the difference in the attitudes and to make it apparent to everybody, I had the teachers take ten children for a writing test from each of two rooms in a girls' school in Nuremberg at the end of their first school year, in one of which the vertical, in the other of which, the sloping hand was written, and while they wrote they were photographed. Both divisions received throughout the same treatment: warnings to sit erect were not given, and the children were not influenced in the position of their slates, as during the course of the year they had been instructed by the teachers. With each group three trials were made. The results were invariably the same: correct positions of those taught the upright writing, and bad positions of those writing the sloping style.*

*Through the kindness of Dr. L. Kotelmann, Editor of *Zeitschrift fur Schulgesundheitspflege*, Hamburg, Germany, I am enabled to show the accompanying illustrations reproduced from the photographs taken by Dr. Schubert. One cannot fail to note the marked difference to which the author refers.—A. G. Y.



In the group writing the upright hand, all do not sit correctly, but the children with faulty positions, are an exception. In this group no child sits so badly as is the case with the great majority of those writing the sloping style. Of the latter group, only two children can be recognized as in good positions. The instruction, therefore, to incline the copy-book, has helped matters but little.

We are further told that in Vienna, as in these other towns, the middle, left inclined position of the book has not sufficed to make the pupils sit erect when writing, and Dr. Schubert quotes the following from a letter of Prof. E. Fuchs, descriptive of a visit to some of the schools in that city, some of the pupils in which write the vertical, while others write the sloping style, the latter, however, always with the book exactly in front of them, but tilted to the left, the required degree of tilting indicated by an oblique line on the desk:

We were led into a room where all the pupils wrote the upright writing, and where they therefore sat faultlessly erect. We find that, as a matter of course, when the teacher has just warned the scholars to sit erect, but how little such a warning is worth we see in the next room which we visit. Here also the command is given: "Pen ready, sit erect!" But in this room where the children wrote the sloping style, scarcely had they written a line before they had forgotten the straight attitude; they turned the upper part of the body sidewise and bent more and more towards the desk, supporting themselves on the elbow. Some laid their heads on the left arm as though they wished to look under the pen; others let their heads sink so low that they almost put out their eyes with their penstocks. A renewed caution from the teacher to sit erect had again only a very fleeting effect.

The most instructive was the inspection of the mixed classes, where a part of the children wrote the upright, and a part the sloping hand. Standing behind them and looking over the room, one could determine from the attitudes of the pupils which kind of writing they wrote. We note the children whose position was bad and those in which it was good, and then pass through the aisles to see which style they wrote. We find that all whose attitudes are bad have written obliquely. One girl only whose writing was upright, was an exception, but, on enquiry, she told us that she had begun to use the upright writing only two days before. Of those using the upright writing, all but one sat correctly, while the positions of a great part of those whose writing was inclined, were bad.

The difficulty of teaching children the common sloping writing, and at the same time of keeping them from falling into faulty postures is set forth by Mr. John Jackson of London, who, as well as Dr. Kotelmann of Hamburg, brought the claims of upright writing to the attention of the International Hygienic Congress of last summer.

After numerous conversations with individual and large bodies of teachers, the one great complaint with them is the insuperable difficulty in teaching sloping writing. First, there is the peculiar position of the body, sideways to the desk; next, there is the position of the arms, one on the desk and the other close in by the side; then the hand must be twisted outwards, the pen must point toward and over the right shoulder; and when all this is obtained (when is it obtained? I would ask) the next task—and it generally proves in every sense a cruel task—is to get the writing arranged, the angle determined, and the angle observed. Is it not a notorious fact that hundreds and thousands of children will write vertically, whether their teacher sanction it or no? Is it not true that pupils will tilt up their books to an angle sufficient to give verticality (optically considered) to the down strokes, and will hold the pen as vertical writers hold it (pointing outwards), notwithstanding the reiterated remonstrances of their teachers? A pupil is restless, and changes his posture or angular inclination to the desk, his copy-book records the incident where a painfully obvious break in the parallelism shocks the teacher's eye; he tilts his book or straightens it again at his own or the teacher's desire, and the obliquity of his writing varies most faithfully in consequence. In vertical writing none of these difficulties and anomalies irritate the teacher; none of these absurdities vex the puny bodies and the souls of our children. There is no posture of the body to inculcate or attain, for every girl and boy will naturally assume the right posture; there is nothing to do with regard to the pen except to restrain it from falling into a wrong direction, certainly there is no care demanded to train it into quite an awkward and constrained direction. The book lies evenly on the desk, the writer sits evenly at the desk, the pen follows the direction of the hand and arm that guide it, and the writing always observes the one position of the perpendicular, for there is only one vertical to a horizontal, whereas there are hundreds of degrees of slope between 0° 90°. The difficulties of the teacher and of the pupil are reduced to a minimum, and, so far as it can be, writing and the teaching of writing are pleasant fac ors in the ordinary school life.*

Finally it may be said that Dr. Cohn, who for a while believed that the tilting of the copy-book wholly rectified the trouble in teaching the sloping writing, does not now think so, and says that "the upright writing is the writing of the future;"† that Dr. Noble Smith,‡ a leading English authority, says, "The more slanting the writing, the worse the position, and I would strongly advise that upright writing be universally substituted for the slanting;" that Prof. Uffelman of Rostock says, "I must declare that the upright writing is the correct form;" that Dr. Toldt, professor of anatomy in

*Upright versus Sloping Writing, p. 8. London.

† Die Schule der Zukunft, p. 15, Hamburg, 1890.

‡Curvatures of the Spine, 3d ed., p. 73. London, 1890.

Vienna, after examining the claims of the vertical writing from the anatomical and physiological points of view, pronounces in favor of it; that, in Buda Pesth, the board of education has called the attention of the Minister of Instruction to the advantages of the vertical writing; that it has now been introduced into three hundred schoolrooms in Vienna; that the Austrian Minister of Instruction favors it, and has adopted it for his own children, as have many physicians for theirs; that in Basle it has been introduced into sixty-one school-rooms, and the School Desk Commission have unanimously voted in favor of it; that in Denmark it is coming into favor more and more, and Dr. Hertel earnestly advocates it; that it is favored throughout the British Civil Service on account of its superior legibility.

Arithmetic.—The methods hitherto in favor in teaching arithmetic have not been the best, and many of our better teachers are now aware of this fact. The beginning of their arithmetical course with the task of defining arithmetic, and the prefacing of each separate process with learning a formal rule, is terribly dampening to the ardor of the young aspirants for arithmetical honors; doubly discouraging because the rules are framed in words as yet entirely above the heads of the little ones.

The young pupil should be led directly to his work of using numbers, without a single rule to bother him; in this way he will the most rapidly acquire skill in the use of figures, and only when his own experience has put him in a position to understand the rules, should there be any thought of teaching them. Then, however, he hardly needs them.

The arithmetical text-books of some countries are very insignificant little things in comparison with the bulkiness of American books in the same field, but practical methods in the hands of teachers, every one of whom has been trained for his professional work, forwards the pupils rapidly in their ability to use numbers. For instance, Dr. Klemm,* relating what he saw in the schools of Munich, says: "From a lesson in arithmetic which followed, I gathered the following examples. The reader will please notice that this was the second year:

$43 + 9 + 7 =\ ?$	$6 \times 8 - 36 =\ ?$
$32 + 27 =\ ?$	$45 \div 7 =\ ?$
$28 + ? = 53.$	$\frac{5}{6}$ of $42 =\ ?$

* European Schools, p. 304.

29 how many halves? 65 — 8 — 7 = ?
64 — 19 = ? 63 — ? = 37.
56 = ? + 6. 8 = ¼ of what number?
Divide 51 into three equal numbers.
How many whole ones are 56 quarters?"

A teacher in another of the schools in Germany being asked by Dr. Klemm why he refrained from using any techinal terms, the teacher said: "No; we don't burden the memories of our pupils with technical terms such as trapezoid, rhomboid, parallelogram, parallelopipedon, etc. We call a rhomboid a four cornered figure and are done with it. The child in the common school is no happier, nor wiser, nor better prepared for life when he has learned these Latin and Greek terms. If a boy enters a technical or high school and studies geometry, the terms will be given him there. The common school has no business to burden its course with ballast."

Further conversation with the faculty of the school revealed the fact that they all entertained the same view which General Walker in Boston urged lately, namely, that the study of arithmetic had in the course of time become overburdened with matter of a nature unsuited to pupils of a common school, and that efforts were being made everywhere in Germany to eliminate such things. Said the rector of the school, to whom the assistant teachers all looked up with great veneration, he being a fine looking, white haired man: "We sound the battle-cry, 'Elimination,' all along the line. We want to eliminate much from an overcrowded course of study in geography, grammar, and arithmetic, and add more literature and history so far as to counteract the vicious influences of bad reading matter smuggled into the hands of our pupils by, Heaven knows, unscrupulous publishers. We want to do more in manual training, more in the so-called accomplishments, drawing, music, etc., introduce a little of book-keeping, and thus make the common school education what it ought to be—practical. *We want to teach less for oblivion* than hitherto."

The following from a report of the superintendent of schools of Quincy, Mass., may serve as a counter picture of mind stunting, erroneously called mental development:

While inspecting a B grammar room I saw this problem placed upon the board, which the pupils were expected to perform: "A grocer's quart measure was too small by half a gill. How much did he thus dishonestly make in selling four barrels of cider, averaging 34 galls , 2 qts., 1 pt. each, if the cider was worth 24 cents a gallon?" This is not an isolated case; it is only one of the many problems which teachers continually give and examiners require that are wholly above the heads of children and can only be solved by an adult with a pretty clear head for reasoning. Such problems are not only useless but are positively pernicious, by putting obstacles in their way that it is impossible for them to overcome, thus causing them to become discouraged. I confess to having seriously misjudged children as to their powers of logical reasoning, and shall hereafter in my examinations confine myself to those topics in arithmetic in their simple form which children should know and are able to comprehend.*

Too much time has been wasted on arithmetic, that should be saved for other things worth more to the pupils,—say, the mother-tongue, sense-culture, physical culture, release from drudgery.

Geography.—As an example of the natural and rational method of teaching, Dr. J. M. Rice† tells how he saw geography taught in Elberfeld, Germany, the subject of the lesson being the river which flows past the city:

"Who can tell me something about this river?" asked the teacher. Sixty hands were raised; for all the children had seen it, and were glad of an opportunity to speak of it.

"How many children have seen where it rises?" A few had seen the place.

"How many more would like to see its origin?" All hands came up again.

"We shall try to find it this afternoon."

The children looked happy, for they were to go on an excursion. Upon signal they fell into line, and then left the building. As they walked through the streets two by two, they conversed quietly. After a few minutes they arrived at the bank of the river which they were to study. The teacher then put a few questions to them.

"Which way shall we go?" asked he.

"To the right," said one of the pupils.

"How do you know?"

"Because I have often seen the source."

Another said that the water always flows downward, so that the origin of the river would be found by following the stream in the direction opposite to that in which it flows.

"What else have you noticed thus far?" asked the teacher. One child had noticed the direction of the wind; another, something in regard to new buildings, etc.

When the city limits had been passed, the teacher told the children that they might make a little more noise. A song was suggested, and the little ones sang and were merry. After a few minutes they spoke again, and said that they were rising more

*Report Com. Ed, 1882–83, p. LXXXII.

†Forum, Vol. XII, p. 530.

rapidly than before, that the trees were beginning to bud, that the grass was beginning to grow. They likewise pointed out a few mountain-streams. During this walk the children were never allowed to lose sight of the river, because that formed the main object of the lesson. One of the children said that the river was getting smaller. When asked for the reason of this, he remarked that they were above the places where it is fed by little streams. When they arrived at a railroad bridge, they spoke of the cars, the destination of the trains, and something regarding the telegraph.

After a walk of an hour and a quarter, the children reached the top of the mountain. A view of the surrounding country was taken, special points noticed and spoken of, and then the source of the river was looked for in all directions At last a child called out joyfully that he had found it. Sure enough, he had found, beneath some loose stones, the spring from which the river arises. All the children looked at it, played with the stones, and then ran around in the fields. After awhile they gathered close to the teacher, sang a few more songs, and then fell in line for the homeward march. Three hours after leaving, the children returned to the school-house.

The next morning the children discussed in the class-room the walk of the previous day. During this lesson their joy and enthusiasm knew no bounds. In answer to every question, every hand was raised. I asked the teacher why he did not keep the children seated quietly. He answered, "Why should I destroy their mental activity by compelling them to direct most of their attention towards controlling the movements of their muscles?"

As the lesson proceeded, I listened with astonishment to the enormous amount of things which the children related about their walk, and to the words which indicated the vividness of the impressions which these things had left upon their minds. The walk was intended primarily for a geography lesson; but, besides learning something of geography, many other channels of thought had been opened to them. The children had seen trees bud: now they were anxious to see them bloom. They saw the farmer use the river for the irrigation of the soil: they were now desirous of observing the effect of this irrigation upon the crops.

Upon such walks, and the knowledge gained by means of them, the whole German system of elementary education is founded. This is true of large as well as of small cities. All the work centres upon the ideas gained in these walks, which serve not only as a means of introduction to the study of geography, but likewise to that of history; historical points being visited for this purpose. Further, by means of the various things noticed and spoken of upon these excursions the children gather information on botany, geology, physics, astronomy, zoology, and other branches of science.

When the study of geography is begun in this way, with the things accessible to the observation of the pupils and restricted to learning well a moderate number of facts that can be made interesting, instead of a mass of general statements of no interest, what is learned will be remembered, and time will be gained for some other purposes. An improvement has been made in some schools by removing geography from the primary grades, and of considering it under the head of "Reading and Observation" in the first two years in the grammar schools.

Though much improvement has taken place, the maps of some school geographies and atlases, still strain pupils' eyes too much in the search for the names of towns and other geographical details hid securely in small type amid a bewildering confusion of lines and colors.

The Mother-Tongue.—"What a treasure has the student whose mother-tongue is English! It is the language that was, long ago, ample enough in every way to loose the soul of Bunyan; it hemmed not in the imagination of Milton, and was yet taxed to speak forth the universal mind of Shakespeare*."

"I may avow," says President Eliot of Harvard University, "as the result of my reading and observation in the matter of education, that I recognize but one mental acquisition as an essential part of the education of a lady or gentleman—namely an accurate and refined use of the mother-tongue. Greek, Latin, French, German, mathematics, natural and physical science, metaphysics, history, and æsthetics are all profitable and delightful, both as training and as acquisitions to him who studies them with intelligence and love, but not one of them has the least claim to be called an acquisition essential to a liberal education, or an essential part of a sound training."†

"Our mother-tongue alone, as the instrument of our thinking, is the instrument of our culture. It is hence the thing of all things that we should master first and master thoroughly. In this philosophy and common sense are at one.

"But the obvious way to master our mother-tongue is to study *that*, and not the mother-tongue of somebody else—to study it in its own masterpieces, not excluding indeed its adopted ones, whether from the Greek or Latin or any other original, but studying these in its own idioms, forms, and words, not in theirs."‡

"The truth is that the study of other languages than our own, whether ancient or modern, may be so pursued as to harm the cause of good English, or so pursued as to be of great service to it. Not

*Modern Language Notes, VI. 154.

†Pop. Sci. Monthly, XVI, 145.

‡Paul R. Shipman, Popular Science Monthly, XVII, p. 149.

a few graduates of preparatory schools resemble the young man in one of Mr. James Payn's novels, 'whose education had been classical, and did not, therefore, include spelling.' "*

For the promotion of real intellectual training, for its utility, and as a means of lightening the burden of mental drudgery, and thus lessening the complaints of overpressure, the study of the English language for those who claim it as their mother-tongue should occupy a first and a central place from the primary to the college course.

Foreign Languages.—As the study of the foreign languages, and particularly, Greek and Latin, has so often been charged with a large share of the blame for overpressure in the schools, there are the best of reasons why those who have the physical welfare of the schools at heart should wish that all unnecessary difficulties in the acquisition of these languages be cleared away, and that every non-essential in their study be left out.

The opinions as to the proper methods of teaching languages are various. Without sufficient reason some authorities would have the pupil learn a living language in one way, and a dead language in quite a different way. The mere fact that one is the language of a living people and undergoing its perpetual development, and the other is not, is without significance. If a given method is good in one, there is every reason to be assured that it may be made successful in the other.

There is a practical unanimity that the easiest way and the best way to acquire a modern language is for the child to get it in the natural way in which he learns his mother-speech,—by hearing it and imitating what he hears. In this way it is an easy matter for a child to learn to understand and to speak several languages. This method deserves just as wide an extension in the schools as it is practicable to give it in order that the call may be answered for the acquisition of a knowledge of foreign languages at an age earlier than has been customary.

A second way of learning a foreign language, called a natural method because in it the pupil troubles himself little or not at all with grammatical forms until he is well along in his knowledge of words and their meanings, alone or standing in the sentence with other words. This, the method of Claude Marcel, instead of learning at first to understand and to imitate the spoken word, begins with

*Prof. A. S. Hill. Our English, p. 27.

reading, and aims at acquiring a good reading knowledge of the language in the shortest possible time and in the easiest possible way. To this end the reading book put into the hands of the pupil has the foreign text on one page and its translation into the pupil's vernacular on the opposite page. The time wasting drudgery of thumbing the dictionary or searching vocabularies is thus avoided. In this way a pretty good sized collection of books may be read through with interest in the time required to go through one in the usual way.

Direct reading, says Marcel,* "that by which the written expression, as in the native idiom, directly conveys the thought, is the end to be attained. *Indirect reading*, that by which the idea is apprehended through the medium of the mother-tongue, that is, *translation*, is only an introduction to direct reading. At an advanced age of the study, translation becomes an obstacle to the understanding of the language, for it is not always possible. So would spelling, which is an auxiliary in learning to read one's own language, prove an obstacle to reading if persevered in.

The process by which a learner is enabled to follow directly the train of an author's ideas cannot be made too easy. This spontaneous association of the ideas with the words that represent them constitutes the real practice of the foreign language, and the groundwork on which advancement in all its other departments is based. Translation, on the contrary, being the practice of the national idiom, becomes thereby a most efficient means of improvement in it.

But as direct reading can be arrived at only through the medium of translation. the student must, as a preliminary step toward it, attend seriously to the latter. No parsing, no grammatical comment on the language: all he requires is to advance rapidly in the comprehension of the text in hand, that he may become acquainted with a large number of words and phrases. Practice is now the object; we will subsequently suggest modes of mental culture.

The application of these empirical methods to the acquisition of the dead languages has been deemed impracticable, but, says Dr. Löwenthal:†

This has been shown not to be so, not only by Dr. Schliemann, who at a ripe age learned Greek from the Greek classics better than it is learned by most Hellenists, but by the ten thousand uncultured Jewish boys in Galicia, Poland, and other places, who, year after year, learn Hebrew within a short time. Hebrew is also a dead language, and in its grammatical construction, is a very complicated tongue, and still worse for the children who learn it, no kind of language is spoken with grammatical correctness in their environment, not even from their mother-tongue (mostly an atrociously mangled German) do they acquire any knowledge of grammar; and

*The Study of Languages brought back to its True Principles, p. 6. New York, 1880.

†Grundzuge einer Hygiene des Unterrichts. p. 84, Wiesbaden, 1887.

yet these boys from nine to thirteen years of age, read and understand any Hebrew book, write letters in Hebrew correctly, and even poems, and later, as men, read and write Hebrew newspapers, translate even German classics into Hebrew. and represent William Tell or other plays in the Hebrew language to an audience that understands it.

The instruction that yields such results is purely empirical; the child begins with the translation of the Old Testament: "*Bereschith*, in the beginning; *bara*, created; *elohim*, God; *eth-haschamajim*, the heaven; *weeth-haarez*, and the earth." In this way he goes on. Whether *reschith* is masculine or feminine, that *bara* is a verb in the past tense, that *elohim* and *schamajim* are plural, that *eth* is indicative of the accusative, and so on, the boy, and usually the man, have not the slightest suspicion; he cannot name the form, he does not know the rule, but he uses both correctly,—he handles the tools as they should be handled. Later, if he has an inclination to scientific study, he can very easily, with a little help, or without it, get an insight into the grammatical construction of the language which he has really mastered. This is really the case with all German-Jewish theologians who in their childhood, along with the customary school and gymnasial studies, learn Hebrew from the Bible, study philosophy in the German universities, and later take up the grammar and syntax of the language.

Note, now, the results of the study of Greek and Latin in our gymnasia, in which the graduates have just put in more than 4,000 hours work, not to say anything of work at home, and can there then be any doubt as to the worthlessness of the grammar and dictionary methods in the learning of the ancient languages? In the Berne city gymnasium, and it is about the same everywhere, the first three and a half years of the eight and a half years, given to the continuous study of Latin, is squandered in the senseless drill on the grammar and forms of a language as yet unknown, and then the reading of Cornelius Nepos is begun. After eight or nine years of study, twenty-four graduates (as was the case in the final examination in one of the Swiss gymnasia) attained in Latin: rank 1 or 2, none; rank from 2 to $3\frac{1}{2}$, five; rank 4 to 5, fifteen; rank 5 to 6, four,—an average of $4\frac{1}{8}$ for the whole class. No. 1 is the highest and No. 6 is the lowest rank. This result of an eight years' study is so lamentable that it suggests a general intellectual inability on the part of the students, which the examination proves just as little as it does mental incapacity in two students whose rank in the ancient languages was only five, though in all other branches their rank was from one to three.

Such a grade of special inability to learn languages, which is often adduced as an explanation of occurrences of this kind, does not exist, especially among children and young people, for they learn in the empirical way any language without exception, though some more rapidly and easily than others Let for once the students in the gymnasia learn Latin from Cornelius Nepos, Tacitus and Cæsar, in just as empirical a way as the Jewish boys learn Hebrew from the Old Testament,—of course, under teachers who can read the Latin classics without preparation,—and it would be a wonderful thing if the same results were not achieved, the more so as the instruction would be given by cultured teachers who would know how to use the empirical method still bet er than the Hebrew teachers of the countries mentioned.

The arguments against such methods of language study as have been suggested are well known to every person who has had much interest in subjects of this kind, but the enormous demands that the prevailing methods make on the time and energies of our students, and the fact that so wide a gulf still separates the average college graduate from a mastery of Latin, not to say anything of Greek, raises the question in many minds whether a complete acquisition of one or both these languages, so far only as the ability to read readily and to understand without the interposition in the mind of the approximately corresponding words of the vernacular, would not be a true gain over the present order of things. The mental training that comes from much reading in a foreign language, and the getting of meaning from context, guessing if you please, is of no mean order. And beyond this every lover of the ancient classics assures us there is a rich field of intellectual and æsthetic culture, but, alas, a promised land which our students, like Moses, view only afar off from the mountain top of their Pisgah.

Grammar.—By deferring the study of grammar, whether of the native language or of others, to the proper period in the educational course, and clearing the text-books of what is not essential, another direction is suggested for the gaining of time for physical and sense education. There are probably now but few persons used to thinking about educational matters that are not ready to acknowledge the great waste of school time and energy that has gone out here. Professing to teach the art of speaking and writing, grammar has not taught it. Parsing and the other exercises of formal grammar have left but little time to imbibe correctness of speech from familiarity with good models, for practice in narration and in writing, and in friendly school-room criticism of slips in speech. To learn to use our mother tongue correctly, we must use it. "By dint of forging, one become a blacksmith," says a French proverb.

Dr. Wm. A. Hammond* would make a sweep but little too radical when he says:

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* Popular Science Monthly, XXX, 726.

As for grammar, it should be banished from all schools, except perhaps from the senior year of a university course. No child ever learned to speak good English from studying grammar. It has driven many a poor little wretch into headaches and other nervous troubles. It is the most ingenious device for forcing an immature brain into early decrepitude that the cunning of man has yet devised.

And Clarence King* well says:

The grammar of a language is a rather interesting thing to read over when you already know the language. A few months of English grammar as we learn it several years after we are entirely familiar with English speech is a very easy episode of the younger school days; but classical grammar, how it has stunted generations and prevented them from learning any classics!

The utter needlessness of so great a waste of time on the grammar of any language may be inferred from the late Dr. Youman's statement of the case.†

When it is remembered that the Hebrew language had no grammar till a thousand years after Christ; that the masterpieces of Greek literature were produced before Aristotle first laid the grammatical foundations of that language; that the Romans acquired the Greek without grammatical aid, by reading and conversation, that the most eminent scholars of the Middle Ages and later, Alfred, Abelard, Beauclerc, Roger Bacon, Chaucer, Dante, Petrarch, Lipsius, Buddeus, and the Scaligers—Latin scholars, who have never since been surpassed, learned this language without the assistance of grammar; that Lilly's grammar, in doggerel Latin verse, was thrust upon the English schools by royal edict of Henry VIII, against the vehement protest of men like Ascham, and that the decline of eminent Latinists in that country was coincident with the general establishment of this method of teaching; that Dante, Petrarch, and Boccaccio gave to the world their immortal works two hundred years before the appearance of the first Italian grammar; that Shakespeare, Milton, Dryden, Addison, Pope, Young, Thomson, Johnson, Burns, and others, whose names will live as long as the English language, had not in their childhood learned any English grammar; that Corneille, Moliere, La Fontaine, Pascal, Bossuet, Boileau, and Racine, wrote their masterpieces long before the publication of any French grammar; that men like Collet, Wolsey, Erasmus, Milton, Locke, Gibbon, Condillac, Lemare, Abbe Sicard, Basil Hall, Horne Tooke, Adam Smith, and a host of others, have emphatically condemned the method of acquiring language through the study of grammar; that the most eminent masters of language, Demosthenes, Seneca, Malherbe, Clarendon, Montesquieu, Fenelon, Voltaire, Rousseau, Montaigne, Boileau, Dante, Galileo, Franklin, Gibbon, Robertson, Pope, Burns, Byron, and Moore, acknowledge that they attained their excellences of style by the study and imitation of the best models of writing; and finally,

*Forum, XIII, 32.

†Culture Demanded by Modern Life, p. 9. New York, 1867.

that mere grammarians are generally bad writers, when we recall facts like these, we can begin to rate at something like their true value the claims of the grammatical study of defunct forms of speech for mental training. That there is a useful discipline in the critical study of language, as in the critical study of most other things, is not denied, but that it has either the transcendent importance usually assumed, or that it cannot be substantially acquired by the mastery of modern tongues, is what the advocates of the dead languages have failed to prove.

Sense Education.—Education of the senses neglected, all after-education partakes of a drowsiness, a haziness, an insufficiency which it is impossible to cure.*

It is astonishing to find how greatly the perceptions of children are neglected by those who have them in charge. I have frequently been struck with the fact that even pupils who are considered to be well advanced do not know how to use with even moderate ability, their sense-organs. I met not long ago with a boy of ten years who had mastered, to the satisfaction of his admiring parents, several branches of knowledge; and yet, when shown a picture in a child's book, told to look at it closely for a minute, and then to tell what he had seen, could name only a man, a horse and a tree. His little sister, seven years old, who did not know how to read, and who was regarded by the father and mother as being somewhat stupid, saw, under like circumstances, a man, a horse, a tree, two little birds on the ground, a cat crawling through the bushes and about to spring on them, a house, a woman standing in the door, and a well at the side of the house I had the satisfaction of telling the parents that at sixteen she would know a good deal more than would the boy at that age, provided she had an equal chance. Here is the opportunity for those who have charge of children during the first ten or twelve years of their lives. All nature is before them; the woods, the fields, the sea, the heavens, animals of all kinds, men and women, the habitations of man, factories and the various objects made in them, and a thousand other things afford the means for educating the child without a single book being brought into use.†

As the ear is most sensitive to sound in childhood, so in early years the eye is more freshly alive to color, which is the basis of vision. In the first decade scientific observation should be taught with all its highest subtlety, all its richest intricacy. By twelve every child should possess a trained sensorium and be an accurate scientific observer. College faculties are abundantly familiar with the sort of youth who comes to enter the vestibule of science with a sensorium grown hopelessly dull and insensitive for the want of early use.‡

On the Study of Hygiene.—As hygiene is one of the branches which the teachers of this State are required to teach, it

* Nyulasy—Brain Growth and Education, Health Lectures for the People, Australian Health Society, p. 38.

†Dr. Wm. A. Hammond—Brain Forcing in Childhood, Pop. Sci. Monthly, XXX, 724.

‡Clarence King—The Education of the Future, Forum, XIII, 33.

is necessary to enable them to do so, that they themselves have some knowledge of hygiene, the more, and the more practical, the better.

In the teaching of this subject, the goddess Hygeia has been adored more with the service of the lip than with that of the heart. That her protection and rich blessings may fall upon her disciples, she must not be served with the dry mummery of the words of the text-book, but each truth presented on the printed page, should be illustrated and put into practical use by the teacher, as far as is possible, in his own conduct and in the school and home life of his scholars.

To illustrate, it is possibly worth something to his pupils to read and repeat in the class, "It takes but a few minutes for the air in an ordinary unventilated school-room to become bad, and to keep it good we need to change the whole of it several times every hour. School-rooms are very rarely so constructed that they can be ventilated well," and then to pass on to the next topic with no recurrence in the teaching or in the school-room life to the truth just recited. It will be quite another thing in its influence over the lives of the children, if the teacher stops right here and invites his pupils to make with him a sanitary inspection of the school-room facilities for getting fresh air in and foul air out. "Is there any ventilating apparatus present,—any fresh air inlets and foul air outlets?" If none, "How may we then, under the circumstances, do the best we can to remedy the faults of the room; for ventilation, in some way, must be had: it is indispensable." Then the open window at recess, when all are out, and the conscientiously supervised window boards form an example that sinks the truth deeper in the life of the pupil than wordy precept upon precept. If ventilating apparatus is present, foul air flues for instance, then, "Are they artificially heated? Are they smooth internally? Do they run as straight and short as possible? Are they unobstructed? Are they specially heated? Do they take the air from the lower, or the upper part of the room? From an inner or an outer wall? From the same side into which the fresh air enters (if provision is made for fresh air) or from an opposite side? Is there a perceptible draught through the flue: if so, feeble, moderate or strong?" These questions are, all of them, important in judging as to the effectiveness of the ventilating system which the compulsory school laws of the State send us to, good or bad, and with a practical turn on the part of the teacher, the average pupil may easily be taught to answer them correctly.

Assuming that they are all answered satisfactorily, then, "Apply the rule or tape to the foul air register and give its dimensions." "That equals how many square inches?" Then, "Estimate what part of the opening is obstructed by the fret-work?" "How much remains?" "Thumb of rule fashion, how many square inches needed by each person?" Then, "How many square inches of unobstructed opening for the average attendance of the school?" "The actual opening of the foul air registers present is sufficient for how many persons?"

If need be, the recitation time of several days in hygiene may well be wholly given to this practical investigation, the scholars spending some of their study hours in making the simple calculations, after the teacher has pointed out the way. Such a lesson is fruitful, instead of bearing dry leaves only. The pupil takes pride in his acqusition of something tangible, carries his knowledge into his home, and becomes a youthful missionary in a field in which the harvest is ripe but the laborers are few. A few facts thus learned are worth much more, whether for discipline, or for life's purposes, than pages and pages learned and repeated parrot-like, and forgotten by the pupil before he leaves the shadow of the school-house.

This is but a single point in the teaching of the laws of health after a method that is eminently practical and entirely practicable with any teacher who wills to adopt efficient methods in the schoolroom.

Every child should be impressed as the teacher best can, with the idea that the most precious and perfect of mechanisms has been intrusted to his care; that there are many foolish ways in which this structure may be spoiled, that the perfect working of this living machine, the child's body, gives him one of the richest treasures of life—good health, that first and always like a careful engineer we must see that this living mechanism of ours is not destroyed or made weak by neglect, or by making it work in ways, or under conditions, to which it is not adapted, that here, as everywhere, though it may be a hundred times easier to do wrong than right, we must do right.

It is worth noting that in the text-books on "Physiology and Hygiene" there is a preponderance of physiology and anatomy and too insignificant a dose of that which should be the chief aim,—the teaching of the ways of healthy living, and the avoidance of those dangers which threaten life. If time permits, it is highly desirable to build our knowledge of hygiene upon the sound basis of physics, chemistry and physiology, but every scholar, whether he goes as far as the high school or not, should be taught in a practical way, the main truths or laws of hygiene; and fortunately they are simple enough that the average youthful mind may grasp them when presented *directly*. Do not defeat the end by too cumbersome means.

Elements of Agriculture. School Gardens.—"It is a most ludicrous misconception of the nature of science to suppose that the little manuals and primers which abound for the purpose of disseminating information apart from scientific methods, really teach anything at all."*

The teaching of the elements of agriculture, or the elements of any science, in a way that is anything more than a farce, implies that the pupils are, in the first place, to be initiated into the art of seeing things correctly for themselves; for instance, how plants grow from seed to seeding; the differences between the various species and varieties of plants; the influence, favorable or unfavorable, of environments, and other observations by the hundred that must form the basis of scientific teaching. In other words the study of things must precede the study of the words about things.

The idea of school gardens is a familiar one to the people of many European countries. They are valued for heightening the interest and love of the pupils in their school, for furnishing the means of teaching practically the elements of botany, the laws of plant life and growth, the methods of planting and caring for flowers and other ornamental plants, and of raising fruits and vegetables on a small scale. Work and observation in these little gardens, is a healthful recreation for both pupils and teacher. It is said to have an elevating influence on the intellectual, moral, and economic tendencies of, not only the pupils, but of their parents as well. If the "elements of agriculture" can be taught in the common schools as they are thus in many of those of Sweden, Switzerland, Germany and Holland, the innovation will prove a blessing to our children, whether they are to spend their lives on the farms or not. If, on the contrary, this topic is to be forced upon the pupils in the form of dry and lifeless book study, under the hands of non-interested and incompetent teachers, it is questionable whether the result will be such as to please the originators of the movement, or whether it will not prove one more adverse influence, rendering the term "Agriculture" repellent rather than attractive.

* Dr. Mary Putnam Jacobi. Primary Education, p. 88. New York. 1889.

PHYSICAL CULTURE.

An educational system that interests itself solely in the training of the intellect is shamefully one-sided. The roots of mental activity pierce deeply our physical life and draw sustenance from it, consequently the best development of the mind is possible only when the physical health is at its best. *First,* then, in the order of importance among the things that the public schools should concern itself with, is the health of its pupils, for this is the basis of the citizen's usefulness to himself and the State; *second*, should be the training of the character, for the endowment of the citizen with physical strength and mental acuteness is hardly desirable if they are to be turned against society; *lastly*, the fullest and broadest intellectual culture compatible with sound physical health should be encouraged.

These were the principles that guided in the evolution of that most illustrious of ancient cultures, and these are the views that are to-day widely influencing the nations of this busy age of ours as a means of self preservation. In the schools of hardly another civilized nation has so little been done for the physical training of its pupils, as in ours. To show this it may be mentioned that, at one of the late conferences of the teachers of Vienna, where strenuous exertions were making to secure more ample playgrounds for the school children, one of the teachers gave the results of his enquiries as to the provisions for physical culture in various German and Swiss cities. Of 20 cities from which he had heard, gymnastic exercises were obligatory in the boys' schools in all, and in the girls' schools in 14, the time devoted to these exercises ranging from one to five hours each week; two hours in most of the towns. In addition to gymnastics, 12 of these towns have provided special playgrounds for the children; 7 have, by flooding playgrounds in winter, or otherwise, provided skating courses for the pupils; 14 have school baths or other facilities for bathing; and 18 arrange for school excursions from one or two yearly to monthly or even weekly excursions.*

Points in the Physiology of Muscular Exercise.—The will directs and controls the action of the voluntary muscles through the intermediate organs, brain, spinal cord, nerves.

* Zeit. f. Schulges. III, 542. 1890.

That the muscles may do their various kinds of work easily and well, education is just as indispensable as it is that the brain may do its work easily and well. In either case, the knowing how to do is equivalent to a real gain in power. "The man who exercises his muscles is like the general who drills his troops, in order to have them under control on the day of battle."*

Certain parts of the brain, called motor centres, control the movements of the muscles in the different regions of the body. In exercising this direction of muscular movement, these parts of the brain are developed and strengthened.

Just as there is a close connection between mind and body, there is an intimate relation between one part of the body and every other part. Exercise of the muscles affects profoundly every other bodily function.

Muscular exercise increases the activity of the flow of blood through the muscles, and in response to the demand fo more blood, the work of the heart is increased. Hence there results a quickening of the whole systematic circulation.

The increased activity of the circulation in the muscles tends to accelerate the nutritive processes in them. As a result, they increase in size, and their power is augmented. As an accessory result, the nutritive processes in all the other organs of the body are promoted in some degree.

In a heat engine all its energies are derived from the conversion of heat into mechanical motion. The human body is such an engine; all its vital activities are due to the conversion of heat into muscular, nervous, and other forces. The "fires" of the body burn unceasingly until death extinguishes them. A part only of their heat is converted into the forces required for the various vital activities; of the remainder, a part is utilized in maintaining the normal temperature. Any excess escapes through the regulating mechanism of the body.

The fuel which supports the combustive processes of the body, through which heat is evolved, are the tissues themselves, but, in much larger part, material derived from the food, which may have just entered the circulation and is burned and cast out without ever becoming a fixed part of any tissue.

As the fuel burned in a furnace is turned into carbonic acid and other gases and ashes, so the combustive processes going on in the

*Lagrange. Physiology of Bodily Exercise, p. 24, New York, 1890.

body leaves waste products which must be got rid of through the excretory organs.

When muscular exercise is taken, it is accompanied by an increase in the heat formation and an increase in the products to be excreted; and the production of heat and products to be eliminated are in proportion to the amount of muscular work done.

One of the resulting waste products is carbonic acid. It is excreted through the lungs. When the exercise is moderate, it passes away as fast as formed and no striking phenomena appear. But when the exercise is immoderate, as in running, it accumulates in the blood and, involuntarily, the breathing is quickened and deepened to meet the requirement of a more rapid elimination of carbonic acid.

If the muscular exercise is still more immoderate, as in a closely contested rowing match, the evolution of carbonic acid is more rapid than the lungs can eliminate from the blood, and breathlessness and other evidences of carbonic acid poisoning appear. When the muscular effort is carried to the extreme, the face assumes a leaden, or livid hue, indicative of the beginning of asphyxia, partial unconsciousness occurs, and symptoms of vertigo come on. At this stage the contestant may fall in a dead faint, which may be fatal unless prompt help is given. In the same way the race-horse sometimes falls, overpowered by the carbonic acid rapidly liberated by his exertions.

Another class of waste products of combustion, the nitrogenous, are excreted chiefly by the kidneys. Their elimination is slow as compared with that of carbonic acid. When muscular work has been excessive, particularly in a person not accustomed to regular work of this kind, symptoms of auto-intoxication supervene; muscular stiffness, a febrile movement, and in some cases a fever of considerable intensity lasting some days. Animals that escape the hunting hounds sometimes die some days after their run.

The processes of combustion, ordinarily supported mostly by material other than that of the muscular tissues, is carried on more largely, or it may be entirely, at the expense of the essential elements of the bodily tissues when the food is insufficient, or when muscular exercise is in excess of the powers of digestion and assimilation.

Muscular exercise may, therefore, be a means, either of developing and strengthening the body, or of injuring it. It is beneficial when muscular work is alternated with sufficient periods of muscular rest, and when the quantity of work is sufficient to stimulate and arouse all the vital functions,—respiratory, circulatory, digestive, secretory, excretory. It is physically harmful or dangerous when a great muscular effort is made by muscles, heart, and lungs not habituated to such strains, as in lifting; when the exertion is continued after breathlessness and other symptoms of carbonic acid poisoning are evident, as in running or rowing; when work is not followed by rest sufficient for reparation of tissues and elimination of waste products; when, from insufficient food, or other cause, work is done largely at the expense of the muscular and other tissues; or when too much muscular work is done in addition to hard mental work.

As regards the influence of physical exercise on the brain and the mind, there is a prevalent error. We are told that the student is endowed with only a certain amount of vital force, that its expenditure in physical work diminishes by so much that part available for mental work, and vice versa. We should say, rather, that the organism of the student is endowed with the means of *evolving* vital force, and that the quantity available depends much on how he runs the machine. The raw material out of which vital force is to be manufactured is the food material (fuel) furnished by the digestive organs, and the atmospheric oxygen contributed by the lungs. The first requisite, then, is ample digestive and breathing power. Physical exercise properly taken is a stimulant and a help to digestion and assimilation, as it is to all the other physical functions, and is the best means of devel ping lung power. Instead of curtailing the amount of vital force, judicious physical exercise increases the sum total of it so as to leave a larger balance for mental work than would otherwise be available. A brain which constitutes a part of a strong, healthy organism can safely do more work than a brain that is associated with a feeble and ill-cared for body. Muscular exercise is an indispensable means of maintaining health and vigor of both body and mind.

Demonstration of the Physical Advantages.—Muscular exercise, as we has seen, increases the wear and tear of the muscular tissue, loads the tissues and the circulation temporarily with waste matter, but at the same time rouses into activity those functions whereby the system is rid of needless and noxious material. Moreover, it accelerates the nutritive processes that repair tissue disintegration and build up and develop the body. How potent a means physical training is for the healthful development of the body is shown by the experiences related by Maclaren.* It had been ordered that gymnastic training be introduced into the English army and Maclaren says:

The first detachment of non-commissioned officers, twelve in number, sent to me to qualify as Instructors for the Army were selected from all branches of the service. They ranged between nineteen and twenty-nine years of age, between five feet five inches and six feet in height, between nine stone two pounds and twelve stone six pounds in weight, and had seen from two to twelve years service. I confess I felt greatly discomfited at the appearance of this detachment, so different in every physical attribute; I perceived the difficulty, the very great difficulty, of working them in the same squad at the same exercises; and the unfitness of some of them for a duty so special as the instruction of beginners in a new system of bodily exercise—a system in which I have found it necessary to lay down an absolute rule, that every exercise in every lesson shall be executed in its perfect form by the instructor, previous to the attempt of the learner; knowing from experience how important is example in the acquisition of all physical movements, and how widely the exercises might miss of their object if unworthily represented by an inferior instructor. But I also saw that the detachment presented perhaps as fair a sample of the army as it was possible to obtain in the same number of men, and that if I closely observed the results of the system upon these men, the weak and the strong, the short and the tall, the robust and the delicate, I should be furnished with a fair idea of what would be the results of the system upon the army at large. I therefore received the detachment just as it stood, and following my method of periodic measurements, I carefully ascertained and registered the developments of each at the commencement of his course of instruction and at certain intervals throughout its progress.

The muscular addition to the arms and shoulders and the expansion of the chest were so great as to have absolutely a ludicrous and embarrassing result, for before the fourth month several of the men could not get into their uniforms, jackets and tunics, without assistance, and when they had got them on they could not get them to meet in the middle by a hand's breadth. In a month more they could not get into them at all, and new clothing had to be procured, pending the arrival of which the men had to go to and from the gymnasium in their great coats. One of these men had gained five inches in actual girth of chest. Now, who shall tell the value of these five inches of chest, five inches of additional space for the heart and lungs to work in? There is no computing its value, no power of computing it at all; and before such an addition as this could be made to this part of the body, the whole frame must have received a proportionate gain. For the exercises of the system are addressed to the whole body, and to the whole body equally, and

* Physical Education, p. 72. Oxford, 1869.

before this addition could be made to the chest every spot and point of the frame must have been improved also—every organ within the body must have been proportionately strengthened.

But I tried another method of recording the results of the exercises. I had these men photographed naked to the waist shortly after the beginning of the course and again at its close; and the change in all, even in the small portraits, is very distinct, and most notably so in the youngest, a youth of nineteen, and as I had anticipated in him, not merely in the acquisition of muscle, but in re-adjustment and expansion of the osseous framework upon which the muscles are distributed.

But there was one change the greatest of all—and to which all the other changes are but means to an end, are but evidences more or less distinct that this end has been accomplished, a change which I could not record, which can never be recorded, but which was to me, and to all who had ever seen the men, most impressively evident; and that was the change in bodily activity, dexterity, presence of mind, and endurance of fatigue; a change a hundred fold more impressive than anything the tape measure or the weighing chair can ever reveal.

The men composing this detachment had been irregularly selected, the youngest being 19, the eldest 28, the average 24; and after a period of eight months training the increase in the measurement of the men were:

	Weight—Lbs.	Chest—In.	Forearm—In.	Upperarm—In.
The smallest gain	5	1	1-4	1
The largest gain	16	5	1 1-4	1 3-4
The average gain	10	2 7-8	3-4	1 3-4

A cheerful fact, says Edwin Checkley,* is that nobody need consider himself unfit for training. I was born a weakling. Nobody thought I was really worth rearing. To-day I can lift three men, each weighing one hundred and fifty pounds, and trot with them for a hundred yards. If I had not been born a weakling my family would never have taken the trouble to make me, and I would never have taken the trouble to make myself, physically what I am.

Intellectual Advantages of Physical Culture.—Body and mind need each other, and the one is the most perfect when the other is in best condition.†

And what if this daily exercise, beside the bodily benefit and improvement which ensues, should also bring actually better mental work? Unbending the bow for a little while, taking the tension from the brain for a few minutes, and depleting it by expanding the chest to its fullest capacity, and increasing the circulation in limbs —these, instead of impairing that brain will repair it, will markedly improve its tone and vigor.‡

* A Natural Method of Physical Training, p. 146.

† Kate C. Hurd, M. D., Prof. of Physical Culture, Bryn Mawr School, Bost. M. & S. Jr., CXXII, 602.

‡ Wm. Blaikie—How to Get Strong, p. 49.

This fatigue of the body, says Dr. Gautier,* is a relief to the mind, a derivative from the brain, a powerful means of eliminating the wastes of organic life by abundant perspiration and deep breathing, these factors in overpressure against which the will and energy are powerless.

Dr. Geo. D. Stahley, from his wide experience while in charge of a public institution for the insane says:

The sacredness of the human body, the incalculable importance of healthy physical functions, the dependence of a sound mind on normal bodily health, these are truths which have been burned into my very life, by a professional experience, which has been as sad and as terrible, as it has been scientifically interesting.†

The truth of these assertions has been proved experimentally at the State Reformatory at Elmira, N. Y. In a paper on "The Pedagogic Phase of Physical Training,"‡ Dr. Hamilton D. Wey refers to the practical use that is made of physical training in that institution as a means of awaking and developing the mind.

There is no greater educational fallacy than the idea that the brain is educated at the expense of muscle, and muscle at the expense of brain, that excellence in both cannot be attained simultaneously.

The body deteriorates under exclusive mental cultivation, because it is sacrificed through neglect and inertia, and proper hygienic conditions lost sight of and ignored. It deteriorates because the laws of physiology are unheeded and transgressed.

I would that I could portray with the same distinctness and power of definition by picture of pen, as I can recall it by mental imagery from object lessons furnished by my work in physical training, the reciprocity existing between the physical and mental state. As physical conditions have been improved, the volume and character of mental action have been increased; while conversely, with exclusive mental cultivation and corporal neglect, the physical man would maintain itself for a time until a certain degree of mental fulness had been attained, after which body and mind synchronously would decline as if to emphasize the words of Scripture that much study is a weariness of the flesh.

A little more than three years ago the work of physical training as a pedagogic measure was entered upon at the New York State Reformatory, at Elmira. This departure in the treatment of youthful criminals was brought about through a recognition, based upon years of observation, of the futility of attempting to treat primarily, by mental and moral means, certain delinquents who had demonstrated by their acts their unfitness and inability to maintain themselves in harmony with society.

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*Le Surmenage Scolaire, p. 11. Paris, 1887.

†The Physical Basis of Education, p. 2.

‡Physical Training Conference, 1889, p. 102. Boston, 1890.

An experimental class of twelve was formed. We took them in hand, regulated their diet as to quantity and kind, washed and massaged them, and put them daily through free-hand exercises. It was a laborious task to teach them precision and rapidity of action in their exercises, but perseverance demonstrated their susceptibility and responsiveness to this mode of stimulation.

The class was continued for five months, when the men were returned to the conditions of prison life they were formerly unable to conform to. For the succeeding five months they were carefully watched and noted to see if the improved physical state and resulting increased cerebral power would prove ephemeral and subside upon withdrawal of the stimulation that produced it, or, continuing, be the beginning of a state freed from former embarrassments.

The latter was the case, as generally they maintained themselves in the performance of their requirements, which previously they could not do, in the threefold lines of behavior, school, and labor, averaging collectively seventy-one per cent. as against forty-six per cent. for five months preceding their being taken in hand.

From this beginning the work of physical training has gone on, until now the physical training class has come to be a school preparatory to those of letters and the trades for the unformed and crude boy, the weak in body, and feeble in mind.

Gymnastics.—Objectors to systematic training for the body are wont to affirm that school children get sufficient exercise in the course of their games and home work. The friends of physical culture might almost as well maintain that the systematic mind training of the schools is needless, since, with little or almost no help from teachers, many a child has grown into a useful manhood or womanhood, or even advanced to positions of eminence. They might maintain, too, with some degree of plausibility, that this free and natural way of getting an education has its advantages in leaving the child's sense perceptions undulled and his physical development less interfered with.

But we have no sympathy with either of these extreme disputants. We must maintain, and, as far as may be, increase the efficiency of the mental training in our schools; and, at the same time, in these same schools, the physical culture of the scholars should be regarded as forming an indispensable foundation for the intellectual education of the child. Just as the guidance and encouragement of the skilled teacher is almost indispensable to the average student in his mental growth, so is intelligent guidance just as much needed by the average boy or girl in his or her physical development. The unsystematic and haphazard physical training which the child gets in home work and when roaming at his own sweet will is not enough. The gross quantity of exercise may often be enough; but the work is distributed to the muscles without reference to their needs, often overburdening and over developing a special set of muscles called to do the special work, while other groups of muscles are inactive and developed insufficiently.

A well devised system of gymnastic exercises aims at the harmonious training and developing of all the muscles, and the avoidance of one-sidedness, and other tendencies to deformity characteristic of many occupations and some games and sports.

But the improvement of the physique is not the whole story of gymnastic results. One of the first effects is the education of the movements. "Everyone has noticed," says Lagrange, "how rapidly gymnastics diminish the awkwardness and clumsiness of the man who practices them. The recruit who has been used to rough agricultural labors becomes rapidly more polished. His muscles, hitherto used to slow obedience, in order to perform their easy movements with more strength, are obliged to obey with precision and rapidity. They undergo a discipline to which they are strangers, and perform an apprenticeship which makes their action more prompt and easy."

It will be seen farther on that free sports are accorded a place second to nothing else in the physical culture of school children, nevertheless gymnastic exercises have a value of their own distinct enough to merit a place in every school.

Results.—In Cleveland, the results of the school-room gymnastic training have been: "An improved carriage of body in sitting, standing and walking, a decrease of round and stooped shoulders, a marked improvement in discipline, and greater ease in governing the pupils."*

From an eleven years' observation of the results of gymnastic training, Jaeger states that the difference in absence from school between pupils who were under gymnastic training and those who were not was 25 per cent. in favor of the former.†

To see a delicate girl with a hollow chest and stooping shoulders, thin arms and a drooping carriage, gain from one to three inches in chest girth in four months time, one or two inches in arm measurements, to find her spine growing more erect and her chest capacity increasing twenty-five to fifty cubic inches, while strength tests show that she has doubled the power of back and limbs, is a gratifying

* Proc. Am. Assoc. for the Advancement of Physical Education, 1890, p. 58.

† Burgerstein, Die Gesundheitspflege in der Mittelschule, p. 61. Vienna, 1887.

result which is not uncommon as shown by the vital statistics from various quarters.*

The Place for Gymnastic Exercises.—When the weather is suitable, the school should receive its gymnastic training in the open air. There the deep inhalations caused by the muscular work may be fed with pure air, an important element in physical culture. If the exercises are done in the school-room, a pure air supply through open windows or otherwise must be provided, and the air must not be filled with dust. If the exercises can be done only in a dusty atmosphere, it were better to omit them and turn the school out for free play instead.

The Dust Question.—We have long known that dusty air is not healthful air, but the significance of a dusty atmosphere, particularly in closed, inhabited rooms, is seen in a new light since we have learned that, attached to, or floating among, the particles of dust, is a multitude of micro-organisms, some of which may be the germs of infectious diseases. To show how the raising of a dust fills the air with germs, it may be mentioned that Tucker found that the air in the wards of the City Hospital, Boston, had about seventy times as many germs after the morning sweeping as it had when all was still. The objections and dangers of gymnastic training in a dusty atmosphere are well told by Dr. F. A. Schmidt of Bonn.†

Now, in quiet breathing, we take in with each inspiration one-third or one-half litre (about one pint) of air, while there are already three litres of residual air in the lungs, to which each breath is added. From the uniform admixture of the old and the fresh air, a quantity is expelled at each expiration equal to that taken in with the inspiration. Remembering now, that we breathe in and out from sixteen to twenty times a minute, this half litre of air with a certain quantity of dust suspended in it, during the one and one-half to two seconds, while it is passing into the lungs, sweeps through the narrow cavities of the nose and the naso-pharynx, through the larynx and trachea, and only after it passes through the narrowest twigs of the air passages does it reach the air cells,—all the way over moist mucous membranes. It therefore, appears improbable that, in ordinary quiet breathing, in air with only a small or moderate quantity of dust suspended in it, the particles of dust penetrate so far as the air cells.

But it is another matter when the quantity of dust in the air is very great, and when such air must be breathed for a long time. Then, indeed, particles of dust penetrate through the finest divisions

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*Mary T. Biswell, M. D., Proc. Am. Assoc. for the Advancement of Physical Education, 1888, p. 13.

†Die Staubschadigungen beim Hallenturnen. Leipzig. 1890.

of the air passages to the air cells, and the irritation of these particles causes the migration of white blood corpuscles from the pulmonary blood vessels. These white blood corpuscles surround the dust particles, tending thus to render them harmless, and, mixed with the mucus of the lining membrane, are coughed up as "dust cells," or they re-migrate into the tissue of the lung and there permanently store up the foreign matter. Thus it results that the lungs of adults contain a considerable quantity of the insoluble particles of dust that give them an appearance very different from that of the lungs of the new-born infant.

But in breathing air loaded with dust, the fullness or depth of respiration is of more significance than length of time. Even when compelled to breathe deeply through the mouth while exerting ourselves in speaking or singing, we lose entirely the protection of the nasal passages against the penetration of dust, for the air is then drawn directly into the larynx and trachea and reaches the lungs well laden with dust. This is notably the case, also, when the depth of respiration is increased by physical exercise or work. While quiet, in a lying or sitting posture, only a portion of the lung takes part in the act of breathing—those parts indeed of our lungs that are the most fully under the influence of the great muscles of respiration, and that can therefore, the most easily free themselves from foreign matter by the act of coughing. These are the middle and lower parts of the lungs.

During active muscular exercise the respiratory range is greatly increased. Then come into play the reserve forces of the lungs, and the upper lobe and its apex participate—parts from which harmful matter is not so easily expelled after it has once been breathed in. There the particles remain unhindered in their harmful action upon the lungs.

Rapid walking requires the inspiration of four times as much air as when at rest, and running increases the respiratory action about seven fold. With the increase in the quantity of air breathed during these and similar movements, there is also a corresponding increase in the quantity of dust inspired, and not only that but it penetrates to the more remote, less movable and less resistant parts of the lung.

There is another reason why the inhalation of a dusty atmosphere during gymnastic exercises is undesirable. When we exert ourselves to the utmost in lifting heavy weights, the muscles of respiration, including the diaphragm, are fixed in a rigid involuntary spasm. As a result, breathing is temporarily suspended, and a stagnation of unærated blood occurs in the pulmonary circulation. With the cessation of the exertion, the breath is drawn in with long gasps. Or, if the trainer makes a sprint around the gymnasium track, at the end of his course he snaps at the air with open mouth, breathing it in with the deepest possible inspirations, each of which is alternated with only short expirations.

In these deep spasmodic disturbances of the natural breathing, the best conditions possible are present for the deep and plentiful inhalation of dust when it is present in the atmosphere.

There are, therefore, weighty reasons why rooms devoted to indoor gymnastic and other physical exercises should be as clear of dust as possible, and, as the keeping of the air of gymnasiums reasonably free from dust is very difficult, why physical exercises should be conducted in the open air when practicable.

Gymnastic Teachers.—To fit up a gymnasium for a school and leave the pupils to follow their own inclinations is indiscreet. A gymnasium run in that way is probably capable of doing as much harm as good. Gymnastic training with apparatus should be under the skilled supervision of a special teacher. In the common schools it is highly desirable that gymnastic instructors be provided to teach the teachers. When the State begins to realize the value of physical culture, an instructor in gymnastics will be provided for each normal school in the State.

"It is of more importance than is at first apparent," says the Earl of Meath, "that the gymnastic instructor and school teacher should be one and the same person:"*

1. For reasons of economy, which should not be overlooked, as many districts would be unwilling or unable to pay the salary of an additional teacher.
2. For the sake of the teacher himself, who would be benefited by being obliged to devote a certain portion of each day to his own physical development.
3. For the sake of discipline, which could be much more easily maintained by the regular school master than by any outsider.
4. Because proficiency in physical exercises would enhance the respect of the scholars for their teacher.
5. Because there would be no danger of divided authority, or of one-sidedness on the part of the school teacher or gymnastic instructor.

School Games and Sports.—Gymnastic training is far from being all the means at hand for the promotion of physical culture: it is doubtful whether it is the better part of it. Gymnastic exercises may be made interesting to a school to a certain degree, but they are hardly play. In free play or in the school games to which the pupil turns with avidity, he gets the advantages of muscular exercise, the deep breathing of pure air, recreation, and the salutary influence of a happy mind. In Germany, the land of gymnastic

* North American Review, LII, 1891. (No. 6.)

training, there is at present a strong movement in favor of re-introducing into their schools the old national games and others from abroad as a means of antagonizing the unfortunate tendencies of the present age to make our children lose too early the love of play and to become prematurely old.

In the German towns, Brunswick, Görlitz, and others, games suited to the purpose in view have been introduced into the schools. In some of these towns the school authorities require all the scholars to take part in the plays and games; in others, influences of a different kind are brought to bear to lead the greatest possible number to participate in them. In Hamburg and other places, associations have been formed to encourage school games and to provide suitable playgrounds.

Dr. Eitner of Görlitz was authorized by the Prussian Minister of Instruction to form classes for the purpose of instructing teachers how to lead their pupils in school games. The first course was given in 1890 and was attended by teachers from all parts of Germany.* The next year a similar course was given to teachers in Berlin. The German Emperor, it is said, is enthusiastically in favor of this movement and plays football himself with his own sons and Prince Henry at the new palace near Potsdam. For this year (1892) arrangements have been made for systematic school plays in the schools of Prague, and in the Galician province of Austria.

England has still a wide lead in sports. Her example has not been without influence in this Continental movement, nor in this country; yet how much more games and sports pervade the whole life of the English nation than it does ours, was observed by the Earl of Meath, an ardent friend of physical culture:

Whereas in England every available field in the neighborhood of our large cities is snatched up for football or cricket, and thousands of clerks, factory hands, and young artisans, especially in the northern towns, struggle of a Saturday afternoon for room in which to play these invigorating national games, in America athletics are in a great measure confined to the universities, the schools, the richer classes, and the professionals.†

A foreign investigator of the value of the English sports gives the following opinion: "I think that, from what I have already said, it will be perceived that England possesses in her games for youth a

*Zeit. f. Schulgesund. III, 131.

†North American Review LII, 1891.

great treasure that has the power to give new strength and new life to each succeeding generation." *

We credit the system of physical culture in the schools of Germany with having done much for the well being of her pupils, but an observer from that country, writing on the influence of the English school sports on the physical condition of English boys says:

The English youth makes a much more healthy development, is physically more energetic, is finer looking, and, in his modes of life and inclinations, is more youthful than the German lad, and in after life retains his early vigor and liking for active muscular exercise much longer, in general, than is the case with us—a lasting result of a well spent youth.

Conversely, an English teacher, after visiting and inspecting some of the German high schools says:

Gymnastics has been suggested as a substitute for our sports. I need not affirm that this substitute is an insufficient one. The very first question put to me was whether the boys in England do not present a much fresher and freer appearance. This I at first denied, but, after further observation, I was constrained to change my opinion. There is no striking difference between the younger pupils of the two countries, but, as one goes into the higher German schools, one notes the absence of freshness and health. The pupils of the two or three higher classes appear pale, narrow-chested, and overworked, and give the impression that the introduction of the English system would prove salutary.†

After reminding us how excellent a kind of exercise is got in playing well chosen school games—how the movement of the blood is quickened, how the breathing gains in depth and fullness, and how the appetite is sharpened—Raydt‡ continues:

It results that the condition of mild mental tension, with the cheerfulness and joyousness which children's games draw out in the happiest way, influences the whole nervous system in the most favorable way. It is not all the same for the health whether one walks two miles (4 km.) back and forth on a short track, or walks the same distance over a charming way in pleasant conversation with a cherished friend. Thus is it in children's games, and on account of their joyous and refreshing influence, their place cannot be filled by any gymnastic exercises. In this connection Dr. Warre, director of the school at Eaton, very fittingly remarks: "Gymnastic exercises there are, and military training, and to spare, but these do not in any way represent ancient athletics, or fulfil the same office as the social games which are the proper pastimes of youth in merrie England."

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* Raydt. Das Jugendspiel, p. 27. Hanover, 1891.

† Sudwestdeutsche Schulblätter, VII, 46. 1890.

‡ Das Jugendspiel, p. 22. Hanover, 1891.

Time for Play.—"Every spare moment," says Dr. Dukes, "not already occupied by work, meals, or sleep, should be alloted to play." Recesses for this purpose should not be given grudgingly. Dr. Dukes refers to "one of the best private schools in existence in this country" in which the pupils are worked severely, but in which there is an arrangement of play time that he approves, ten distinct intervals interspersed through the day, amounting to rather more than four hours. The same author recommends strongly a half day of freedom every other day alternating with the three days of work all day.

In the schools of many continental countries recesses are more frequent than we allow, and the pupils have Wednesday and Saturday afternoons as half holidays; an arrangement better than ours, which works the pupils too much five days in the week, and lets them play too much on the sixth.

The Leader of the Games.—Shall the teacher, himself or herself, be a participant in the games? By all means let him do so if he can bring to the play somewhat of the zest and joy of the child, if his robustness and elasticity warrant, and if his aptness and skill in the games will raise him above a mean place in the estimation of his youthful playfellows.

The teacher should at least have a careful oversight of the playgrounds and of the children's games; the right formation of character requires this as well as the proper development of their bodies. Rudeness, tyranny, and meanness are to be repressed; acts of generosity and truthfulness should receive at least a smile of recognition from the teacher; new games should be devised or explained; and the diffident, or for other reasons backward children should be encouraged to join in the sport. A wide field of usefulness on the playground is open to the teacher, as well as in the school-room, and the cultivation of the field of recreation may be made a powerful auxiliary to the field of school-room work. Nowhere else does the teacher have so good a chance as on the playground to learn the character of his pupils, which is usually many sided. In the school-room it is shown only in part; on the playground entirely new facets of their individualties are turned toward the teacher. By all means then let the pupils see that your interest is with them in their play, as in their work, and, if joining them, be a leader in the games or be led, as seems most expedient. But remember that, whatever role you play in the school-room, here you are no dictator, save when a question assumes a moral aspect. The players must have their utmost freedom of will. Play that is not voluntary ceases to be play.

Nothing else tends so strongly as school games to bind the child to his school. One of the early leaders in physical culture said: "Games are flowery bands by means of which one may draw children to one's self."

Character of the Games.—The first requirement in a school game is that it shall be attractive to the children, and in this is included adaptation to age. The next is that, with the pleasure of the play, the scholars get active exercise in it. Some of the games should be of a kind that can be dropped abruptly at the end of a fifteen minutes' recess without being spoiled. Others should be suitable for a holiday or half holiday. The outdoor games well known to the children of a school should be supplemented by those of a suitable character from the juvenile lore of other places or countries. It is hoped that a pamphlet to aid teachers in this direction may be available before long.

Playgrounds.—Speaking of the sad lack of play for the child o the city, a sympathizing writer asks: "When and where shall he, as a student in the intermediate school of the great city, find opportunity to satisfy that innate need of exercise that drives him on with irresistible power. Playgrounds are few; skating, swimming, riding—these cost money, sometimes much money, and on account of distance, often much time; throwing snowballs, he must not; sitting still,—this he must do."*

Ample room for playgrounds should be considered an indispensable requirement of a school lot; and it is an excellent idea to give the children a good, comfortable play shed with open sides for rainy and extremely hot weather.

Athletics.—Since the "athletic mania" has pervaded our higher institutions of learning and a large part of the youthful population generally, much discussion has taken place on the influence of athletics over the schools and on the participants mentally and physically.

Many physicians, observing the physical effects of athletic contests, pronounce decidedly against them. They are able to adduce some cases in which serious and lasting physical harm has resulted,

*Burgerstein.—Die Gesundheitspflege in der Mittelschule.

or have observed the pitiful extreme of muscular exertion in an intercollegiate rowing match. One authority describes it as follows:

To the respiratory distress succeeds a sensation of anguish generalised throughout the organism. The head feels as if bound by an iron band. Vertigo is very distressing. All sensations become more vague; the brain is overcome by a kind of drunkenness. The subject begins to become unconscious of what is passing, his muscles continue to work mechanically for a time, then they stop, and the man falls in a faint.

Another describes as follows the effects upon the participants in rowing contests:

They almost lose consciousness of time and place, and their motions become purely mechanical. It seems impossible to them to row a dozen strokes more. Incessant encouragement is necessary from the coxswain or from the shouts of the spectators to enable them even to keep their senses long enough to finish the race.

"A member of the Harvard freshman crew of 1875 gave the following reason, significant from a sanitary point of view, why the race was lost to Columbia: 'Oh, we had the best of them all the way, but unfortunately, our strongest man fainted just at the end of the third mile.'" *

The President of Columbia College said in 1890, "Last summer our crew, though not victorious, strove so hard for victory that the men fainted in their boat."

Whether the accident of syncope occurs or not in competitive contests of this kind, the contestants are reduced to an extremity that is an invitation to Fate to inflict a physical disaster.

But if these picked crews invite danger, what may be said of those who enter athletic contests with insufficient preparation or none at all, who do not know whether their vital organs are sound enough and strong enough safely to stand the strain. These are the cases that most frequently throw discredit on athletic exercises.

A most important principle in exercise, says Maclaren,† and one which should ever be borne in mind, is, that it should be regulated by individual fitness, for the exercise that scarcely amounts to exertion in one person will be injurious and dangerous to another.

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The infringement of this principle, that "Exercise should be regulated by individual fitness, that it should be approached gradually and increased only with increasing strength," has been the cause of much perplexity and suffering. Scarcely a summer passes without our attention being drawn to some victim of its transgression—some

*Proc. Am. Assoc. for the Advancement of Phys. Ed., 1888, p. 50.

†Physical Exercise, Oxford, 1869.

one who has escaped suddenly from his desk or study, and without preparation, or gradation, or precaution of any kind or degree, has betaken himself to mountain climbing, shooting, boating, or some other exciting pursuit, to break down in the effort, or to struggle through it and sink down for many a month and day after it, his powers overtasked, his energies exhausted. Now for the brain-tired, city-worn, business weary man, these are the pursuits which he would do best to follow, and these are the scenes among which he would do most wisely to mingle, did he do so in accordance with the dictates of reason and in obedience to the laws by which health and strength are maintained.

In answer to the inquiry, what per cent. of college athletes are injured in taking the so-called violent exercises, Dr. D. A. Sargent* says:

During my professional career I have examined over ten thousand men of different ages from all classes and conditions of life. Of this number over one thousand were athletes, professional and amateur, who had engaged for several years, and attained some prominence, in such severe physical exercises as rowing, running, boxing, swimming, jumping, wrestling, football, weight-throwing, fencing and walking contests. Out of this number of athletes I have not found over one per cent. affected with the slightest cardiac disturbance, and in only two of these cases did I feel positive that the trouble was due to athletics alone.

It seems to me reasonable to admit that athletes are endowed by nature with a stronger heart and lungs and a better organism throughout than are possessed by most mortals. The exercises in which they excel are the ones that we prescribe for those persons whose heart and muscles we wish to strengthen and invigorate. Does not the work done or the feat accomplished presuppose an organism equal to it? This is my conviction, and I have yet to learn of a single case where a sound heart in a sound organism has been injured from the practice of athletic exercises under proper conditions and capable supervision.

I am informed that over 50 per cent. of the men who apply for admission to the army and navy, and to the police force of two of our large cities, are rejected on the ground of physical incompetency. And yet men of much less physical stamina than they are qualified to enter athletic contests. The great mass of these aspirants for athletic honors are weeded out in the preliminary struggles with their companions or play-fellows. Those that are successful in these local encounters are spurred on by admiring comrades or club-mates to greater efforts. They become fired with an ambition to break a record, win a prize, or gain distinction at any hazard, and they begin to train.

I shall not at this time undertake to describe the course of training as it is pursued by the larger portion of these young aspirants; let it suffice to say that it begins and ends with a continuous series

*Educational Review, II, 457, 189.

of trials and tests in which one part of the organism is forced into competition with another, until finally the weaker part gives way, and the efficiency of the individual for any more great efforts has been permanently impaired. These are the men who bring athletics into bad repute. It they had been subjected to a physical examination they would have been advised not to compete in violent exercises, and the pulmonary, cardiac, or constitutional weakness then discovered would have been traced to its true cause, and not attributed later to excesses in athletics. Back of most of the cardiac disturbances which are ascribed to over-exertion in sport will be found an early history of rheumatism, scarlet fever, degenerative trouble of the kidneys, or the lingering effects of some other disease. Dissipation in early life, excessive use of alcohol and tobacco, vitiated air, poor food, sedentary employment, want of regular exercise, tight clothing, cramped positions, over-study, loss of sleep and too rapid growth—all these tend to weaken and derange the heart's action and impair its ability for great efforts. Among college students the great majority fail to come up to the athletic standard because they have never had any systematic exercise or physical training. Most of them have devoted the period in which the greatest growth and development usually take place to study in preparation for college. Consequently they enter trained in mind, but not in body, for the ordeals of college life. The pitiful wail of the captain of the crew or the captain of the "eleven" for "better men," is not all a myth, but represents a serious want of stamina and brawn in our national physique.

Admitting that the general practice of athletics by all classes under the present highly competitive system is likely to result in injury to some, let us consider briefly a few of the precautions that are necessary to observe in order to reduce the risk to a minimum. The young man who aspires to be an athlete, should have himself examined and tested by a good physician before beginning to practice athletics, and get his written opinion as to the advisability of entering athletic contests. I say *written opinion*, because I have learned from experience that some physicians are very free with their spoken opinions where they are not expected to assume any responsibility. The best adviser is likely to be the young man's family physician, for he will be familiar with his history, and constitutional peculiarities. Second, it is best not to engage in violent exercise until one is at least eighteen years of age, and in most cases it would be better for him to postpone his athletic attempts until he is twenty. The heart and lungs do not get their full development until after this age, and if forced in their work before this time, they will be likely to be impaired in their later efficiency and to retard the final development of the whole body. The tables prepared by Drs. Beneke and Boyd on this subject should be in the hands of every practicing physician and schoolmaster, for it is in the preparatory schools, that are now fostering highly competitive exercises among growing boys, and not physical training in its best sense that the evils following over-exertion are most likely to occur.

There are three axioms, says President DeWitt, of Bowdoin,* to which physical education must conform: First, the best exercise is that which reaches the largest number and does most for the weakest men; second, the best exercise is that which makes the hardest work attractive; third, the best exercise is that which most successfully co-ordinates body, mind, and will. Developing giants, lowering records, winning races and knocking out opponents are doubtless interesting things to do; but they are no part of that physical education which the college aims to give to its students.

Students who participate in those contests in which the maximum of muscular development and physical endurance is essential to success are martyrs to the cause of physical education. They acquire greater physical development than a student needs to carry on his college studies to the best advantage, and they form habits which oblige them to keep up, after graduation, more exercise than is consistent with engrossing professional pursuits. The influence and example of such severe training as a university crew undergoes are valuable in keeping up the athletic tone of an institution and in setting the pace for the average student to follow. But the greater physical benefit comes, not to the eight who row the great race, but to the thirty or forty who train with them, and who only row in class races or do not race at all.

Postures.—The teacher should aim to make his pupils overcome their bad habits in sitting and standing. Sitting and standing all day in faulty postures will do much to counteract the good that may be derived from exercises for physical culture. The teacher's admonition is needed often by some pupils to help them overcome these bad habits.

A frequent faulty sitting posture is that in which the hips slide forward on the seat so that the sacal and lumbar portions of the spinal column are not supported while the shoulders rest against the back of the seat. The spinal column is therefore abnormally curved, and the chest and abdominal organs crowd each other. This is sometimes owing to sheer laziness on the part of the pupil, but is more frequently due to a faulty shape of the seat. In some seats it is almost impossible to rest against the back without this slipping forward.

Breathing.—The gradual increase of the respiratory capacity should be one of the first concerns of physical culture. Lung power and heart power form the basis of physical endurance whether in athletics or the exigencies of life. In ordinary breathing only a portion of the lung is called into action; a part of its capacity lies dormant and undeveloped in the average man or woman. When,

* Forum, June, 1891.

therefore, the middle-aged individual yields to the temptation to take a run for which his lungs and heart have not been trained, the tide of blood thrown upon the lungs is more than they can take care of, and then there is danger of a sudden calamity. Dr. Hammond has collected seventy cases of death during recent years of men running after a street car and dropping dead in the street.

For developing lung power, complicated apparatus and exercises have been devised; but the essential thing in developing lung power is lung work. The simple expedient of standing erect and alternately expanding the lungs to their full capacity and emptying them as much as possible by deep breathing through the nostrils, is an efficient school exercise for developing the lungs. For keeping the heart, as well as the lungs, in a condition safely to meet the various emergencies of life, running, and skipping the rope are among the best of exercises. Both, however, are capable of much harm when imprudently used.

The exercise of the muscles of the arms and chest may result simply in piling up muscle on the exterior of the chest with but little real work for the respiratory muscles, and but little increase of lung power.

Running.—Under the eye of the teacher, or other intelligent supervision, running is one of the best of physical exercises. Hardly any other exercise is so well suited to increase heart and lung power, and to fit a boy for tests of endurance. The Prussian Minister of Instruction has deemed it of sufficient importance to issue a special circular on this subject.

Running enlarges and strengthens not only the muscles of the legs, but those of the trunk and chest and the muscles of respiration. As paradoxical as it may seem, exercises of the legs are worth more for developing the lungs than exercises of the upper extremities.

The run should at first be made slowly and steadily, the distance being lengthened only as lung power and heart power are increased.

Exercise may either improve a weak heart and weak lungs, or be a decided injury to them, according to whether the exercise is taken in moderation and regularly, or immoderately and only occasionally.

Mr. Blaikie* reminds us, in his picturesque way, how far we are behind England in cultivating the "staying powers" of our boys:

Run most American boys of twelve or fourteen six or eight miles, or, rather, start them at it—let them all belong to the ball nine if

* How to get Strong, p. 25.

you will, too—and how many would cover half the distance, even at any pace worth calling a run? The English are, and long have been, ahead of us in this direction. To most readers the above distance seems far too long to let any boy of that age run. But, had he been always used to running—not. fast, but steady running—it would not seem so. Tom Brown of Rugby, in the hares-and-hounds game, of which he gives us so graphic an account, makes both the hares and hounds cover a distance of nine miles without being much the worse for it, and yet they were simply school boys, of all ages from twelve to eighteen.

Let him who thinks that the average American boy of the same age would have fared as well, go down to the public bath-house, and look carefully at a hundred or two of them as they tumble about in the water. He will see more big heads and slim necks, more poor legs and skinny arms, and lanky, half-built bodies than he would have ever imagined the whole neighborhood could produce.

Running is unsuitable for pupils with disease of the heart or lungs. After it is ended the participants should not stand about, and still worse throw themselves upon the ground. They should keep in gentle motion until well cooled and clothing has dried; still much better is a change of underwear.

Manual Training.—Dorothy Tennant Stanley has lately drawn for us with her facile pen and pencil the characteristics of a somewhat picturesque class of juvenile humanity, not by any means confined to London. Failure in large measure has been the result when the ordinary methods of instruction have been applied to these boys; in fact we fear that the general verdict would be that these "Street Arabs" are incorrigible. But not so thought certain business men of New York. They believed that it is possible to reach these boys and favorably to mould their characters, intellectually and morally, by means of a well devised system of combined manual and mental training. Accordingly a so-called Workingman's School for them was opened in the city. Something of the methods pursued, and of the results achieved were given by Franklin Haven North in 1885:

But the theory of the founders of the institution is that children are not naturally vicious, but are rendered so by surroundings or influence; and hence, if they failed in successfully dealing with them, they would be compelled to fall back upon the assertion that bright and well-behaved children may be made into expert artisans—a proposition which no one has ever denied.

Fortunately for them and fortunately for those whom they especially set out to aid, not one child out of that multitude which has applied for admission has been found to be beyond the reach of intelligent treatment; not one has been found where evil propensities were more than skin-deep.

Strange to say, the lad who upon entry proved the most stupid, most stubborn, and ill-mannered, rose by rapid stages, until, finally, he reached the head of his class. This lad, upon his first appearance, was found to be not only dirty and ragged, but so obstinate that he would only answer questions when it pleased him to do so. His eyes were half closed, he rarely looked up, and altogether he seemed, if the description of those who saw him may be relied upon, more fitted for the career of a cow-boy or that of a bandit than for such peaceful occupations as those of the mechanic and decorator. The manager of the school called up the official physician and asked him what ailed the lad. The physician made a careful examination, and then reported that, besides being naturally vicious, the lad was weak-minded. But this was by no means satisfactory to the manager. He examined the lad himself, and made an altogether different diagnosis of the case. In his opinion the lad's behavior and appearance were due to a long course of ill-treatment and neglect. He had him thoroughly washed, fed, and clothed, and prescribed good treatment.

At first he was dull, very dull; his mind seemed never to have been called into action, but little by little he began to wake up; day by day his eyes opened wider and wider; the cloud that seemed to have settled over his face was gradually dispelled; and finally one day, when something more interesting than usual was afoot, he so far forgot himself as to smile. Henceforward he gave no further trouble. His teachers say he made rapid progress, and they finally discovered that, instead of being mentally weak, as the physician had said, he possessed a mind unusually acute.*

Last June, a year ago, says the Superintendent of Schools of Toledo: a pale-faced boy was promoted to the High School. He was a youth of slight physical frame, of the sort that physicians sometimes recommend to be taken from school for the benefit of their health. At the beginning of the year he entered the class in manual training, and with some curiosity I watched the physical effects upon the lad. After some months I began to detect rounded lines in arms and legs where before there was a painful straightness. Walking home with him one day I enquired about the training school and its effects upon his health. "Well," he said, "I do not know that my health is better than it ever was; it has always been good, but then I am a good deal stronger than ever before." The Manual Training School not only educates the hand, but it puts legs and arms on the boys instead of the miserable caricatures we sometimes find instead. It puts down under the life a good physical foundation.†

The value of manual training as a means of physical culture depends upon the character of the work at which the pupils are set. When the kind of work is judiciously selected, the alternation from pure intellectual work to the hand work and its attendant mental

*Pop. Sci. Monthly XXVI, p. 632.

†Toledo School Report, for 1885, p. 68.

training is a grateful relief and a benefit to body and mind; but when the manual work is fine wood-carving or other work that tries the eyes, or when it keeps the pupils in stooped postures long at a time it is not to be recommended from a sanitary point of view.

Physical Culture for Girls.—He who looks upon active physical exercise and outdoor games as unsuitable and unbecoming to girls must be ignorant of the worth of sound health for the future woman, whether in her sacred home duties, or in her more public life.

There is furthermore in the practice of gymnastics an æsthetic side. Not only is beauty o form enhanced by physical culture, but the fulness of grace and beauty of motion comes only after continued schooling of the muscles, the servants of motion. True grace and precision of motion is not an inborn accomplishment: it must be acquired, and no other influence is so potent to give it as a well planned and systematic course of physical training and outdoor games in girlhood.

One year of good exercise will do more for a woman's beauty than all the lotions and pomades that were ever invented. Interesting as are the changes produced in a man by proper physical training the change in a woman is more striking and significant. Exercise seems to have a particularly immediate effect on a woman's complexion. I have witnessed simply marvellous changes in the complexion, form and disposition of women under light training. I have in mind one well-built girl who carried herself poorly, breathed badly and had an unsatisfactory complexion. She joined a gymnasium, taking the lighter exercises, and began walking a good deal. In a few months a remarkable change had been produced. The nnanimated pose had disappeared, the breathing was better (though still not what it should be, no special training having been directed to the lungs), and the complexion was so clear that one could scarcely credit the change. Under my own training I have watched most interesting changes as a result of breathing exercises alone, and the extent to which locally directed exercises have improved forms that were considered hopeless would not be believed save by observation.*

But do not stop with your encouragement of sports for boys. Do yet more for the girls. There is a reason why the girls of sixteen in America are taller and more robust than their mothers. We can trace it directly to more intelligent ideas of dress and open air exercise, to horseback riding and to lawn tennis. Increase these opportunities and let the girls play hockey and cricket—as indeed, they are already doing in the English schools—let them fence and shoot and swim, but above all give them gymnasiums in every city and town in the land.†

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*Checkley—A Natural Method of Physical Training, p. 142.

†John S. White, LL. D., New York, in Proc. Am. Assoc. for the Advancement of Phy. Ed., 1888, p. 51.

Gaining Time for Physical Culture.—How shall we gain time in our schools for physical culture? An examination of what has been written under "The Hygiene of Instruction" will suggest more than one way in which time may be saved for this purpose. If the question is physical culture or no time for physical culture, we shall do well to put the pruning knife to mathematics, geography, history, misuse of dictation exercises, grammar, languages, and simplify the teacher's marking drudgery. But the first thing required is an intelligent appreciation of the great worth of physical culture. Where there is a will there is a way.

As to the fear that might be expressed by some teachers that so much time taken from the daily session would retard the pupil's intellectual advancement, Von Hippel says that, according to his experience, this is not the case in the Giessen Gymnasium. (See page 114.) The graduates of this school enter the university as well fitted for their position as the graduates of any other institutions, and many of them take a high place in future years.

SCHOOL BUILDINGS.

Site.—It is desirable to have the school-house placed as near as possible to the centre of population of the school district, yet this idea should not lead to the choice of a lot otherwise unsuitable. A moderate increase in the length of the walk to and from the school is a much less serious evil than a place unsafe by reason of unhealthful surroundings or liability to accidents.

The ground chosen for the school-house should be naturally dry, or it must be made so. Clayey soil, or one beneath which, and at no great depth, there is an impermeable stratum of clay is undesirable.

If the ground-water stands at any time of the year near the surface, it should be lowered, and consequently the soil made drier, by laying unglazed drain tiles deep enough below the surface to lower the ground-water well below the bottom of the cellar, or at least four or five feet below the surface if there is no basement. If drainage is needed and no suitable outlet can be got for the subsoil drains, some other site should be sought.

The soil should be free from decaying organic matter, especially excrementitious matter of animal origin.

The surface of the school lot should not be a hollow, or a sag, but its surface should be gently rounded naturally, or made so artificially, particularly at the spot occupied by the school building.

To escape bleak winds and hill-climbing, the school-house should not be placed on a high hill. If everything desirable in a lot is attainable, it should be in a sheltered and sunny locality.

A consideration which should always have much weight in the choice of a lot is, which way are the school-room windows to look, and on which side are the playgrounds to be? The rule should be: School-rooms so placed that the direct sunlight shall shine into them as little as possible during school hours, and playyards so located that they may be on the sunny side and be sheltered from cold north and west winds by the school-building or otherwise. (See Lighting.)

There should be no trees near enough to the school-house to intercept the light in the least, nor to throw their shade upon any part of the building. The same precaution should be observed against the obstruction of the school-room light by neighboring buildings, and, furthermore, the school-house should not be built where there will be a possibility of the erection in the future of buildings that will interfere with the school-room lighting, or otherwise be a nuisance.

The advantages of a quiet neighborhood for the school lot are not generally valued as they should be. The disadvantages of a location in the manufacturing or business centre of a city or village are, from the moral side, the subjection of the pupils to undesirable influences, and from the physical side, pollution of the air by dust and otherwise.

There is, however, in the interest of instruction, a side of this question that should have much weight. In a school-house located in a noisy place, the attention of the school is too often distracted, but still worse than the results of unusual sounds is the continuous rattle of wheels, or the whir and din of machinery near at hand. Under such conditions the work of the school-room is carried on at a disadvantage. The words of teacher and of pupils are heard with difficulty. All are, in the drowning noise, sunk to a level in hearing power with the slightly or moderately deaf, and at what a great disadvantage the only slightly hard of hearing pupil often is, under the most favorable conditions for hearing, is well known.

The nervous and mental strain of school work is severe enough for pupils and teacher without unnecessarily increasing the tension by an unwise selection of a school lot.

Area of Grounds.—In the country the school lot should never be less than half an acre. One acre is still better. "With an acre of land," says Prof. Whitford, "the preferable form for the site is rectangular, having sixteen rods front and ten rods deep; and with a half acre, eight rods in front and ten rods deep."

Arrangement of Grounds.—The lot should be large enough to give ample room for playgrounds, for outbuildings, for division of the rear of the lot into two yards, one for the boys and one for the girls. Then both sexes may have recess at the same time, consequently a longer play time can be secured for all.

It would be very desirable, also, to provide ground for a school garden, if we could get our teachers to take an interest in such a matter and give it an intelligent oversight.

"No school grounds," says Gardner,* "are complete without a sheltering porch or pavilion, under which the scholars can sit when the sun or rain prevents their being actually out from under cover and on the ground. Porches attached to the main building serve something the same purpose, but cannot always be had without obstructing the light of the school-rooms or causing other inconvenience."

The playground should never be paved nor covered with coarse gravel. A part of the playground should be covered with sand.

The school-house should be set well back, away from noise and dust.

* Town and Country School Buildings, p. 126.

THE BUILDING IN GENERAL.

Orientation.—The placing of the building in relation to the points of the compass is a matter of importance to be considered before a school-house is planned and even before the lot for it is chosen. The two main points to be thought of are, *from which direction are the school-rooms to receive their light, and where shall the playyard be located?* (See "Lighting" and "Playgrounds.") We do not want the direct sunshine coming into the school-rooms during school hours, but we do want it in the playyard. The rooms may therefore be placed so as to receive their light from the northwest to the southeast, but preferably from north to east, and the sides of the building on which the playground lays should be from northeast to southwest, preferably east to south.

When the building is to have several rooms, it is a bad plan to have them on every side of the building, for then some of them must necessarily receive an unfavorable light. It is much better to put the school-rooms on the one or two sides that will furnish the most favorable light, and on the other sides place the entrance, corridors, wardrobes, stair-cases, halls, library, and teachers' rooms.

There should be no hesitation in placing the building out of line with the street, if otherwise the sunshine cannot be kept out of the rooms where it is not wanted, and cannot be secured where it is wanted.

Foundations.—The foundation walls must be so constructed as to prevent dampness rising through them. To prevent this, a damp-proof course of asphalt, perforated glazed tiles, or other effective material should be laid.

Buildings set on posts are unsuitable as winter school-houses in this climate. Banking up for cold weather imperfectly protects the floor from cold and makes the lungs of the pupils the recipients of whatever noxious emanations the artificial heating may draw from the ground. A good dry cellar is very desirable under even the most unpretentious school-house.

Basement.—The bottom of the basement should be at least three or four feet above the average level of the ground-water. The construction of this part of the building should be of the best, for it is interposed between the school-rooms and influences that are harmful to health. It should be of good height and well lighted.

All danger of emanations from the soil, and of dampness should be guarded against. To this end, the floors should be laid with from four to six inches of good concrete, thoroughly rammed and grouted with hot coal tar and asphalt. There are so many facilities for cheating in work of this kind that the basement pavement should never be laid by contract. The best of material should be provided and it should be laid by day labor.

Height of School-Houses.—Of late years many writers have called attention to the ill results upon the health of pupils, especially of girls, of being compelled to climb the stairs in too lofty city school buildings. There are undoubtedly good grounds for complaints of this kind, and for more reasons than one, it is not desirable to have the pupils climb more than one flight of stairs to any school-room.

The climbing several times daily of a single flight of properly constructed stairs, can have no injurious influence upon the health of sound scholars; but our system of public education is applied to the mind almost exclusively and does not particularly concern itself with the preservation and improvement of physical capability. It could hardly be expected to be otherwise than that a pretty large percentage of the scholars in the public schools should suffer locally or generally from this lack of systematic physical culture. We are, in fact, obliged to build, not for pupils who are all robust, but for pupils, many of whom would suffer an injurious strain by the hasty climbing of long flights of stairs.

As to the liability of injury in climbing school-house stairs, it does not all threaten from the mere fact of the climb. Mountain climbing is an exhilerating pastime, and one conducive to health under proper regulations as to persons and methods. Physicians have even prescribed mountain climbing with the happiest results in certain kinds of diseases of the heart and cardiac weakness. Stair climbing, too, may be for the generality of pupils, a means of physical improvement, or it may cause a serious strain, according to how it is done If the school girl, deficient in muscular strength makes the ascent on the run, as is often the case, breathlessness, undue acceleration of the heart's action, and other symptoms of local physical strain, are the results. The injunction to go up stairs at a moderate pace would be a wise premonition if there were any likelihood that it would be heeded In view of the oft-enunciated fact that youth is indiscreet, long ascents to school-rooms should be excluded from school-house plans, that the average pupil may not be injured by improper methods of climbing, and that the feeble ones may not be hurt by the climb, at whatever pace it may be made.

I believe, therefore, that I am entirely in accord with the best authorities, in laying down the rule that school-rooms are better for any grade of school on the ground floor, and that no school-room be located higher than the second floor.

Construction.—Warren R. Briggs* regrets that money enough is not usually appropriated to make it possible to adopt a fireproof construction for school-houses. "My own preference," says he, "would be to reduce the exterior effect of the building to the verge of barrenness, in order to obtain funds enough to render the structure fireproof—not only in the floor, but in all other portions as well."

Exterior Finish.—A pleasing exterior is desirable, but exterior decoration should be entirely subservient to that which is essential within the building. Well lighted rooms, good ventilation, and other sanitary necessities will be assured as the first things by an intelligent building committee, and then the architect's fancy for external ornamentation may be gratified, if there is anything left for it.

Projecting roofs, verandas, or anything else that would intercept any of the light that belongs to the school-rooms should not be admissible.

The Entrance.—If the entrance can be placed on the sunny and sheltered side of the house, it will make it pleasant and more comfortable for the children.

If there are more than three steps leading to the entrance there should be a railing on each side ; if not more than three steps, they may lead to the platform from all three sides.

Sheltering porches are more than ornamental ; they protect from rain and hot sunshine and tempt the children to come into the outer air more than they otherwise would. The outer door should be of ample width, and with all other school-house doors should swing outward as the law provides.

Halls and Corridors.—The halls and corridors should invariably be warmed. When the children pass from the well-warmed school-rooms into a hall or corridor whose temperature is

* Building, V, 113. 1886.

down to the freezing point or lower, and put on their chilly wraps for the homeward tramp it is both unpleasant and unconducive to health.

The warming of the halls and corridors may be by direct radiation, unless they are to be used as wardrobes, in which case it is better to plan ventilation for them.

A proper width for the corridors of rather small school-buildings is seven or eight feet; but the corridors of large city school-buildings should not be narrower than ten or twelve feet. The corridors should be of ample size to permit all the pupils to move about in them at recess when the weather prevents them from going out, especially if no covered playroom is provided. A well planned school-building has the corridors running along one of its sides instead of in its center. Corridors and halls should be well supplied with windows for lighting and for window ventilation.

Wardrobes.—The arrangements for the accommodation of the pupils' outer garments are various, some commendable and others not so good

1. Arrangements may be made for hanging them up or otherwise storing them in the school-rooms.
2. Hanging the clothing in the halls and corridors.
3. One large room as a wardrobe for the whole school, or one for each sex.
4. One for each school-room.
5. Two for each room.
6. One for each floor.
7. Two for each floor.
8. Board partition wardrobes in the corridors.

The outer garments should never be stored in the school-room. The hygroscopic qualities of clothing are very marked; it therefore absorbs the perspiration and its decomposing constituents, and readily becomes impregnated with gases. On the other hand, when warmed to the temperature of the school-room air, clothing readily gives up again to the air the offensive material it has absorbed.

Furthermore, on account of its porosity, clothing is very likely to transport any particulate matter which it receives from its surroundings. Matter of this kind, dangerous in the school-room, is the infection of many diseases. The history of epidemics is full of instances in which the clothing of school children has served as the medium for conveying infection from one child to another, and from one home to another.

One or two large rooms as the wardrobe for a building of more than one floor is not a good arrangement.

The utilization of open halls and corridors is not the best way, but is allowable when the school-house appropriation permits nothing better.

One wardrobe for each school-room does very well, but one for each sex is preferable.

A good and economical arrangement is two wardrobes, one for each sex, on each floor, particularly on floors with not more than four or five rooms each.

When arranged in this way, lighting, ventilation and economy are favored by having the two wardrobes finished up in the same room, and divided by a matched hard wood partition only seven feet high.

An excellent way to make the wardrobes is to have the corridors of ample width and take the wardrobes from them by means of this same kind of matched board partitions running only a little more than half way to the ceiling. Made in this way, they are light and airy, and the cost of construction is but slight. The whole upper part of the corridor is unobstructed, and the wind has full sweep when it is wished to flush out these rooms with fresh air.

Mr. Warren R. Briggs advises leaving wardrobes of this kind open at the bottom, as well as at the top, running the corner posts only down to the floor. He says:

I have used rooms of this description in all grades of buildings with marked success. Usually they have been constructed of matched and beaded hard wood in narrow strips, but if it is desired, they can be made more pleasing to the eye by the use of panel work. Their great advantage lies in their perfect ventilation, convenience, and the comparatively small amount of space that they occupy.

The wardrobes wherever located should be warmed and ventilated.

Staircases.—Stairways should not be planned in the center of the school building: they should be placed against an outer wall or in wings designed expressly for them, where they can be well lighted. All staircases should be built with one or two landings so as to break the flight into two or more runs

In all large school buildings the stairs and their enclosing walls should be fireproof. Box-stairs are the best and safest in school-houses. With them balusters are entirely unnecessary, and only brass or iron hand rails are needed, bolted to the side walls with metal brackets. Mr. Briggs says he has had good success in making these rails of two inch wrought-iron pipe, on each end of which are screwed neat cast-iron caps.

The width of the stairs should never be less than four and a half feet in any school-house, and in large buildings they should be from six to eight feet wide.

A proper height for the risers is from six to seven inches, while for small children five or five and a half inches is better. The treads should not be less than eleven inches, and twelve inches is still a better depth.

Winders, or circular stairs, are wholly inadmissable.

In most plans for large school buildings it is desirable to have two flights of stairs, one in either end of the building. This is to be recommended to ensure a greater degree of safety in case of fires, and to lessen the tramping and noise before the doors of the rooms on the lower floor.

THE SCHOOL-ROOM.

Its Shape.—The best shape for the school-room is that of an oblong, the width being to the length about as three to four. The teacher's desk should be at one end of the room. This shape is recommended by authorities, generally, because it is the one that admits of the most satisfactory lighting, renders less difficult the supervision of the children's work and deportment, and the acoustic qualities of rooms of this shape are said to be less troublesome than those of square rooms.

When only a small number of pupils are to occupy the school-room, its shape may more nearly approach the square with the principal lighting still from one of the longer sides.

Length.—The length of a well-planned school-room is limited by the distance at which writing on the teacher's blackboard can be distinctly seen at the rear row of desks, by the distance at which the teacher's words are easily understood, and by considerations of facilitating the government of the school.

Large, clear writing on the blackboard can be read easily by the normal eye at a distance of about thirty feet. Some late authorities say about twenty-seven feet. The teacher's writing is, however, very often indistinct, and the eyes of many pupils are abnormal. Thirty feet is as far as the teacher can speak to pupils without too much exertion, and as far as the average child can distinctly hear the words of the teacher. The nearer the pupils are to the teacher, the more easily is the discipline of the school maintained.

The authorities on school hygiene agree very nearly on this question. Dr. Lincoln* says the school-room may be from thirty to thirty-three feet long; Eulenberg and Bach,† that it shall not be more than thirty-one feet; Janke‡ from twenty-nine to thirty-two and one-half feet; the German imperial regulations of 1880 and those of the Prussian government correspond essentially with Janke's rule; the school-rooms in the Boston High and Latin school building are thirty-two feet long and twenty-four feet wide, typifying the ideas of Dr. Philbrick's wide experience.

Width.—School-rooms of more than a moderate width cannot be lighted properly in all their parts, and they make difficult the supervision of the pupils' work and conduct. As the teacher cannot keep the whole school under his eye at once, he is obliged to turn his head from side to side rather continuously.

The laws of optics applied to the lighting of school-rooms teach that the amount of light received at any desk diminishes rapidly as its distance from the windows increases. The principal light should come from windows at the left of the scholars. The distance into a school-room at which we may depend on windows to furnish a satisfactory lighting is not great. This distance has usually been stated in this country to be one and one-half times the height of the window top above the floor. This is in conformity with the French regulation of 1880. It indicates that windows whose tops are twelve feet above the floor will give a fairly good light eighteen feet from them.

Assuming one-sided lighting, and that the windows are properly distributed and are of sufficient size, other authorities limit the width of the school-room to two and one-half times the height of the window tops above the tops of the desks. Eulenberg and Bach would not have the width of the room more than twice this height, and the opinion of Prof. Forster§ of Amsterdam coincides with theirs.

*School and Industrial Hygiene p. 79, Philad. 1880.
†Schulgesundheitspflege p. 159. Berlin, 1890.
‡Grundriss der Schulhygiene, p. 24. Hamburg, 1890.
§Deutsche Viert. f. öffent. Gesundh. XVI, 44. 1894.

The width of the school-room, then, is limited by the height to which it is practicable and expedient to extend the school-room windows. Dr Lincoln says that the width should never exceed twenty-four feet. The later German authorities range from nineteen to twenty-four feet, the maximum being usually put at twenty-three feet. These widths include the width of the aisle beyond the last row of desks.

Height of School-Room.—That a school-room may be well lighted, and may be ventilated without troublesome draughts, it must have a height of at least twelve feet, and practical considerations relating to the cost of construction, to the acoustic qualities of the room, and, on the lower floors of more than one-story buildings, to the expenditure of energy in stair climbing, makes it undesirable that the ceiling shall be more than thirteen feet in rooms of ordinary size. But the absolute need of good lighting necessitates an increase in this height within certain narrow limits as the width of the room is extended.

It has been assumed that echoes are likely to be troublesome in rooms more than twelve or thirteen feet high, but Eulenberg and Bach express doubts as to the danger of acoustic difficulties in rooms of good height; in certain schools of Berlin the ceiling is 5.5 m. high (14 ft.—9 in.) and they have heard of no complaints from the teachers that their voices are not distinctly heard. They therefore consider a height of from 4.3 m , 4.5 m. (14 ft.—1 in. to 14 ft.—9 in.) unobjectionable.

In planning school-houses, architects should hold to the fundamental rule not to make them too long nor too wide. They will often find building committees strongly inclined to impose impossible tasks upon them, to wit: the planning of a faultless lighting for rooms too wide to admit of it. Though the architect has an eye for business, he is at liberty to urge his views as to what is practicable and advisable in the class of buildings under consideration, and an intelligent understanding of the peculiar requirements of school buildings should lead him to try how far the erroneous notions of his clients may be overcome.

Floor Space.—The whole floor surface, divided by the number of pupils to be accommodated, should give at least 20 square feet to each pupil.

Cubic Air Space.—With 20 square feet of floor space, and ceilings twelve feet high at the least, each pupil will have not less than

240 cubic feet of air space. To make good ventilation practicable, the cubic air space should never be smaller than this.

Teacher's Platform.—Located at one end of the school-room, this should be five feet wide and eight or ten feet long. It should be raised but a single step above the general floor level.

Aisles.—That the distance between the windows and the last row of desks may be reduced as much as possible, the aisle between the window side of the school-room and the first row of desks should not be more than two feet, or two feet and a half.

If single desks are used, eighteen inches will do very well for the aisles between the desks, or if double desks, two feet will be the proper width.

The aisle between the last row of desks and the wall at the right of the pupils should be of good width. This is the main blackboard wall, and the entrance is usually on this side. This aisle should be four feet or four and a half feet wide.

Counting from the teacher to the rear of the room, his platform will take five feet at least, the distance from the platform to the first desks should be four feet and a half, each desk and seat will need two and a half feet, and the rear aisle should be four feet wide, especially if the local heating apparatus is at the rear.

On Planning a School-Room.—The proper way to plan a school-room is first to determine the number of scholars to be accommodated, then to make a schematic arrangement of their desks, to lay off the central, rear, and side aisles, and to calculate space in front of the teacher's platform for the movements of classes. Having, meanwhile, borne in mind that the width of the school-room should be to the length about as three to four, we have merely to draw a line at each margin of the assigned space to represent the walls and we have our plan to be tested critically by the rules for lighting school-rooms, by that for floor space, and to be furnished with the necessary details.

As an illustration we wish to plan for thirty-five pupils to be seated at single desks. (See Fig. 3).

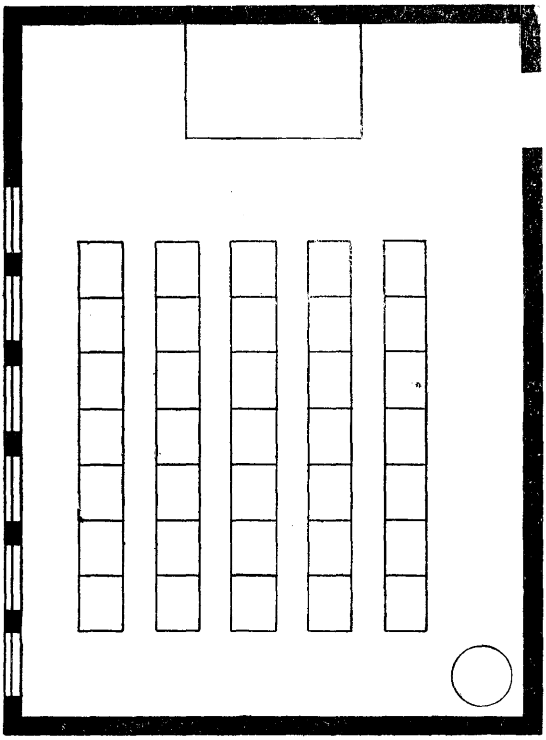

FIG. 3.

WIDTH.

Aisle on window side	2′	6″
Five rows of single desks....	10	0
Four central aisles......	6	0
Aisle on blackboard aside..................	4	6
	23′	0″

LENGTH.

Teacher's platform..	5′	0″
Front aisle	4	6
Seven rows of single desks	17	6
Rear aisle	4	0
	31′	0″

In such a room, 23 feet wide and 31 feet long, the farther side of the last row of desks is $18\frac{1}{2}$ feet from the windows, each of the thirty-five pupils has a little more than 20 square feet of floor surface, and slightly more than 240 cubic feet of air space. The room is also in good proportion as regards the relation of width to length.

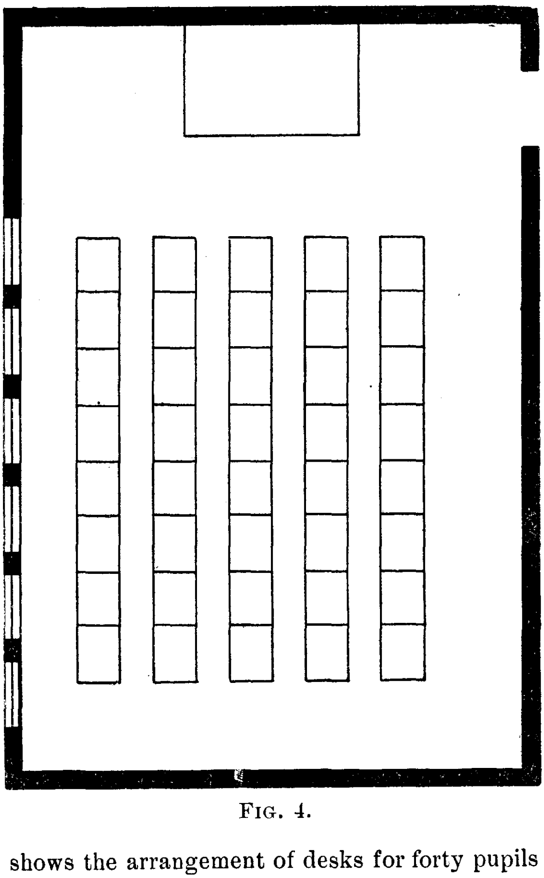

FIG. 4.

Fig. 4. shows the arrangement of desks for forty pupils in a room 23×33. The farthest edge of the last row of desks is eighteen and one-half feet from the windows at the left. With the same width of aisles as in Fig. 3 each pupil has almost nineteen square feet of floor space on an average. To increase this to twenty square feet each, the room could be made slightly longer.

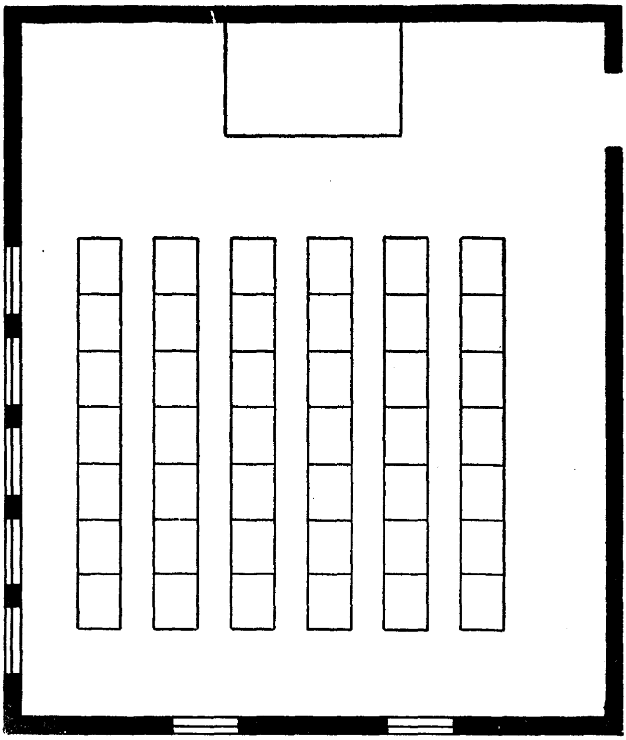

FIG. 5.

Fig. 5 presents an arrangement of forty-two desks in six rows. This room does not so nearly approach the ideal shape as Fig. 3. The last row of seats is a little too far from the windows at the left for satisfactory one-sided lighting,—twenty-two feet to the farthest edge. The whole width of the room is twenty-six and one-half feet, and its length thirty-one feet.

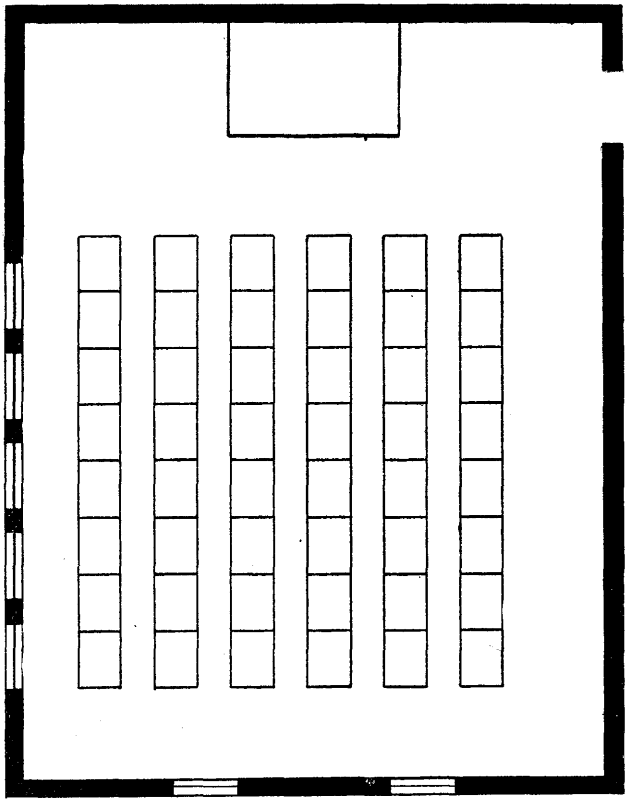

FIG. 6.

Fig. 6 shows forty-eight desks in a room $26\frac{1}{2}\times33\frac{1}{2}$ feet which is well up to the extreme for both length and width, and, at the same time, the average of floor space per pupil is not quite up to twenty square feet.

Interior Finish.—The less projecting finish there is to catch the dust, the better. To facilitate the cleansing of the rooms, all woodwork should be plain and smooth. Of our native woods oak, ash, maple, or birch, is excellent for the inside woodwork, finished in the natural wood. A heavy coat of a good filler and two coats of varnish, each well rubbed down, should be used. Whitewood and white pine are too easily marred.

The walls should be smooth and it is highly desirable to have them finished so as to permit washing when necessary.

Impermeability of walls is desirable rather than otherwise. It is absurd to depend upon the "natural ventilation" through the walls for any part of the air supply for a room full of children. It is more in line with sanitary requirements to provide for cleanliness of walls by making them washable and incapable of straining out and storing up dirt and bacteria. There is, therefore, no sanitary objection to painted walls.

Wainscoting.—The walls of the school-room should be wainscoted in wood to the window sills on the window sides, and to the blackboards on the blackboard sides of the room. A poor substitute for this is to paint the walls in oil to the height of five or six feet and, if necessity compels, to leave the upper part of the walls in the lime finish.

Warren R. Briggs makes a plea for enameled bricks for the walls of the better class of school-rooms. "Of course," he admits, "side walls built of these bricks are more expensive, to start with, than those constructed in the ordinary manner; but where their durability is taken into account, and the benefits derived from a sanitary point of view are considered, I believe it safe to say that, in the long run, it would be economy to introduce them into all our public school-houses.

"A compromise might be made by introducing these bricks for a dado or wainscot running up under the blackboards and windows only, above the blackboards using Portland cement applied directly to the brick walls as described for ceilings. This would make a durable and pleasing wall without much, if any, additional expense.*

Color of Walls and Ceiling.—The tint of the walls and ceiling has an influence on the amount of light in the room worth enlisting on the right side. Dark walls rob the room of needed light, white walls are too dazzling and irritating to the eyes.

Schmidt-Rimpler says that he has often seen spasm of the accommodation arise as the result of looking at dazzling surfaces in the school-room.

The walls should be of a very light neutral tint, a light gray, light bluish-gray, or light greenish-gray.

The ceiling, on the contrary, should be left white that it may be as effective an overhead reflector of light as possible.

In some parts of Europe there is a custom worth noting of painting a long arrow on the ceiling, indicating north and south.

Blackboards.—The blackboards must receive a good light. The only proper place for the main blackboard surface is on that

*The Planning and Construction of School-Houses, Building, V, 113. New York, 1886.

wall which is at the right of the pupils and opposite the windows that are at their left. It will be noticed in the plans given in this paper, that this wall has been reserved as much as possible for this special purpose. The wall at the teacher's end of the room may also be used for blackboard surface, wholly or in part as the plan admits. Placed as is here advised, there will be the least danger of dazzling reflections from the blackboards and of indistinctness of the writing on them.

The interdiction of blackboards between or near windows is as absolute as that of windows before the eyes of the pupils.

Area.—I agree entirely with a teacher who says that, "there is too much use made of the blackboard in teaching." The modern school room runs to blackboards too much. The available space on the two walls is ample, if the room is properly planned.

Height.—The height of the blackboard and its width should be proportional to the sizes of the pupils in the room. The most frequent error is to place them too high for small pupils.

If primary pupils are to be sent to the board, its lower edge should be as low as 24 or even 20 inches. For older pupils the lower edge should be from 24 to 30 inches high. In mixed and advanced schools the blackboard should extend to a height of about seven feet, that its upper part may be used for drawings or other work that is to be left undisturbed.

Beneath the blackboard, the upper part of the wainscoting should support a trough-shaped moulding to catch the crayon dust and to hold the crayons.

Material.—The very best material for blackboards is natural slate. At the present prices its cost should be no bar to its use in all of the better class of school-houses. Next in desirability to the natural slate are some of the artificial slating, or liquid blackboard preparations. Many of these preparations, however, are injured by the application of wet erasers,—a serious fault if chalk dust is to be avoided in the school-room atmosphere. Blackboard surfaces should be of a dull black, not shiny.

Chalk Dust.—Another source of dust that may, under a careless teacher, be an injurious nuisance is the chalk whisked into the air by a row of pupils at the blackboard, one hand holding the crayon and the other the brush laden with dust. Here it is not a question of infection, but the records in works on industrial hygiene are replete with evidence of the harmfulness of breathing mineral dust. This evil needs only a little care for its mitigation. In the first place it is the question of the expenditure of a little more money for dustless crayons instead of the common kind. With common chalk, a damp eraser should be used, and not a brush loaded with dry chalk dust.

Floors.—The construction of the floor is of importance with reference to the healthfulness of the room. Rough or loose floors, or floors full of cracks, are difficult to keep clean and favor dustiness of the school-room air.

The cracks in floors and spaces beneath the floor boards, all filled with dirt, have been assumed to be favorable places for the lodgment and development of disease germs. Some observations, notably those of Emmerich of Munich apparently confirm this opinion.

Cold floors are a prevalent nuisance in cheaply constructed school-houses. They cause the children much suffering during the winter terms, and sitting with cold feet is a prolific cause of catarrhal affections.

In country school-houses with no basements, extra care should be taken to ensure warmth of floors. The floors should be double with an intervening air space.

Floors should be made as non-absorbent as possible. They should be of hard wood, in boards not more than four or five inches wide, well laid. They should be oiled at least twice a year.

A method of constructing floors for school and other public buildings, that has come into use in France and Germany is to imbed parquet sections or narrow boards of well-seasoned oak or other hard wood in a layer of asphalt. Floors of this kind have proved highly satisfactory, for they remain firm and free from cracks, are warm and easily kept clean, and in every way are said to answer sanitary requirements. It is further claimed that they are not expensive.

Floors of this kind are specified in the regulations issued by the French Minister of Instruction relative to the construction of school-houses.

Cleanliness of School-Rooms.—Cleanliness and neatness should be the standing order of the day in every school-room. There should be no paper, bread crumbs, or nut shells on the floor. There should be mats and scrapers at the entrance, and the pupils should be trained to use them in carefully removing dirt from their shoes before entering.

The reason for this care, which concerns us now, is that dust and dirt in the school-room is a serious sanitary evil. Of what does this school-room dust consist? Of the whole flood of dried and pulverized wastes from human and animal sources, of wastes from the pupils' homes. and from the street brought by the wind, but brought much more plentifully on the shoes of the pupils.

Dust of itself is an irritant to the eyes and the air passages. Dust is known to be a bearer of disease germs. Consumption is certainly transmitted thus, and it is very probable that many other infectious diseases are spread in the same way. An infectious inflammation of the eye, granular conjunctivitis, is sometimes very prevalent in schools, and it is believed that the germs of this disease are spread by means of the dust in school-rooms as well as in other ways.

To mitigate this dust evil as far as possible, school-rooms should have better care than many school-rooms get. They should be swept daily at the close of the afternoon session after all the pupils have left them. The windows should be wide open. Dust that settles on desks and other furniture should afterward be removed with a cloth.

Before sweeping it is preferable to strew the floor with damp sawdust.

Hardwood floors properly prepared by oiling may be kept clean by wiping with a damp cloth.

The damp way of cleansing floors is far better than the dry way, for, in the latter, much of the dust is simply displaced and settles in the school-room again.

Floors and walls must be washed carefully at much more frequent intervals than they are in most school-rooms, if decency is a principle in the school management.

Spitting upon the floor is a filthy habit, and circumstances may make it a dangerous one. The pupils should be taught not to do it.

School-Room Doors.—There is some advantage in having the school-room door placed near the teacher's desk; the turning of the pupils' heads to see who comes is thereby avoided, and the teacher has entering or departing pupils more closely under his control.

All school-room doors should have transom windows of good height over them hung at the base and adjustable from the floor.

They are of great advantage in window ventilation, especially in warm weather.

With transoms over them there is no need of great height of doors.

LIGHTING.

The question of lighting school-rooms cannot be decided as in lighting dwelling houses, from the point of view of rejoicing the inmates with floods of sunshine, for the problem relates to rooms whose many inmates are to be fixed in their positions,—they cannot, at their convenience, carry their work nearer to, or farther from the windows, or move away from dazzling reflections or direct sunshine when troublesome. These inmates are to be children engaged in the acquisition of learning and mental culture, and this acquisition comes largely through strenuous eye-work. The eye and what will render the conditions under which it works the most favorable, are therefore the first consideration.

Though the proper lighting of school-rooms is one of the most important problems in school hygiene, most of our school-rooms are not well lighted. (See page 88).

Direction of Light.—A. With Regard to the Points of the Compass.—It has already been said that school-buildings should be so placed as to exclude the direct rays of sunshine from the school-rooms during school hours, and that the preferable light is therefore from the E., N. E., or N. This is the emphatic recommendation of the State Board of Health's Committee on School Hygiene.

Direct sunshine in the school-room is cheerful, and we are told that it sets in motion and revivifies the air. But in school work, the organ the most severely taxed is the eye. Of no other school diseases do we hear so much as of eye troubles. The eye, therefore, is entitled to our first consideration in planning school-rooms. It is dazzled, irritated and imperilled by work on small objects illuminated directly by the sun. It is also seriously endangered when the direct sunshine falls upon the desk, or upon the floor, or on the wall not far from the field of vision. One of the first important rules in lighting is to exclude the direct rays of the sun from the school-room during school hours.

Further, we do not want to trust any theoretical notions as to the revivifying power of the sun. Air once breathed can never, in closed rooms, be made fit to breathe again. We want to be rid of it, and to get fresh air from out of doors to take its place. For this purpose pure air "revivified" out-doors by the sunshine and supplied by an efficient ventilating system, and play in the open air, are what we may trust to preserve the health and vivacity of child life.

While at work on this paper and at other times the present writer has had ample opportunity to compare the north light with that from other quarters of the heavens. With eyes rather overworked, but not diseased, the position has most of the time been between two windows, one looking to the east, the other to the south, In this room, in sunshiny weather, with outside blinds and inside shades, it has been found most of the time impossible to secure a light that is not trying to the eyes. Changes have often been made to another room lighted only from the north. Here, at all times, in clear or in cloudy weather, the light has been satisfactory. The change in bright weather has made the mildness of the lighting and the entire absence of dazzling reflections from window casings, walls, floor and work table very noticeable.

Strangely many authorities recommend a southerly lighting, but most of the leaders in this opinion live at a higher latitude than ours, and in places where there is more cloud, fog, and smoke than we have, and where the late hours of the afternoon session are darkened in winter by the early setting of the sun. For us, with our geographical conditions, the southern lighting should be positively rejected.

In our climate the days are many in which clouds pass rapidly over the face of the sun, giving rapid alternations of light and shade. As the accommodation of the eye according to the amount of light is not an instantaneous process, these rapid changes in the intensity of light, when the lighting is southerly, are extremely trying to the eyes, and no protection can be given by curtains.

Other authorities strongly support the view held in this paper, that other than a southern exposure of school-rooms is desirable. Prof. Forster* of Breslau, says:

Many of the advocates of the southern exposure of school-rooms pass over this point lightly with the remark that, "Protection from the direct rays of the sun may easily be had by the use of curtains!" But this "easily" I must dispute. The curtains are not yet invented that will keep back the direct rays of the sun and at the same time

* Deutsche Viert. f. off. Gesundh. XVI, 422.

let the diffused light of the clear sky pass through. The inventor of such a curtain would be regarded as a benefactor of the human race. As such a protection some have recommended thick, white linen, but this is too dazzling. Then ground glass has been recommended, but this is also too blinding in direct sunshine and in cloudy days intercepts the light too much. Again, all green, gray, or blue curtains, if thick, absorb too much light and make the desks most distant from the window, too dark, while if thin, they let through too many of the heat rays. Venetian and other blinds darken the room altogether too much and are wholly unsuitable. If the curtains are brought across the upper part of the window, they obscure just that part of the window opening that is the most valuable for lighting the school-room.

The loss of light when school-room curtains are drawn was determined by Cohn with Weber's photometer to be very great. According to the kind of curtains present it varied from 75 to 89 per cent., and blinds with adjustable slats shut off from 57 per cent. to 91 per cent. of the light according to the position of the slats.*

Windows to the *north* furnish a light that is more uniform, soft, and agreeable to the eye than that from any other point. It is preferred by microscopists and others whose work is trying to the eyes. Windows on this side need no blinds.

Windows to the *east* let the sunshine stream into the room in the morning, but it is soon gone after the opening of the forenoon session.

School-room windows to the *south* should be avoided for the reasons stated.

Windows to the *west* admit the long level sunbeams that are so troublesome in the latter part of the afternoon session. Light from this direction is not objectionable in schools with no afternoon session. West windows have the disadvantage in some localities of admitting much dust in summer.

B. **With Regard to the Pupil.**—All authorities unite in condemning windows placed before the eyes of the pupils. They do not throw their light on the work of the pupil, but they do dazzle his eyes with their glare.

Windows at the pupil's right, throw troublesome shadows over his work when he is writing.

Windows at the rear throw the shadow of the pupil's head and shoulders upon his work, and cause him to twist his body to avoid this trouble.

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* Deutsche Viert. f. off. Gesundh. XVII, 202.

Windows at the left admit the light from a direction the most favorable to the pupil for all kinds of work, and the chief source of light should be from windows on this side.

Windows both right and left of the pupil are objectionable by reason of troublesome cross lights and shadows that are very unfavorable to the health of the eye; but windows may be placed over the blackboard at the right for ventilation in warm weather and, when the school-house is only one room wide, for sunning the room at noon and at other times while the children are out. While they are at their studies, however, the blinds of these windows must be kept tightly closed.

Windows at the rear, in addition to those at the left, are hardly objectionable if the left light is in great preponderance, except for the fact that they trouble the teacher who is entitled to consideration. If the rear windows will admit the direct sunlight any time during school hours, the left windows should be of ample size to light the room without them when the blinds of the rear windows are closed.

One-sided lighting with windows looking east, north-east, or north, is the ideal method if the rooms are not too wide.

Quality of Light.—The kind of light wanted in school-rooms is the soft, diffused light from the open sky, and to ensure abundant light a good-sized patch of sky should be visible from every desk in the room. Direct sunlight and dazzling, reflected lights, whether from outside objects, as neighboring buildings, or from improperly tinted school-room walls, are harmful during school hours.

Quantity of Light.—"The eye, like the stomach," as a European surgeon has said, "suffers from too much, and it suffers from too little." In the school-room the too much light for the eye is out of the question, *provided* it is only diffused light and not direct sunshine or objectionable reflected light.

The total window-opening should equal at least one-fifth of the floor surface, and this rule will hold only within certain widths of room, and when no buildings, trees, or other external objects intercept a part of the light.

With Weber's photometer, Cohn determined the amount of light in 133 school-rooms in Breslau, some old and miserably lighted, some new and well lighted. The degree of lighting in the lightest places near the windows ranged from 61 to 1410 in clear weather and from 32.6 to 1050 in cloudy weather. At the darkest desks, the light varied from 1.7 to 160 in clear weather, to from 1 to 69 in cloudy weather.*

Compare these figures with those obtained by the same author in testing out-doors the light of the open sky,—305 for the lowest and 11,430 for the highest.

The quantity of light found at the darkest desk should, according to Cohn† and others, equal at the very least that of ten meter candles.

Schmidt-Rimpler‡ tests the lighting of school-rooms by laying a small test-type upon the desk and comparing the distance at which it can be read with the distance at which it is legible near the window.

Height of Window Sills.—The window sills should not be less than three and one-half feet above the floor. Dr. Lincoln says four feet. The Darmstadt commission requires them to be as high at least as the heads of the pupils.

The reason why school-room window sills should be pretty high is that light admitted low illuminates the pupil's work but very little, but dazzles his eyes instead.

Height of Window Tops.—The most favorable light for study enters the room at a point somewhat above the student's head. The higher the point at which light enters, the farther it penetrates into the room. When the ceiling is left pure white and the light is well admitted to it, it becomes a useful auxilliary in lighting the school-room. If, therefore, a given amount of glass is to be used in lighting a school-room, it will best light it if it is placed as high in the school-room wall as practicable.

The required height of the ceiling has already been given (See "The School-Room.") The space left between the top of the window and the ceiling should not be more than one foot. Six inches is still better. Even in brick or stone buildings, by using iron girders, the tops of the windows may be less than a foot from the ceiling.

Shape and Size of Windows.—The light given by the uppermost part of a window is of too great value to have any of it sacrificed for architectural effect. Windows of arched and Gothic shapes should, therefore, never be used for lighting school-rooms.

If the walls of the building are thick, space worth saving for the passage of light may be gained by splaying the inner openings of the windows.

*D. Viert. f. öf. Ges XVII, 201

†Die Schule der Zukunft, p. 7. Hamburg, 1890.

‡Die Schulkurzsichtigkeit, p. 79.

As the sashes should be light and run easily, it is not desirable to have them more than three feet wide.

When the ceiling is to be twelve feet high, and there are to be twelve lights to a window, (three wide and four high) a light of suitable size is one 12x22 inches. If there are to be only four lights to a window, 18x44 inches may be chosen.

If the ceiling is to have a height of 13 feet, for a twelve-light window, we may take a 12x26 inch, or, for a four-light window, 18x50 inch pane.

A Model Window Wall.—To light from one side only a school-room 23×31 feet, with ceiling 12 or 13 feet high, the following arrangement is given as a guide:

Length of room	31 –0″
From front corner to first window	5–0
Six windows, each 3 ft. wide	18–0
Five spaces between windows, 1 ft. each	5–0
From last window to rear corner	3–0
	31–0

Height of ceiling	12′–0″
From floor to window sill	3′–6″
Window opening* (4 lights, each 22 in.)	7–4
Space above windows	1–2
	12′–0″

With this arrangement we have a ratio of 1 : 5.4 between glass surface and floor surface, slightly below the desirable ratio of 1 : 5. As the tops of the windows are 10 feet and 10 inches high, the distance from them at which the lighting will cease to be ample is 16 feet and 3 inches. (See "The School-Room-Width.")

Height of ceiling	13′–0″
From floor to window sill	3–6
Window opening (4 lights, each 26 in.)	8–8
Space above windows	0–10
	13–0

*The term "window opening" is here exclusive of space occupied by the sash. That is preferably taken from the "space above windows."

This arrangement gives a ratio between glass and floor of 1 : 4.5 which is ample. The height of ceiling permits windows whose lighting may be deemed ample at the distance of 18 feet and 3 inches.

Therefore, in school-rooms in which unilateral lighting is to be used, and in which the last row of desks will be 18 feet from the windows, the ceilings should not be less than 13 feet, nor the tops of the windows less than 12 feet high.

To light from left and rear, a school-room 23x31 feet should have five windows, at least, at the left of the scholars.

Windows Grouped or Distributed?—There is not much of this question left if a proper quantity of light is to be admitted from the left of the pupils. If we are pleased to call it grouping, there should be but one group extending the whole length of the left hand wall with a comparatively narrow space of unoccupied wall at front and rear, and narrow and equal spaces between the windows.

This is really an even distribution of the windows along the wall as they should be arranged The space between the windows should not be more than 16 inches, and when the lighting is from the left only, still narrower spaces are better.

Sashes and Their Hanging.—The sashes should be light, both to save light and to make their motions easy. They should be hung on pulleys with friction rollers, so as to move at a touch. The quantity of light derived from a four-light window is somewhat greater than from a twelve-light window, especially when double windows are on. The four-light window is therefore preferable if the somewhat greater cost does not interdict it.

Eyes should be fixed to the upper sashes so they may be opened or shut with a pole, or still better is an arrangement of pulleys and cords by means of which the sashes may be raised or lowered at pleasure.

Blinds and Shades.—Curtains or shades, needed at times to shut out injurious light, are often a nuisance when, through negligence, they are left down after the need of their protection has passed. For instance, Schmidt-Rimpler found vision 27-35 at the farthest desk in a room where two curtains were unnecessarily drawn, but it rose to 35-35 after the curtain was raised. Two things suggest themselves; first, that teachers should carefully supervise the use of shades when they are present, and, second, the advantage of obviating the need of them by taking the principal light of the room from those quarters of the heavens whence direct sunlight does not come during school hours.

The best of material for school-room shades is a light grey linen. When it is drawn, this permits some diffusion of light through its texture while intercepting the direct sunshine. Dark-colored and painted shades are not suitable for the school-room.

School-room shades should be hung so that, at will, the upper half of the window, the lower half, or both, may be covered. There are at least two kinds of fixtures that permit this.

Double Windows.—The discomfort arising from sitting near a window is due in large part to the downward flow of the air that has been chilled by coming in contact with the cold window, and in a much smaller part to the inward leakage of cold air. This draughty condition near windows is prevented by double windows, and they are thus called for in all school-rooms during winter in the interest of the health and comfort of the children, as well as with a view to saving fuel. Their cost, Dr. Marble* urges, will be saved in two winters.

It has been affirmed, as an objection to them, that double windows diminish the amount of light that would otherwise enter the room. In our climate in winter this is not true. By preventing the frosting of the panes they save more light than they obstruct. They should, however, be of a kind to interfere with the light as little as possible. In some quarters, two thicknesses of glass set about half an inch apart in the same sash are preferred.

Neighboring Buildings, etc.—All the foregoing directions for lighting school-rooms may be followed and the end,—satisfactory lighting,—may be defeated by the environment. The very proper rule has been laid down that a school building should not be lighted from a street the width of which is less than twice the height of the opposite houses. Buildings nearer than this diminish too much the patch of sky visible from the farther desks, or shut the sky entirely out of view. Dr. Forster† of Breslau has exhibited very clearly in Fig. 7, the result of the non-observance of this rule. It represents a tall school building with buildings of equal height on the opposite side of a narrow street. A series of lines *a c* drawn from the roof of the opposite buildings to the tops of the windows, and then projected across the rooms, divide each into two regions of different illumination. Below the plane thus formed, the light comes directly from the sky; above it, the only source of light is reflection from the

*Sanitary conditions for school-houses, p. 34. Washington, 1891.
†D. Viert. f. off Gesundh. XVI, 417.

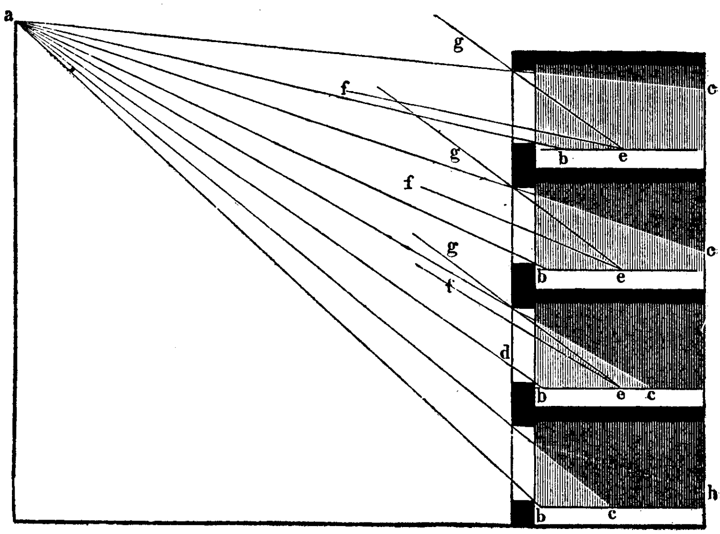

FIG. 7.

opposite buildings, from the surface of walls, floors, desks, etc., and, except possibly in the brightest of summer, it is insufficient for easy reading and writing. It will be observed that in the uppermost room this plane strikes the farther wall high up and the region of relative darkness is far above the tops of the desks. On the ground floor, it falls so near the window that practically the whole room is dark. The intermediate rooms are partly light and partly dark. The light in those portions of the rooms above the line *a c* is utterly unfit for work; but whether that below this line is suitable or not, depends, in the first place, on what Forster calls the *angle of aperture*, and, in the second place, on the degrees of obliquity of the rays of light, or the *angle of incidence*, at a given point in the school-room.

The angle of aperture, in Fig. 7, is enclosed between the lines *e g* and *e f*. The line *e g* is drawn from the point in question to the top of the window opening; the line *e f* from the same point to the summit of the opposite building. The size of this angle is determined by the arc of sky visible at the point *e*. It will be observed that this angle would become wider by moving the point *e* nearer the window, or smaller by moving it in the opposite direction; and that it is progressively smaller from the uppermost room to the lowest room where it vanishes altogether.

The fixing of the lowest permissible limit for this angle is not easy. Forster thinks it should be at least 5° at the top of every desk in the school-room. Dr. Willoughby* would have it not less than 10°.

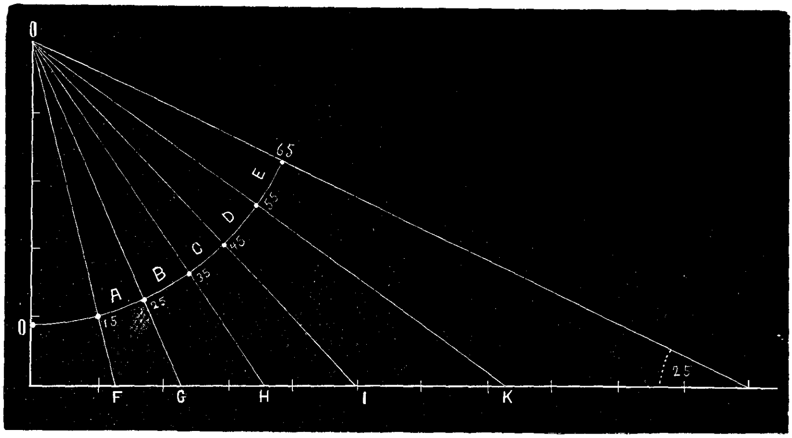

FIG. 8.

The angle of incidence is shown in Fig. 8. Let *o* stand for a luminous point from which equal pencils of light, *o a*, *o b*, *o c*, *o d*, and *o e*, emanate at equal distances from one another and to fall on a horizontal surface, *m l* It will be found that the successive sections of this surface, *f g*, *g h*, *h i*, *i k*, and *k l*, illuminated by these pencils of light, increase progressively in width, and that consequently the intensity of the illumination of each diminishes progressively inversely as the square of their relative widths, or the tangents to the angles they subtend. Thus if the width of the sections is represented by 1, 2 and 3½ the intensity of the light in the several spaces will be as 1, 1-4 and 1-12. Thus, applied to school-rooms, with the highest available point of illumination limited by what is practicable in the height of windows, it may be seen that the distance from a group of windows at which a desk may be well lighted should be borne in mind in planning the lighting of school-rooms.

Forster believes that the obliquity of the light, or the angle of incidence of the highest rays of light striking any desk, should never be less than 25°.

*Trans. of the Soc. of Medical Officers of Health for 1886-87. p. 17, London.

DESKS AND SEATS.

The faulty positions of school children while at their desks, is, as has already been explained, a prolific cause of deformity and of eye disease. As desks and seats of improper shape and proportion influence pupils almost irresistibly to assnme these faulty positions, the consideration of the r quirements in good school furniture, is one of the most important missions of school hygiene.

The Seat.—The seat should be just high enough so that the whole sole of the pupil's foot may easily and squarely rest upon the floor when the lower leg and thigh are at a right angle. In other words, the he ght of the seat above the floor should equal two-sevenths of the total height of the child.

The seat should be wide (deep) enough to support the nates and four-fifths of the length of the thighs, or one-fifth of the height of the body may be taken as the required width. It should be sloped gently backward, so the pupil will not slide forward when he rests against the back, its front edge should be slightly rounded downward, and it should be hollowed out so that the weight shall be distributed over the whole surface of the glutei muscles, thus avoiding painful pressure.

The Back-Rest.—Even in Germany, where so much has been written in advocacy of the exact erect position of children while at their school desks, the truth is dawning that the powers of the muscles, whose function it is to keep the spinal column erect, are soon exhausted when called upon to maintain the same position long; that the tiresomeness of such a position long maintained causes them to permit the body to lapse into various postures of fatigue that have an injurious tendency upon eyes, spinal column, lungs, abdominal organs, and general health; and that to avoid this the seat and back-rest must hold the pupil in a restful position.

The back-rest should extend upward to the shoulder blades at least, and it must support the pupil in a position so that the center of gravity of the upper portion of the body shall fall a little backward of the tuberosities that support him on the seat.

With reference to the pupil, the most important points of support are the sacral and lumbar regions,—the lower part of the spinal column and the "small of the back."

American school seats may be classed under two leading forms: in one the back rises upward from the seat nearly perpendicularly and gradually curves backward as it rises, as is shown in Fig. 9.

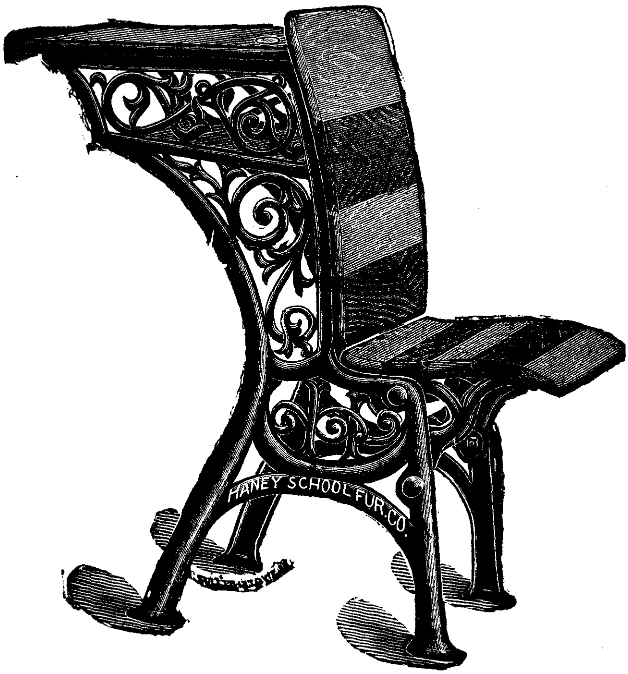

FIG. 9.

As this gives a firm support to the sacral region, it is a much better shape than the other which we may call the S form, which presents a concavity to the lower part of the pupil's trunk, and a convexity to the upper dorsal region. (See Fig. 10.)

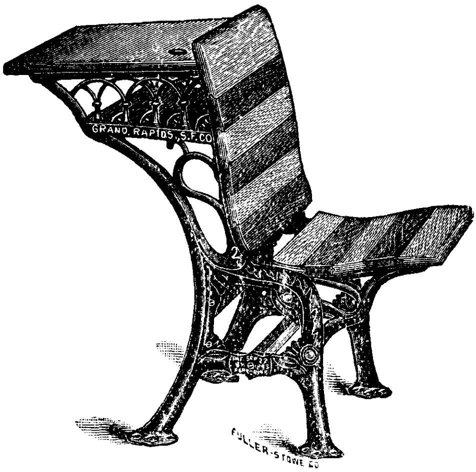

FIG. 10.

It fails to give support to the spinal column at just those points where support is most needed. In some seats with backs thus shaped, the lower curve is not great, but just so far as it exists it is wrong.

No American seat, so far as I know, follows the curve of the pupil's back just above the sacrum thus giving a salutary support to the "small of the back." In some English desks the attainment of this has been sought with pads fixed to the back-rest or adjustable to the size of the pupil.

In the German speaking countries the question of the correct shape of the back-rest has been the subject of many investigations the latest of which known to the writer being that of the Vienna school desk commission of 1889. This commission reported that the school seat should have a back-rest conforming to the normal curves of the spinal column. This support should be a combination of the peculiarities of the customary perpendicular support for the sacrum and loins and of the high sloping shoulder rest. The lower part should rise perpendicularly to the center of the curve at the small of the back where it should be provided with a lumbar pad. The upper part of the support, reaching at least to the shoulder blades must start from the most prominent part of the lumbar pad and slope backward at an angle of 10° or 15° as it extends upward. This gives a combined sacral, lumbar, and shoulder rest.* Janke†

* Zeit. f. Schulges. II, 546. 1889.

† Grundriss der Schulhygiene, p. 48. 1890.

recommends the same form of back-rest and gives one-sixteenth of the total stature of the pupil as the proper height of the perpendicular part, and one-eighth of it as the proper height of the most prominent part of the lumbar support.

Desks.—The height of the desk is usually too great; it should require the pupil to raise his elbow but very slightly when carrying it a little forward and outward into the position for writing. It should equal, as some direct, the height of the bent elbows when hanging at the sides of the pupil. If the height of the nearer edge of the desk exceeds this, it should not more than one inch.

For writing, the surface of the desk, except the narrow upper level strip, should slope 15° from the horizontal; for reading, the most convenient inclination is from 40° to 50°. In our desks generally no provision is made for this change of slope, but from 15° to 20° does fairly well for all purposes.

The desk and seat are finished preferably in natural wood, but if the upper surface of the desk is of a color and finish that will not strongely reflect the light, it will be grateful to the pupils' eyes. Janke recommends painting the top of the desk black, but it might be feared that the result would be too sombre.

Relation of Desk and Seat.—The elevation of the edge of the desk above the seat is technically known as "difference." Authorities are not in accord as to the normal ratio between "difference" and the height of the pupil,—their estimates range from one-eighth to one-sixth of the pupil's stature.

The measurement of a small number of children and young adults, —91 in all,—inclines me to the belief that, with American children, one-seventh of the total height represents very nearly the mean height of elbow above the seat, and that the ratio between "difference" and the total height should be very nearly as 1 to 6.5.

Or, as giving practically the same results, to one-seventh of the pupil's height add from one-half to three-fourth inch for the required "difference",—one-half inch for smaller children, three-fourths inch for older ones, particularly girls. The shelf for books should be high enough to make this rule practicable.

Another word relating to school desks is "distance," used to designate the horizontal space between desk and seat. When a vertical line, falling from the edge of the desk just grazes the front edge of the seat, we speak of *null distance*; when this line falls forward of the edge of the seat it is *plus distance*; when it falls upon the seat it is *minus distance.*

For writing, the edge of the desk should overhang the seat,—that is, distance should be minus.

A Massachusetts physician* made the following statement which is of interest in this connection:

My attention has been directed for several years to the effect of position in schools upon the spinal column. I was first induced to notice it in our high school girls, from the fact that they could be pointed out from grammar school girls of the same age by their awkward, stooping attitude and swinging step, and I was led to trace it to some cause satisfactory with theory. I found in the high school that the desk was placed so far from the seat, in order that they might have room between seat and desk to stand during recitation, that they could not rest their books upon the desk without leaning forward to study, which fully accounted for the stooping and rounding of the spine and shoulders in six months after leaving the grammar school,—which they did on the average at the age of twelve and a half years.

After a contention of a year against the objections of teacher and some of the committee, I succeeded in having the desk placed near enough to the seat to allow the pupil to rest the book with ease while sitting erect. And in another six months the effect was apparent in all the classes, as one could select by difference of form those who were admitted before and after the change.

In setting up desks, plus distance should always be rejected and care should be taken to have the desk overlap the seat one or two inches: this will enable the pupil, if the seat is of the proper width, to write sitting erect, with the lower part of the spine supported by the back-rest. A nearer approach of seat and desk than two inches minus distance is not desirable, for the reason that it would restrict the movements of the pupils too much. When thus placed the pupil cannot stand erect at his desk, but, with our desks for one, or at most two pupils each, this is but a very slight inconvenience, necessitating a sideward movement of the feet into the aisle before rising. Too great a "distance" of desk is a common error found in school-rooms, and its tendency is to induce deformity.

Sizes of Desks.—An important element in the prevention of school-room diseases and deformities is the fitting of every pupil with a seat and desk corresponding to his size. In some places, but not in our own State, the rational policy has been adopted of measuring the pupils in their schools once or twice yearly, and giving every one, as nearly as possible, a desk and seat adapted to his size.

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*5th Annual Report Mass. St. Bd. of Health, p. 401.

The taking of the measurements can be rapidly done, the only measurement required being the pupil's height as Spiess has convinced himself by the measurement of 1079 scholars; that is, of the total height of the child take:

For the height of seat, 2-7.

For the depth of seat, 1-5.

For the "difference," 1-7.

Spiess* believes with Koller, Cohn and others that there should be a separate size of desk for every ten centimeters difference in the height of pupils. He measured 15,000 pupils in the schools of Frankfort, Germany, and

2 per cent. were shorter than 110 cm.

97.6 per cent. were between 110 and 179 cm.

0.4 per cent. had a height of 180 cm. or more.

Spiess, therefore, provides seven sizes of desks for the 97.6 per cent. of pupils, and he recommends a minimal size desk for the abnormally small 2 per cent., and a maximal size for the unusually tall one-fourth per cent. It will be observed in the following that he ingeniously makes the central figure of the numbers which include the height of the pupil correspond to the number of the desk suited to him, thus:

Height from	100	to	109	cm.,	desk No.	0
"	110	"	119	"	"	1
"	120	"	129	"	"	2
"	130	"	139	"	"	3
"	140	"	149	"	"	4
"	150	"	159	"	"	5
"	160	"	169	"	"	6
"	170	"	179	"	"	7
"	180	"	189	"	"	8

The numbering of the desks in this country is indicative of nothing: certain numbers or sizes are assigned by their manufacturers to pupils between certain years of age, but children of the same ages differ so much in size that this practice is altogether irrational. Size only should be the guide.

Adjustable Desks.—The advantages of using in the school-room seats and desks readily adjustable to the sizes of the pupils are acknowledged by authorities in school hygiene to be very distinct, but it costs more to manufacture such furniture than it does the old

*Deutsche Viert. of. off. Gesundh. XVII, 285. 1885.

kinds and,—the children are sold to the lowest bidder. After the pupils are measured, it is a simple matter to fit each with a suitable desk, if those of a good adjustable pattern are used. Without adjustable desks there is considerable difficulty in properly seating a school. With the combined desks and seats the sizes in mixed schools cannot be graded from the back to the front seats: all that can be done is to have the sizes grade from one side of the school-room to the other. In using the Boston school desk or other patterns in which the seats are distinct from the desk, the trouble is not so great, but even then with a good assortment of sizes, it is very difficult to seat all the pupils as they should be seated and to place them as the well-informed teacher would like to have them placed.

Several adjustable desks are on the market, one of which, the Basic City Desk, formerly called the Rushville Desk, was exhibited in connection with the Brooklyn meeting of the American Public Health Association and was highly commended by the members. In this pattern the seat and desk can be raised or lowered independently of each other, and fixed at any height indicated by the measurement of the pupil. It will also be noticed that the shape of the back is in conformity with that recommended under "The Back-Rest", in that it has the single curve. See Fig. 11.

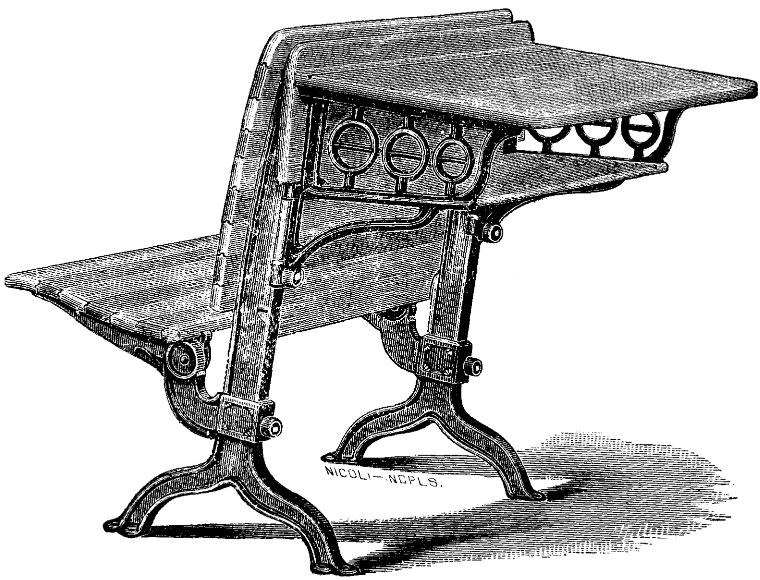

FIG. 11.

The adjustable desk of G. A. Bobrick, C. E., shows a very careful study of the chief requirements in a school desk. The seat and desk are adjustable to any desired height, and, in addition, the depth of seat can be adapted to the length of the pupil's thigh. This desk is furnished, at the pleasure of purchasers, with either chairs or seats adjustable or not, to the length of the pupil's thigh. See Figures 12, 13, 14 and 15.

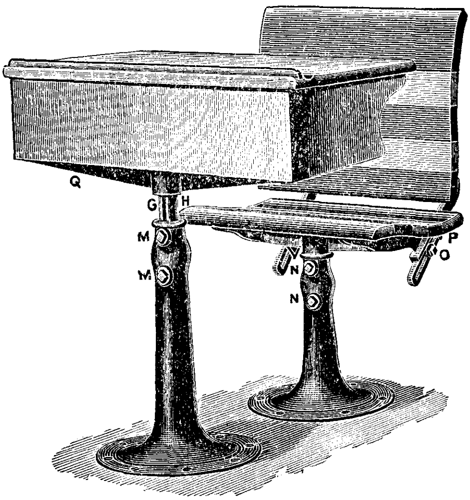

FIG. 12.

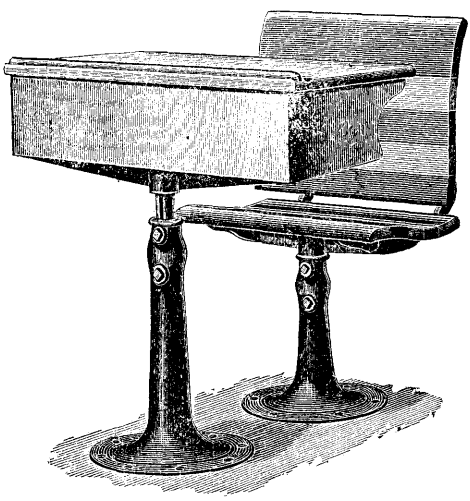

FIG. 13.

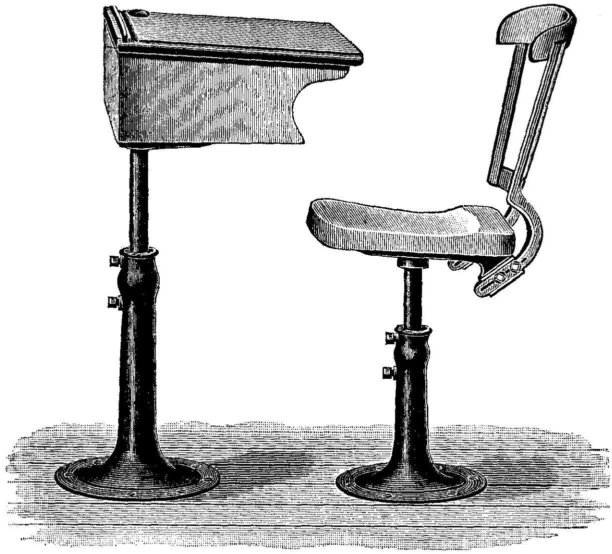

FIG. 14.

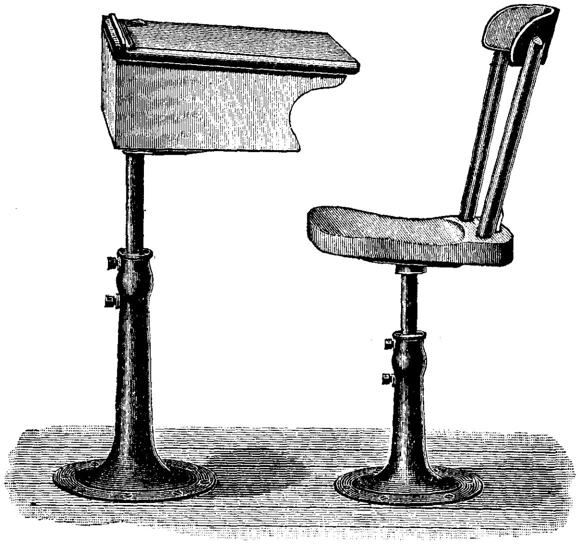

FIG. 15.

Another adjustable desk, for the sale of which Carroll W. Clark & Co., Boston, act as agents, is shown in Fig. 16. The desk is raised or lowered by moving the set nut B up or down the screw thread on the rod A. The desk is held in position by a key which

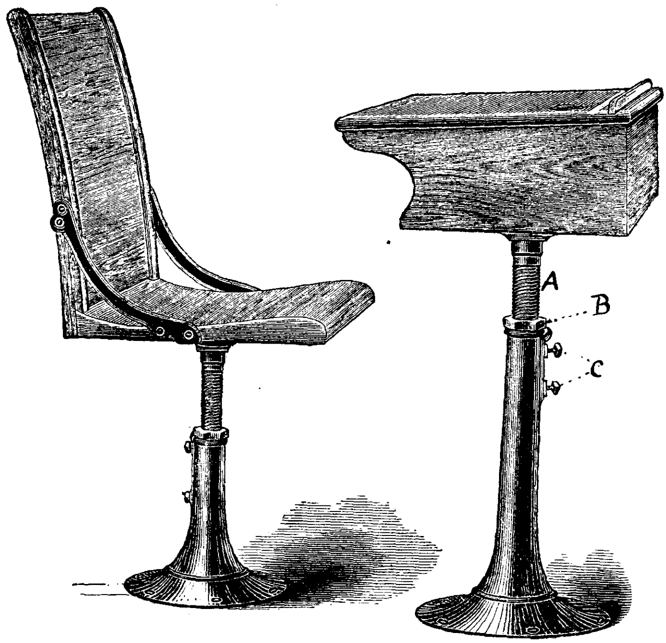

FIG. 16.

fits into a key-way in the pedestal and the rod A. When the proper position is obtained the set screws C are turned down upon the key and all the parts are firmly fastened. The set nut B cannot be moved by the scholar and the position of the desks cannot be changed without the wrench which turns the set screws at C. The chair is adjusted in the same way. It will be noticed that the shape of the back-rest of the seat conforms to that recommended in this paper,—that of the single curve.

Some Other Patterns.—Various foreign patterns of school desks are so constructed as to admit changes in the distance between seat and desk, giving plus or null distance for reading and study, and minus distance for writing. In some of these desks, the slope of their tops can be adjusted from 15° or 20° for writing to 40° or 45° for reading. These features are not found in many American desks, but a pattern may be seen in the Chauncy Hall School, Boston, Mass., that is worth the study of manufacturers of school desks. The one idea in the planning and construction of the desks for that school was to have them as nearly faultless as possible from a hygienic point of view. To this end, half a dozen or more of Boston's physicians and surgeons, well known names in American medicine, some of whom were leaders in all that relates to the treatment or prevention of diseases of the eye and of spinal and other deformities, were asked to plan the desk. They carried out the work entrusted to them with great care. Figures 17 and 18 show the results. It will

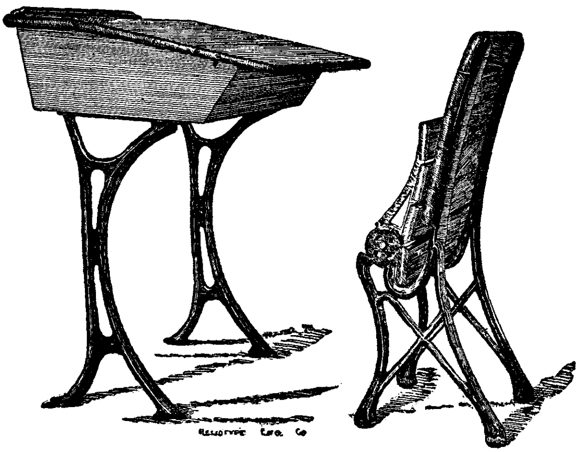

FIG 17.

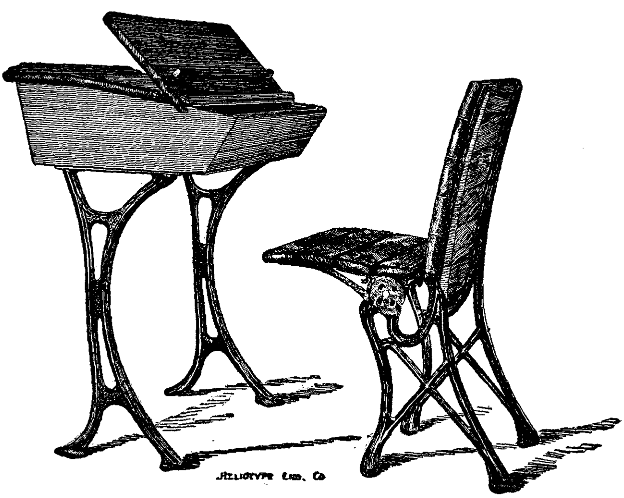

FIG. 18.

be observed that the back-rest has the single curve, that that portion of the top of the desk nearest to the pupil, turned down gives minus distance for writing, permitting the pupil to sit erect and have the support of the back-rest, and turned up enables the pupil to place the book from which he studies at the proper distance from the eye and to have it supported at the proper angle.

Fig. 19 shows the so-called Boston school desk and chair. As the seats are entirely independent of the desks, with a sufficiently large

FIG. 19.

number of sizes (three or four in a graded room and a larger number in a mixed school) the problem of satisfactorily seating all the pupils in the room is not so difficult, as with combination desks. There is, however, an opportunity for somebody to plan a chair to go with this desk that will support the pupil in a proper position more successfully than any that has hitherto been in use. By dint of careful study, it should be no difficult matter to make the improvement.* The particular chair shown in the engraving, has the advantage of a broader and firmer support than is usual in chairs of this kind.

In Fig. 20, as well as in Fig. 9, we have one of the few school desks of the combination style whose back-rest has the approved single curve.

*Since this was written, I have examined the chair shown in Fig. 16, and find that its back more nearly approaches the desired shape than any other known to me. A. G. Y.

If, when the pupil is properly seated, the position of the book-shelf, or other structural features of any desk makes it impossible to

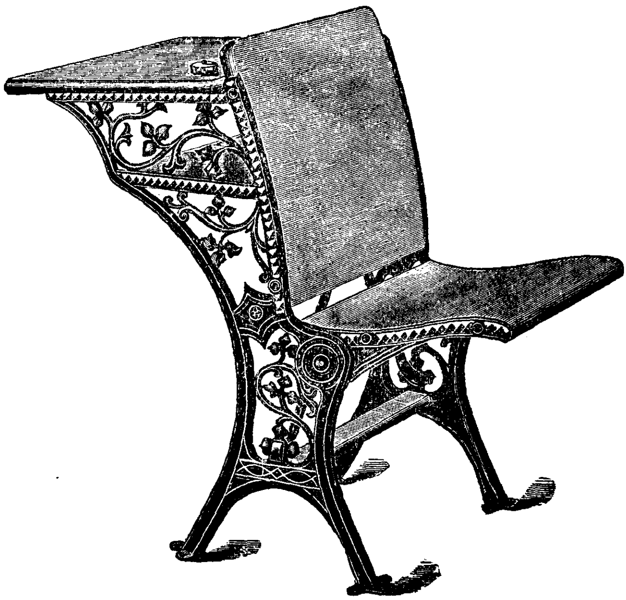

FIG. 20.

have the difference between the height of the seat and that of the desk so small as one-seventh of the pupil's height while standing, the desk should be rejected as unsuitable.

Single or Double Desks.—Irrespective of the question of cost, single seats and desks are in every way preferable to double ones. With single seats and desks the teacher can control the school much more easily, the pupil can do better work, there is less liability to the spread of infectious diseases, and in some degree a safeguard against over-crowding is ensured.

Correct Sitting.—"To sit in the seat properly, the soles of both feet should rest squarely on the floor not far apart, and the whole width of the seat should be utilized so that the body may be supported as much as possible by resting against the normally constructed back. In this connection it should be observed that the sacrum and the small of the back should rest firmly against the lower part of the back-rest, while the upper part of the spine finds a sufficient support against the slightly backward inclining upper part of the back-rest. In this position the chest is free in its movements, the abdominal organs are not subjected to pressure, and the movements of the arms are unhindered."*

*Janke—Grundriss der Schulhygiene, p. 62.

VENTILATION.

"Good ventilation, lighting, and warming of a school-room," says Sir Edwin Chadwick, "will augment the capacity of attention of the pupils by at least one-fifth, as compared with that of the children taught in school-rooms of the common construction."

The principal of a school formerly without ventilation, but now with fairly good provisions for renewing the air, makes the following statement of the beneficial results observed: "In point of health there has been a decided gain. Both pupils and teachers are doing more and better work on account of the purity of the air; there have been no complaints of headache and *ennui*, formerly so frequent; the children have been in no way exposed to draughts from open doors and lowered windows, consequently have been entirely free from coughs, colds, and catarrhal affections."*

Yet so important as good ventilation is, most of the so-called arrangements for ventilation found in school buildings are barefaced shams. They have been put in with no intelligent understanding of the rudiments of the principles involved in the question. For instance, the foul air ducts have almost invariably been found much too small, or they are leaky, or they are long and tortuous, or they are not constructed with a flue to carry the foul air outside the building, or the flue is unheated, or there is some other serious blunder. Tested with the air meter, the air in the fresh air and the foul air ducts, shows, in many instances, absolutely no movement. If there is any movement, it is almost always too feeble to approximate a fair ventilation, taking the size of the duct into consideration.

I have been more than astonished to find the number of so-called "experts" in the heating of school buildings scattered through the country, unknown men, of course, but nevertheless so impressed by their own importance and so convinced that they have grasped and digested in one supreme mental effort, without any practical investigation or study, all that there is to know about the heating and ventilation of buildings, that it is as useless to attempt to reason with them as it would be to expect the Egyptian Sphinx to answer questions. These stupid oracles of school boards and committees cause more trouble and inconvenience and do more to prevent the introduction of good systems than any other one thing that I know of. They so hamper and disgust men of sound sense and judgment who, rather than enter into any controversy, let them have their

*The Sanitary Engineer, XV, 576.

way to the detriment of the building and the discomfort of its occupants. I have found such cases as this repeatedly, and I believe all others in my profession are troubled in the same way.*

Results of Breathing Impure Air.—It is a fact that modern science brings to our notice repeatedly that the functional activity of organic life engenders products that are detrimental to the organisms that produce them; thus, the vital activity of the yeast plant is gradually brought to a standstill by the accumulation of the product of its functional activity,—alcohol,—and its activity can be started again only by re-establishing the conditions favorable to its continued growth; to wit, the removal or dilution of the alcohol in its field of growth. With the bacteriologist it is an every day observation that bacteria, grown in his culture media, thrive luxuriantly for awhile, then, if not transferred to fresh culture media, pass through a stage of lessened activity, and finally perish, poisoned by their own excretions, or remain dormant.

These organisms, reduced to the utmost simplicity of structure, consist of a single cell. Man and the higher animals are components of a vast accumulation of cells, each one of which, by virtue of its functional activity is likewise excreting products that are so poisonous to it and the system generally that accumulation beyond certain limits results in death.

An illustration of the truth of this that has many times pointed a sanitary moral since the sad occurrence, is the history of the Black Hole of Calcutta.

In school experience the speedy loss of life from the re-inhalation of "Pettenkofer's man-poison," as Du Bois-Reymond calls it, is out of the question, but cases of slow poisoning from moderate quantities of the same poisonous agent are unfortunately very common.

In an unventilated school, or other room occupied for some time by many persons, a disagreeable, stuffy odor is perceptible on entering it. Those occupants of the room who are accustomed to noticing the difference between pure air and polluted air, feel that the air of the room is unsuitable for breathing; respiration is not free and easy and the air breathed does not satisfy the wants of the system. Sustained work, whether muscular or mental, is carried on with difficulty, and with persons somewhat sensitive to air pollution, there follow flushing of the face, throbbing of the temples, ringing in the ears, and headache; while work day after day in an atmosphere

*Briggs—The Planning and Construction of School-Houses, Building, V, p. 226.

polluted by repeated breathing, has a tendency toward loss of appetite, impoverishment of the blood, and general debility. In this connection the reader is again referred to page 96 of this report.

The bad effects upon our domestic animals of breathing a polluted atmosphere, have many times been noted. We are told by Parkes:*

Formerly, in the French army, the mortality among the horses was enormous. Rossignol states that, previous to 1836, the mortality of the French cavalry horses varied from 180 to 197 per 1,000 per annum. The enlargement of the stables, and the "increased quantity of the ration of air," reduced the loss in the next ten years to 68 per 1,000. In 1862-66 the rate of death was reduced to 27½ per 1,000, and officers' horses (the property of the State) to 20.

The admission for lung diseases were, in 1849-52, 105, and in 1862-66, 36; for glanders, 1847-52, 23; 1852-66, 7½. In the Italian war of 1859, M. Moulin, the chief veterinary surgeon, kept 10,000 horses many months in barracks open to the external air in place of closed stables. Scarcely any horses were sick, and only one case of glanders occurred.

In the English cavalry (and in English racing stables) the same facts are well known. Wilkinson informs us that the annual mortality of cavalry horses (which was formerly great) is now reduced to 20 per 1,000, of which one-half is from accidents and incurable diseases. Glanders and farcy have almost disappeared, and if a case occurs, it is considered evidence of neglect.

Without further enlargement on this subject it should be perceived that the failure to furnish the school-room with adequate supplies of fresh air is false economy, when viewed as an economic question, in that it wastes the school money by subjecting the pupils to conditions under which they cannot do their best, and in that it is conducive of ill health which may be lasting.

Better for mind and body one hour of sharp close study in a pure atmosphere, than two hours spent in languid, listless work in the polluted air of the unventilated school-room. Better, if this must be the price of securing pure air, to economize by shortening daily sessions, or in almost any way so be it the physical basis of mental action is not undermined while mental activity is still spurred on.

"We would consider parents crazy," says Dr. Bell,† "who gave their children a moderate dose of opium, tobacco, or some other stupefying drug before setting them at their studies; but these narcotics would be no less weakening and paralyzing in their effects, nor any less poisonous in their permanent effects, than the air of most of the school-rooms to which we send our children year after year."

*Practical Hygiene, Sixth Edition, p. 105.
†Sanitarian VII, p. 302,

Some of the Poisonous Principles of Polluted Air. —It was formerly taught that the unpleasant effects from rebreathed air are due to the gas, carbonic acid. The following facts served as the basis of this belief. One of the most marked changes undergone by air in serving the process of respiration is a great increase in its quantity of this gas. While the free air of the outer world has from three to four parts of carbonic acid in 10,000, the air of expiration contains more than 100 times as much of this gas. Carbonic acid is unsuited for supporting the process of respiration. A lighted taper plunged into it is suddenly extinguished.

Animal life is almost as suddenly extinguished when enveloped in it. Mixtures of this gas with common air in varying proportions, cause death more slowly, or may give rise to various symptoms indicative of insufficient oxidation of the blood and of the animal tissues.

Later observations, however, have shown that, with a given percentage of carbonic acid in the air breathed by man or animals it makes a great difference whether the excess of carbonic acid has been derived from pure chemical sources, or from the lungs of living beings. For instance, the air of a school-room that contains twenty parts of carbonic acid in 10,000 of air, is found to be disagreeable and harmful to breathe; while the air of an experimental chamber charged by chemical processes with twenty parts of carbonic acid, or with even more, is breathed with no disagreeable results. Observations of this kind easily lead to the assumption that the air expelled from the lungs contains some substance other than carbonic acid deleterious to animal life.

Organic Nitrogenous Poison.—Entering a crowded and ill-ventilated school-room we have an unpleasant consciousness of a malodorous something which is characteristic of a stagnant, rebreathed air. Such air has an excess of carbonic acid, but carbonic acid is odorless. This disagreeable something excreted from the lungs has the power of clinging to a room rather tenaciously, for, if the ventilation of a school-room is neglected for awhile, it takes some time to rid the room of the foul odor, even with ventilation through wide open windows.

Chemical tests show that this ill smelling something is an organic nitrogenous substance. From experiments on animals in which the carbonic acid and watery vapor were removed, and the organic matter left, it has been found that the organic matter is very poisonous. A few years ago Brown-Sequard and Arsonval made known the results of their extended researches into the nature of this poison. They condensed the exhalations from the lungs of men and dogs and obtained thereby a liquid with an alkaline reaction. From two to four cubic centimeters of this, injected into the veins of animals, caused dilatation of the pupils, slowing of the respiration, great muscular weakness, particularly of the hinder extremities, and a very rapid pulse. But when from ten to twelve cubic centimeters were used, the death of the animals followed speedily, even when the fluid had been boiled.

Other investigators who have repeated the experiments of these scientists have not interpreted their results as indicative of an expiratory poison. Another series of experiments made by Brown-Sequard is confirmatory of the conclusion that the poison of expired air is not a myth. He arranged eight closed air-tight cages so connected with glass tubes passing from one to another that, by means of an aspirator, air could be made to traverse the cages successively. With a rabbit placed in each cage, the first received only pure air; the second, air polluted by the first animal; the third, that polluted successively by two rabbits, etc. Special arrangements were present for the removal of excrement. The eighth rabbit died in two days, the seventh in three days and so on until the death of the third one in eight days. The first and second rabbit remained alive. Quantitative determinations of the carbonic acid content of the air of the several cages showed that it could not have caused the death of the animals. When bits of pumice stone impregnated with sulphuric acid were placed in the glass tube between the sixth and seventh cages the rabbits in the seventh and eighth cages remained well,—a result indicative of the destruction or neutralization of the peculiar poison by the acid.

Dr. Merkel has lately, in the Hygienic Institute of Munich, repeated the experiments of Brown-Sequard with great care and, obtaining like results, comes to the following conclusions: That the expired air of healthy men and animals contains volatile organic substances in very small quantity; that in these organic substances we, in all probability, have to do with a base that, in its free state, is poisonous.*

A series of experiments made by Claude Bernard seem to show that the system may gradually acquire in some degree a tolerance of

*Archiv für Hygiene, XV, 1—1892,

the poisonous principles in rebreathed air. In one of them a sparrow was enclosed in a glass globe. For an hour he hopped about as actively as usual, and then gradually showed signs of suffering from breathing the air poisoned by his own lungs. At the end of the second hour another sparrow was placed in the globe. It fell asphyxiated by the foul air and died in a few moments. At the end of the third hour the first sparrow became unconscious. Taken out and carried into the open air, it soon recovered; then, replaced in the globe, it died almost instantly.

These observations are simply confirmatory of a well known fact, that the human breath contains a poison that should be removed from inhabited rooms by ventilation and should not be rebreathed.

Carbonic Acid.—When carbonic acid gas, either pure or mixed in rather large proportion with air, is breathed, asphyxia and death may result. When breathed habitually in such proportions as are found in badly ventilated school-rooms, there is reason to believe that the free exchange of oxygen and carbonic acid in the lungs is in some degree interfered with.* Nevertheless this gas is not regarded poisonous in the sense in which we know some of the other components of polluted air to be.

In the quantity in which it is found in school-rooms our chief interest in it is that we can use it as an index of the total pollution of the atmosphere. As chemistry presents no convenient and trustworthy method of estimating directly the degree of organic pollution, we solve the problem indirectly by a determination of the proportion of carbonic acid. Experience and observation have made it very certain that the organic nitrogenous pollution corresponds very closely with the carbonic acid content of an atmosphere fouled by respiration.

The experiments of Pettenkofer, Parke, and others have determined for us pretty clearly that air containing more than a very few parts of carbonic acid, presumably derived from human lungs, is lacking in that degree of purity necessary to ensure the health of the pupils.

Pettenkofer considers air containing ten parts of carbonic acid to 10,000 bad and unfit to breathe. He fixes the limit of allowable carbonic acid at seven parts, and would have five parts, or two parts over the out door normal, as the ideal to be aimed at.

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*Gréhant. Les Poisons de L'Air, Paris, 1890.

Parkes takes two parts in 10,000 as the maximum degree of respiratory impurity admissible in a properly ventilated air space, or six parts as the whole amount of carbonic acid, assuming the normal as four parts per 10,000. This standard of purity of air is the one that is now very generally accepted.

Carbonic Oxide Gas.—When the draft in school-room heaters is insufficient, and consequently when combustion is incomplete, full oxidation of the carbon of the fuel does not take place and carbonic oxide is formed. The escape of this gas into the school-room is a much more serious matter than an admixture of carbonic acid.

The poisonous qualities of carbonic oxide are intense and positive. It seizes strongly upon the hæmaglobin, and, as its affinity for this coloring matter of the blood is greater than that of oxygen, it is destructive of the oxygen-carrying function of the red corpuscles of the blood. Persons who are profoundly narcotized with carbonic acid may speedily be restored to life and health by prompt removal to the fresh air, or, when breathing is extinct, by artificial respiration. Not so with carbonic oxide. Poisoning with this gas is a much more serious matter. Owing to the close chemical union of it with the red blood corpuscles, the admission of fresh air into the lungs, or even of pure oxygen gas, is almost powerless to make the poisonous gas lose its hold, and death will follow in many cases in spite of the most skillful treatment.

According to Dr. Gautier,* the eminent French chemist, the smallest quantities of the oxide of carbon in the air might prove dangerous. With one part in 10,000 of air there is destruction of the eighth of the total quantity of the blood. There is every reason therefore for solicitude to exclude every trace of carbonic oxide gas from the school-room.

Much has been said of late years about the power of diffusion of carbonic oxide through the castings of stoves and furnaces when they are too highly heated. To avoid the danger of this is only one of several weighty reasons for putting in school-room heaters whose radiating surface is so ample as never to become very hot. Dampers and other draught-checks between the fire and the smoke flues endanger the leakage of this gas.

Carbonic oxide is doubly dangerous for being, like carbonic acid, entirely devoid of smell.

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*Lancet, Vol. I, 1889, p. 357.

Hydrogen Sulphide.—This gas too is very poisonous, and even when mixed in small quantities with air is dangerous to breathe. Breathed into the lungs, it robs the blood corpuscles of their oxygen and destroys them. As is the case with carbonic oxide, when hydrogen sulphide is habitually breathed in small quantity, chronic poisoning results, it impoverishes the blood and leads to pallor and feebleness. This gas is given off from many organic substances when undergoing decomposition, and from these sources it sometimes gains admittance to school-rooms. It announces itself plainly by its smell which is usually described as like that of rotten eggs.

Sewer and Privy Vault Gases.—The sanitary arrangements of the school-house should be such as to preclude the possibility of the entrance into the school-room of the gases of putrefaction, derived from privies, sewers and urinals. A large component of these gases is hydrogen sulphide, mingled with ill-smelling ammoniacal products and other gases. The great mass of medical and sanitary experience indicates that the prolonged breathing of air tainted with but a small admixture of these gases has a debilitating effect and predisposes strongly to other diseases: Anæmia, scrofula, consumption, diarrhœa, dysentery, diphtheria, typhoid fever, etc. Children especially are more susceptible than older persons to the noxious influences of privy and sewer emanations. Breathed in concentrated doses, even adults are often overcome with pain in the stomach and the joints, headache, nausea, and vomiting, muscular weakness, asphyxia and sometimes death.

Poisonous Principles Other than Gaseous.—The reader is referred to "The Dust Question" and "Cleanliness of the School-room," pages 225 and 258.

Humidity of the Air.—We have been taught by most writers on the subject that the air of artificially heated rooms should have a considerable degree of humidity and that special provisions should exist in connection with the heating apparatus for the evaporation of water. It is very likely, however, that many of the unpleasant results ascribed to dryness of air are referable to conditions, the removal or mitigation of which, is more rational than the evaporation of water. They are due undoubtedly in some cases to the leakage into the air of harmful gases from the stove or furnace. Generally the trouble is in connection with heaters that are altogether unsuitable for use in school buildings. Their heating surfaces are so small that they must be heated highly to keep the rooms at a comfortable temperature. Consequently the air coming into the rooms from the apparatus is overheated, its suspended organic matter has been scorched and has thereby liberated traces of harmful gases, and the air has perhaps received an additional contamination by diffusion through the unduly heated radiating surfaces, or through their joints.

In school houses supplied with heaters that furnish an ample quantity of fresh air only moderately warmed, there is rarely complaint of dryness of the atmosphere.

The evaporation of water for the special purpose of moistening the atmosphere, is an expensive process: it calls for the burning of an additional portion of fuel, the heat from which is expended, not in warming the rooms, but in converting water into steam. The expenditure of the money in warming larger volumes of fresh air, and thus, in securing better ventilation, would be a more judicious investment.

Amount of Air-Supply.—We have the trustworthy authority of Parkes for the statement that the amount of fresh air that should be supplied to persons in health and during repose is:

For adult males,	3,500	cubic feet	per head	per hour.
" " females,	3,000	"	"	"
" children,	2,000	"	"	"
" a mixed community,	3,000	"	"	"

The Committee on School Hygiene of the State Board of Health has fixed upon 2,000 cubic feet per hour as a quantity of air that it is practicable to furnish to pupils while in their school-rooms, and advises that the plans for ventilation should aim at no smaller supply.

Testing the Air—Measurement of Air-Supply.—To estimate the efficiency of the ventilating arrangements in the school-room, various methods may be used. An ever-ready way of testing the quality of the air in enclosed spaces is an intelligent use of the sense of smell. The air of a school-room that is imperfectly ventilated is characterized by a peculiarly unpleasant smell, variously described as close, stuffy, musty, fetid, etc. To appreciate moderate or slight degrees of foulness of air, the test should be made immediately after entering the room from the fresh air. After one has been in a foul atmosphere a little while, the sense of smell becomes habituated to it and blunted in its power to detect its offensiveness. The school-room should be free from disagreeable odor; if it is habitually pervaded by the characteristic smell of foul air, its ventilation is deficient.

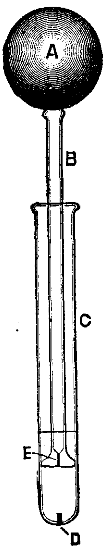

FIG 21.

A handy method of air-testing which gives results approximately correct, is by means of Wolpert's air tester. It consists of a test-tube, on the bottom of which is a black mark. The test-tube is to be filled with lime water to a mark about an inch and a quarter from the bottom. By means of a rubber bulb and its attached glass tube, the air to be tested is pumped through the lime water until the resulting milkiness renders the black mark invisible when held over a sheet of white paper and the eye looks down through the test-tube. By reference to a table on a card that accompanies the instrument, the number of bulbfuls of air used shows the number of parts per 10,000 of carbonic acid. The cost of the instrument is very moderate. It is shown in Fig. 21. It may be obtained from Codman & Shurtleff, Boston.

By means of the air meter, the quantity of fresh air entering the room through the inlets, or leaving it through the outlets may be determined. The linear discharge for a given time, usually one minute, is shown by the dial. The multiplication of this linear discharge by the sectional area of the duct expressed in feet and fractions of a foot, gives the cubic discharge. This multiplied by sixty shows the quantity of air in cubic feet which enters or leave this particular opening in the hour. Divided by the figure expressing the number of persons in the room, and we have the quantity of air per hour for each.

Various Makeshifts.—When, unfortunately, the teacher finds that his school-room is destitute of means for its proper ventilation, there are various expedients to which he may resort to prevent in part the evils of the lack of ventilation. The room should then be supplied with "window boards." These consist of pieces of board four or five inches wide and of a length slightly shorter than the sash is wide. Then, raising the lower sashes, these boards are placed under them. The result is a space between the two sashes where they overlap, through which the air enters in an upward direction, obviating thus much of the danger from draughts on the children's heads. Carefully supervised, these window boards are worth considerable, though they are a sorry substitute for a good system of ventilation.

As an efficient temporary auxiliary to the window board ventilation, the school-room windows should be widely opened as often as possible,—at recess, at noon, and after the closure of the afternoon session,—that the full sweep of the winds may effect a complete renewal of the air.

HEATING AND VENTILATION.

In any system of school-house ventilation worthy of respect, the heating of the rooms and their ventilation are so intimately connected, that it would be difficult to consider them separately, and it is not desirable to do so. To ventilate a school-room properly, the incoming air must be warmed artificially before it is discharged into a room; and to warm a school-room in all its parts with an approximation to uniformity of temperature, the current of incoming warm air is needed to prevent stagnation and stratification of the school-room air.

Some Definitions.—Heating is said to be by *direct radiation* when the heater is placed in the room to be heated.

A room is heated by *indirect radiation* when its heater is not placed directly in it, but is enclosed within a space through which fresh air is warmed, as it passes on its way to the room.

Natural ventilation is that kind of change of air secured when doors and windows are allowed to remain open. An efficient ventilation of this kind is of course entirely impracticable the greater part of the year.

Artificial, or forced ventilation is obtained by the employment of some artificial means for moving the air. The forces the most frequently used for this purpose are the rarefying power of heat applied to air in flues and mechanical power applied through the medium of fans.

When the force is applied in forcing air into a room we speak of the *plenum* method.

When exerted in moving air from a room the term *extraction*, or *vacuum method* is used to designate it.

Temperature of Rooms.—There is a marked difference in the advice of American and European authorities as to the proper temperature for the school-room. For instance, at a rather recent meeting of a teachers' association in England, it was stated that from 55° to 60° Fahrenheit is the proper temperature.* Habituation to rooms too highly heated, and perhaps other conjoint causes, have rendered our school populations unable to bear comfortably or safely temperatures so low as these. It is desirable, however, to keep the school-room air at as low a temperature as is compatible with comfort. For our pupils the temperature should be kept between 65° and 68° Fahrenheit. Provided the pupils' clothing is dry and the school-room air is fresh and pure, degrees of temperature between these extremes will be comfortable and more conducive to health than higher degrees.

Uniformity of temperature in all parts of the room is greatly to be desired. It can be obtained in a well ventilated room; it cannot be had in a room in which a proper rotation of the mass of the air is not provided for by the ventilating arrangements. The difference in temperature near the floor and near the ceiling should be but a very few degrees.

When the incoming warmed air is only moderately heated a uniformity of temperature at different levels is much more easily maintained. There are also other important reasons why the heater should deliver the air at a very moderate temperature,—a temperature that we are told by Rietschel† should not exceed 30° C. (86° F.), and that in some of the best work in this country does not exceed this.

Location of Inlets.—Though an ample quantity of fresh warmed air enters the school-room and a correspondingly large quantity is withdrawn from it hourly, a faulty location of inlets and outlets may defeat the attempt to secure adequate ventilation.

The inlet should be placed on the inner wall of the school-room because in most cases it is less expensive to so place it, and, as will be seen farther on, because this location is the most favorable to an equable distribution of the incoming air.

The inlet should not be placed in the floor, because, when thus placed, dirt and dust fall through it and are returned by the current of warm air that should be pure air, but which becomes, by this arrangement, filthy air.

The inlet should not be placed at or below the level of the heads of the pupils lest disagreeable draughts be felt by the nearer pupils.

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*Sanitary Record X, 517. London, 1888–89.

†Luftung und Heizung von Schulen, p. 69. Berlin, 1886.

No matter at what height the warm air is introduced, its immediate destination is the ceiling. To get it there at once with no inconvenience to the occupants of the room, and preserve its purity, the warm air duct should carry it to the inlet placed at a height of seven or eight feet at least.

Location of Outlets.—The outlet for the foul air should be placed in the same inner wall with the inlet, benea h, or nearly beneath i', and close to the floor. Thus located we get the best possible distribution of air in the room, we draw from the lower, dusty, and impure portion of air next to the floor, we secure the greatest economy of heat by removing the cooler lower portion, we have a better draught in the ventilating flues by having them in the warmer inner walls, and we simplify the construction of the ventilating arrangements.

Outlets near the ceiling are extravagantly wasteful of fuel by letting the warmed air escape immediately, before it has come down to the breathing level of the pupils.

Outlets in the wall opposite to the inlets permit the air to escape before it has made a complete revolution: a more or less stagnant air space fills the central and lower part of the room.

With the inlet and outlet both located in the inner wall opposite the outer window wall, as has been advised, we secure the most favorable conditions for a complete circulation of the whole mass of air in the room. The warm air as it enters the room has an upward impulse due to its lighter specific gravity than that of the air of the room generally. Reaching the ceiling it gradually flows outward to the cooler walls and, falling sl›wly, it acquires an accelerated downward momentum as it passes the colder windows. We thus on the inner side of the room have an upward, and on the outer side a downwaɪd force exerting themselves to rotate the whole mass of air in the room. This rotary mixing up of the air ensures the least possible difference between the temperature of the air at the ceiling and that at the floor, and brings the fresher air of the room downward and then backward across the breathing line where the pupils can use it.

Size of Inlet and Outlet.—The flues for supplying fresh air to a school-room should, stated roughly, have a cross section, undiminished at any point by register faces or otherwise, equal to about twenty square inches to each occupant. The discharge ducts should be somewhat larger for the reason that the air in them will be cooler and therefore its movement will be less rapid than that of the supply. From an examination of the "Plans for Ventilation" given farther on, a more authoritative presentation may be gathered on this and other points.

Open Fireplaces.—Open fireplaces are hardly thought of now-a-days as the sole dependence in heating school-rooms. As only from ten to twenty per cent. of the heat generated in them is utilized in warming the room, they are very wasteful of fuel, and their value as ventilators for the school-room is often over-rated.

Stoves.—A naked, unjacketed stove which heats the room by direct radiation is altogether unfit for use in school-rooms. In connection with it there is no adequate provision for the supply of fresh air, it fails to set the air of the room in motion sufficiently to equalize the temperature at different parts of it, consequently the pupils farthest removed from the stove are often freezing while those nearest to it are suffering with the heat.

Jacketed Stoves.—In a ventilating jacketed stove, the local heater is surrounded with a casing or jacket, between which and the heating surface there is a space opening into the room at the top and communicating at the base with the outer air by means of a fresh air duct. By means of this arrangement the fresh air is warmed as it passes upward into the room between the stove and its jacket, and a steady stream of fresh warmed air flows into the room. Moreover, this ascending stream of fresh warm air sets the general mass of air in motion and tends strongly to equalize the temperature of the room.

The results attained with jacketed stoves have sometimes been unsatisfactory for the reason that the requirements of local heaters of this kind have been imperfectly understood,—the capacity of the stove to pass air through it has been too limited, the fresh air inlet has been of too contracted proportions, or some other error in construction, has rendered the apparatus incapable of delivering the required quantity of fresh warm air to the room, or of otherwise doing satisfactory work.

So far as I know the first systematic attempt to determine the conditions under which jacketed stoves may be expected to supply the large quantity of air needed in school-rooms and to warm it to a degree of comfort was made in Lynn, Mass., under the supervision of Dr. J. G. Pinkham. The following text and illustrations taken from a paper by Dr. Pinkham entitled "The Ventilation of School

Rooms by Stoves."* describe the arrangements used by him and show the results in ventilating work:

"**Red Rock Street School-House.**—This is a brick building of good construction and in a healthy locality. The ventilating apparatus was put into it during the summer of 1886, and the description which follows is from the report of the committee on sanitation for that year:

There are in each room two large stoves (Barstow's 'Puritan', No. 18), one on each side of the room near the front. Each stove is encased in a galvanized iron jacket about six and one-half feet high, with a spreading base. Air is admitted to the space between the stove and its jacket by an air-box running through the side wall, the opening for each stove having a sectional area of four and one-half square feet, being large enough for the whole air supply of the room. In cool weather one stove in each room is used; in cold weather both stoves.

There are two extraction flues, built in one stack, at the rear of the building, one with a sectional area of 5.2 square feet for the upper room, and one with a sectional area of 4.1 square feet for the lower room. They are of brick, and in an inner corner of each is a fire-clay smoke pipe connecting with the stove pipes. These smoke pipes end at the level of the chimney top, and the whole is covered with an iron cap, like an Emerson ventilator, but rectangular. For heating the flues one of D. W. Cushing's "Ring Cylinder" stoves is set into the *with*, or partition between the flues, projecting into each. The flues are enlarged opposite the stove to compensate for the obstruction of its bulk. As the cellar does not extend under the rear of the building the flues end at the floor level of the lower room. The openings from the rooms into the extraction flues are made at this level, from the lower room directly through the wall, and from the upper room by means of a thirty-inch tin pipe, running down beside the stack, from the upper floor. The flue-heating stove is set about three feet above the lower floor, and access to it is had through an iron door opening into the school-room. Most of the air withdrawn from the rooms goes through large openings close to the stack; the remainder (15 or 20 per cent.) is drawn through ducts under the back platform, and thence into the extraction flues. The total area of outlet openings from each room is about equal to the sectional area of its extraction flue. All outlet openings are covered with wire netting of about one inch mesh. Inlets on outside of building are protected by boxing and fine netting.

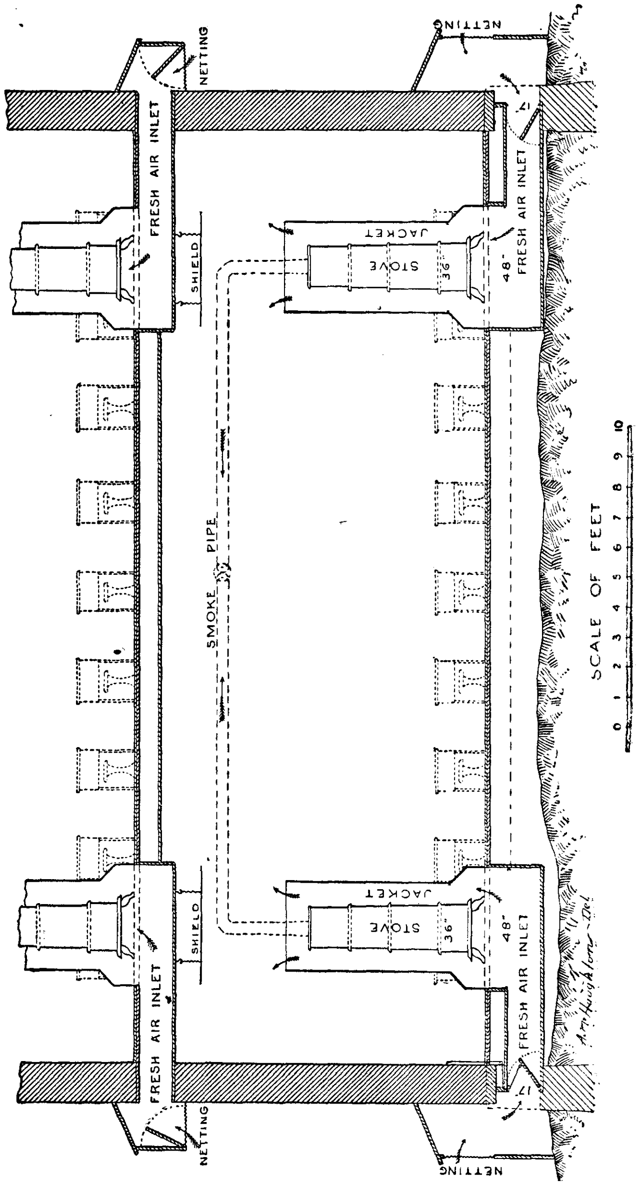
The illustrations which follow will make this description plain. All dimensions are given in the floor-plan and sections. The capacity of the lower room is 10,700 cubic feet, that of the upper 12,040 cubic feet, allowance being made for chimney, platforms, stoves and jackets, but none for furniture or persons. The air space per scholar, using the average attendance during the winter term of 1886 as the basis of calculation, is for the lower room one hundred

*Nineteenth Annual Report of the State Board of Health of Massachusetts. 1887.

and ninety-four cubic feet, for the upper room two hundred and forty cubic feet. The actual air space enjoyed by each pupil in any school varies, of course, from time to time with the number in attendance. The average age of the pupils in the lower room is seven years, nine months; in the upper room nine years, six months.

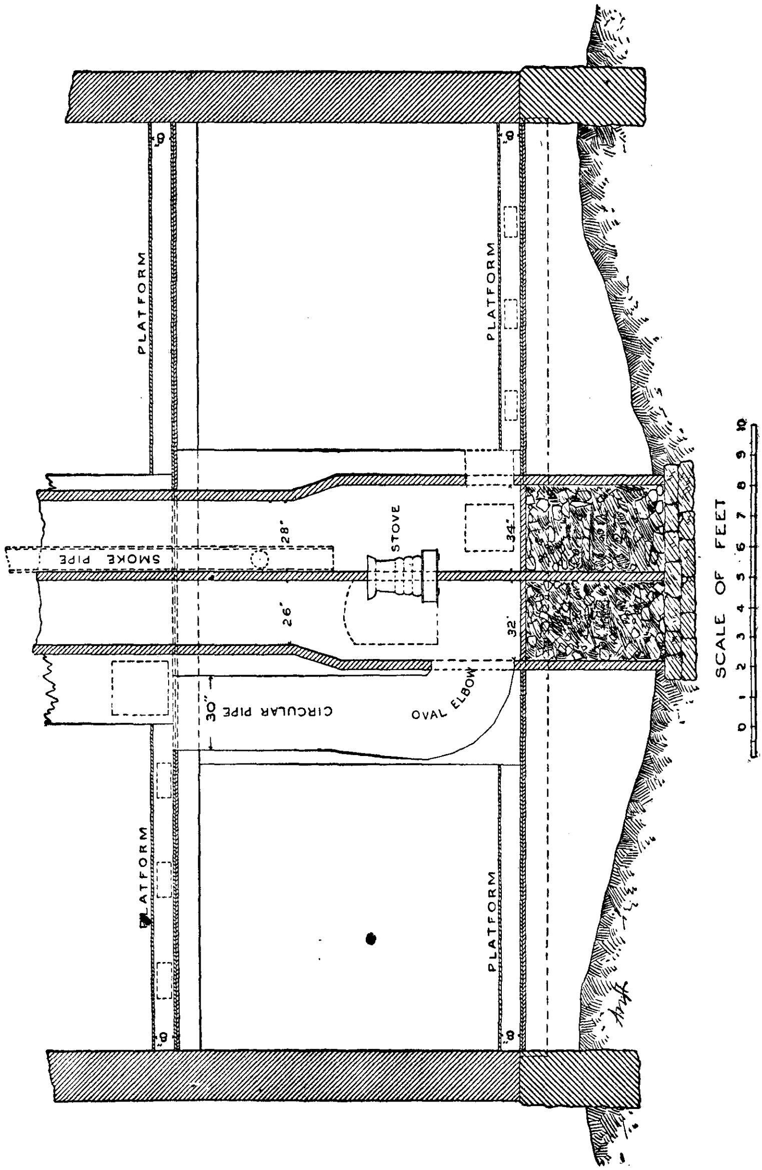
RED ROCK STREET SCHOOL HOUSE

SECTION THROUGH HEATING STOVES AND FRESH AIR INLETS



The results at this school-house have been most excellent, as shown by charts A and B, and the accompanying tables. There was no difficulty in managing the apparatus after its working was fully understood.

Visitors to the school note the seeming purity of the air, and the teachers bear similar testimony.

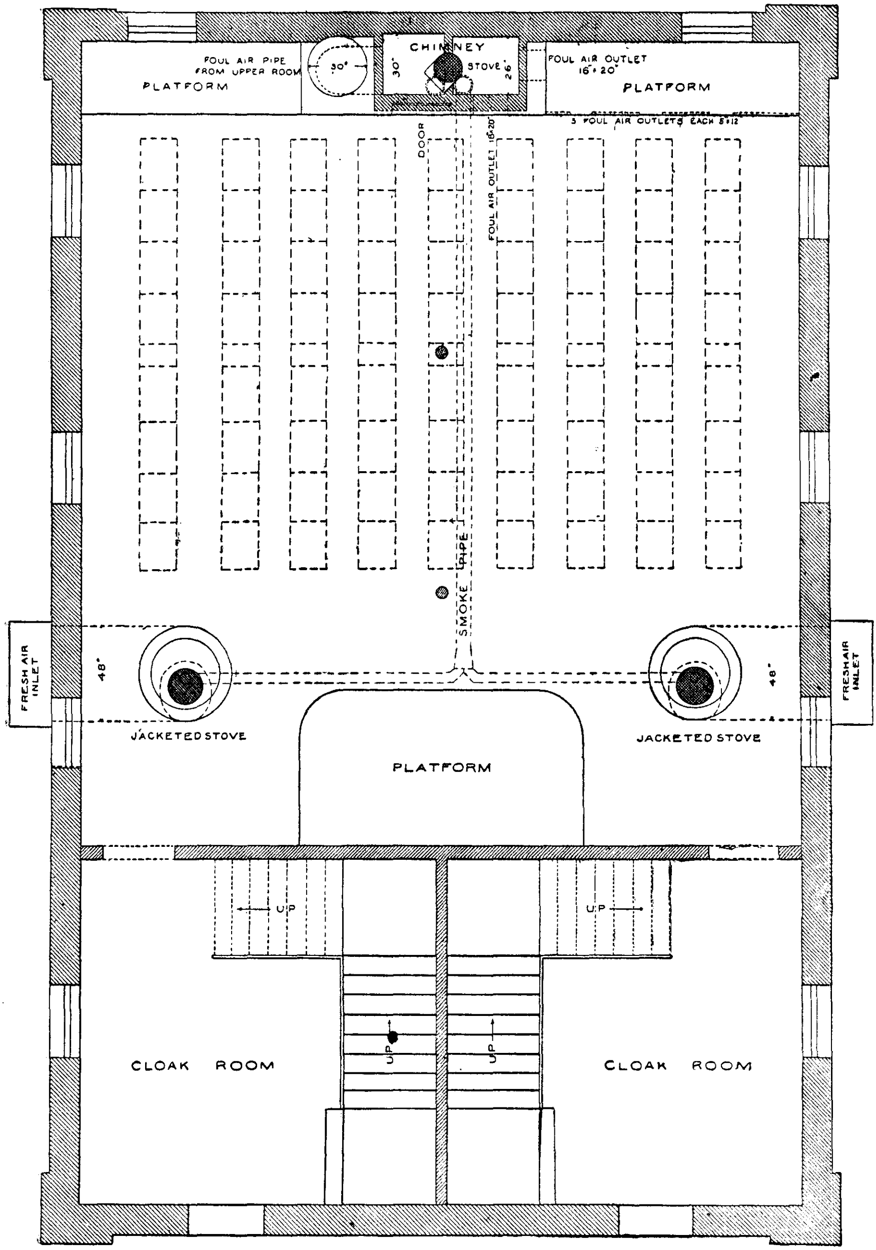


RED ROCK STREET SCHOOL HOUSE

SECTION THROUGH CHIMNEY ON LINE PARALLEL TO REAR WALL

RED ROCK STREET SCHOOL HOUSE LOWER ROOM

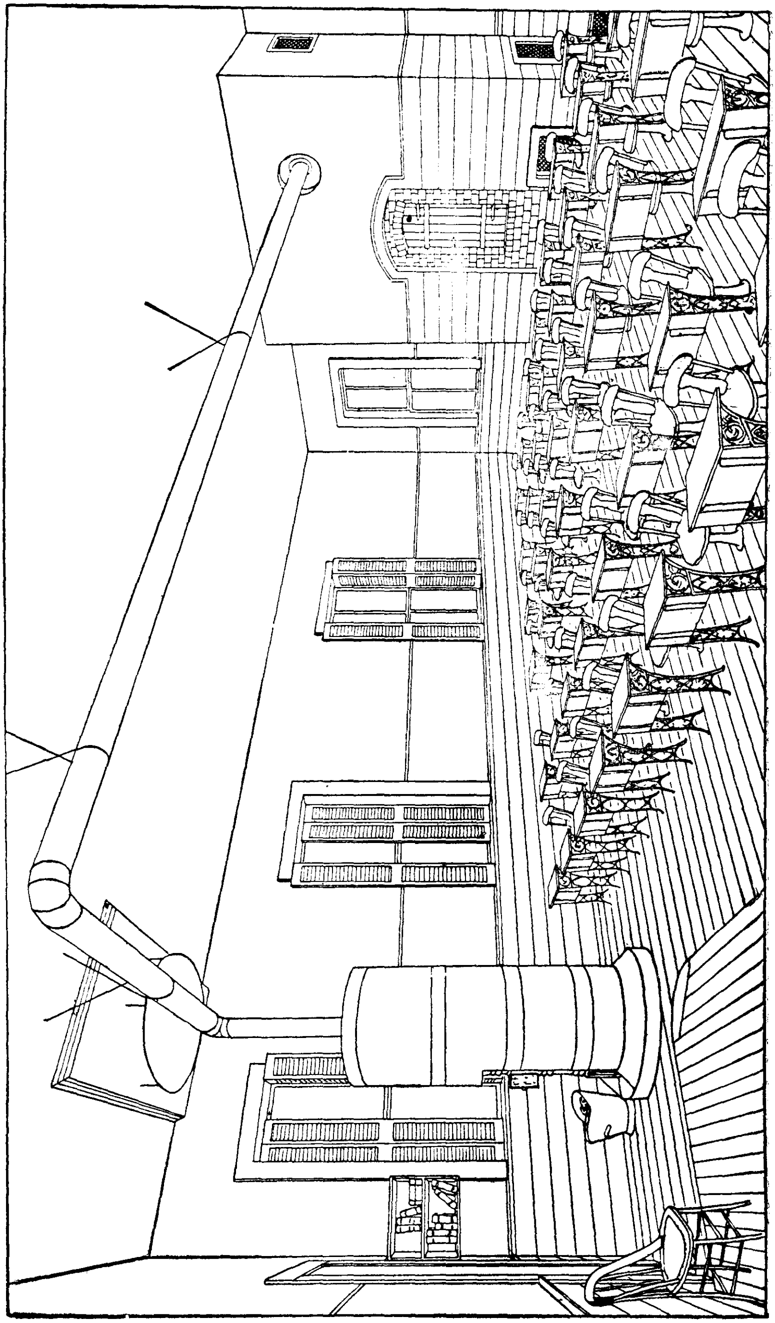
PLAN



FRONT

SCALE OF FEET

0 1 2 3 4 5 6 7 8 9 10



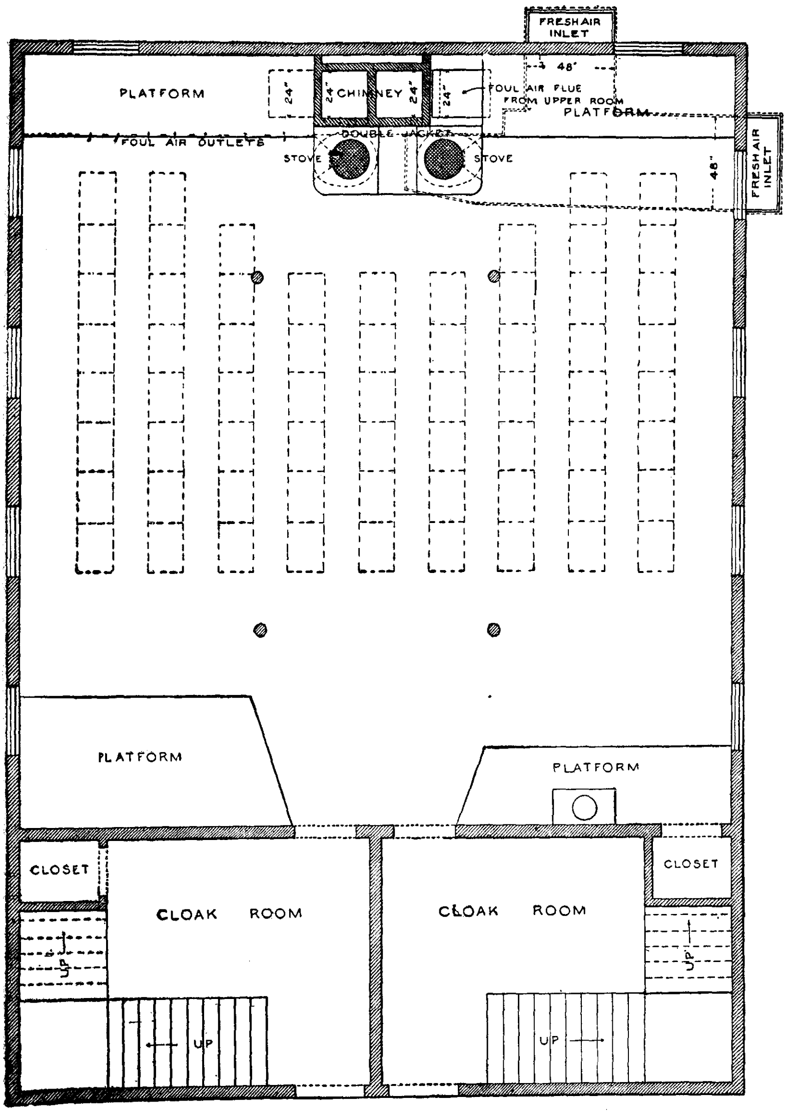
Measurements of the outflowing air have been made at various times. These show an average for the lower room of 108,510 cubic feet per hour, or about 2,100 cubic feet to each pupil; for the upper room 84,664 cubic feet, or about 1,900 cubic feet to each pupil. In making these estimates the cubic contents of the rooms were added to the outflow, and the average attendance of the pupils employed as a factor.

It is probable that in mild weather these figures would be somewhat reduced. They might be considerably reduced, and still leave quite a liberal supply for pupils of the ages specified if the commonly received views as to the amount required are correct. It is intended that the fire shall be kept burning in the flue-heating stove at all times, except in warm weather. In this way the air supply may be kept up when the jacketed stoves are not in use."

March 7, 1887, with fifty-eight persons present, the weather clear and the temperature out of doors ranging from 30° to 34° Fahrenheit, the discharge of air from the lower room varied from 94,000 to 122,000 cubic feet. Samples of air taken at various times during the forenoon session showed 4.71, 5.20, 4,26 and 4.82 parts respectively of carbonic acid per 10,000 parts of air. The results in the upper room with fifty-two persons present, were not quite so favorable.

Baltimore Street School-House.—This is an old wooden building with thin walls, and of rather loose construction. The rooms are so arranged as to make it inconvenient to place the stoves in the front part. They were, therefore, placed in the back part, as shown in the illustrations. Those in the lower room are enclosed in a double jacket, and placed directly in front of the chimney. The fresh air is admitted to a chamber underneath the platform, and from thence is conducted to the jacket, traversing both stoves before its escape into the room. In the upper room the stoves are surrounded by cylindrical jackets and placed one on each side of the chimney. The smoke pipes open directly into the flues. The foul air from both rooms is carried down to the bottom of the chimney by tin ducts, as at the Chase Avenue school-house. On account of the character of the building it was not thought best to attempt to supply so much air as at the Red Rock Street school-house. Hence the extraction flues and inlets were made somewhat smaller. The diagram shows a section through the chimney, the stoves in the upper room, the foul-air ducts, etc. The view is from the front, and the stoves in the lower room are shown in dotted lines. The arrangement in this building has an advantage over the others in that the apparatus occupies but little space and is out of the way. It was put in during the summer of 1887, and has hardly been in operation long enough to determine fully its merits or defects. The observations thus far made, as exhibited in charts D and E and the tables, prove that the air of the rooms is generally pure. But they show at the same time that there is occasionally a failure of the respired air to diffuse itself rapidly or to pass away from the breathing zone; a fact which may perhaps, be accounted for by the entrance of cold air by other channels than those which lead to the stove jackets. Such an event

PLAN



FRONT

SCALE OF FEET

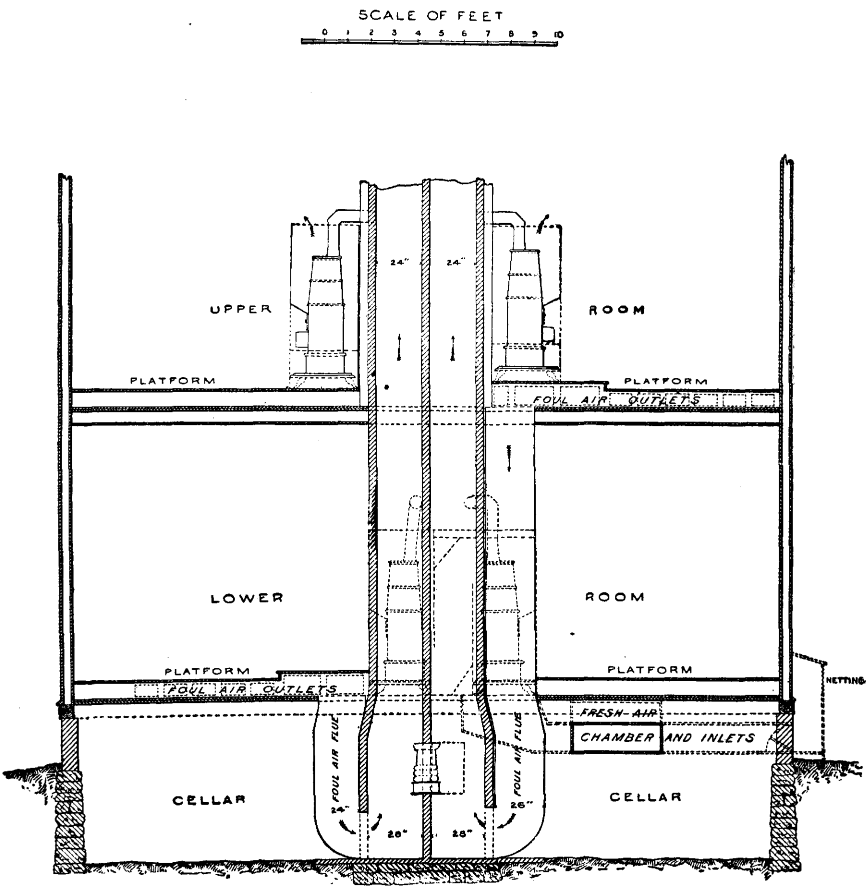
0 1 2 3 4 5 6 7 8 9 10

would not only keep the floor cold, but would cause the air in the middle of the room to remain more or less stagnant at times,—in fact, to give us the results shown by certain of the air analyses. That this is true, a brief consideration of the physical laws which control the movements of air under such circumstances will make apparent. Samples of air taken at different altitudes from near the middle of the lower room, December 31st, gave the following results:—

Just before recess, at floor, 8.29 parts of carbonic acid to ten thousand volumes of air; at the breathing line of pupils, 13.66 parts;

BALTIMORE STREET SCHOOL HOUSE

SECTION THROUGH CHIMNEY ON LINE PARALLEL TO REAR WALL



at the ceiling, 6.16 parts. Near the close of the session, at floor, 4.16 parts; at the breathing line, 6.51 parts; at the ceiling, 7.64 parts. The day was an extremely cold one, and as the fires had not received proper attention in the morning the room did not get fairly warmed until after ten o'clock. The upper ventilator in the chimney had also been left open during the early part of the session, allowing the pure, warm air to escape in the most direct way possible. When the room is well warmed, as on February 23d, the date of the observations shown in the chart, the air is thoroughly diffused. This appears to be proved by the constant purity of the air at the breathing line, a fact which the analyses of that date show.

Advantages of the System.—The advantages of this system of heating and ventilating school-rooms may be briefly summarized as ollows:—

1. It is extremely simple, and can be easily applied to that large class of school buildings which it is convenient or practicable to heat by stoves only.

2. When the conditions of success are observed, it is possible to secure perfect, or nearly perfect, ventilation by this method.

3. The position of the stoves in the school-room prevents any waste of heat. When arranged as at the Red Rock Street school-house the whole apparatus is under immediate supervision of the teacher, who can attend to it without leaving the room.

4. The heating of the rooms is more satisfactory than with the unjacketed stove, or the hot-air furnace. The disadvantages of the stove, as commonly used, are well known. No provision is made for a supply of fresh air, and the temperature is very unequal in different parts of the room. The ordinary furnace supplies a small amount of highly heated air. When the heat becomes too great, registers are closed, and the fresh air supply, what there is of it, is thus shut off. By the jacketed stoves, as used in Lynn, a large amount of moderately heated air is furnished, and there is little danger of over-heating. The jackets around the stoves protect those sitting near from the direct or radiant heat.

Expense of the System.—This includes the cost of construction and of maintenance. The cost of the improvements at the Red Rock Street school-house was $567.77; of those at the Baltimore Street school-house, $554.56. At the Chase Avenue school-house $418.16 was originally expended, but subsequent changes considerably increased the cost. Quite a large part of the first cost came from the necessary tearing down and building up again. It is notoriously expensive to make changes in completed buildings. The school-house mechanic, who has had a general oversight of the work of making these improvements, estimates that if put in during the process of construction the apparatus in a two-room building would not cost more than $350; in a one-room building, $225. The changes could probably be made in an old one-room building for $350. When the arrangements form part of the original plan of a school-house, they are likely to be much more satisfactory than when added afterwards.

The cost of maintenance involves an increased outlay for janitor service and for fuel. In country districts where the fires are cared for by the voluntary service of teacher and pupils the former item is not to be reckoned. In Lynn an extra allowance of fifty cents per week for each additional stove is made during the season when the fires are in operation. This amounts to something near $40 per year for each building of two rooms.

From our experience thus far it is difficult to form an exact estimate of the increased cost of fuel. The coal and wood are supplied to the city on contract, the bins being filled up when necessary. It is certain that the consumption of fuel increases somewhat in proportion to the amount of fresh air supplied. At the Chase Avenue school-house, as nearly as can be ascertained, from five to six tons more of coal have been burned each year since the ventilating apparatus was put in than before. It would be not far from the truth if we should reckon the increased cost of fuel for the building at $30 per year, or $15 for each room. This added to the increased outlay for janitor service makes $35 per room,—surely not an extravagant sum to pay for anything so necessary to health as pure air.

The Conditions of Success.—1. The first point to be mentioned under this head is that the building should be of good construction. It is not uncommon for school-houses to admit air freely, not only around doors and windows, but even directly through the walls. Such a defect in structure is a serious obstacle to the success of this plan of heating and ventilating. Brick is a better material for walls than wood, because it is not so good a conductor of heat. In the case of wooden buildings a layer of tarred paper under the clapboards and back-plastering the walls are suggested as expedients for keeping air out and heat in. Double windows, or windows with double frames, might be used. Floors should be double and well laid. The underpinning should be tight, and there should be no dampness under the building. When an old school-house is to be ventilated in this way, a few hundred dollars might, in many instances, be profitably spent in the direction indicated above.

2. The extraction flues should be of a size proportionate to the amount of air to be removed. Those at the Red Rock Street school-house are suggested as models. In order to produce a satisfactory draught in them it is necessary that they receive a larger amount of heat than that derived from the smoke pipes. If a stove be used for this purpose, as in Lynn, it should be set into the partition between the flues in such a way as to supply an equal amount of heat to each. The partition between the flues should be made tight around the stove. When the fire is in operation the door into the chimney should be kept shut. Other methods of heating the flues might be used,—a gas-jet, for instance. The experiment of using kerosene-burners at the Chase Avenue school-house was abandoned on account of the disagreeable smell produced.

3. The foul air should be discharged into the flue at the bottom, or at any rate below the space where the flue-heating stove or burner is placed. The attempt at the Chase Avenue school-house to produce a draft by applying heat at the bottom of the flues, while the foul air was let into them at the floor level of the rooms did not prove satisfactory. Indeed, a theoretical study of the problem might have shown that this was likely to be the case; for such an arrangement would necessitate an ascending and a descending current of air, with more or less of irregular movement and conflict, in the lower part of the flues.

4. The combined area of the outlets from the rooms into the flues, making allowance for registers, wire netting and other means of obstruction, should be somewhat greater than that of the extraction flue on cross section. They should open as directly as possible into the flue, or into the duct leading to it. To take the foul air from numerous openings, or from different parts of the room, materially impedes the outflow, while it does not appear to aid in the distribution of the pure air.

5. The stoves should be situated near the sides of the building, in order that it may not be necessary to convey the cold air for a long distance under the floor. To do this would be to produce more or less coldness of the floor, an evil to be avoided.

6. The inlets should each be large enough for the total air supply of the room, so as to be sufficient when only one stove is in use. The space within the jacket, around the base of the stove should be equal to the inlet. No air-duct can be considered larger than its smallest part.

7. Lastly, teacher and janitors should be thoroughly instructed in regard to the working of the apparatus. Any scheme of ventilation will prove a failure if not intelligently managed.

The Puritan Jacketed Stoves.—Once at the office of the Barstow Stove Company, Boston, and just on the point of going to Lynn, the writer suggested to that firm the need of a ventilating school-room heater with a capacity of warming moderately an ample supply of fresh air. The stoves used by Dr. Pinkham were mentioned incidentally. The firm appears to have been interested in the idea as is made apparent by the fact that a representative of it reached Lynn as soon as I did to examine the stoves in the Red Rock Street and other school-houses. The result was a "Puritan

Jacketed Stove," using coal as fuel, Fig. 28, and later a wood-burning stove with the same name, shown in Fig. 29.

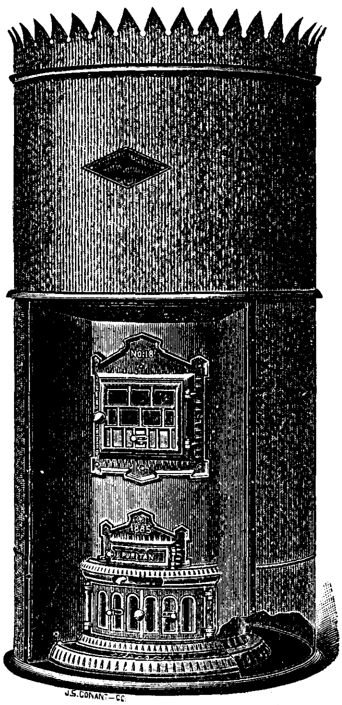


FIG. 28.

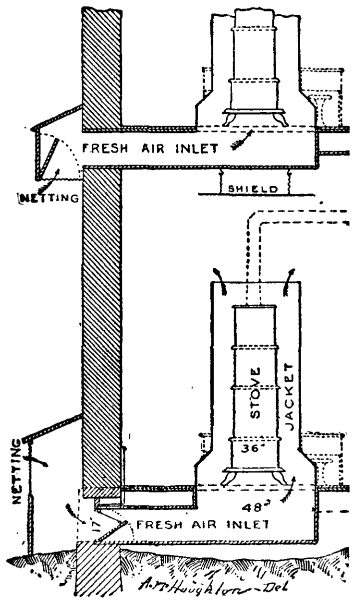


FIG. 29.

These stoves are, so far as I know, the best ventilating stoves on the market, though, in the coal burner, the free area for the movement of air between the stove and its jacket is rather too small, a fault which I have understood the proprietors are about to remedy.

Furnaces.—"A school-house or auditorium furnace," says Prof. Woodbridge,* "should be suited to the movement of large volumes of air through it, and furnished with ready means for changing at will the temperature of that air without altering the volume of flow; and it should at the same time be economical in the use of fuel, and effective in heating. For economy in fuel the furnace must be one in which combustion is as complete as possible, and also the transference of heat from the combustion gases to the air to be heated; its fire-box should not admit of too deep a fire; the combustion chamber should be of such character and furnished with

*A Method of Warming and Ventilating Small School-Houses.

such required means for the combustion of unburned gases escaping from the coals as to effect their complete burning; the furnace shell between the hot gases and the air to be heated should be of such

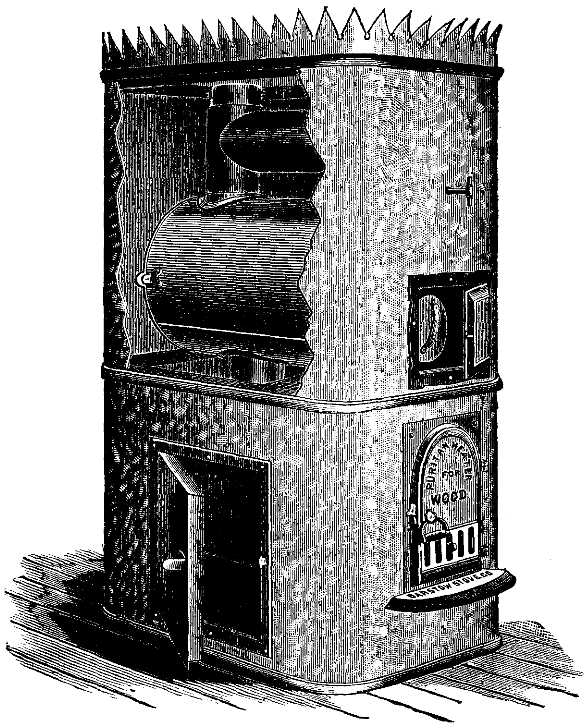


FIG. 30.

form on both sides as to insure the intimacy of contact between the hot gases and a low-temperature shell on one side, and between it and the air to be heated on the other.

"The essentials for obtaining these desiderata are a fairly shallow fire-box; good grates and simple means for effective stoking; a large combustion chamber, and an adequate supply of heated air within it for the burning of the combustible gases; large area of furnace shell, both for absorbing the heat from the hot gases and for yielding the same to the air.

"For purposes of ventilation, the free area for air movement through the heating chamber of the furnace should be large, and the whole body of air should be uniformly warmed by contact with a large and moderately heated surface, rather than by the mingling of highly heated air with other volumes of cold air, and so finally imparting to the whole volume the temperature desired. To meet these requirements the furnace must have a large horizontal and relatively small vertical extension; its fire-box must be well protected, and the temperature of its shell must be low.

"The ordinary house furnace is not well adapted to the work under consideration. Its shell surface is but from twenty to fifty times the area of its grate, whereas the ratio should be more nearly that between the radiating surface of a well-proportioned steam system and its grate, or from one hundred and fifty to one, to three hundred to one."

Gold's Hygieian Heater.—"The general form of it is similar to that of a locomotive boiler. The body of the furnace is in box form with arch top, and contains a fairly shallow fire-box and large combustion chamber. The cylindrical part of this furnace may be extended almost indefinitely by means of rings attached to the body of the furnace, and to each other by bolts. We have in this furnace a horizontal, rather than a vertical extension of surface. Beyond this, we have upon the body of the furnace itself and upon the extension rings, rigidly attached to them as one piece with them, cast iron flanges, and attached to these flanges are spurs, or pins, which greatly extend the surface of the heater. The heating surface is, therefore, so large in proportion to that of the grate that it cannot have a very high temperature. I should say, also, that the fire pot is lined with brick, so that that part of the furnace cannot be highly heated, or it cannot be heated to anything like a red heat.

"The external surface is about eight times the internal, and the area of the exterior surface, in such a form as this before you is about 100 times the area of the grate. This ratio may be made much larger by extending the cylindrical part of the furnace. The rings making up this part are very carefully put together sleeving closely one into the other; and they are drawn and held together tightly by short bolts, so that it is practically a very tight furnace, and it is not especially liable to breakage by warping.

"For completeness of combustion, which is always desirable, the furnace has a large combustion chamber, and the gases in rising from the coal, from one part carbonic oxide gas and from another part air, have a chance to mingle and to complete the combustion before coming into contact with the cool surfaces of the furnace. There is, furthermore, a very finely perforated plate in front admitting air, which, on striking upon and passing over the fire, becomes heated, so that it is quite common to see, in the rear and upper part of the furnace, the blue flame characteristic of the burning of carbonic oxide gas."*

This heater is adapted to the burning of either wood or coal. Fig. 31 shows the Hygienic Heater before its brick walls are laid, and Fig. 32, the same heater set in brick-work, the brick-work removed from one side to show the apparatus.

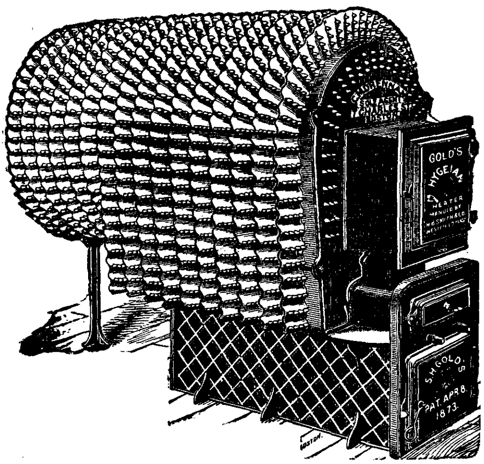


FIG. 31.

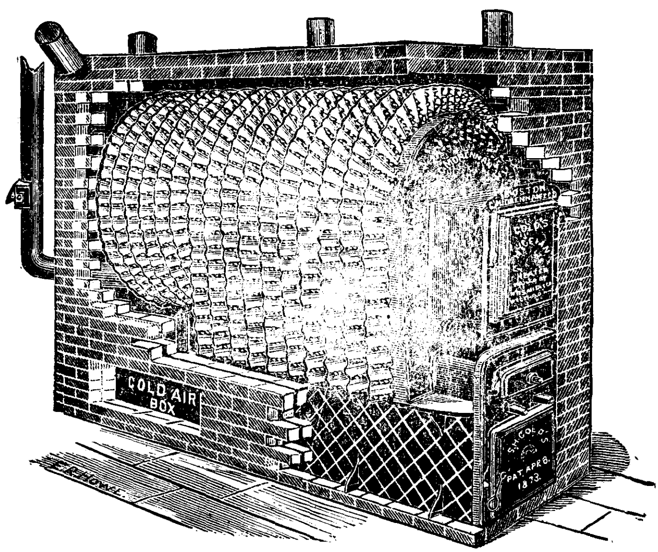


FIG. 32.

*Prof. S. H. Woodbridge, Jr. of the Assoc. of Engineering Societies, IX, 179. 1890.

The Smith Air Warmer.—This furnace is shown in Fig. 33. The manufacturers are now making some changes in the apparatus that they claim will still more improve it as a school-room heater.

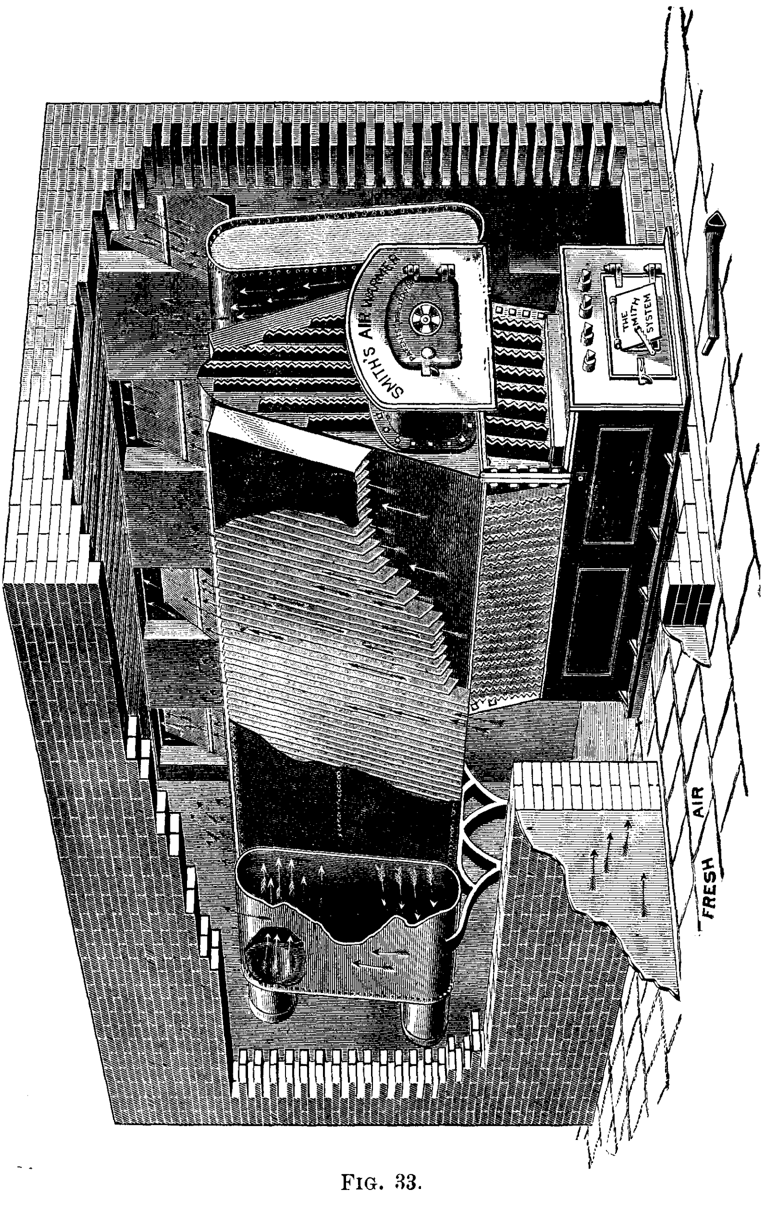


FIG. 33.

The Mahony Warm Air Furnace.—The manufacturers claims are that this furnace has the advantage of an extensive radiating surface, the proportion of heating surface to grate surface being as 80 to 1, and that its flues are so constructed as to distribute the heat equally to all parts of the heating surface. See Fig. 34.

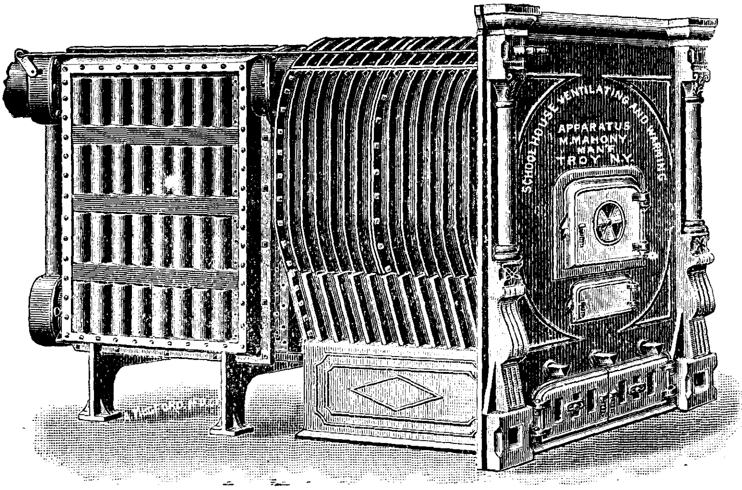


FIG. 34.

The Hess "Pure Air" Furnace.—This furnace, manufactured in Chicago, has gained some notoriety in the West. The illustration, as seen in Fig. 35, gives the impression that the furnace has a large radiating surface and that it may be well adapted to school-house requirements.

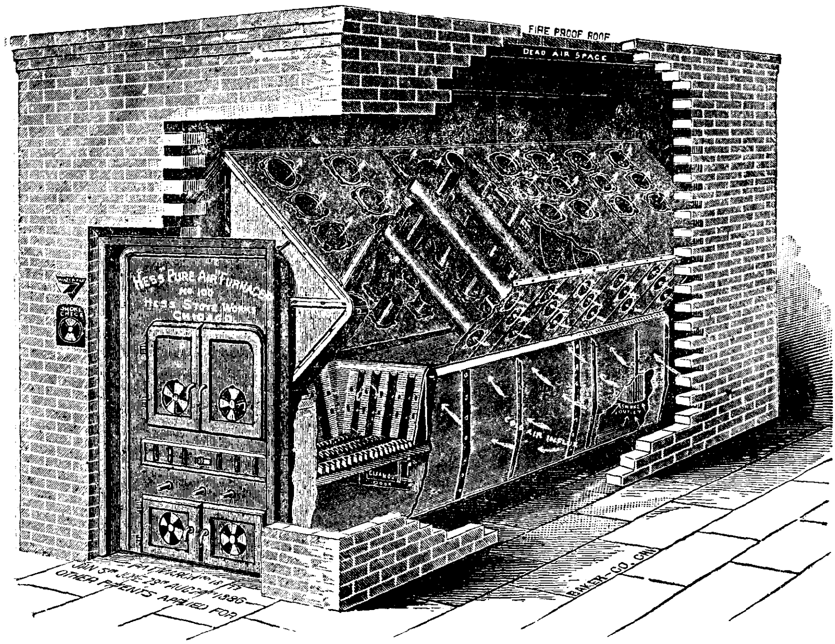


FIG. 35.

PLANS FOR HEATING AND VENTILATING SCHOOL-HOUSES.

Arranged for the Board by Prof. S. H. WOODBRIDGE.

The systems of warming and ventilation shown in the accompanying figures have been adapted to building plans designed without special regard to arrangements best adapted to effective ventilating work and simplicity of arrangements therefor.

The methods of ventilation shown in the plans are limited to what may be termed the natural as distinct from the mechanical, or forced, and for the reasons: 1st, That many school committees oppose carrying a steam pressure in boilers within school buildings sufficient to run an engine, and 2d, that the services of an attendant capable of running and properly caring for an engine and fan mechanism would demand higher wages than school committees feel justified in paying for janitorial services in small buildings, and 3d, that water power can be advantageously substituted for steam only when the pressure in the supply main is high, and the water rates are low. When water is supplied through reservoirs into which it is pumped by steam, its price may be anywhere from fifteen to thirty cents per thousand gallons. At twenty-five cents a thousand it costs as much per cubic foot as illuminating gas at $1.87 per thousand cubic feet.

A fair average for work done on every cubic foot of air moved through an easy working mechanical system of ventilation is ten foot pounds. For supplying a school of 200 scholars with a per capita air quantity of 2000 cubic feet per hour, the power expenditure would at that rate of work be 66,666 foot pounds per minute. If the water pressure were 40 pounds, and the efficiency of the motor were 70 per cent., the volume of water required per minute would be 16.5 cubic feet or 990 cubic feet per hour. If the water pressure were 80 pounds, 8.25 or 495 cubic feet of water per hour.

Thus, while water power may be reasonably chosen on the score of safety and lower cost of attendance, its use is, under the stated conditions, much more costly than that of steam, especially when the steam escaping from the engine running a fan can be used for heating purposes. If only so low a proportion of the "live steam's" heat as 90 per cent. is available in the exhaust steam for heating purposes, and if four pounds of coal per hour are required to generate the steam necessary to develop one horse power of work delivered through the engine to the fan, then 0 8 pounds of coal per hour represents the cost of fuel required for power as against the 990 or the 495 cubic feet of water.

The cost of electric service for motor work varies with localities and the work done. Ten cents per hour per horse power is a fair price for small work. The cost for such work as that above mentioned would, at this rate, be twenty cents per hour, as against the cost of 1000 or 500 cubic feet of water or 0.80 of one pound of coal.

The greater surety and equableness in ventilating work attainable by mechanical power, because of its comparative freedom from the disturbing action of winds; the readiness of control of the volume and the direction of air movements made possible by its use; the relatively small size of flues required and the adaptability of a fixed size of flues for all weathers and other variable conditions, give to forced ventilation such advantages that its use should be abandoned only when considerations of safety or economy can be clearly shown to outweigh those in its favor.

In the working out of the accompanying plans it has been assumed that the consideration of mechanical ventilation could not be entertained in connection with the buildings for which ventilating designs have been asked. The aim of this study has been to embody such features in all the plans as seem essential to effective, reliable and economical work under the given conditions. These are:—

First—Generous inlet areas, so located as to reduce to a practical minimum all interference of wind with the ventilating work. To this end the inlet windows should be so placed as to be exposed to wind action from whatever quarter it may blow. Their aggregate area should be such that in quiet weather the air entering all the windows with moderate velocity will furnish an abundant supply for the building. The area of each windward exposure should be such that under the pressure of wind a full supply of air can enter on that side alone.

Second—The use of check valves, so arranged as to admit the air freely on the windward side of the buildings, and to prevent its escape on the leeward side. These valves may be made of the lightest gossamer rubber cloth, which because of lightness and smoothness and imperviousness, is well suited to the purpose. Its lightness offers little resistance to the movement of air; its smoothness prevents the accumulation of dust; and its imperviousness prevents the leakage of air. If arranged as shown in Fig. 38, Group I, their action will be found noiseless. For use in places where the currents are strong enough to produce flapping and noise, closely woven and light weight woolen stuff may be used rather than rubber gossamer.

Third—Large and direct air conduits from inlet windows to the heaters at the base of the warm air ducts supplying air to rooms. So far as practicable these conduits should be large chambers rather than "cold-air-boxes." Inlet and conduit areas should be so large as to virtually place the whole out of door atmosphere at the disposal of the heating and ventilating apparatus. The quantities of air moved upward to the rooms from the heaters should be controlled by valves between the heaters and the rooms, rather than by dampers between the heater and outer air.

Fourth—The placing of the furnace and its smoke flue and other hot pipes within the cold air chamber. The heat yielded from the walls of a boiler or a furnace casing is by this means given to the air moving to the rooms, as is also that yielded by so much of the smoke pipe as can be brought within the chamber. In the case of steam heating, the steam mains are run as far as practicable within the chamber, and are not covered.

Fifth—Such area of warm air flues as to allow a sufficient flow of air for the ventilation of the rooms when the outside air is at or near 50° F.

A ventilating apparatus should be planned for the minimum inside and outside temperature difference, and the heating apparatus for the maximum temperature difference under which the systems are to be depended upon for ventilation and for warming. Means must therefore be provided for the effective and easy regulation of air flow and of temperature, according to conditions of weather.

When the outside temperature reaches the upper limit, the ventilating ducts must have their maximum carrying capacity, or area of cross section, and the heating system must be working at its minimum capacity. In cold weather these conditions must be reversed. The effective or working area of the flues should therefore be variable within a range corresponding to inside and outside temperature differences.

In the plans presented such variation of flue area is made possible by simple means. The flues are given a size adapted to ventilating work when the motive pressure, due to the difference between inside and outside temperature, is least. In the coldest weather the switch dampers at the bottom of the flues can be so placed as to cause all the air entering the flues to pass through the heater, whether steam pipes or furnace. The size of the area for that flow is made such that under the most favorable conditions for strong draught the volume of air moved will be that required for ventilation. When, on the other hand, the outside temperature reaches the upper limit, the opening of the switch valve enlarges the area for the entrance of air into the flues to the full capacity of those flues, warm air flowing slowly through the heater, and cool air through the freer area of the flue bottom.

When the outside temperature is above 50° or 55° it is not advisable to rely on artificial ventilation alone, unless such ventilation is mechanical, that is by means of fans, or artificial motive power. Artificial ventilation is at best but a far off imitation of and a poor substitute for the natural ventilation of summer, when windows and doors may be open to entering breezes and escaping volumes of air ten or a hundred fold larger than could be moved and distributed through a building by any practicable system of artificial ventilation.

The windows of a school-house, as of any other building requiring free ventilation, should be provided with transoms hinged at the bottom and mounted to swing inward, when necessary, and furnished with protecting side pieces to prevent the lateral discharge of air. So far as practicable such windows should be opened only on the windward side of rooms. When these are open the entering air will be given an upward direction and will mingle with the warmer ceiling air before setting floorward, and will reach the occupants with the least possible draught effect. The steam apparatus, or the furnace would at such times furnish heat for warming the air passed in partly through window tops rather than entirely through the cold air chamber, the mixing of cold and warm air being effected within the rooms rather than within the flues.

Sixth—The use of diffusers at the point of inlet to the rooms.

The purpose of this device is to prevent the movement of the air in contracted and continuous current across a room. Such a current is not favorable to a uniform distribution of the air supplied, and tends strongly to draught production, and the more so as the temperature of the air supplied is low.

The aim of the diffuser is to divide the entering air current into half a dozen or more parts, and to give to each part an independent direction, so causing the air to more immediately reach different and widely separated parts of the room, and, by sending but a fractional part of the air in any one direction, to reduce the liability to draught effects.

Seventh—The provision for warming the building preparatory to use by the rotation of contained air, rather than by the heating of cold air taken from outside. By this means the warmth of night fires, banked or slowly mulling, may be made effective toward maintaining the building's warmth, and the morning heating may be much more rapidly effected than by supplying out of door and cold air to the heaters, and also with a much less consumption of fuel.

To make such rotation rapid the air movement must be free, conduits large, and frictional resistance low. An inspection of the plans will make it appear that the channels for the air's return to the heaters are as large as halls, stairways and doors will admit of.

Eighth—Large discharge flues furnished with dampers for the regulation of air flow, or for closing the flues when ventilation is not required.

When the motive power producing air flow is chiefly in the supply branch of the system, larger flues must ordinarily be provided for discharge than for supply. The temperature of the discharge flue is lower than that of the supply, and the velocity of air flow is correspondingly less, and areas must be inversely as velocities. Furthermore, the effect of successive enlargement and contraction of channel from the supply flue to the discharge flue should be offset by reducing the work required to reimpart motion to the air at the entrance to the discharge flue.

If the flues are not made sufficiently large, they must be heated to the point necessary to produce the velocity required to move the desired volume of air. When the contraction of a vent flue is due to the presence of a smoke pipe within it, the imparted heat may compensate for diminished area and increased friction unless they are disproportionate or the pipe and the flue temperature are not in effective adjustment. It is not, in these plans, considered effective beyond compensating for its own presence.

No general provision is made for the further heating of the discharge flues, since they are proportioned for doing the required ventilating work when the outside temperature is not higher than 50.° But one example of vent flue heating is shown.

Ninth—Provision for warming feet and drying clothing. On economic and hygienic grounds it is best, for purposes of ordinary school-room ventilation, to locate the inlet for fresh air in the upper half of the room. One reason for this arrangement is the avoidance of draughts produced by a strong and continuous inflow of air. The more free the ventilation the cooler the air supply must be, and the cooler the air the greater the necessity for elevating the currents above the occupied part of the room as well as for diffusing it as thoroughly as possible. If heating rather than ventilation is desired, the warm air should, for the best results, be entered horizontally at the floor. The hallways require thorough warming rather than free ventilation, and in them therefore, the register should be located at the floor. An additional reason for placing the hall registers at the floor is that the occupants should be able to warm feet and dry clothing by a more rapid process than is possible in the still air of a room however comfortable its temperature.

Tenth—The use, whenever practicable, of successive ventilation. Separate supply and discharge ventilation might be furnished for the halls, the school-rooms, the wardrobes, the play-rooms and the water-closets. By such a method of ventilation the air supplied to the halls would for the most part escape unused, whereas if it were passed on to the school-rooms, it could be made to serve the double purpose of hall and room ventilation. The air within a well-ventilated school-room is abundantly pure for the ventilation of a wardrobe. If suitable for breathing, it must be equally so for airing clothes. The school-room air may, for this purpose, be in part vented through the wardrobe. So also in case of the play-rooms,—if the basement rooms are used for that purpose,—they may in cold weather take their supply from the halls, and the water-closets may in turn be supplied from the play-rooms. The successive movements must always be, as described, from the better toward the worse,—as from hall, through school-room, via wardrobe to vent,—or from hall through play-room via water-closet to vent.

By a well planned application of the successive method effective ventilation of several apartments may be secured by the use of a smaller volume of air and at a cost considerably lower than would be possible were the apartments equally well ventilated by independent means.

Eleventh—The heating is made entirely indirect, so making the warming of the rooms dependent on and inseparable from ventilation.

A combination of direct and indirect heating has its chief advantage in the effective means it furnishes for warming rooms on the windward side of buildings, so making the equable warming of a building less subject to the interfering effect of wind action, an action which often seriously affects the flow of air through flues, and the distribution of its contained warmth throughout a building. The objection to the use of direct heat is, chiefly, the liability to its abuse. False notions of economy on the part of school committees, the willingness of janitors to win favor with school boards by reducing fuel consumption to a minimum, their temptation to lighten labor by heating with the least tolerable ventilation,—since free ventilation of school-houses requires more active fires, fifty per cent. more fuel combustion and closer attention to and work upon fires than does the heating of a box-tight building—all tend to the misuse of direct heating. The sole purpose of direct heating in combination with a ventilating system should be to furnish heat for warming air forced by wind pressure through walls and windows—or to warm the rooms where wind action interferes with the flow of warm air to the windward rooms through the supply flues.

The aim in the arrangement of the ventilating furnishment for the buildings whose plans have been submitted for the incorporation of such systems has been to reduce the adverse effect of wind to a minimum, and to make its action as far as possible co-operative with ventilating work.

Were forced ventilation employed, and also automatic means for controlling the admission of steam to radiators, and so the temperature of rooms, the method to be recommended would be that of passing air to all rooms at the lowest temperature required for the proper warming of the rooms most easily warmed, and of adding the heat needed in other rooms by direct radiators within them and under automatic control.

GROUP I.

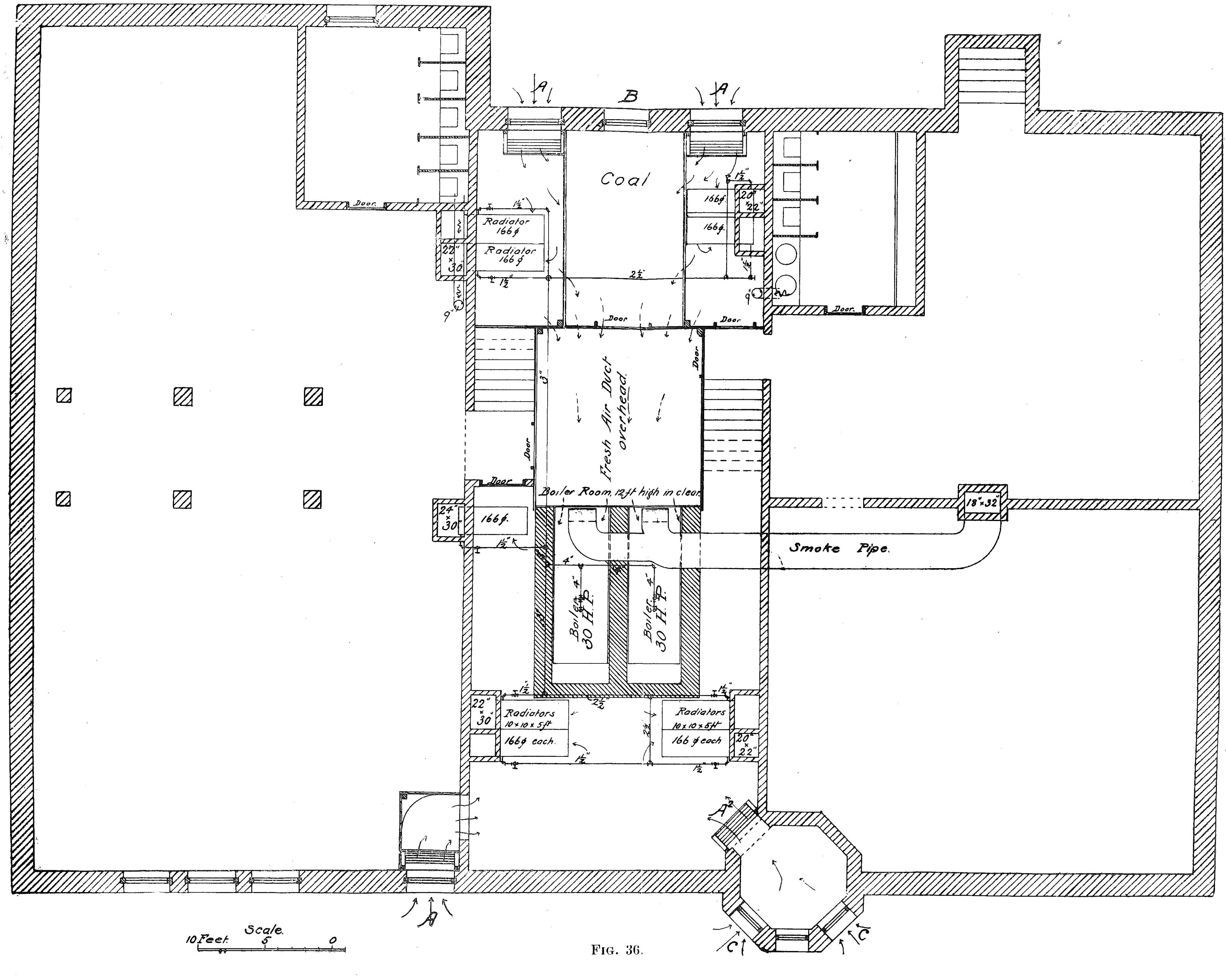
Fig. 36 shows basement plan for an eight room building. The space included between the corridor walls is appropriated to the purposes of heating and ventilation. It should have a clear height of at least twelve feet. Its floor should be of good concrete with facing of Portland cement. Its ceiling should be wire lathed and plastered. Within this space are shown two thirty horse power low pressure boilers, the fire-room and the coal-hold. The air inlets, provided with check valves, are shown at A, A, A, and C, C. The ceilings of the coal-hold and of the fire-room should be two feet lower than the ceiling of the air chamber, so that a passage of large area may be provided for air movement between the front and the rear parts of the chamber. The stairways to the playrooms are separated from the air chamber by the partitions shown, and doors placed in those partitions are available for use in warming the building by the rotation method.

The heating surfaces at the bottom of the flues should be so made up as to provide an effective free area for air movement equal to one-third that of the flue with which it is connected. The actual free area may be larger than that prescribed, if its character is such as to reduce the freedom of air flow through it.

The form of coil best suited to the conditions of space and work here found is one made up of 100 one-inch pipes five feet long, arranged ten pipes broad and ten pipes deep, the lower end being connected with steam chests, and the other in pairs by return bends. Nason tubes should not be used for this work.

These coils may be made in three sections, the two lower ones of four pipes each, and the uppermost of two pipes, and each section having its own supply valve and independent discharge.

The area of opening between the top of the upper steam chest and the bottom of the flue wall should be made equal to one-third the area of the cross section of the flue under which the coil is placed. See Fig. 37.



A
B
A
Coal
Radiator 166 ϕ
Radiator 166 ϕ
166 ϕ
166 ϕ
20" × 22"
22" × 30"
Door
Fresh Air Duct overhead.
Boiler Room, 12 ft high in clear.
24" × 30"
166 ϕ
18" × 32"
Smoke Pipe.
Boiler 30 H.P.
Boiler 30 H.P.
Radiators 10 × 10 × 5 ft 166 ϕ each.
Radiators 10 × 10 × 5 ft 166 ϕ each
22" × 30"
20" × 22"
A²
A
C
C
Scale.
10 Feet 5 0

FIG. 36.

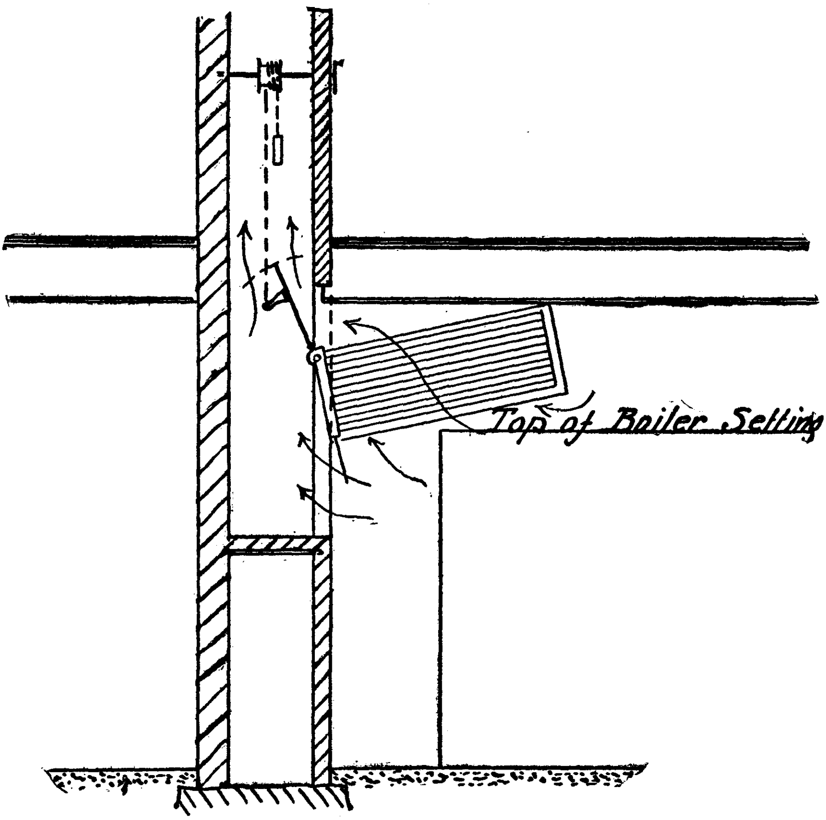


FIG. 37.

The water-closets are shown vented through independent pipes extending to and through the roof, and connected with the seats for the purpose of effecting a strong local ventilation. See Group II, Fig. 45. At the bottom of these pipes should be placed a gas burner of twelve cubic feet capacity. See Group II, Fig. 42 Gas is recommended rather than steam, because ventilation of the room is most needed when steam is least required for heating the building.

If the basement rooms are to be used for recreation purposes, they may be ventilated during recess time by connecting them with the vent shafts used by the rooms immediately above them. These four discharge flues may, by means of proper connections and switch valves, be made to ventilate the playroom during recess and the school-rooms during school sessions. The supply air at such times could in cold weather, be obtained from the halls through the stairways, and in mild weather from out of doors through the windows.

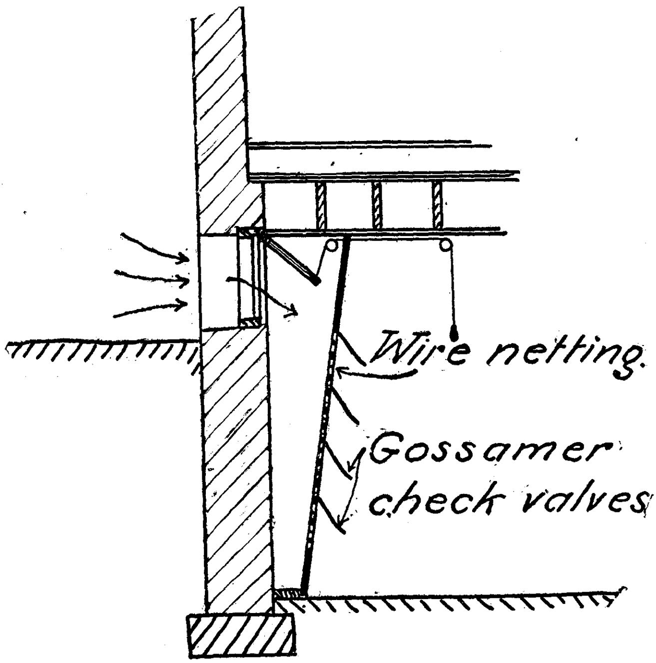


Fig. 38.

Fig. 39. For the movement of air from the halls into the school-rooms, the doors should be furnished with transoms.

To allow the air to pass into the wardrobes from the school-rooms, the lower panels of the doors should be open slat work or coarse wire netting.

To effect successive ventilation and to prevent the too direct escape of hall air, the doors from the halls into the wardrobes should be self-closing.

If it is not desired to provide means for shutting air off from some rooms while not in use the diffusers at the inlets may be backed by coarse wire netting, not finer than one-fourth inch mesh, instead of registers with valves. For the setting of diffusers and gratings, wooden frames of at least one inch stock and suitable width should be set into the brick work. The gratings which carry check valves should be held in place by screws for easy removal when adjustment or repair of the checks may be required.

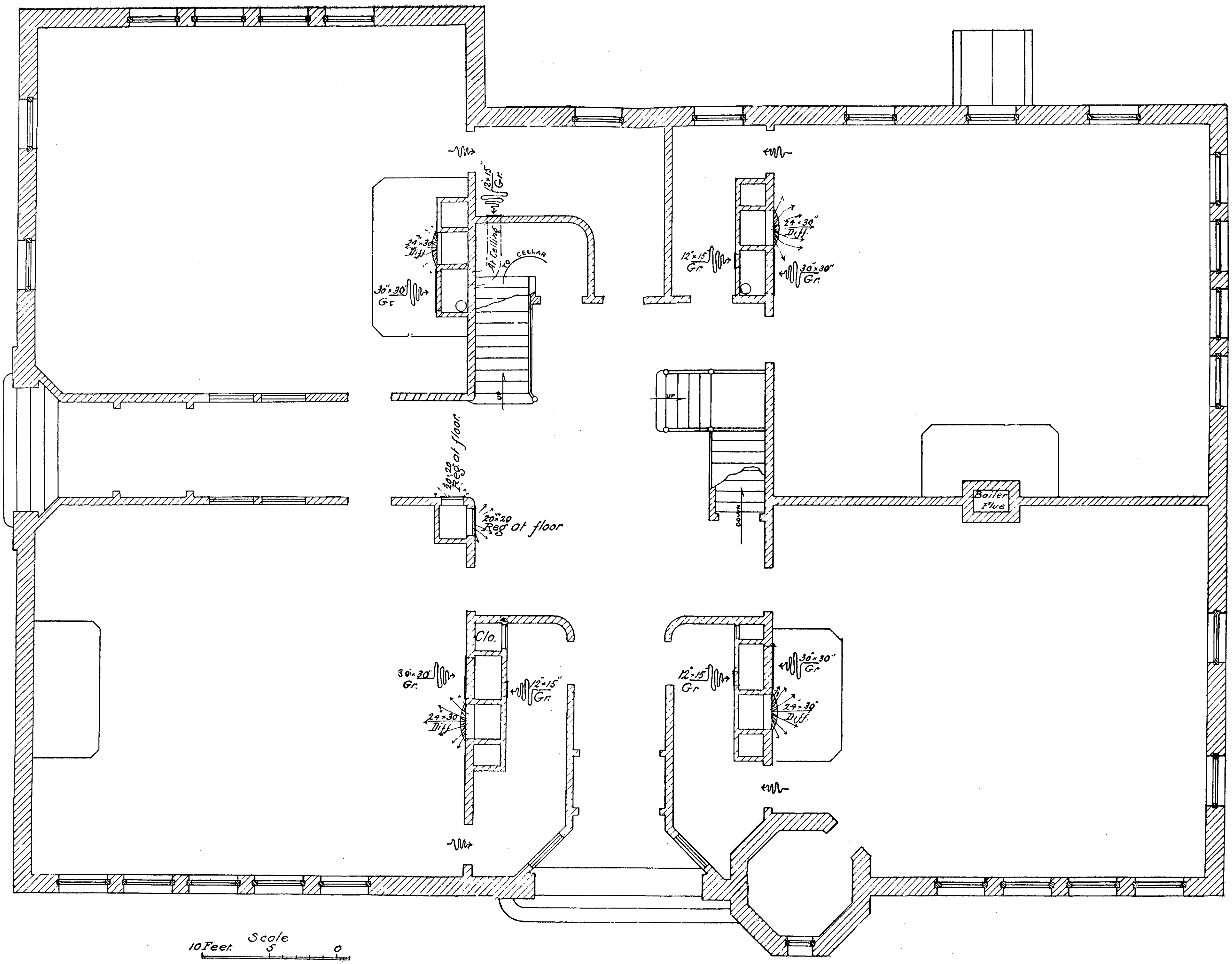
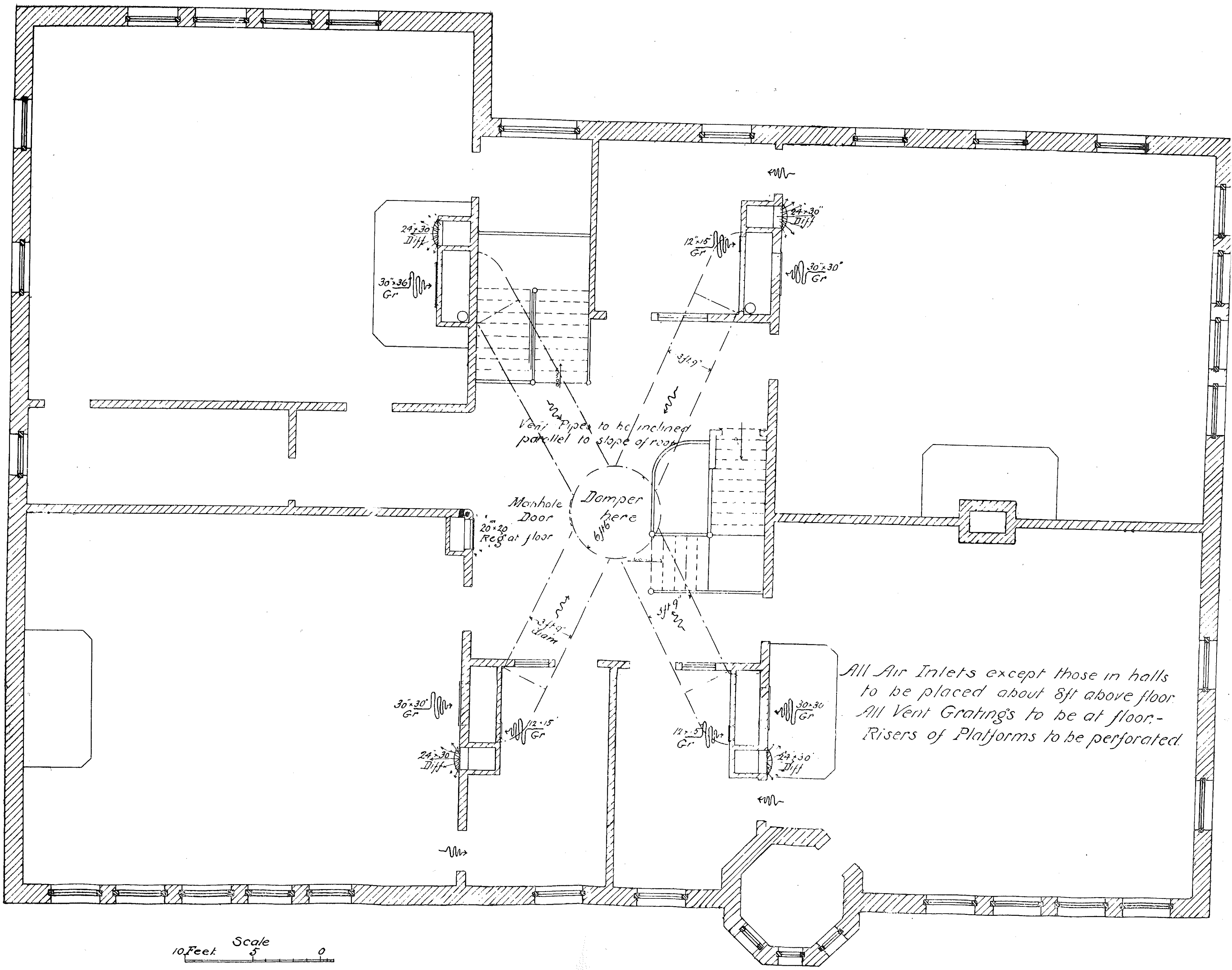

12"×15" Gr.
24"×30" Diff.
30"×30" Gr.
To Ceiling
TO CELLAR
UP
Reg at floor
20"×20" Reg at floor
DOWN
Boiler Flue
Clo.
Scale
10 Feet 5 0

FIG 39.



24×30 Diff
30"×36 Gr
12"×15 Gr
24×30" Diff
30"×30" Gr
3ft.9"
Vent Pipes to be inclined parallel to slope of roof
Damper here
6ft.6
Manhole Door
20"×20 Reg at floor
3ft.9" diam
3ft.9"
30"×30" Gr
12×15 Gr
24×30 Diff
30×30 Gr
12×15 Gr
24×30 Diff
All Air Inlets except those in halls to be placed about 8ft above floor.
All Vent Gratings to be at floor.-
Risers of Platforms to be perforated.
Scale
10 Feet 5 0

FIG. 41.

Fig. 41. On this plan is shown an arrangement of vent duct piping in the attic.

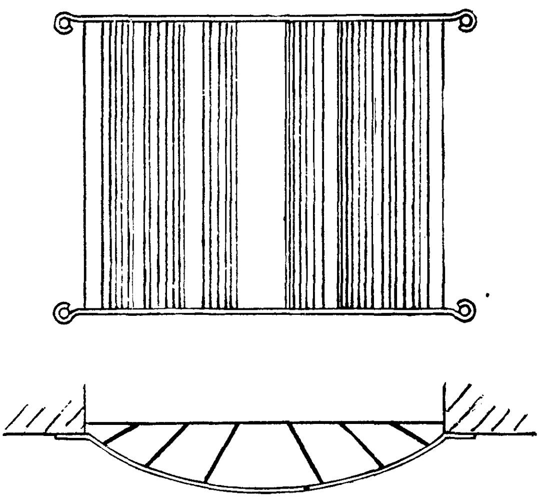


FIG. 40—Diffusors.

The four vent flues might be carried out through the roof separately. In that case their tops should be built up above the ridge of the roof, and the central tower, shown on the furnished plans, should not be built, as its presence would endanger the action of the flues in windy weather. If the flues are carried directly out, dampers should be placed in each of them.

The damper or dampers should be made controllable by chains from the floor below, and should be provided with suitable arrangements for adjusting and holding them in any desired position. The principal use of such dampers is to control the rate of flow of air from the rooms. They also serve the purpose of preventing excessive chilling of the flues when the ventilation is not in progress, as at night. If dampers are not used, check valves placed on the vent gratings will prevent the reversal of flow and consequent chilling of rooms. They cannot regulate air flow.

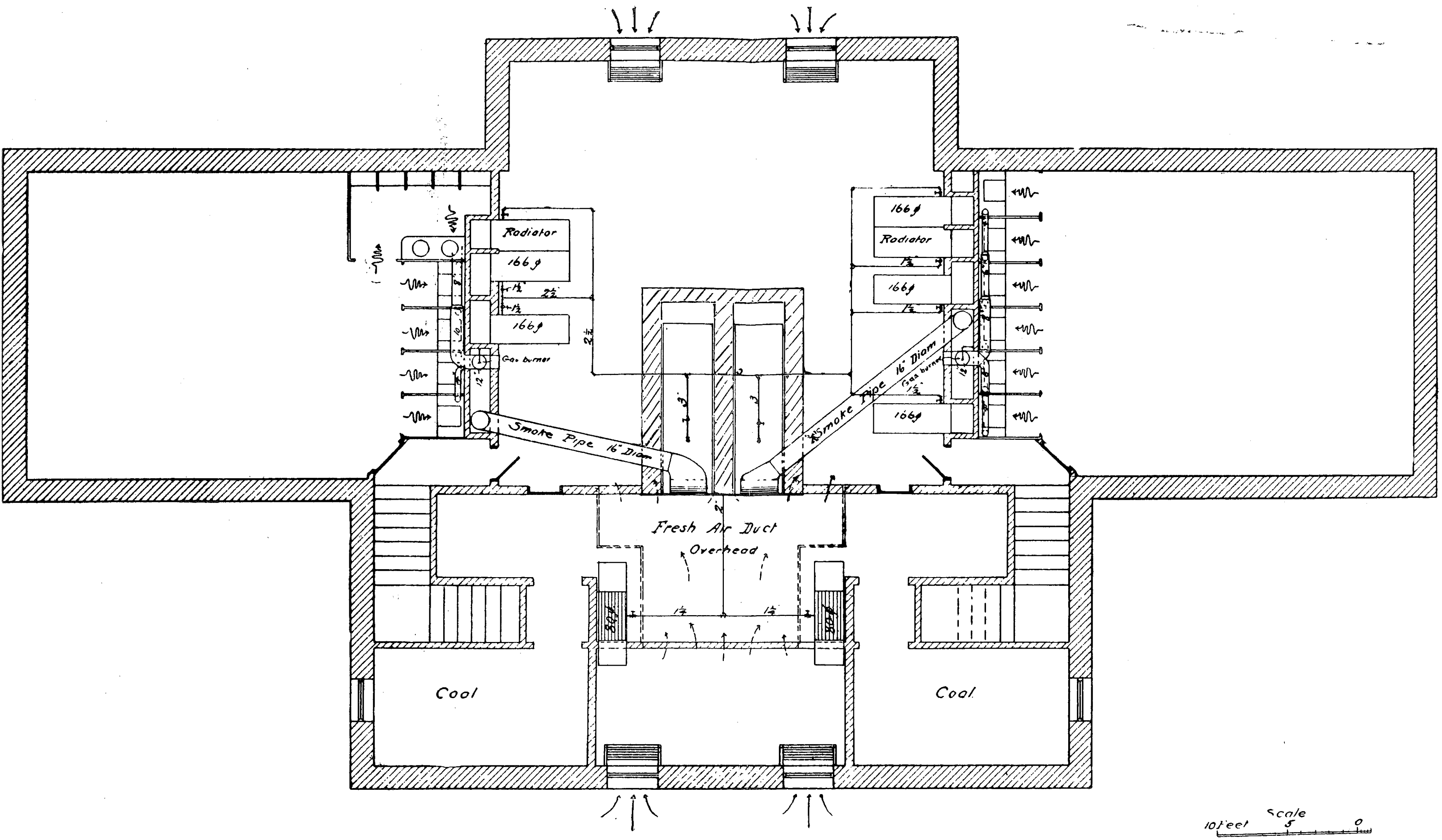
GROUP II.

Fig. 42. The same general arrangements appear in this plan as in Fig. 36 of Group I. The fresh air inlets are upon two sides of the building, and the fresh air chamber extends through the building, occupying the middle part of the basement. The boilers and the smoke and steam pipes are within this chamber, as also the fire-room, the ceiling of which is dropped two feet below the air chamber ceiling to form a connecting duct between the front and the rear parts of the chamber. The dotted lines show the position of the fire-room walls, these being carried to the air chamber ceiling, as also the two ends of the transverse wall which are outside the limits of the air duct. These partitions may be made of one and one-half inch boards tinned on the fire-room side.

For the rotation of air, for warming the building before it is occupied for school work, doors are placed at the entrance to the playrooms, which in the plan are shown to contain the closets. The playrooms are in this case practically sanitary rooms, and, even for purposes of warming the building, it is not desirable that the circulating air should be allowed an entrance into them and an after return to the building. The two doors at the foot of the stairs should be closed at such times, but at all other times they may be swung back against the closet partitions, to which they are hinged, these particular partitions extending to the ceiling for the purpose of making a tight dividing wall between the sanitary rooms and the other parts of the building.

Fig. 43 shows four floor registers in the hallway and the arrangement is sketched as offering an alternative plan with that described under Group I, for hall warming. Exposed hot radiators in a passageway, liable at any time to be crowded, are not advisable. On the score of personal safety, unobstructed floor space and effectiveness in warming and drying clothing, it is better to place such radiators under the floors and connect them with registers as shown in Fig. 44.

Fig. 45 represents the method recommended for the ventilation of the water-closets. The aim is to secure a continuous downward flow of air in large volume through the seat. The air vents with which the basins or "closets" are furnished are generally quite inadequate, their area being seldom more than from two to three square inches. The figure shows the basin under a hinged cover,



Radiator
166 ♯
166 ♯
Gas burner
Smoke Pipe 16" Diam
Radiator
166 ♯
166 ♯
166 ♯
Smoke Pipe 16" Diam
Gas burner
Fresh Air Duct
Overhead
Cool
Cool
Scale
10 feet
5
0

FIG. 42.

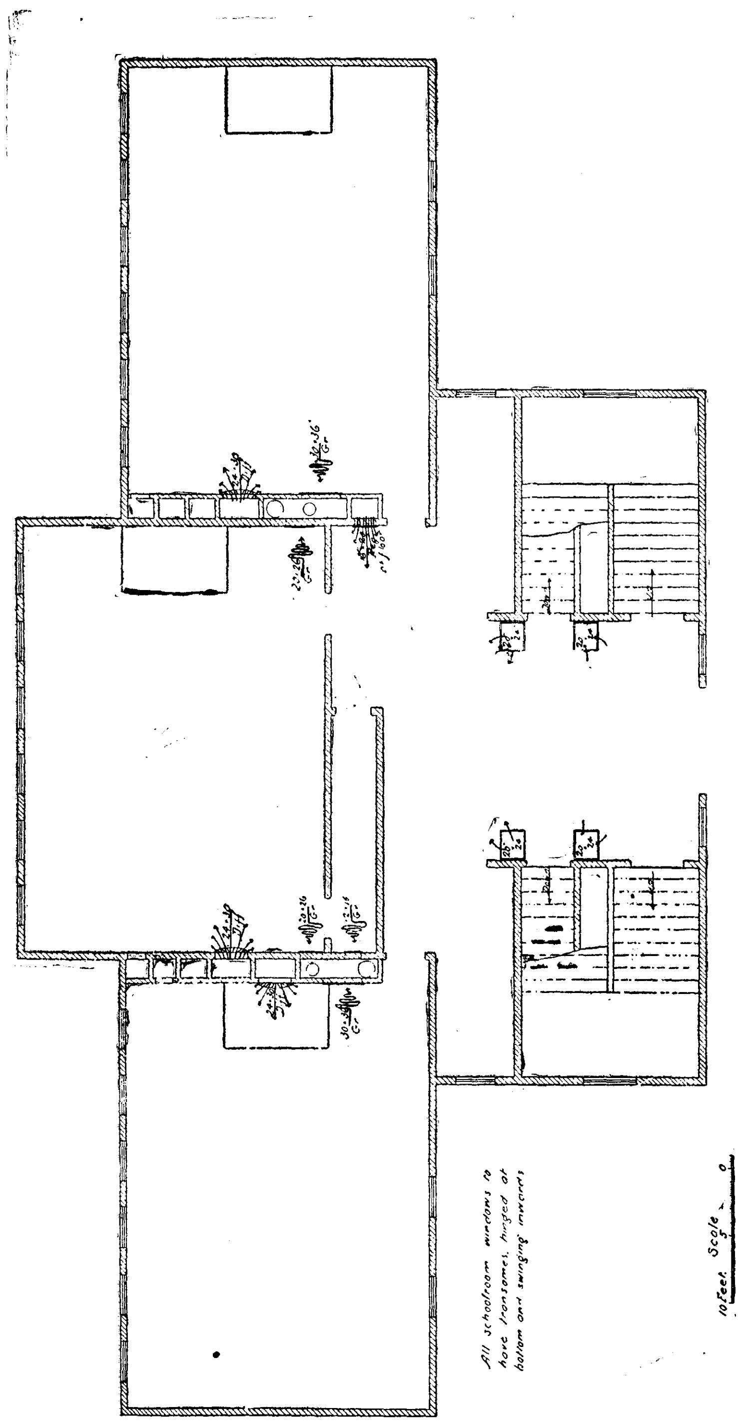

All schoolroom windows to have transomes, hinged at bottom and swinging inwards
Scale
10 Feet 5 0

FIG. 43.

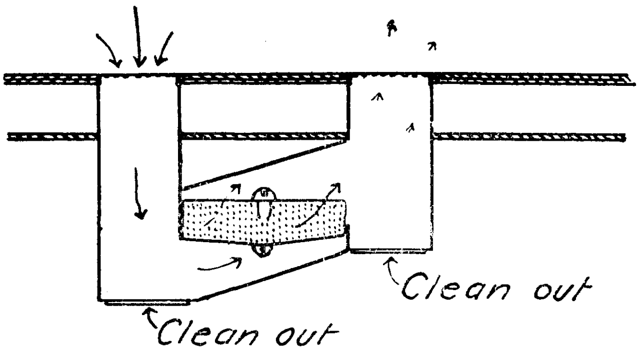


FIG. 44.

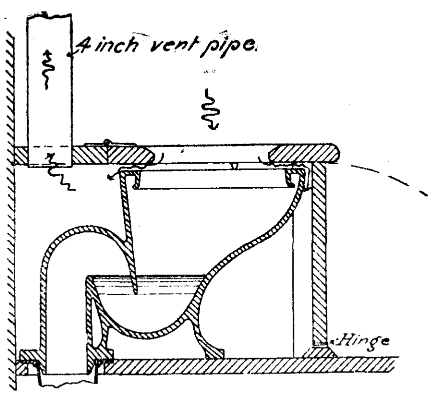


FIG. 45.

or seat, which extends from wall to wall of the closet. The riser is also hinged at the bottom. By raising the seat and dropping the riser, the basin and its fittings can be as much exposed as if the basin were adjusted for use without such covering. The clear space between the under surface of the seat and the top of the basin should be at least one-half inch wide. As a closet, the Boston short hopper is recommended rather than the type shown, a cut of which is not available at the moment for the sketch. The floors should be asphalted; the bottom of partitions and of doors should not reach the floor by from four to six inches, and doors should swing inward and be held open by a spring except when in use.

Fig. 46 shows the method of attaching the gossamer check valves to the vent gratings. They should be made of the lightest rubber

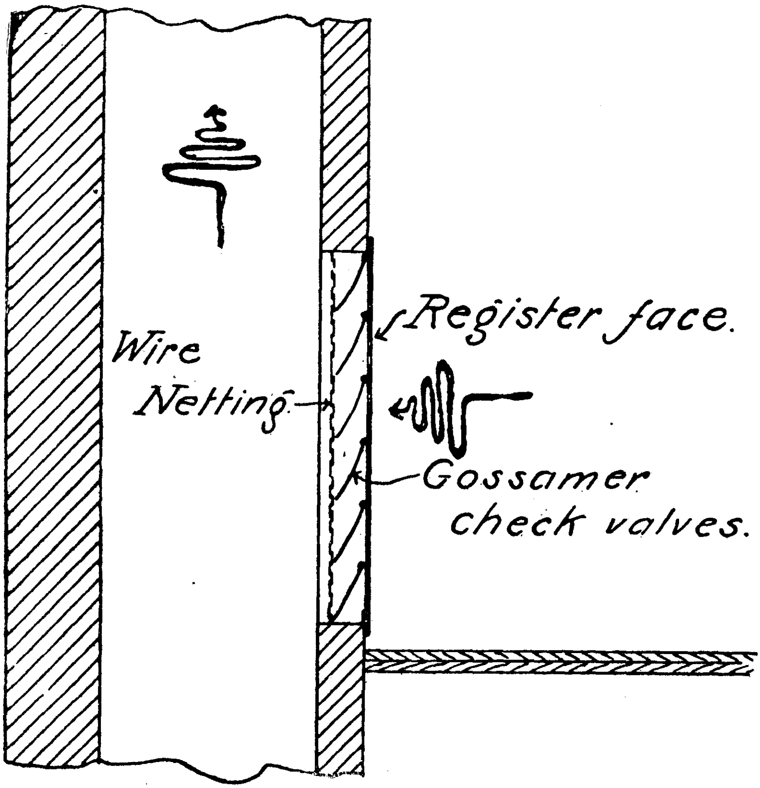


FIG. 46.

gossamer. The strips should not be more than six inches in width, secured at the top to a light piece of wood one-fourth inch thick and one-half inch wide, or to a small and straight wire. The strip should be so hung that the bottom of one laps over the top of the one next below by one-half inch, and the ends of the strips should be so secured that when in use the gossamer shall not draw away from the ends and gather in the middle. The wooden strips or wire rods carrying the gossamer cloth may be wired to the face, which should be secured by screws into a wooden frame set for the purpose. Should the draught prove strong enough to cause noise by the flapping of the check valves, coarse wire netting may be placed behind the register face and valves, as shown in the figure.

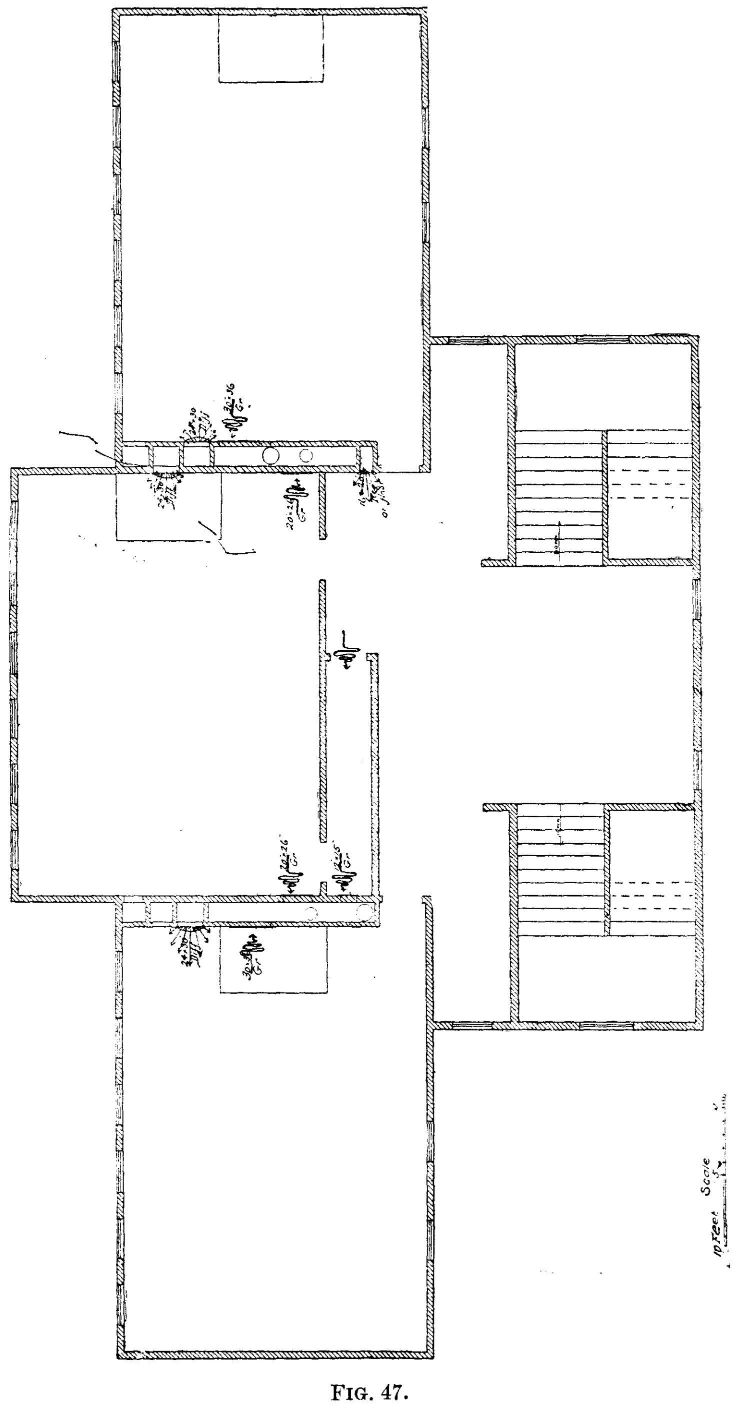


FIG. 47.

GROUP III.*

Fig. 48 shows the basement plan of a four roomed school-house. The air chamber occupies the central part of the basement, and the

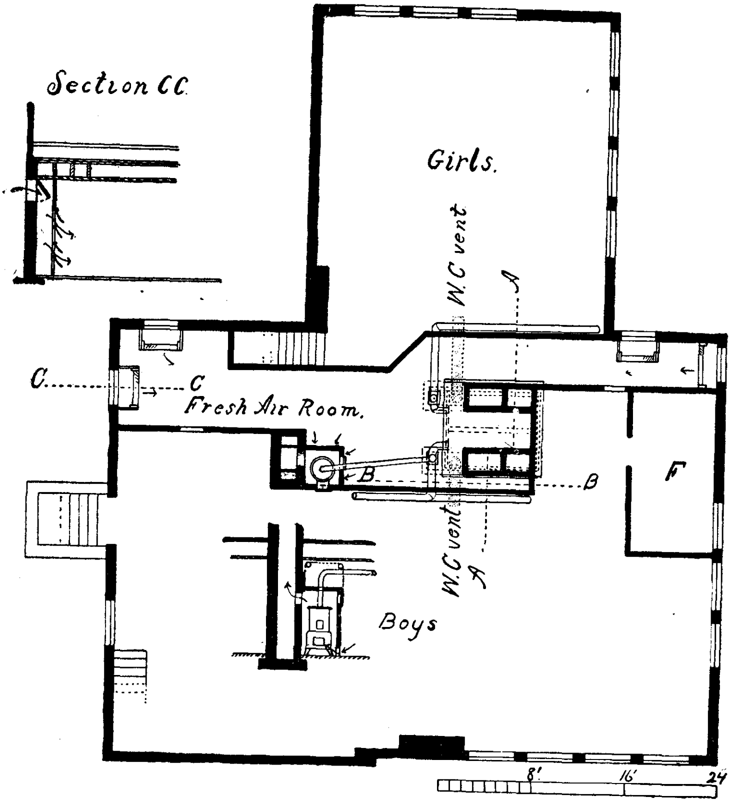


FIG. 48.

air enters it from both sides of the building through valved inlets. The air is warmed by a battery of two Gold's Hygienic Heaters placed between the main walls of the corridor. The walls of the air chamber are so run as to convey air to both sides of the battery, into which it enters through a series of openings ranged along the

* The draughtsman made several errors in the drawings for the figures under Group III. In Fig. 49 the stippling indicative of the foul air flue at the left should have been carried down to and below the vent opening.

In Fig. 51 the two upper arrows in Section B. B. should have been placed at the vent openings above them and the baffling should be just below the vent openings.

In Figures 52 and 53 the construction of the flues between the wardrobes (G. W. and B. W.) is wrong, and the direction of the arrows should be reversed.

base of the two battery walls next the air chamber. See Figures 49 and 50. The top of the battery housing is two feet lower than the

Section AA.

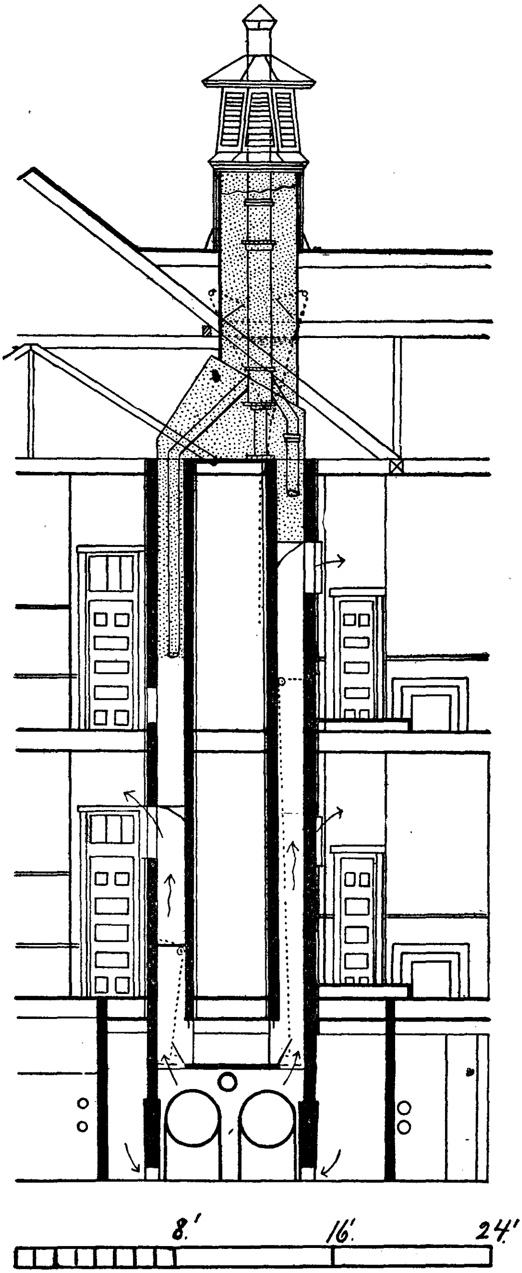


FIG. 49.

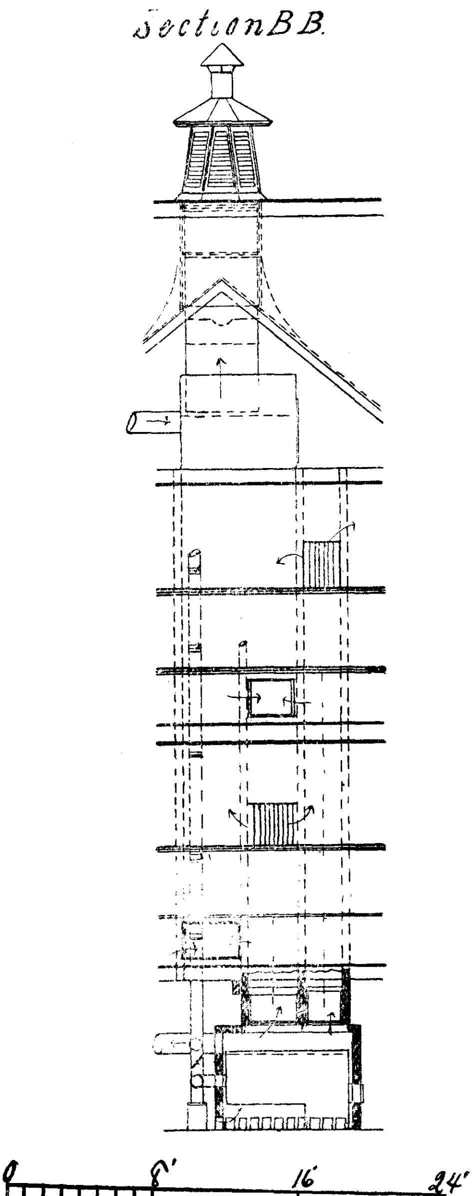


FIG. 50.

ceiling of the air chamber, and the space between the top of the battery and the ceiling is open to the fresh air chamber at the rear of the battery, the fire doors of the battery being at the end toward the fuel room F. The smoke pipes from the furnaces are shown extended into the playrooms and arranged in trombone form along the walls of those rooms adjacent to the battery. See Fig. 49. If these rooms are not used as playrooms, or if they do not require heating, these extended pipes should be placed in the air chamber. For heating by rotation of air, doors connecting the playrooms with the air chamber may be opened, as also those connecting the upper rooms of the building with the basement.

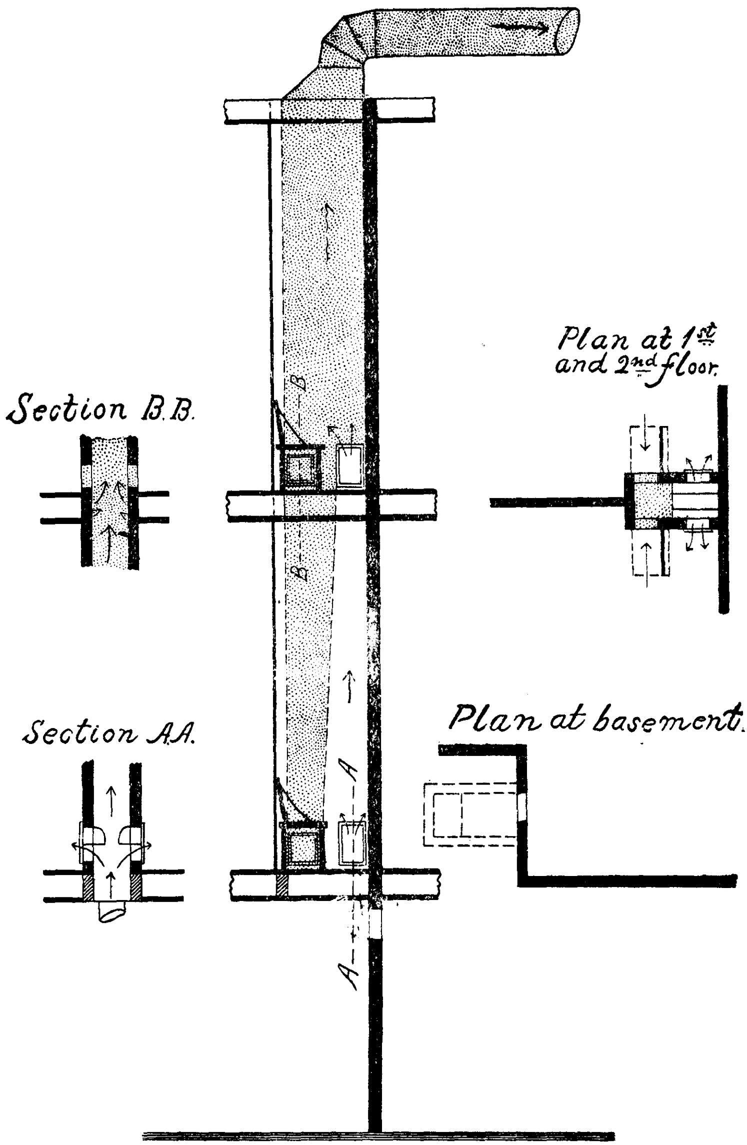


FIG. 51.

For the warming of the wardrobes, which are in this case so separated from the school-rooms as to be inaccessible for ventilation from the school-rooms by the successive method, a special stove is provided, as shown in detail in Fig. 48. It takes air from the air chamber, and passes it to the supply duct shown in Fig. 51, or in case of severe weather, when the heat is insufficient for ventilation of the entire building the warmed air may be passed in whole or in part into the air chamber, the quantities moving either way being determined by the position given the valves shown in the figure.

If sanitary conveniences are to be placed in the basement, they may be vented through ducts run through the main shafts and heated by gas flames. The closets should then be so arranged as to admit of successive ventilation by taking warmed air from the playrooms, to which fresh air may be admitted either through windows or from the furnace and air chamber as circumstances may require or conditions favor.

Figures 49 and 50. In these figures are shown the arrangements of dampers for mixing the hot air of the furnace chamber with the cool, or cold air of the air chamber, and of flues for the supply of fresh air to and the discharge of vitiated air from the rooms, and of the smoke pipes within the air shafts and of the dampers near the top of the vent shaft.

The area of the aperture through which the warm air escapes to the supply flue with which it connects should be equal to one-third that of the flue, and the damper should be of such size as to completely close, (when fully open), the aperture between the cold air chamber and the flue.

The areas of the several flues are shown in Figures 52 and 53. The diffusers are shown in better form in another group in connection with which their construction is described and their function stated.*

The smoke pipes from the furnace should be eight inches in diameter up to the point of their union, from which point upward the diameter should be ten inches. Doors should be provided at the base of the larger pipe for the purpose of cleaning both it and the branch pipes.

The dampers should be arranged for easy manipulation from some convenient place either on the first or the second floor of the building.

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* See page 318 and Fig. 40.

For effective action in all weathers the vent shaft must be carried above the ridge of the roof and the surmounting louvres should have a total free area equal to at least twice the area of the shaft.

Fig. 51 shows the method proposed for the ventilation of the wardrobes. The warm air enters at the floor level where wanted for the warming of feet and the drying of clothes. The air is discharged through a grating at the same level and located either beneath a bench with solid front and open back riser, or on the other side of the shaft. Connection between the wardrobe vent shaft and the main shaft is made by means of a pipe fifteen inches in diameter between the two. To insure a movement of supply air to the lower room throttling and baffling plates are placed in the shaft as shown in Section AA.

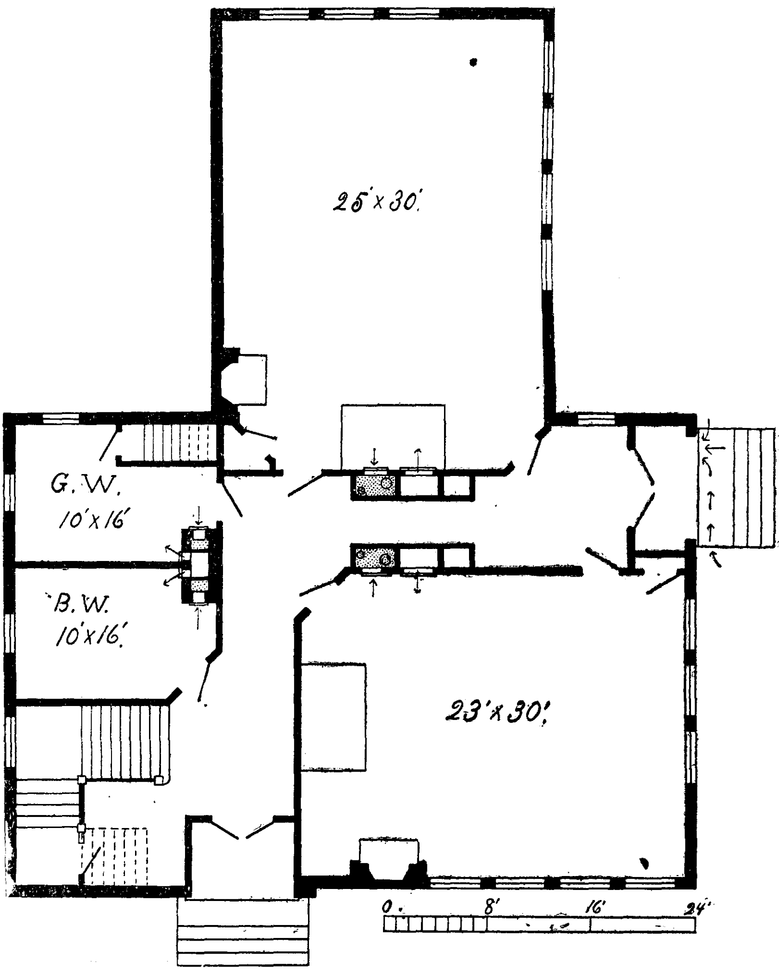


FIG. 52.

Figures 52 and 53 indicate the arrangement of rooms on the first and second floors of the building.

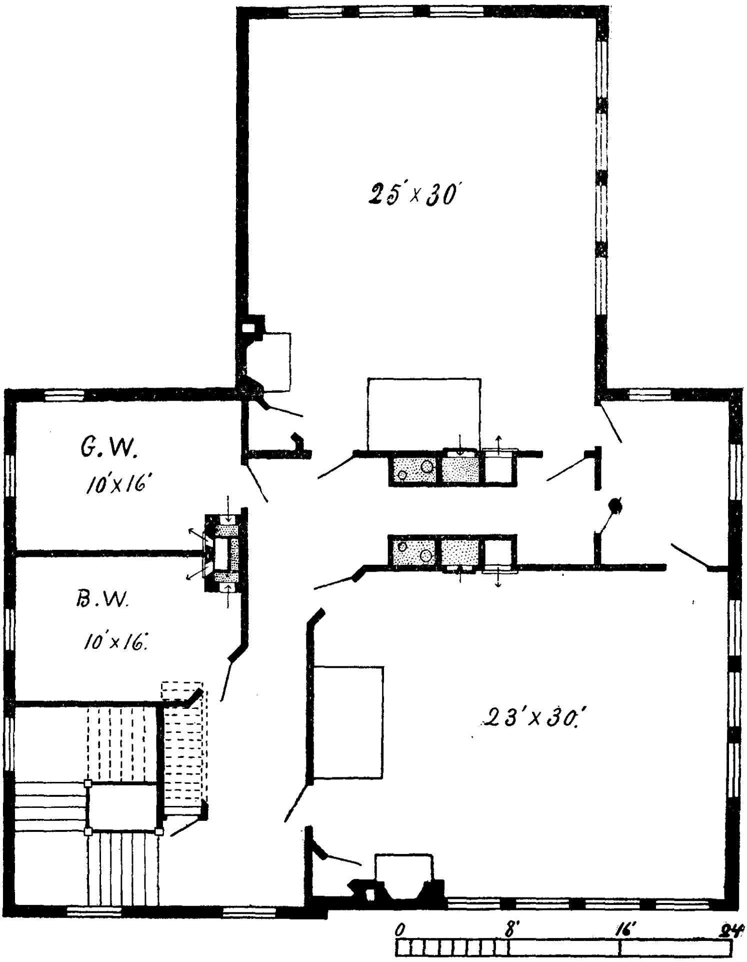


FIG. 53.

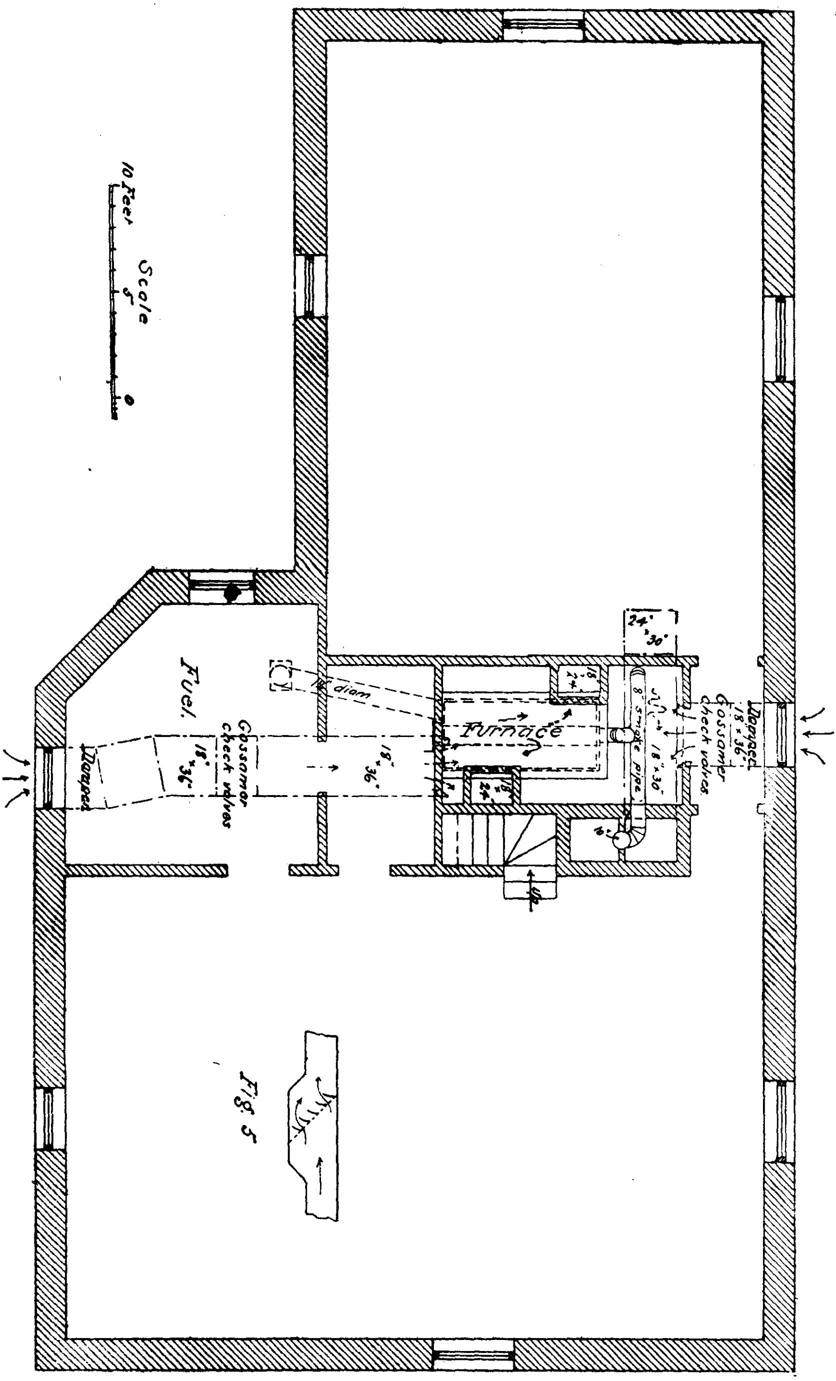

Scale
10 Feet
5
0
Fuel.
Furnace
Gossamer check valves
Damper
18 x 36
Fig. 5

FIG. 54.

Fig. 54 shows a basement arrangement for a one-story, two-roomed school-house. The air chamber is reached by a supply duct from each side of the house. At a convenient point these ducts are enlarged to receive the check valves, as shown in Fig. 5. (Included in Fig. 54). The heating is done by a Gold Hygienic Heater, a furnace to be recommended for ventilating work among those obtainable in open market. Figures 55 and 56 show details in the arrangement of the setting for

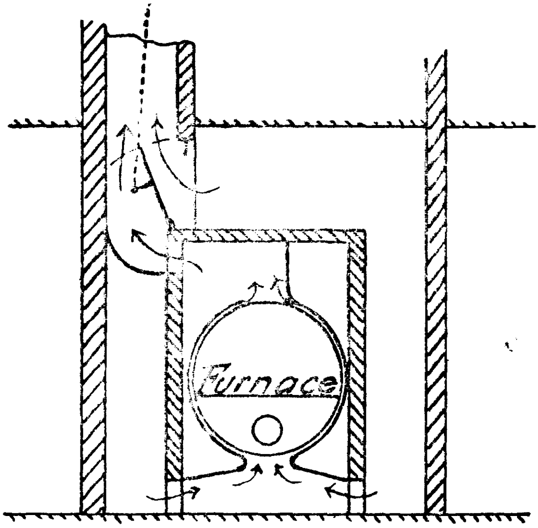


FIG. 55.

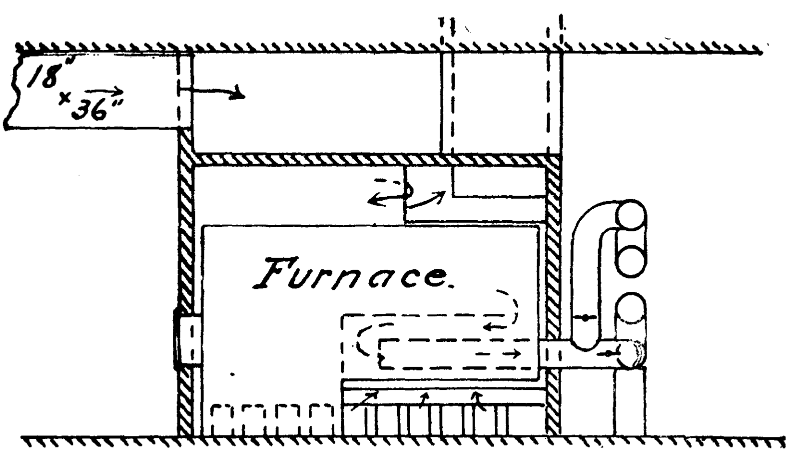


FIG. 56.

these furnaces. The furnace should have a grate area of at least five square feet for use in the colder parts of the State, for which the

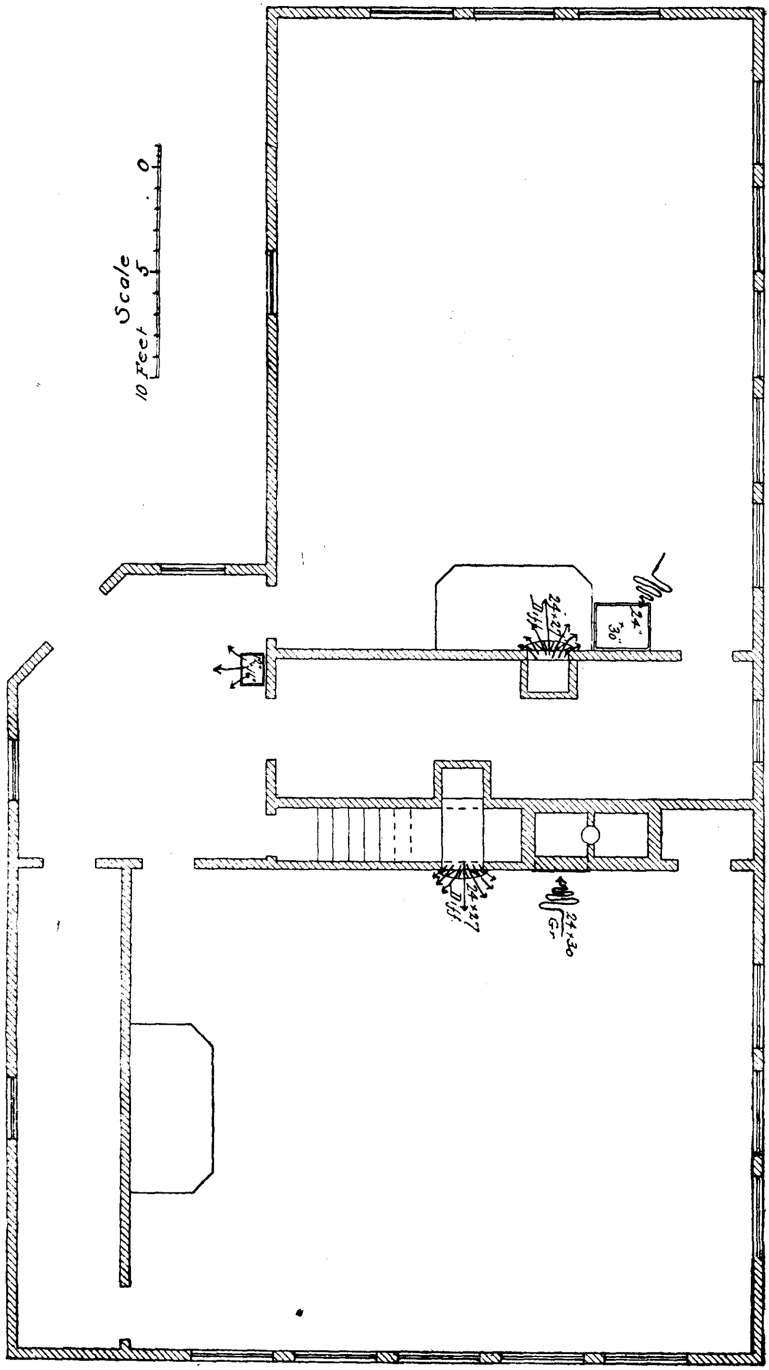


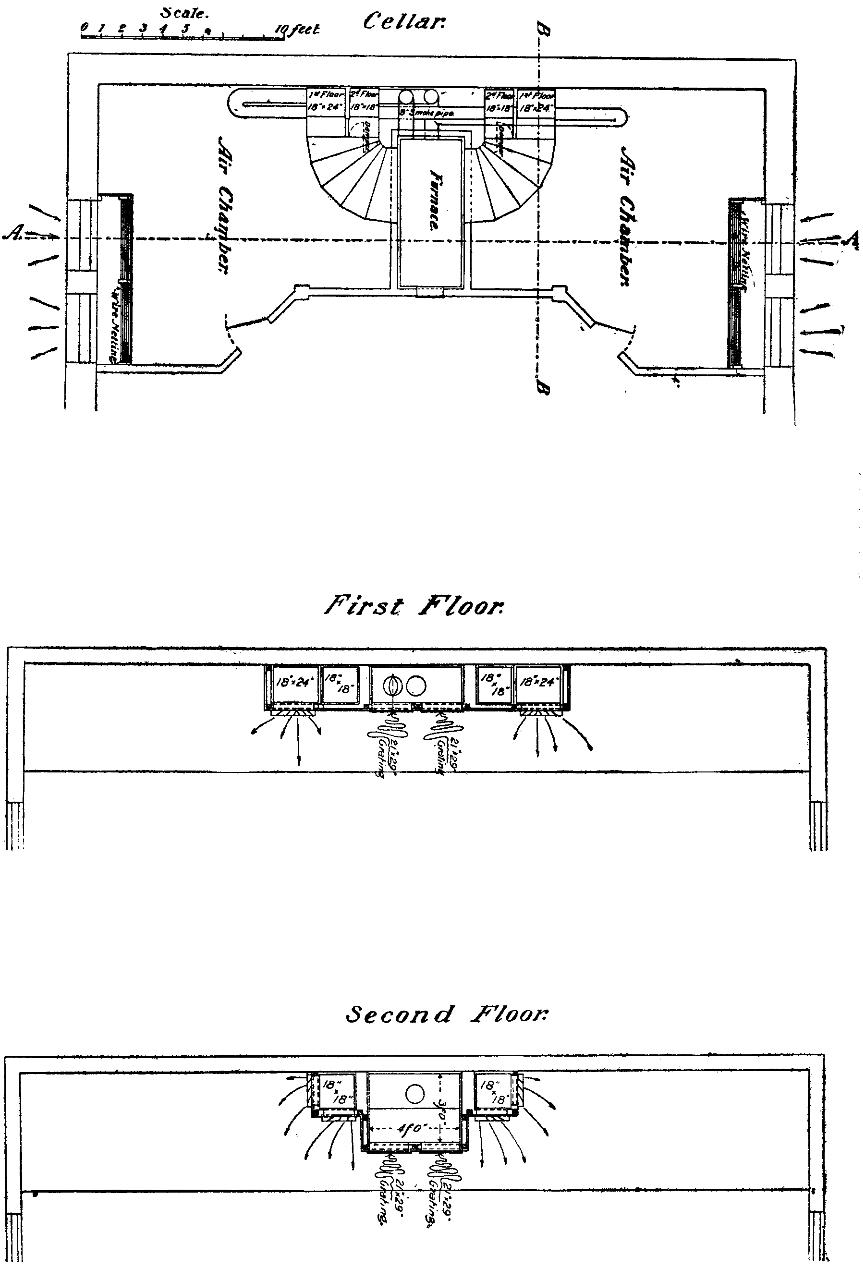
FIG. 57.

heating power of all the apparatus shown or described in this paper has been proportioned. The furnace shell may be extended as required by the addition of sections. Inside of the furnace the maker should place a guard to prevent the throwing of coal into and the accumulation of ashes within the drum of the furnace. There should also be placed within the furnace a plate of such form and size as to cause the hot gases to reach and heat the lower part of the drum through its entire length. Also, to insure a better contact of cold air with the furnace shell, it would be well to partially surround the shell and its flanges with sheet iron, separating it from the outer edge of the flanges by a couple of inches, as shown in the figure. To cause air of nearly equal temperature to be delivered through the ducts, one in the front and one in the rear parts of the furnace, the sheet iron jacket on that side of the furnace next the front duct may be carried up to the ceiling of the furnace housing, so compelling the air issuing from about the front and hot part of the furnace to travel well toward the back end of the hot air chamber before it can reach the front flue. The air should be admitted to the furnace through the whole extent of the furnace wall. The openings for the escape of warm air from the furnace should have an area of one-third that of the flue with which it connects. The extension of the smoke pipe within the air chamber is for the purpose of effecting as complete a transfer of heat as possible from the combustion gases to the air. By means of the switch valve or damper, the draught can be made direct whenever desired, an essential to all similar arrangements described.

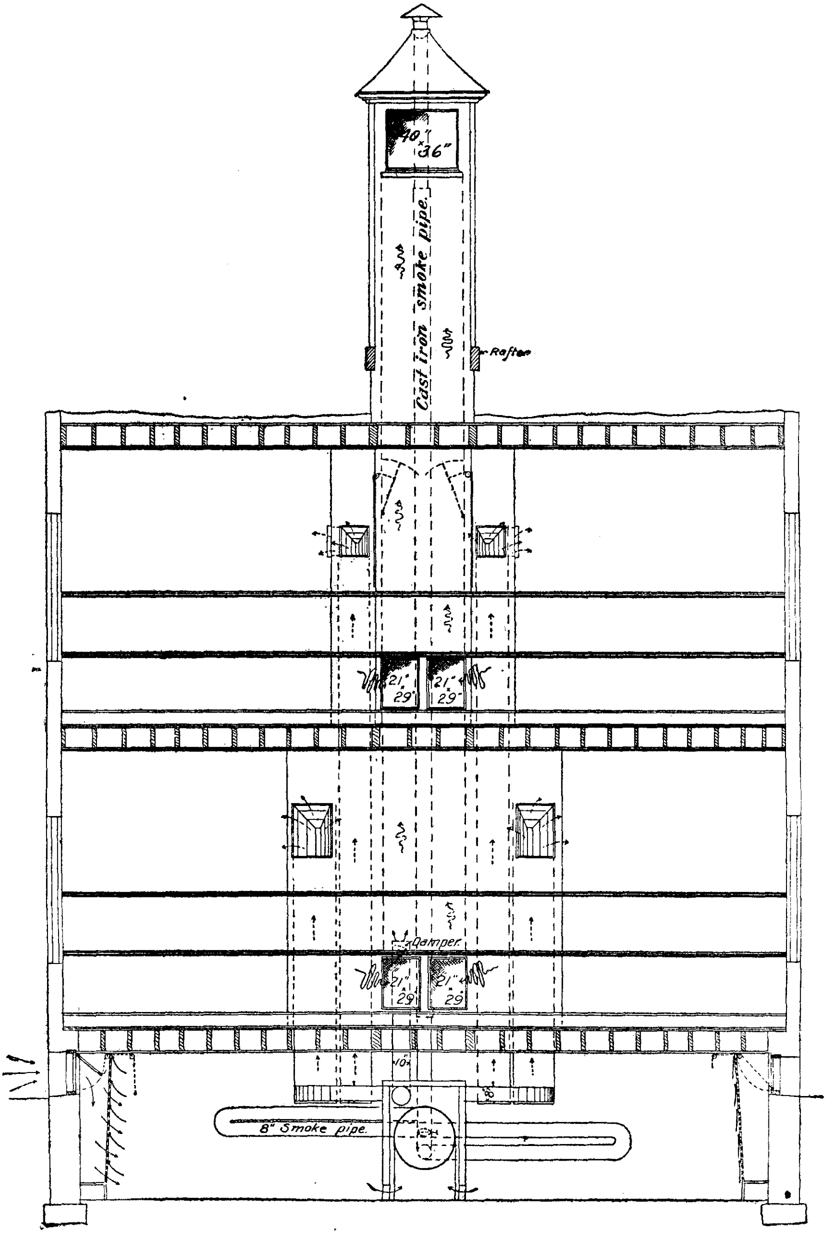
For the warming of the halls and the drying of clothing, connection is made as shown, with the furnace. The slight ascensive force of the warm air in so short a rise, and the resistance to flow through so long and comparatively small a duct endangers the desired direction of air flow. A separate fire in a small jacketed stove beneath the register, and the connection of the lower part of the jacketed chamber with the hallway by means of a 10-inch pipe would insure a flow of warm air into the hall. This method is to be recommended in all cases in which ventilation of halls or wardrobes is not desired. In severe weather, the stove could be used as an auxiliary to the furnace. The discharge flues from the rooms should be carried above the highest part of the roof by at least one or two feet, and generally higher.

GROUP V.

The figures in this group illustrate a method of ventilating a two-storied, two-roomed school-house. The internal arrangements are such that the apparatus must be located at the rear of the building and of the school-rooms. The end of the basement is partitioned off by a wall and the enclosure is made the air chamber. In this chamber the furnace is placed, the two parts of the chamber being connected by the space between the rear of the furnace and the wall of the building, and that between the top of the furnace housing and the air chamber ceiling. These connecting spaces are clearly shown in Fig. 63. The heated air is conducted to the flues by means of a curved and flat iron pipe, the sectional area of which is one-third that of the flues with which it connects. See Fig. 51. Dampers are placed in the branches of these ducts to effect the desired division in the air quantity flowing to the flues. They are shown in the two inner branches only, but the other branches require them equally, for the reason that the outer flues receive the hotter air escaping from the front part of the furnace, while the inner flues being the taller, have the stronger draught. The varying conditions cannot be met as surely by a single adjustment made once for all, as by trial and occasional readjustment as conditions require. The general arrangement of mixing dampers, trombone extension of the smoke-pipe, valved inlet windows, doors to air chamber for warming by rotation, are shown in Figures 58, 60 and 63.



FIGURES 58, 59, 60.

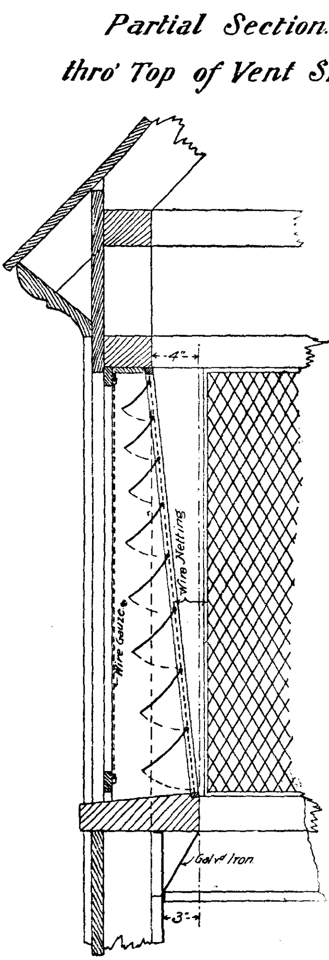


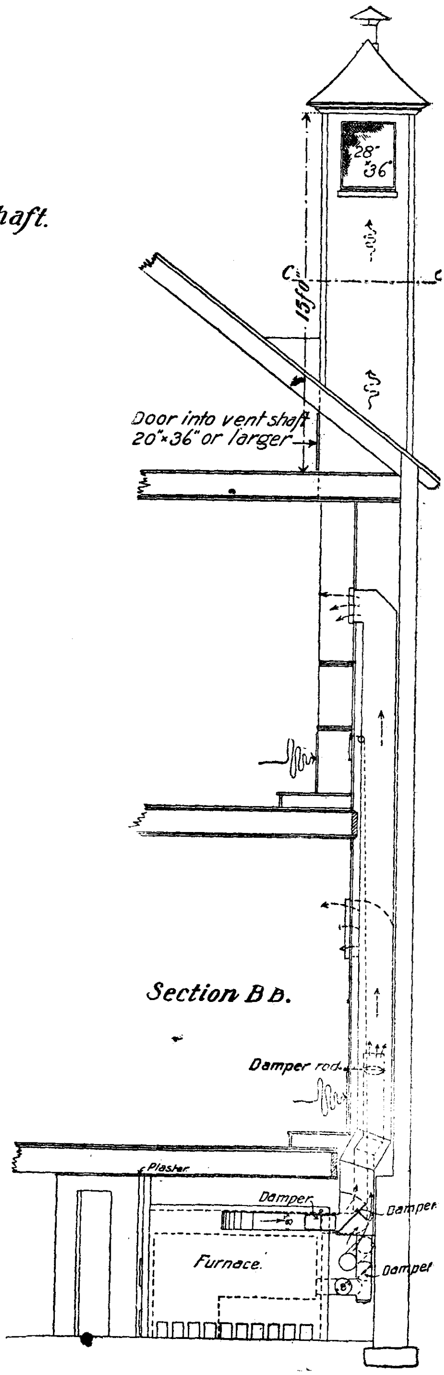
Section AA.

FIG. 61.

Figures 59, 60 and 61 show the arrangement of flues for the ventilation of the two rooms, an arrangement determined in part by the presence of a central chimney of brick. The whole system is planned to furnish means for copious ventilation. The area of the dual ducts to each room is, therefore, large, as is the inlet window area, and the capacity of the vent shaft. In the side of the supply flue to the second floor there is not room to place a single register or grating having a discharge capacity equal to the carrying capacity of the flue; hence the placing of two registers in each flue, with diffusers shaped with reference to their location and the equable distribution of air through the room.

In Figures 58, 59, 61 and 63, there is shown a 10 inch pipe connected with the furnace chamber and opening into the vent shaft, and furnished with a damper for the control of air movement through the pipe. The purpose of this pipe is the warming of the vent flue in weather when the heat is not wanted for the warming of the schoolrooms, and the flow through the vent flue is sluggish, conditions which are simultaneous. The objection to warming a vent flue by this method is that the entrance of the hot air, by which the warming is done, prevents the entrance of an equal body of vitiated air which would be moved from the room rather than through the furnace were the vent flue equally heated by some other means than by the admission of heated and fresh air. Under the conditions named, however, and illustrated in the figure, the method is one to be recommended.





FIGURES 62, 63.

Fig. 62 shows a vent flue outboard terminal adapted to accelerate the flow of air within the flue in windy weather, or to maintain the draught when the terminal has of necessity an unfavorable position due to surroundings. The four openings, one on each side of the vent duct, have an aggregate area equal to twice the area of the flue. These openings are covered by a frame over which is stretched copper wire gauze of about $\frac{1}{8}''$ mesh. Within is another frame fixed in a position about 10° out of the vertical, inclining outward at the top. This frame carries a wire netting of coarse mesh, and upon it check valves are so hung as to allow the air to move outward from the shaft, and to prevent its inward movement. When there is no wind, the valves, hanging free from the frame, allow the air to move outward on all sides. When the wind moves with higher velocity than the outward flow rate, those valves on the windward side close, and the partial vacuum formed on the leeward side causes a correspondingly rapid flow of air from the shaft on that side. The method is admirably adapted to overcoming the adverse action of wind currents about flue tops having bad exposures, as when below the ridge of a building, or when surrounded by higher buildings or when in the neighborhood of roof or other surfaces which produce disturbing eddies. The action of such a vent flue terminal is often so energetic as to cause a very rapid discharge movement of the air through the shaft. Hence the greater necessity of throttling dampers in such a flue, and an intelligent use of them, for it not infrequently happens that the cause of a cold room is its too free ventilation, a ventilation such as to exceed the heating capacity of the boilers or furnaces. The material of which the valves are made should be light so that they may be easily lifted by the outflowing air, soft, so that their flapping may not be noisy, and strong, that they may not be destroyed by their own action in windy weather.

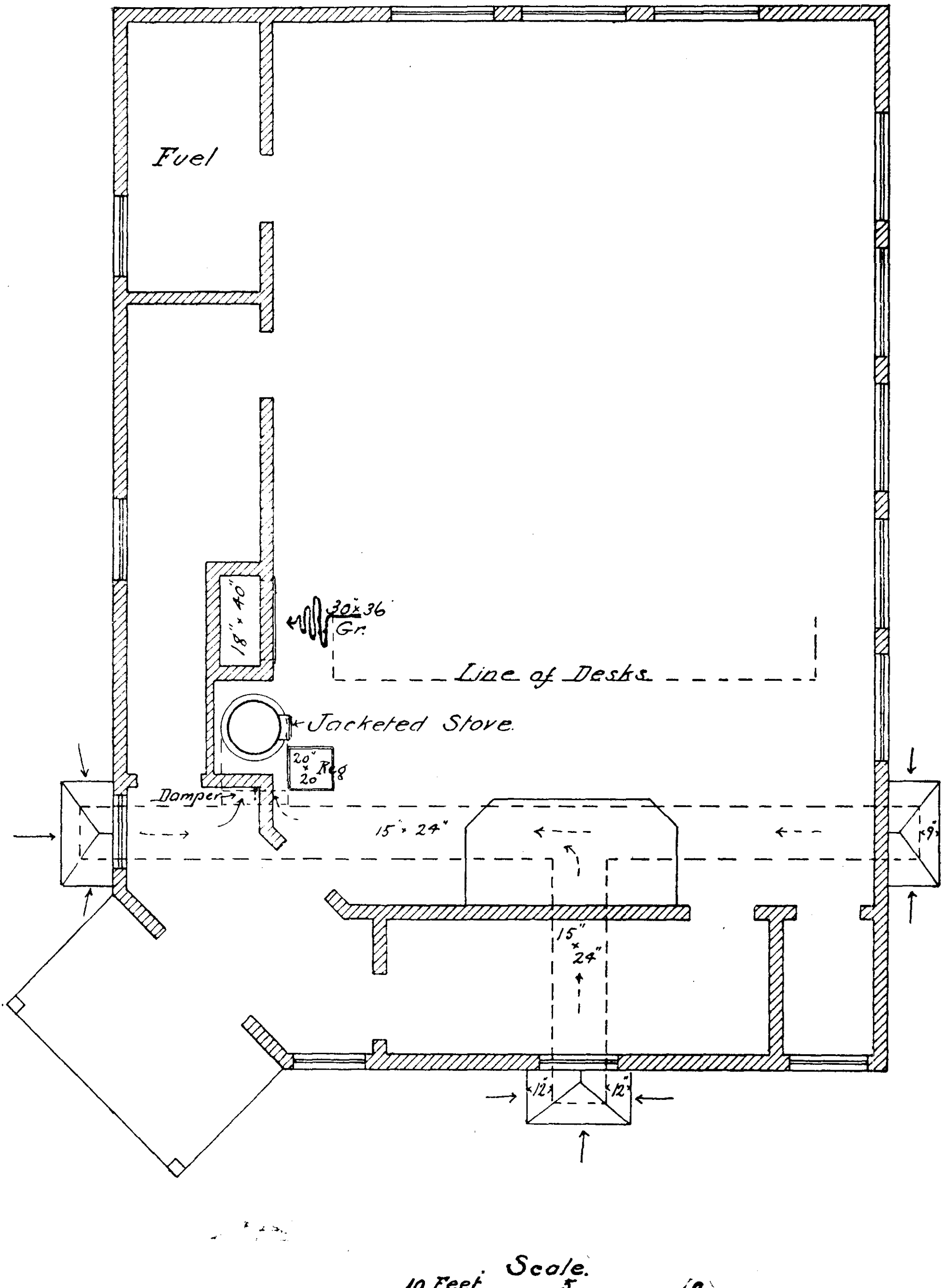

Fuel
18" × 40"
30 × 36
Gr.
Line of Desks
Jacketed Stove
20" × 20" Reg
Damper
15" × 24"
9"
15" × 24"
12"
12"
Scale.
10 Feet
5
10

FIG. 64.

Fig. 64. In this plan is shown a method for warming and ventilating a one-roomed school-house. The supply air reaches a jacketed stove through a duct beneath the floor, the duct having three connections with outside air, the third being made advisable because of the interfering effect of the porch, if closed in. The duct is connected with boxes on the outside of the building, the boxes having open tops, except as they are capped as shown in the plan, and also in Fig. 65, to protect them from rain and the check valves from

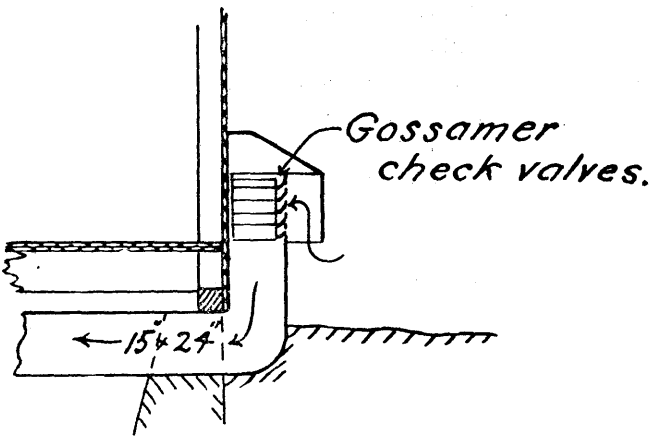


FIG. 65.

meddling boys. The check valves are placed on the inside of wire gauze frames fixed to the three sides of the upper end of each box.

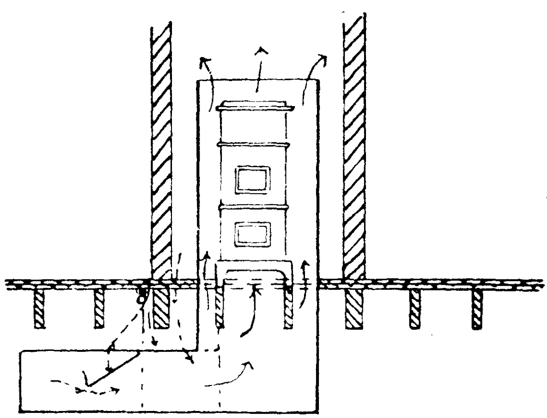


FIG. 66.

In the cold air duct and near the stove is a hinge damper swung from the top of the box and manipulated by a cord and pulley on the corridor wall. Fig. 66.

In the school-room floor is a large register connected with a large sized duct leading to the air box beneath the stove by means of which the air may be rotated for warming the room. It must be closed when the duct damper is open.

A sufficient surface of the front and lower part of the stove should be left uncovered by the jacket to furnish direct heat for drying and warming clothing.

The vent shaft is made large because it must be low, and the register face is large to reduce the velocity of flow and the liability of exposing the nearest seat to draught. It is imperative in this instance, as in all cases in which the chimney size is adapted to the mildest weather in which artificial ventilation is wanted, that the flow should be regulated by means of a damper, as shown in Fig. 67. The furnace pipe enters above the damper and may be given an extended form in the recess space above the stove.

The stove should have a grate surface of at least two and one-half square feet, and together with the pipe, a radiating surface of

125 square feet, proportions not generally obtainable in the market. Fig. 67 is not designed to show such a stove, but only the arrange-

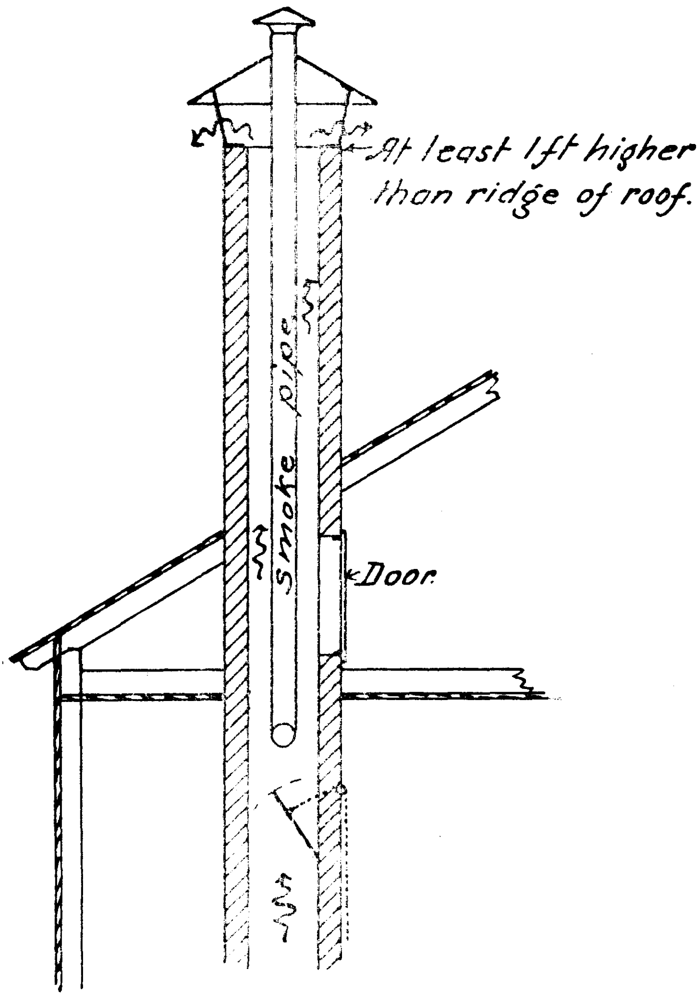


FIG. 67.

ments of supply duct, damper, register connections, and jacket suitable for this method of ventilation.

PRIVIES, WATER-CLOSETS AND URINALS.

The methods of excreta disposal adopted by a school and the care or carelessness with which the necessary conveniences are supervised, have an important bearing upon both the moral and physical health of pupils. In no other way can so vivid an impression of the "Impending Paganism in New England" be had as to become an improvised health officer and make a round of inspection of some of the adjuncts of the schools in some of our towns. "These miserable shanties," says one New Englander who has had the welfare of the school population at heart, "devoid of the simplest comforts, besmeared with nastiness, adorned with obscene scrawls, cannot but be injurious to the morals of children. No parents, could they see these places, would wish to have a carefully reared child frequent them, but there is no alternative. No matter how repugnant to delicate sensibilities these teeming monuments of filth may be, children are forced to use them day after day, and it is no wonder that their finer instincts are blunted, their modesty corrupted and the seeds of sensuality and vulgarity are sown."

With a view to guarding the health of the pupils from danger, the method of disposal should be such as to preclude the entrance into the school-rooms of the gases from privies or other fixtures.

The investigations of Erismann on the effect that the decomposition of excrementitious matter has on the air led to results quite remarkable and worthy of being remembered. In this process of decomposition, oxygen is absorbed and various gases, mostly ill-smelling and poisonous, are given out. He found that a privy vault holding eighteen cubic meters of excreta not only absorbs a large quantity of oxygen, but pours forth into the surrounding atmosphere gases, the combined volume of which is, every twenty-four hours, 18,792.7 litres, or about the same number of quarts. With reference to the character of these gases and the result of breathing them, the reader is reminded of what has been said in the chapter on "Ventilation" about "Hydrogen Sulphide" and "Sewer and Privy Vault Gases."

The school-room at least can be spared the infliction of a nuisance of this kind by placing the outbuildings at a considerable distance; or quite a degree of proximity is allowable provided some of the improved forms of conservancy are employed and that there is a reasonable assurance that they will receive such constant management and care as they will require.

Still better in every way, when circumstances make it practicable, is the use of some of those modern appliances which have made it safe to bring the conveniences into the school building itself, or into an annex closely connected with it. Then the inconveniences and discomforts of visits to distant outbuildings in inclement weather will be avoided, together with the danger of those diseases that are brought on by delaying as long as possible to obey the calls of nature.

Privies.—Where nothing better is practicable in a district a school privy is allowable provided it is properly located and constructed. It should be placed at a safe distance, but it is preferable to have it under the teacher's observation. The accommodations for the two sexes should be entirely distinct, and with separate approaches. If in the same building, the isolation between the two rooms should be more secure than that afforded by a single board partition. It is far preferable to have the two privies in separate buildings, or in the same building with a room for fuel or other use interposed between the two.

The privy vault should be entirely above the surface of the ground; no excavation whatever should be made for it. This shallow catchbasin may be laid in cement with a foundation extending downward below the reach of frost, or if parsimony or necessity prevails, the catchbasin may be a tight, plank box, sixteen or eighteen inches deep, two feet wide and of the required length, whole or in sections. Before use it should receive a thorough application of hot coal tar.

Provisions should be made for the storage of dry earth,—common field or garden loam,—or sifted coal ashes, and arrangements should be made with some person to sprinkle into the catchbasin daily a small quantity of this material,—enough to ensure dryness and inoffensiveness of the collection. Arrangements should also be made to have this compost hauled away to a field or garden at intervals of from one to four weeks during term time of school.

Earth Closets.—What has been described may well be termed an earth closet,—nothing less commendable should be tolerated. Under this heading the arrangement shown in Figures 68 and 69 will be described. In Fig. 68, a double covered walk, separated by a double partition, leads to the porch of the boys' earth closets on one side, and to that of the closets for the girls on the other. The size of each main closet room is seen at a glance, as well as the several dimensions of the compartments. The closet rooms should be lathed

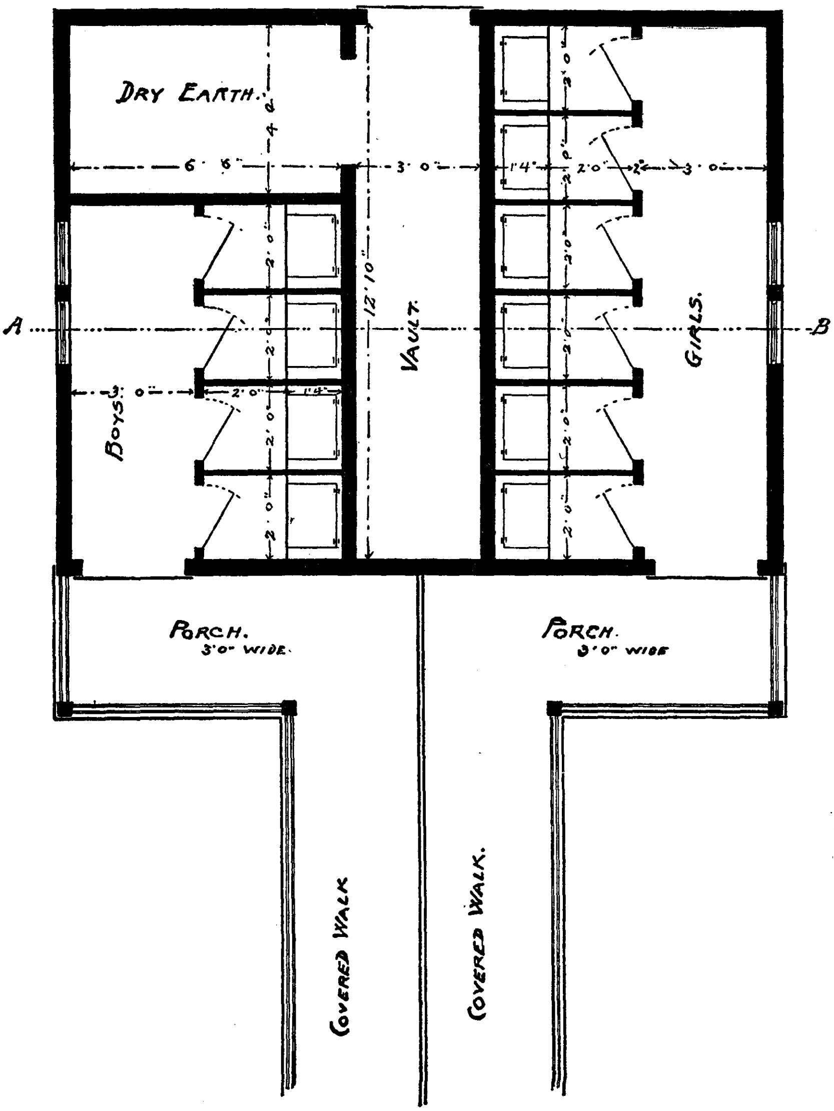
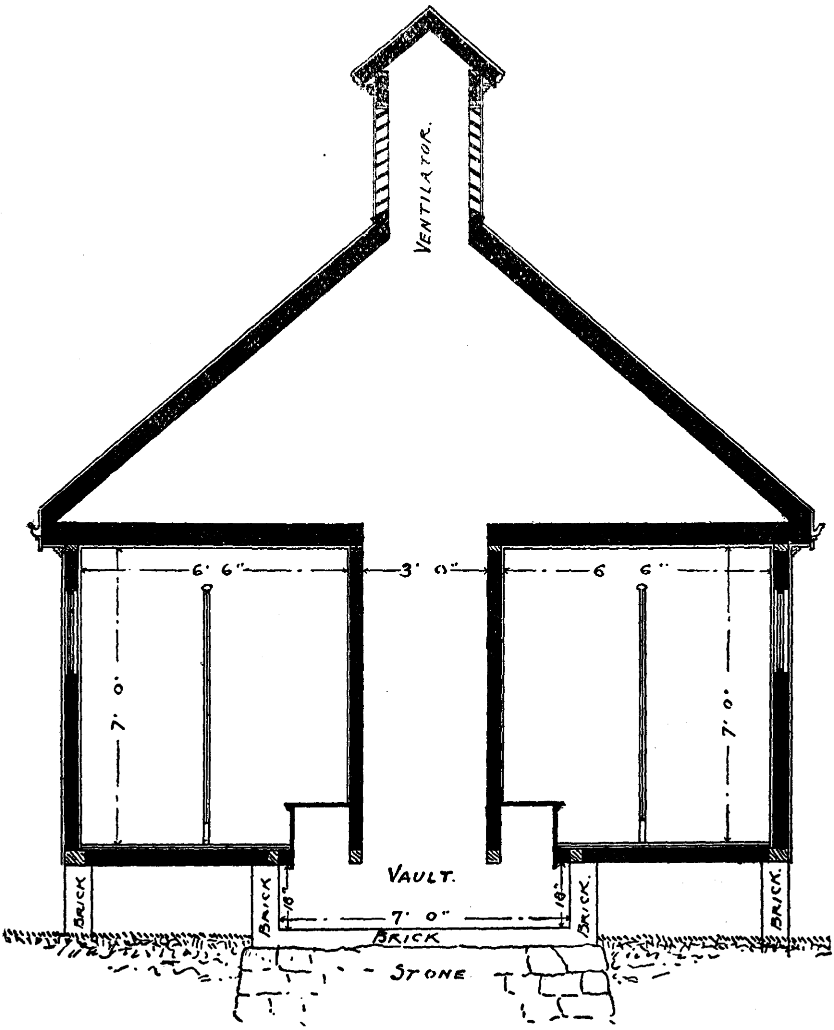


FIG. 68.

and plastered, or still better, walls and ceiling finished with smooth matched boards. The vault, resting on a frost-proof foundation, is built of brick laid in cement and cemented and asphalted on the inside. At the back end of the vault there is an entrance for the janitor who is to keep this door securely locked. Near this door is a bin for dry earth.

It will be seen by the section shown in Fig. 69 that the vault extends under the seat on each side and six inches beyond, and that



·SECTION·AT·A·B·

FIG. 69.

the boarding back of the seat is carried down to the floor level. The inside of the riser of the seat should be covered with tin or zinc to prevent saturation of the wood-work. The vault is open to the ventilator on the roof. The closet rooms and the vault should be of tight construction so that the circulation of air will be from the seat downward through the vault to the ventilator above.

A shovel should be kept in the vault by means of which the janitor scatters daily a small quantity of dry earth over the deposits,—just enough to keep the compost dry and inoffensive.

Assuming the necessity of providing one seat for every twenty-five boys and one for every fifteen girls, this building will suffice for a four-room school-house with from forty to fifty pupils in each room. For smaller school buildings the length of the vaults can be diminished but the proportions from left to right should not be changed. No provisions are here shown for the boys' urinal. That should be placed outside of the closet building and if of the simplest construction with the admission of the action of wind and sunshine, and with a load of loam removed periodically and replaced with fresh, there will be less danger of nuisance than with drains and no constant water supple to flush them.

Ventilating Drying Closets. — Fire Closets. — The arrangements already described are recommended for schools to which a constant and plentiful water supply is not available. For schools under these conditions, a class of patented fixtures which, in some of their forms are commendable, have come into use of late years.

In some of these drying closets, the foul air from the school-rooms, on its way to the foul air shaft, is made to traverse the closet vaults, thus completely drying the excreta, so that, by pouring kerosene oil upon the mass everything may be burned at rather long intervals.

Some authorities have objected to this direct connection of the closet ventilation with that of school-rooms on the grounds of danger of a reversal of the current, particularly in the warm season when the furnace fires are not burning. To meet this objection, it has become customary to put a special heater into the base of the foul air shaft, to ensure an upward movement of the air at all times.

In the work of some firms who put in closets of this class, the closets have a special flue for drawing air through the vaults,—a system of ventilation distinct from that of the school-rooms.

Water Carriage.—In all places in which an abundant water supply is at hand, water carriage is preferable to any other system of excreta disposal in connection with schools. Separate closets of good form may be used, or still better are some of the best forms of "trough" closet, or water closet ranges.

Separate Closets.—If it is decided to use separate closets, a flushing rim short hopper of a desirable shape will not be expensive and will be preferable for use in schools to any other form.

Trough Water Closets.—One of these, the Parsons' Trough Water Closet, manufactured by the Meyer-Sniffen Company, is shown in Fig. 70. Its flush is automatic and can be set to act at

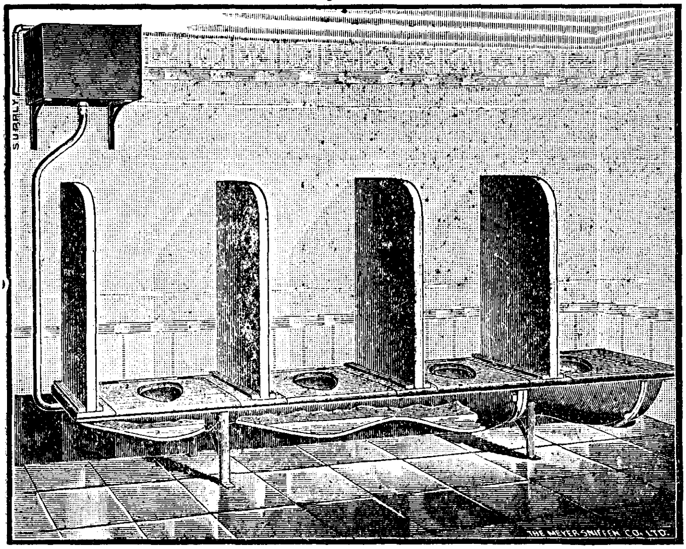


FIG. 70.

longer or shorter intervals of time, or can be adjusted to the demands of the hour. During the time outside of the school hours, the water can be shut off. This apparatus is simple in construction, is durable, and has proved satisfactory.

Another style of trough closet, or water-closet range, is seen in Fig. 71. This also has an automatic flush. Either of these styles of closet can be obtained in sections so as to make a range adapted to the number of persons to be accommodated.

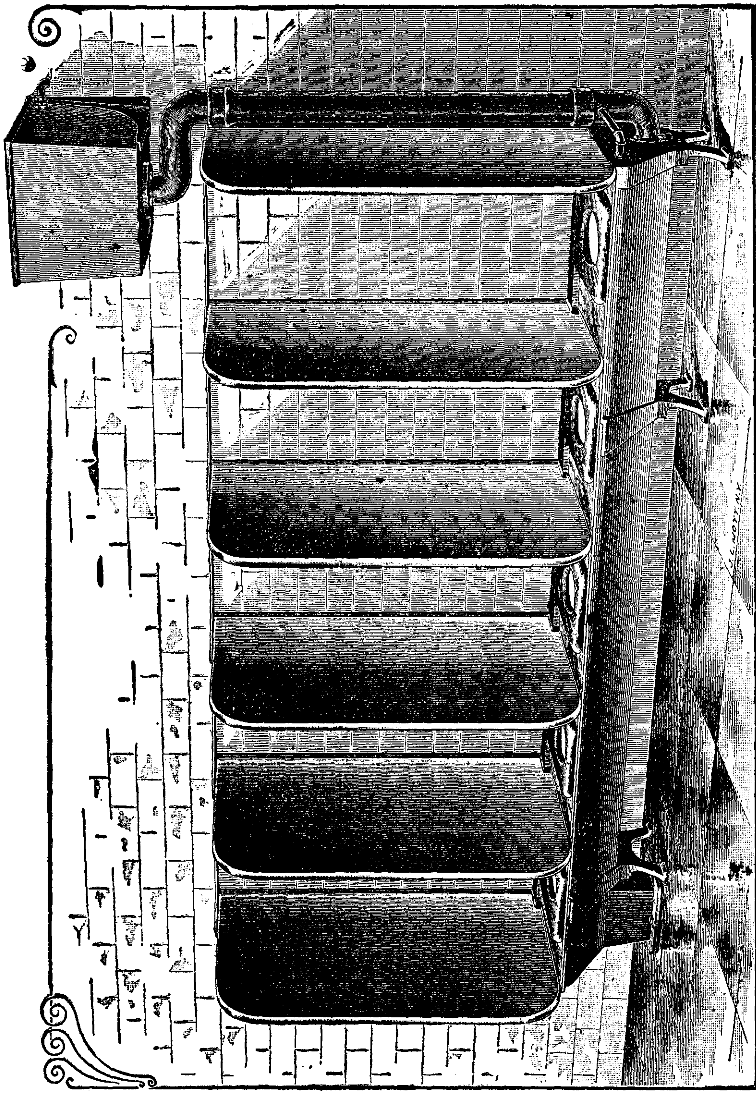


FIG. 71.

Ventilated Water-Closet Ranges—In another class of school water-closets, or water-closet ranges, the vault, or catchbasin, is connected with a special vent flue, just the same as in the ventilated drying closets, so that the draft is downward through the seat and up the flue when the cover is raised. Such a one is seen in Fig 72. It has a slate vault, with provisions for filling it with water and for flushing as required.

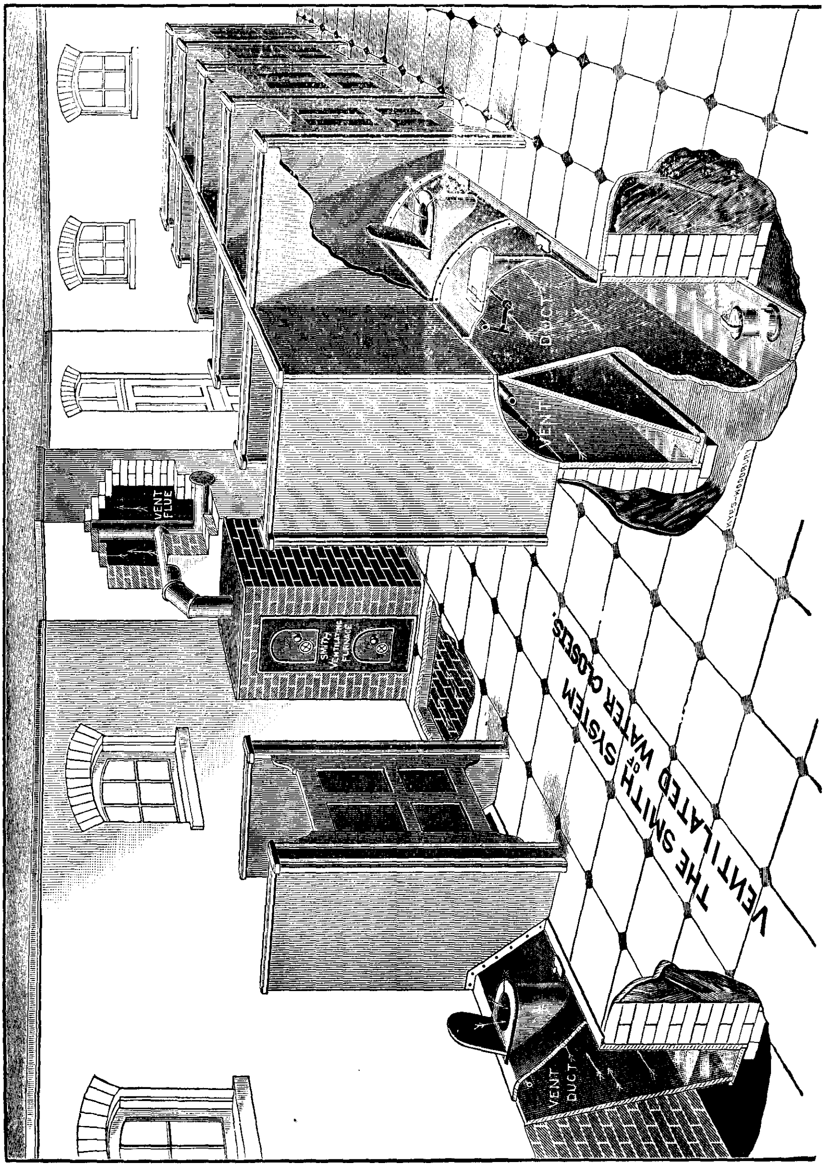
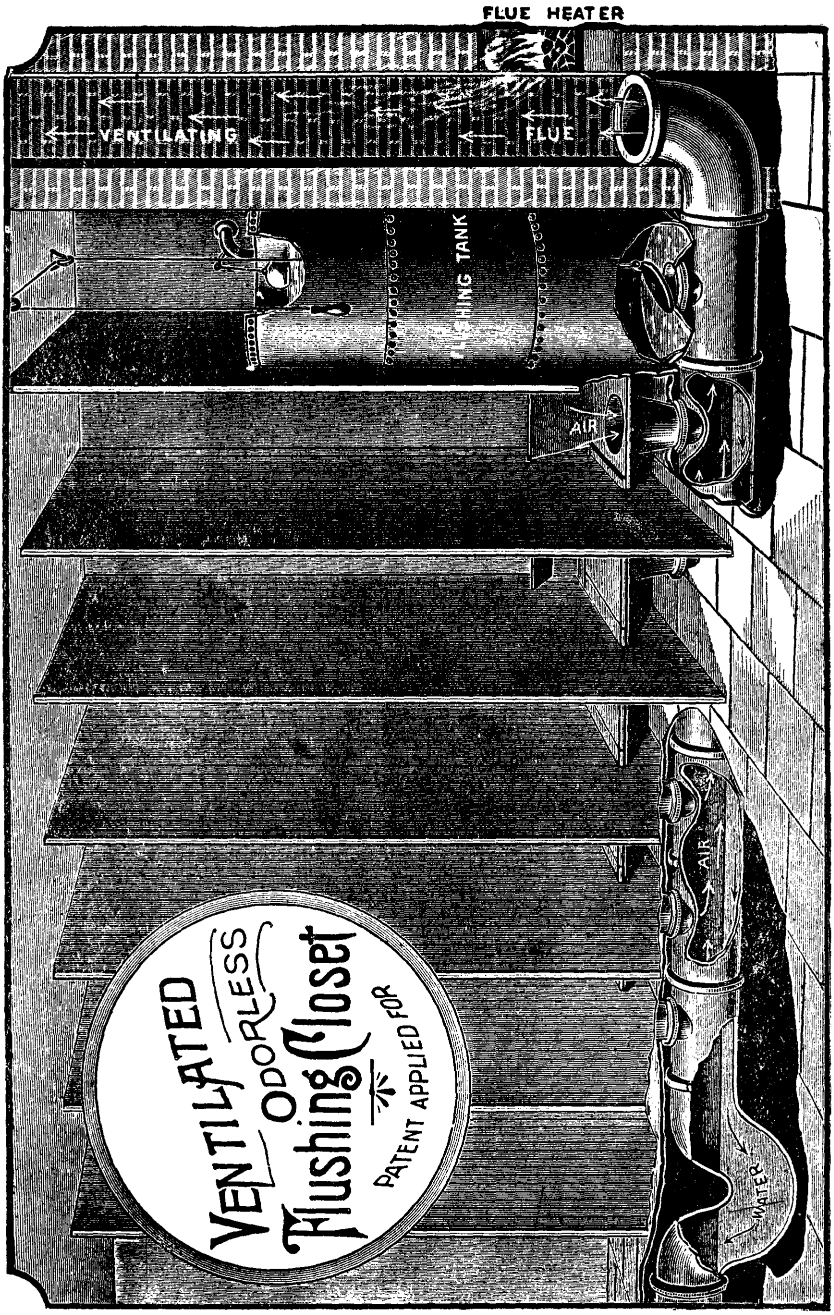


FIG. 72.



FLUE HEATER
VENTILATING
FLUE
FLUSHING TANK
AIR
AIR
WATER
VENTILATED
ODORLESS
Flushing Closet
PATENT APPLIED FOR

FIG. 73.

Fig. 73 shows the carrying out of this idea in a different form. The vault consists of large salt-glazed tiles, which material is objectionable on account of the danger of leakage from cracks. A solid iron pipe would insure greater safety in this direction. The manufacturers have made an improvement in the shape of the bowl, not shown in the cut, to ensure its cleanliness. As this part has no water flush it is an important consideration whether the bowl will in practice remain ordorless.

Urinals.—The individual porcelain urinals are altogether unsuitable for school use. Much better is a trough of smooth slate with a back of the same material, but the best arrangement is an upright surface of oiled slate with that part of the floor next to it of non-absorbent material and sloping slightly toward the urinal. At the foot of the upright surface there should be a gutter from which a properly trapped soil pipe leads to the sewer.

Several business firms now put in urinals with a narrow open space between the gutter and the slightly overhanging floor, which connects with a heated flue by means of an intervening duct. There is secured thereby a strong downward draft that removes all odor. A ventilated urinal with some of the details of construction differently arranged is shown in Fig. 74.

Supervision.—Whatever kind of sanitary appliances are put in for the accommodation of a school, constant supervision is indispensable to keep them in an unobjectionable condition. But it matters not whether earth closets or water-closets are provided, there should be no excuse whatever for the person who has charge of them if they become a source of nuisance. With earth closets an ordorless condition must be maintained with a careful use of the absorbent material; with water-closets and urinals the janitor should not be sparing of soap and water applied with the scrubbing brush when necessary, and the teacher should see that this part of the janitor's work is well understood and honestly done.

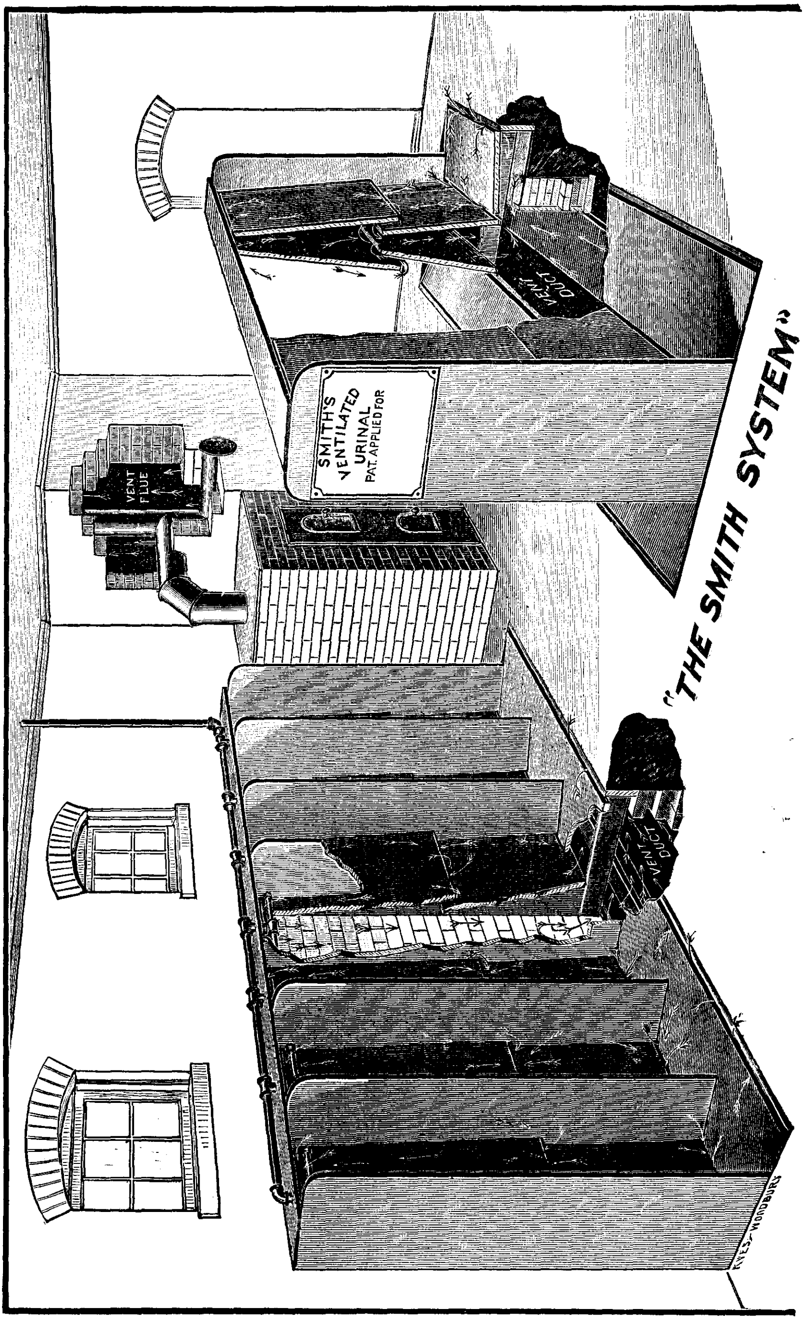

VENT FLUE
SMITH'S VENTILATED URINAL PAT. APPLIED FOR
VENT DUCT
VENT DUCT
"THE SMITH SYSTEM"

Fig. 74.

SCHOOL-HOUSE PLANS.

Some of the plans for school buildings shown on the following pages were contributed by architects in this State or elsewhere, some are modifications of plans from various sources, but the greater part of them have been prepared expressly for this paper, and very closely in accordance with what, after long and careful study, appear to be the most important requirements in school buildings.

One-Room School-Houses.—A plan for a one-room country school-house is shown in Fig. 75, suitable for the accommodation of

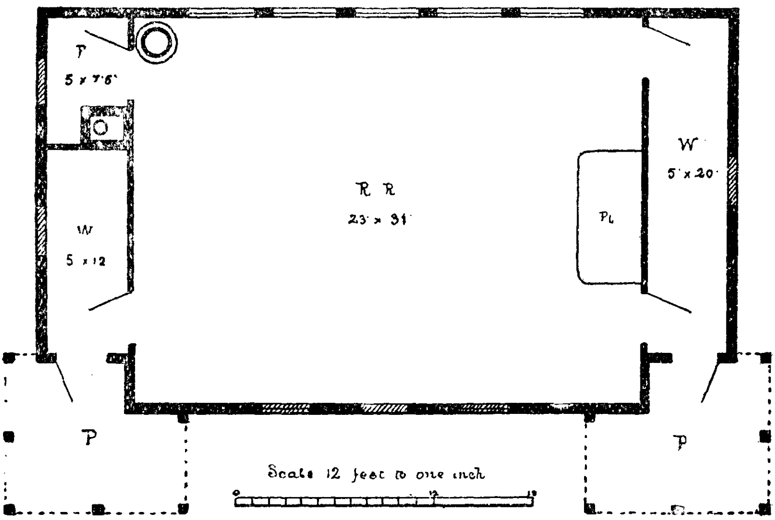


FIG. 75.

thirty-five pupils without crowding. The lighting is entirely from the left, giving, in a room of this width, the best possible lighting, provided the windows are large and high, the light is taken from a point between northwest and east, and that neither trees nor other buildings are too near. A porch and entrance for each sex are provided, together with a wardrobe for each, that for the girls being at the teacher's end of the room, that for the boys, at the end where the heater is placed. The heater, represented by the double circle, is placed at the rear at what will be the coldest corner, provided the windows look to the north or east. A small fuel room is shown near the stove. The wall opposite the windows is reserved for the blackboard. Over the blackboard are three windows, not for lighting, but for summer ventilation. The blinds of these windows should be kept closed when the school is in session. In the wardrobes, W. W., also, the windows are placed high, above the hooks for the clothing of the pupils.

Fig. 76 shows a plan very nearly like the preceding one, with the exceptions that both porches (P. P.), entrances, and wardrobes, are

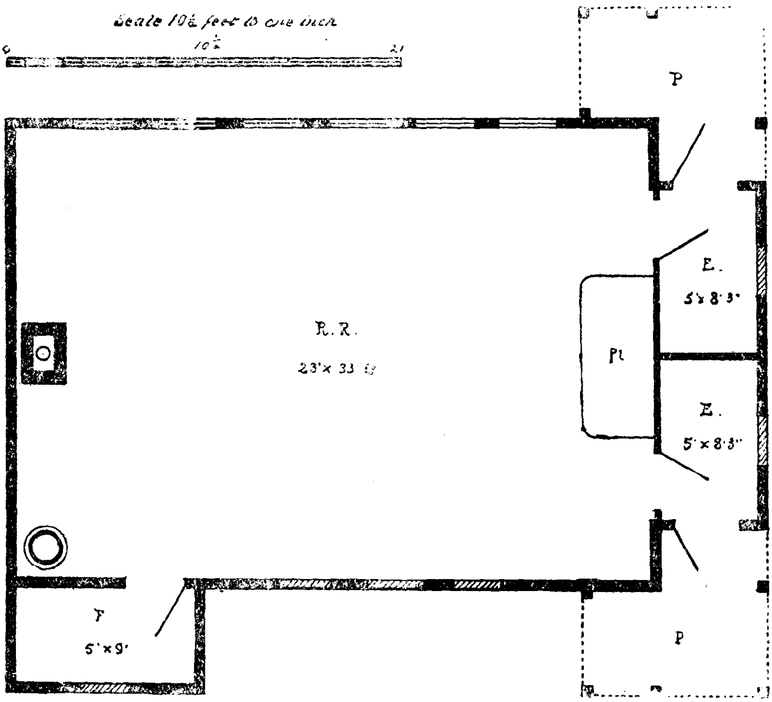


FIG. 76.

at the teacher's end of the building, and that the heater and fuel room are placed at the rear and right-hand side of the pupils. As the length of this room is thirty-three feet, another row of desks could be placed across the back part of it, thus making the room do for forty pupils.

The plan in Fig. 77 is the only one shown with the lighting from the two sides of the room. It will be seen that there is in it no advantageous place for the blackboard. It has a room for either thirty-five or forty pupils, has an entry, wardrobes, fuel room and a closet in one of the rear corners.

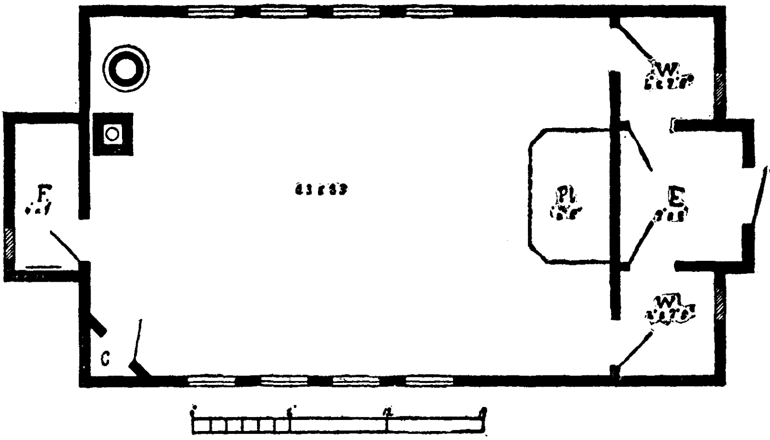


FIG. 77.

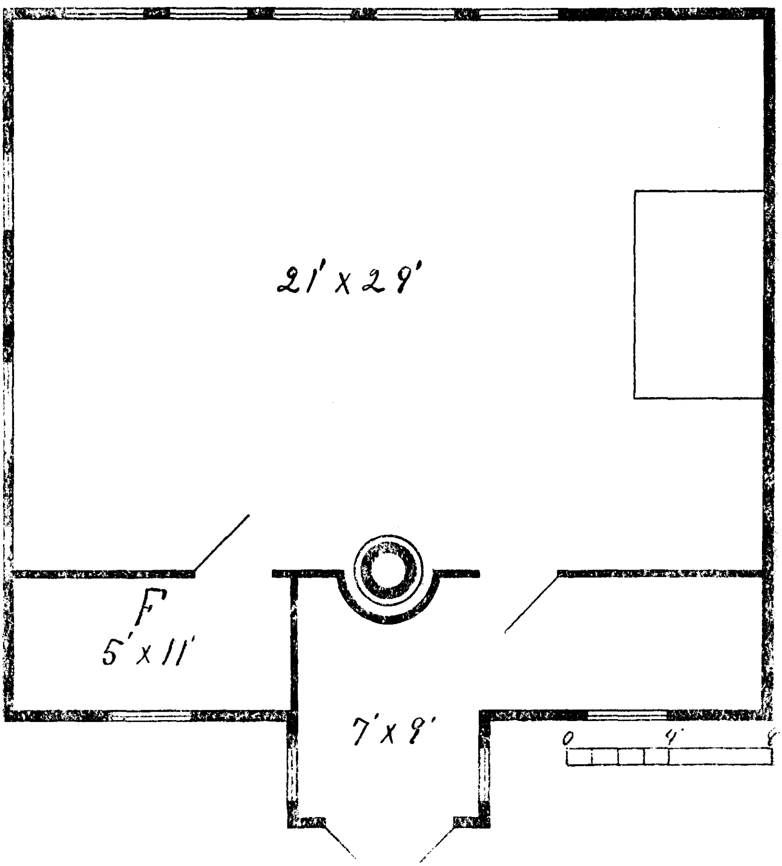


FIG. 78.

Fig. 78 shows a plan for a small country school-house when the necessity of strict economy calls for a building of very simple construction. The one good-sized entry and wardrobe should be provided with hooks for clothing for the pupils of both sexes. It provides for a good fuel room near the stove. The jacketed stove is placed in a recess, or alcove taken out of the entry. By an oversight of the draftsman, the ventilating flue and smoke pipe are not shown in the angle between stove and fuel room.

Fig. 79 is another plan for a cheap one-room schocl-house. Its main features are the economical way in which wardrobe space is provided and the abundant lighting. If the six windows at the left of

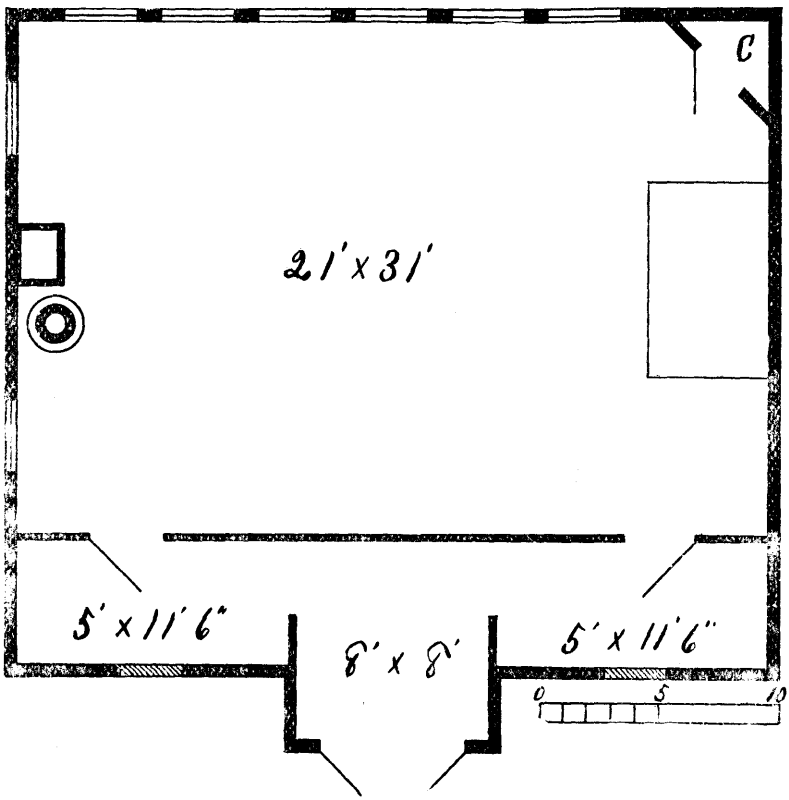


FIG. 79.

the pupils are as large and as high as are advised on pages 264 and 265 the light would be ample without the two windows back of the seats. A corner closest for the school is shown at C.

Fig. 80 represents the plan of a country school-house in the town of Greenwood in this State. Its general arrangement shows an

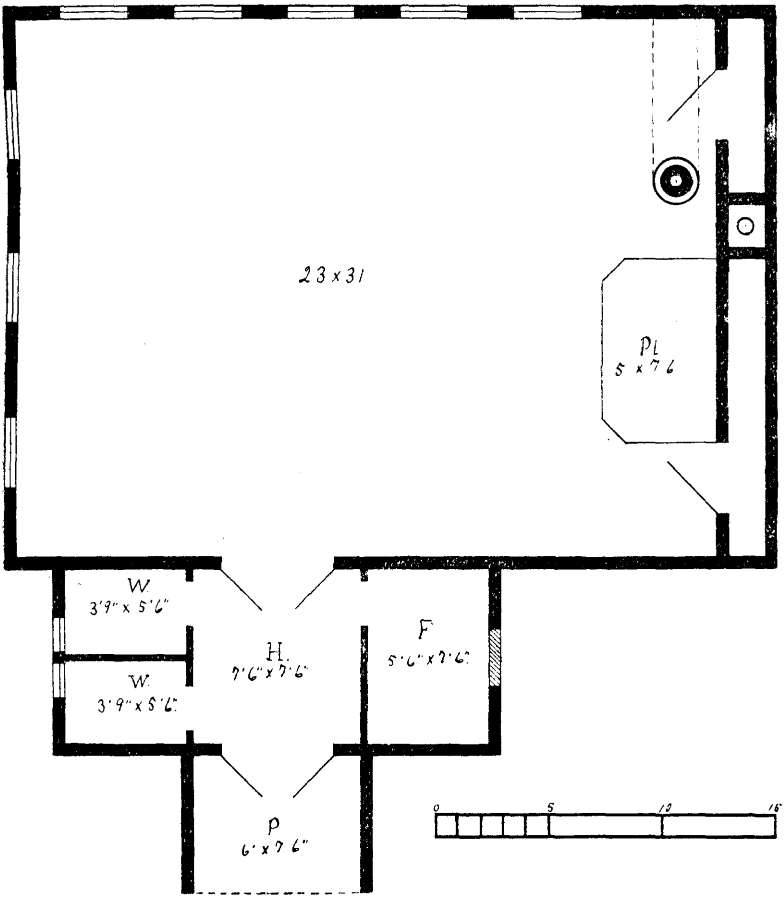


FIG. 80.

intelligent study of what is desirable in school-houses of its class. It has a sheltering porch, P., an entrance hall, H., two wardrobes separated by a matched board partition about seven feet high, a fuel-room, F, and two closets back of the teacher's platform. An error was committed by the workmen in making the fresh air duct to the jacketed stove much too small. If its intake of fresh air had been from more than one side of the building it would have been better.

The plan shown in Fig. 81 was drawn for a corner lot, though it may be used for lots lying on one street only, particularly on streets not running with the cardinal points of the compass. Its one room

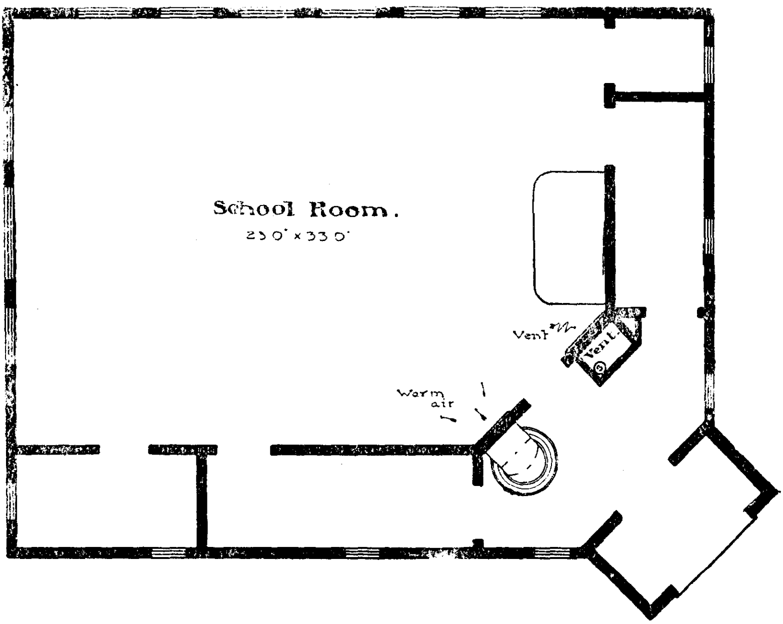


FIG. 81.

is 23x33 feet. There are a storm porch, an entrance hall, two wardrobes through which the pupils pass in entering or leaving the schoolroom, a closet at the right-hand side of the teacher for school material, and a fuel room. The fuel room was located with reference to a position of the heater near it The heating and ventilation here shown were arranged by Mr. J. B. Badger, Vice-President of the Smead Warming and Ventilating Company, Boston. The jacketed stove is set in the hall where it receives its care by the janitor, but discharges its warmed air into the room well above the heads of the pupils and opposite the walls in which the windows are placed. The ventilating shaft is heated by an iron smoke pipe set in one corner, and takes the air from the floor at the end of the teacher's desk. With this arrangement the entrance to the fuel room should be through the boys' wardrobe. There is perhaps a superabundance of window surface. One window at the left of the pupils could be omitted, or preferably, a diminution of the window surface back of the scholars might be made.

Fig. 64 shows the same plan with the heating and ventilation differently arranged.

Two-Room School-Houses.—In Fig. 82 we have a two-room building with the idea of a corner entrance again carried out.

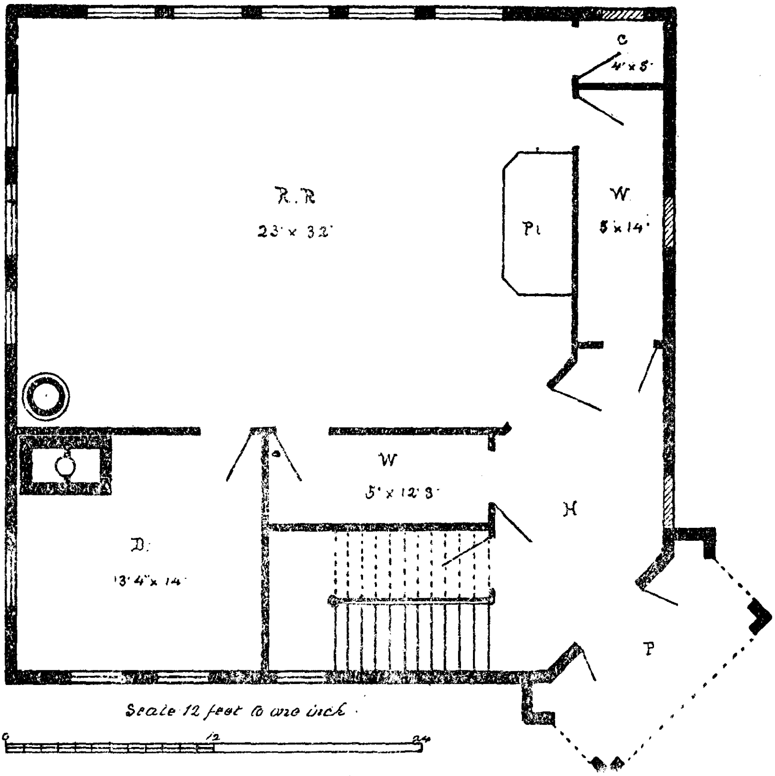


FIG. 82.

The room, D, and its corresponding room on the second floor may be assigned to various uses,—fuel room, recitation room, or school library and cabinet. If not wanted, it can be omitted from the plan, in which case it would be better to place the window to light the staircase so that from the landing it would throw its light both directly up and down the stairs. This would also make it advisable to build the ventilating flues in the corner of one of the wardrobes, or as shown in Fig. 81, but not at the right of the teacher. It would be an improvement to heat this building and some others with a furnace in the basement instead of with jacketed stoves as shown in the plans.

In Fig. 83 a plan is shown for a one-story, two-room building. It has a good entrance hall and wardrobes. The placing of the ventila-

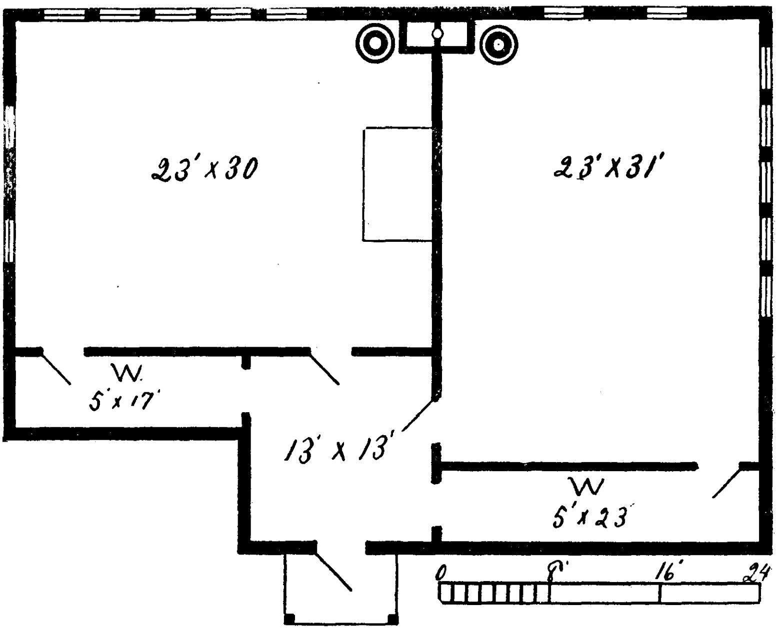


FIG. 83.

ting flues in one stack between the two rooms is in the interest of economy.

Fig. 57 (heating and ventilation arranged by Prof. Woodbridge) is of a plan for a two-room school-house, roomy entrance hall, stairway to basement, closet in one room, and two wardrobes, all on one floor. The wardrobes can be assigned, one to each sex, or one to each room. One minor advantage of this plan is that the teachers from their desks command a view of the hall and outer doorway.

The plan for the new Gas House Hill school-house, built in Augusta a few years ago, is shown in Fig. 84. The plan is essentially the same

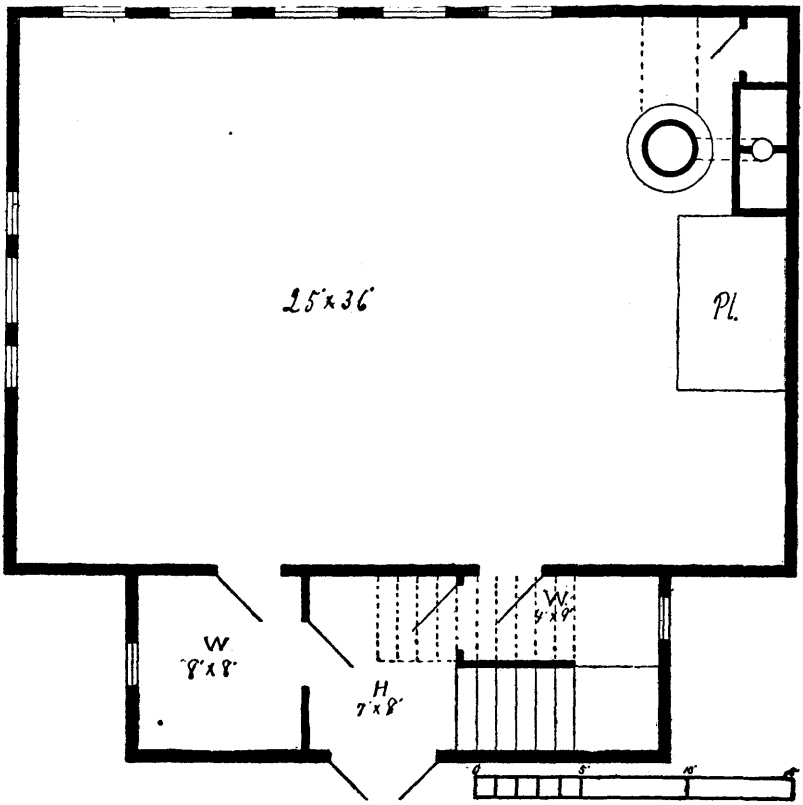


FIG. 84.

on each floor. There is a hall, two wardrobes, a school-room exceeding slightly what may be deemed the normal dimensions of a school-room, and a closet. There is a separate ventilating flue for each room with a cast iron smoke pipe between them. The heating on one floor is done with a small furnace with its casing open at the top; on the other, with a ventilating stove which supplies an inadequate quantity of fresh air.

Fig. 85 is the plan for a building in which there is a difference in the size of the two rooms. It is arranged with reference to economy

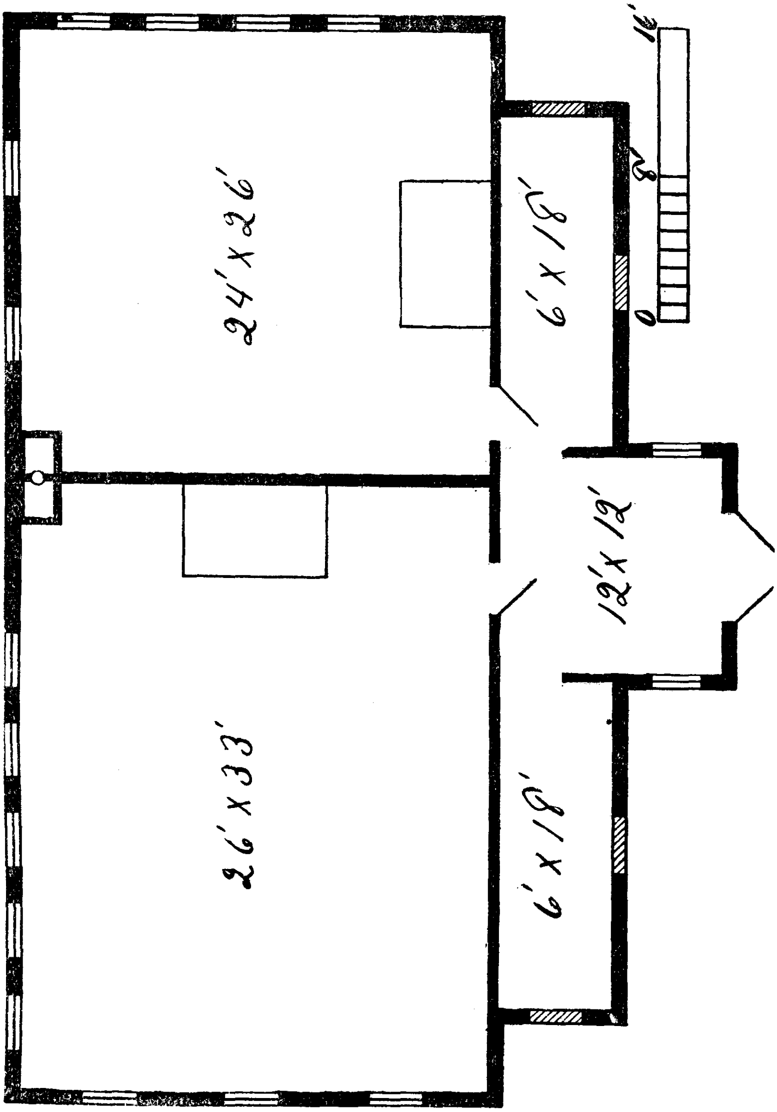


FIG. 85.

of construction. The windows in the wardrobes are placed high so as to economize space for the children's clothing.

In Fig. 86 we have the plan for a one-story school building with an entrance hall, two school-rooms, one wardrobe for each room, a

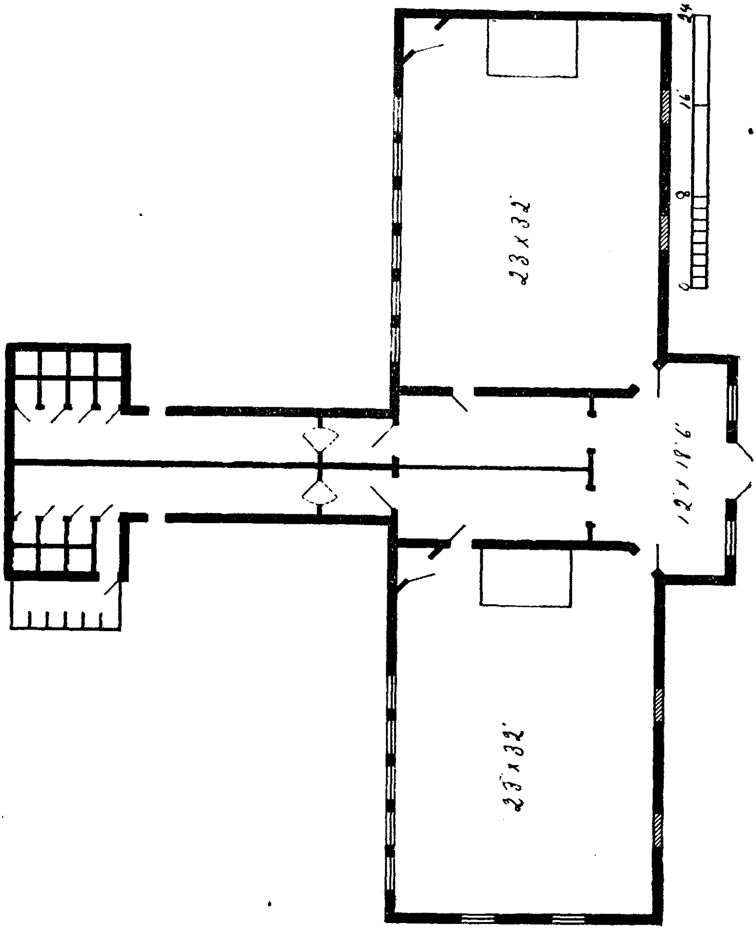


FIG. 86.

closet in each room, and an exit through doors at the rear to covered walks leading to the privies or earth closets. A good feature of this plan is that, with a well chosen orientation of the building, both rooms may receive their light from the same favorable point. The windows above the blackboard are for ventilation only. One wardrobe is for the boys in both rooms and the other for the girls. The board partition between them extends but little more than half way to the ceiling.

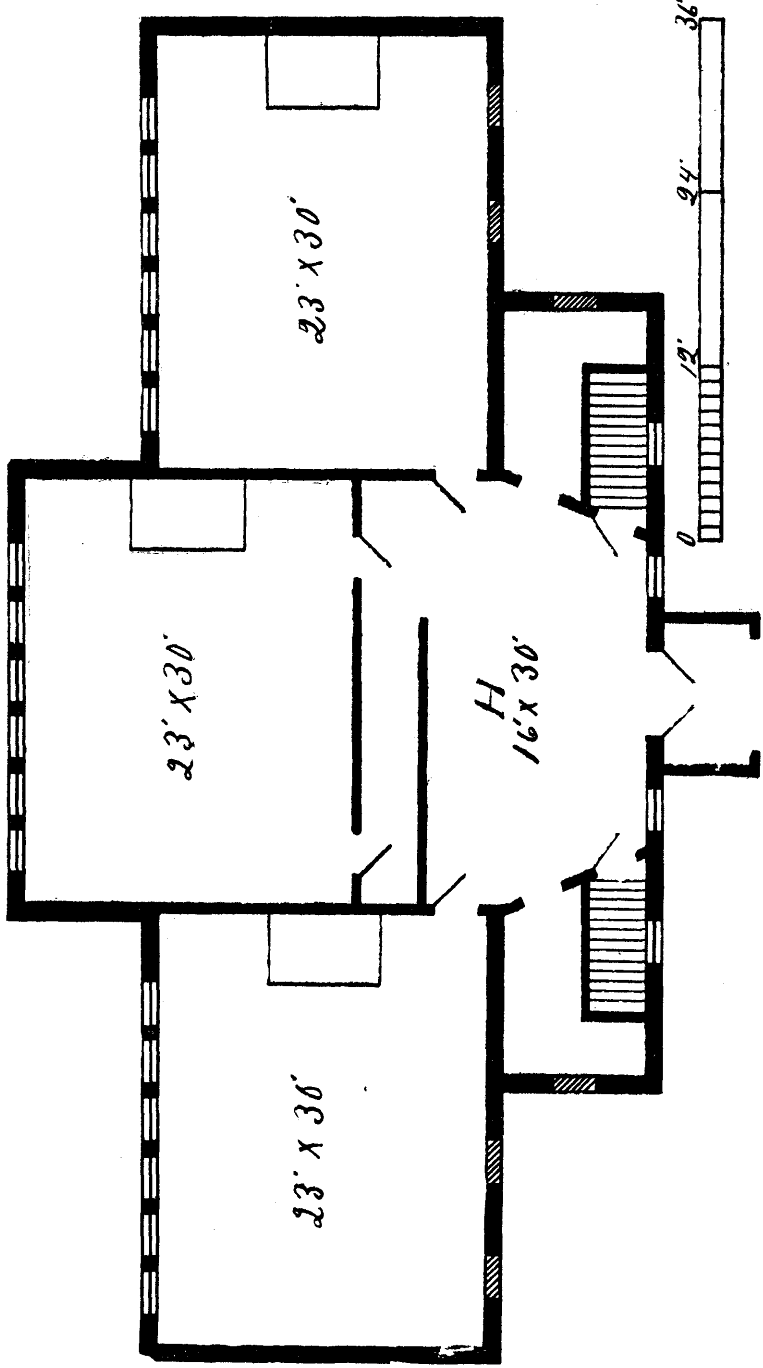


Fig. 87.

Three-Room School-Houses.—The disadvantage stated on page 243 of having school-rooms on opposite sides of a building is obviated in the plan shown in Fig. 87. Here the school-rooms are all placed on one side of the building where they may be amply lighted from the scholars' left, while the entrance hall of ample size, wardrobes, and stairways to the basement are grouped on the other side.

Figures 42, 43, and 47, show a two-story building similarly arranged.

Four-Room School-Houses.—The school-house shown in Fig. 88 has on each floor an ample hall, two school-rooms and one wardrobe for each room. The staircase is easy, well lighted, and has a

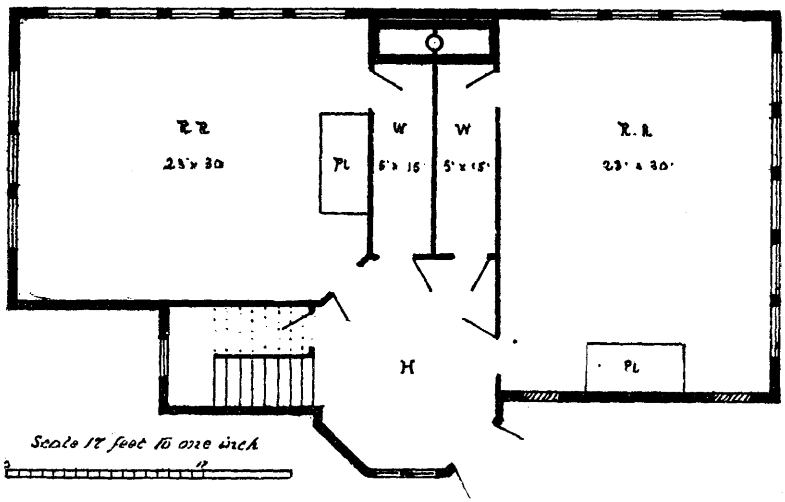


FIG. 88.

wide landing half-way up. The heating apparatus is in the basement to which access is had by means of stairs beneath the flight to the second floor. In this plan the rule is observed of taking the principal light for the rooms from not more than two sides of the building.

Figures 48, 52, and 53 give the plan of basement, first floor and second floor of a new school-house in Augusta built from plans drawn by E. E. Lewis, Architect, Gardiner. It has two entrances and two roomy wardrobes. The stairs, broken by two landings are easy and well lighted. The open fireplace in each room is a feature of this plan.

The plan shown in Fig. 89 was drawn by Dr. J. O. Webster for the reconstruction of an old building. With the left-hand light taken

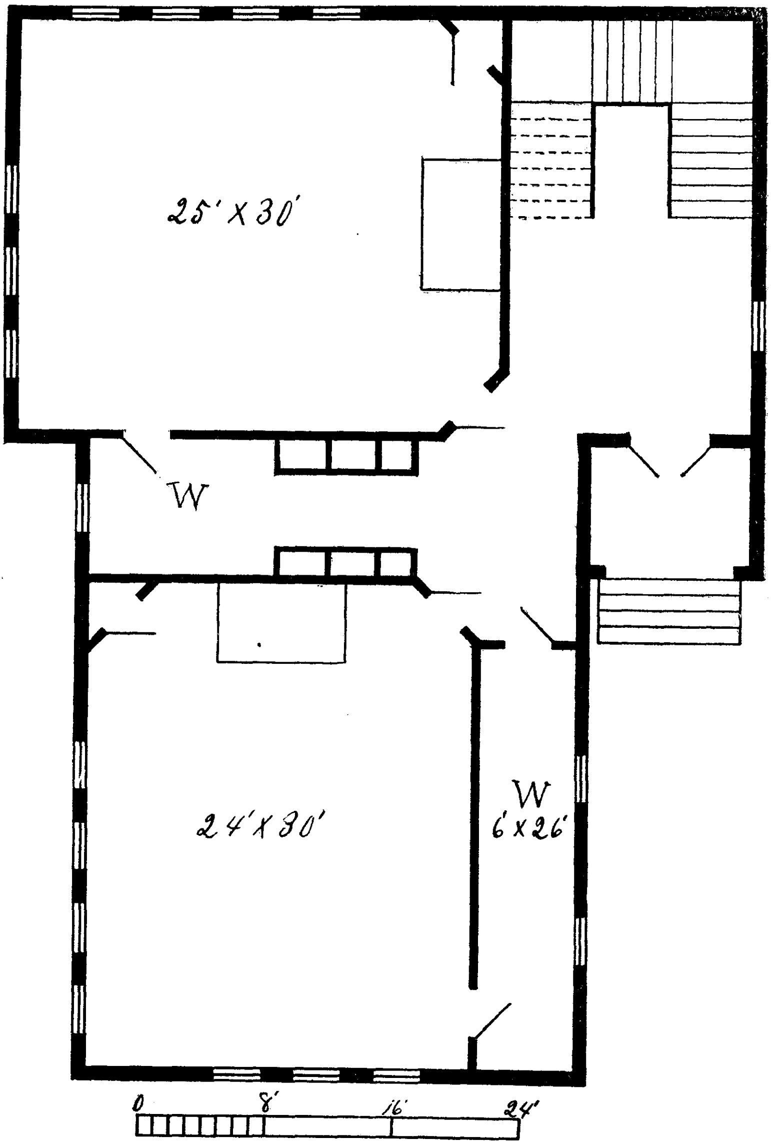


FIG. 89.

from two sides only of the building, with easy stairs well located for ample lighting, and with its wardrobe for each room, this is a good plan.

Six-Room School-Houses.—The plan shown in Fig. 90 is for a two-story building with three school-rooms, a large hall, and

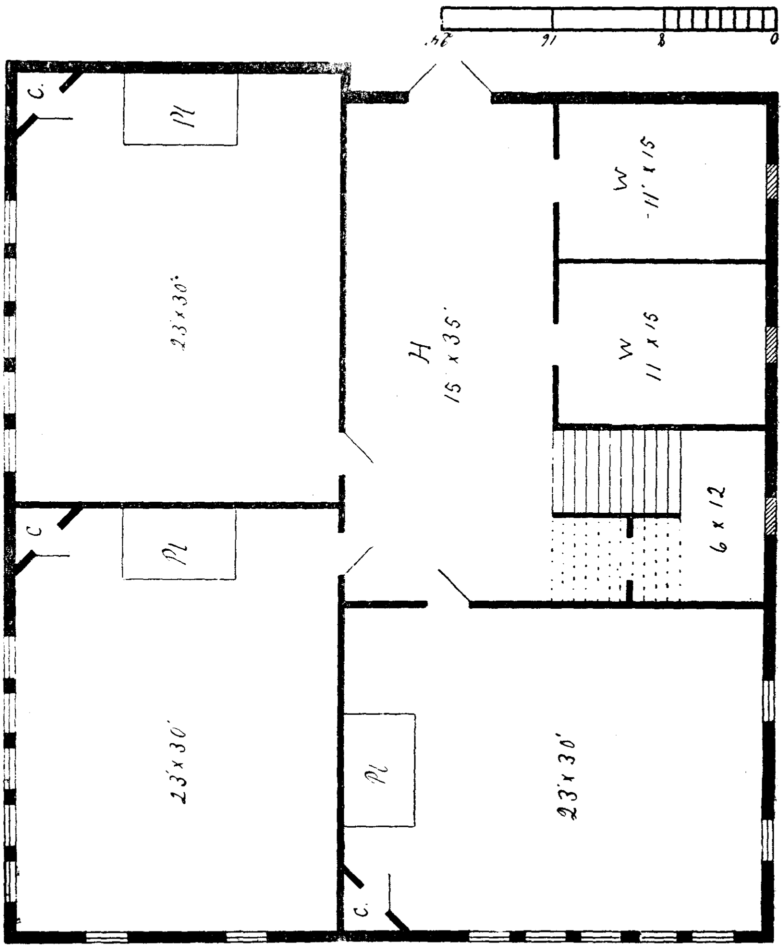


FIG. 90.

one wardrobe for the boys and one for the girls on each floor. The stairs are wide, easy, and well lighted. The two wardrobes are finished as one room, and then divided by a matched board partition as described on page 247.

The plan shown in Figs. 42, 43, and 47, like that given in Fig. 90, is arranged with the view of taking the light for the rooms from a point of the compass from which the most favorable light may be obtained and putting entrances, halls, wardrobes, and staircases on the opposite side or sides. In this plan two of the rooms might have one or more windows at the rear of the pupils, but the six windows in each room will give an ample supply of light if of the size and arrangement recommended on pages 264 and 265.

Fig. 91 is a modification of a plan drawn by C. A. Dunham, Burlington, Iowa. Its one fault is that one of the rooms at least must

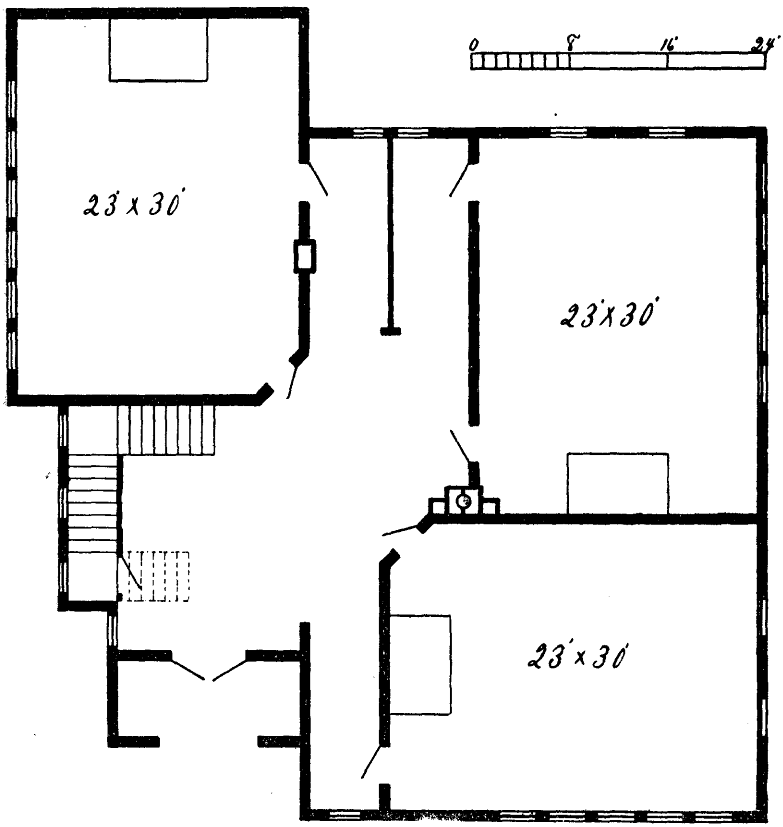
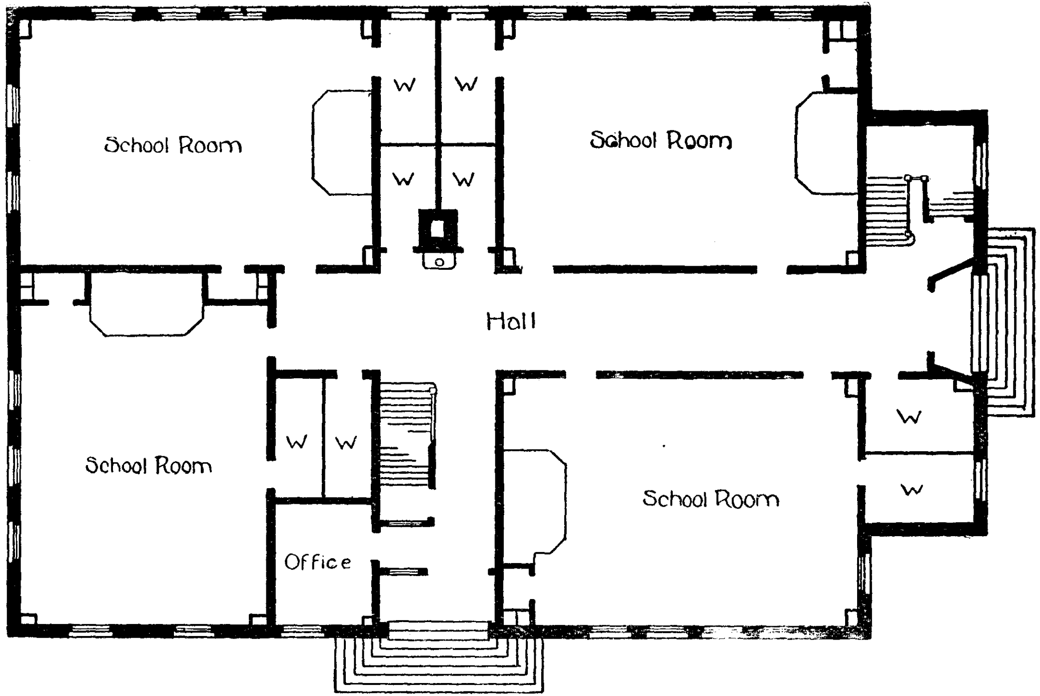


FIG. 91.

take its principal light from a side of the building through which direct sunshine will stream during school hours.

Buildings With More Than Six Rooms.—Fig. 92, the ground plan, and Fig. 93, the second floor, show a new schoolhouse built in Houlton under the direction of W. E. Mansur, Architect, Bangor, Maine. Each of the four rooms on the first floor is 24x34 feet. The principal light is invariably from the scholars' left. On the second floor the large room, 34x58 feet, imposed a

Fig. 92.



FIRST FLOOR·

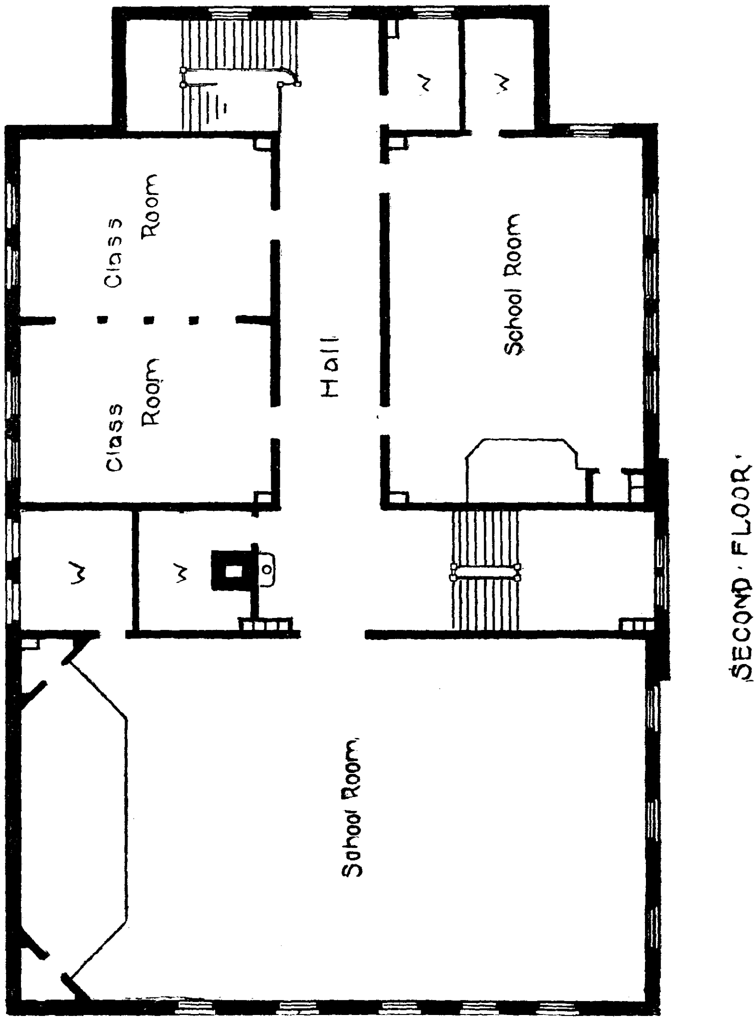


FIG. 93.

difficult task upon the architect. He met the difficulty of properly lighting the room as well as he could by carrying the ceiling and the window-tops to an unusual height. The wardrobes are divided by matched board partitions only eight feet high.

The plan shown in Fig. 94 is a good one of its kind. The building has two entrances and a safe, easy and well lighted stairway at either

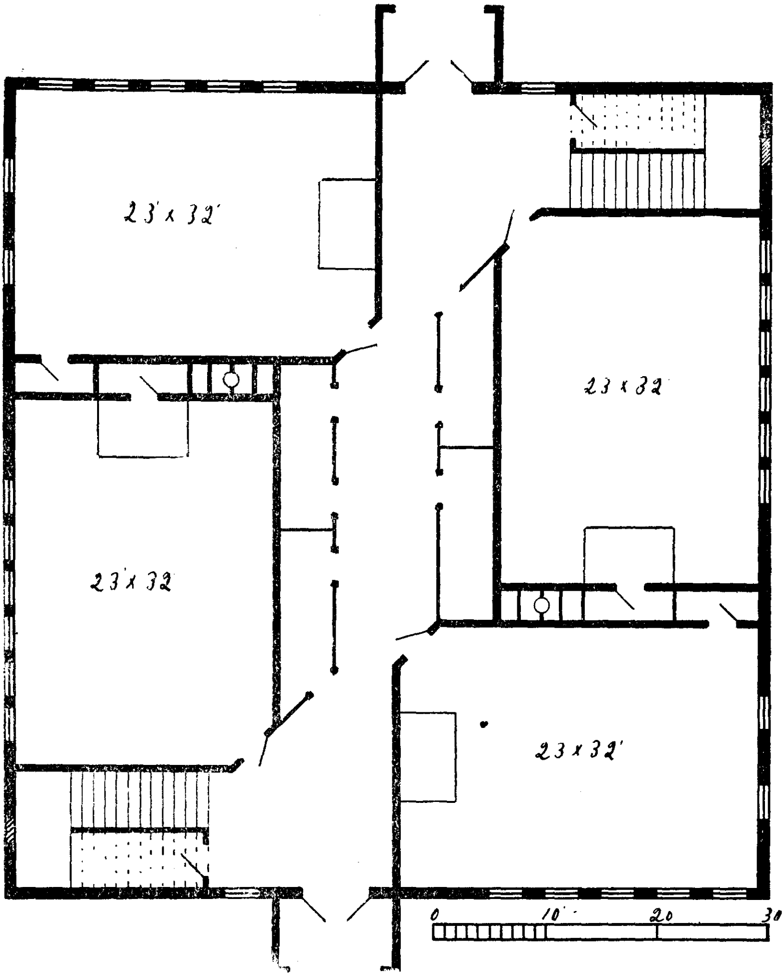


FIG. 94.

end. The stairways are, furthermore, so located that the pupils from the second floor can pass directly out without crowding the hall on the first floor, thus favoring quietude as far as possible. The wardrobes are taken out of the hall with matched partitions seven or eight feet high. The width of the rooms makes the ample lighting of them from one side practicable. The one serious fault with the plan is that some of the rooms must have the trouble of direct sunshine in them during school hours or the unavoidable darkness when window shades are drawn.

Through the kindness of Mr. J. A. Schweinfurth, Architect, Boston, the plans shown in Figures 95 and 96 are presented.

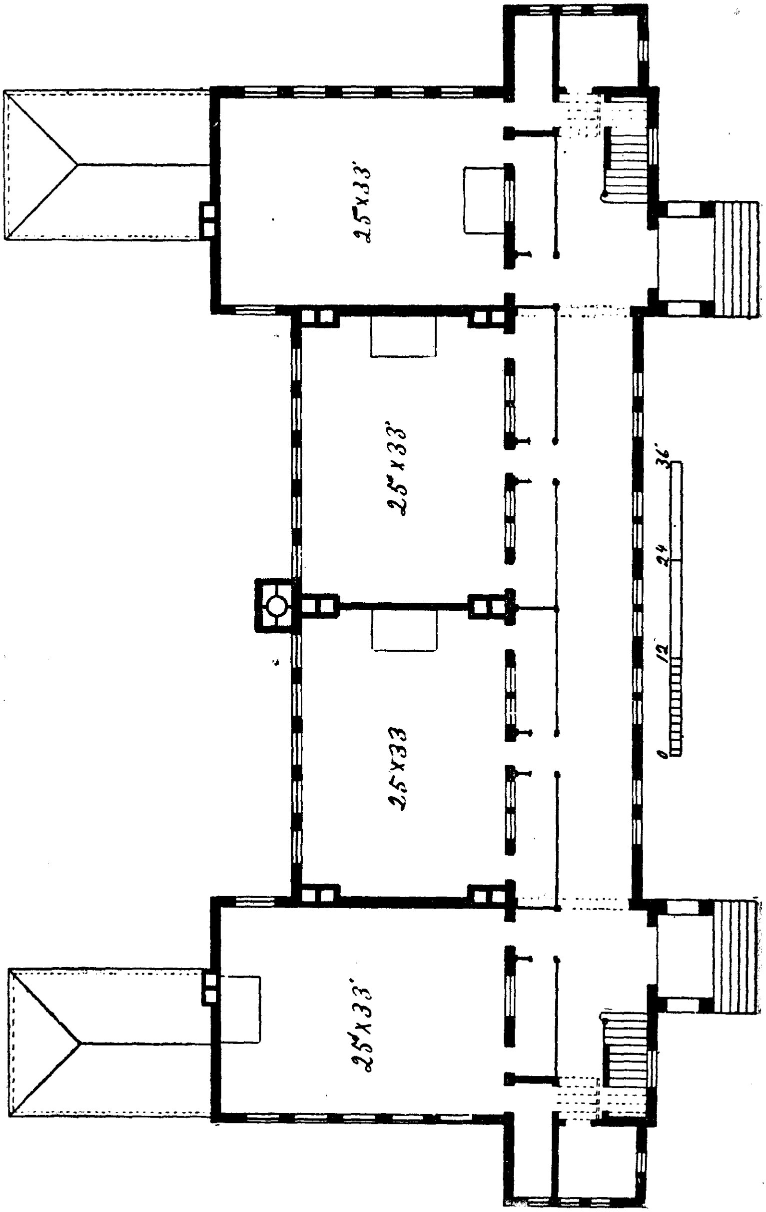


FIG. 95.

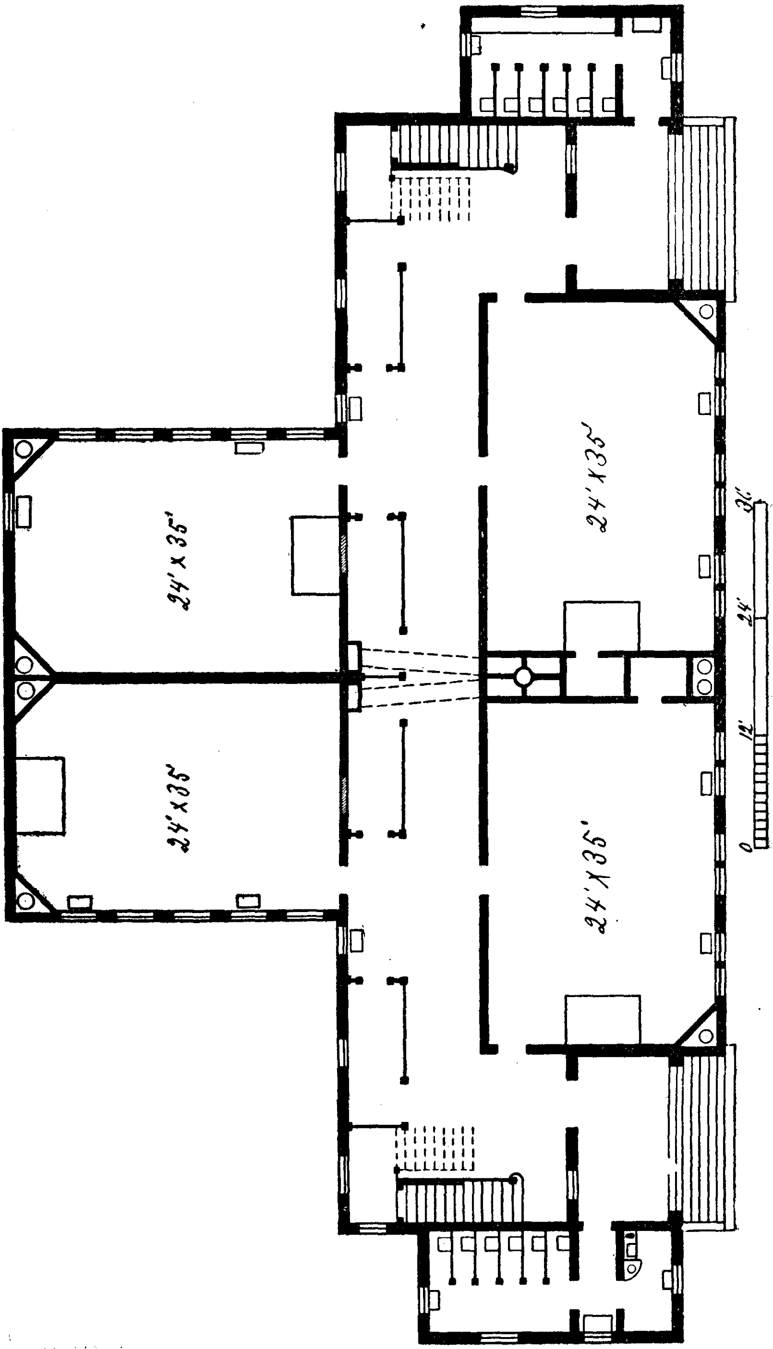


FIG. 96.

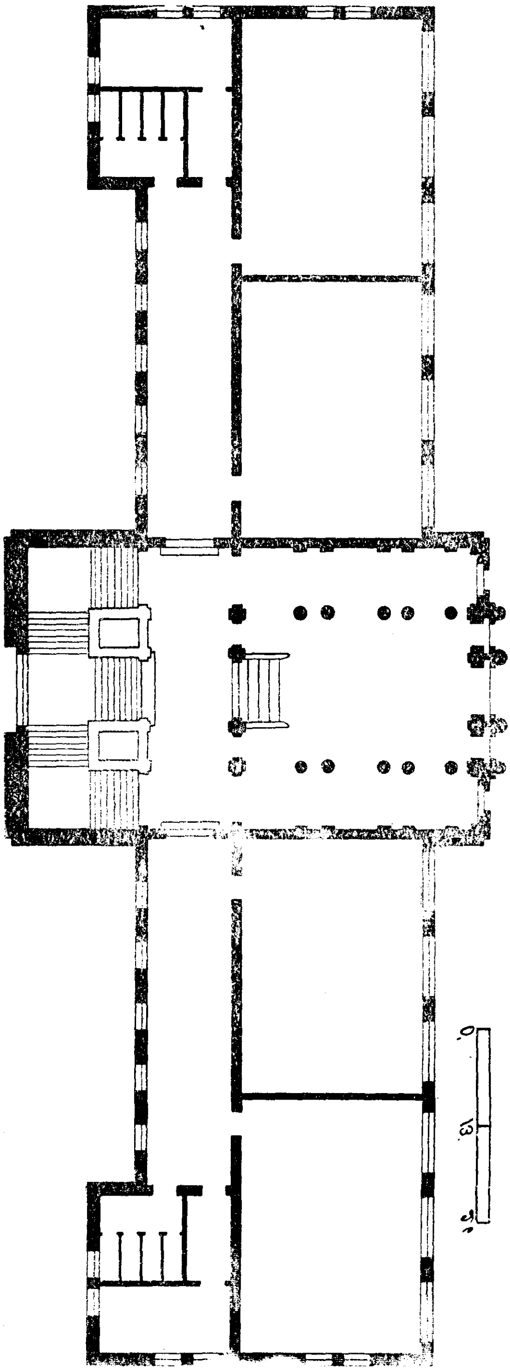


FIG. 97.

In Fig. 95 the idea, now so much in favor, of making school buildings the width only of a school-room and an ample corridor is carried out with a slight modification. This form, more than any other, favors an ample lighting of school-rooms and corridors, and in warm weather, window ventilation. The wardrobes in this plan are included in the wide corridor, and separated from them with matched board partitions, as described on page 247.

Fig. 96 shows the floor plan of a school-house built by Mr. Schweinfurth in Auburn, N. Y. Its many good features commend it.

The plan shown in Fig. 97 is given as representative of the better class of school-houses now building in Europe. It was drawn by Alexander Koch, now of London, but formerly of Zurich, Switzerland, and through his kindness I am enabled to present it, together with the front elevation, seen in Fig. 98. The large window surface shows how ample light may be secured with unilateral lighting.

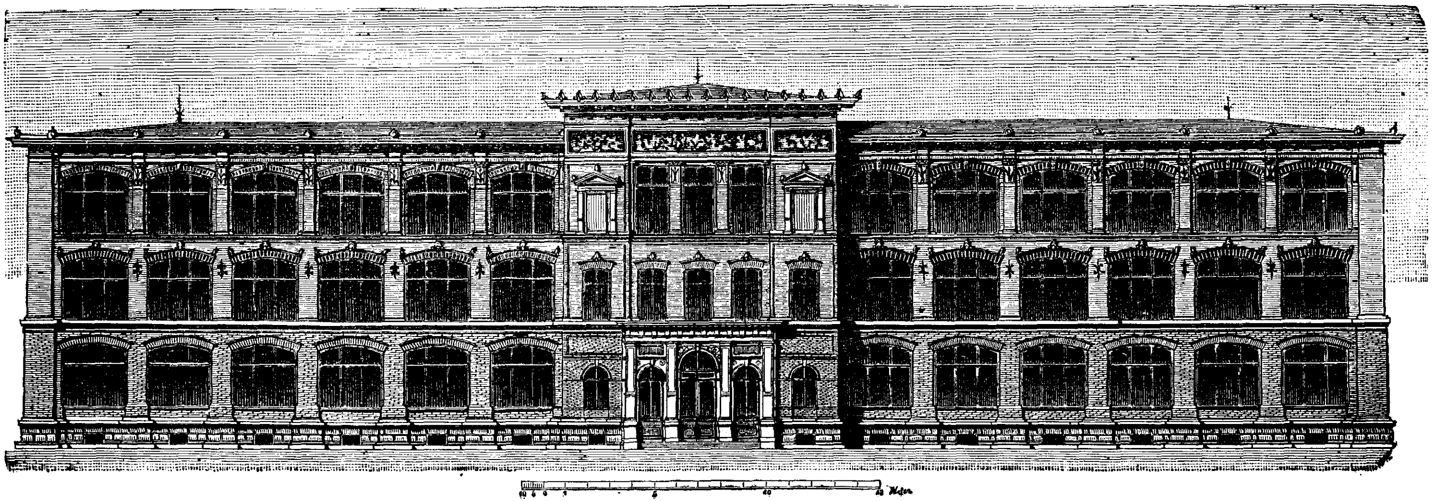


FIG. 98.

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