Notes on school hygiene / by John T. Prince.

NOTES

ON

SCHOOL HYGIENE.

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SCHOOL HYGIENE.

Introductory Note.

The following statement is a brief summary of the best thought attainable at present upon the preservation of health and prevention of disease, so far as the conditions and practices of the schools are concerned. It is made chiefly for the benefit of school officers who may not find it convenient to consult the authorities upon the various subjects treated, and who are ready to be guided by the experience of others.

The large amount of ground covered and the limits of a pamphlet intended only for general use prevent an exhaustive or full treatment of any of the subjects. Little space is given to a discussion of present needs or to proofs of existing faulty conditions. Investigations have sufficiently shown that in all school buildings except those which have been recently built or renovated the hygienic conditions, so far at least as ventilation and lighting are concerned, are almost universally poor. Reports of recent investigations in Europe and this country are cited by Dr. William H. Burnham of Clark University (4, pp. 27, 28)* and by Dr. A. G. Young, secretary of the Maine State Board of Health (2, p. 85). Other reports of investigations made by school boards and local associations in several American cities are given in the following-named pamphlets and periodicals: —

Report on the Sanitary Condition of the Public Schools of Buffalo, by the Buffalo School Association, 1898.

Report upon the Boston Schools in the Publication of the Associa-

* The figures in parentheses refer to the numbered titles of reference books and articles which are printed at the close of this report. For a more full bibliography of the subjects connected with school hygiene, see Kotelmann's School Hygiene, pp. 353–382; also Journal of Proceedings of the National Educational Association for 1898, pp. 506-523. The last-named compilation, made by Dr. Burnham, consists of 436 titles of books and articles published in this country and Europe.

tion of Collegiate Alumnæ for December, 1898, pp. 53–58. Richmond Hill, N. Y.

Sixth annual report of the Massachusetts State Board of Health, Lunacy and Charity.

Annual reports of inspection department of the Massachusetts District Police since 1890.

Report of the Mayor's Sanitary Commission, Boston "Herald" of March 20, 1896.

Report of the Sanitary Condition of the Schools of Washington, D. C. (Senate Document No. 65), fifty-fifth Congress, third session.

Report upon the Condition of School Buildings of Baltimore, in the Baltimore "Sun," May 18, 1898.

Some of the above-named reports show a condition of school buildings which should excite general concern, for most of the places in which the investigations were carried on are places in which great interest is taken in education. The presumption is that, if the school buildings of such places as Boston, Philadelphia and Baltimore are a menace to health, those of most other places need to be looked after more closely than they are.

It is hoped that the standards of school sanitation here presented will cause officials in control to make a careful examination of existing conditions, and, if found faulty, to take measures for their correction. It is hoped also that the suggestions relating to the inspection and hygienic treatment of pupils will be of substantial assistance to superintendents and teachers.

Hygienic Conditions.

The hygienic conditions of schools may be separated into two classes, one class consisting of those for which the public authorities are responsible, and the other class consisting of those for which the parents or pupils are responsible. Among the former class of conditions are: (1) the location of buildings, (2) construction and plan of buildings, (3) school equipment, (4) composition and adjustment of the school program. The conditions for which the parents or pupils are responsible are those which relate to (1) home requirements, (2) social diversions, (3) food and rest, (4) personal habits of pupils. These conditions will be treated briefly in order.

Two classes of conditions.

Location of School Buildings.

The ground upon which the schoolhouse is placed should be high, and the soil gravelly or sandy, so as to allow good drainage and a dry cellar. Clayey soil and soil in which there is refuse or organic matter are to be avoided. The building should not be located near a swamp or standing water, or any place whose odors are offensive. It should be so retired that the school shall not be disturbed by noises from without, and so far removed from the boundaries of the lot upon which it is placed that no building upon an adjoining lot can shut out the light from the schoolrooms.* In choosing the lot upon which the building is to be placed, let there be generous provision made for play and exercise grounds, and, if possible, room for shrubs and flowers.

Desirable features of location.

Construction of School Buildings.

Whenever it is possible to do so, an architect should be employed to draught plans and oversee the work of construction of school buildings. One who makes a careful study of school architecture is likely to provide all that health, convenience and good taste demand to a far greater degree of satisfaction than a carpenter or a building committee can provide without such help.† The following notes indicate the practice followed in the best constructed buildings.

An architect needed.

School buildings should in no case be more than three stories high. In the country they should consist of but one or two stories. A cellar should be under the entire building, and be thoroughly ventilated. It should be cemented throughout, and be so arranged that it may be used for boys' and girls' playrooms in cold and stormy weather.

Height of school buildings.

The lower floor of the building should be not less than 18

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* A detailed summary of desirable features of location for school buildings is given by Eulenberg and Bach (4, p. 19).

† In Massachusetts, plans and specifications of proposed school buildings must be approved by an inspector of factories and public buildings, according to chapter 481, section 25, of the Acts of 1894. Chapter 508 of the Acts of 1894 provides for inspection by the same official of all school buildings, with authority to correct existing defects of sanitation.

inches above the surface of the lot, and the walls should contain vertical air chambers. The floors of the schoolroom should be of hard-wood, kiln-dried boards not over four or five inches wide, fitted so close as to permit no cracks in which dirt can settle. The floors should be so built as to permit the least possible vibration and transmission of sounds. Double floors with heavy building paper or mineral wool between them will help to accomplish the desired end.*

Construction of floors and ceilings.

The size of the schoolroom should be determined by considerations of health as well as of convenience. Authorities differ as to the amount of space needed, probably owing to the fact that the amount of fresh air breathed depends less upon the size of the room than upon the way it is ventilated. It is safe, however, to assume that, on account of proper ventilation, a minimum of 16 square feet of floor space and 250 cubic feet of air space per pupil should be required.† The pupils' eyesight should also be considered in determining the size of the room. If, as is assumed by some authorities, ordinary writing upon a blackboard cannot be easily read beyond 30 feet, this distance or a little more should be the limit of the length of the room. The width of the room should be limited to the extent at which satisfactory lighting can be had from the windows on the side of the room. This distance has been generally regarded to be 24 feet. For purposes of ventilation and lighting, the room should not be less than 12 feet, and need not be more than 13 or 14 feet high.

Size of schoolrooms.

Ample provision should be made for corridors and cloak rooms, placed in such relation to air and sunlight as to provide for good ventilation. Under no consideration should the outer clothing be hung in the schoolroom, as is sometimes the case.

Corridors and cloak rooms.

Every school building should have one or more rooms that can be used for play in cold or stormy weather, and for physical

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* Floors consisting of narrow boards or blocks of wood laid in cement have been found very satisfactory. They are described by Dr. Burgerstein (12, p. 54).

† These amounts are somewhat larger than the requirements in several European States, as quoted by Dr. Burnham (4, p. 25).

exercises at any time. These rooms should be well ventilated, and, if possible, exposed to the sun a portion of the day. They should be so situated as to be easily accessible from all the rooms, and so constructed that noisy exercises shall not disturb the schools when they are in session.

Play and exercise rooms.

In the construction of school buildings, provision should always be made for the pupils to wash their faces and hands, and whenever it can be done, facilities for plunge or shower baths should be provided. This is especially important in schools whose pupils have not bathing facilities at home.*

Facilities for washing and bathing.

The best material for wall blackboards is natural slate. They should be built into the walls at such parts of the room as will be most convenient for use and least harmful to the eyes. As a rule, they should not be placed where the reflection of light is such as to make it difficult for pupils at their seats to see what is written upon them, and in no case should they be placed between windows.

Material and place for blackboards.

Ventilation and Heating.

By far the most important as well as the most difficult problem in the construction of schoolhouses is the method of their ventilation. The problem consists in keeping the air of schoolrooms as nearly as possible in the condition of pure outdoor air, which consists of oxygen and nitrogen in certain proportions, with a small quantity of carbonic acid gas and water. After it has been through the lungs, the air is changed by an increase of about 4 per cent. in volume of carbonic acid gas and by a decrease of about the same quantity of oxygen. There is also found in vitiated air more or less of organic matter and an increased amount of watery vapor. Authorities differ as to the causes of the effects of breathing what is called "bad air," some averring that the organic matter from the skin and lungs is the cause of the deleterious effect, and some that the dangers lie not from the existence of any

Character of vitiated air.

* Baths have been introduced in a number of American and European schools. The reports of their use are very favorable to their continuance. For reports from Germany, see (4, p. 38; 11, p. 470).

poison in the respired air, but from the excess of the carbonic acid and deficiency of oxygen. But all agree, for one reason or another, that the amount of carbonic acid in the air is the measure of its impurity.* The relative amount of carbonic acid in the air is ascertained in various ways, the simplest test being made by means of Wolpert's air tester, which consists of a test tube filled with lime water, and a rubber bulb with an attached glass tube for pumping the air to be tested into the lime water. The number of bulbfuls of air used in the test to make the lime water opaque, indicates, as shown by a table, the vitiated character of the air. This instrument, at best, can give but an approximate test of the character of the air, but sufficient, it may be, if found very bad, to warrant an accurate analysis or to provide better means of ventilation.† The quality of air may also be inferentially determined by estimating the amount of fresh air that is forced into or out of a room in a given time. This may be done by means of an anemometer placed in the current. The rate per second or minute multiplied by the number of superficial feet in the opening will give the volume, which may be compared with the amount needed.

Method of testing the purity of the air.

Authorities are agreed that air containing 10 parts of carbonic acid to 10,000 is unfit to breathe, and that for healthy respiration air should contain not more than 7 parts of such gas to 10,000. Measured by such a standard, the air of most schoolrooms not provided with modern methods of ventilation would be regarded as bad or very bad.‡

Standard of purity of air.

The amount of air required for each child varies from 1,800 to 2,500 cubic feet per hour. If there is for each child the

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* For statements as to the cause of contamination in breathing respired air and for making the amount of carbon dioxide in the air the measure of its impurity, see (1, p. 69; 3, p. 34; 12, p. 124; 27, pp. 18, 23; 20, p. 741).

† Sold by Codman & Shurtleff, Boston, Mass. More accurate testers are those of Pettenkoffer and of Smith-Lunge, both of which are fully described by Kotelmann (1, p. 73). The method given by Dr. Cohen is described by Professor Burrage (3, p. 37). Other methods of testing the air are described by Richards and Woodman (27, pp. 33, 35).

‡ Many tests made of the air in schoolrooms in this country and in Europe show most alarming results. From 20 to 50 parts of carbonic acid gas to 10,000 have been frequently found in schoolrooms, and sometimes the proportion has been found to be 70 and even 90 to 10,000. For a record of these tests, see (4, p. 27; 2, p. 85).

amount of space previously indicated (16 square feet of floor space and 250 cubic feet of air space), the air should be changed every ten or twelve minutes, — that is, each pupil should be provided with at least 30 cubic feet of fresh air per minute.* This amount of air, having a temperature of not less than 60°, may be introduced and distributed by properly located flues without producing dangerous draughts.

Amount of space needed for each child.

When the outside temperature is above 60° F., ventilation is easily effected by means of open windows and doors. To avoid dangerous draughts of the incoming air of a low temperature, boards are sometimes placed under the lower sashes of the windows, so as to allow the current of air to pass upward and away from the heads of the pupils. To effect the same end, the upper segments of windows are made to turn upon hinges. Open doors into large well-ventilated hallways have also been found useful means of ventilation.

Ventilation by means of windows and doors.

To effect ventilation that is at all adequate in weather having a temperature below 50° F., the natural currents of air should be supplemented by artificial means, either by heated flues which eject the air from the room or by fans which force air into it. By the former method, called the vacuum or gravity system, fresh air takes the place of the air which is forced by gravity from the room through the heated flues. By the latter method, known as the plenum system, the forced current of inflowing fresh air drives the vitiated air from the room through flues provided for the purpose.

Two methods of artificial ventilation.

In regulating the introduction of air, great care should be taken respecting the source of supply. The air should not be taken from the basement, but from the outside, where there are no offensive odors or dust. Some means of furnishing moisture to the air should be employed.

Source of supply of air.

Attention should be given to the size, situation and number

* This amount agrees with Dr. Billings's estimate, and is not far from the carefully wrought conclusions of De Chaumont, based upon the investigations of Pettenkoffer (4, p. 24).

of ventilating shafts. The size of the inlets must be large enough to supply fresh air sufficient to compensate for the air that is taken out, and the outlets must be of sufficient size to make the desired change of air.*

Size of ventilating shafts.

The flues should be so situated as to provide for the fullest circulation of air in the room. Experiments have shown that good if not the best results are attained by placing the inlet in the middle or upper part of the wall and the outlet near the floor upon the same side. It is also advisable to have two or more outlets, so as to avoid draughts occasioned by rapidly moving currents.†

Situation of flues.

In rooms where the warm air enters only in the upper portion, and where there is no direct radiation, extra provision should be made for warming feet and drying clothing. This may be done by placing radiators or registers at the floor of the halls, where heating rather than ventilation is the main desideratum.

Direct radiation in halls.

An open fire is a poor means of heating, but an excellent means of ventilation. Many modern school buildings have fireplaces in every room, in most of which no fire is ever made. Doubtless the unused fireplace may serve as a means of ventilation, but not nearly so efficiently as a fireplace with even a little fire in it. Apart from possible dangers of draughts, there is probably no better means for carrying away the vitiated air than an open fire. The excuse usually offered for not having a fire in the fireplace is entirely insufficient. There is no good system of ventilation that does not require care, trouble and expense.

The open fireplace as a means of ventilation.

This may be a good place to say that skill and good judg-

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* Professor Clark (6, p. 66) estimates that a shaft 20 feet high, with a difference in temperature of 20°, should have a sectional area of 5½ square feet to carry off 48,000 cubic feet per hour. This estimate is made upon the basis of supplying 1,000 cubic feet per hour for each pupil. To supply 2,000 cubic feet per hour, the sectional area of the outlet should be 10⅔ square feet.

† The matter of location of inlets and outlets is discussed fully by Professor Burrage (3, p. 43); also by Mr. Carpenter (7, p, 55), who says that much depends upon existing conditions. He says: "It has been proved practically that with rooms of about the proportion shown in the diagram [15 : 32] good results in the diffusion of heat and air are obtained by introducing the air at a point two thirds of the distance from floor to ceiling and near one corner, and locating the register for discharge of air on the same side of the room but near the floor and near the lower diagonal corner."

ment are necessary in looking after any appliance designed for ventilation. It should not be intrusted, for the sake of economy or any other reason, to ignorant or unreliable persons, since ordinarily as much depends upon the way in which a system of ventilation is managed as upon the system itself. Nor should a knowledge of the system used be confined to the engineer or janitor. For the sake of needed co-operation, the superintendent of schools and the teachers — especially the principal — of the school in which the system is used ought to know the construction of the system and the best method of working it.

Management of apparatus.

In the best systems of ventilation flushing of the schoolroom by natural air currents is necessary to carry off the organic dust and condensed vapors which cannot be fully taken away by the ventilating flues. Upon this point Professor Clark says (6, p. 63): "Nothing can take the place of aeration by means of open windows. Artificial ventilation, though required for changing the air when the windows are necessarily closed, is insufficient, even under the best circumstances, unless the room is from time to time thoroughly refreshed and purified by the sweep of the free winds through all its windows widely opened. Such an atmospheric washing should be secured three or four times daily in all weathers; at recess, particularly, it should be insisted on, banishing teachers and pupils from the room meanwhile, if necessary."

Frequent sweep of winds through rooms necessary.

In the choice of means of heating schoolrooms, the necessity of bringing into them the needed supply of warmed fresh air must be kept in mind. The direct radiation from stoves and from steam and hot water pipes does not accomplish this end, and is therefore not a desirable means of heating. This statement applies only to schoolrooms where there is not an adequate supply of warmed air by furnace or indirect radiation. Heating by direct radiation alone may be permitted in dressing rooms and halls, but not in schoolrooms. If, however, air from without is introduced behind the stoves and radiators, some of the objections are removed. The loss of heat by supplying air in this way is shown by Professor Woodbridge (8, p. 19). The method of supply-

Direct radiation not desirable.

ing fresh air in rooms where stoves are used and of constructing outgoing air ducts will be referred to later. Hot water as a means of heating is to be preferred to steam, for the reason that in moderate weather the heat can be better regulated by hot water than by steam, and that in very cold weather the air is not so likely to be overheated or "burned."*

Hot water as a means of heating.

The objections urged against heating by the hot-air furnace are: (1) An unequal distribution of the heat in the various parts of a large building and in the upper and lower parts of each room; (2) the production and dissemination of offensive gases; (3) the occasioning of dryness of the air, already referred to. Makers of modern furnaces have sought to overcome all these objections, and in some measure have been successful, so far as small buildings are concerned; but for large buildings the hot-air furnace is not to be recommended.

Objections to hot-air furnaces.

Perhaps the most unsatisfactory means of heating schoolrooms is the ordinary wood or coal stove, — the means most generally employed in country districts. To avoid the unequal distribution of heat in rooms heated in this way and to promote in some degree ventilation, the stove should be enclosed by a metallic jacket, the enclosed chamber being connected with the outer air by means of a shaft of sufficient size to admit the needed amount of air. In addition to this, flues should be so constructed as to carry away the vitiated air in sufficient quantity to keep the air of the room in good condition. To avoid radiation from overheated surfaces, two stoves should be provided for use on very cold days. A more detailed description of this method of heating and ventilation will be given later.

Jacketed stoves for heating and ventilation.

By far the best method of heating schoolrooms is by indirect radiation, by which coils of pipe are heated in chambers, from which the warmed air is taken into the rooms. This is done either by the plenum or by the gravity system, already referred to. On many accounts the plenum system is to be preferred, by which the warm air

Indirect radiation preferred.

* The burning or dry sensation, as explained by Kotelmann (1, p. 113), is frequently due to the scorching of dust particles which come in contact with overheated surfaces.

is forced into the rooms by fans propelled either by electric or water motors or by steam. But in the opinion of good judges this plan works best when the foul-air flues are heated so as to draw the air from the rooms, or when these flues are connected with exhaust fans. The only objection to the fan system is the first cost. When the system is once established, the cost of maintaining it is said to be less than the cost of maintaining a simple gravity system. This is especially true when the steam used in operating the fans is used for heating the rooms.

The fan system.

It is not necessary to give in detail the plans of heating and ventilating by the method just described. It is used now in most of the larger modern buildings, and its merits may be easily tested by actual observation. But there is a class of school buildings about the ventilation of which great difficulty is found. I refer to the large number of one and two room country schoolhouses which are now practically without any means of ventilation, and which are heated only by stoves. To show that the desired ends and means of ventilation may be attained to some degree of satisfaction even in these smaller school buildings, two plans of systems in actual use are briefly described. They are such as meet the approval of our State inspectors, the standard of which is given in the following statement, which is sent to towns and cities by the department of inspectors of factories, workshops and public buildings: —

The heating and ventilation of one and two room buildings.

In the ventilation of school buildings the many hundred examinations made by the inspectors of this department have shown that the following requirements can be easily complied with: —

1. That the apparatus will, with proper management, heat all the rooms, including the corridors, to 70° F. in any weather.

2. That, with the rooms at 70° and a difference of not less than 40° between the temperature of the outside air and that of the air entering the room at the warm-air inlet, the apparatus will supply at least 30 cubic feet of air per minute for each scholar accommodated in the rooms.

Standard of requirements made by the Massachusetts authorities.

3. That such supply of air will so circulate in the rooms that no uncomfortable draught will be felt, and that the difference in tem-

perature between any two points on the breathing plane in the occupied portion of a room will not exceed 3°.

4. That vitiated air in amount equal to the supply from the inlets will be removed through the ventiducts.

5. That the sanitary appliances will be so ventilated that no odors therefrom will be perceived in any portion of the building.

To secure the approval of this department of plans showing methods or systems of heating and ventilation, the above requirements must be guaranteed in the specifications accompanying the plans.

Among the various kinds of jacketed stoves in use there seem to be none giving more satisfactory results than that described by Dr. J. G. Pinkham of Lynn in the nineteenth annual report of the Massachusetts State Board of Health. Some modifications of the plan have been made since it was first adopted, but the main features of the apparatus are retained, such as are described in the following extract from Dr. Pinkham's report: —

Description of jacketed stoves such as are used in Lynn, Mass.

There are in each room two large stoves, one on each side of the room, near the front. Each stove is encased in a galvanized iron jacket about 6½ 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 4½ 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 *withe*, 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 30-inch tin pipe, running down beside the

stack, from the upper floor. The flue-heating stove is set about 3 feet above the lower floor, and access to it is had through an iron door opening into the schoolroom. 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.

Superintendent Bruce of Lynn reports that the stove as above described is in some of the two, four and six room buildings of Lynn, and that they "find it satisfactory, with intelligent and attentive regulation by teacher and janitor." He regards it as "a practicable scheme for a one-room country school." Superintendent Hobbs of Rockland, Mass., reports its use in one such school of that town as very satisfactory. Its cost, he reports, including stove, jacket, flues and stack heater, is less than two hundred dollars.

Small furnaces recommended for country schools.

Reports from the inspection department of the Massachusetts District Police seem to favor the use of small furnaces for one and two room buildings. The cost of them is said to be not more than most of the jacketed stoves in use, and they are in some respects more satisfactory. The following description of a furnace in use in Ayer, Mass., is taken from Inspector Moore's report of March, 1892: —

Description of small furnace used in Ayer, Mass.

The Washington Street school in this town is a frame building, containing four rooms, two on each floor. It was heated by wood stoves, and the air was, of course, bad. As there is no cellar under the building, the committee adopted the plan of heating by small portable furnaces, one in each room, open at the top like jacketed stoves.

The air is supplied to these furnaces through galvanized-iron pipes of a cross-sectional area of 4 feet each, with a well-arranged valve, in control of the teacher. Two brick chimneys, each 3 feet square inside, were built to carry off the vitiated air. The openings to these chimneys are direct from each room, and each has a net area of 5 square feet. A small oil stove is placed in each chimney, a little above the lower opening.

The result of an inspection made November 5 indicated excellent work. Although the day was mild and there was very little fire in the furnaces, I found the amount of air passing through the rooms to be very large. In the west room on the second floor the amount was 1,750 cubic feet per minute, and a smoke test showed the circulation to be very good. The air in all the rooms was free from odor, and the teachers expressed themselves as highly pleased with the ventilation. I understand the cost was about one hundred and seventy-five dollars a room.

Lighting.

The two chief considerations in reference to lighting schoolrooms are the amount of light and the direction from which it enters the room. In several European States the ratio of window surface to floor surface in schoolrooms is fixed by law, at 1 to 6 when the building stands free, and 1 to 4 when the light is obstructed by neighboring buildings (1, p. 47). In Prussia the least amount required is 1 to 5, — a ratio now generally accepted as the least amount of lighting surface schoolrooms should have. This amount should be increased if the light is obstructed by high buildings or trees. Many authorities agree with Dr. Cohn, that there cannot be too much light in a schoolroom (12, p. 99). The test of brightness certainly should be applied to places farthest away from the windows, and upon cloudy days. The standard usually recognized in Germany (4, p. 34) is that of a minimum brightness on dull days of 10 normal metre-candles, *i.e.*, of 10 spermaceti candles, 1 metre distant, each candle weighing 1/6 of a pound. Where photometric measurements cannot be made, Von Hoffman's method of testing the amount of light might be followed. He says that the light is insufficient when a normal eye cannot read the Snellen type No. 6 at a distance of 6 metres (4, p. 34). Other tests suggested by Dr. Burnham are to ascertain if every pupil can see some portion of the sky, or if every normally sighted pupil can, upon a cloudy day, read Diamond type at a distance of 30 centimetres.* Dr. Burnham further says: "The light in schoolrooms is very apt to be deficient, because officials do not realize that light diminishes, not as the distance, but as the

Ratio of window surface to floor surface.

The minimum of light needed.

Distance of seats from windows.

* This foot-note is printed in Diamond type.

square of the distance." It seems reasonable to place 20 feet as the greatest distance from which any pupil should be seated from a well-lighted window.

As to the direction from which the light should enter the schoolroom, authorities are divided. Professor Forster, Dr. Young (2, p. 261) and others urge that schoolrooms be so situated that no direct rays of the sun can enter them; while Dr. Cohn, Dr. Burgerstein (12, p.11) and many others advocate a southern exposure for the rooms. Perhaps a compromise may be made by having the room exposed to the sun's rays a small portion of the forenoon or afternoon. Dr. Kotelmann (1, p. 36) has this view, and says a southeast exposure is to be preferred. Again, there is some difference of opinion as to the proper direction of light in respect to the pupils at their seats. The weight of opinion, however, seems to favor admitting the light from the left of the pupils, or from the left and rear, provided the former light is the stronger. Nearly all authorities are agreed that lighting from both the left and right sides is not advisable. In no case should the light come to the pupils from the front. The windows should consist of large panes of glass of good quality. They should extend as near as possible to the top of the room, and be placed close together.

Direction from which light should enter the room.

Venetian blinds * and curtains of a dark color are not favored, on account of their obstruction to light. Fixtures should be used which will permit the curtain to be raised from the bottom, or so that it may be raised or lowered from the middle of the window, as circumstances require. It should be remembered, however, that the upper part of the window is much better for lighting purposes than the lower, and that it should not be covered by a curtain unless to shut out the direct rays of the sun.

Kind of curtains needed.

In rooms that are insufficiently lighted, the ceilings and walls should be light, but not dazzling. A light gray or green color for the walls is recommended by good authorities. The light of such rooms is increased and diffused by the use of prisms and reflectors. Hennig's daylight re-

Color of walls.

* Professor Forster (3, p. 55) and Dr. Kotelmann (1, p. 50) both condemn the use of Venetian blinds in schoolrooms. Dr. Kotelmann estimates that only .6 to 1.5 per cent. of the daylight passes through the slats inclined 45°.

flector is described by Kotelmann (1, p. 46) and commended by him. In our own country the products of the American Luxfer Prism Company of Chicago and New York have been in successful use in stores, factories and schoolrooms. From tests recently made in the Massachusetts Institute of Technology, under the direction of Mr. Charles L. Norton, the following conclusions were reached, as stated by Mr. Edward Atkinson: —

The use of prisms and reflectors for the diffusion of light.

First. — Windows of the customary height, but of one third the width commonly adopted, when glazed with ribbed or suitable prismatic glass, will give on a bright day as much effective light as the full width of window glazed with plane glass; on a cloudy day, or in a position where the light from the sky is derived from a limited area, even a greater ratio.

Second. — Windows of the common type now in mills, workshops or schoolrooms, now fitted with plane glass, if reglazed in the upper half only with ribbed or prismatic glass, will yield on a bright day more than fifty per cent. excess of effective light, or on dark days a larger ratio. If reglazed down to but not including the lower panes (in which we advise plane glass), the increase in effective light will be much greater.

Water-closets and Outbuildings.

In places where there are systems of sewerage and water supply, there ought not to be any difficulty in keeping the water-closets in a perfectly good condition. The problem of preventing an offensive and unsanitary condition of the premises is especially difficult in places where there is no water system for flushing and no sewers to carry off the refuse matter. Where there is a water supply without sewers, the temptation is to empty the refuse into cesspools. But this should not be done. The cesspool Professor Burrage regards as "one of the greatest of sanitary evils" (3, p. 60), and as "more dangerous than the badly constructed sewer." Where circumstances do not permit the erection of water-closets, or the ventilating, drying or fire closets (3, p. 61) which are now successfully used in many places, separate sanitaries must be provided, and cared for in ways which will prevent the dangers of infection or the

The danger of cesspools.

Drying closets.

annoyance of bad odors. To accomplish these ends, (1) the privies should be placed at a good distance from the school building; (2) the privy vault should be entirely above the surface of the ground, the catch-basin being constructed so as not to leak; (3) provision should be made for the storage of dry earth or sifted coal ashes, and for sprinkling the catch-basin daily with this material. "Nothing less commendable" than these accommodations for sanitaries, says Dr. Young (2, p. 253), "should be tolerated."

The dry-earth system.

Water Supply.

The purity of water supply for schools is no less important from the standpoint of health than that of the air supply. Under the laws of the State there seems to be ample protection from harm in the case of public water supplies. The greatest danger lies from the use of water taken from wells in remote country sections, and especially wells that are used only a portion of the year. Respecting these sources of water supply for schools Dr. Frank Wells says (26, p. 17): "During the vacations no water is taken from them, and hence it becomes stagnant. In the autumn, when the term commences, the water in this condition is drunk by the scholars, thereby, either alone or in connection with the unsanitary condition of the surroundings, tending to produce sickness, which may be wrongly attributed to the houses in which the children dwell."

The use of wells in country towns.

Unfortunately, the purity of water, unlike that of air, cannot be ascertained by simple tests (27, p. 80). The only safe course for school authorities appears to be to examine carefully the surrounding conditions, nearness to privy vaults, cesspool, drains, etc., and, if there are possible occasions of contamination, to call the aid of the State Board of Health or an expert analyst.

Examination of conditions advisable.

Baths.

The great use of baths in connection with the schools is becoming to be recognized, both on account of the means they afford for cleanliness and for the habit which frequent bathing

tends to form. School baths have been introduced in several cities of Germany, with great success. Dr. Burnham describes briefly the plan pursued in these cities, and further says (4, p. 38): "The reports from those schools where baths have been introduced are uniformly favorable. The bathing is usually voluntary, but it is generally approved by the parents. Some of the children have a sort of hydrophobia at first, but generally after a little time enjoy the bath. In Gottingen, after a half year, ninety per cent. of the pupils voluntarily shared in the school baths. The children return to their study refreshed in mind and body. There is an improvement in the air of the scholroom. It is maintained that the bath has an educating effect upon the children, in giving them a sense of cleanliness. Much stress is placed also upon the educating influence that the introduction of school baths has upon the parents, in making them care for the children's underclothing and the like. In many cases great improvement in the health of children has resulted from the habit of regular bathing."

School baths in Germany.

In Boston, one of the schools — the Paul Revere — is supplied with baths whose use is thus described by the principal, Mr. Dutton: "Since the baths have been opened, an average of one hundred and seventy-five pupils have had a bath every school day. This gives every pupil in the school over eight years of age an opportunity to bathe once a week. Ninety-five per cent. improve the privilege. The baths are in charge of a matron; each class is assigned a time to bathe, as they would for a recitation.

Baths in the Paul Revere School, Boston.

"The scheme works smoothly and beautifully, and is a blessing to the children physically, mentally and morally, and a blessing to the teachers, too. I am inclined to think that, if a child bathes once a week from eight to fourteen years of age, he will always seek to be clean and wholesome.

"The city furnishes towels and soap. The average expense thus far, per bath, has been about 3½ cents. I think and trust that the time is at hand when all of our schools will be equipped not only with shower baths but with swimming pools. As educational agents they cannot be surpassed."

The expense given above is much greater than that of the school baths in Germany, which are stated to be about one

fourth of a cent apiece. In Germany, however, "the pupils bathe by classes, the bathing is carefully supervised, pupils come in divisions like soldiers and follow each other every five minutes, and thus a large number of pupils bathe in a very short time" (4, p. 38).

Furniture and Furnishings.

Investigations have clearly shown that there is a close relation between certain physical deformities and wrong habits of sitting occasioned by continuously constrained and unhygienic positions in school. As a consequence, the importance of providing proper desks and seats in the interests of health is now generally recognized. The width, height and shape of the seat, the shape, height and slope of the desk, the distance between the seat and the desk and the difference between the height of the seat and that of the desk, are considerations which have received the close attention of specialists both in Europe and this country.* The following statements may be said to fairly summarize their conclusions. The height of the desk should be the distance from the sole of the foot to the knee, equal, according to careful estimates, from three elevenths to two sevenths of the height of the pupil. The width of the seat should be about three fourths of the length of the upper leg, or one fifth of the height of the pupil. It should be sloped gently backward, and its edge should be rounded. The back rest should be such as to give support to the back under the shoulders and above the hip bones. The distance from the front edge of the seat to a perpendicular dropped from the rear edge of the desk should be for writing a minus distance; that is, the edge of the desk should overlap the seat from one to two inches. For all other purposes the distance should be zero, but never plus. These conditions imply that either the top of the desk or the seat must be movable. The difference or perpendicular distance from the seat to the upper edge of the desk should be such that the pupil sitting erect can easily place his forearms upon the desk without changing the natural

Desirable features of desks and seats.

Height of desks and size of seats.

The distance from seat to desk.

Relative height of desk and seat.

* For the detailed records of investigations and conclusions of specialists see (12, p. 55; 1 p. 128; 2, p. 270).

position of the shoulders. Some authorities say that this distance should be about one sixth the height of the pupil. The slope of the desk should vary from that of about 30° for writing to that of about 45° for reading, which again implies a movable desk top.

Movable desk tops and seats.

The desirability of having some arrangement by which pupils may easily get into and out of their seats and stand in recitation is an added reason for providing more room between the desk and seat than is permitted by the above-mentioned measurements. Many inventions have been made to supply these needs, as well as to secure a varying slope of the desk top;* but, apart from the common hinged seat, few of them have as yet been adopted by American school furniture makers. Where the small seat is used there is less need of movable desk tops and seats than where the seat is long and is of uniform width, as it is generally in Germany. The minute studies from which the above general statements are derived were made with reference mainly to stationary desks and seats. A large number of measurements and estimates have been made, so as to ascertain the average size of the bodies of pupils for pupils of a given age. While the tables embodying these estimates are of great value to school authorities who desire to know the approximate sizes of desks and seats needed, they are of comparatively little value to those who secure for the schools adjustable seats and desks. Such furniture will come more and more into use, in spite of its increased cost over the stationary kind, as the necessity of a constant adjustment of the school seat and desk to the corresponding measurements of the child's body becomes obvious. While the measurements and directions above given are of special value to authorities who are selecting and putting down stationary desks and seats, they will also be found useful to those who are setting up and adapting to pupils the adjustable desks and seats. Some of these seats are constructed with reference to changing not only the height of the desks and seats but also the slope of the desk top.

Adjustable seats and desks.

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* A full description of these inventions in Germany is given by Burgerstein (12, p. 75) and by Kotelmann (1, p. 147). An interesting essay upon school seats, by Drs. Bradford and Stone, is printed in (13, p. 611).

Of school furniture, other than desks and seats, which should be selected on hygienic grounds, may be mentioned movable blackboards, crayons, erasers, outline maps and drinking cups.

The material to be preferred for a movable blackboard is natural slate, both because it can be erased with a moist cloth or eraser, and thus reduce the amount of dust raised, and also because it has not a shiny surface. Artificial applications that have not these objectionable features may be used. The dustless crayons are likely to raise less dust than the ordinary crayons, and for that reason are to be preferred; but when they are so hard as to give faint lines, they should be used sparingly. Crayon holders, especially for colored crayons, are recommended.

Movable blackboard and crayons.

Outline maps should be selected that have clearly drawn lines, and should be placed for use upon map stands in a good light and near to the pupils using them. Care also should be taken to select only those books for pupils' use which have clear and well-defined print, and whose pages have a plain, dull surface. This is especially important in the selection of text-books, or those books which are in constant use by the pupils. The best authorities advise for young children books printed from "Pica" or "Great Primer" type, and condemn, for pupils of any grade, the use of books printed from type smaller than "Long Primer."

Charts and text-books.

The following are illustrations of these types: —

Long Primer.

Pica.

Great Primer.

Much attention has been given of late to the dangers of the common use of drinking cups in school. To avoid all possible dangers of infection, either individual cups or the drinking fountain should be used. By the latter plan, pupils are enabled to drink from a constantly flowing jet of water rising three or four inches, thus avoiding all possible danger of contamination. The fountains are used with success in Boston (Roxbury), Mass., Webster, Mass., Plainfield, N. J., Asbury Park, N. J., and Westfield, N. J.

The common drinking cup.

The common use of penholders and pencils by the pupils, though less objectionable than the common use of drinking cups, is nevertheless to be avoided as far as possible. Each pupil of the schools of Springfield, Mass., is provided with his own penholder and pencil at the beginning of the year, as well as with a drinking cup.

The common use of penholders and pencils.

The Care of School Buildings and Appliances.

What has been said of the importance, from a hygienic point of view, of care in connection with ventilation, may be said with equal force of the school building in general. It should not be necessary to say that the schoolrooms should be kept as free from dirt and dust as good homes, and yet the fact is quite forgotten by many persons who have the management of schools.

In the first place, the thorough cleaning which every good housekeeper deems necessary for her home at least once a year should be done for the schoolhouse. A few days before the end of the summer vacation the floors should be thoroughly scrubbed and all other parts should be washed and wiped. The windows should be washed frequently.* During the school year the floors in all parts should be swept, or, if oiled, carefully wiped three times a week, the more exposed parts being brushed up daily. The rooms should be carefully dusted daily with a damp cloth. The sweeping and dusting should be done at such a time and in such a way as to leave no floating dust in the room while the school is in session. The best time and way of sweeping is after school at night, with open windows, the floors being sprinkled with damp sawdust. One method of allaying the dust in schoolrooms, to which much attention has been given recently, is that of oiling the floors. If the material is wisely selected and carefully put on, great good from a sanitary point of view will result. But the floors so treated must be wiped off frequently, to accomplish fully the desired results. Annoyance from oiled floors on account of their soiling dresses

The washing, sweeping and dusting of schoolhouses.

* Eulenberg and Bach (11, p. 544) say that the windows should be washed every month. When windows are washed, as they frequently are, only in July, they are likely to become dusty before the school begins in September. The better time for washing the windows is September or October.

will be slight, if too much oil is not used and the floor is frequently cleaned.*

The sanitaries need careful attention daily. Water-closets and urinals should be thoroughly flushed two or three times a day, and all traces of uncleanness be wiped away. Occasionally simple disinfectants and deodorizers, such as superphosphate and lime, should be sprinkled in the vaults and about the urinals; but it should be understood that nothing of this kind can take the place of a liberal application of water. In places where there is no plumbing, corrosive sublimate, bleaching powder or copperas may be used as a deodorizer.

The care of water-closets and urinals.

If the sanitary drinking fountain, such as has been referred to, is not used, or if individual drinking cups are not provided, the cups used for drinking should be washed frequently with hot water and soap. If the building is supplied with public water, the cups should stand under running water all the time during school hours. In some quarters the custom has prevailed of using each night sulpho-napthol in disinfecting the drinking cups. It has also been used about doors, hand rails and sanitaries.

Care of drinking cups.

One possible cause of infection is the common use of pencils, penholders, erasers, etc. This danger has been prevented to a large extent in Everett, Mass., by a simple means of disinfection devised by Dr. Whitehill of that city. It is thus described by Superintendent Condon: —

Disinfection apparatus.

> The danger of contagion through the distribution of pencils, penholders, drawing models and other articles which are used by several pupils, has long been recognized by the medical profession. We believe it has been left for a member of your board, Dr. G. E. Whitehill, to devise a simple, inexpensive and yet effective piece of apparatus for thoroughly disinfecting supplies of this kind. The apparatus consists of a tin chest, with a tightly fitting cover, in size 12 by 12 by 15 inches. In this is room for trays 1 inch in depth, with wooden sides, and the bottom covered with wire netting of a

* The desirability of keeping the schoolrooms free from dust, especially those rooms in which gymnastic exercises are given, is shown by a scientific treatment of the dangers of breathing dust, written by Dr. Schmidt and quoted by Dr. Young (2, p. 225).

small mesh. The bottom tray rests upon a narrow shelf at each end, having a space 2½ inches below the lowest tray. The other trays rest upon each other. In the free space at the bottom is kept a sponge saturated with formaldehyde. Each class room is supplied with a tray, and as the pencils, penholders, erasers or other articles are collected, they are placed in this tray, to be left over night in the tin chest. The formaline gas evaporates and comes in contact with all the articles in the different trays, destroying any germs which may have adhered to them.

The danger from infection is partially met in the recommendations of the Marlborough, Mass., board of health: (1) That the teachers in the schools shall require each pupil to keep and use his own individual books and school apparatus, desk and chair in the schoolroom, and hook for outside clothing; (2) that only such apparatus be used in the schools as can be thoroughly cleansed and disinfected by being dipped in boiling water; (3) that the drinking dippers in the school buildings be boiled as often as once a week.

Rules for avoiding infection.

Next in importance to providing windows and shades of the right kind in schoolrooms, is the proper care of them. The windows should be kept clean by frequent washing and wiping, and the curtains should be so managed that all the pupils may receive the most and best light that the windows will afford. It is safe to say that in a majority of rooms whose windows are furnished with curtains the latter injunction is not followed. The curtains generally are drawn from the top, and in far too many rooms they cover during the entire day — and sometimes during cloudy days — the upper third or half of every window. Sometimes also the curtains upon windows placed in front of the pupils are not drawn, while much work is required to be copied from blackboards situated between two windows. There can be little wonder at the large number of pupils in the middle and higher grades having diseased eyes, when the prevailing conditions and practice in the schools are considered. In almost every one of the scores of investigations which have been made within ten years in Europe and America the results were most alarming, — from twenty to

The use and abuse of curtains.

The number of pupils having defective sight.

sixty per cent. of children in the elementary schools having defective sight, and even a higher percentage in high schools.* Some investigations have shown that, while many cases of impaired sight may be traced to inheritance, a large percentage of cases is directly due to an overstrain of the eyes in school.† Teachers should constantly guard themselves against requiring written work to be done during cloudy days, especially during the last hour of the day. Upon very dark days very little reading or study should be required. In schools which have more than one grade there should be at such times oral and general exercises for all the pupils.

Exercises on dark days.

In no respect are complaints of neglect more frequently heard from superintendents than in connection with the care of the heating and ventilating apparatus. In rooms heated by stoves it is not uncommon to find the temperature below 60° during the first hour of the morning session, because the fire was built late, and 75° or 80° later in the day. The all too small aperture for letting out the impure air is frequently closed by janitors, and allowed to remain closed by careless teachers. Even the best apparatus for heating and ventilation does not escape the results of carelessness and ignorance. The stack heater for the exhaust flue frequently remains unused for days and weeks together, simply to save coal or kerosene, or possibly a little trouble. Janitors are inclined to close the fresh-air inlets in cold weather, and permit air to enter from the basement, with the result of having the air circulate through the schoolrooms and water-closets in common. So many and various are the ways of neglecting the ventilating apparatus, that nothing short of a complete automatic attachment will suffice to keep the room unfailingly at the desired temperature of 68°.

The care of the heating and ventilating apparatus.

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* For details of some investigations, see (3, p. 151; 1, p. 241; 2, p. 100; 12, p. 353; 4, p. 7).

† Dr. Kotelmann cites several instances (1, p. 112) in which great differences in the soundness of pupils' eyes were shown to be due to differences of school conditions and requirements. In one case the percentage of myopia had in eight years decreased three to fifty per cent. in the various rooms of a high school whose hygienic conditions had been improved.

Composition and Adjustment of the School Program.

Thus far, among hygienic conditions for which school authorities are alone responsible, I have referred only to those of an external kind. Other conditions of the same class affecting the health of pupils are those which relate to the composition and adjustment of the school program. These will be treated briefly under the following heads: (1) course of studies, (2) daily program and instruction, (3) intermissions, (4) school sessions, (5) length of recitation, and (6) amount of work required of pupils.

Course of Studies. — It is easy enough to say that the school program should have such an extent, variety and arrangement of studies as will conduce to the physical as well as mental well-being of all the pupils; to make and apply such a program is quite a different matter. The difficulty of arranging a course of studies suited to all is realized when it is known that all pupils, the bright and the dull, the strong and the weak, should have enough provided for them fully to tax their powers without injury either to the body or to the mind. The task, however, of laying out a general course of studies is considerably lessened if it is kept in mind that the adaptation of subjects to pupils lies largely with the teacher. To give her sufficient freedom in this regard, the course which she has as a guide must be general and elastic; that is, it must be such that the work required of pupils will be subject to conditions of temperament, health and outside demands, as well as to those of intellectual ability. So important is this principle of adaptation, and such is the difference in pupils, that, if the requirements of any course of studies prevent one pupil from doing much more than what another pupil of the same class will be able to do, or if they force one pupil to do much less than what another pupil of the same class ought to do, they are not what they should be. Again, the importance of protecting the children during the transition period from the kindergarten to the school or from the home to the school should be recognized by giving a large proportion of observa-

Difficulty of arranging a course of studies suited to all.

An elastic course needed.

The adaptation of work to the needs of individual pupils.

tion, manual and physical exercises during the first year or two of the course.*

It is well known that it is not so much the amount of work that one has to do as the worry occasioned in doing it that causes physical and mental collapse. And so it is not so much the number of studies, or even the amount of work given to them, as the strain of anxiety in preparing for examinations, and fear of not being promoted, that most injures the pupils. So far as the course of studies has to do with these occasions of exhaustion and ill health, it should be made so as to protect both teachers and pupils from possible excesses or mistakes.†

Anxiety attending examinations and promotions.

In the interests of health, there should be a liberal allowance of time provided in the course of studies for physical and manual exercises ‡ and for instruction in physiology and hygiene. The amount to be done in these subjects and the place in the program they should take will be referred to later.

Allowance of time for physical training.

The course of studies of the larger cities should make provision for all defective or weak-minded children that are not provided for by the State, giving the utmost freedom and opportunity to teachers of small classes to adapt the work to the needs and capacity of individual pupils. Of this class of children Dr. Lincoln (16, p. 83) writes: "Outside of the class returned in statistics as feeble-minded, there exists a much larger class (perhaps five in a thousand) of 'backward' children, a type with which all primary teachers are familiar, who are so deficient as to be incapable of profiting by ordinary school methods. They constitute a distinct type, differing from the grosser types only in degree of defect; they display all the cardinal features of imbecility in a lesser degree. Few classes are without some specimen, hopeless

Treatment of defectives.

Special classes for weak-minded children.

* The reasons for limiting the formal work of the first year in school and a detailed plan of exercises for that year are given in the sixty-second annual report of the Massachusetts Board of Education, pp. 409-413.

† Matters of grading and promotions of pupils are discussed in the sixty-first report of the Massachusetts Board of Education, pp. 297-314; also in (13, pp. 303-356).

‡ For a careful estimate of the proper proportion of time which should be given to drawing, manual training and singing, see pp. 457-479 of the sixtieth report of the Massachusetts Board of Education.

under existing conditions, yet fondled and defended by parental love, which can see no inferiority in its own offspring. A movement for the education of these children in special classes under trained inspectors has just begun in the United States, which up to the present includes the cities of Providence, Worcester, Springfield, Boston, Philadelphia and Chicago." The children here referred to belong to what has been called the "abnormally deficient" class, — a class separate and distinct from the class consisting of merely dull children of normal type. These children should also have special provision made for them, not only on account of the better progress they will make in their studies, but also on account of the desirability of preventing tendencies to moral and physical degeneracy. In many places, at present, small ungraded classes are formed for the benefit of children who are slow, or who for other reasons need individual attention. Such classes generally consist of not more than twenty pupils, and the work done is mainly with individual pupils. Transfers are constantly made to and from the class, as occasion demands.

Special treatment of dull children.

Daily Program and Instruction. — There is a feeling abroad, occasionally expressed by physicians and newspaper writers, that there is "over-pressure" in the schools to such an extent that many children are falling by the way and made invalids for life. There is another feeling abroad, expressed quite frequently by opponents of the "new education," that teachers are doing too much for their pupils, and are thereby helping to create a race of degenerates, — "soft pedagogics" is the term sometimes given to designate the process. Widely divergent as are these criticisms of present practice in the schools, there is perhaps enough truth in both charges to put teachers on their guard in respect to the demands they make upon their pupils. Viewing the matter solely from the standpoint of health, we may agree that hard intellectual work *of the right kind*, done within proper limits of time, can in no way be injurious to children. It must be as healthful for them to exercise the brain actively as it is for them to exercise the legs actively. It is not hard work that is harmful or repugnant to

Opinions relating to "over-pressure."

Hard intellectual work no injury.

the normal child so much as work which is not suited to his needs and powers. Of course a discrimination must be made between the natural tendencies of the child and those tendencies which have been imposed upon him. The former may lead and point the way of the best training, while the latter may indicate the course to be resisted.

What is needed for health's sake is not necessarily to lessen the work of children, but to lead them to work in such a way and at such times that the largest results in mental strength and alertness will be gained with the least fatigue. This is not done by carrying on the same subject or kind of work too long at a time, or by giving work that is uninteresting. The duration of effort is not always the measure of fatigue attending it, and neither time nor fatigue necessarily determines the amount or intensity of effort exerted. There is some study which cheers and invigorates, while there is other study which palls upon the mind and wearies it to the point of stagnation. No one will say that the former study, although alert and active, is nearly as harmful physically as the latter. The two states of mind needed for the physical as well as for the mental well-being of pupils are interest and freshness; the former depending largely upon the subject and the way it is presented, and the latter upon the times in which the recitation or study is carried on.

The problem not less work but less fatigue.

Interest and freshness necessary to best work.

One means of determining the proper place and order of recitations in the day's program is the condition of the pupils in respect to fatigue. While work of any kind must be accompanied by fatigue, and while fatigue in itself is not harmful (17, p. 144), it becomes harmful when long-continued or heavy demands are made upon the mind which lead to exhaustion and disease. Both experience and fatigue studies have shown that the branches of study which most tax the mind should be given in the early part of the day, while the children's minds are rested, and that those which make the least demands should be given later. The subjects upon good authority which are most fatiguing are mathematics and foreign languages, and those which are least fatiguing are singing and drawing (18, p. 81). If the school day of five

Fatigue harmful when long continued.

hours is divided into two sessions, it would seem best to have a three-hours session in the forenoon, occupied by recitations and study that are most taxing to the pupils; and a two-hours session in the afternoon, occupied by singing, games and manual exercises. What has been said of the desirability of placing the most taxing recitations early in the day will apply to written examinations which have been found to be very fatiguing.*

Order of day's program.

Intermissions. — Results of investigations have shown that the time of the short recess and even that of the long noon intermission is not long enough fully to rest the pupils; that is, at the beginning of the period after the intermission the available strength for mental work is not as great as at the beginning of the morning session. The extended scientific observations of Burgerstein in Germany (12, p. 237) and of Key in Sweden (1, p. 227) all go to prove that a liberal allowance should be made for intermissions during the school day, — an allowance even greater than is made in Germany,† and far greater than is made in any of our American schools. Thus Kraeplin (1, p. 194) says that recesses should be longer than they generally are, and should follow one another at shorter intervals; and Kotelmann (1, p. 195) approves the program proposed by Hakonson-Hansens, in which, in a six-hour school day, from 8 A.M. to 2 P.M., there are six intermissions, — five of ten minutes each and one of twenty minutes.

A liberal allowance for intermissions.

These recommendations, based upon the most careful investigations and the almost universal practice of German schools, may well lead us to question the wisdom of our school authorities in limiting the time of recesses as much as they do. Especially should they attract the attention of those who are inclined to abolish the recess altogether, or to substitute, for the games of the old-fashioned recess, gymnastic exercises. More will be said upon the subject, when the general hygienic treatment of pupils is discussed.

Present practice in America.

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* Dr. Newsholme and others (28, p. 66) would diminish fatigue by change of subjects; alternating language or history with mathematics, and mentally fatiguing subjects with penmanship or manual training.

† In Prussian secondary schools the total time given to intermissions daily must be not less than forty and not more than forty-five minutes. In Bavaria the same class of schools are obliged to have a recess of ten minutes every hour.

School Sessions. — As to the desirability of having two school sessions or one in the day, there is, as there well may be, a difference of opinion, for there are good reasons as well as objections that may be urged upon either side of the question. The arguments usually given in favor of the single session are: (1) the shortness of the days in winter, and consequent limited period of daylight; (2) the saving of an extra walk to and from school; (3) the greater opportunity for needed recreation in the way of games, excursions, etc. The arguments opposed to the single session and in favor of the double one are: (1) There is less danger from over-exhaustion, when there is an entire break of one or two hours in the work of the day, than when the work is continuous or when it is interrupted by only a recess of twenty or thirty minutes; (2) there is more likelihood of a good breakfast and dinner being eaten under the two-session plan than in the one. If the above-named arguments fairly represent all that can be said upon both sides, it will be admitted that for hygienic reasons the two sessions should be preferred. This, however, does not in any way imply that the single session may not be so managed as to conform thoroughly to the best hygienic rules; as, for instance, if pauses of ten minutes are given for recreation at the close of every recitation and study period, and if hot soup or some other nutritious food is supplied the pupils in a half-hour intermission.

Arguments for and against the single session.

Length of Recitation. — There is substantial agreement among specialists as to the proper length of the recitation and study period. This agreement is summarized in the following statement, made by Dr. Rowe (18, p. 167): "The longest period which a child of five to seven years should be expected to have for a given exercise should not exceed fifteen minutes. For a child of seven to ten years, it should not exceed twenty minutes; for a child from ten to twelve, not over twenty-five; and from twelve to sixteen, not more than thirty. These figures have been approved both by experiment and experience. They are maxima for all confining exercises."

Periods of study and recitation.

Amount of Work required of Pupils. — European and American standards of what should be required of pupils differ con-

siderably both in theory and in practice. Dr. Kotelmann points out (1, p. 212) that in the Prussian and Bavarian secondary schools from six to twelve hours a week of home study is required from pupils of the lower classes, and from twelve to eighteen hours of such study from pupils of the upper classes. Some of the secondary schools of other parts of Germany make even more severe requirements than these. The requirements of the people's schools are doubtless less than are those of the secondary schools; but it is safe to assume that the older pupils of the former schools have not less than twelve hours of home work weekly. When it is considered that the number of hours a week in which the schools are in session in January is at least twenty per cent. more than our schools require, we can appreciate the enormous pressure that is put upon the pupils there. The specialists in hygiene recommend that the requirements of home study be lessened, as is shown by the following tables, the first being the recommendations of the expert commission for the secondary schools of Elsass-Lothringen (1, p. 213), and the second the recommendations of Dr. Key, as quoted by Dr. Burgerstein (12, p. 289): —

Requirements of home study in Germany.

TABLE I. — *Showing the maximum hours per week recommended for school instruction and home study by the expert commission for the secondary schools of Elsass-Lothringen.*

AGE.	Class.	SCHOOL INSTRUCTION.				Home work.
		Studies.	Singing.	Gymnastics.	Total.	
7, 8, ...	IX., VIII.	18	$\frac{2}{2}$	$\frac{4}{2}-\frac{5}{2}$	$21-21\frac{1}{2}$	$\frac{6}{2}$
9, ...	VII.	20	$\frac{2}{2}$	$\frac{4}{2}-\frac{5}{2}$	$23-23\frac{1}{2}$	$5-6$
10, 11, . . .	VI., V.	24	2	$2-3$	$28-29$	8
12, 13, 14, . . .	IV., III.	26	2	2	30	12
15, 16, 17, 18, . .	II., I.	30	2	2	34	$12-18$

TABLE II. — *Showing the number of hours per week recommended by Dr. Key for school instruction and home study.*

AGE.	WHOLE NUMBER OF HOURS' WORK REQUIRED WEEKLY, INCLUDING SINGING AND GYMNASTICS.		NUMBER OF HOURS WEEKLY REQUIRED FOR —		NUMBER OF HOURS OF HOME STUDY —	
	In the school and home.	In the school alone.	Singing.	Gymnastics.	Weekly.	Daily.
7, . . .	12 — 18	12 — 18	1	2	-	-
8, . . .	18 — 24	15 — 21	1	2	3	½
9, . . .	24 — 30	18 — 24	1	3	6	1
10, 11, . .	36	29	2	3	7	1⅙
12, 13, . .	42	32	2	3	10	1⅔
14, . . .	48	35	2	3	13	2⅙
15, 16, . .	51	35	2	3	16	2⅔
17, 18, . .	54	35	2	3	19	3⅙

American practice varies greatly, but it is doubtful if the requirements of any school are as great as those recommended above. Practice in the best schools at present seems to favor a short divided period of three hours' attendance for the younger pupils, and an attendance of five or five and one half hours for the older pupils. This amount of time spent in school, with a well-arranged program, having the proper number of manual and physical exercises and recesses, ought not to be harmful to any well child. But the proper length of a school day cannot be considered apart from the requirements of home study. The time given above ought to be all the time needed for study by pupils below the seventh grade, upon the assumption that children are admitted to school at five years of age, and that there are nine grades below the high school. The maximum amount of home study for pupils of the seventh grade might be half an hour daily, and for pupils of the eighth and ninth grades from one hour to one and one half hours daily. For pupils of the high school the maximum amount of home study daily might be extended to two and three hours. These figures are given upon the assumption that no study of any kind shall be

Requirements of study in America.

The maximum amount of home study which should be required.

required or permitted at recess or after school. The following table embodies the suggestions which I have made as to a proper amount of school and home study. It will be seen that the requirements are far less severe than those recommended by Dr. Key, but it is believed that they more nearly fit American conditions than his do.

School and home study.

GRADE OR YEAR IN SCHOOL.	NUMBER OF HOURS WEEKLY GIVEN TO—					
	School attendance (including recesses).	Recesses and gymnastics.	Singing.	Recitation and study in school (*not* including gymnastics and singing).	STUDY AT HOME.	
					Minimum.	Maximum.
1, ...	15	2	1	11½	-	-
2, ...	20	2	1	15½	-	-
3, ...	27½	2½	1	22	-	-
4, ...	27½	2½	1	22	-	-
5, ...	27½	2½	1	22	-	-
6, ...	27½	2½	1	22	-	-
7, ...	27½	2½	1	22	1¼	2½
8, ...	27½	2½	1	22	2½	5
9, ...	27½	2½	1	22	5	7½
10, ...	25	2	1	20	7½	10
11, ...	25	2	1	20	10	12½
12, ...	25	2	1	20	10	15
13, ...	25	2	1	20	10	15

The recommendations contained in the above table are made with confidence, since they agree with the practice of the most carefully managed American schools. Of course, it is understood that the amount of time indicated for home study is intended only for those pupils who are well. The time given is subject to change for those who for any reason cannot do the full work of the school without impairment of health. If children have to practice upon the piano one or two hours daily, or if by fulfilment of social functions they are unable to meet all the requirements of the school, they should stand precisely where the weak-bodied pupils do in relation to the school. Neither class is to

The requirements to meet existing conditions.

blame for the obstructing conditions, and neither class should be made to suffer by too great exactions. But it should be understood that under such circumstances the work of a class or year is incomplete, and must be made up before full credit is given.

In one respect the recommendations of requirements above given differ from the requirements usually made, and that is in reference to the amount of home study. Two standards are set, one for the least amount of time which should be spent in study, and one for the greatest amount of time so spent. These separate standards of requirements are fixed in the belief that the bodily as well as the intellectual welfare of pupils is enhanced by an accommodation of demands to ability. The ordinary practice is to state one period of time for home study, which is supposed to be the time suited to the "average pupil." The result is that some of the pupils far exceed the amount named, while others stop far short of it. Both classes of pupils may be injured, one from doing too much and the other from doing too little. The placing of a minimum for home study means that the bright pupils must not be deprived of the advantage of a certain amount of strenuous effort. The maximum limit is placed for the benefit of that class of pupils — generally girls — who conscientiously do more than is required of them, and who, for the sake of their health, need the restraint of a fixed standard of time for study, beyond which they shall not be permitted to go.

Minimum and maximum requirements to be made.

Outside Conditions.

In tracing the causes of ill health among school children, no one will deny that there are likely to be some causes for which the school authorities ought not to be held responsible. When we consider the close connection between one's state of health and one's habits in respect to eating and sleeping, and when, further, we consider the extent of control which the parents have or ought to have over their children in these respects, we cannot leave the influences of the home out of consideration in any treatment of the health of school children. This consideration is all the more imperative on account of the fact that the school must take the child as it

Private lessons and social diversions.

finds him, and must in the interests of the child conform to all the conditions imposed upon him from without. If his strength is given largely to private lessons or social diversions, or if his system is weakened by insufficient sleep or nourishment, there must be a certain degree of conformity of opportunity and demands to his impaired powers. The conditions cannot be fully met by the teacher without a knowledge of the child's impaired abilities and the occasions of them. A wise conformity to conditions means more than a mere acceptance of them and adaptation of the school program to fit them; it involves an effort on the part of the teacher to remedy as far as possible the faults which obstruct the work of the school.

Causes of physical and mental weakness.

The causes of physical and mental weakness for which parents and pupils are responsible have already been hinted at. They are want of attention to diet and sleep, social diversions, uncleanliness and other bad personal habits. It is vain to suppose that these obstructive conditions can be fully controlled by the teacher, or even appreciably so, in a large number of cases. It is hoped, however, that every teacher will make an effort to urge upon parents and pupils alike the importance (1) of a large amount of restful sleep every night,* (2) of a sufficient diet of nutritious food taken at proper times,† (3) of abundant recreations that will invigorate and refresh both body and mind, (4) of a careful

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* Dr. Key, who has given much attention to the subject, says that children from seven to nine years of age need eleven hours of sleep daily, that children from ten to thirteen years of age need ten or eleven hours, and that children beyond this age up to eighteen need from eight and one half to nine and one half hours (12, p. 289). He found in his investigations in Stockholm that those pupils who had an insufficient amount of sleep had from five to eight per cent. more sickness than their schoolmates who had sufficient sleep. Dr. Dukes (23, p. 124) would allow the following number of hours per night for sleep: children five years of age, thirteen and one half; six, thirteen; seven, twelve and one half; eight, twelve; nine, eleven and one half; ten, eleven; eleven, ten and one half; twelve and thirteen, ten; fourteen, nine and one half; fifteen and sixteen, nine; from seventeen to nineteen, eight and one half.

† The attention of parents and pupils should be especially called to the importance of eating a substantial breakfast, and of taking plenty of time for it. This advice is particularly needed for pupils of high schools, who frequently are found attending a five-hours school session after a hasty and insufficient breakfast. School luncheons should also be made a subject of careful attention. In many places food of a very nutritious kind and at little cost is provided at recess by the school authorities or by some one authorized by them. Dr. Newsholme (28, p. 96) recommends the giving of penny dinners, such as are given in some of the London Board Schools. He also recommends giving to each child in the poorer districts a mug of milk and slice of bread before the morning's work begins.

attention to cleanliness by frequently brushing the teeth and bathing the body, and (5) of pure personal habits which will in no way injure the body or debase the mind.

To be successful in checking the evils of bad personal habits among boys, such as the use of tobacco and secret vice, demands the utmost efforts of teachers, who first of all must realize their prevalence and the enormous injury done by them to the body and mind. While the chief reliance for success must be made upon constructive lines, such as giving the pupils instruction in physiology, and leading them into good habits of industry, the preventive and personal means must not be neglected, in which courage and tact will be required. For the fullest success in many cases, the co-operation of parents will be needed.

Bad personal habits among boys.

Dr. Burgerstein (21, p. 257) urges the great need of a systematic effort to spread hygienic knowledge among the people. The means recommended are as follows: distribution of brief tracts, courses in normal schools and secondary schools, university extension lectures, associations, popular lectures, reading rooms, portable exhibits.

Instruction for the people in hygiene.

Some superintendents have found it useful to send to parents at the beginning of the year a printed letter or circular, giving a few suggestions relating to the habits and health of the children. An example of what is needful for parents to know is shown in the following letter, prepared by Dr. Wm. H. Maxwell, and sent to the parents of all the pupils in Brooklyn when he was superintendent of the schools of that city. It follows, in the same circular, a letter addressed to teachers respecting the requirements they should make of the pupils.

A circular letter to parents concerning the habits and health of children.

To Parents.

1. The health of your children is paramount to every other consideration. When children, particularly girls, between the ages of ten and seventeen, exhibit evidence of nervous disorder, such as twitching of the face and hands, or extreme irritability, it is a sure sign either that the school work is too severe, or that they are not living under proper hygienic conditions, or both. In all such cases school work should be either materially lessened or be intermitted until there is a restoration to health.

2. In the majority of cases, to conquer the difficulties of arithmetic and grammar or the intricacies of a new language is harder work for the child than are, for the business or professional man, his every-day avocations. Hence, children need constant care, sympathy and encouragement.

3. Children should spend not less than two hours every day in the open air, and, if possible, should engage in games requiring both skill and activity.

4. Children should spend at least twenty minutes every day in practising at home the gymnastic exercises they learn at school.

5. Children should not be permitted to attend social parties or public meetings or entertainments on evenings preceding school days.

6. Children should spend in sleep not less than nine, and, if possible, ten, hours out of every twenty-four.

7. The following practices should be prohibited, as being injurious to health: study before partaking of food in the morning; the rapid reading of lessons just before the beginning of a school session; study during the noon intermission; study immediately after the close of school, before mind and body have been rested by play or other suitable change of occupation; study immediately after eating a hearty meal.

8. When children study or read either by sunlight or by artificial light, care should be taken that the light is sufficient, and that it falls upon the page from the left.

9. Children should have fixed hours for study, never exceeding the time specified in the rule of the Board of Education, and nothing should be permitted to interfere with these hours of study.

10. When parents find that their children, after conscientious effort, cannot accomplish the work assigned by the teacher in the time specified in the rule, they should at once communicate the fact to the principal of the school, and ask diminution of the tasks assigned.

11. Parents should never urge children to make extra efforts to obtain promotion, nor show annoyance if they fail to obtain promotion. What children need for intellectual and moral progress is systematic, not spasmodic, work. If, for any good reason, a child is not promoted or graduated at the end of a term, he should not be reprimanded, but encouraged to try again. Nor should parents, by finding fault with the teacher, weaken her influence for good.

12. Cigarette smoking by growing boys is dangerous alike to the physical, the intellectual and the moral well-being. Parents cannot be too vigilant in preventing their sons, who have not yet reached maturity, from using tobacco in any form, and particularly in that of the cigarette.

Inspection and Supervision.

In what has been said thus far it has been assumed that all the circumstances relating to the health of pupils should be known by the school officials, and that no adverse conditions be allowed to exist. The hygienic conditions of the school relate, as we have seen, to the location, construction and plan of buildings, school equipment, and the composition and adjustment of the school program. The effects of adverse conditions must also be recognized before they can be properly prevented or treated. It is hardly supposable that all these circumstances and the means of correction can be fully known and understood by the teachers in charge. It is desirable, therefore, that they shall have such professional assistance or advice as will enable them to correct existing faults and to prevent disease and contagion.

Professional advice and assistance.

The circumstances concerning which advice and assistance will be most needed are those relating to the ventilation and lighting of the schoolroom, the desks and seats, the amount and kind of mental and physical exercises needed to keep the pupils in good physical health, the detection of incipient forms of disease, and the method of treating each pupil not in a normal condition of body or mind.

The most apparent need of advice is in the detection of the first stages of contagious diseases, such as diphtheria, scarlet-fever and measles. The laws of Massachusetts provide for the careful exclusion of all pupils from school who are sick with or who have been exposed to infectious diseases; * but a careful observance of this law cannot prevent the spread of disease which appears in such incipient form as to escape the detection of parents and teachers. What is needed, for the sake of the community as well as of the persons afflicted, is some form of inspection which will keep from the school all pupils from whom there is any danger of contagion. This is accomplished to a very satisfactory degree in so-called medical inspection, which is carried on in New York, Boston, Cambridge and several other American cities.

Medical inspection of schools.

* Chapter 496, section 11, Acts of 1898.

The plan which has been followed in Boston for the past six years is as follows: By a special arrangement with the school committee, inspectors are appointed by the board of health to visit each day all the schools soon after the opening of the morning session. If any of the children appear not well, they are examined by the inspector; and if he finds any child with symptoms of an infectious disease, he exercises his authority as agent of the board of health and orders the child to be sent home. He at once reports the case to the board of health, and follows it up, seeing to it that the child is either properly isolated or sent to the hospital. Later, he makes another visit, to see if all danger of infection has ceased.

Plan of medical inspection in Boston.

If a child is found to be ill, but without symptoms of an infectious disease, "the teacher is advised to send the child home, with a message, written or oral, as may seem best, stating what the trouble may be, and suggesting, if medical care seems to be needed, that the family physician be called." Further particulars and results of the plan are given in Superintendent Seaver's report for March, 1900 (19, p. 38).* It is entirely feasible for any city or town to follow the plan above indicated. Some idea of the cost will be gained from the following statement of Dr. Durgin, chairman of the Boston board of health (21, p. 1500): "The board of health divided the city into fifty districts, giving an average of about four schoolhouses and 1,400 pupils to each district. No difficulty was experienced in finding well-qualified and discreet physicians who would undertake the duties prescribed, and the board secured and appointed one physician for each district, with a salary of two hundred dollars a year."

The laws of the State of New Jersey (chapter 96, article XXX., of the laws of 1900) provide that any local board of education may employ a competent physician, who shall visit the schools at stated times and examine pupils referred to him by the teachers, and "at least once during each school year examine every pupil, to

Medical inspection of schools in New Jersey.

* Plans of general medical inspection are contained in the report of the board of school visitors, Hartford, Conn., March 31, 1900; also in (5, p. 17; 9, p. 54; 21, p. 1489). The last-named reference has accounts of inspection plans and results in Massachusetts, New York, Philadelphia, Berlin and Paris.

learn whether any physical defect exists, and keep a record from year to year of the growth and development of such pupil, which record shall be the property of the board of education, and shall be delivered by said medical inspector to his successor in office." The law further provides that he "shall lecture before the teachers at such times as may be designated by the board of education, instructing them concerning the methods employed to detect the first signs of communicable disease, and the recognized measures for the promotion of health and prevention of disease."

The above law provides for one form of medical inspection which has been adopted with success in several cities and towns, and that is inspection of the sight and hearing of pupils. As would be expected, the results of investigations differ as to the percentage of pupils having defective sight and hearing, depending upon the age of pupils, conditions under which pupils have used their eyes, and the character of the examination. Tests recently made in the suburban towns of Milton, Wellesley and Brookline show that there are under the most favorable circumstances a large number of pupils who are suffering from defective sight.

Inspection of sight and hearing.

In Milton the eyes of 709 children were examined by an oculist, Dr. L. W. Mansur of Boston, for the purpose of ascertaining what pupils needed glasses. As a result of the examination, 195 pupils, or a little less than one third of the whole number, were recommended for further examination for glasses, 13 of the pupils having myopia and 108 astigmatism.

Examination in Milton, Mass.

In Wellesley the examination covered a period of three and a half months, the oculist, Dr. David W. Wells of Boston, devoting about eight hours a week, and an assistant working all the time the schools were in session. The purpose of the examination was to ascertain the condition of the sight and hearing of each pupil, and to point out those who needed treatment. The following table gives the result of the examination: —

Results of examination in Wellesley, Mass.

	Number examined.	Average age (years).	Normal.	Far sight and far-sighted astigmatism.	Near sight and near-sighted astigmatism.	One eye far-sighted, one near-sighted.
Primary, . .	318	7	47	228	25	18
Intermediate, .	176	11	47	103	15	14
Grammar, . .	93	13	23	50	12	8
High, . . .	98	15	23	53	12	10
Total, . .	685	14	140	434	64	50

	Per cent.
Need treatment on account of defective vision, ...	23
Need treatment on account of unbalanced muscles, . . .	3
Need treatment on account of disease, ...	4
May need treatment later on account of astigmatism, marked difference in the two eyes, or unbalanced muscles, . . .	20
Color blind, — all males, ...	2
Normal vision in both eyes, ...	30
Normal hearing in both ears, ...	89
Defective hearing, ...	2

("Defective" means: vision, .7 or less; hearing, 36.5 or less.)

Of the 685 pupils examined, 434, or 63 per cent., had far sight and far-sighted astigmatism; 64, or 9 per cent., had near sight and near-sighted astigmatism.

Testing of pupils' eyes in Everett, Mass.

In Everett material was furnished the principals for testing the eyes of all the pupils above the second grade.* From the tests given it was shown that, of the 2,345 pupils examined, 1,167 had perfect vision in both eyes. Of the others, 539 were advised to consult an oculist, 252 being fitted with glasses, or receiving other treatment which resulted in permanent improvement.

The above-mentioned tests probably show better results than could be found in most places, for in all the three towns the conditions were exceptionally favorable. Yet enough is shown in the tests to warrant their being made in every school at least once a year. Dr. Risley says:† "The skilful correction of the errors of refraction in our children's eyes by glasses would go

Dr. Risley's advice respecting care of eyes.

* The materials furnished were the regular line of cards used by opticians in ascertaining the range of vision. The tests were all made by the principals, under the direction of a competent physician, who held several meetings and gave them minute instructions for making the tests and recording results.

† Norris and Oliver's System of Diseases of the Eye, Vol. II., p. 417.

far to arrest the acquisition of near sight and its attending pathological conditions." He strongly advises that children be examined upon their entrance to school, saying that, if the eyes of the children were properly attended to at that time, less complaint would be heard of the harmful influence of schools upon them.

Great as are the direct benefits derived by the tests of sight and hearing, they are not the only ones. Teachers see, after such tests, as they never have seen before, the reasons for poor work or apparent dulness of certain pupils. Moreover, a knowledge of the weakness of pupils leads the teachers to a more intelligent accommodation of the work.

Indirect benefits of tests.

It will be seen that two of the three tests spoken of above were made by the principals and teachers, under the direction of competent persons. This, at least, any town or city can do.

Dr. Allport of Chicago, who has directed the examination of the eyes and ears of public school children in Chicago and Minneapolis, suggests even a simpler and less expensive plan than either of the plans above mentioned. He has caused to be printed instructions and tests upon a large card,* which are all that will be needed for teachers to conduct the examination. The examination is intended only to ascertain what pupils need an examination for glasses or further professional advice respecting the sight or hearing.

Dr. Allport's plan of testing sight and hearing.

The Legislature of Connecticut, in 1899, passed a law providing for the testing of eyesight in all the public schools of the State. Under the law, the State Board of Education is required to furnish test cards and blanks and instructions for their use to the school authorities. The superintendent, principal or teacher in every school is required to test the eyesight of all the pupils during the fall term of each year, and notify in writing the parent or guardian of every pupil who has any defect of vision, with a brief statement of each defect.

Compulsory law for examination of eyes in Connecticut.

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* Cards may be obtained from Mr. Almer Coe, optician, 65 State Street, Chicago, Ill.

In compliance with the above law, the school visitors of Hartford caused to be examined 9,735 pupils, of which number the eyes of 1,596 were found defective or diseased.

Tests in Hartford, Conn.

Probably the most extensive test of sight and hearing that has been made in this country was that made last year in Brooklyn, N. Y., in which 50,000 children were examined, under the direction of the physical training department. "Of these, 28 per cent. were found to be deficient in eyesight and 10 per cent. in hearing. Notifications were sent to the parents of most of these children. As a result, about 2,000 reported treatment and 832 secured glasses within a year and a half of the tests."

Tests in Brooklyn, N. Y.

One kind of investigation made by the physical training committee of the Brookline Education Society deserves attention, on account of its unique character and the practical results it promises. The investigation was of the physical condition of the children and the hygiene of the class rooms, and was carried on with the assistance of the teachers and medical inspectors. The questions asked were in relation to the pupils' nutrition and condition of spine, and the ventilation, lighting and temperature of the schoolrooms. The results of the physical examination were as follows (22, p. 22): Out of 2,594 children, the nutrition was considered to be excellent in 1,603, or 62 per cent.; good in 605, or 24 per cent.; fair in 262, or 10 per cent.; poor in 104, or 4 per cent. In the same number the following deformities were observed: of the spine, 4; of the chest, 7; of the extremities, 9; of the head, 4. A more individualized physical examination was made by the same committee through the co-operation of some physicians. Sixty-one boys were examined, with the following results, in part (22, p. 23): Percentage of pupils having poor preservation of teeth, 29.5; abnormal condition of throat, 54.1; abnormal condition of heart, 24.6; abnormal development of chest, 16.4. As one result of the investigation, the committee strongly recommended that certain vacant land be left an open space for a playground for the children of the neighborhood.

Investigation of the physical condition of the pupils in Brookline, Mass.

Instruction.

From the beginning of the course to the end of it, careful and systematic instruction in hygiene should be given, first independent of anatomy and physiology, and later in close connection with those subjects. It is not the place here to suggest methods of instruction, and yet it may be proper to state that instruction in hygiene will be effective only as it is made concrete and applicable to every-day experience. Pupils may be told or they may read from the book all the rules of hygiene, and afterwards be able to repeat them, and yet not be able to see their application so far as their own lives are concerned. If they do not see this clearly, and do not know the reasons why the laws of health should be obeyed, they may as well remain in ignorance. For example, in the higher grades of the grammar school and in the high school pupils should be led not merely to learn the fact that rapid eating is harmful, but to know why it is harmful; not merely to say that pure air is necessary to health, but to ascertain from measurements whether their own bedrooms or schoolrooms are sufficiently supplied with it. There is not a fact of hygiene connected with school conditions or home conditions which might not be profitably worked out by the pupils themselves. If this practice of applying in our teaching to everyday life the principles of hygiene were universal, there would be in time less reluctance on the part of school authorities to provide all the means possible to insure conditions of health, and parents would not be so willing as many now are to defy all the principles of dietary science. Speaking of the ignorance of parents respecting food, Mrs. Richards says (25, p. 17): "To my mind, there is but one efficient remedy for this gross ignorance and misapprehension of the office of food, and that is, to have the science of food taught in all our public schools. Make the simple, fundamental, well-known principles of diet a part of the natural science training in the school, add interest and point to the teaching by classes in cooking, not for the sake of the dishes

Instruction in hygiene throughout the course.

Instruction to be practical.

The science of food to be taught.

prepared, although they should be well done, but for the sake of the illustrations they give of the principles taught."

General Hygienic Treatment.

Having considered the dangers to health to which pupils in school are exposed, we ought next to ascertain exactly what teachers can do to avoid those dangers, and to correct faults which already exist. The first means which suggests itself is physical training.

The chief direct ends of physical training are health and symmetry of body and grace of bodily movements. That these ends are promoted to any degree by the prevailing gymnastic practice in the schools is seriously questioned by many people. There are, doubtless, gained by the exercises a certain degree of muscular strength and increased circulation of the blood; but these are not the only nor are they the chief conditions of health most needed for our pupils. What they most need is recuperation or rest from mental fatigue, and this, it is believed, is not gained by the tenseness of mind required in sharply following the orders of a leader in gymnastics. Teachers, in response to the question as to whether they or the pupils are rested by such exercises, almost invariably answer in the negative; and yet they have grown in favor to such an extent in some places as to constitute the only exercise which the pupils are permitted to have. The growing doubt as to their use as a means of promoting health is shown by the changed character of the exercises recommended by directors of gymnasiums. The dissatisfaction with prevailing methods is voiced in the following statement, recently made by a prominent director of physical culture in one of our State normal schools respecting the system in common use: "I believe the classification of exercises in this system to be the most scientific and effective, but I want to protest most earnestly against their application, as so often seen, by which such exercises are a dose of repulsive medicine, instead of the natural, voluntary, joyous response of the child." In other words, the recreative elements of exercise are wanting in many of the gymnastic exercises. These elements, it is believed,

The use of gymnastic exercises and their limitations.

The faults of application.

may be supplied in part by a more intelligent application of the principles underlying the best systems of gymnastics, and in part by substituting for many of the gymnastic exercises recreative games and plays, in which the response of the children is "natural, voluntary and joyous." To meet successfully the desired ends, the games should be such as to enable all the pupils to join in them voluntarily. They should give abundant opportunity for free, joyous and frequently emulative action. They may be educational in character, or such as will exercise the pupils' powers of observation, imitation, memory and judgment. To accomplish the best results, it will be necessary for the teacher to direct and oversee the games,* and, if she is sympathetic enough, to participate in them. The games will afford the best opportunity for profitable child study, and for creating in the teacher sympathy with and interest in the children.

Recreative games and plays needed.

It is a cheering sign that in many places the recess, so long abandoned, is being restored, to be spent, not as formerly in rough-and-tumble sports or in aimless idleness, but in well-directed, joyous exercise, which sends the children back to their studies refreshed and invigorated. The following carefully selected list of games † will suggest what may be played by children of different ages. Some of them, as will be seen, are appropriate for the school yard alone, while others can be played in the schoolroom or gymnasium, or, if there is no gymnasium, in the basement playroom. Those marked S. may be played in the schoolroom, and those marked G. in the gymnasium or playroom. The figures indicate the grade of pupils for which the games are best adapted, 1 standing for the primary grade, 2 for the lower grammar, 3 for the upper grammar and 4 for the high school.

The recess being restored.

A list of good games recommended.

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* Miss Brown, of the Washington, D. C., Normal School (10, p. 631), recommends dividing the class into two or three sections, thus freeing the children from apparent direction by the teacher, and giving her an opportunity to do individual work.

† They are selected from the list of games given and described by Superintendent G. E. Johnson in Vol. III. of the Pedagogical Seminary and from "One Hundred Gymnastic Games" prepared by ten members of the alumni of the Boston Normal School of Gymnastics. These are very valuable contributions to educational literature, and should be within reach of every teacher.

Bean bags in a circle, S., G., 1, 2, 3.
All up, S., G., 2, 3, 4.
Ball hunt, S., G., 2, 3, 4.
Beast, bird or fish, S., 3, 4.
Call tag, S., 1, 2, 3, 4.
Birds, S., G., 1, 2.
Follow the leader, S., G., 1, 2, 3, 4.
Ducks fly, S., 1, 2.
Going to Jerusalem, S., 1, 2, 3, 4.
Catch ball, S., G., 1, 2, 3.
Guess ball, S., G., 1, 2, 3, 4.
Herr Slap Jack, S., G., 1, 2, 3.
Observation, S., 1, 2, 3, 4.
Basket ball, G., 3, 4.
Ball and bases, G., 3, 4.
Ball stand, G., 3, 4.
Bears and cattle, G., 3, 4.
Black and red, G., 3, 4.
Cat and rat, G., 1, 2, 3, 4.
Hunt the fox, G., 1, 2.
Steeple chase, G., 3, 4.
Dodge ball, G., 2, 3, 4.
Garden scamp, G., 2, 3, 4.
Hanging cats, G., 1, 2, 3, 4.
Jump the shot, G., 1, 2, 3, 4.
Lame fox and chickens, G., 1, 2, 3, 4.
Last couple out, G., 3, 4.
Ninepins, G., 2, 3, 4.
Stealing sticks, G., 3, 4.
The billed cat, G., 1, 2, 3, 4.
Three deep, G., 2, 3, 4.
King's castle, G., 2, 3.
Fox and geese, G., 2, 3.

All of the above-named games marked "G.," and many others, like "I spy," "tag," "duck on the rock," may be played on the playground. There are many games like "geography," "assumed characters," and "authors," which will be found a valuable help in connection with the regular work of the school.*

In what is said of the importance of games and plays as school exercises, it is not meant that gymnastic exercises have not a distinctly constructive and corrective value, nor is it meant that they should be excluded from the school. Emphasis is here placed upon exercises of recreation and relaxation, because they have to some extent been discontinued in the abandonment of the recess, and because in the strain of school work they are especially needed. In the thirty minutes allowed daily for recesses, fully two thirds of the time should be given to the wholly recreative exercises. If any more than the remaining time is needed for gymnastics, let it be taken from the time which has been assigned for recitation and study. In school buildings provided with a gymnasium, regular semi-weekly or tri-weekly periods should be

The true value of gymnastic exercises.

Time for recreative exercises.

* In an interesting test, given recently to over 2,000 children, by Mr. Monroe of the Westfield, Mass., Normal School, it was found that 32 per cent. of the favorite games mentioned were ball games; 31 per cent., chase games; and 10 per cent., motion games. Further details of the test are given in (24, p. 1084).

set off for systematic exercise in gymnastics, — periods sufficiently long to give opportunity for carefully graded class and individual work.

That the effects of systematic physical training are felt in other ways than in promoting bodily health should be realized by every teacher. Dr. Hartwell says (21, p. 510): "If we once admit, as we must admit, that thought and feeling, judgment and volition are inexpressible and ineffectual except through motor acts, and that motor acts are animated and controlled by the central nervous system, the inference is clear that physical training is an essential element in the development of mental health and power." Of the beneficial effects of games in intellectual and moral development Dr. Lincoln says (16, p. 71): "These games are well suited to bring out some of the basal traits of character and intellect, — quick sight, dexterity of hand, agility, lung power, voice, speed, endurance, with love of fairness, self-assertion, will-power, social instinct and general experience of unveiled human nature."

Special and Individual Treatment.

It is a well-known principle of education that the needs of individual pupils should be met as far as possible. This principle is especially important when applied to physical training. It is applied in every case of eye or ear defect that is observed and treated, and in the case of children who are sent home from school on account of illness. The same principle is recognized in placing defectives in separate schools and classes. In our State institutions for the blind, deaf and feeble-minded it is found very important to give individual treatment to the inmates, especially to those of the feeble-minded school. The same is true with the "abnormally defective" schools and classes already alluded to. In these classes special and individual physical treatment of the pupils, such as manual exercises, baths and gymnastics, is found to be very useful. As time goes on doubtless the treatment will be still more individualized, with the view of preventing possible moral as well as intellectual ills. We may well carry this process of individualization still further in the physical treatment of normal-minded pupils who have signs of

Ways of meeting the needs of individual pupils.

physical defects, as shown in wrong postures, awkward movements and malformations. A recent movement in Brookline bids fair to do much in this direction. Here those pupils who are found to need corrective exercises are examined by the instructor of physical training, with a view of prescribing daily home and school exercises. In the clinic, which is held for an hour once a week, a careful examination is made of the pupils who are taking the special treatment, for the purpose of ascertaining what progress is made and what change of treatment is needed.

Examination and treatment of pupils in Brookline, Mass.

It is on such special and preventive lines of treatment for abnormal children that the schools of the future will more and more work. It will not be, however, until the people believe in a policy of prevention rather than mere restraint and punishment in respect to crime. It may be that society for many years to come will seek to protect itself by means of the pound of retributive cure meted out to criminals; but more and more apparent as time goes on will become the effectiveness of the ounce of prevention in the special treatment of children and youth before the crimes are committed. Already there are signs of an awakening realization of the value of reformative measures in the quite general approval among thinking people of the great work which Mr. Brockway has done during the past few years with the prisoners in Elmira. Here for several years men were treated according to their individual needs by giving them baths, massages, physical and manual exercises, and by providing for them study and useful occupations, with the result, as Mr. Sanborn has pointed out,* "of securing the astonishing percentage of more than seven reformations out of every ten persons." If the value of special hygienic and educational treatment of criminals is thus marked, what cannot be said of the value of such treatment when given to young persons before fixed habits are formed?

Prevention better than restraint and correction.

Experience in Elmira, N. Y.

To carry out the needed corrective and preventive treatment for abnormal children, as well as the regular constructive work

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* Papers in Penology, February, 1900, p. 29. Elmira, N. Y.

for all, there should be employed, in addition to the usual force, a health officer, called the school physician or director of hygiene, whose duty will be to examine from time to time the pupils, for the purpose of ascertaining which of them need special treatment, and to prescribe what that treatment shall be. His duty also will be to inspect the hygienic conditions of the schools, and to recommend needed improvements. In addition to these duties, he will direct and assist the teachers in carrying on the physical training of the school, both in its educational and in its hygienic aspects.

A health officer for all the schools needed.

Thus will be assured in education the same consideration for the body which is now believed to be necessary for the mind. Physical training in its broadest sense will become the business of the school no less in the special correction of existing ills and the prevention of greater ones than in the more general building up of the body. Health of body will be regarded not only as coequal in educational importance with health of mind, but as inextricably bound up with it, both in the processes of education and in the ends of efficient service in the world.

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