American School Building Standards

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FRANKLIN EDUCATIONAL PUBLISHING COMPANY
COLUMBUS, OHIO
1910

The Champlin Press, Columbus, Ohio

PREFACE.

The present work is offered to the public in the belief that there is still great need for the dissemination of reliable information regarding correct design and construction in public school buildings in this country, and that "every little helps."

The author makes no claim of originality for most of the matter contained in the work, unless it be as regards arrangement and selection. He has drawn freely upon all the well known modern works upon the subjects treated, modifying conclusions as experience and the most recent authorities approve. The controlling motive has been to so condense and standardize the best present day practice as to produce a compact handbook for ready reference, eliminating both the historical and purely aesthetic phases of the subject, for the sake of utility.

The author acknowledges help received from, and opinions influenced by, publications of The Boston Schoolhouse Commission, Mr. Edmund M. Wheelright, Prof. A. D. F. Hamlin of Columbia University, Mr. Warren R. Briggs, Mr. M. C. Huyett, Prof. Rolla C. Carpenter of Cornell University, Prof. S. H. Woodbridge of the Massachusetts Institute of Technology, Mr. R. Clipston Sturgis, Mr. W. B. Ittner and others.

TO MY BROTHER

Edwin Stanton Mills:

This book is affectionately dedicated by

—THE AUTHOR.

THE MAN WHO KNOWS.

From the American School Board Journal, April, 1908, revised.

There was a time,—and not many years ago,—when the majority of our American cities and towns saw very little expert skill employed in the designing of buildings for school purposes. Indeed, even now, one often meets people who unblushingly proclaim that "most any one" can design a school building, since it is "nothing but a collection of plain rectangular rooms, a few entrances, exits, stairs, etc." Worst of all, these people actually seem to believe what they say, incredible as that may seem. Unfortunately the existence of such sentiments, in altogether too many otherwise enlightened communities, renders still possible the erection of so called school buildings which, to those WHO KNOW, plainly and loudly proclaim hideous defiance of all laws of art, hygiene, ventilation and in some cases of even common sense.

The adage "If ignorance is bliss, 'tis folly to be wise" can not excuse or palliate such conditions, for it is a case in which the lives and health of your children, and your neighbor's children, are at stake, and it is your duty to **know.** No one can tell how many cases of ruined eyesight, tuberculosis (consumption), chronic female disorders, nervous collapse—yes even dangerous epidemics, owe their beginning or continuation to such miserable excuses of school buildings as are above described. Cases have been known in which contagious diseases have been carried from one season to another in unsanitary rooms. The entire country was horrified at the frightful catastrophe at Collinwood in which more than 160 children and one teacher lost their lives by fire. Yet making proper allowance for the effect of panic, and other extenuating circumstances, it appears to be established, beyond the possibility of a doubt, that no such calamity could have occurred in a building properly designed and constructed. Moreover it is undoubtedly true that the absence of many more such catastrophes can be credited to no cause but the absence of some initial accident necessary to set the trouble in motion. Have you such a building in your town? Be sure about it, and, if so, do all you can to see that it is replaced with one of the right sort. The lives of your own children may be the price to pay for neglect of this all important duty.

The public school concerns intimately more people than any other class of public edifices, (1) because every citizen avails himself of its privileges in his youth, and sends his children to the same school in later years; and (2) its design unquestionably affects, for better or worse, the health, happiness and morals of the pupils, to say nothing of the educational work carried on therein.

While much has been done, especially in our larger cities, toward standardizing and formulating data of school design, this should only serve the purpose of imposing upon every school board and all architects of school buildings, the duty of mastering such details which are now readily procurable; a duty which, as Professor Hamlin says, "is all the more imperative when one reflects how large a span of the life of a community is spent within the walls of its schools, and how important it is to surround its children with the most perfect environment for their hours of study. The school houses of any community are gauges of its enlightenment. They should be the best and most carefully constructed buildings it possesses, not the most splendid and ornate, but the most perfect in design and complete and thorough in execution and equipment."

In this day of enlightenment, everybody should know that an educational theory which does not put the utmost stress upon the correct relation of mind and body, with its hygienic and ethical meaning, would be simply ridiculous. No matter how small or inexpensive your building must be,—if it is to contain only one school room,—you are grossly negligent unless you make every provision known to the architect's and builder's art to provide for the comfort, safety and health of the precious children who will be forced to use it, and unless you do your part by influencing your board, for the very first step, to secure THE MAN WHO KNOWS to direct, and instruct them and thus avoid the countless errors and omissions which are certain to come if any one less skilled or experienced undertakes the work. Do not allow a feeling of false loyalty to prejudice you in favor of a local architect simply because he is a "home man" unless you are absolutely certain that he is THE MAN WHO KNOWS. Such misplaced sympathy is responsible for many hideous and dangerous buildings.

Simple fairness prompts the supposition that many boards really desire to exercise these precautions and to secure buildings correctly designed and built, but owing to the inexperience of the individual board members,—usually men elected to serve for short terms only, and engaged in business, the professions or other callings not in any way related to the designing or construction of buildings,—they do not know and can not easily or quickly learn how this result may best be accomplished, or where THE MAN WHO KNOWS is to be found. These facts alone are sufficient justification for the following statement relating to architects and their work.

Architects are men who design and supervise the construction of buildings for the occupation of human and other beings, in which buildings the elements of beauty and pleasure are of importance. In early days the architect's work required only a mastery of building construction, supplemented with knowledge of how to beautify and emphasize that construction. But the designing of buildings to meet modern conditions requires the architect to be thoroughly versed, if not expert, in architecture, art, structural engineering, steel and iron work, reinforced concrete and other fireproof construction, heating and ventilating, sanitary engineering, electricity, and other important subjects of such variety and magnitude that one might easily imagine the men who presume to undertake such formidable tasks are like fools rushing in where angels fear to tread. Indeed it would require more than the lifetime of an ordinary man, unassisted, to master each one of the subjects involved in the designing of buildings—if it were possible to accomplish such a stupendous task in any length of time—but such a result is perhaps not within the bounds of human possibilities.

Clearly it is impossible for any one man to combine very great skill in several of these subjects at the same time, and therefore we find that most architects, when called upon to handle branches of work in which their experience or training is limited, have no hesitation in retaining experts in those lines to execute that part of the work. On the other hand many of the ablest architects deliberately train themselves as specialists in buildings requiring proficiency in a limited and definite line of work. It is surely easy to understand how men of such *special training* are able, with notable ease and proficiency, to handle the work toward which all their training has been inclined, and also to appreciate how much more the perfection and success of a building enterprise is assured when all its details are kept at all times within the grasp of one competent individual. It is by men of such specialized training that your school buildings should be designed.

Architects are professional men and have no organization comparable with Unions or Orders having oaths of allegiance or requiring unwilling obedience. In this country the largest and most authoritative organization of architects is the American Institute of Architects, a voluntary association comprising many but not all of the best architects in America. Many good architects are not members of the institute and suffer no embarrassment thereby. This institute sets up certain high professional standards evolved from the experience and judgment of the best men in the profession, and toward these standards its members are urged—not compelled—to aspire. Its work is thus wholly unselfish, aimed only at the uplifting and enlightenment of its members, and the advancement of the profession of architecture.

The institute, however, recommends a code of ethics, and a minimum schedule of fees, below which the experience of thousands demonstrates that its members **can not afford** to work. The code of ethics and schedule of fees of the institute may be found on page 215 to 219. To this code and schedule no member is compelled to adhere, but all come to it sooner or later, and many exceed it. Honest and sufficient compensation—indeed an adequate living can not be assured otherwise.

A member who sets at defiance the standards and recommendations of the institute may be expelled therefrom, but the institute has no power, such as legal or medical societies possess in some states, to prevent members thus deposed from continuing in practice. Nevertheless, while architects outside of the institute may practice the profession and charge such fees as they see fit,—being accountable only to themselves,—the standards of the institute have become the standards by which all American architects are measured, both by the profession itself and by the general public, thus demonstrating the justness and righteousness of those standards more effectually than the use of any force or coercion could ever do. So generally is this true that all so called architects who practice under other standards or for lower fees may well be regarded with caution and in most cases with **suspicion and distrust.**

As a rule all architects who work for less than the institute schedule of fees may be grouped under three classes—(1) Young or inexperienced men anxious for a start and willing to sacrifice the fee for the experience. (2) Those men who fall under the head of "has beens" and are therefore in need. (3) Dishonest men who intend to seek the balance of the full fee by indirect and crooked methods. Whatever the class, be assured that "January sales prices" are just as risky and deceptive in the building world as in mercantile business, and almost certain calamity is involved in considering **cheap architects.** Any school building which is at all worthy of a competent architect's attention merits the service of the best man your board can induce to undertake the work. Even were the financial difference necessary to secure the best man an item of considerable size, it is nothing compared to the risks otherwise involved. Inexperience will certainly display itself in every important feature of your building besides annoying you constantly by its bungling and inefficient management of the work itself; while cut prices, rebates and graft schemes of every sort simply put a premium on dishonest and cheap work, which will be foisted upon you at unexpected times and in devious ways you can not discover until too late. No power on earth can force an incompetent practitioner to do high grade work, or a dishonest one to do honest work. No matter how many "smart" or "practical" men may sit upon your board, the rogue will always beat you.

In all activities of life the specialist becomes the most expert. The marvelous developments in the trades, arts and sciences in these recent years would have been absolutely impossible except for the existence of the specialist—"men of one idea" whose time, thought and money were concentrated on the accomplishment of a single purpose. And there is no class of building more worthy of the best efforts of the educated specialist than our public school buildings. The wonderful improvement made in school work by some of our cities in the last few years shows what may be done when the highest skill of the specially trained architect is brought to bear upon this problem. What has been done in some cities may be done in all. What may be done in the cities is also possible in the towns, and what is possible in the towns may even be done in the country. Every board member, every teacher, every citizen should make it a part of his business—as it is certainly a part of his duty—to help forward the cause of better school buildings by securing THE MAN WHO KNOWS.

SELECTING AN ARCHITECT.

When an individual or a body of individuals proposes to undertake the erection of a building of any magnitude, the very first questions to be confronted are (1) The advisability of employing an architect and (2) the wisest method of selecting the one best qualified for the work in hand. With regard to (1) nothing will be said, as any one who attempts a building in this day of the world without the guidance of a competent architect deserves the trouble he is sure to encounter. But with reference to the method of selection many people need guidance and help.

It is an old saying that there's two sides to every question, and this one is no exception. Many architects and laymen claim that the only right way to choose an architect is by individual selection,—upon the basis of integrity, professional skill and experience, just as men in other professions are selected, and where no sufficient reasons exist for doing otherwise, this is by far the simplest and easiest method. Supporters of this view offer the following arguments in its favor.

> (1) Any other method involves competition among several architects, the waste of much time, often much needless expense,—both to owners and competitors, much annoyance and sometimes hard feelings.

(2) In all competitions the gambling instinct is appealed to, and the prospect of winning the prize tempts architects to submit the sort of work MOST LIKELY TO WIN, regardless of real architectural merit; and unless the owner retains professional advisers to guide him, he, being incompetent to judge, is almost certain to select unwisely.

(3) Even if, by accident, the owner selects a competitive DESIGN of real merit, he runs the risk of thus choosing a MAN brilliant in design but inexperienced or unsafe in constructive ability, or perhaps even utterly irresponsible.

(4) Under the very best conditions of competition it is exceedingly difficult to select an architect with absolute fairness to each competitor, and it is practically impossible when the owner trusts his own untrained judgment to make the selection.

However, in spite of these seemingly conclusive arguments against competitions, it remains a fact that, aside from private work done for individuals, the great majority of important architectural contracts are, have always been, and perhaps always will be awarded by competition of one sort or another. And the following are some of the reasons offered in explanation of this state of affairs.

1—Architects themselves are not of one mind in opposing competitions. The American Institute of Architects solemnly pronounces against competitions and yet, recognizing their prevalence and growth, spends years trying to formulate a satisfactory code for their regulation. Meantime, some of its most prominent officers and members engage in competitions,—and, indeed, some of them would hardly be known, or able to continue in architecture without such practice.

2—The people practically demand competition in public work, and look with suspicion and distrust upon all contracts not so awarded. Nothing offers the yellow journal a more welcome subject for sensation and cries of "Graft" than an award without giving at least several good men a chance. As a result, there are but few monumental public, or even semi-public buildings in this country, the architects of which were not selected by competition of some sort, while the list of those important building designs selected in competitions, and of those architects who have become famous thereby would be a long and representative one.

3—Many individuals and bodies of men claim to see great advantage in competitions arising from the number of different designs or schemes presented to choose from, these being the work of trained minds all directed to the solution of a given problem; and some —but not all by any means—are willing to pay all competitors in order to secure this real or fancied advantage.

4—In many cases, competitions are unavoidable, such as the requirement of competitions by law, or by condition of bequests, or by reason of inability to choose otherwise from among equals in ability or favoritism. And, as above stated, they are almost unavoidable in public work.

Resumé.

To express in a word the best thought and advice upon the subject: Be good, and if you can't be good, be as good as you can. Always be sure your architect is "The man who knows." If such a man, having the requisite integrity, ability and experience is available, have nothing to do with competitions. But if no such man is readily available, or if any reasons exist, such as above suggested, why the competition is wise, necessary or unavoidable, then arrange your competition and its requirements with the utmost care, being particularly watchful to have its terms wise, honest and fair to all concerned,—or better yet, turn the whole matter over to professional advisers who KNOW HOW to guide you safely and wisely.

Data on Competitions.

The American Institute of Architects recognizes the following underlying principles for the conduct of competitions:

On the Forms of Competition.

The following forms of competition are recognized:

1. Limited: In this form, participation is limited to a certain number of architects, of ample qualification, whose names are stated in the program and to any one of whom the owner is willing to entrust the

work. This form is generally employed by conservative owners having large interests at stake. It has the advantage that the owner, and the professional adviser, may meet the competitors and fully discuss the terms of the competition with them before the final issuance of the program.

The Institute is of the opinion that, unless cogent reasons prevent it, competitions should be of this limited form.

II. Open: (*a*) *Open to all architects.* This form has sometimes to be employed on account of legislative enactment. It consists in permitting all architects—or all within certain limits—(without regard to their qualifications), to take part.

(*b*) *Open to approved applicants.* In this form all architects who desire to compete make application, accompanied by evidences of their professional capabilities. The owner, with the assistance of his professional adviser, determines which of such applicants he deems capable of properly executing his work, and issues invitations to all such, or a limited number of them. This is obviously a much better form than the open competition, for if the standard be kept high, none but men of experience and ability will be admitted. Like the open competition, however, it fails to insure the participation of architects of the highest standing.

III. Mixed: In this form, a limited competition is conducted simultaneously with one open to approved applicants, the program being uniform to all. This form has the advantage of insuring the participation of architects of known ability.

General Requirements.

1—The object of a competition is to secure the most skilled architect.

2—Nearly all owners are ignorant of architecture and building, and especially of drawings. Therefore, an architectural adviser should be employed to draw up a program for the competition, to assist in selecting the architects who are to compete, and to advise the owner regarding it. The same adviser, or better, a jury of three practicing architects should advise the employer in making the award.

3—The amount to be spent on the building, as stated in the program, should be sufficient to erect such a building, or no cost limit should be set. Architects are no better able than other mortals to accomplish the impossible, and owners simply invite trouble by tempting them to do so.

4—The program should be made in the form of a proposal on the part of the owner, fully specifying awards, payments, etc., the acceptance of which by the successful competitor, upon notification of award, will form a contract between the parties.

5—Whenever practicable the competitors and the professional adviser should meet with the owner, and agree upon terms to be binding upon all, (but this is seldom feasible except on very large work).

6—Competitors should be paid for their services as follows:

a—In limited competitions each competitor invited should be paid for his services an amount sufficient to cover the cost of the work demanded.

b—In competitions open to all architects, a few should be repaid their expense—say five competitors.

c—In mixed competitions, the architects especially invited should be paid as above stated, and in addition, prize offered for the best schemes offered, said prizes not to be confined to the uninvited competitors.

7—The drawings required should be the least in number, and sufficiently elaborated only to express the design and arrangement of the schemes submitted, and each competitor should be confined to exactly the same number, style and scale of drawings.

Discussion.

The following paragraphs may well be omitted by any readers who already understand or approve the foregoing general principles of fair competition, but for the benefit of others a little explanation may be appreciated; the numbers refer to the above paragraphs as discussed.

I—Object of competition to secure best architect.

This proposition appears self-evident, and yet all architects know some competitions are held in which the best architect is deliberately turned down for a local favorite, a grafter, or a smooth talker; and others are held merely to dispel public criticism, the winning architect being known all the time to the owner. All such methods are manifestly dishonest and unfair whatever the motive, and architects and owners alike should eschew them.

2—Employing architectural advisers.

If there is any occupation or profession in which "Fools rush in where angels fear to tread" it is in the designing and construction of buildings, and most owners consider themselves absolutely competent to select the best architectural scheme from among any number submitted to them. The utter fallacy of such misguided confidence is best proven by the results displayed in the many hideous structures thus designed. Tremendous and immediate improvement would follow upon a change in this matter as herein suggested, particularly in public work like schools, churches, etc., etc.

3—Item three is self-evident.

5—Item five applies only to limited competitions.

4—6 and 7 Contract, Payments, Professional adviser, etc.

Most owners do not appreciate and must be taught that every architect who properly enters into competition for their work does so at great inconvenience and expense to himself, for no competitive scheme is worthy of anybody's consideration which is not the result of the most careful application of a mind trained in that particular line of endeavor. No fair minded or honest man should be willing to accept such services FOR NOTHING, but should be glad to limit the competitors for his work to such a number as he is willing and able to pay a fair compensation, proportioned to the value of their services.

As a matter of fact, a large number of competitors, even for a very important building, is generally a great detriment. In the largest competitions there are rarely more than five or six whose work is really worthy of serious consideration, except those competitions in which the competitors are carefully selected on the basis of equal and proven ability, and are personally invited on that basis. As a rule, a large number of competitors serves in many ways to complicate the management of a competition,—first, by seeming to hold out to a large number of persons the hope of employment which only one can obtain, and of which the majority will in reality stand no real chance of success, the element of chance involved tempting many into useless expense and labor. On the other hand, this method very largely increases the labor of those who serve as judges in such competitions, causing them, if they are fair, to spend much time and effort upon productions which are not worthy of it. We doubt whether it is ever wise, or good business judgment, to consider more than a half dozen carefully selected competitors on any contract amounting to less than $200,000, and it is very easy to inform applicants who are too late that the number has been limited and the list filled.

The expense incurred by the employment of a professional adviser and by the paid competition itself will be many times repaid in the excellent results obtained in the finished building. The charges of such professional advisers and the proper amount to pay competitors may always be proportioned to the magnitude of the building project itself, and only a very small proportion of the total expenditure, comparatively speaking, need ever be set aside for these purposes, but in all cases where each competitor is paid it is a fair proposition for the owner to require that all schemes presented under such conditions shall remain his own property. By this method he secures not only the benefit of studying the solution of his problem as offered by several competent men, but also has the benefit of the comparative criticism of his professional adviser with reference to all of the schemes. Further, the architect whom he finally employs may honorably be permitted to inspect the various schemes before undertaking his own final study of the project. Surely no argument is required to show that the advantage of such procedure is all on the side of the owner, and in the interest of good architecture.

It is almost impossible to properly judge competitions unless the competitive drawings are all based upon the same premises; that is, they should all be drawn in the same scale; each competitor should present the same number of drawings (representing the same definite portions or views of the building); each competitor should be required to bring his building within approximately the same number of cubic feet of contents, and the style in which the various drawings are rendered, gotten up and displayed should be identical in the case of each competitor. Further, the number of drawings required should be the minimum number which is absolutely necessary to express the design and arrangement of the building, and should be as simple as possible, thus avoiding unnecessary expense to all concerned.

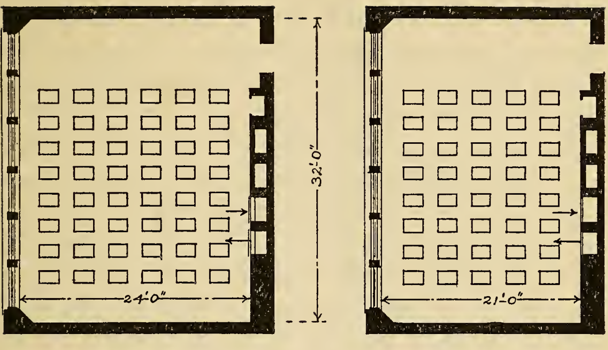
Whatever the method may be which governs a competition, the utmost care should be used to guarantee to every competitor therein an ABSOLUTELY EQUAL opportunity to present his plans and ideas and to receive from the owner every consideration which is shown to each other competitor. The program should be drawn up explicitly and carefully stating all conditions of the competition, and each competitor should be supplied with an identical copy of this program. Any communication whatever which is held between any competitor and the owner, prior to the time of the competition, should be in writing, and should be made known, with the reply thereto, in full to every other competitor, and an equal opportunity offered to each of the others. It should also be borne in mind by the owner that the real purpose of a fair competition is not to obtain advice or counsel from architects gratuitously, but, as previously stated, to select the MOST SKILLFUL ARCHITECT and the BEST ARCHITECTURAL SCHEME among those considered.

THE SCHOOL ROOM.

The controlling elements in planning a school building are the class rooms and the communications, the former being, of course, the fundamental unit in every school house design. Experience demonstrates that for the utmost efficiency a school room in an elementary building should not seat more than forty pupils, but in high schools, the work being done largely by lectures, no definite limit can be placed upon the seating capacity of rooms.

Size of Rooms.—In school rooms each pupil has a desk, and under ideal conditions the rooms should be proportioned to allow 20 square feet of floor space and 260 cubic feet of volume for each pupil, but under no conditions should these figures be less than 15 square feet of floor space and 200 cubic feet of volume per pupil. It is almost universal practice to make school rooms slightly oblong with the teacher's desk at one end of the room, in the proportion of 24 feet by 30 feet and 25 feet by 32 feet, etc., with ceiling heights of not less than 12 feet or more than 14 feet. Primary school rooms should not be made smaller than other rooms in elementary buildings because activity is absolutely vital in small children, and the rooms should be ample in size to provide opportunity for much physical exercise, outside of net seating space.

Lighting.—Some architects have resorted to the use of prismatic glass in lighting school rooms pro-



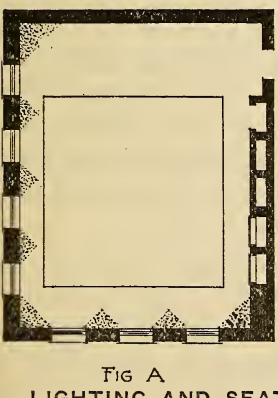


Fig A

Fig B

Fig C

LIGHTING AND SEATING OF SCHOOL ROOMS.

The upper drawings show ideal designs for school rooms, one to seat 48 and the other 40 pupils. Dimensions given, also the arrangement of windows, heat and vent flues, door, etc., correspond with the best present day practice. Some authorities insist upon two exits, and such should be the case in non-fireproof buildings.

Fig. A, illustrates imperfect lighting with dark spaces between windows and in corners.

Fig. B, is a vertical section through the school room, illustrating the light shut out near ceiling by transom bars and fancy top windows.

Fig. C, is a similar section showing correct location of windows with reference to floor and ceiling.

ducing a glare annoying to both teachers and pupils, but under ordinary conditions of lighting it may be stated emphatically that the school room can not be too well lighted. The writers on school hygiene, and the laws of different states vary somewhat, but there is substantial agreement that the amount of transparent glass surface admitting light to school rooms should in no case be less than one-fifth of the floor space of the room, while the laws of some states require one-fourth of the floor space in actual glass area. In rooms with ceilings 13 feet or more in height it is easily possible to secure even a higher ratio of glass than last stated and such opportunities should never be neglected. Care should also be observed to give rooms with a northern or poorly lighted exposure sufficient added glass surface to furnish the room with an abundance of light. As a rule, the use of prismatic glass should only be permitted in school rooms having obstructed sky lines, or dark exposure, and should be carefully shaded when the lighting justifies it.

Direction of Light.—There is now practically no dissent from the opinion that the proper method of lighting a school room is from the left side of the pupils, and that if it is **necessary** to admit light in any other side of the room it must be at the rear of the pupils. It is, of course, out of the question to admit light from in front of the pupils, as the light shining directly into their eyes would produce immediate and serious results. It is also very bad practice to admit light from the right of pupils because the great majority of children are right-handed and thus could not work at writing without casting a shadow thereon by the hand. When windows are placed in the rear of the pupils, even though the pupils themselves may not be injured by such an arrangement, the teachers are compelled to face the light almost continually, thus entailing risk of serious injury to their eyes. Further, when light comes from more than one direction into a school room the conflicting lights are almost certain to cause shiney places to appear on the blackboards, and the corners of the room between the walls containing windows are rendered too dark for use as blackboard spaces, whereas rooms lighted from one side only have a constant light on all portions of the walls, no shiney spots on blackboards and no dark corners. Thus it will be seen that there are some objections to all lighting schemes except the one in which light is brought from the left of the pupils, to which no reasonable objections can be stated.

The Design of Windows.—Windows in school rooms should always extend as near the ceiling as possible. It is said that actual tests show that the upper one-fourth of windows furnish one-third of the light coming through the entire window. It is therefore obvious that windows with transoms at the top and windows having arches and fancy tops seriously decrease the amount of light which is admitted to school rooms and should never be used in school buildings. The windows in school rooms should also be set with the least possible space between them, large mullions being carefully avoided, as these cause deep shadows producing alternate zones of light and shadow, which are annoying and injurious to the eyes. Window sills in school rooms are usually set about 3 feet 6 inches up from the floor.

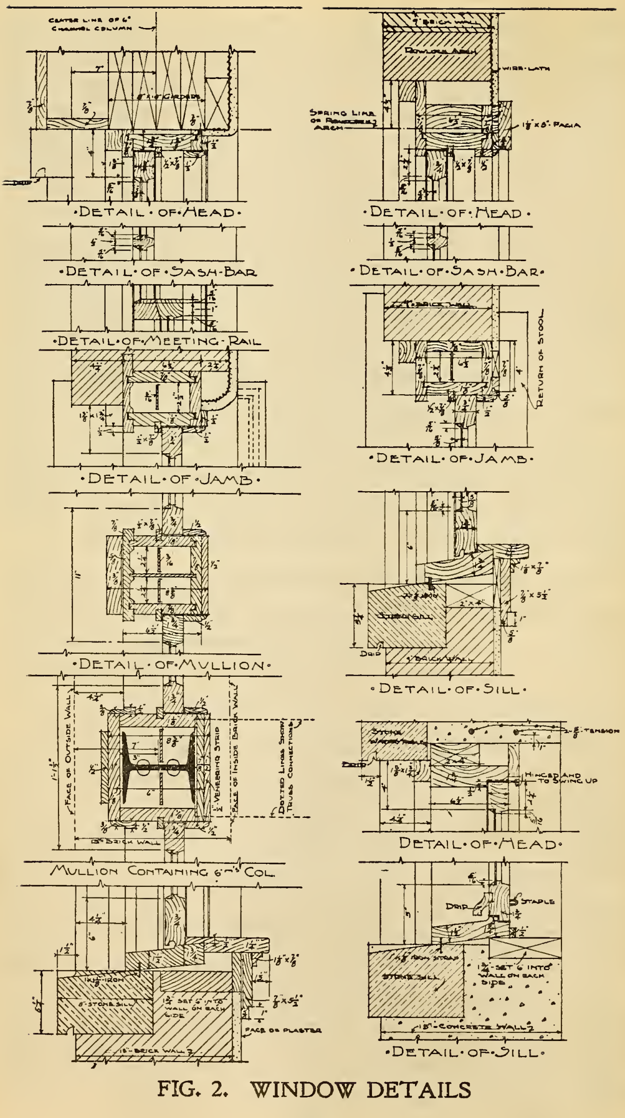


FIG. 2. WINDOW DETAILS

Finish of Walls.—The walls of school rooms should be finished smooth but without high gloss and should be painted so that they may be washed down and thoroughly cleaned as desired. There is general unanimity of preference for greenish tints in the decoration of school rooms, although other warm tints are used, particularly in rooms having sunless or cold exposures. Reds, yellows, blues and grays,—except grays of an olive tint,—should be avoided. The paint used should have no gloss but should dry flat. The ceilings may be made white or of a lighter tint than is used for the side walls.

Window Shades.—Window shades in school rooms should be opaque. In case it is necessary to have the color of the shade exposed to the outside some particular tint to match the color of the building, duplex shades should be used so that the inside surface may be of somewhat the same tint as that used on the walls or a trifle darker. Window shades should be hung on adjustable rollers so that the entire shade, roller included, may be moved to any part of the window desired. Venetian blinds should never be used in the school room, if for no other reason than because they are unsanitary.

Blackboards.—Slate blackboard is much to be preferred over any other sort, but several brands of artificial blackboard can be obtained which are practically satisfactory and produce excellent results. In elementary school buildings as much blackboard as possible should be provided in every room. The height of blackboards from the floors should be as follows: Primary grades, 26 inches; intermediate grades, 30 inches; grammar grades, 36 inches. Blackboards should be at least 3 feet 6 inches high, and 4 feet is better. All blackboards should have a chalk trough at the bottom 3 inches wide containing a woven wire cover ¼ inch mesh, easily removable. The trough may also well be furnished with clean-out holes in which the chalk dust may be brushed and removed by proper receptacles. In many of the better class of buildings mechanical means are provided for removing this refuse. Hooks should also be provided on the under side of chalk troughs to receive rulers or yard sticks, and in primary and intermediate grades a shelf may be provided over blackboards to receive pictures, drawings and art objects, although this shelf is a dust catcher and other provision for pictures, etc., is preferred.

Doors.—Each school room should be provided with at least one door 40 inches to 44 inches wide near the teacher's end of the room, and where finances will admit, the door should be glazed with plate glass, the lower half of which is chipped. Transoms may be used with the doors if desired, although in all buildings in which mechanical ventilating apparatus is installed the transoms should be made stationary and serve only for an architectural effect or for increased light in corridors, etc.

Other Conveniences of the School Room.—Every school room should contain a small closet for the personal use of the teacher, having sufficient space for the storage of her wraps and personal effects. It should also be made large enough to contain a limited number of books such as may be kept at the school room for reading to pupils, etc. Platforms for teachers' desks are but little used and are only provided upon special request to meet specific conditions.

THE SCHOOL BUILDING.

General Character.—A principle of architecture generally recognized is that a building should express by its general character the purpose for which it is erected, a principle very applicable to school buildings because it is so easy to comply with this requirement. The school building should be simple, dignified and plain and should be built of the most enduring materials procurable; first, because this contributes to its safety, permanence and endurance, and second, because the true character of the building will be best expressed through such materials. If at all possible, not only the exterior but the interior walls should be made of masonry construction. The building should be as near absolutely fireproof as possible and in case it is more than one story in height, it will be found that the difference in percentage of cost between a combustible building and a fireproof building, at the present time, is very small indeed. There is practically no dissent at the present time from the view that in every school building the corridors, stairways, entrances, etc., must be absolutely fireproof and that emergency exits, also fireproof, must be provided. To insist upon less severe requirements means to endanger the lives of pupils for a very niggardly saving of expense which can be justified upon no grounds whatever.

The Building Site.—There are but few cities in the United States in which it is not possible to obtain abundance of ground for school buildings in any part of the city. In the cities referred to the conditions must, of course, be met as they exist and fortunately our largest cities are producing admirable results even under the conditions referred to. Everywhere else suitable grounds may be obtained for any building to be erected, and the latter should be set as far from streets and adjoining buildings as possible, thus ensuring (1) an abundance of free air to circulate all about it, (2) clear light so that every room in the building may be properly lighted, and (3) the absence of dust and noise. Various rules have been laid down for the proper distance to be left between a school building and any adjoining buildings, some maintaining that a line drawn from the foot of the wall of the school building to the top of the nearest structure should cover an angle not more than 30 degrees with the horizontal; but in any case it is absolutely essential that play grounds surrounding schools should be ample and well cared for. Many teachers connected with the play ground associations of the large cities are emphatic in their statements that properly conducted play grounds are powerful factors in the moral and mental development of school children. It is a common saying that Americans, as a people, take life too seriously, and the utmost care should be exercised to prevent this condition in school children by definite provisions for recreation, especially as the curriculum in our city schools is already exacting and becoming more so.

Owing to the fact that streets in many of our cities run north and south or east and west, it is usually necessary to set the buildings parallel with the streets, but this arrangement is not as good as the one which admits of setting the school building at an angle with the north and south direction so that in all seasons of the year every room in the building will at some time during the day receive direct sunlight. Medical authorities agree that the spread of many forms of disease can be arrested by an abundance of sunlight. While trees beautify the surroundings of the school building, care should be exercised not to allow them close enough to the building to interfere with the perfect lighting of every room.

Foundation and Basement.—The foundation of every school building should be abundantly water proofed, an item in building construction which until recent years has not received very great attention, but which is now so thoroughly worked out that the basement may easily be made moisture proof at slight expense. In the smaller school buildings of the country, basement stories are usually made use of not only for heating equipment, but for play rooms, etc., and in such cases it is only necessary to provide that all such rooms shall be clean, well lighted and hygienic in character. But in the larger and better class of buildings, economic considerations and the desire to avoid going up in the air with several stories, renders it advisable to make use of the basement for actual school purposes, in which case every rule which applies to the proper design of school rooms in any other story applies also to the basement.

Number of Stories.—There has been a remarkable change in public sentiment in recent years regarding the number of stories admissible in a properly designed school building, and it may safely be said that there is a strong sentiment against having more than two stories above the basement. In many cases the basement story is made the same height as the other stories, the basement floor being placed at the ground level or a very slight distance below it. In some of our largest cities where suitable sites can not be procured, it becomes absolutely necessary to erect buildings three and even more stories in height, but such design is inexcusable under other conditions, and indeed some of the buildings referred to contain elevators for the use of pupils. There can be no debating the proposition that, on hygienic grounds, school buildings should not exceed two stories above basement unless elevators are provided for the use of at least female pupils. Serious troubles may be brought upon young growing girls by too frequent climbing of stairs and there is, of course, an added danger in case of fire or panic.

Attic.—The attic of a school building should be floored with a tight floor, not only because of the convenience of access to all parts of the building, but also to prevent an undue radiation of heat from the school rooms in winter and the super-heating of school rooms in the upper story in warm weather. In any case the greatest of care must be exercised in all parts of the attic to provide against fire and to give the attic space suitable ventilation.

Roofs.—It will hardly be denied that there is a substantial preference in favor of flat roofs for school buildings. While it can not be denied that many beautiful effects are obtained by the use of pitched roofs especially in cases where tile and other ornamental coverings are used, it must be granted that money so expended can often be used to better advantage elsewhere in the building, and it is a well known fact that flat roofs are not only more economically constructed, but seldom cause trouble by leakage or expense for repairs. In the large cities they are also used as playgrounds.

Entrances and Exits.—No school building should be constructed having less than two large entrances and exits, and all entrances and exits should be fireproofed. It is perhaps safe to say that no school building can have too liberal provision of entrances and exits. No set rule can be laid down for the dimensions of such portions of the building without knowing the magnitude and capacity of the building in which they occur, but if builders are liberal to the point of extravagance in this regard it must be remembered that they are thereby only adding to the safety of the building. Steps entering school buildings should always be placed on the inside of the building. All vestibules should be large and roomy to provide shelter for the children and to protect the interior corridors from direct contact with the outside weather. Every entrance should have a suitable lobby with inner and outer doors to protect the interior of the building from draughts and storm. All vestibule corridors and stairways in every school building should be carefully and abundantly lighted by direct light from outdoors, and long narrow corridors in every case should be avoided. In many of the states, laws now require that all doors throughout the building shall open outward, and in any case this rule should be adhered to in school buildings.

Corridors.—Main corridors should be at least 8 feet wide and in buildings of eight rooms or larger, 10 feet should be the minimum width. Secondary corridors may be 8 feet or wider, and all corridors should be as straight and as perfectly lighted as possible. See the Boston requirements.

Stairways.—The simplest standards of common sense dictate that every school building should contain at least two stairways, and there is a growing demand that all stairways must be fireproof, but it is not enough simply to require that there be two stairways. It must also be required that they be so placed in the building that in case one becomes stopped up, because of fire or panic, the other stairway will be not affected thereby. It is the height of bad design to have the two stairways terminate in one hall in the center of the building. In case the building is more than two stories high both stairways should be carried from the bottom of the building to the top. Whether the stairways are fireproof or not, they should be enclosed in absolutely fireproof masonry walls from top to bottom, and in non-fireproof buildings there should be direct access from the stairway enclosure to the ground, regardless of the connections between the stairways and the interior portions of the building. Large windows should also be provided on the stair landings, being accessible from the landings themselves, thus reducing the risk of panic and crowding in the stairways, not only by providing an abundance of light but a means of egress from the building in case of emergency. Circular or angle steps should never be permitted in a school building under any circumstances.

In case stairways are built fireproof they should be constructed of iron or steel, with treads of slate or treads of cast iron, containing an inserted tread of lead similar to the Mason Safety tread. A simple form of iron stairway can be constructed at a very slight increase of cost over the ordinary type of stairway, all items considered. There is considerable difference of opinion regarding the correct width for stairways, but there is comparative agreement that the maximum width of steps between railings should not exceed five feet. In other words, if a flight of stairs must be 8 or 10 feet in width, it should be separated in the middle by a balustrade consisting of an iron railing and screen between the railings and steps, thus making an equivalent of two stairways in one. In case this arrangement is followed an iron rail should continue around the plat-

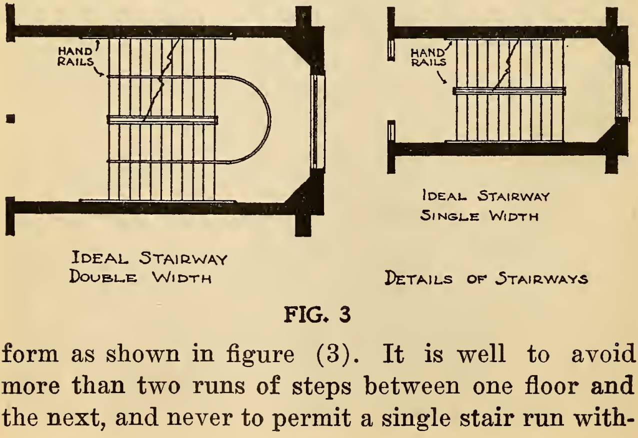


FIG. 3

form as shown in figure (3). It is well to avoid more than two runs of steps between one floor and the next, and never to permit a single stair run without a landing. In the best design the two runs should be in reverse directions, and so designed that there is no opening or well left between the runs. The landings of stairways and the spaces at bottom and top of same should always be liberal, and many authorities recommend the filling out of square corners as shown in figure (3). The height of risers in school stairways should never exceed 7 inches, and from 6 inches to 6½ inches is much better practice.

Floors.—It is almost generally conceded that for finishing floors of school rooms maple is preferable to all other woods because of its toughness and the closeness of its grain. While it is not as hard as oak, yet the latter is much more objectionable because of its open grain. Rift sawed Georgia pine has also been used extensively for school room floors, but, in case the maple can not be procured to advantage, the writer prefers to finish school room floors with plastic cement of which there are several first class brands on the market. These are especially fine for corridors and toilet rooms where money is not available for tile or marble. These cements are fireproof and do not produce any dust from the friction of human feet, such as is the case with ordinary cement floors. Further, seats or furniture may be fastened to the floor in same manner as wood flooring and all cracks and unhygienic features are absolutely removed. But best of all, by the use of such materials for flooring, it is possible to make a cove and base continuous with the floor, as shown in figure (4), thus rendering the floor one of the sanitary features of the school room. Such floorings are also very easily cleaned and kept clean. For sound-proofing of floors in non-fireproof buildings the writer usually follows the plan indicated in figure (4), from which it will be seen than an air space is provided between the sub-floor and finishing floor, which with an abundance of deadening felt should be almost impervious to the passage of ordinary school room sounds.

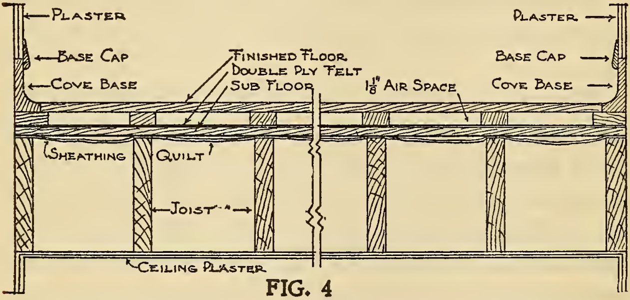


FIG. 4

Plastering.—The plastering used in school buildings should be what is known as hard or cement plaster finished with a smooth white coat to be decorated with paint. Corners of walls and ceilings should be concave and all fancy cornices, mouldings, etc., should be avoided. No school building should be covered with wall paper or finished with a rough surface which would prevent washing or wiping down the walls at frequent periods during the school year, if advisable.

Wainscoting.—Wainscoting should never be used in a school building unless money enough is available to render it possible to use glazed brick or tile. Wainscoting of wood is unsanitary, soon becomes unsightly and also increases fire risk.

Coat Rooms.—There is perhaps no feature of school design upon which there is, at the present day, a greater divergence of opinion than the question of coat rooms. It is generally conceded that in primary and grammar school buildings the coat room should be connected with the school room, but some authorities hold that there should be tight doors between coat rooms and school rooms, while other authorities contend that there should be merely openings between the two, these latter holding that the foul air in finding its way to the vent stacks should proceed from the school room into the coat room and thence out through vents to the roof. Under this plan there is no access direct from the coat room to the corridor. Other authorities prefer connection between the coat room and corridor and a separate ventilating system for the coat rooms from that which serves the school rooms. Still other authorities recommend a system of large closets in connection with the school rooms themselves, as shown in scheme (3), the door of the coat closet consisting of a rolling or sliding partition which is lowered to the floor after the wraps are in place, this partition containing vent registers at the bottom. In any case it may be said that the minimum size for a coat room adjoining a standard class room should be 125 square feet floor space and that coat rooms must, if possible, be well lighted and in every case thoroughly ventilated. In buildings above the grammar grades the almost universal practice, at the present day, is to provide separate coat rooms not located in connection with the school rooms which they serve, and in the better buildings lockers are provided for the use of each pupil, the entire system of coat rooms being included in the system of forced ventilation of the building.

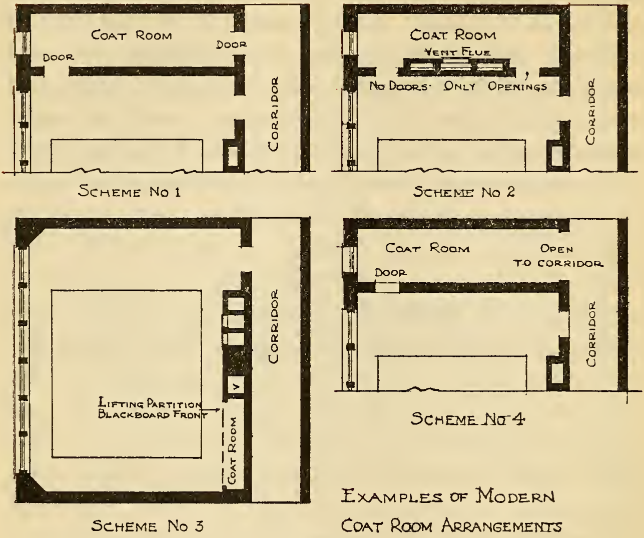
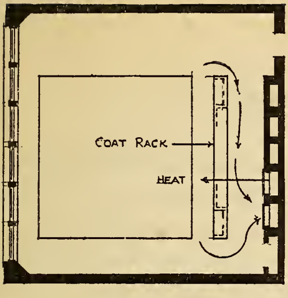
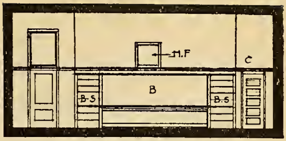


FIG. 5

Figure 5 illustrates four coat room schemes all in common use. Advantages are claimed for each one. In fireproof buildings perhaps scheme No. 3 is most used because of economy. Of the others, the author prefers scheme No. 2.





ELEVATION
LOOKING TOWARD COAT RACK

KEY
B= BLACKBOARD
B-S= BOOK SHELVES
C = TEACHER'S CLOSET
H·F= HEAT INLET

FIG. 6

Figure 6 illustrates a type of coat closet, which is hardly a coat room, but is more like a coat rack or wardrobe. It consists of a rack or framework about eight feet high, erected about five feet away from the wall containing heat and vent registers.

The back or wall side of this rack contains hooks for clothing, but no doors or covering for same. The front or room side of the rack may be covered with blackboard, may contain shelves for books, or both blackboard and shelves as shown.

Admirers of this scheme claim many advantages for it, but chiefly that it enables teachers to have surveillance of the coat room space without leaving the school room. To offset this and other advantages claimed, however, it must be granted that the scheme is unsightly, unsanitary, wasteful of space and more expensive than any other coat hanging scheme above described.

SPECIAL ROOMS.

Apparatus Rooms.—In every school building to contain any considerable quantity of apparatus such as high school buildings, suitable rooms should be provided for the storage and care of such apparatus, and in proportion to the value of the apparatus is it important that such rooms should be fire-proof and fool-proof. They should be provided with suitable cases in which the apparatus may be protected from dust and interference, the cases being furnished with lock and key so as to be kept under the control of the head of the department at all times. It is always desirable to have apparatus rooms connected with physical and chemical laboratories, and the floor area of same should equal about one-fourth to one-third that of the laboratory.

Astronomy Room.—High schools which are equipped with observatories should have a small room adjacent to the observatory which may be heated in cold weather, as the observatory itself is always cold. This room may also contain cases for small instruments.

Assembly Rooms or Auditoriums.—Two different systems are used in the designing of American high school buildings with regard to Assembly Halls. In some, especially those located in small cities and towns, the Assembly Hall is intended for use only as a public Auditorium, in which ample stage facilities are necessary together with provision for stereoptican entertainments, and in which audiences of from

800 to 1500 persons may be seated. In other buildings the Assembly Hall partakes more of the nature of a study room, being seated with desks and intended for the use of pupils only. In still other buildings the stage equipment is provided even though the room be seated with desks for study purposes, and in such schools the Assembly Hall is used not only for a study room but also for such literary and chapel exercises as are conducted for or by the pupils. In either of the latter schemes the hall must be large enough to accommodate all pupils of that building at one sitting, this end being accomplished by different means in different buildings.

Under the present heading, reference is had only to the room intended as an auditorium in which no desks are provided and the following are the important items regarding same. Such rooms should never be placed higher than the second floor of a building and never lower than the first floor, providing the basement story is out of the ground, a "ground floor" Assembly Hall being favored by all authorities and required by law in some states. If galleries are used, entrance to the same may be had from the second floor. Auditoriums in school buildings should be provided with a stage as high as possible and at least 15 feet in depth behind the curtain and should be equipped with a rigging loft, dressing rooms and a small amount of drop scenery and curtains, much the same as may be found in theaters. The larger and more elaborate the Auditorium, the more liberal and better equipped should be the stage. The floors of school Auditoriums are almost invariably made level, or at least with very slight incline, no attempt being made to copy theaters in this regard.

Direct current outlet contained in an iron box should be located in gallery to supply light for the lanterns, and a white curtain may well be included in the equipment of the stage for the same purpose. An ample switchboard should be provided on the stage by which every light in the Auditorium may be controlled at will, both separately and as a whole, and the stage should be lighted with foot lights, borders, etc., in much the same manner as the stage of a small theatre, all being controlled from the switchboard.

Means of exit must be provided directly from the Auditorium to the ground outside regardless of exits provided inside of the building, and no Auditorium should be placed high enough above ground to render this impossible.

Balance Room.—In the larger and more complete high schools a small room is provided in connection with physical laboratory in which delicate balances are kept in cases for experimental purposes. These rooms need not be larger than 50 square feet area.

Biological Rooms.—In the better high schools biological rooms consist of a pupil's laboratory, a private laboratory for the instructor, a dark room and apparatus room all of which are described under their several headings below. The biological laboratory should be abundantly lighted and equipped with cabinet desks containing a drawer for each pupil having the use of such desk, also glass cases for specimens, and also containing suitable demonstration table, preferably with slate top, and instructor's desk. Equipment of private laboratory and apparatus room may be made as simple or elaborate as available finances will permit. The size of biological or other laboratories is dependent upon the number of pupils required to use them. If the building contains a conservatory it should adjoin the biological laboratory.

Bicycle Room.—In cities and towns where bicycles are used to any extent it is advantageous to have provision in school buildings for a bicycle room containing permanent bicycle racks, and a bicycle run from ground level down to the room. Such rooms should be provided with substantial locks.

Board Room.—In many places it is necessary to provide rooms in the school building for the use of the Board of Education, the size of which should be proportioned to the number of members on the Board. Such rooms should always be provided with private toilet room, and if possible a telephone closet and fireproof vault. If the Clerk of the Board is a permanent employe, who devotes his entire time to the work of the Board, an additional work room should be provided for his use having abundant light.

Boiler Room.—The boiler room for school buildings should if possible always be located outside of the main building. In case this is impossible the floor above boiler room should be made both fireproof and heat-proof regardless of the construction of the balance of the building. Boiler rooms must always be at least twice the length of the boilers themselves to provide for cleaning flues, and in case fuel is also contained in the same room abundant provision must be made for storing same. No boiler room should be less than 12 ft. clear height and considerably more height is advisable.

Business Department.—The Business Department in high schools should contain at least three rooms, one each for bookkeeping, shorthand and typewriting. Ordinarily the room for bookkeeping is made the size of an ordinary school room and the other two rooms about one-half this size. The rooms for shorthand and typewriting may be separated simply by a glass partition, and be so located that one instructor may oversee both rooms. The three rooms of this department should be well lighted, located *en-suite,* and in the more elaborate buildings may also be supplied with an additional small room for the instructor's private use.

Chemistry Rooms.—Rooms for the study of chemistry in high schools include lecture room, laboratory, apparatus room, balance room and dark room. The size of the lecture room and class room is dependent on the number of students required to use them, and the other rooms proportioned thereto. The equipment of the laboratory may be as elaborate and complete as finances will admit, but in any case it is advisable to use work tables having closed hoods which are connected with suction pipes under the floor and these, in turn, with vent risers in the walls leading to an exhaust fan by means of which all air in the laboratory may be drawn through the work tables and forced out doors; this method of ventilation preventing the escape of foul odors into the building. The chemical laboratory should also be provided with a floor drain readily accessible at all times.

Clerk's Office.—The data for a Clerk's Office may be found under the head of Board Rooms.

Coal Room.—Coal rooms should be located outside of building if possible but always in conjunction with boiler or furnace room. They should be large enough to contain not less than a half season's supply of coal, and if possible a supply for the full season.

Coat Rooms.—This topic is treated in conjunction with school rooms but as here employed refers to those rooms, in the larger high school buildings, which are centrally located and intended to contain the wraps for an entire floor or any other large number of pupils. Two systems prevail in this regard, one being the use of steel or other closed lockers, each pupil being provided with his own locker and the key thereto; and the other system consisting of open racks in which the wraps are allowed to hang on individual hooks and are kept under the espionage only of the janitor. The users of both systems seem to be satisfied, so that it is largely a matter of individual choice.

Commercial Rooms.—See paragraph on Business Rooms.

Conservatory.—In large and elaborate high schools a conservatory is provided in connection with the Biological Laboratory. This is a room constructed all of glass, located on a sunny side of the building and so arranged with piping that it may be kept at any desired degree of temperature uniformly. It usually contains an aquarium and a counter-table under the windows constructed of slate and supported on brass pipe. It should be separated from the Biological Laboratory by a partition all of glass, and the frame work of the outside should be constructed in the same manner as the highest grade hot-houses, preferably of metal frame with glass filling.

Dark Rooms.—Dark rooms are considered one of the essentials of modern high school buildings to provide for photographic work. They may be very small,—not over fifty square feet area,—and should be provided with a sink, running water and two or three convenient shelves. The chief essential of these rooms is that they must be absolutely dark, be painted on the inside with dull black paint and be separated from any outside room by two doors or some other device which will render it impossible by accident, or otherwise, for any daylight to be admitted into the room while experiments are going on.

Directors' Room.—In connection with large and complete gymnasiums, at least one and preferably two rooms should be provided for the personal use of the Director, this room being connected with the gymnasium itself by a glass door or partition and being well lighted, although skylight will answer for this purpose.

Dining Room.—In buildings containing departments of domestic science a small dining-room is desirable in connection with the room in which cooking experiments are conducted. This room need not be large, say 180 square feet.

Domestic Science.—The department of domestic science in present day high schools as a rule comprises two departments called by some domestic economy and domestic art, the former consisting of a department for the study of cooking and the latter for the study of sewing, etc. The room for domestic economy is much like a laboratory, and its size will be dependent upon the number of pupils to be accommodated, the work being done at specially designed tables which must be so disposed as to leave abundance of working room all around them. Provision must be made for carrying gas supplies to each table and plumbing supplies to each sink, and in addition, a general sink of liberal dimensions and preferably of slate or soapstone should also be provided. Ample provision must be made for cupboards for the storage of utensils, dishes, etc., and it is advisable if possible to provide for a small icebox for the preservation of food supplies.

The room for domestic art or sewing seldom needs to be larger than the ordinary school room unit and in many buildings only half this area is ample. The chief requirement for this room is an abundance of light and ventilation.

Drawing Rooms.—Every modern high school must make provision for both free-hand and mechanical drawing, and while not necessary, it is usually advisable that the rooms for these two departments shall be close together and communicating. A first requisite for drawing rooms is an abundance of light, preferably north light, but skylight is also acceptable, especially for free-hand drawing. Drawing rooms should contain cases for books, studies and models, a teacher's desk and abundant provision for drawing tables, easels and chairs or stools. The room for free-hand drawing should contain a shelf not less than 18 inches wide and about 2 feet 6 inches above the floor, and also a second shelf about 12 inches wide located 7 feet or 8 feet above the floor, both shelves extending clear around the room except where windows and doors are located. The wall space between these two shelves should be covered with Compo board or other soft material which will readily take thumb tacks, and the outside surface of same should then be covered with burlap of a neutral tint.

Dressing Rooms.—Two, and preferably four small dressing-rooms should be provided in connection with the stage of auditoriums or assembly halls, and, while it is not necessary, it is nevertheless advisable that these rooms should have outside light and ventilation and stationary lavatory in each room. Gas lights should also be provided as well as electric lights.

Engine Room.—In every building containing machinery, such as engines, dynamos, etc., a separate room or rooms must be provided to contain the same so that this delicate machinery may not be contaminated with the dust from boiler or coal rooms, and so that all machinery units may be kept within close compass, thus being more easily attended to by the engineer. The electric switchboard should always be located in the engine room, and this room should have connection by telephone or speaking tube with the office of the principal or superintendent of the building. The engine room should be lighted from outdoors if possible, should be equipped with a clock containing the program or control and alarm bell, providing the same are used elsewhere in the building. The engine room should also contain a sink and water-closet for the engineer's use, either in the room itself or connected directly therewith.

Fan Room.—Where blast fans are used for heating school rooms, ample provision must be made for them in the proper location. Most architects err in locating fan rooms by not providing for sufficient height or proper means of obtaining fresh outside air. It is always wise if possible to have fans located near the center of the building so that the work to be done will be symmetrically divided on both sides of the fan.

Furnace Room.—The general requirements of furnace rooms are similar to those of boiler rooms except for the provision regarding cleaning of flues, but abundance of space should be left in front of furnaces for firing space. The height of rooms to contain hot air furnaces need not be made as great as that for rooms to contain boilers.

Gymnasium.—Where gymnasiums are used in school buildings it is safe to figure on an area for the gymnasium itself of about 8 or 10 square feet per pupil in the building, but every well equipped gymnasium should also have locker rooms, and rooms for shower baths and toilets for each sex in addition to the gymnasium itself. The height of a gymnasium should be not less than 20 feet and should be made 25 feet in the clear if possible. It is impossible to lay down any definite rule for the equipment of gymnasiums, locker rooms, etc., because the requirements and supply of money are seldom the same in any two cases. Elsewhere in this book may be found the equipment schedule of the Boston public schools, which is a safe guide.

It is generally considered best to locate gymnasiums in basement stories, as it is much easier to sound-proof the ceiling than it is to sound-proof floors, which would be necessary in case the gymnasium were located in the upper stories. Every gymnasium must be provided with the most liberal provision for ventilation and, if possible, also have outside light, although the latter is not an absolute essential. It is not necessary that gymnasiums should be heated to a high degree, but provision should be made so that this matter may be within control.

Wherever possible, running tracks are provided in gymnasiums, the chief requirement of which is that no radius of any turns in same should be less than 15 feet, and that the floor of running track should be slanted to allow for the inclination of the runners' bodies. It is well to cover the floor of running tracks with cork, and also to have the slant especially designed so that the curves will be exactly correct. It is also of vital importance to so design the supports of running tracks that it will be impossible for runners to collide with them in going around the track, no matter how close to the outside rail they may be running.

The ideal floor for gymnasium is hard maple, cut opposite to the grain of the wood, although some authorities recommend hard asphalt set in concrete and covered with linoleum. The use of pressed brick for inside walls of gymnasiums is preferable to any other wall covering, although hard plaster is used in some places. The circular iron stairway from the running track to the floor of gymnasium, and also the brass sliding pole, are features which may well be included in the building equipment.

Janitor's Room.—Where the machinery is looked after by the janitor, the engine room will answer the double purpose and no extra janitor's room be required, but in buildings containing no engine room and in buildings in which separate engineers are provided, the janitor should be given a room for his own use, containing toilet facilities and space for storage.

Kindergarten.—Primary, and in some cases intermediate school buildings, should have two kindergarten rooms, separated by sliding or folding doors, these rooms so isolated that games and music will not disturb other classes. The floors and walls should be carefully sound-proofed. These rooms should never be located above the first floor and should be provided with a separate toilet-room, equipped with low fixtures of special pattern for the use of children. A circle should be painted on the floor and the walls of the room may well be finished in the manner described for drawing rooms, so as to provide for pictures, models, etc.

Kitchen.—In all school buildings where lunches are served to pupils, it is advisable to provide for a kitchen, the size and equipment of which will be dependent on the number of pupils daily to be taken care of. In any such room, however, ample smoke flues must be provided, a liberal sink equipped with hot and cold water, and such other equipment as the circumstances of the case demand.

Library Room.—Most American cities of the present day have large libraries, so that it is rarely necessary to provide a library in school buildings larger than necessary to contain such works of reference as are especially required in the curriculum of the school. In every case, however, a library should be well lighted, conveniently located, equipped with metallic book-cases and also with good, comfortable chairs and tables. In some of the larger high schools libraries are made sufficiently large to accommodate an entire class at one time. In smaller buildings where no separate library is possible provision is usually made in the superintendent's or principal's office for sufficient book-cases to answer the purpose.

Locker Rooms.—In connection with the gymnasium in basement, locker rooms should be provided for each sex, which should be well ventilated but may be lighted either by skylight or artificial light if necessary. The lockers usually employed are of sheet steel construction, and usually two tiers in height, provided with a lock and key for the use of each pupil. Locker rooms usually also contain compartments about 4 feet square built of slate or marble partitions, and having either doors or curtains at the front, these compartments being used as dressing-rooms for the purpose of classes doing gymnasium work. Locker rooms must always have immediate access to the gymnasium and also to the rooms containing shower baths and toilets.

Locker rooms are also provided in the upper portions of some school buildings, as described under the heading of coat rooms. Wherever locker rooms are provided and steel lockers made use of, it is wise to insist upon patterns which are connected with the exhaust ventilating system, so that air may be sucked through the lockers, thence to the wall risers and thus out doors.

Lunch Rooms.—In nearly all large cities, high school buildings must be provided with lunch rooms for the convenience of pupils. In some buildings these rooms are not provided with conveniences for serving any sort of food, but are merely intended to provide a place in which pupils may eat lunches brought with them to school. This case is very simple, requiring simply a room of ample size and convenient location, equipped with broad-armed lunch chairs, such as are used in the various dairy lunches throughout the country. In other places provision is made for serving warm food, and in such cases kitchens must be provided as above described and permanent lunch tables or counters at which the food may be served. It is impossible to give any general requirements, owing to the great difference in custom throughout the country in this regard.

Manual Training Department.—Manual Training Departments of present day school buildings usually consist of rooms in which are taught the art of joinery, wood-turning, forging and metal working. This department should also always be provided with a liberal stock room for the storage of materials and tools. Manual training work is usually done in basement stories, and in portions of the building so located that the noise can not easily interfere with the work in other portions of the building. Forges should, if possible, be connected with down draft suction pipes leading to exhaust fans, so that all smudge in these rooms may be forcibly drawn out and forced into the open air without contaminating the balance of the building. The equipment of each of the rooms or departments named depends entirely upon the scope of the work being undertaken, the number of pupils engaged in the work and the finances available for the building and equipenmt.

Museum.—Many school buildings contain museums, the chief requirements of which are that they should be well lighted, should be fire-proof and equipped with the necessary cases of proper design for displaying the exhibits belonging to the school.

Music Room.—As a general rule music is taught in separate classes, but many buildings also contain separate rooms for the teaching of music. Such rooms need not be seated with desks but use may be made of the wide armed lecture chair ordinarily used in lecture rooms. Blackboard space must be provided and some musical instrument such as piano or organ.

Observatory.—Where high schools are equipped with observatories it is essential that the walls supporting same must be solid masonry from the ground to the observatory floor, and it is also essential that the floor upon which the observers walk must not at any point be in contact with the floor which supports the instruments. The designing of observatories is an art in itself and the utmost care should be exercised in providing for one which will work satisfactorily. The majority of high school observatories in existence at the present time are not satisfactory.

Physical Laboratory.—As stated with regard to other laboratories, the size and equipment of the physics laboratory is dependent upon the number of pupils, the size of the building and the financial assets in hand. In the larger buildings the physical laboratory is arranged en suite with a physics lecture room, apparatus room, balance room, dark room and also, where possible, a private laboratory and office for the instructor of the department. The chief requirement of design in the physical laboratory is that none of the work tables should contain any metal whatever in their construction and that whereever it is necessary to use metal in any portion of the room, it should not be of iron or steel. The physical laboratory should be so arranged and designed that it will be as free from vibrations as possible, and most authorities prefer this department to be located directly upon the ground in the basement story.

Play Rooms.—In grade buildings throughout the country, play rooms should be provided but these are almost invariably located in the basement. They should be made as cheerful as possible, one being provided for each sex, and directly connected with toilet rooms. It is also advisable to have doors opening to the outside from basement play rooms and that stone or cement stairways be provided to give access directly therefrom to the playground outside. A splendid finish for the interior walls of play rooms is pressed brick.

Principal's Office.—Every school building supervised by a principal should contain an office for the use of the principal, and in large and important buildings both a public and private office and private toilet room should be arranged for the use of the principal. In buildings where the Board of Education or its Clerk do not have their offices, it is important that the principal should have a fireproof vault connected with his office.

Recitation Room.—Rooms for recitation purposes only, as distinguished from class rooms, differ therefrom in the matter of size and in the method of seating. Ordinary school rooms usually have fixed and permanent desks. Recitation rooms are usually equipped with wide armed lecture room chairs. School rooms seldom provide for more or less than forty pupils, but class rooms are arranged with provision for seating any number from twenty to one hundred. Such rooms seating more than forty pupils usually have the floors arranged in steps so that pupils in the rear seats may see over the heads of those in front. The rules for direction of lighting school rooms are not held to be as immutable, in the case of recitation rooms, as they are in ordinary school rooms.

Rest Rooms.—Every school building should contain at least one emergency or rest room which may be used by pupils of either sex taken suddenly ill. These rooms should have a pleasant, sunny exposure, be well lighted and connected directly with a private toilet room. They should be equipped with a couch or davenport, easy chairs, a table and reading matter, and should have a small cupboard containing medicine and other conveniences suitable for rendering first aid to the injured or sick.

Stage.—For description of stage requirements see Assembly Room, Dressing Room, etc.

Superintendent's Office.—The requirements for Superintendent's rooms are identical with those given for principal's office.

Shower Rooms.—In connection with gymnasiums, provision should be made for separate rooms for the use of each sex, equipped with shower baths. The type of baths to be used are fully described in the chapter on sanitation. In, or adjacent to the shower room, should also be provided toilet rooms of ample capacity and correct design. The floor of shower rooms, locker rooms, toilet rooms, etc., should be of tile if possible.

Science Lecture Room.—Every important high school building should be equipped with a large lecture room for the teaching of science, the floor being arranged in steps to provide for the seating of classes in chairs. The science lecture room should be provided with facilities for lantern exhibitions and should have a large and complete demonstration table with slate top on which scientific experiments of various sorts may be performed. The lighting in the room should be so arranged as to be controlled by a switch, located on or near this demonstration table, and some provision should be made whereby the windows may be absolutely dark at the will of the instructor upon a moment's notice.

Study Rooms.—In high school buildings where the plan of separating the classes into general study rooms is followed, these rooms are made of a size sufficient to seat one or more classes together at a time at desks, such as freshmen-sophomore, junior-senior, etc., and where this plan is followed the general rules as to area per pupil, ventilation, lighting, etc., given in chapter on school rooms, should be followed. It is also important where the study room system is used that ample locker or coat rooms be located in proximity thereto, for obvious reasons.

Toilet Rooms.—The equipment of toilet rooms is fully discussed under the head of sanitation, etc., and it will suffice to say here that separate toilet rooms must be provided for each sex, and must be well lighted and ventilated. If possible, the ventilation must be performed by the suction of air through the fixtures, thence into the wall risers and out doors, this system being entirely separate from the general ventilating system of the building. Wherever possible, separate private toilet rooms should be arranged for the use of teachers of each sex, although these may be adjacent to the rooms used by pupils.

Vault.—Fire-proof vaults should be provided as stated in paragraph on principal's office and Board Room.

SANITATION.

No effort will be made in these pages to deal with the subject of school hygiene which covers every aspect of school life likely to affect the health of children, such as periods of study, care of the eyes, discipline, medical inspection, etc., as the purpose of the present work is to cover the essentials of correct school buildings without reference to administration.

Heating and ventilation also properly come under the head of sanitation, as nothing is more important for correct sanitary conditions than pure air, but this subject will be treated in a separate chapter. Sanitation as here considered, will have reference only to those features of the school buildings themselves which conduce to healthfulness and comfort.

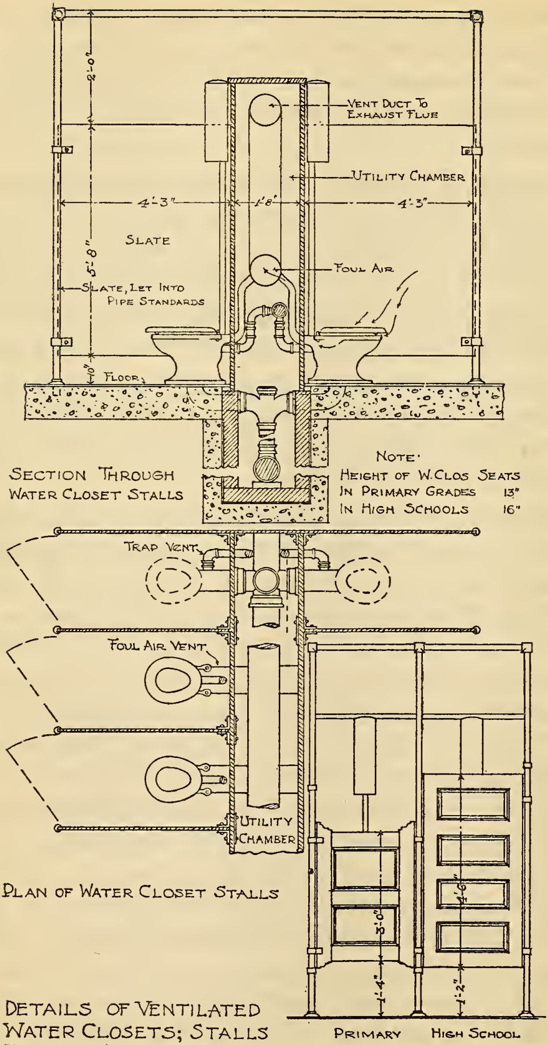
Walls.—In a previous chapter the recommendation has been offered that school walls should be finished smooth and decorated with paint, also that corners and mouldings should be finished round so as to admit of easy cleaning. The first step in the proper sanitation of the school building is to have it so designed as to be easily and perfectly cleaned. When these provisions have been made in the building itself, proper hygienic conditions of walls will be maintained if janitors are forced frequently and thoroughly to brush or wash down the walls, and if provision is made for having them recoated with paint at reasonable intervals.

In the designing of school rooms the use of wood frames around doors and windows should be reduced to a minimum, and the finish should be made as nearly like that which is used in hospitals as possible. It will be found that it is not necessary to use casing around windows and doors, such as is used commonly in dwelling houses, but that the jambs of doors and windows may be formed as shown in figure (2 p 30), thus eliminating all unnecessary woodwork, mouldings and other devices upon which dust is liable to gather and disease germs to lodge.

Sewerage and Drainage.—Reference has already been made to the necessity of waterproofing basements of school buildings to render them dry, but it is of even more importance that school buildings be so situated that the ground surrounding them may be readily drained, and that all sewage resulting from the building itself may be quickly and surely disposed of. Nearly all American cities at the present time have effective sewerage inspection, and definite codes governing the construction of sewers, so that elaborate detail on this subject seems unnecessary. For cities in which no regulations exist it is very easy to obtain copies of codes from neighboring cities from which the standards of good work may be obtained. For buildings in country districts in which no sewage facilities are provided, the service of sanitary engineers should be obtained to design sewage disposal plants to care for the sewage from the buildings. In every school building, the sewage and plumbing system should be made absolutely tight, rendering the escape of sewer gas in the building impossible. In buildings set with allowance for scant fall to the sewer, rendering the building liable to the danger of sewage backing up into the basement, proper valves or traps should be installed by means of which this may be rendered impossible.

Plumbing Fixtures.—No part of the building so concerns its sanitary condition as the system of plumbing and plumbing fixtures which is installed therein. Probably no class of material entering into the construction of buildings has been brought to a higher standard in recent years than sanitary plumbing, and the best demonstration of this statement is an inspection of school buildings erected fifteen or twenty years ago in comparison with those being erected at the present time.

Probably the first step in the present development, was the abolition of the range and dry closet systems, and the development of individual water flushing closets of sanitary design. The process of development has been a long one, and has probably not yet reached its utmost perfection, but several types of water closets have been developed which are highly satisfactory for school use. First among these may be mentioned the system of closets known as latrines because they are the least satisfactory of the types now in use. They are merely a modern development of the old style range closet, in which a number of bowls are arranged consecutively and connected together in such a manner that the entire range may be flushed by the flow of water which is caused to pass through them at short intervals. They may also be provided with positive means of ventilation, but care should be exercised that the ven-



Details of Ventilated Water Closets; Stalls Utility Chamber Etc.

Elevation of Stall Doors

tilation of closets has no connection whatever, with the system of ventilation controlling school rooms. The merits claimed for latrines are that they are so simple in construction that it is almost impossible for them to get out of order, and that the control of the flushing device rests entirely with the janitor, who adjusts the apparatus as desired. Properly constructed latrines, connected with plumbing thoroughly well done, and so designed as to be flushed automatically and powerfully, are quite satisfactory and are being used in a large number of present day schools.

However, another and better type of closet is being used extensively, consisting of a porcelain bowl of either wash down or siphon jet pattern, so designed that pressure upon the seat of the fixture admits water to the tank placed on the wall in the rear of the closet. When the seat is released the water in the tank immediately rushes into the bowl thoroughly flushing and cleansing it and no more water is wasted than the operation requires. It is impossible to make use of the fixture without having it thoroughly flushed with water at each operation, and the mechanical part of the apparatus is so hidden and protected from view that it is practically impossible for mischievous boys to cause any damage thereto. Various other forms of special closets for school buildings are on the market, but the one just described has more in its favor than any other type which has yet been developed. One closet should be provided in each school building for every twenty-five boys and for every fifteen girls. Near every closet or system of closets should be an ample number of lavatories supplied with soap and towels, not only to provide pupils the opportunity of washing but to teach them the advisability of so doing.

Every water closet should be surrounded with a partition making a small compartment to ensure privacy, but many authorities contend that no doors should be provided at the front of such compartments in elementary and intermediate buildings. These partitions should be of black slate, soap stone or marble, and should be set up from the floor 10 or 12 inches and should be of such design that they may be frequently and easily cleaned. Water closets and closet systems should always be so arranged that they may be well lighted and easily cleaned. Wherever possible, provision should be made for the positive ventilation of every fixture, but most certainly of every toilet room. The closet bowls should not exceed 14 inches in height, especially in the lower grades. A utility chamber or working space of 24 inches should be provided behind the backs of closets wherever possible, wherein all tanks, flushing and plumbing pipes of every description may be concealed. A door must be provided for the admittance of inspection or repair men. In buildings having forced ventilation, these utility chambers serve well the purpose of vent chambers, through which the closet compartments may be ventilated. Individual compartments should be about 3 feet 6 inches in depth, front to back, providing no doors are used, or 4 feet 6 inches, front to back, when doors are used, and they should be 30 inches or more in width.

Next in importance to the closets comes the urinal fixtures. A urinal which is sanitary must be so designed that it will (1) thoroughly flush frequently, (2) maintain a body of flowing water to keep the surface of the urinal constantly flushed without waste, and (3) be effectively ventilated. In buildings where the saving of expense is an important item the best type of urinal now in use consists of a large exposed surface of black slate about 4 feet in height, the bottom of which is carried up from the floor about 4 inches and out from the wall about the same distance. The surface of the slate is kept constantly moist by a flow of water supplied from the top of the slab. Under the bottom of the slab is provided a porcelain or cement trough into which the water is received, and the space back of the urinal slab serves as a vent chamber through which the air is drawn and forced to the outside air. Such urinals are illustrated in the Appendix. Recently a much superior but more expensive urinal has been perfected consisting of solid white porcelain about 18 inches wide and 4 feet high shaped like half of a cylinder standing on its end. These urinals are made all in one piece having all exposed surfaces glazed, and adjacent parts being fitted into each other with perfect cemented joints. The fixtures are built into the tile or cement floor of the toilet room and there are absolutely no open joints or crevices in which foulness may gather and produce annoying odors. Each urinal is provided with a flushing device which distributes water evenly over the concave surface of the urinal, the flushing being accomplished by an automatic tank which may be set to operate as often as desired. Each urinal is also supplied with a vent opening protected by a shield under the bottom of the urinal and thus perfect ventilation may be assured. One urinal should be allowed for every eighteen or twenty boys.

Lavatories.—So many admirable patterns of lavatories are on the market that it is hardly necessary to say much concerning them except that the matter of individual use should always be considered, and ample provision made whereby each pupil may have access to a separate lavatory when necessary. Many of the solid porcelain or cast iron porcelain enameled lavoratories are suitable for use in school buildings, and those types are preferred which do not have any direct connection with the walls, and every part whereof is readily accessible for cleaning. All lavatories should be provided with self closing cocks of substantial and durable pattern, and should have some device for controlling the waste, other than the old fashioned chain and stopper. Each lavatory should be provided with liquid soap and a device from which same may be obtained. Whereever possible, hot water should be supplied to the lavatory as well as cold water.

Sinks should be provided for the use of janitors, engineers, etc., which should be cast iron porcelain enameled, having roll rim backs in one piece with the sink. These sinks should always be supplied with both hot and cold water, where possible. In all cities where gas may be obtained, it is now possible to have an abundance of hot water, by means of instantaneous heaters, which are both effective and economical.

In buildings equipped with gymnasiums, or in which it is desirable to provide shower baths, they should be arranged in stalls consisting of a dressing compartment and a shower compartment separated by duck curtains. The shower stalls and dressing stalls may be constructed of either black slate, soap stone or marble as the available funds may justify; and the shower stall should be not less than 3 feet by 3 feet, inside measure, the dressing stalls not less than 3 feet by 2 feet 6 inches, inside measure, and all stalls at least 6 feet 6 inches high above the finished floor. If the funds will admit the shower stall should have a marble or porcelain counter-sunk floor slab with combination drain and trap in the center thereof. A curbing of the same material as the stall partitions 6 inches high should be provided between the shower and dressing compartment to keep the water from splashing the floor of the dressing room. The dressing room should be provided with a seat of the same material as the walls thereof for use in dressing.

Stall partitions should be set in the finished floor 1 inch. The wide variety of shower fittings manufactured is fully illustrated in the catalogues of the various manufacturers from which selection may be made in accordance with the funds available. Essentials in every outfit are that the showers should be of plain type with shower head having removable face with ball and socket joint so the angle may be changed at the will of the bather. The shower should be provided with non-scalding valve, and should come from the wall or ceiling instead of from the floor. In the better class of work temperature regulating chambers are always provided and if desirable needle baths, sprays, etc., may be added to the equipment.

Another sanitary feature deemed necessary in every modern school building is the drinking fountain, the first and most important requirement of which is that it must be of some type which does not permit of the use of the old-style germ ladened cup. Owing to this requirement, leading manufacturers produce pedestal fountains with porcelain bowls and with some type of bubbling cup on top, by means of which a stream of running water, arising therefrom, may be used for drinking without the necessity of any contact between the lips and the fixture. The better patterns of fountains are provided with self-closing faucets to avoid wasting water, and the fitting through which the water emerges is made of porcelain to prevent corrosion or discoloration which would result in case metal is used.

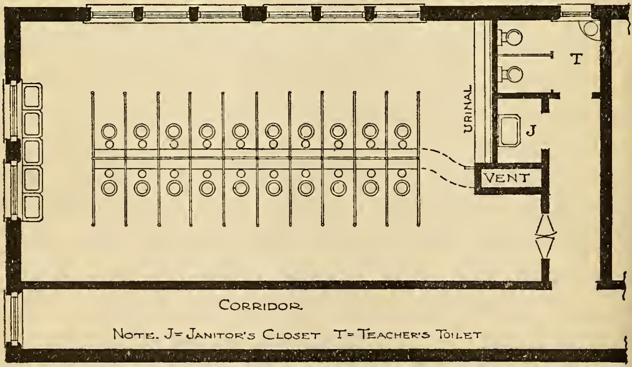


FIG. 8

Figure 8 illustrates an ideal arrangement for toilet rooms for either sex, and shows the vent through which the foul air of the toilet room, after being drawn through the fixtures themselves is exhausted to the open air, outside the building.

Location of Sanitary Conveniences.—There is much discussion of the proper location of toilet rooms or sanitaries in school buildings. Some authorities assert that toilet rooms for children should never be placed in the basement and argue in favor of detached pavilions. Undoubtedly, it is best in the large and more expensive types of buildings to provide ample toilet conveniences on each floor, located, wherever possible, in well ventilated wings or separate portions of the building,—ease of access and complete isolation being the two principal requirements regarding their location. In any case every school building should be provided with at least one toilet room on each floor for the use of teachers, and this may, without disadvantage, be arranged in connection with the toilet rooms for pupils. There can be no objection to the placing of toilet equipments in basements providing the basements are dry, well lighted, equipped with proper facilities for water supply and sewerage, and also provided there is a good positive system of ventilation of the compartments used for the toilet equipment.

The floors of toilet rooms must always be of non-absorbent materials, and if constructed of cement the cement must be absolutely water-proof as elsewhere stated. Toilet room floors of unglazed or semi-glazed tiles, or of artificial plastic cement, make ideal materials for the purpose, especially because cove mouldings may be used at the walls instead of base mouldings, thus rendering it possible to keep the rooms absolutely clean. Wherever the supply of funds will admit, toilet rooms should be wainscoted with glazed tile or marble.

Vacuum Cleaning.—One of the sanitary devices which has now been brought to a high degree of excellence is a device whereby buildings may be cleaned by means of vacuum equipment. Many different systems of vacuum cleaning are on the market, some of which are absolutely dependable and the cost of installing such plants is not relatively very high, especially compared with the positive and excellent results obtained therefrom. By means of such devices not only floors but walls, ceilings and any other portions of rooms desired may be thoroughly cleaned. Estimates of the cost of installing such apparatus, full directions concerning their use, and the results to be secured from them are readily obtainable from any of the manufacturers of such apparatus.

FIRE PROOF AND PANIC PROOF SCHOOL BUILDINGS.

Until very recent years the impression has prevailed that, owing to its excessive cost over ordinary construction, no method of fireproofing could be employed in any school building except the largest and most expensive ones, because the voting public would consider such expenditure needless extravagance. This impression has been somewhat strengthened by the ever increasing cost of structural steel, and the difficulty of obtaining it without weeks or months of annoying delay, which also added to the expense and difficulty of fireproof construction.

Recently these conditions have become decidedly modified owing to three potent influences; (1) one or two frightful school calamities have awakened the public conscience to the conviction that it is almost criminal parsimony, instead of wise economy, to spare the added expense necessary to render school buildings fireproof and panic proof. (2) The alarming scarcity of lumber has not only greatly increased the cost of timber for construction purposes, but the quality of timber now procurable in many parts of the country is so inferior, and of such short lengths, that various expedients of design have become necessary in order to render such timber useable at all. These expedients have seriously added to the cost of non-fireproof construction until there is but a narrow, and ever narrowing, margin between the ordinary type and the fireproof type of buildings. When to this factor is added the cost of fire escapes and other such devices, required in many of the states by law, it is found that there is but little difference between the ultimate cost of the non-fireproof building and that of the so-called fireproof structure. (3) Most potent of all, however, must be mentioned the almost marvelous growth of reinforced concrete construction, by the use of which, intelligently handled, school buildings may be made fireproof at practically the same cost as the ordinary combustible type of building; providing the latter is sufficiently complete to comply with the ordinary safeguards for life and health which are now demanded by the laws in the most progressive states. In addition to the moderate cost of reinforced concrete work, its increasing popularity is doubtless due to the fact that the ingredients entering into its construction may be found in almost every part of the country. Such steel as is necessary to reinforce the concrete may be made of the simplest patterns, everywhere procurable on short notice, and of such character that no steel company or combination can easily work schemes for putting unreasonable prices upon them. Generally speaking, therefore, no progressive board of education should be willing to consider any school building proposition which precludes the possibility of fireproof construction.

One has only to think, for an instant, of the 160 innocent children who were roasted to death in the frightful holacaust, at Collinwood, Ohio, in 1907; of the homes thus darkened by the angel of death, and the desperate efforts of those in authority, in such cases, to find some excuse on which their blasted reputations can be hung, to become convinced that it is little short of criminal to participate in the erection of school buildings which are not practically fireproof and panic-proof.

Definitions.—The term fireproof, while well understood by competent architects, is still but a hazy term in the minds of many people. It is safe to say that there are few, if any, buildings which are **absolutely** fireproof,—i. e., which could not be destroyed by any fire, however great, from without or within. But it is a safe statement that there are very many buildings in the country fireproof in the sense that they could not be utterly destroyed by any fire which can ever assail them, and in which the salvage in case of fire would amount to 70 or 80 per cent. Practically all of these buildings are indestructible by fire from within themselves, and could only be seriously damaged by fires of indescribable fierceness attacking them from the outside. In Chicago, the term fireproof construction applies to all buildings in which the parts thereof carrying weights or resistance, including all exterior and interior walls and partitions, all stairways, elevator enclosures, etc., are made entirely of incombustible materials; and in which all metallic structural members are protected from fire by incombustible materials. "The materials which shall be considered as fireproof covering or protection are, (1) burned brick, (2) burned wall tiles, (3) approved cement concrete, (4) burned terra cotta, and (5) approved cinder concrete.'' The definition of fireproof construction in the New York building code is in effect similar to that stated from the Chicago code; but is more explicit, especially with reference to the construction of high buildings. From the foregoing definitions it will be readily seen that school buildings are easily made of fireproof construction, and it may be done without the excessive expense which is contingent upon the construction of high office buildings, etc.

Application to School Buildings.—All walls of a school building, except mere dividing partitions, should be of solid brick masonry, particularly those walls which enclose or surround stairways. Dividing partitions, where necessary, may be constructed of hard burned terra cotta tile plastered with cement plaster. All floors should be constructed of either hollow terra cotta tile or entirely of reinforced concrete, preferably the latter. Stairways should be constructed of either iron and steel, or of reinforced concrete, and should be isolated in stairway halls and entirely surrounded with masonry or non-combustible materials. The stairway leading to basement should be kept strictly separate from stairways leading to upper portions of the building. Steep roofs, to be finished with tile or slate, should be constructed on steel trusses, the roof surface being formed of slabs of concrete or terra cotta tile and covered with ornamental tile or slate on the outside. Flat roofs may be of either tile or reinforced concrete and should be covered with asbestos roofing, waterproof cement or waterproof tiles laid in cement.

Various preparations are on the market, of a fireproofing nature, for finishing floors and this may be used in place of wood flooring; but buildings which are fireproofed as above outlined, may be considered well within every requirement of safety for school building purposes if the floors, doors and windows are made of wood. However, where sufficient funds are available, even the doors, windows and trimmings may be procured of non-combustible materials, if desired.

Precautionary and Extinguishing Appliances.—Where school buildings are exposed to adjacent structures the utmost care should be observed in rendering the exposed portions of the school building absolutely fire resisting, with reference to the outside danger; which may be done by means of metallic frames and sash in windows and the use of wire glass. In case of an exposure of unusual risk and danger, a sprinkler system could be installed on the outside of the building so arranged as to provide a sheet of water pouring down over the building in case fire reaching a certain temperature should ever come against it. Sprinkler systems may also be installed in any portions of school buildings in which it is considered that an unusual danger of fire may arise, such as laboratories, manual training rooms, engine and boiler rooms; the above rooms containing combustible material.

Every school building whether of fireproof or ordinary construction should be provided with stand pipes connected with the city water system, or in case this source of supply is of questionable value, with a pressure tank located in the attic and kept constantly supplied with a large volume of water under pressure. Outlets from the standpipes should be provided on each floor and supplied with a liberal quantity of non-rotting hose equipped with nozzles, ready for instant use. In addition, fire extinguishers should be supplied in all school buildings, particularly in locations exposed to combustible materials as above named. The use of such devices are advisable even in buildings of fireproof construction, and their absence in combustible buildings is absolutely inexcusable.

Panic Proofing.

It is a remarkable fact that even in buildings which are generally known as fireproof structures, it is still possible for accidents to occur which may give rise to frightful panics on the part of those occupying the buildings. This is, perhaps, especially noticeable in school buildings where little children are congregated in large numbers and easily frightened by any unusual noise, the smell of smoke, or an alarm of any sort indicating danger. The instinct for self-preservation often drives even adults to extremes, which, after the passing of the excitement, seem to the actors themselves almost idiotic; but during the frenzy created by the alarm, reason is cast aside and the sedate human being actually becomes, for a time, an ungovernable maniac. For this reason, much study should be devoted to the arrangement of school buildings so that the occurrences of panics will be rendered practically impossible.

It is not necessary here to speak of the administrative duties of teachers in keeping pupils constantly drilled, in anticipation of fire or panic, regardless of the character of the building occupied by them, as it is now universal practice, made necessary by law in many of the states, for teachers to require constant practice in this regard. Reference must be made, however, to those features of arrangement and construction in the school building which, (1) render the creation of undue alarms practically impossible and (2) provide such facilities that even where the alarm does occur an escape to safety may be easily and quickly made. Some of these features have been touched upon in other portions of this work, but may be briefly reviewed here.

Every building should contain at least two fireproof stairways surrounded by fireproof masonry walls, not connected with each other in any particular, and if possible placed upon opposite sides of the building. Under no circumstances, should a school building be designed with a central hall into which all stairways open, as a fire or panic in such a hall would instantly and effectively block all means of egress from the building. There should be no connection, in any case, between the stairways leading to the upper portions of the building, and the stairways leading down to the basement used as such,—i. e., containing heating apparatus, etc. Every building should contain a liberal number of stairways and these should be of ample capacity. Buildings which are not of fireproof construction should contain emergency stairways, so that each emergency stairway will serve not more than two school rooms in the second story. Every school building should be constructed so as to render the use of outside fire escapes unnecessary, as the latter are not only unsightly and expensive, but almost as dangerous as some of the features within a combustible building itself. School rooms in first story in combustible buildings should be provided with a doorway leading direct to the ground in addition to the usual exits by means of corridors, etc. Basement rooms should have an area space outside the foundation walls, and exits provided into the areas from every basement room to be used by pupils so that instant egress may be had therefrom to the outside in case of fire or alarm.

Design of Stairways, Entrances, Etc.—Every door in school buildings should open outward, whether leading from the school room to the corridor, the corridor to the vestibule or the vestibule outside. No top and bottom bolts should be permitted on doors, and no doors within combustible buildings should be provided with key locks, except main entrance door, library, book closets and boiler room doors.

The proportion of stairways is covered elsewhere in this work, but it may be added here that no stairway should have more than one landing and all landings should be of ample capacity. The outside wall of landings should be made octagonal or circular construction, reducing the landing space to approximately a half circle approaching in capacity that of the stairways, and in case the stairways are of double width, as elsewhere described, the railings forming the division should be carried on a circle arc clear around the landing. The balustrade separating the upper from the lower flight of stairs should be made high, absolutely rigid and with no open space whatever between the top rail of same and the steps, this space being filled either with reinforced concrete, metal screen or balustrade or some other similar device rendering it absolutely impossible for pupils either willfully, or by pressure during a panic, to fall from one flight of stairs to the one below. A solid wall separating the two flights is the best design of all, but the same may be constructed of a steel frame fitted with wire glass, if desired, and this form of design is seen in many of the higher grade schools of the present day.

General Provisions.—In general, the danger of panics in buildings is made remote in proportion to the simplicity and directness of the plan. The more liberal, straight and thoroughly lighted the corridors are, the less danger there will be of panic. Secondary corridors should be avoided, if possible, but in any case must be liberal in size, well lighted and not only have access to principal corridors, but if possible, to emergency stairways at the end of secondary corridors. All emergency exits and other means of egress from the building which are not prominent and obvious at a glance should be prominently marked "EXIT", and in case the buildings are used at night, lights should be provided in connection with these exits so that the letters will appear in red. Such exit doors not only should open outward, but be so fastened that it will always be possible to open them from the inside without difficulty. There should be absolutely no "dead ends", dark nooks or useless spaces in which frightened children could become jammed without easy escape.

Finally when every possible precaution has been made, the children should constantly be impressed with the fact that no danger can ever come from the building which they need to fear.

HEATING OF SCHOOL BUILDINGS.

Practically all works relating to school building treat the subjects of heating and ventilating conjointly as one subject. With reference to some systems this is fitting, because in them the heating and ventilating is performed at one operation, the heated air being used also for ventilating; but perhaps a more intelligent understanding of the subject may be obtained if the two processes are first considered separately and afterwards with reference to their relation to each other.

Direct Heating.

All systems of heating may be grouped under two general heads, (1) direct heating systems in which the heat radiating apparatus is located in the room being warmed, such as stoves, steam and hot water radiators, and (2) indirect heating in which the heat radiating apparatus is not located immediately in the room to be warmed, but in the basement or some other portion of the building distant from the room or rooms being warmed. There are buildings in which both the direct and indirect are used in combination, which systems are discussed fully in the chapter on ventilation.

One principle should be borne in mind constantly,—that ventilation on any positive or sanitary basis is an utter impossibility in rooms warmed by the direct system; heating is possible but no practical ventilation. It is also well to remember that the process of heating a room is a three-fold operation; (1) heating the air within the room, (2) heating the walls, floor and ceiling of the room, and (3)

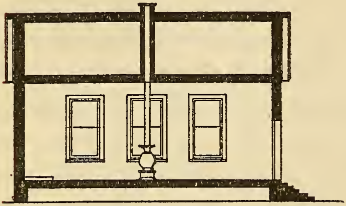
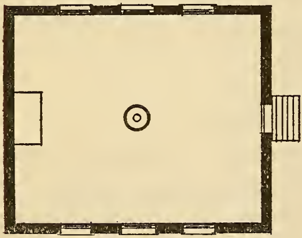


Fig. 1



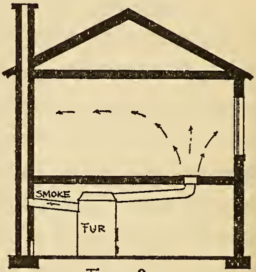


Fig. 2

EVOLUTION OF HEATING SYSTEMS

Fig. 1 DIRECT HEATING, NO VENTILATION

Fig. 2. INDIRECT HEATING · NO VENTILATION

heating the air which may find its way into the room through crevices, around windows, doors, etc., to replace air which has leaked out in the same or any other manner.

Heating Devices: Direct System.—The heating apparatus of the earliest schools undoubtedly consisted of enormous open grates or fire places which were, without question, bright and cheerful but not suited to school requirements. The open fire-place superheats those nearest the fire and leaves cold those at a distance. It is also expensive, as at least 50 per cent of the heat producing power of the fuel is lost through the open chimney. Open fire places may produce slight ventilation by reason of the draught created by the hot air passing up the chimney, but such ventilation is limited exactly to the amount of air which can leak into the room around doors, windows, etc., and such leakage rather contributes to the discomfort of the occupants of the room, than to ensure a perfect ventilating system.

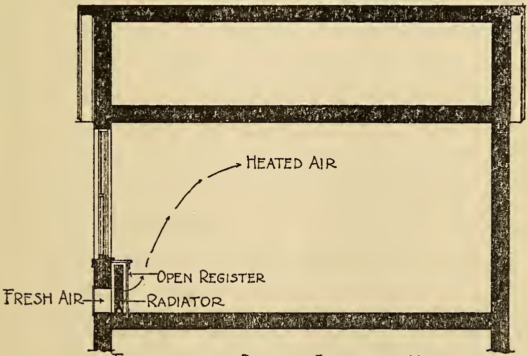
Doubtless, the next step in the development of direct heating apparatus, was the modern iron stove which is still used, particularly in rural districts, for heating school rooms. Any sort of stove is but little better than the open fire place, possessing all of its defects and no additional merit except that of economy. The stove produces even less ventilation and in fact possesses but one reliable characteristic, —the ability to produce a great deal of heat at one point in the room quickly, and with a limited quantity of fuel. With the use of steam for heating buildings, the annoying and unsightly radiator came into use, and in many cases soon replaced the old-fashioned fire place and stove; but steam radiators for direct heating of school rooms are little better than fire places or stoves, and are incapable of producing any ventilation whatever. They are chiefly admirable as dust catchers. Owing to the excessive temperature and rather depressing effect of steam heat, hot water is often substituted therefor, but aside from the different character of heat furnished by the two systems and the very slight economy resulting from the use of hot water, the two systems are identical in principle and results.

Many schemes have been devised for modifying and elaborating the apparatus for direct heating, above described, and for combining so called systems of ventilation therewith, but with very indifferent success. Even though flues are provided for the outflow of heated air from the rooms they do not ventilate, except in the imagination of the designer.

Indirect Heating.

Indirect heating is any system in which the heat radiating surfaces are located outside of the room to be heated. Indirect systems may consist of hot air furnaces, or a "Battery" of steam or hot water coils located at some central point or points in the building, the apparatus being so connected with flues and piping that the air which is heated in the apparatus is conducted, in the flues, to the rooms to be heated. Flues or outlets are then provided in each of the rooms for the escape of the air in the room outdoors. Where no fan or blower is used, such a system is commonly designated as a gravity system, this phraseology being based on the theory that the heated air entering the room is rarified, by means of the heat, sufficiently to cause it to rise in the outlet flues and escape outdoors, thus creating space in the school room which will be immediately filled by other heated air and the operation thus kept up indefinitely; a theory, however, far from reliable or trustworthy. Where the operation is controlled by means of fans or blowers the result may be positive and sure, but this phase of the subject is treated under the head of ventilation.

In the systems of direct heating described it is assumed that the heating apparatus simply warms, and keeps warmed, the air in the school room, no provision being made for the admission of fresh air or the egress of vitiated air except by leakage as stated. Indirect heating, however, involves some movement or change in the air of the rooms being heated, and a system of flues to provide for same; for if no means be provided whereby the air first in the rooms may find its way out, it is manifestly impossible to introduce fresh heated air from the basement, or other central point, into the rooms. Indirect heating, therefore, has the advantage over direct heating that it necessarily involves more or less positive ventilation.



EXAMPLE OF DIRECT-INDIRECT HEATING

Direct Indirect Heating.—A system of heating once much in vogue, but now obsolete and little used, was the direct-indirect system, which can be used only in connection with steam or hot water. This system consisted of the placing of radiators adjacent to windows, or other openings, leading direct outdoors, the theory being that the heat in the radiator would induce currents of fresh air to pass from out doors over the radiator into the rooms to be heated. Of course, no air whatever would enter the rooms in such manner unless flues were also provided whereby air in the rooms might find its way through these vents outdoors, and even in such case, ventilation by this system is exceedingly uncertain. Systems of this sort give much annoyance through freezing of the steam pipes exposed to the cold air and it is impossible to construct such a system so as to supply an ample and positive volume of fresh air for ventilation.

GENERAL PRINCIPLES OF VENTILATION.

Ventilation in reality is a branch of sanitary science, and although many believe the science still to be in its infancy, vast progress has been attained in its development and perfection within very recent years.

Ventilation, as contemplated by this work, refers to the continuous renewal of the air within buildings intended for school purposes. It will have no reference to accidental or imperfect ventilation, such as may be obtained through windows, doors or other such means, but only to such positive ventilation as may be brought about *only* by means of a definite supply of fresh air *forced* into the rooms at one or more places by means of *pressure* from a blower or otherwise, and the consequent displacement of the foul air in the room by means of the same pressure, —in short, will refer to a gradual, complete and continuous changing of the air from foul to fresh so that the air breathed by the occupants of the rooms will be at all times as near perfectly pure as possible. No such result can be attained unless the volume of fresh air supplied is based on the number of occupants, and length of periods during which the rooms are occupied, and unless the supply of fresh air, and the removal of foul air, is accomplished regardless of the varying internal and external temperatures, as well as the velocity and direction of the air outside of the building.

A few general principles, now well established, regarding the character and motion of air in a room should be kept in mind to insure an intelligent grasp of the subject.

(1) The air in a room must be conceived of as a definite medium, just as one thinks of the water in a bucket which is filled to the brim with that liquid. As it is impossible to put more water into the bucket without forcing out of the bucket some of the water which is already therein, so is it impossible to force air into a room without displacing some of the air already within the room. Further, the volume of air which can be delivered into any room is always equal to the quantity of air displaced therefrom, if the pressure remains the same.

(2) The air of nature is a mechanical mixture of nitrogen and oxygen, with a little carbonic acid, a form of oxygen called ozone and more or less vapor of water. The amount of carbonic acid in the open air of nature is from 4 to 6 parts in 10,000 by volume.

In places where ventilation is not perfect, air contains also impurities such as sulphuretted hydrogen, sulphuric, nitric and other acids and often more or less solid matter like particles of dust. Air in rooms occupied by human beings becomes rapidly contaminated by the products of respiration from the human beings, the pores of the skin, etc. Air also contains bacteria or disease germs; and many authorities believe that the dust particles in air are largely responsible for the distribution or propagation of the bacteria of various diseases.

(3) While the ends to be sought in ventilating are threefold (1) hygienic, (2) economic and (3)

mechanical, both heating and ventilating are most important for hygienic reasons. Pure air is as important to the human body as food and water. A candle will not burn in air impoverished of oxygen. So also, breathing impure air dulls the fires of the body and thus clouds the intellect. The more the bodily vitality is lowered, the greater is the danger of contracting both temporary and permanent disease. Real vital energy must not be expected in abnormal atmospheric conditions.

If pure air is entirely absent, death is immediate. One cubic foot per minute will barely support life. Five or even ten cubic feet per minute admit of but low vitality; thirty cubic feet per minute will ensure vigor and health, but additional fresh air up to the point where noticeable draught begins, is the ideal condition.

(4) The air in a room is always in motion owing to the fact that certain portions of the room, such as glass, may be colder or hotter than other portions, such as walls, and this inequality of temperature is certain to result in air motion by the force of gravity, cold air falling because of its density and heated air rising because of its rarity.

(5) Carbonic acid gas expelled from the human lungs by respiration, or emitted through the pores of the skin, is 50 per cent heavier than pure air and therefore falls toward the floor.

(6) The air in nature is purified by the action of winds, rain, lightning, etc., but it is impossible to purify the air inside of a building except by removing and replacing it with fresh air brought from out doors; therefore any so called system of ventila-

tion which does not positively produce this result is not in reality a system of ventilation at all.

(7) Positive ventilation can be secured only where provision is made for (1) some source of power for forcibly moving the air, (2) flues and inlets for conducting the fresh air into the rooms, (3) outlets and flues for conveying the exhausted air again to the out doors.

(8) The quantity of fresh air necessary to maintain a fixed standard of purity may easily be determined, using the carbonic acid as the index. Each adult averages 20 cubic inches of air at each breath, and about 20 respirations each minute. Knowing the amount of carbonic acid in pure air, and in air expelled from the human lungs, and knowing by experiment that discomfort if not harm attends the breathing of air containing more than 8 parts in 10,000 of carbonic acid, it is easy to figure the requirements for any standard. This subject is fully elaborated in Prof. R. C. Carpenter's excellent work on Heating and Ventilating Buildings.

In Massachusetts the state law requires that the ventilating apparatus of all school buildings shall supply at least 30 cubic feet of fresh air per minute or 1800 cubic feet per hour for each pupil, upon which basis the air in a standard school room containing 40 pupils would have to be wholly changed once in every 8 minutes. This has practically become the standard the country over.

Inlets, Outlets and Flues.—The utmost care must be observed in designing inlets, outlets and flues for ventilation. It is an easy matter to bring a definite volume of air into a given space in a given time, but it is often exceedingly difficult to accomplish this result reaching all parts of the room with the fresh pure air, but avoiding the formation of air currents, draughts and eddies. Te secure satisfactory results the air should be uniformly distributed, should be warmed enough to prevent a feeling of chilliness on the part of individuals in the room, and should proceed at a speed which will not give the sensation of a draught. Air entering a school room should not have an initial velocity in excess of 15 feet per second at the opening in the flue, or in excess of 6 feet per second in the school room.

The best results are obtained when the air inlets are located at a considerable height above the floor and the outlets are located at the floor on the same side of the room as the inlet. The advantages of this arrangement are that heated air tends to rise and spread uniformly just under the ceiling, after which it settles lower and lower in the room, gradually displacing the cool and foul air there-in and the room is thus soon filled with fresh warm pure air while the vitiated air passes out through the vent shafts under the impelling force of the fresh air which has been forced into the room. Mr. Warren R. Briggs, of Bridgeport, Conn., published in the third annual report of the Connecticut State Board of Health, 1879, the results of a series of experiments made by him to determine the most advantageous location of inlet and outlet flues for ventilation purposes. The results of these experiments were given in the work published by Mr. Briggs in 1899, on the American School Building. These experiments were conducted with a model having about one-sixth the capacity of an ordinary school room and the movements of the air were made visible by mingling smoke therewith whereby all changes undergone in the air were made visible.

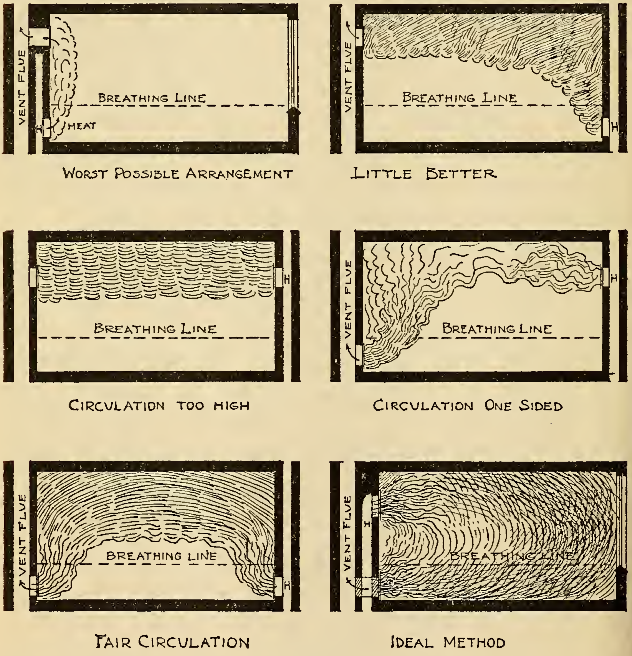


FIG. 12.

These experiments are illustrated in figure (12). It is perhaps well to add that the practice of the best ventilating engineers and the experience of the years which have elapsed since these experiments by Mr. Briggs demonstrate the correctness and reliability of his conclusions.

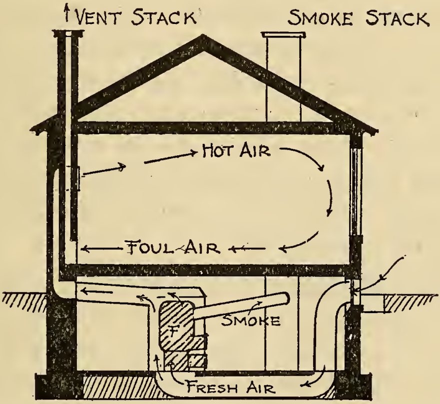
SYSTEMS OF VENTILATION.

Until very recent years, ventilation was regarded more as a luxury than a necessity. Although the discomforts of poorly ventilated rooms have always been known and deprecated, the apparent necessity of complex and expensive methods for correcting the difficulty has undoubtedly retarded the advancement in this department of building economy. But, as a result of the recent advance in hygienic science and experiment, it is now well known that the vitiated atmosphere of crowded rooms is positively and undeniably injurious, often leading to the propagation of various dangerous diseases, and that continued exposure to it is reasonably certain to be followed by serious consequences. A vitiated atmosphere lowers the vitality and therefore decreases the physical and mental working power of the individual and at the same time increases his susceptibility to disease. It is of the utmost importance that school buildings should be ventilated according to the most advanced principles, and every school board should insist upon expert service in this department of building economy whether it has been afforded elsewhere or not. The practice, followed by many boards, of permitting various manufacturers to submit their own layouts is a very unwise practice, being due no doubt to the fact that many architects not skilled in the designing of ventilating apparatus are glad to have manufacturers assist them in this manner.

This procedure not only defeats all true competition, but has the additional defect of making the boards of education act in the capacity of judges of the various ventilating schemes submitted, which they are utterly incompetent to do, and many failures can be explained by the following out of this program. If any portion of a school building is worthy the attention of an expert surely this is it.

Ventilation by Natural Methods.—On the basis of least expense, natural agencies, such as air supply through doors and windows, were long depended upon, but it is apparent that such ventilation is not a "system" at all and is both spasmodic and disagreeable, if not dangerous because of draught.

Ventilation by Gravity.—The first step away from ventilation by natural methods consisted in supplying buildings with flues either for the introduction of fresh air, the withdrawal of vitiated air, or both; but where no method was employed for **forcing** fresh air in through the former, or **drawing** the foul air out through the latter, such systems of flues were even less dependable than the natural processes above referred to. This led to a further step in advance known as the Gravity System and consisting of some means of encouraging or **inducing** a movement of the air in the rooms into the foul air flues. One such plan involves the use of two flues for each room, one leading into the room from a furnace, or battery of furnaces, located in the basement, and the other leading from the room to a point above the roof of the building. It is the theory of this system that when the air used for heating the rooms leaves the furnaces, it both rises and expands in volume, because of its heat and lighter specific gravity, and thus enters the room with a certain velocity due to these causes. This velocity is **supposed** to be sufficient to displace an equal volume of



GRAVITY SYSTEM
OF HOT AIR INDIRECT HEATING
AND VENTILATING COMBINED.

This illustration shows diagramatically the principle of a gravity system of heating and ventilation, showing the path of outside cold air as it passes over the furnace, up into the school room and outdoors again through the vent stack. The motion of the air is produced by the heat of the furnace.

the air already in the room and force it up the vent flue and thus out doors. This is a beautiful **theory** and such systems sometimes do operate with a fair degree of satisfaction when the wind and weather conditions are favorable, but if the winds or weather are unfavorable, the system is just as certain to prove ineffectual and little better than no system of ventilation whatever.

A final step in the development of the gravity system consists in placing gas jets, steam coils, iron smoke stacks, etc., in the exhaust flues, with the idea that the heat thus generated will cause a positive draught and thus force foul air up the exhaust flue and thus out doors, but the same objections may be urged to this phase of the gravity system, which is sometimes called ventilation by aspiration, as have been urged against the simple gravity system, differing only in degree.

Forced or Mechanical Ventilation.—The inevitable result of the unsatisfactory results obtained from all methods of ventilation previously referred to, has been the general conclusion of all authorities that there is no system of ventilation, of any sort, which is positive, uniform or otherwise dependable except the method of supplying air for ventilation **by force** from a blower or fan; and that if the air is wanted in a particular place, at a particular time, and in certain definite quantities and velocities, it must be **forced** to go there under the necessary conditions in spite of winds, weather and all other such conditions. Further, actual experience is demonstrating that no positive system of ventilation is so inexpensive—results considered—as the fan system, in buildings of eight rooms or more.

Ventilation and Heating Combined.—Although the subject of heating has been separately treated in the present work, experience has demonstrated that in our climate it is never wise to operate the system of ventilation entirely by itself, as the air used for ventilation should at least be warmed to the temperature of the room into which it is introduced. In some systems the heating and ventilation is performed at one operation, the ventilating air being first forced through the heating furnaces or coils thus raising it to a high temperature, in which condition it is introduced into the school room under pressure from the fan or blower. After passing through the room it is forced out through the ventilating stacks, but not until it has performed the two operations at once. The latter system while in more common use is not as good practice as the systems in which the heating and ventilating are more nearly independent of each other for the following reasons:

1. In order that the ventilating air shall not lose so much heat in its passage through the school rooms as to cause an unpleasant and cooling feeling upon the occupants of the room, it is necessary to overheat the air at the furnaces, thus cooking or burning its dust and depriving the air of the humidity which it must have for the best results.

2. Owing to the absence of this humidity the mucous membranes of the persons occupying the room become affected and are more liable to colds and other irritating affections.

3. Such dry air quickly affects the vitality and comfort, if not the health of the pupils occupying the rooms, and it is very frequently found necessary to resort to the opening of windows or transoms to secure fresh air in its natural condition of humidity

because of the absence of same in the ventilating air furnished to the room, thus counteracting and nullifying the mechanical ventilation.

Systems of Forced Ventilation.—There are two systems of forced ventilation, (1) the Exhaust system, and (2) the Plenum or pressure system. The exhaust system consists in using a fan to forcibly withdraw the air from rooms. This system is now little used except for ventilating toilet rooms, chemical and other laboratories, etc. In this system a partial vacuum is created within the apartment and, as all air currents and leaks are thus inward, there is nothing to govern the quality or velocity of the air, and it is difficult to provide proper means of warming it. In the case of toilet rooms, laboratories, etc., the system is very desirable, and in many buildings imperative. Further, the tendency of the air in corridors and adjoining rooms to leak into the toilet rooms, etc., because of the vacuum above described, is a positive merit rather than a defect in this case because it counteracts all tendency of foul smelling air to pass from these apartments into other portions of the building.

By the Plenum system, fresh pure air may be forced into the rooms at any desired degree of temperature or velocity, at any desired degree of humidity, and under such conditions as may be positively controlled at all times; and all leakage is outward through windows, etc., thus preventing the drawing of polluted air into the room from any source whatever. Moreover, all air which is forced into the room by the Plenum or pressure system, and owing to that pressure, forces out of the room an equal volume of the vitiated air, which is already in the room, and does so by positive measurable processes which remove all doubt as to the actual results accomplished. When it is remembered that the physical energy of the body is absolutely dependent upon a constant and positive supply of fresh pure air, as surely as the energy of the engine is the result of the fires under the boilers, the vast importance of this result is easily realized.

Heating and Ventilating Air.—Air used for ventilation is always heated in cold weather before its introduction into school rooms, and as already explained, may be sufficiently heated so that the heating and ventilating may be performed at one operation. In buildings where steam or hot water is used for heating, the air for ventilation is frequently heated to only 70 degrees by means of indirect coils located in the basement, the idea being that the radiators in the rooms are to provide the heat necessary for the rooms, and the indirect coils in the basement are for the purpose only of tempering the ventilating air so that it may enter the rooms at the same temperature as the air which is already in the rooms. This latter plan is considered far the best system of heating and ventilating now in common use and is much to be preferred over any system in which the heating and ventilating is done at one operation.

Quantity of Ventilating Air.—Professor Woodbridge says that "Only two considerations should be allowed to limit the quantity of air supply: Air draughts and bank drafts." In other words, ventilating air should be supplied in maximum quantities up to the point where danger arises from colds due to draught, providing the funds in hand will admit of such liberal supply. The length of time rooms are actually occupied continuously has much to do with the quantity of ventilating air which should properly be used in the rooms. Under the Massachusetts law, as first passed, it was attempted to require 50 cubic feet of air per capita per minute in public schools, but as it was found impracticable to obtain such a high standard, especially within reasonable financial limits, the standard was dropped to 30 cubic feet per minute which is now generally adopted in school work throughout the country as the **minimum** volume to be provided in any system of ventilation worthy of the name. As more and more attention is given to perfecting ventilating apparatus, the time will probably come when 40 cubic feet or even 50 cubic feet may be obtained within reasonable limits of expense and this is the goal toward which all progress should be aimed.

Air Velocities.—The inlets and flues in a ventilating system should be so designed that the velocities of ventilating air will be as follows: Leaving the register into the room 350 linear feet per minute; passing through distributing flues and risers 750 linear feet per minute; in mains and branches 1000 to 1500 linear feet per minute. The velocity of ventilating air in toilet rooms, laboratories, gymnasiums. physical training rooms and other such special rooms may be varied from the above to suit the special conditions as the judgment of the engineer dictates. But all such rooms should have much larger per capita supply than ordinary school rooms.

Heating by Rotation.—As a measure of economy, many heating and ventilating plants are so designed that for quick preliminary heating of the building the ventilating air is drawn from within the building itself into the fan chamber, and thence forced back again into the building thus making a complete rotation of the building without contact with the cold air from out doors. This process no doubt saves expense in the initial heating of buildings, and may be recommended for that purpose only, but all air for ventilating purposes, while rooms are occupied, should be drawn directly from out doors and if possible from a point above the building rather than near the ground.

Automatic Control.—Wherever the funds in hand will permit, the heating and ventilating apparatus should be automatically controlled, and no first-class building may be considered complete without such control. While many systems are on the market the Johnson system and Powers system are probably in more general use than any others. One remarkable effect of impure air is to render the occupants of the room more or less insensible to heat. Thus both teachers and pupils in poorly ventilated rooms will frequently complain of cold when the thermometer indicates the actual temperature of the room to be as high as 75 or 80. Under such conditions the addition of more heat, without pure fresh air, simply aggravates the conditions. Moreover, if teachers in various parts of the building are permitted to tinker with the heating and ventilating apparatus to satisfy their own whims, or even if an experienced janitor is allowed to have control of this matter, the results will prove very unsatisfactory and annoying. By the use of an automatic system the heat may be kept permanently at any desired degree in every portion of the building, and the flow of ventilating air may be controlled according to the wishes of the superintendent of the building, and kept within any bounds desired. This result is accomplished by means of thermostats, located in each room, which are connected by means of compressed air pipes with various dampers located at the proper points in the heating and ventilating system. In some of the systems the work is accomplished by means of electricity instead of compressed air. Thermostatic valves are also provided for attachment directly to steam or hot water radiators so that no matter what system of heating and ventilating is used, automatic regulation is not only feasible but has been demonstrated absolutely reliable. In general the cost of automatic regulation amounts to about one-tenth or one-twelfth of the cost of the entire heating and ventilating system.

Location of Openings.—The location of inlets and outlets for ventilating air is a very important matter and has much to do with the efficiency with which the ventilating air performs its work. Naturally the air currents within a room always tend downward owing to the cooling effect of windows and the outside walls, and the movement of the air which is thus slightly chilled is over the floor and back toward the warmer and inner walls again. The tendency of the air near the ceiling is naturally toward the outer walls and the falling currents above mentioned. For these reasons the proper location for the air inlets is upon the inside wall at a point as nearly as possible central with reference to the outside or exposed walls, and the best practice includes the use of diffusers to spread the air in every direction horizontally, as it enters the rooms, in order to encourage its distribution into all portions of the room, and avoid the danger of a mere circling of air in a vertical plane from the point of inlet to the point of outlet. It is also advisable to have the inlet high enough to avoid any possibility of draught upon the occupants of the room and the best practice of the present day is to locate inlets at least seven feet above the floor level. From the foregoing reasoning, it will be obvious that the outlet for vitiated air should also be on the inner and warmer wall of the room, and should be in or near the floor so as to catch all impure air as it passes over the floor, before it has an opportunity to rise along the inside wall and become again a part of the air current ventilating the room. Where it is possible to do so, it is advantageous to have two inlets and outlets for the purpose of better distribution of the ventilating air.

Humidity.—We do not usually note by our feelings the presence of moisture in the air any more than we note the air itself. It is only by the lack of moisture that its absence is manifest. Of course there is not in nature such a thing as dry air or air wholly without moisture. The warmer the air is, the greater amount of vapor is required to produce a given percentage of moisture; and the colder the air is, the less vapor is required to produce a given percentage of moisture. This explains why the percentage of moisture contained in outside winter air is comparatively small, and when such air is warmed to 70 degrees or higher without any increase of moisture, the capacity of the warm air for absorbing additional moisture is very great, and therefore evaporation from all moist surfaces exposed to it becomes rapid. As a result the mucous membranes of the nasal passages, the skin, and the moist surfaces of the eye and ear, are more or less affected and often serious discomfort results. In view of these conditions the larger and more complex systems of heating and ventilating, at least in the better grade of school buildings, include apparatus for maintaining the humidity of the air at a percentage approved by the best medical authority, and wherever the funds in hand will admit of such equipment it should be included.

Filtering Air for Ventilation.—Another refinement found in the better grade of heating and ventilating plants, consists of air filters for the purpose of purifying the air which is used for ventilation. While such an equipment may be desirable or necessary in some localities which are particularly dusty or smoky, it is not as yet considered of sufficient importance to be included in the majority of American school buildings. Hygienically considered, it is not of great importance, as the filters would in no case remove disease germs. And simply to remove dust from the air by the ordinary methods of filteration requires so much extra fan power in forcing air through the filters that the result does not justify the added expense.

NOTE. All readers who care to study a more exhaustive and technical paper relating to the warming and ventilating of school buildings are referred to a treatise written by Professor S. H. Woodbridge of the Massachusetts Institute of Technology for the Board of Education of the State of Connecticut in 1898. Professor Rolla C. Carpenter, in his exhaustive work on heating and ventilating buildings, page 430, publishes this treatise and pronounces it the best general discussion of the subject hitherto published. The author acknowledges this paper to be his authority for many of the conclusions on this subject contained in the present work.

STATE SCHOOL CODES.

The following states are still without any definite laws or code governing the character of public school buildings, in regard to construction:

Alabama	Mississippi
Arizona	Missouri
Arkansas	Montana
California	Nebraska
Colorado	Nevada
Delaware	New Mexico
District of Columbia	North Carolina
Florida	Oklahoma
Georgia	Oregon
Idaho	Rhode Island
Illinois	South Carolina
Indiana	Tennessee
Iowa	Texas
Kentucky	Vermont
Louisiana	Washington
Maine	Wisconsin
Maryland	Wyoming
Michigan	

None of the states in the above list have any laws or codes governing the construction of school buildings at the present time (January, 1910), although some of the states in this list have laws requiring drawings and specifications for school buildings to be submitted to the state boards of health or the state factory inspector for approval before the buildings are constructed. These conditions obtain in

Indiana, Vermont and one or two other states. However, no state in the above list has any requirements whatever regarding the heating and ventilating, lighting, sanitation, fireproofing or panic proofing of school buildings.

In all of these states, notably Missouri and Illinois, the large cities like St. Louis and Chicago have city building codes, the provisions of which apply to school buildings in common with all other buildings, but as a rule such city building ordinances relate only to safety of construction and fire protection.

THE CONNECTICUT LAWS.

All public schoolhouses, the construction of which was not begun before the passage of this act, shall be constructed in accordance with the provisions hereof.

No school house for the accommodation of pupils of grammar school grade, or of a lower grade, shall be constructed so as to contain more than two stories above the basement. No schoolhouse for the accommodation of pupils of a higher grade than grammar school grade shall be constructed so as to contain more than two stories above the basement, unless such schoolhouse is of fireproof construction throughout, and in that event shall not exceed three stories above the basement.

All schoolhouses of eight or more class rooms not of fireproof construction throughout shall be built as follows: (a) The outer walls shall be brick, natural or artificial stone, terra cotta blocks, re-inforced concrete, or other fireproof material. (b) The walls separating the schoolrooms from the halls or corridors shall be of masonry or other fireproof material. (c) There shall be a stairway constructed in at least two opposite sides of the building leading to the ground floor from the floor or floors above, and no such schoolhouses hereafter built shall contain circular stairs. (d) There shall be one exit constructed in at least each of two opposite sides of the building upon the first floor leading to the ground, which may be the same as the exits from the floor or floors above the first. (e) The stairs and stairways shall be of fireproof construction. (f) All doors leading from rooms into halls or corridors shall be hung so as to swing into the hall or corridor, and all doors leading from the corridors out of the building shall be so hung as to swing outward. (g) There shall be a door of fireproof material at the head of each stairway leading from the first floor to the basement. (h) All wooden partitions, ceilings, floors and woodwork about the heating apparatus or plant shall be covered with asbestos, tin, sheet iron, or other fireproof material so as to effectually overcome danger from fire.

No door leading from a schoolroom into a hall or corridor, or from a hall or corridor out of the building shall, during school hours, be locked or bolted, or secured in any other manner than by a spring which will readily yield to pressure from the inside.

There shall be placed in a hall or corridor of every such school an alarm consisting of a bell or gong arranged or equipped so as to be sounded from at least one convenient station or place upon each floor, and of sufficient size and volume of tone to be distinctly heard in every room when sounded. In the absence of such alarm there shall be placed in each room an alarm consisting of a bell or gong of sufficient volume to be heard throughout the room where placed, all of which alarms shall be arranged or equipped so as to be sounded simultaneously from the same station or place, at least one of which stations or places shall be conveniently located in a hall or corridor upon each floor.

Any janitor, teacher, or other person who violates the provisions of the fourth section of this act shall be fined not more than three hundred dollars, or imprisoned not more than three months, or both. Every member of a board of education, school board, board of school visitors, or building committee, or official who is charged with the duty of planning, contracting for, or building a public schoolhouse, who plans or contracts, or participates in contracting for, or votes to build, or builds such schoolhouse in violation of any of the provisions of this act shall be fined not more than three hundred dollars, or imprisoned not more than three months, or both.

Approved June 10, 1909.

THE KANSAS LAW.

Be it enacted by the Legislature of the State of Kansas:

Doors in Schoolhouses.—That the doors of all public or private schoolhouses of more than one story shall open outwards, and all doors of schoolhouses shall remain unlocked while school is in session.

Separate Exits.—That in every public or private schoolhouse of two or more stories every story above the first shall be provided with either two or more exits from the upper floor, separate and distinct from the exits of the lower floor, or shall be provided with sufficient and suitable fire escapes, which shall be built of iron or steel.

Furnaces.—That the tops of all furnaces in public or private schoolhouses shall be covered with asbestos covering or masonry, and the top of such furnace shall not be nearer than eighteen inches to the nearest woodwork above. The ceiling above said furnace shall be covered with asbestos.

Plans—State Architect.—That no contract shall be let for the erection of any school building, nor shall any public funds be paid out for the erection of schoolhouses of two or more stories, until the plans for such buildings shall have been submitted to the state architect and approved as to all the requirements of this act.

Inspections.—That each county superintendent shall annually inspect each public school building, including the county high-school building, in districts under his supervision; and the mayor or fire marshal shall annually inspect all public and private school buildings in cities of the second class; and the fire marshal shall annually inspect all public and private school buildings in cities of the first class. The examining officer under this section shall report to the respective school boards having jurisdiction any violation of this act, or any conditions which he may deem dangerous, or which will in any way prevent a speedy exit from the building, and it shall be the duty of said school board when thus notified immediately to make such changes as are required by this act, and such boards are hereby authorized to draw upon their general revenue funds, without further appropriation, to comply with all requirements of this act.

Fire Drills.—That in every public or private school having more than one hundred pupils (excepting colleges and universities) a fire drill and summary dismissal from the building shall be practiced at least once each month at some time during school hours, aside from the regular dismissal at the close of the day's session.

Penalties.—That any officer or member of a school board who shall permit any provision of this act to be violated for sixty days may be removed from his office by a civil action. Independent of such civil action, any officer, member of a school board, city superintendent, principal or teacher violating any provision of this act shall be guilty of a misdemeanor, and shall be punished by a fine of not less than fifty dollars or more than five hundred dollars, or by imprisonment in jail not exceeding six months, or by both such fine and imprisonment; provided, however, that this act shall not prevent the prosecution and punishment of an officer or other person under the ordinary provisions of the crimes act for death or injury to any child in a public or private school occasioned by the negligence of such officer or other person.

When Effective—Penalties.—That within sixty days after the taking effect of this act the provision of section 1 of this act must be fully complied with, and within one hundred and twenty days the provisions of sections 2 and 3 must be complied with; and any neglect to comply with the provisions of this act beyond the times herein specified shall subject the officers and persons named in this act to the penalties prescribed in this act.

This act shall take effect and be in force from and after its publication in the statute-book.

Approved February 23, 1909.

Published May 29, 1909.

MASSACHUSETTS LAW.

In the State of Massachusetts, school, and all other public buildings are under the authority of the Inspection Department of the District Police, whose inspectors are required to enforce the laws regarding factories and public buildings. The city of Boston has a school house commission consisting at the present time (January 1st, 1910) of three persons: R. Clipston Sturgis, Jas. B. Noyes and Tilton S. Bell.

This commission has full charge of the school buildings in the city of Boston, determines the character of buildings to be erected for school purposes, selects the architects and approves the drawings and specifications used for the construction of such buildings, and has prepared a very elaborate and itemized building code, relating to school buildings for the city of Boston, based on the experience and researches of the members of the commission, as well as the experience gained from the construction of many buildings in recent years. It is believed that this code represents the very acme of public school requirements at the present day, and may safely be considered as authoritative, proper allowance being made for local modifications and conditions necessary in the different parts of the country. This code is reproduced in full by permission from the 1909 report of the Boston School House Commission among the following codes.

State Law:—Form of specification to accompany plans for public buildings and schoolhouses.

This form is intended to give architects and others general information as to what is required by law and the regulations of this department, and, if fully filled out, may be accepted by the inspector in place of a copy of the building specifications, but full detail specifications may be required if deemed essential to a clear understanding of the plans.

The law requires that a copy of the plans of every public building and every schoolhouse (except in the city of Boston) shall be deposited with the inspector of factories and public buildings of the district in which such building is located, before the erection of the building is begun, which plans shall also include the system or method of ventilation to be provided, together with such portion of the specification as the inspector may require.

The plans usually required are a plan of each floor, including the basement and the attic, if the attic is occupied, and a front and a side elevation, and also plans and sectional detail drawings of the system of ventilation. Further plans may be required by the inspector if deemed by him to be necessary.

In planning buildings to be used for schoolrooms, or places of assemblage above the first story, provision should be made for at least two stairways, and such stairways should be as far apart as practicable.

No such stairways should be less than four feet wide in the clear, and winding steps should be avoided. The height of rise and width of tread of all stairs, measured on the cut of the stringer, should be given on the plans. No flight of stairs should be more than fifteen steps between landings.

The main stairways from places of assemblage should have a width of not less than twenty inches for every hundred persons accommodated therein. Such stairways should be railed on both sides. All outside doors to such buildings should open outwardly, and be plainly so shown on plans. The standing leaf of all pairs of doors leading to ways of egress should be fastened by face bolts, operated at top and bottom by one handle, at a convenient height from the floor.

In the ventilation of school buildings the many hundred examinations made by the inspector 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 degrees F. in any weather.

2. That, with the rooms at 70 degrees and a difference of not less than 40 degrees, 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 thirty cubic feet of air per minute for each scholar accommodated in the rooms.

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

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

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.

MINNESOTA LAW.

NOTE: The State of Minnesota has no definite law or code governing the construction of school buildings but all plans for school buildings in the State of Minnesota must be prepared in accordance with the regulations of the State Board of Health which are as follows:

No school room, or class room, except an assembly room, shall have a seating capacity that will provide less than eighteen square feet of floor space and 216 cubic feet of air space per pupil, and no ceiling in buildings hereafter to be erected shall be less than twelve feet from the floor.

A system of ventilation, in order to be approved by the Minnesota State Board of Health, shall furnish not less than thirty cubic feet of air per minute for each person that the room will accommodate, when the difference of the temperature between the outside air and the air in the school room shall be thirty degrees F. or more.

In a gravity system of ventilation, in connection with a furnace or steam plant, the flues for admitting fresh air to the room, as well as the vent flues, shall have a horizontal area of not less than one square foot for every nine persons that the room will accommodate.

The flues for a "plenum" or "vacuum" system of ventilation shall have a horizontal area of not less than one square foot for every fifteen persons that the room will accommodate.

The window space shall equal one-fifth of the floor space of the school room.

In all rooms not exceeding twenty-five feet in width all the light shall be admitted to the left of the pupils.

In rooms exceeding twenty-five feet in width, light shall be admitted to the left and rear of the pupils.

Translucent instead of opaque shades shall be used in the windows for controlling the light.

The top of the windows shall be as near the ceiling as the mechanical construction of the building will allow.

No cloak room shall be less than six feet wide, nor shall it have less than one window.

The so-called "sanitary wardrobe" which allows the foul air of the room to pass through the clothing of the children before passing into the vent duct, shall be condemned as unsanitary.

THE NEW HAMPSHIRE LAW.

Buildings, etc., in Cities.—No schoolhouse shall be erected, altered, remodeled, or changed in any city school district, unless the plans thereof have been previously submitted to the school board of that district and received its approval, and all new school houses shall be constructed under the direction of a joint special committee, chosen in equal numbers by the city councils and the school board.

Upon the completion of a new schoolhouse, the city councils shall, by vote, transfer it to the care and control of the school board. Whenever a schoolhouse shall no longer be needed for public school purposes, the school board shall re-transfer its care and control to the city.

Doors to Open Outward.—The outer doors and doors of passage leading outward, of churches hereafter built or rebuilt, school houses containing more than two school rooms, and halls and other buildings used for public gatherings, shall open outward; and it shall be the duty of the selectman of towns to see that these provisions are complied with, and to prosecute persons who neglect to do so.

THE NEW JERSEY LAW.

Suitable Accommodations Must be Provided.—Each school district shall provide suitable school facilities and accommodations for all children residing in the district and desiring to attend the public schools therein.

Penalty for Non-compliance.—Whenever such school facilities or accommodations shall be inadequate and unsuited to the number of pupils attending or desiring to attend such schools, the county superintendent of schools shall transmit to the custodian of the school moneys, of the school district an order directing him to withhold from the district all moneys in his hands to the credit of such school district, received from the state appropriation or from the state school tax, until suitable facilities or accommodations shall be provided, and shall notify the board of education of such district of his action, with the reasons therefor. Such order shall not take effect until approved, in writing, by the State Superintendent of Public Instruction, and said approval shall state when said order shall take effect.

Suitable Water-Closets.—Each board of education shall provide at least two suitable and convenient outhouses or water-closets for each of the school-houses under its control. Said outhouses and said water-closets, if detached from the school-houses, shall be separated by a substantial, close fence, not less than seven feet in height. The board of education shall have said outhouses and water-closets kept in a clean and wholesome condition.

Amount Raised without Submission to Voters.—The question of raising the amount needed to carry into effect the provisions of this section shall not be submitted to the legal voters of the school district, but the board of education shall notify the assessor or assessors and collector, by notice signed by the president and district clerk or secretary, of the amount for such purpose, and such amount shall be assessed, levied and collected at the same time and in the same manner as other special school taxes are assessed, levied and collected.

Approval of Plans by State Board.—In order that due care may be exercised in the heating, lighting and ventilating, and other hygienic conditions of public school buildings hereafter to be erected, all plans and specifications for any such proposed school buildings shall be submitted to the State Board of Education for suggestion and criticism before the same shall be accepted by the board of education of the district in which it is proposed to erect such building.

Doors to Open Outwardly.—In any school-house of two or more stories in height, the doors leading from the class-rooms to the corridors, and from said corridors to the street or to the ground surrounding such school-house shall open outwardly. All swing-doors shall have plate-glass windows of suitable dimensions.

Requirements in Erecting School-Houses.—In order that the health, sight and comfort of the pupils may be properly protected, all school-houses hereafter erected shall comply with the following conditions:

I. Light.—Light shall be admitted from the left, or from the left and rear of class-rooms, and the total light area must, unless strengthened by the use of reflecting lenses, equal at least twenty per centum of floor space;

II. Ventilation.—School-houses shall have in each class-room at least eighteen square feet of floor space, and not less than two hundred cubic feet of air space per pupil. All school buildings shall have an approved system of ventilation by means of which each class-room shall be supplied with fresh air at the rate of not less than thirty cubic feet per minute for each pupil;

III. Height of Ceilings.—All ceilings shall be at least twelve feet in height;

IV. Stairs.—All stairs, except cellar stairs, shall be not less than four feet in width and shall have intermediate landings. The several flights of stairs shall be enclosed by brick walls or by partitions of slow burning construction, and without open well holes. The risers of stairs shall not exceed seven and one-half inches in height, and the treads shall be at least ten inches in width, exclusive of the projecting nosings;

V.—Every school-house having eight rooms shall have two flights of stairs of not less than four feet in width, or, in lieu thereof, one flight of stairs situated near the center of the building, not less than six feet in width;

VI.—Every school-building having more than eight and less than sixteen rooms, shall have two flights of stairs not less than five feet in width;

VII.—Every school-house having sixteen or more rooms shall have three flights of stairs not less than four feet in width, or, in lieu thereof, two complete flights of stairs not less than six feet in width;

VIII.—Every building more than one story in height shall have metal ceilings, wooden ceilings painted white, or some light-tint, or plastered ceilings on metal lath.

THE NEW YORK LAW.

No schoolhouse shall hereafter be erected in any city of the third class or in any incorporated village or school district, and no addition to a school building in any such place shall hereafter be erected, the cost of which shall exceed five hundred dollars, until the plans and specifications for the same shall have been submitted to the commissioner of education and his approval indorsed thereon. Such plans and specifications shall show in detail the ventilation, heating and lighting of such building.

Such commissioner of education shall not approve any plans for the erection of any school building, or addition thereto, unless the same shall provide at least fifteen square feet of floor space and two hundred cubic feet of air space for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by him unless provision is made therein, for assuring at least thirty cubic feet of pure air every minute per pupil, and the facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes.

No tax voted by a district meeting or other competent authority in any such city, village or school district exceeding the sum of five hundred dollars, shall be levied by the trustees until the commissioner of education shall certify that the plans and specifications for the same comply with the provisions of this section.

All schoolhouses for which plans and detailed statements shall be filed and approved, as required by this section, shall have all halls, doors, stairways, seats, passageways and aisles, and all lighting and heating appliances and apparatus, arranged to facilitate egress in cases of fire or accident and to afford the requisite and proper accommodations for public protection in such cases. All exit doors shall open outwardly, and shall, if double doors be used, be fastened with movable bolts operated simultaneously by one handle from the inner face of the door. No staircase shall be constructed with wider steps in lieu of a platform, but shall be constructed with straight runs, changes in direction being made by platforms. No door shall run immediately upon a flight of stairs, but a landing at least the width of the door shall be provided between such stairs and such doorways.

This act shall take effect immediately.

The following points should be specially observed:

1. The plans and specifications must be submitted in duplicate, the original set to be returned after the indorsement of approval, the duplicate to be retained on file at this Department.

2. The plans and specifications must show in detail the ventilation, heating and lighting of the building and must be accompanied by a guaranty from the contractor that the system of ventilation described will provide at least 30 cubic feet of air every minute for each pupil. It will be necessary to give the size of windows, distance from top of window to ceiling and number of panes in sash.

3. At least 15 square feet of floor space and 200 cubic feet of air space for each pupil to be accommodated in each study or recitation room must be provided. In this connection it will be necessary not only to state the size of the rooms (length, breadth and height) but also to give the number of individual desks to be placed in the room.

The plans and specifications must clearly show that proper provision is made in all respects "to facilitate egress in cases of fire or accident and to afford requisite and proper accommodations for public protection in such cases."

THE NORTH DAKOTA LAWS.

Whenever a school house is to be purchased, erected or constructed in a common school distric the school board shall consult with the county superintendent of schools, and the county superintendent of health, with regard to plans providing for the proper construction, lighting, heating and ventilation; provided, further, that it shall be the duty of the state superintendent of public instruction to furnish plans for school houses of one and two rooms as will be in accord with the best ideas pertaining to heating, lighting, ventilating and other sanitary requirements.

Board of Inspectors.—The county superintendent of health, the chairman of the board of county commissioners and the county superintendent of schools of each county are hereby constituted a board for the purpose of inspecting school houses and outbuildings with reference to their sanitary condition, and whenever the county superintendent of schools shall report to said board of inspection that a school house or out-building is in an unsanitary or unsafe condition, said board shall inspect the same and shall direct the district school board to make such changes or repairs as are necessary to make such building or buildings sanitary, safe and fit for school purposes.

To Purchase or Rent Lots and Erect School-houses.—They shall cause suitable lots of ground to be procured and suitable buildings to be erected, purchased or rented, for school houses, and shall supply the same with proper conveniences and fuel, and shall have power, with the directors and controllers of adjoining districts, to establish joint schools, and the expense shall be paid as may be agreed upon by the directors and controllers of said districts.

School Buildings.—That in order that due care may be exercised in the heating, lighting and ventilating of public school buildings hereafter erected, no school house shall be erected by any board of education or school district in this State, the cost of which shall exceed four thousand ($4,000.00) dollars, until the plans and specifications for the same shall show in detail the proper heating, lighting and ventilating of such building.

Lighting.—Light shall be admitted from the left or from the left and rear of class-rooms, and the total light area must, unless strengthened by the use of reflecting lenses, equal at least twenty-five per centum of floor space.

Class-rooms — Air-space — Heating. — School houses shall have in each class-room at least fifteen square feet of floor space, and not less than two hundred cubic feet of air space per pupil, and shall provide for an approved system of indirect heating and ventilation, by means of which each class-room shall be supplied with fresh air at the rate of not less than thirty cubic feet per minute for each pupil, and warmed to maintain an average temperature of seventy degrees Fahrenheit during the coldest weather.

THE SOUTH DAKOTA LAW.

School House Plans.—Plans for school buildings approved by State Superintendent: In order that due care may be exercised in the heating, lighting and ventilation of public school buildings hereafter erected, no school house shall be erected by any board of education or school district board in this State until the plans and specifications for the same showing in detail the proper heating, lighting and ventilation of such building shall have been approved by the superintendent of public instruction.

School houses shall have in each class room at least fifteen square feet of floor space, and not less than two hundred cubic feet of air space per pupil, and shall provide for an approved system of heating and ventilation by means of which each class room shall be supplied with fresh air at the rate of not less than thirty cubic feet per minute for each pupil, and have a system of heating capable of maintaining an average temperature of seventy degrees Fahrenheit during the coldest weather.

THE UTAH LAW.

School Sites and Buildings.—When necessary for the welfare of the schools of the district, or to provide proper school privileges for the children therein, or whenever petitioned so to do by one-fourth of the resident tax payers of the district, the board shall call a meeting of the qualified voters, as defined in Section eighteen hundred and eleven, at some convenient time and place fixed by the board, to vote upon the question of selection, purchase, exchange or sale of a school house site, or the erection, removal, purchase, exchange, or sale of a school house, or for payment of teachers' salaries, or for the current expenses of maintaining schools. If a majority of such voters present at such meeting shall by vote select a school house site, or shall be in favor of the purchase, exchange, or sale of a designated school house site, or of the erection, removal, or sale of a school house, as the case may be, the board shall locate, purchase, exchange or sell such site, or erect, remove, or sell such school house, as the case may be, in accordance with such vote; provided, that it shall require a two-thirds vote to order the removal of a school house.

Provided that no school house shall hereafter be erected in any school district of this State not included in cities of the first and second class, and no addition to a school building in any such place, the cost of which school house or addition thereto shall exceed $1000, shall hereafter be erected until the plans and specifications for the same shall have been submitted to a commission consisting of the State Superintendent of Public Instruction, the Secretary of the State Board of Health, and an architect to be appointed by the Governor, and their approval endorsed thereon. Such plans and specifications shall show in detail the ventilation, heating, and lighting of such buildings. The commission herein provided shall not approve any plans for the erection of any school building, or addition thereto, unless the same shall provide at least fifteen square feet of floor space and two hundred cubic feet of air space, for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by them unless provision is made therein for assuring at least thirty feet of pure air every minute for each pupil, and the facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes. No tax voted by a district meeting, or other competent authority in any such school district, shall be levied by the trustees until the commission shall certify that the plans and specifications for the same comply with the provisions of this Act. All school houses for which plans and detailed statements shall be filed and approved, as required by this Act, shall have all halls, doors, stairways, seats, passageways, and aisles, all lighting and heating appliances and apparatus arranged to facilitate egress in cases of fire or accident, and to afford the requisite and proper accommodations for public protection in such cases.

No school house shall hereafter be built with the furnace or heating apparatus in the basement or immediately under such school building.

The commission herein provided shall serve without compensation, but shall receive their actual and necessary expenses incurred in the performance of their official duties, except the architect, who shall receive as above provided, and four dollars per day while attending meetings of the commission, the amount for which shall be verified on oath and be paid from the state school fund.

Approved March 9th, 1909.

The words, "Public Buildings", as used in this chapter, shall mean churches, school buildings, hotels more than two stories high, and places of amusement more than one story high, and buildings, factories, mills or workshops more than two stories high in which persons are employed above the second story.

Said board shall take cognizance of the interests of the life and health of the inhabitants of the State. shall make or cause to be made sanitary investigations and inquiries respecting causes of disease, especially of epidemics, and the means of preventing same; the sources of mortality and sickness and the effect of localities, employments, habits and circumstances of life on the public health; and, when requested, or when, in their opinion, it is necessary, shall advise with municipal officers in regard to drainage, water supply and sewerage of towns and villages, and in regard to the erection, construction, heating, ventilation and sanitary arrangements of public buildings; and said board may compel the owners of such buildings to provide them with the necessary appliances and fire escapes for preventing accidents to persons who may be in such buildings; and said board shall exercise the powers and authority imposed by law upon said board.

Said board shall, when necessary, issue to local boards of health its regulation as to the lighting, heating and ventilation of school houses, and shall cause sanitary inspection to be made of churches, school houses and places of public resort, and make such regulations for the safety of persons attending the same as said board deems necessary. Public buildings now standing or hereafter erected shall conform to the regulations of said board in respect to sanitary conditions and fire escapes necessary for the public health and for the safety of individuals in such public buildings.

A person, corporation or committee intending to erect a public building shall submit plans thereof showing the method of heating, plumbing, ventilation and sanitary arrangements to said board, and procure its approval thereof, before erecting such building.

A person, corporation or committee which erects a public building without the approval and without complying with the regulations of the state board of health as provided for in the preceding section, shall be fined not more than five hundred dollars, nor less than one hundred dollars, and shall make such building to conform to the regulations of said board before the same is used, otherwise such building shall be deemed a nuisance, and be put in proper condition by the local health officer under the direction of said board at the expense of the owner.

Said board may examine or cause to be examined a school building or an outhouse and condemn the same as unfit for occupation or use, and a building or outhouse so condemned by written notice served upon the chairman of the board of school directors, or the person having such school in charge, shall not be occupied or used until the same is repaired and the sanitary conditions approved by the state board of health. A person who violates a provision of this section shall be fined not more than fifty dollars nor less than five dollars.

THE VIRGINIA LAW.

Approved March 11, 1908.

Whereas, it is of great importance to the people of this commonwealth that public school buildings hereafter erected by any school board shall be properly heated, lighted and ventilated; therefore,

1. Be it enacted by the general assembly of Virginia, that the State board of inspectors for public school buildings shall not approve any plans for the erection of any school building, or room in addition thereto, unless the same shall provide at least fifteen square feet of floor space and two hundred cubic feet of air space for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by said board unless provision is made therein for assuring at least thirty cubic feet of pure air every minute per pupil, and the facilities for exhausting the foul and vitiated air therein shall be positive and independent of atmospheric changes. All ceilings shall be at least twelve feet in height.

2. All school houses for which plans and detailed statements shall be filed and approved by said board, as required by law, shall have all halls, doors, stairways, seats, passage-ways, and aisles, and all lighting and heating appliances and apparatus, arranged to facilitate egress in cases of fire or accidents, and to afford the requisite and proper accommodations for public protection in such cases. All exit doors in any school house of two or more stories in height shall open outwardly. No staircase shall be constructed except with straight runs, changes in direction being made by platforms. No

doors shall open immediately upon a flight of stairs, but a landing at least the width of the doors shall be provided between such stairs and such doorway.

All school houses, as aforesaid, shall provide for the admission of light from the left, or from the left and rear of the pupils, and the total light area must be at least twenty-five per centum of the floor space.

THE WEST VIRGINIA LAW.

Must Provide Sites and Buildings.—The board of education of every district shall provide by purchase, condemnation, leasing, building or otherwise, suitable school houses, and ground in their districts, in such locations as will best accommodate the pupils thereof, and improve such grounds and provide such furniture, fixtures and apparatus for the said school houses, as the comfort, health, cleanliness and convenience of the pupils may require, and keep such grounds, school houses, furniture, fixtures and apparatus in good order and repair, but no board of education may purchase school apparatus of any kind without the advice and consent of the county superintendent first had in writing.

County Superintendent Shall Approve Plans.—Whenever any board of directors shall be authorized by the electors of their district to erect a school building, it shall be the duty of such board, before entering into any contract for the erection of any building, to obtain the approval of the county superintendent, of the plans and specifications for the building to be erected, including also the heating, lighting, ventilating and safety thereof.

Approval of Location and Plans.—In the construction of school houses the board of education of each district shall have regard to economy, convenience and durability of structure, and the health and comfort of pupils, and no such school house shall be constructed until the location and plan thereof have first been approved by the county superintendent, and in the event the board of education cannot agree upon plans or location, the county superintendent shall select the plans and location for such house.

THE OHIO CODE.

Classification According to Construction.

First Class Construction, Fireproof Building.—This classification includes such buildings as are built entirely of incombustible, fire and water proof material, with all metal structural parts thoroughly fireproofed, except that the floors, doors, windows and the usual trim of rooms are of ordinary construction.

Second Class Construction. Composite Buildings.—This classification includes such buildings as have the enclosing walls and roof covering of incombustible materials with doors, windows and frames of wood, and the interior walls of brick; or, columns and girders made of fireproofed iron and steel; the floor construction of wooden beams.

In buildings of this class, a single thickness of metal lath or furring, and hard incombustible plaster will be deemed sufficient protection for iron and steel columns and girders.

Third Class Construction. Frame Buildings.—This classification includes such buildings as have the enclosing and interior partition walls constructed entirely of wood. Wood frames covered with a veneer will be included in this class.

Classification Required According to Height.

Where the basement ceiling is 6 feet (six feet) or more above the grade line, the basement will be rated as the first story.

All buildings over two stories high shall be of No. 1 (fireproof) construction.

All buildings one story high, without basement and with the floor line not over 3 feet 0 inches (three feet no inches) above the grade line, can be of No. 3 (frame) construction.

Auditoriums.

Any one room where more than one hundred (100) persons can congregate will be considered an assembly room.

No assembly room can be located above the second story in buildings of the first class, above the first story in buildings of the second class; or in any building of the third class.

One balcony may be used in connection with auditoriums, providing the same has means of egress in the same proportion as called for in school rooms.

Dimensions of School and Class Rooms.

Floor Space.—The minimum floor space per pupil to be as follows:

Primary grades 12 (twelve) square feet per pupil.

Grammar grades 16 (sixteen) square feet per pupil.

High Schools 18 (eighteen) square feet per pupil.

Height of Stories.—Basement play and toilet rooms to be not less than eight feet high.

Class rooms 20 feet 0 inches (twenty feet no inches) wide and less, 11 feet 0 inches (eleven feet no inches) story.

Class rooms from 20 feet, 1 inch (twenty feet one inch) to 24 feet 0 inches (twenty-four feet no inches) wide, 12 feet 0 inches (twelve feet no inches) story.

Class rooms 24 feet 1 inch (twenty-four feet one inch) to 28 feet 0 inches (twenty-eight feet no inches) wide, 13 feet 0 inches (thirteen feet no inches) story.

Heater Room.

For Buildings of First and Second Class Construction.—Furnaces, hot water heating boilers, and low pressure steam boilers may be located in the basements, providing the heating apparatus, breeching, fuel room and firing room are inclosed in fireproof apartments, with masonry wall not less than 1 foot, 1 inch (one foot, one inch) thick; with ceilings of reinforced concrete, brick or hollow tile arches, and provided with self-closing (not automatic) fire doors of a type as approved by the National Board of Fire Underwriters.

No boiler or furnace shall be located under stairways or corridors.

Exits.

Buildings of First Class Construction.—Exits from rooms in the superstructure shall be in the proportion of 30 inches (thirty inches) in width to every fifty persons or fraction thereof; but in no case shall an exit be less than 3 feet 0 inches (three feet no inches) nor more than 6 feet 0 inches (six feet no inches) wide.

No fire escapes or stair towers will be necessary in buildings of first class construction and all exits shall lead to the corridors.

Each basement room shall have a direct exit not less than 3 feet 0 inches (three feet no inches) wide with stone, cement or iron stairs leading up to the grade line; area-ways around stairways shall have substantial hand rails and guards on both sides. These exits to be in addition to the usual service stairways and means of egress.

Buildings of Second Class Construction.—Each room in superstructure used by pupils, or the public, shall have at least two separate and distinct means of egress.

Two doors or openings leading into the same hall or corridor will be considered as only one means of egress.

Communicating doors between any two class rooms will not be considered as a means of egress.

The proportion of exits to the seating capacity shall not be less than 30 inches (thirty inches) to each fifty persons or fraction thereof. One half of the exits shall lead to the main corridors, and the other half to fire escapes or inclosed fireproof stairways. No exit shall be less than 3 feet 0 inches (three feet no inches) or more than 6 feet 0 inches (six feet no inches) wide. Each room in the basement shall have a direct exit not less than 3 feet 0 inches (three feet no inches) wide, with stone, cement or iron stairs leading up to the grade line.

Area-ways around such stairways to have substantial hand and guard rails on both sides.

These exits to be in addition to the usual service stairways and means of ingress.

Buildings of Third Class Construction.—Each room shall have at least two, three foot exits; one leading to the open with steps to the grade, and the other the usual means of ingress; all steps to have handrails on both sides.

Stairways.

Buildings of First Class Construction.—Buildings of first class construction shall have at least two stairways, located as far apart as possible; the same to be continuous from the grade line to the topmost story. No further means of egress will be necessary.

Stairways must be separated from main corridors by self-closing doors at each story.

Buildings of First and Second Class Construction.—No basement stairway shall be placed under nor within twenty feet of any stairway from the first to the second story, except under the following conditions, viz.: basement stairs may be placed under a first story stairway only when a grade line platform, open to the air, is inserted and no direct connection is made between the stairway below the platform and the one above the same.

Inside stairways from the basement to the first story shall be inclosed in masonry walls not less than

1 foot 1 inch (one foot one inch) thick, with fireproof ceiling or soffit above and be provided with a self closing fire door, as approved by the National Board of Fire Underwriters, which shall be placed at the head and foot of the stairway; the steps shall be of iron or concrete.

Width of stairway shall be at the rate of 30 inches (thirty inches) per hundred persons or fraction thereof.

No stairway shall be less than 3 feet 6 inches (three feet six inches) nor more than 6 feet 0 inches (six feet no inches) wide; or have less than three nor more than sixteen risers in any run.

No stairway shall have winders and all nosings shall be on a straight line.

Maintain a uniform width in all stairways, and stair platforms, by rounding the corners and beveling the angles.

Provide hand rails on both sides of all stairways and steps.

Stairways shall have a uniform rise and tread in each run, viz:

Primary schools to have not over 6 inches (six inches) rise or less than 11 inch (eleven inch) tread.

Grammar schools to have not over 6½ inch (six and one-half inch) rise or less than 11 inch (eleven inch) tread.

High schools to have not over 7 inch (seven inch) rise or less than 10½ inch (ten and one-half inch) tread.

The above dimensions to be cut on the stair horse.

All treads shall be covered with rubber or lead mats.

To be Used on Buildings of Second Class Construction.—One fire escape shall be used for each one hundred and fifty persons or fraction thereof.

Fire escapes shall be 3 feet 6 inches (three feet six inches) wide, with 7 inch (seven inch) rise, 10 inch (ten inch) tread and shall be constructed according to the Standard Specifications as prepared by this department.

No runs shall have more than 18 (eighteen) nor less than 3 (three) risers.

No winders shall be used, and return platforms, if used, shall be 3 feet 6 inches by 7 feet 0 inches (three feet six inches by seven feet no inches).

Platforms inserted in straight runs of fire escapes shall be no less than 3 feet 6 inches by 3 feet 6 inches (three feet six inches by three feet six inches).

Where there are no openings in the walls, the fire escapes may be placed against the wall, and be supported upon standard brackets, and will be built according to the B Standard Specifications as prepared by this department.

Where openings occur, the fire escape may be run either at right angles to the wall; or, parallel to the wall provided it is placed 2 feet 6 inches (two feet six inches) away from same, and will be constructed according to the B Standard Specifications, except that columns will be used instead of brackets and the construction will be known as the "C" Standard.

Fire escapes shall be supported every eight feet, either by standard brackets or steel columns as the case may require.

Where fire escapes run at right angles to the building, they will be supported on gas pipe or angle iron columns with a 3x3x3-8 inch (three inch by three inch by three-eighth inches) angle riveted to the top of the two columns, with columns thoroughly sway braced.

When fire escapes parallel the wall, they must be supported by gas pipe or angle iron columns, with 3x3x3-8 inch (three by three by three-eighth inches) L angle riveted to the top of the two columns and bolted to and through the wall.

Balconies level with the floor line shall be placed at the top of all fire escapes.

Where fire escapes run at right angles to the building, or are placed against the wall of the building, the top balcony must be at least 3 feet 6 inches by 3 feet 6 inches (three feet six inches by three feet six inches.)

Where fire escapes parallel the building and are placed 2 feet 6 inches (two feet six inches) away from the wall, the top balcony must be at least 3 feet 6 inches by 6 feet 0 inches (three feet six inches by six feet no inches).

Where balconies are used in connection with fire escapes, channel irons will be used instead of lattice work to support the balcony and the construction of the same must be figured to safely support total live and dead load of 125 (one hundred an twenty-five) pounds per square foot.

The following dimensions given for gas pip columns, refer to the internal diameter of the sam

GAS PIPE COLUMNS.

$2\frac{1}{2}$ inch column, 15 feet and under.
3 inch column, 15 to 17 feet.
$3\frac{1}{2}$ inch column, 17 to 19 feet.
4 inch column, 19 to 21 feet.
5 inch column, 21 to 25 feet.
6 inch column, 25 to 30 feet.

L ANGLE COLUMNS.

$2\frac{1}{2}$x$2\frac{1}{2}$x$\frac{3}{8}$ inch L's, 15 feet and less.
$2\frac{1}{2}$x3x$\frac{3}{8}$ inch L's, 15 to 20 feet.
$2\frac{1}{2}$x$3\frac{1}{2}$x$\frac{3}{8}$ inch L's, 20 to 25 feet.
Two $2\frac{1}{2}$x$2\frac{1}{2}$x$\frac{3}{8}$ inch riveted, 25 to 30 feet.

Enclosed Fireproof Stairways.

To be used in Buildings of Second Class Construction.—Emergency stairways shall be enclosed by masonry wall not less than 1 foot 1 inch (one foot one inch) thick; with brick, hollow tile or reinforced concrete floors, platforms and ceiling, and with iron, stone or concrete steps; and provided with a sufficient number of windows to properly light the same.

No open risers can be used.

There shall be no basement openings into space under inclosed fireproof stairways.

The same enclosure can be used for more than one stairway providing there is no direct connection between any two stairways or stories.

Width of stairs shall be at the rate of 30 inches (30 inches) per hundred persons or fraction thereof. No stairway shall be less than 3 feet 6 inches (three feet 6 inches) nor more than 5 feet 0 inches (five feet no inches) or have less than three or more than eighteen risers in any one run.

No winders shall be used and all nosings shall be on straight lines.

Maintain a uniform width in all stairways and stair platforms by rounding the corners and beveling the angles.

Provide gas pipe hand rails on both sides of stairways.

Stairways shall have a uniform rise and tread in each run, viz:

Primary schools to have not over 6 inch (six inch) rise or less than 11 inch (eleven inch) tread.

Grammar schools to have not over 6½ inch (six and one-half inch) rise or less than 11 inch (eleven inch) tread.

High schools to have not over 7 inch (seven inch) rise or less than 10½ inch (ten and one-half inch) tread.

The above width of tread to be measured from nosing to nosing.

Treads shall have roughened surface.

Exit Doors.

For Buildings of First, Second and Third Class Construction.—Exit doors shall not be less than 3 feet 0 inches (three feet no inches) wide, swing outward (viz., towards the open), and be so hung as not to interfere with passageways or close other openings.

No double acting doors will be permitted.

Seats, Desks and Aisles.

All class, recitation, study, high school or assembly rooms seating more than fifteen persons shall be equipped with seats, chairs or desks securely fastened to the floor by screws.

The chairs and desks of teachers may be portable.

Auditorium Seats and Aisles.—The least average width of chairs measuring from center to center of arm, shall not be less than 20 inches (twenty inches): and the least spacing of seats from back to back, measuring horizontally, shall not be less than 30 inches (thirty inches).

No seat shall have more than six seats between it and the aisle on either side.

Aisles with seats on both sides of same shall not be less than 3 feet 0 inches (three feet no inches) wide where they begin, and shall be increased in width towards the exits in the ratio of ½ inch (one-half inch) to the foot.

Aisles having seats on one side only shall not be less than 2 feet 0 inches, (two feet no inches) wide at their beginning, and increase in width the same as aisles having seats on both sides.

Class Room Seats and Aisles.—Class rooms shall have aisles on all wall sides.

In primary rooms, center aisles shall not be less than 17 inches (seventeen inches), and wall aisles not less than 2 feet 4 inches (two feet four inches) wide.

In grammar rooms center aisles shall not be less than 18 inches (eighteen inches), and wall aisles not less than 2 feet 6 inches (two feet six inches) wide.

In high school rooms center aisles shall not be less than 20 inches (twenty inches), and wall aisles not less than 3 feet 0 inches (three feet no inches) wide.

Passageways.

No halls or passageways leading to stairways shall be less in width than the width of the stairway.

Hall and passageways shall be so designed and proportioned as to prevent congestion or confusion.

Flues, Etc.

All flues shall rest on and start from the ground and shall be built with no less than 9 inch (nine inch) walls.

Vent flues for class, recitation and high school rooms shall be of such a size as to provide not less than ten square inches of flue space per pupil. Registers shall be 50 per cent (fifty per cent) larger than the area of the flue.

Vents for toilet rooms shall provide one square inch of flue space to thirteen cubic feet of contents.

Vertical ventilation flues shall be built of brick with an outer wall not less than 8 inch (eight inch) thick.

Division walls shall be no less than 4 inch (four inch) thick.

Vent flues shall extend through and above the roof.

Ventilation carried through floor construction, furring or stud partitions will not be permitted.

Optics.

The proportion of glass surface in each class, study, recitation or high school room shall be not less than one square foot of glass to every five square feet of floor surface.

Windows must be placed either at the left or the left and rear of the room, but in no case on the two opposite sides of any room.

Tops of windows shall not be placed more than 8 inches (eight inches) below the ceiling line.

Vaults.

Vaults for outside water closets to be not over six feet deep, and must be constructed of brick or concrete walls not less than 9 inches (nine inches) thick. No part of the vault to extend under the floor of the closet.

Fire Extinguishers.

Provide standpipe and hose in basement with sufficient length of 1½ inch (one and one-half inch) hose to reach any part of the story. Hose lines shall be provided with nozzles and hose racks and hose shall be connected ready for use.

Provide three-gallon chemical fire extinguishers of a type approved by the National Board of Fire Underwriters for all stories above the basement. Fire extinguishers shall be provided in the proportion of one to every four class rooms, or equivalent or fraction thereof.

Hose and extinguishers must be examined at least once every six months, and be put in first class working condition ready for use.

Plumbing.

Remove waste plug from lavatory bowls, or use sinks instead of lavatories.

Use sanitary school house drinking fountain with jet giving a continuous flow of water where holly service is available.

Where pumps are used invert the outlet.

No tin cup or tumblers shall be allowed in or about the building.

Provide one water closet for each fifteen girls, and one for each twenty-five boys or fraction thereof. Provide one ventilated individual urinal for each fifteen boys, or fraction thereof.

No dry closet system will be permitted.

Plumbing shall be installed as per code prepared by this department.

Gas Fittings.

No rubber hose connections shall be made with any stove or heater; the same must be made with metallic piping.

All piping shall be capped, tested and proved tight before plastering is done.

Electric Work.

Electric equipment shall be installed according to the "National Electric Code."

Fire Alarm.

All buildings with basement, and all buildings over one story high, to be provided with an 8 inch (eight inch) in diameter fire gong in connections enabling the ringing of same from any story or basement.

In semi-detached buildings provide gong for each section. All gongs to be connected up so as to ring simultaneously from one story or basement of either section.

Construction.

No nine inch wall can be used over ten feet high except for flues.

Cover all floor joists with rough sub-floor as soon as the joists are laid.

In calculating construction the superimposed load on class room floors must be assumed at 60 (sixty) pounds per square foot, uniformly distributed, and for halls, auditoriums, stairs and corridors it must be assumed at 80 (eighty) pounds per square foot uniformly distributed.

Hardware.

Double acting spring hinges shall not be used, but all outside entrance and exit doors shall swing outward, and all inside doors shall swing outward toward the natural way of egress; all doors from halls to rooms and cloak rooms shall swing into halls.

Single outside entrance doors shall have key locks on same that can be locked on the outside, but that can always be opened on the inside by simply turning the knob, whether same are locked on the outside or not, the locks being operated by key on outside only. No night latch attachment being placed on face of lock, or other bolts, hooks, thumb knobs or other locking device being used on doors.

We advise that doors from halls to rooms and cloak rooms have no locks upon same, but that they be equipped with knob latches only; however, if locks are desired, same style locks as above specified for entrance doors shall be used so they can be locked on hall side, but that will always open on room and cloak room sides, whether locked on hall side or not. Locks of this kind are used so that the building and rooms can be locked from the outside to prevent access to building or rooms from the outside, but so that under no conditions can a person be locked in the building.

Outside doors used for exit purposes only, shall have one knob latch only, no bolts, hooks, or other locking devices being used.

One of each pair of outside or inside double doors shall have a double extension panic bolt on same, bolt to have push bar, push plate, push handle or other device whereby the simple act of pushing against the same will release the top and bottom bolts at the same time and allow the doors to swing open. Independent top and bottom bolts will not be permitted. The outer door of each pair of outside and inside double doors shall have lock or latch as above specified.

All bolts, latches, faces of locks, working parts of extension bolts, and other exposed working parts about this hardware, shall be cast bronze metal to prevent rusting, etc., which would interfere with the working of same.

Sliding doors for entrance or exit purposes, or for openings that are in the natural course of exit from buildings shall not be used.

Single doors to fire escapes, inclosed stair towers and emergency exits from basement shall be fitted with one knob latch, (without key) or equivalent.

School room doors shall have knob latch (without key) or equivalent.

The only doors in the building that may have key locks will be one main entrance door, library door, closets and boiler room doors.

Heating, Ventilation, etc.

Heating.—The heating system shall be so designed and proportioned, as to uniformly heat all parts of the building to a uniform temperature of seventy (70) degrees in ten (10) degrees below zero (0) weather, and also so as to provide at least thirty cubic feet (30 cu. ft.) of outside fresh air per minute per person the room is designed to accommodate.

The systems doing this and approved, are stoves, furnaces, indirect steam or hot water radiator system, or mechanical fan plenum system. A direct-indirect or semidirect system of steam or hot water heating will not be approved.

Stoves.

Stoves may only be used in one-story structures without basements, and same shall be closed jacketed stoves. Outside fresh air shall be brought in under the building through vitrified sewer tile or masonry ducts, and turn up and be connected to bottom of stove, then to circulate up around radiating surface of stove, between jackets and stove, and be heated and enter into the room from top of stove. Separate cast iron trays under stove, or solid cast iron bases in connection with stoves, shall be provided, these trays being kept up three inches (3 inches) above floor and having a diameter of at least two feet no inches (2 feet 0 inches) greater than the diameter of stove. No smoke pipe connection between the stove and smoke flue, shall be over five feet no inches (5 feet 0 inches) long. Vent flues as hereinafter specified, shall be used in connection with room where stoves are used.

Furnaces.

Furnaces may be used in all classes of buildings, provided same, together with the fuel rooms in connection with same, be located in fireproof rooms as hereinafter specified. All furnaces shall have outside fresh air connection to same from opposite sides of the building, of sufficient size to furnish the required amount of air as above specified. Furnaces shall be connected to masonry hot air flues, which will carry the heated air up and enter same into rooms at a height of at least seven feet six inches (7 feet 6 inches) above floor level. In churches, heating air from furnaces will be allowed to enter into rooms through floor registers, but masonry flues must be provided for all school building work. All furnace pipes must be wrapped with at least three thicknesses of asbestos paper, and must be kept at least eight inches (8 inches) away from wood ceiling joists, etc., and all wood work must be protected by laying one-quarter inch (¼ inch) thick asbestos board over pipes, same being at least twelve inches (12 inches) wider than pipes on both sides. All floor boxes shall be kept at least one inch (1 inch) away from all woodwork, and all these spaces shall be lined with one-quarter inch (¼ inch) asbestos board before metal floor box is placed in position.

Temperature regulating device should be used in hot air flues as hereinafter specified. Vertical metal hot air flues to carry heated air above the first floor shall not be used, but same must be masonry flues.

Indirect Hot Water or Steam Radiator System.

Steam or hot water boilers and fuel rooms in connection with same, shall be located in fireproof rooms as hereinafter specified.

Indirect hot water or steam radiators shall be placed in basement fresh air rooms at the base of masonry hot air flues, and shall be properly connected to same with galvanized iron housing.

Hot air flues, protecting woodwork, outside fresh air connections, etc., same as above specified for furnace work, shall be used in connection with indirect radiators.

In indirect radiator systems, enough direct radiation can be located in the rooms to do the heating, and only enough indirect radiation need be installed at the base of flues to furnish the required amount of fresh air heated to about seventy-two (72) degrees.

Mechanical Fan Plenum System.

In connection with a fan plenum system, furnaces or steam or hot water boilers can be used, provided, the furnaces or boilers together with the fuel rooms in connection with the same be located in fireproof rooms as hereinafter specified. This system shall be so designed with furnaces, or tempering coils and blast coils, to furnish heated air, to have cleaning screens, fan plenum chamber, galvanized iron or masonry horizontal ducts, masonry hot air flues, electric motor, gas or gasoline engine, or a low pressure steam engine operating on a steam pressure not to exceed twenty pounds, to operate fan and such other device as is necessary to make this a complete working system. All parts and apparatus in connection with system to be of ample size so as to make a perfectly free and easy working system, and to thoroughly heat all portions of the building without forcing.

A combination direct radiation and fan plenum system can be installed, enough direct radiation can be placed in the rooms to do the heating, and the fan plenum system need only be designed to heat the required amount of fresh air to about seventy-two (72) degrees.

No steam boiler carrying over twenty (20) pounds of steam pressure shall be located within the main walls of any school building or other public building.

No ashes are to be stored in buildings of the third class construction, and not more than one day's accumulation of ashes shall be stored in the basements of buildings of the first and second class construction.

Pipe Covering.

All steam and hot water main and return piping shall be covered with sectional asbestos pipe covering.

Main and return steam piping where used in radiation in finished portions of buildings need not be covered. All pipes passing through floors, walls, etc., shall have metal protecting sleeves or collars entirely through the floor, wall, etc., and flanging out on both sides for pipes to pass through.

Ventilation.

Air Space.—All rooms, etc., shall be of such a size as to provide two hundred and fifty (250 cu. ft.)

cubic feet of air space for every pupil or person the rooms are designed to accommodate.

Hot Air and Vent Flues.—All hot air and vent flues thirteen by thirteen inches or smaller in size shall be enclosed in four inch (4 inch) brick walls and all flues larger in size shall be enclosed in eight inch (8 inch) brick walls, these flues being smoothly plastered on inside with Portland cement mortar. Division walls in flues can be four inch (4 inch) in thickness. All flues shall start at ground on substantial foundations, and all vent flues shall extend up and out above roof, except as below stated. All hot air flues shall have arched top back of registers, to turn hot air into rooms.

In gravity work for school buildings, all vent flues shall be of such a size as to provide ten square (10) inches of flue area for each person the room is designed to accommodate. Hot air flues shall be figured on the same basis. In gravity work in churches, large assembly rooms, etc., the size of vent and hot air flues need only be figured on a basis of not less than two-thirds (2-3) of the full seating capacity of the room. In mechanical fan system, ducts and flues shall be figured as follows:

Air leaving fan to travel at a velocity of not to exceed one thousand (1000) feet per minute, in horizontal ducts not to exceed seven hundred and fifty (750) feet per minute, and in vertical flues not to exceed five hundred feet (500 feet) per minute.

Twenty (20) gauge galvanized iron flues enclosed with two inches (2 inches) of reinforced concrete, will be accepted in place of four inch (4 inch) brick walls, and twenty (20) gauge galvanized iron flues enclosed with four inches (4 inches) of reinforced concrete will be accepted in place of eight inch (8 inch) brick walls.

Twenty (20) gauge galvanized iron flues may be used in attics of buildings of composite construction, to connect to masonry vent flues and run to a central point for exhaust fan connection, provided, a weighted fire-door or shut off valve is arranged at the top of each masonry vent flue in attic just before galvanized iron connection is made to same; this door or valve being held by fusible link, so that in case of fire traveling up a flue, the link would fuse and fire door or valve close off the flue perfectly tight. These galvanized iron flues in attic only to be used in connection with an exhaust fan connecting to same, otherwise masonry flues are to run out through roof.

Registers.

Register connection to vent flues shall be made at floor line, and to hot air flues at least seven feet, six inches (7 feet 6 inches) above floor level. Registers shall have a free area of at least fifty per cent (50 per cent) greater than the area of vent and hot air flues.

Temperature Regulation.

Either a manually operating, or mechanically operating system of temperature control for mixing hot and cold air in flues, should be installed in connection with all of these heating systems. Cold air by-pass connections should be made from fresh air intakes or rooms, to the hot air flues, and a valve should be arranged in flue so that the hot and cold air can be mixed in flue to regulate the temperature;

this valve should be manually operated by handle and dial located in each school room, or by mechanically operated temperature regulating device.

Fireproof Furnace or Boiler and Fuel Rooms.

In new buildings, these rooms should be enclosed in at least one foot, one inch (1 foot 1 inch) thick masonry or nine inch (9 inch) thick reinforced concrete walls; the ceiling of rooms shall be reinforced concrete or standard fireproof hollow arched tile and iron beam construction, designed to carry a load of at least one hundred (100) pounds to the square foot in addition to the weight of the floor itself. All doors entering these rooms from remainder of building, shall be hinged type, underwriters' approval, two and one-half inch (2½ inch) thick fire doors, tin clad, hung with proper equipment and being normally held closed with weight and chain.

In old buildings, the boiler or furnace and fuel rooms, shall be enclosed in same masonry walls and should have same fire doors opening into same, and the entire ceiling shall be fireproofed as follows: First overlay the entire ceiling with one quarter inch (¼ inch) thick asbestos board, lapped at least one and one-half inches at joints; then furr same with one and one-half inch (1½ inch) high metal furring spaced twelve inches (12 inches) on centers; then lath with metal lath and heavily plaster with asbestos and Portland cement plaster.

All boiler and fuel rooms shall be so arranged in basement that persons other than the janitor will not have access thereto or will not have to pass through same to get from one portion of the basement to the other.

STANDARD CODE OF THE BOSTON SCHOOL HOUSE COMMISSION.

General Information for First Class Construction. Elementary Schools.

School Rooms.—(1) *Size* will be 23 by 29 for elementary grades and not less than 12 feet in clear. Modification allowable only after consultation with the Board. A building having no grades above IV, with no desk larger than 21 inches, might have rooms 22 by 28, but the standard size gives the extra space wanted for modern methods. Desks should be laid out on the preliminary plans. (See drawing.) This drawing should give 18-inch, 21-inch and 23-inch desks, laid out in a 23 by 29 room. The School Committee advise, and this Board has adopted, the policy of having a small portion of the rooms in a building, perhaps 10 or 20 per cent, of a size that will seat 50, *i. e.,* 23 feet by 32 feet. Every class-room shall be consecutively numbered on the plans to designate it. These numbers to be for the doors, as noted below, and for the annunciator. Other rooms that appear on the annunciator to be named on the plans, as assembly hall, teachers' or master's room, cooking-room, manual training room. The kindergarten shall be counted as a class-room. In high schools, both class and recitation rooms to be numbered, other rooms named.

(2.) *Windows* will be on the long side for left-hand lighting. The glass, measured inside the sash, shall contain not less than 1-5 of floor area, about 135 square feet for a room 23 feet wide;* neither double run of sash nor double glazing will be required, but a dustproof metal weather strip; the head square and close to the ceiling; the sill about 2 feet 6 inches from the floor; the windows divided with muntins, no large sheets of glass. Finished with plastered jamb, no architrave, metal corner bead.

(3.) *Doors.*—One to corridor, 3 feet 6 inches by 7 feet, partly glazed, to open out, placed preferably near the teacher's end; brass-plated steel butts, 4-lever mortise lock, master keyed; cast brass knobs. marble thresholds to corridors. Doors to have 2-inch, plain brass numbers, and cardholders 3½ inches by 5 inches, and hooks to hold open.

(4.) *Floors* will be Georgia rift pine or maple.

(5.) *Walls* will be painted burlap up to top of blackboards, or of tack boards, and above this plaster, tinted in water color,—a warm gray green or buff gives the best results,—the blackboards, 4 feet high, 2 feet 2 inches from floor in kindergarten, 2 feet 4 inches to 2 feet 6 inches to Grade IV, and 2 feet 8 inches in Grades V, to VIII. Behind the teacher and on the long side. These will be of best black slate, ¼ inch thick. At end, in place of blackboard, pine sheathing with burlap stretched over it for a tack board, to extend from base to the molding at top of blackboards. In lower grades a rack or tack board for holding cards is required above the blackboard. A picture molding at top of burlap, and also near ceiling in all rooms. (See drawings.)

*It is evident that if this area of glass is requisite to light a room in a building with free space about it, it is inadequate for a room in a building on a narrow street. Under exceptionally free conditions, with no obstructions to the direct light from the sky, it is possible that the area of glass might be reduced, but it appears to be no more than enough for the ordinary conditions of the new buildings, and should be increased, if possible.

(6.) *Ceilings* will be level, plaster tinted a light cream color.

(7.) *Heating and Ventilation.*—The inlet for heat above 5 square feet, the outlet for ventilation about 5 square feet.

(9.) *Bookcase.*—Provide a bookcase in any convenient position, capable of containing 300 octavo volumes (600 volumes in bookcases for upper grades); upper doors fitted with pin tumbler locks and latch and knob; drawers fitted with pin tumbler lock and small brass knobs. Lower doors to have pin tumbler locks; same lock in each bookcase; all bookcase locks master keyed. (See drawing.) Special equipment for care of books where school is held day and evening is described on page 20, Report 1908.

(10.) *Map Supports.*—Provide one map support for each class-room in Grades IV, V, VI, VII, and VIII, preferably behind the teacher's desk or opposite the windows.

(11.) *Teacher's Closet.*—Provide a small closet for teacher's coat and hat, preferably opening from the class-room, but allowable from the wardrobe.

Fresh Air Rooms.—The School committee is responding to the more general demand for fresh-air rooms for children who are anæmic or of tubercular tendencies. At present all that the Board is advising to meet this new demand is that a sunny room, preferable a sunny corner room, be chosen for this work, and that the windows on one or on two sides be made casement to open out, instead of double hung; and that the heat be largely direct, so that the temperature can be quickly raised if necessary when the windows are closed. Otherwise these rooms will be the same as other class-rooms.

Wardrobes.—A (1) *Size.*—Wardrobes will adjoin school-rooms and be from 4 feet 6 inches to 5 feet wide.

(2 and 3.)—*Windows and Doors.*—Outside light, two doors, both connecting with school-room, and not to corridor, and having no thresholds. Doors, double swung, 2 feet 6 inches wide, brass double acting butts, foot and hand plates, hook or adjustable stops to hold open, ventilation under door farthest from vent.

(4.) *Floors.*—Terazzo, with granolithic border and base.

(5.) *Walls.*—Painted burlap up to hook rail; Poles on brass-plated iron brackets with hooks under and pins over, 44 in number; umbrella clips and drip gutter below. (See drawing.) Walls above, plaster, tinted. Height of lower pole, kindergarten, 30 inches from floor; lower grades, 36 inches to 40 inches; upper grades, 44 inches, 48 inches and 52 inches; distance between poles, 8 inches for elementary, 12 inches for high schools. Pins and hooks, 8 inches to 12 inches on centers for elementary and 16 inches to 18 inches for high.

(6.) *Ceiling.*—Plaster, untinted.

(7.) *Light.*—One lamp. Ceiling outlets, electric. Switch in class-room.

(8.) *Heating and Ventilation.*—Heating, direct. Ventilation, direct, 1 2-3 square feet area cross section.

Wardrobes.—B. The so-called Chicago type has been studied in a model for one building, but has not yet been tested in practice. It is a recess 20 inches deep and about 14 feet long, equipped with the standard pole and 44 hooks. The floor is of terazzo, the ceiling is at about 7 feet above the floor. The doors are hung like sash, to slide up, are framed flush and covered with burlap for a tack-board. The ventilator is independent of the room vent, but there is no heat except what is drawn in from the room at the bottom.

Corridors and Vestibules. (1.) *Sizes*—Not less than 8 feet wide for four rooms on a floor; not less than 10 feet for over four rooms, governed by length, access to stairs, etc.

(2.) *Windows.*—Outside light essential.

(3.) *Doors.*—Main outer doors to open out, heavy butts, standard, master keyed, school lock; door check; heavy hooks to hold open. Vestibule doors open out, heavy butts, pulls, push plates, hooks to hold open, door checks, no locks. Outer doors to basement open out, and fitted with standard latch lock. Other hardware as above.

(4.) *Floors.*—Terazzo divided into areas not to exceed 80 square feet, by slate strips, or linoleum on a cement surface.

(5 and 6.) *Walls and Ceilings.*—A light glazed brick, untinted walls and ceilings. Put picture molding at ceiling in corridors.

(7.) *Light.*—Ceiling or short pendant fixtures (electric) 32 candle-power each, also gas for emergency in corridors, on stairs, and in vestibules.

(8.) *Heating and Ventilation.*—Heat direct, supplemented by foot warmers on first floor. Ventilation where possible.

(9.) *Sinks and Closets.*—On each floor above the first one or two 4-foot sinks, and emergency closets, with water-closet, one for boys and one for girls.

Staircases.—(1.) *Number and Arrangement.*—Determined by the Board, but fireproof construction in all cases, and not over 5 feet wide.

(2.) *Material.*—The treads, North River stone on iron string, or concrete construction with granolithic surface. Rails of a simple pattern, easily cleaned; wall rails are not wanted.

(3.) *Steps.* About 6½ or 7 inches by 10. Rail not less than 2 feet 8 inches on runs and 3 feet on landings.

Sanitaries.—(1) *Size.*—General toilet-rooms in basement, in size approximating space for 2.25 water-closets for each school-room, .75 boys, 1.5 girls, and 33 inches of urinal for every school-room, arranged for convenient supervision and circulation.* Slate sinks, length from 10 inches per class-room in small buildings to 6 inches per class-room in large buildings located preferably in the play-rooms. The above refers to mixed schools.

(2.) *Windows.*—Ample outside light; glazed where exposed to view outside with factory ribbed glass. To have wire guards.

(3.) *Doors.*—The doors arranged "in" and "out," with spring or door check and stout brass hooks to hold open; glazed with ribbed glass; half doors to water-closets, except where ordered omitted.

* Inquiries have been addressed to principals of all schools where water-closets and urinals have been installed on this basis, and the consensus of opinion appears to be that the number cannot be reduced without inconvenience, but that it is satisfactory as it stands.

(4.) *Floors.*—Asphalt. Boys' drained to urinal, girls' to floor wash.

(5.) *Walls.*—Salt-glazed brick or other non-porous, inexpensive surface, 7 feet high; above, brick painted.

(6.) *Ceiling.*—Untinted plaster or white-washed concrete. No basement ceiling need be furred level.

(7.) *Light.*—Ceiling or short pendant electric fixtures.

(8.) *Heat and Ventilation.*—Heat direct. Ventilation through water-closets and space back of urinals, allow 10 square inches local vent for each water-closet and 8 square inches for each lineal foot of urinal.

Masters' and Teachers' Rooms.—(1.) In each school of the upper grades a room of about 240 square feet for the master, with a water-closet and bowl and a book-closet adjoining. This room should be near the center of the building, i. e., on the second floor in a three story building. In all schools a room or rooms for teachers, averaging about 300 square feet for ten teachers, with one water-closet and bowl for each ten. Doors to be clearly marked "Master" or "Teachers" in brass letters.

(2.) Where men as well as women are teachers, a separate room with toilet accommodations for men.

(3.) Opportunity in teachers' rooms for warming luncheon, either gas or electric.

Play-Rooms.—(1.) All free basement space to be arranged as play-rooms for boys and girls. Salt-glazed brick, 7 feet high, and painted or whitewashed brick or stone walls above. Granolithic floors drained to floor washes, plaster ceilings or white-washed concrete. Basement doors and windows to have wire guards in channel iron frames; guards to be hinged and padlocked.

Playgrounds.—Playgrounds to have boundary fences and to be paved for the play-yards, coal and ash teams. Borders to be planted.

Plumbing Fixtures.—(1.) *Water-closets.*—The basement water-closets for elementary schools are short hopper closets; elsewhere, a heavy washdown closet. (See drawing.)

(2.) *Slate partitions.*—Any sound, close-grained slate, black, green or purple, supported at ends with iron pipe about 8 feet high, tied together and to the wall, to which doors are hung. (See drawing.)

(3.) *Urinals.*—The urinals will be of slate, floor slab, trough and back, with partitions, flushed automatically, through $\frac{7}{8}$ inch perforated pipe, with cold water; vented at bottom, into space behind. (See drawing.)

(4.) *Sinks* of black slate, self-closing cocks, set 15 inches on centers, and cup-hooks at each side of cocks, and jet drinking fountains, in the external angles. A sink is desired for electrician unless there is one near by.

(5.) *Floor Washes* in sanitaries and playrooms as already mentioned. (See drawing.)

(6.) *Piping.*—(*a.*) Cast iron must be laid on good footing in basement, clean-outs at every change of direction. Soils and vents exposed as far as possible, no asphaltum, but oil-tested, red lead and three coats of paint.

(*b.*) *Supplies.*—Exposed as far as possible; where covered may be plain brass, elsewhere polished brass; no nickel-plate. Hot water for janitor's use in basement, cooking-room, and for master's and teachers' rooms and emergency toilets. Supply from boiler and from summer boiler, if any, or from an independent hot-water heater.

(*c.*) *Fire Lines.*—In buildings over three stories high, one or more lines of 3-inch pipe if requested by the Board.

Special Rooms.

Assembly Halls.—(1.) Assembly halls should accommodate from 400 to 800. It is not considered necessary to seat the full number of pupils in schools of greater capacity. The floor to be level and of wood like class-rooms. The windows to be fitted with rebated moldings to take black shades, and so designed as to make the operation of shades practical and simple. The platform should be capable of accommodating one, or, in the large schools, two classes, and should have removable stepped platforms of wood to take the benches. Galleries may be used where the hall is two stories in height. Anterooms near the platform are desirable, and a connection from adjoining class-rooms to the anterooms or directly to the platform. A dignified architectural treatment of the walls, and a studied color scheme for walls and ceiling is expected. The lighting, acoustics and exits should be such as belong to a small lecture hall. Artificial lighting to be under control from at least two points, one of which must be near an exit. Electric outlet for 30 ampere projection lantern, 25 feet from curtain. Provide recess in ceiling over platform for spring rolled curtain 13 feet long.

Manual Training Rooms.—(1.) *Size.*—Room generally located in basement, should be approximately 900-1,000 square feet, preferably a corner room, and the larger of the two allowed sizes of rooms; and arrangement, shown by drawing, for number of benches there given, 28.*

(2.) *Light.*—The windows should be as near full length as possible, and on two sides. Artificial light in chain pendant electric fixtures, one light to every four benches.

(3.) *Floors.*—Of wood.

(4.) *Walls.*—A basement room should be finished as a shop; salt-glazed brick up to 7 feet where exposed, and above black board space of about 15 running feet, 4 feet high, and above this brick walls whitewashed. If above basement, finished as a class-room.

(5.) *Ceilings.*—Like basement.

(6.) *Heating and Ventilation.*—The same as in class-rooms.

(7.) *Fittings.*—(*a.*) *Stock-room.* — Stock-room should contain at least 80 square feet, preferably long and narrow. Eighteen-inch shelves should run around the room, 5 feet 6 inches and 6 feet from the floor.

(*b.*) *Wardrobes.*—Wall space for 30 double coat and hat hooks, in a separate room.

*In elementary schools for boys only, 25 is sufficient, as this would always take half a class.

(*c.*) *Teachers' Closet.*—Teachers' closet should be large enough to be used also for storage of finished work, and should be fitted with all shelving possible, as well as with the customary coat hooks. An area of 40 square feet is adequate.

(*d.*) *Bookcases.*—Like those in class-rooms, 150 capacity.

(*e.*) *Work-rack.*—About 28 feet long, made in sections, 6 feet 6 inches high, and 2 feet deep. The length is to take 27 compartments (equaling the number of benches) and the height the number of divisions that use the room (two each day, five days, outside limit). Compartments to have numbers painted. (For all of these see drawings.)

(*f.*) *Sink.*—A 3-foot porcelain enameled iron sink, with hot and cold water.

(*g.*) *Furniture.*—(Not included in the building contract.) The furniture comprises 28 benches and stools, 4 display frames about 6 feet long and 30 inches wide, demonstration steps and guard rail, teacher's desk, table 4 feet by 2½ feet with unfinished top, 1 desk chair and 2 common chairs. (See drawing.) Lay these out on preliminary drawings.

Cooking-Room.—(1.) *Size.*—Should have an area of 900-1,000 square feet, preferably a corner room on top floor but generally in basement, and the larger of the two allowed sizes of room, and arranged for 28 stations.

(2.) *Light.*—Windows as in a class-room, if located in a corner, from two sides. Artificial light as in a class-room.

(3.) *Walls.*—Above basement, similar to school-rooms, blackboards, 4 by 10 feet, back of teacher's desk. Walls painted in oils. A basement room may have salt-glazed brick walls up to 7 feet and painted brick above. (See drawings.)

(4.) *Floors.*—The floor linoleum, on cement, except space occupied by ranges, which is tiled.

(5.) *Ceilings.*—Ceilings like basement, or if above basement like class-rooms.

(6.) *Heat and Ventilation.*—Less heat is required than in a class-room, but the ventilation should be the same, with additional vent from the demonstration ranges.

(7.) *Fittings.*—(*a.*) *Wardrobes.*—Provision for 28 pupils, double coat and hat hooks in separate lighted closet, and small teacher's closet.

(*b*) *Work benches,* accommodating 28 pupils, fitted with compartment for utensils, bread-board, etc., a Bunsen burner with a hinged iron grill over it, set on aluminum plates at each station; benches arranged in the form of ellipse, or oblong with access to center from two sides; top of pine 26 inches wide; open underneath and supported on pipe standards. One section detached and fitted as a demonstration bench; a clear space of 4 feet all around. Dining table (furnished under another contract) is to be set in center. (See drawings.) Lay these out on preliminary drawings and include in final drawings and contract.

(*c.*) *Dresser.*—Ten feet long, in 3 sections, 4 adjustable shelves and glazed sliding, or hinged, doors at top; one set of 3 drawers and 2 cupboards on lower part. A shelf should be put in each cupboard about 12 inches from top.

(*d.*) *Fuel-box.*—In 2 compartments, each about 24 inches square and 30 inches deep, with hinged lids; small shelf in one section. Accommodations in the main coal-room for a supply of range coal and kindling wood.

(*e.*) *Bookcase.*—Similar to those provided in class-rooms.

(*f.*) *Sink.*—Soapstone, 5 feet long; 2 cold and 2 hot water cocks; soapstone drip shelves, 24 inches long, at each end of sink, and a small sink about 2 feet long, with 1 hot and 1 cold water cock. Sinks should be near ranges.

(*g.*) *Hot-water Supply.*—(See instructions in plumbing.)

(*h.*) *Coal and Gas Ranges.*—A six-hole coal range and a similar gas range, with hood provided and set on a hearth previously mentioned.

(*i.*) *Refrigerator.*—Will be a part of the furniture. Furnished under another contract.

Kindergarten.—(1.) *Size.*—The rooms can be contained in the space of a class-room and wardrobe, but a slightly larger area, 800 to 900 square feet, is desirable, and preferably the larger of the two allowed sizes of room. They comprise a large room, a small room, a supply closet, a wardrobe and a water-closet. The large room should take a 16-foot circle, regulation lines painted on the floor, with at least 4 feet all around it. The small room, about 200 square feet.

(2.) *Light.*—Windows should be as in a class-room, if on a corner, on both sides. Exposure should be sunny. Artificial light of the class-room type, arranged for the different rooms.

(3.) *Doors.*—Door to corridor as in class-rooms. Wide doors should open from small room into large room.

(4.) *Floors.*—Linoleum cemented on to concrete surface, with painted lines as above.

(5.) *Walls.*—As in class-rooms, with blackboard as in lower grades.

(6.) *Ceilings.*—As in class-rooms.

(7.) *Heat and Ventilation.*—As in class-rooms.

(8.) *Fittings.*—(*a.*) *Wardrobe.*—Hooks for 60 arranged as in ordinary wardrobes.

(*b.*) *Teachers' Closet.*—For clothing of two or three teachers.

(*c.*) *Toilet-room.*—Immediately adjoining, with low-down seat and bowl or sink.

(*d.*) *Bookcase.*—As in lower grades.

Nurse's Room.—(1.) *Size.*—From 200 to 400 square feet, according to size of school.

(2.) *Windows.*—Outside light as in class-rooms.

(3.) *Shades.*—Set to roll from window-sill upward. Not in building contract.

(4.) *Doors.*—One door to corridor, as in class-rooms, marked "Nurse's room."

(5.) *Walls.*—Upper two-thirds plaster, smooth finish, round corners, painted with light green oil paint. Lower one-third to floor, glazed white tile.

(6.) *Floor.*—Terazzo, like corridors.

(7.) *Heat and Ventilation.*—As in class-rooms.

(8.) *Light.*—Pendant electrolier with special shade. Extra socket on body of fixture for hand portable.

(9.) *Nurse's Closet for Supplies.*—Size, 3 by 4; one shelf; 6 hooks for clothing.

(10.) *Bath Tub.*—Five-foot porcelain enameled iron, hot and cold water, where requested by Superintendent of Nurses.

(11.) *Bowl.*—Enameled iron, hot and cold water faucets to turn by foot pressure, i. e., hospital pattern. Hot water must be available all the year.

(12.) *Stove and Clock.*—Gas or electric heater as in teachers' rooms, and a secondary clock.

(13.) *Fittings.*—(Not in building contract.) (*a.*) *Cabinet.*—Oak finish, medical cabinet, adopted as standard by Schoolhouse Commission. (*b.*) *Stool.*—White enamel revolving stool. (Not in building contract.) (*c.*) *Table.*—Dressing table, white enamel frame, glass top and shelf; size 16 by 20, rubber crutch tips. (*d.*) *Filing Case for Nurse's Records.*—Oak finish, to hold 1,000 cards, 4 by 6; lock and key; guide cards. (*e.*) *Writing Table.*—Oak finish, with drawer and lock; size, 20 by 30. (*f.*) *Chair.*—Oak to match table. (*g.*) *Couch.*—Flat frame oak, canvas adjustable top. (*h.*) *Mirror.*—Size 2½ by 3, set over bowl.

High Schools.

Class-Rooms and Recitations-Rooms.—(1.) High school class-rooms are laid out for classes of thirty-six or forty-two, generally the latter. A room, 26 feet by 32 feet, will accommodate forty-two high school desks. The larger class-rooms are to accommodate from sixty to eighty pupils; the larger number can be accommodated in a room 33 feet 8 inches by 43 feet. Recitation-rooms, which to a certain extent will be used also as class-rooms, should be about 16 by 26. These rooms, if equipped with continuous desks and seats as in a lecture-room, or with double desks, such as are to be used in the Charlestown High, would accommodate about thirty pupils each. Lay out desks in one room of each type on preliminary plans.

Assembly Hall.—(1.) For a high school would not differ materially from that already described for elementary schools.

Masters' and Teachers' Rooms.—(1.) For accommodation of the principal there should be an outer office, that is, a waiting-room or reception-room, and an inner office; and rooms for both men and women teachers, which might well be concentrated in the neighborhood of the reception-room and the principal's room. The School Committee now have under consideration a change in the organization of high school teachers, which may require a modification of the arrangement of the offices.

Chemistry.— (1.) *The Room in General Required.*—Laboratory, separate from lecture-room, may be used as recitation-room, but better to use lecture-room and keep laboratory free from desks and demonstration table. Lecture-room, separate from laboratory, but easy of access, may be used for recitation; in that case should have facilities for demonstration. Combined lecture-room for physics and chemistry admissible. Three rooms for administrative purposes, store-room for dry chemicals and apparatus, room for storage of liquid chemicals and preparation of reagents, which may also be used as a teacher's laboratory and an office. The total area of the laboratory and administration rooms should be about 1,200 square feet, and of the lecture room about 600 square feet.

Chemical Laboratory.—(1.) *Size.*—Should accommodate a class of forty to fifty pupils, with apparatus. Accommodation for three such classes.

(2.) *Light.*—On two sides.

(3.) *Heating and Ventilation.*—On same basis as for class-rooms, but removal of gases should also be provided for by a hood, each compartment of which should be ventilated by 9-inch hole at top, venting into elbow or T of drain pipe, thence connected by drain pipe into main flue, in which should be a fan operated by a motor.

(4.) *Walls and Ceiling.*—Walls of brick ideal, but not generally feasible, except on outside walls; plaster walls painted in oils and ceiling of plaster, covered with water-resisting surface containing no lead. All woodwork to have natural finish, except tops of desks.

(5.) *Floor.*—Preferably of concrete; may be of hardwood in narrow strips, filled in by asphalt; should slope very slightly between desks, interspaces again trending to common corner, which may be drained.

(6.) *Equipment.*—Working desks at right angles to greater length of room, in sections back to back between windows; sections movable when top is removed. Each section 21 feet to 24 feet 6 inches long, 2 feet wide, 3 feet to 3 feet 2 inches in height. Distance between double sections about 5 feet, same distance at least between ends of sections and hood, which should be opposite longer line of windows and at right angles to direction of desk sections. Other ends of section near enough to wall to allow for drain at right angles to sections and under windows. Desks to be of ash or any durable wood, natural finish. Top of narrow pine strips, treated with aniline black and waterproof lead finish. Individual desks provided with 3 lockers and 3 sets of drawers each, each set of drawers operated by bar from locker, combination lock to fasten locker. Each double section of desks provided with soapstone sink, placed between sections and flush with section top, which should slope slightly to sink.* Sink 8 inches at least wide, and should begin within 1 foot of the end toward hood, depth here to be 6 inches, running nearly to other end, where depth should be 8 inches. Each pupil to have working space of 3 feet 6 inches by 1 foot 8 inches. Each double section of desks provided with shelf for reagents, running length of desk, 10 inches to 12 inches above desk, supported by metal standards at suitable intervals, of white wood, 1¼ inches thick, 9 inches wide, natural finish, covered with glass plates, ¼ inch thick, 9 inches wide, suitable lengths, clamped

*Individual sinks are preferred by the teachers, although the long trough is apparently adequate for teaching elementary chemistry, and is less expensive.

to wooden shelf with as few clamps as possible. Wooden shelf at free end of each section, 1 inch to $1\frac{1}{2}$ inches thick, 3 feet to 4 feet long, not over 1 foot 3 inches wide, height of 2 feet 8 inches to 2 feet 10 inches, for holding blast lamps, reagent jars, etc. Finish off top of shelf in aniline black. Floor space under second row of windows taken up with line of extra desks, built like sections, furnished in similar way, but without necessarily a drain, to be used for emergency or general utility. Wall space not otherwise occupied may be used for shelves or cabinets. Fixed slate blackboards at end opposite second set of windows, and parallel to desk sections, sliding slate blackboards above hood. Liquid waste may be thrown into desk sink, dry waste into earthern jars. Hood should run at right angles to desk sections. and along wall opposite free ends of sections. In the construction of hood, protection against fire should be considered. Should be built against brick wall. Floor of hoods to be of slate; wood, inside and outside, to be finished natural. Space divided into 3 or 4 compartments, closed by sliding windows. Space against wall not occupied by hood for general link.

(7.) *Gas.*—Lead from gas main at free end of center of double desk sections, branch into 2 leads along back of each section. Take-offs between each working desk space in form of pillar with two $\frac{1}{4}$-inch cocks, at each end desk a single cock. Two $\frac{1}{4}$-inch gas nipples at each side of each compartment of hood. Cocks of these outside of hood. Wall desk fitted with single gas taps at intervals of 2 feet.

(8.) *Water.*—Lead from water main at free end of center of double desk sections. Size, large enough to fill section sink rapidly. Lead of ordinary size along length of section, underside of shelf, take-off at free end of section to which blast and suction pump may be attached. At junction of each four working desk spaces take-off, carrying two valves with hose bibb delivery ¼-inch, the two valves or cocks facing opposite sides. Suction pump attached to these bibbs if desired.

(9.) *Drains.*—Section desk sink to have open drain and mercury arrester, into which should be set movable concave netting of wide mesh to arrest larger solid matter. Main desk drain at right angles to sections along and under windows, between windows and sections, should be in form of wooden trough, in sections dovetailed from 6 inches to 8 inches inside diameter and equally deep, covered with asphalt paint or filling; may be supported on brackets against wall and left open, or covered and provided with movable top. Into this drain will drip the lead pipes coming from section sink. Slate floor of each hood compartment should deepen slightly in center, where there should be a hole 1 inch in diameter, into which is fitted short lead drain pipe, closed by perforated plug; drain pipes to be connected with sloping drain pipe, open or closed, running toward and delivering into general sink.

(10.) *Electricity.*—Current of electricity on section desks need not exceed ten volts, may be supplied from source common to physical and chemical side. Plugs between each working space placed under desk top on frame.

Lecture and Recitation Room.—(1.) *Size.*—Area to depend on number of seatings required or number of pupils in classes; should be large enough for two classes, and should occupy a position between the laboratories for physics and chemistry.

(2.) *Light.*—As much glass area as class-room, preferably from left. Fit windows and other openings admitting light with dark curtains as specified under Assembly Hall. Electric lighting from the top, controlled at point convenient to demonstration table.

(3.) *Floor* stepped up in fireproof construction and finished in wood, like floor.

(4.) *Heating and Ventilation.*—As for class rooms, with extra ventilation to remove fumes. Space at left end of desk provided with register and flue of at least 10 inches diameter, to afford means of down draught. Flue carried under floor to nearest wall, flue and draught actuated by motor, if not sufficient.

(5.) *Equipment.*—Demonstration table, not less than 12 feet long, not more than 3 feet nor less than 30 inches wide, height 32 inches. Placed 4 feet distant from wall, material same as that of room, top made of pine plank and and finished like chemical laboratory desks. Pneumatic sink at right hand of desk, of soapstone in 2 depths. Not to exceed 30 inches long, 20 inches wide. Depth, 4 inches to 6 inches minimum; 16 inches to 18 inches maximum. Length of minimum depth not to exceed 60 per cent of total length. Sink to be depressed in table and provided with flush cover. Sink to have screened drain with mercury trap and overflow. Supply hot and cold water under reduced pressure and cold water under street pressure for quick filling, 2 goose-necks with ¾-inch hose bibbs, to one of which combined blast and suction pump may be attached; steam supply direct from boiler main with a by-pass to summer boiler; supply gas air suction, and gas taps not exceeding 6 in number. Over demonstration table, secured to ceiling, provide a plank with heavy screw hooks. Behind lecture table provide sliding blackboards of not less than 50 square feet, and a canvas curtain on heavy spring roller for attaching charts. Drawers and closets for lesser lecture apparatus and chemicals in body of table, wall on either side provided with shelves for reagent bottles under glass, and side wall provided with cabinets for larger pieces of permanent apparatus, if there is no special room for this. Lifting seats with desk for taking notes arranged on platforms, so that the successive tiers will rise one above the other to insure an unobstructed view of demonstration table. (See drawing.)

(6.) *Electricity.*—Provide three (3) forms of current, viz., one circuit for direct current at 110 volts, 30 amperes, and one circuit for 5 to 20 volts, 50 amperes, and one circuit for alternating current at 110 volts, 30 amperes. Regulating rheostat for the 5 to 20 volt direct current to be located conveniently to table. A 50-ampere ammeter and a 125-volt volt-meter, both with extra large illuminated dials, mounted on swing brackets in full view of class and instructor; suitable means for switching ammeter and voltmeter to either circuit. Terminate circuits in nonreversible push plug receptacles. A projection lantern, and receptacles for same, at end of table and at rear of room. Lantern screen on spring roller at side of room, width of screen usually 12 feet, but dependent on distance and lenses used.

Administrative Facilities.—(1.) *Apparatus Storeroom.*—Should give ample space for storage of extra and reverse apparatus and original packages of stock chemicals. These should be kept in dust-proof cabinets with glass doors and in drawers.

(2.) *Preparation-room.*—This should adjoin the above. Primarily for storage of liquid chemicals in bulk and preparation of liquid reagents, and storage of supply bottles, also fitted for teacher's laboratory. Should have wide center table with gas in center, working desks, with drawers and closets along two sides, also gas, water, sink, blast, suction, steam and electricity. Shelves along desks for storage of liquid chemicals, supply bottles and smaller reagent bottles. An adequate hood should be provided.

(3.) *Office and Balance Room.*—Adjoining storeroom and preparation-room should be small room to contain desk, book shelves, table and a good grade balance.

Physical Laboratory.—(1.) *Size.*—In a space about 30 by 40 feet. A laboratory, apparatus-room and shop.

(2.) *Light.*—The same basis as for class-rooms, one wall having as direct a southern exposure as possible for *porte lumiere* studies. Artificial light as in a class-room Dark curtains in addition to regular shades for darkening room. Windows and all openings admitting light fitted as specified under Assembly Hall.

(3.) *Heating and Ventilation.*—On same general basis as for class-rooms.

(4.) *Equipment.*—Small laboratory tables to accommodate two or four pupils at each, built of hard wood, white pine tops, fitted with 4 drawers, supports and adjustable cross-bar. Wall tables around room on sides where there are windows, with one or two shallow drawers under, but not deep enough to interfere with comfort of pupil. Soapstone drip sinks with cold water to be provided at these tables, one to every six or eight pupils. Instructor's table, fitted with hot and cold water, Richards' pump, numerous cupboards and drawers of various depths and widths. Two-inch plank bolted to ceiling over this table, with space of 2 or 3 inches between plank and ceiling for attachment of pendulums and other apparatus. Provide electric outlet for stereopticon and screen for same.

(5.) *Furniture.*—Provide adjustable stools for all the tables and a sufficient number of tablet arm chairs to accommodate the entire division during demonstration exercises. Chairs to be placed in rectangle formed by pupils' tables and demonstration table. These are not in building contract, but to be laid out on preliminary plans.

(6.) *Electricity.*—One outlet for direct current at 110 volts E. M. F. and 30-ampere capacity. One outlet for direct current at low voltage with regulator conveniently located. One outlet for alternating current at 110 volts E. M. F. and 30-ampere capacity. One outlet for each kind of current at demonstration table, to be single pole push plugs instead of binding posts. Series and multiple connections at each pupil's table. Switch in laboratory to cut out pupils' tables.

(7.) *Gas.*—Pupils' tables to be equipped with gas, 4 cocks to each table. Wall tables to be equipped with gas. Demonstration table to be provided with gas.

(8.) *Bulletin Board.*—25 to 50 square feet of bulletin board, covered with burlap, secured at edges, but not glued on like wall paper.

(9.) *Blackboards.*—As much blackboard space as possible. Sliding blackboards back of demonstration tables.

Apparatus Rooms.—(1.) *Size.*—One large or several small rooms, to open directly out of laboratory, and connected with lecture-room.

(2.) *Equipment.*—To be fitted with dust-tight cases with adjustable shelves and sliding glass doors, 7 feet high; cabinets of drawers of various widths and depths, mostly narrow and shallow. Some of these cases may be in the laboratory if there is sufficient wall space. A small sink and hood should be provided.

Shop.—(1.) A small shop is desirable, though not absolutely necessary. This should be equipped with work bench, power lathe, belted to motor generator, and shelving for tools and stock, and may be set up in apparatus-room.

Botanical and Zoological Laboratory.—(1.) *Size.* In a space about 30 by 40 feet. Laboratory and apparatus-room.

(2.) *Light.*—Windows the same as for class-rooms, one wall with southern exposure. Artificial light as in class-rooms.

(3.) *Equipment.*— (*a.*) *Twenty-one pupils'* tables, 54 inches by 24 inches by 30 inches high, each to accommodate two pupils, to have plate glass tops.

(*b.*) Soapstone sink, 72 inches by 30 inches, 10 inches deep, accessible on all sides. Supply with cold water, about 8 bibbs and 2 hose bibb cocks.

(*c.*) One aquarium, 30 inches long, 20 inches wide and 20 inches high, with supply, gooseneck cock with aspirator and standing waste.

(*d.*) Ice chest, 36 inches by 24 inches.

(*e.*) Cases built wherever practicable. Three sections to contain 42 pigeonholes, 3 inches by 3 inches by 8 inches, for storage of instruments. A liberal supply of cases to contain drawers and cupboards in lower compartment, and shelves above for exhibition of specimens, storage of material, instruments, books, charts, etc.

(4.) *Furniture.*—Forty-two adjustable screw revolving chairs, not in building contract.

Gymnasium and Drill Hall.—(1.) To be used in common for gymnasium exercises, athletic games and the drilling of the school cadets. On account of its size and for structural conditions, to be generally located in the basement, with clear span of ceiling and combined height of basement and first story. Visitors' gallery generally provided at one end, entered from first floor.

(2.) *Size.*—The classes exercising in the gymnasium are from fifty to one hundred, and a suitable floor space for this number, as well as floor space for a full company of cadets at drill, is from 3,750 to 4,000 square feet. The height should not be less than 24 feet.

(3.) *Light.*—Ample outside light in all cases. Electric light from ceiling protected with wire guards.

(4.) *Heat and Ventilation.*—The former sufficient to guarantee a temperature of about 60 degrees, and about twice as much ventilation as is customary for the ordinary class-room. This is, of course, insufficient for the number of people who might occasionally occupy the gymnasium for exhibitions, but it is more than enough for the ordinary number using it for class exercises.

(5.) *Equipment.*—The standard gymnastic apparatus consists of the following fixtures, which may be slightly modified in particular cases.

25 Bar stalls.
25 Bar stall benches.
4 Double booms.
4 Saddles.
20 Vertical ropes.
2 Inclined ropes.

2 Rope ladders.
5 Serpentine ladders.
3 Horizontal ladders.
2 Boxes, 1 horse, 1 buck.
12 Balance boards.
2 4 by 7 mats.
2 5 by 10 mats.
4 Pairs jumping standards and ropes.
4 Inclined planes.
6 Traveling rings.
1 Pair basket ball goals.
3 Basket balls.
4 4-lb. medicine balls.
16 2-lb medicine balls.
24 Small rubber balls, 2¼ to 3 in. in diameter.
8 Indoor baseballs.
1 Fairbanks scale.
1 Water spirometer.
1 Tape measure.
1 Dozen glass mouthpieces.
24 Bean bags.
1 Truck to carry mats.
1 Storming board.
6 Pairs 1½-lb. Indian clubs.
40 Pairs ¾-lb. Indian clubs.
8 Chest weights.
1 Horizontal and vaulting bar.
1 Pair parallel bars.
2 Jump boards.
1 Shoulder caliper.

(6.) *Gun Racks.*—Racks for holding the guns carried by the cadets should be provided on wall. These racks should be protected by locked doors.

(7.) *Special Rooms.*—Adjoining gymnasium and drill hall two small rooms about 10 feet square should be provided for school matron and director of gymnasium.

(8.) *Dressing Rooms, Baths and Lockers.*—(*a.*) *System.*—The clothing of all the pupils is in a central locker-room, each suit being numbered, and all being under the control of the attendant in charge. Dressing-rooms are provided in number equivalent to the number of a class. A class coming for exercise are given their gymnasium clothing and keys to dressing-rooms, which they lock behind them when exercising. After exercise they can take a shower bath. When dressed the dressing-room keys are given up, but the gymnasium clothing is left to be gathered up by the attendant. The clothing is carried to the dry-room, and when dried each set is put back in its proper pigeonhole.

(*b.*) *Lockers.*—The locker-room is controlled by the attendant, and contains pigeonholes, 10-inch cube, one for each pupil in the school, and a counter over which to deliver the clothing. Adjoining this is the dry-room, capable of being heated to a high temperature and thoroughly ventilated. This is fitted with hooks and clothes line.

(*c.*) *Dressing-rooms.*—The dressing-rooms are small cabins, about 3 feet square, with a locked door, a seat and hooks.

(*d.*) *Showers.*—The shower baths are 3 feet square, divided by slate partitions, similar to those for water-closets, each having a bar at the front, over which a cotton sheet can be dropped. Each compartment has two sprays in opposite corners.

Handicraft Rooms.—There should be space in one or more rooms for free-hand drawing, mechanical drawing, woodworking and metal-working.

(1.) *Size.*—The space should be about 3,000 to 3,600 square feet. The free-hand drawing-room should be preferably divided into two drawing-rooms, with a work-room between.

(2.) *Light.*—Windows and artificial light, by special fixtures. North light preferable in the drawing-rooms.

(3.) *Floors.*—Of wood.

(4.) *Walls.*—As in a manual training room.

(5.) *Ceilings.*—As in a manual training room.

(6.) *Heating and Ventilation.*—Same as in class-rooms.

(7.) *Stock-room.* — The lumber stock-room should contain at least 80 square feet, preferably long and narrow. Two 18-inch shelves should run around the room, 5 feet 6 inches and 6 feet from floor.

(8.) *Teachers' Closets.* — Teachers' closet in woodworking room should be large enough to be used for storage of finished work, and should be fitted with all shelving possible, as well as with the customary coat hooks. An area of 40 square feet is adequate.

(9.) *Fittings.* — (*a.*) Bookcases, like those in class-rooms, 150 capacity.

(*b.*) *Cases.* —For work in process, extra tools, supplies, drawing boards, models, paper, finished drawings, etc. (For all of these, see drawings.)

(*c.*) *Display Boards.*

(*d.*) *Sink.*—A 5-foot sink, with hot and cold water.

(10.) *Equipment of Free-hand Drawing-room.*—Provide accommodation for five divisions, each class about twenty-five pupils.

(11.) *Equipment for Mechanical Drawing-room.* (See Fittings.) Also 12 double drawing tables, 7 feet 4 inches by 2 feet, with drawers for instruments.

(12.) *Equipment of Woodworking Room.*—Provide accommodation for four divisions, each class about 20 pupils; 20 benches, 36 inches by 18 inches, fitted with 2 vises, one to be a quick action, iron vise, 3 speed lathes, 1 jig saw, 1 circular saw.

(13.) *Equipment of Metal-working Room.*—Six double benches, 8 feet by 2 feet, fitted with 12 Prentiss iron vises, 3½-inch jaw; wall bench, fitted with 10 stations, tool drawers and 5 Bower's tool holders; one ¼-inch gas hose cock terminal above each bench station; 2 gas blast burners, 1 large, 1 small; metal covered bench with ventilated hood; 1 muffle furnace, ventilated; 1 drill; 1 forge, ventilated; 1 anvil: 1 grindstone; 1 table tool rack; 1 pair bench shears; 1 engine lathe.

(14.) *Motor.*

Household Science.—(1.) *Size.*—The space should be about 1,200 square feet, and should accommodate the kitchen, two small rooms for showing the care of a dining-room and of a bedroom, and a china closet and pantry.

(2.) *Light, Heat, etc.*—The same as that for other rooms, with additional ventilation in the kitchen.

(3.) *Equipment.*—The kitchen to contain the same equipment as that for grammar school cooking rooms, but for 24 stations only; a kitchen pantry fitted with shelving and a china closet fitted with a sink; drawers, cupboards and shelves inclosed with glass doors. The dining-room and bedroom simply finished rooms, having no equipment except the furniture.

Lunch-Rooms.—(1.) *In General.*—The lunchrooms in Boston schools have usually been located in the basement, and where these are high and well lighted this location seems to serve satisfactorily. They should, however, have the special ventilation that is provided in a basement cooking-room. In size, they should accommodate comfortably, seated at benches or small tables, that proportion of the pupils in the school which take advantage of the luncheon facilities.

(2.) *Equipment.*—(*a.*) The counter should be set at 2 feet 8 inches high, and should have a rail 2 feet from it, with openings at intervals, to keep children in single file, and there should be accommodation under the counter for dishes.

(*b.*) *Range.*—A six-hole gas range, with ample oven space.

(*c.*) *Sinks.*—Two good-sized soapstone sinks.

(*d.*) *Ice Box.*—Of sufficient size to take care of milk supply.

(*e.*) *Lockers.*—Sufficient to care for the clothing of the attendants, and for mops and brooms, etc. These should not be under the counter, or near any place where food is kept.

(*f.*) *Furniture.*—In some cases the children are provided with camp chairs and small round tables to seat four. In others, ordinary school benches have been provided. Both seem fairly satisfactory in operation.

Library.—(1.) A space equivalent to a small class-room is ample for library purposes. The book accommodation will depend somewhat on the size of the school. The library is planned as a reading-room, that is, with the books in the room and not in a separate stack-room.

Wardrobes.—(1.) In high schools common wardrobes are—one for boys and one for girls—advised for all the clothing, situated on the lower floor to avoid bringing dirt into the upper floors. There being an attendant on the lower floor, the room, as a whole, can be locked up.

(2.) *Light.*—The rooms should have outside light.

(3.) *Heat and Ventilation.*—This should be thoroughly well heated and ventilated, similar to class-rooms.

(4.) *Equipment.*—The poles, hooks, etc., will be similar to those used in the other schools, but more space should be given the girls, i. e., about 1 foot 6 inches on center. It has been found desirable to have some locked pigeonholes, 20 by 20 by 12 inches.

Heating and Ventilation, Gravity System.—(1.) *Heat Ducts for School-rooms.*

(*a.*) *Location.*—In a corner room, locate the duct on the inside wall within 10 feet of the outside wall. In a room with one outside wall, locate the duct on the inside wall, near the middle.

(*b.*) *Size.*—Allow one square foot area of duct for each nine occupants. The opening into the room is to be the same area as the duct. The bottom of the opening is to be about 8 feet 6 inches above the floor. Galvanized-iron deflectors, painted to match the adjoining walls, will be placed in each opening. In addition, there will be a galvanized-iron ground around the opening.

(2.) Vent Ducts for School-rooms.

(*a.*) *Location.*—In a corner room, locate the duct at the inside corner of the room, and where possible on the same wall as the heat duct. In a room with one outside wall, the duct is to be on the same inside wall as the heat duct, and as near the middle as possible.

(*b.*) *Size.*— Allow one square foot area of vent duct for each ten occupants. The opening into the room will be at the floor, and will be the full size of the vent duct. There will be no guard at the opening. The floor will be carried into the bottom of the duct, and the baseboard will be carried in and around. The inside of the duct exposed to view will be plastered and finished to match the adjoining walls.

Plenum Fan System.—(1.) *Heat Ducts for School-rooms.*

(*a.*) *Location.*—In a corner room, locate the duct within ten feet of the outside wall. In a room with one outside wall, locate the duct on the inside wall, near the middle.

(*b.*) *Size.*— Allow one square foot area of duct for each ten occupants. The opening into the room is to be one-third larger than the area of the duct. The bottom of the opening is to be about 8 feet 6 inches above the floor. Galvanized-iron deflectors, painted to match the adjoining walls, will be placed in each opening. In addition, there will be galvanized-iron ground around the opening.

(2.) Vent Ducts for School-rooms.

(*a.*) *Location.*—The location and size will be the same as those for the Gravity System.

Toilet-room Vents.—(1.) *Duct.*—Allow 10 square inches of duct area for each closet and 8 square inches for each lineal foot of urinal space.

(2.) *Opening.*—Each door into the toilet-room is to have an opening either in the lower panel, with a register face on each side, or underneath the door. The net area through the opening in either case is to be equal to the area of the main vent duct from the room.

Wardrobe Vents.—(1.) **Duct.*—Each wardrobe is to have a vent duct with an area of 1 2-3 square feet and having a register at the bottom of the room.

(2.) **Opening.*—The door leading into the wardrobe at the end farthest from the vent duct is to have

*This would be modified if the Chicago system of wardrobes is adopted.

an opening similar to that for a toilet-room, so that the air can pass from the school-room into the ward robe and thence out through the duct.

Electric Work.—(1.) *Service.*—This should enter basement underground at location to be determined by reference to street mains, and should terminate on a switchboard located in a fireproof closet, opening if possible into the basement corridor.

(2.) *Conduits.*—All wires to be run in iron conduit concealed, except conduits for mains in basement, and side outlets in boiler, engine and stack rooms. Tap circuit conduits to be run above rough floor wherever possible. If floor construction will not allow this, they are to be run below floor beams and above ceiling, a space of 2 inches being left in which they can be run.

(3.) *Wire Slot.*—Obtain from electrical division the location of slots and openings for conduits and panel boards.

(4.) *Cabinets.*—All cabinets to be furnished by wiring contractor, but finished by the general contractor.

(5.) *Cutting.*—All cutting and patching to be done by the general contractor.

(6.) *Outlets.*—Class-rooms to be provided with 9 four-light ceiling outlets, controlled by 3 switches. Wardrobes to have 1 ceiling outlet, controlled by switch in class-room. Corridors to be lighted from ceiling wherever possible. Height of side outlets in rooms to be 6 feet and in corridors 6 feet 4 inches.

Switch outlets to be 4 feet. Switches in corridors, play-rooms, and pupils' toilet-rooms to be operated by private key.

(7.) *Fixtures.*—Fixtures in class-rooms to be of special design to combine a direct and diffused light.

(8.) *Gas.*—Gas outlets to be provided in all corridors, vestibules, stairways, boiler-room and assembly hall exits; all except vestibule to be wall outlets. Gas-piping to be included in the electrical engineer's work.

(9.) *Stereopticon.*—All grammar schools and high schools to be provided with an electric projection lantern with reflectoscope attachment.

(10.) *Clocks and Bells.*—All schools to be provided with an electric system of clocks, operated by a master clock. All primary schools to be provided with a system of signal bells, operated by push buttons. In all grammar and high schools the bell system to be operated automatically by master clocks, according to prearranged programme.

(11.) *Telephones.*—In all schools, each class-room, hall, teachers' room and boiler-room to be connected to master's office, or to room occupied by the first assistant, by a telephone system.

FORM OF PROGRAM FOR COMPETITIONS.

NOTE: Early in 1910 a competition was held by the First Baptist Church of Pittsburg, Pa., under the direction of Prof. Warren P. Laird of the University of Pennsylvania. A large number of well known architects took part in this competition and the program gave such general satisfaction that the same general form has been adopted in the following schedule, which is believed to be as near the very best practice of the present day as it would be possible to arrange. For convenience the program is divided into five general headings and each paragraph numbered so that competitors who may write for information and explanations may refer to the heading, paragraph and lines by number, which is obviously of great convenience and avoids mistakes.

SECTION (1),—THE PROJECT.

P 1. THE BOARD OF EDUCATION OF THE CITY OF.....................PROPOSES to erect a (high or grade) school building on the property of the Board located at.................in the city of ...., which location is fully described on the topographical map supplied with this program.

P 2. TO SELECT AN ARCHITECT FOR THIS BUILDING a competition is hereby established and will be conducted by the said Board under the terms set forth in this program. The Secretary (or Clerk)

of said Board is Mr...........................

(address) ....

P 3. AS ITS CONSULTING ARCHITECT to prepare this program, and act as professional adviser in the conducting of this competition, the said Board has appointed Mr. ....

(Address) ....

SECTION (2)—THE PROGRAM.

P 4. THE TERMS OF THIS COMPETITION are set forth in this program, which constitutes an agreement between the said Board of Education, on the one hand, and each competitor and the appointed architect severally on the other hand.

P 5. IT IS THEREFORE UNDERSTOOD THAT EACH ARCHITECT who submits designs in this competition thereby accepts the terms of same as binding upon him, both as to the competition and any agreement which may arise from it.

P 6. THE TERMS OF THE COMPETITION WILL NOT BE MODIFIED in any important respect without the consent of a majority of the competitors, but additional information will be supplied when necessary.

P 7. COMMUNICATIONS REGARDING THE COMPETITION may be addressed either to the Secretary of the said Board, or to the professional adviser. They must be in writing. Copies of all such communications, with the replies thereto, will be sent simultaneously to each competitor and will thereupon become a part of this program. No such communications will be received nor information issued after..(date)............

P 8. THE TERM ARCHITECT OR AUTHOR AS USED IN THIS PROGRAM means the single competitor, whether he be an individual or a firm of architects. The term "Board" refers to the Board of Education named in Section (1), P1. The term "Appointed Architect" means the architect awarded the prize of this competition, and appointed as architect of the proposed work. The topographical plan of the site, and the schedule of charges of the the American Institute of Architects form an essential part of this program.

SECTION (3)—THE COMPETITION.

P 9. ESPECIALLY INVITED ARCHITECTS. The board have especially invited two (or more) architects to submit designs in this competition each of whom will be paid ...($)... in full compensation for his services in the competition.

P 10. OTHER ARCHITECTS ELIGIBLE The competition will also be open to all other architects who may be qualified, as hereinafter stated, and two (or more) prizes or competition fees will be awarded among said architects as follows: ($.... ......) to the uninvited competitor standing first in merit; ($.........) to the uninvited competitor standing second in merit, etc.

P 11. FINAL JUDGMENT WILL BE RENDERED by a jury composed of the Board's professional adviser, and two other architects to be chosen by ballot by the competitors, this choice to be based on majority preference as shown by the ballots deposited with the Board. These ballots will be invited early in the competition and will not be accepted later than.....(date)............. When arranged, the personnel of the jury will immediately be announced to each competitor. The Board will bear the expense of securing the jury.

P 12. THE ARCHITECTS ESPECIALLY INVITED.

The following architects have been especially invited:

....
....
....

The Board reserves the right to fill any vacancy among the foregoing that may occur during the competition.

P 13. THE BOARD DESIRES THE PARTICIPATION of other architects of good professional standing and experience in the execution of work of this magnitude. All who wish to enter the competition are requested to apply for admission upon forms furnished, upon application, by the Secretary of the Board. The Board will extend invitations to approved applicants to submit designs in the competition. Only architects receiving such invitation shall be eligible to this competition.

P 14. THE PRIZE OF THE COMPETITION will be the commission to design and supervise the construction of the building herein described. This prize will be awarded to the competitor whose design is awarded first prize by the Board as provided in P24 of this program.

P 15. THE NUMBER AND KINDS OF DRAWINGS and their scale, etc., are to be as follows: PLANS; one of each floor will be required. These plans should each include at least the property lines of the site. ELEVATION AND SECTIONS; two of each are required. No drawings other than those prescribed in this section are permitted. (NOTE: In case it is preferred to receive a perspective drawing, the elevations may or may not be omitted as the professional adviser and Board may determine). SCALE; the scale of all drawings is to be one-sixteenth (or one-eighth) of an inch to the foot.

P 16. PERSPECTIVE; in case a perspective drawing is required, the program must state the distance from the building at which the point of sight is to be assumed, and the angles at which the building is assumed to stand with reference to the beholder; also the location of the horizon line.

P 17. RENDERING, ETC., OF DRAWINGS MUST be made with black pencil on tracing paper mounted on cardboard, one drawing to each sheet. No drawing shall exceed in dimensions. . (inches) . . . Brush work may be employed in rendering, but must be in black and white. No landscape or scenic accessories whatever will be permitted on any drawing, but a single human figure 5 feet 8 inches high should be drawn on each elevation, section and perspective to show its scale. Lettering may be done in red, but otherwise neither color nor gold is to be used in the making of any drawing. Treatment of floor and ceiling surfaces may be indicated if desired. Desks, cabinets and other permanent furniture may be shown if desired, but in any case the seating capacity and area of each room should be lettered thereon. Lines of grading, terracing, pavements, steps, etc., and all lines given in the topographical map of the site, may be included but no other scenic accessories. The names of all rooms with their dimensions and areas and any other such information necessary to explain the purpose of the drawings throughout may be lettered thereon. Sections must have story heights from floor to floor lettered thereon. The title to be put upon each sheet of drawings shall be COMPETITION OF THE (HIGH OR GRADE) SCHOOL BUILDING OF ..(city)........and any such other words as are actually necessary to designate parts and uses of the structure; dimensions and capacity; drawings and the scale to which they are drawn. Roman lettering only may be used.

P 18. IT IS A CONDITION OF THIS AGREEMENT that the design submitted by any architect must be his own authorship, produced within his own office under his personal direction. It is understood that by his participation in this competition, each competitor thereby agrees that any violation by him of this section nullifies this agreement so far as he is concerned and any engagement proceeding from it.

P 19. ONLY ONE DESIGN may be submitted by any competitor; flaps and alternative schemes are not permitted. No design may be accompanied by any description or means of illustration other than those expressly provided herein, and the required drawings must conform absolutely to the requirements of this program in every way.

P 20. NO NAMES, SYMBOLS OR ANY OTHER identifying name or mark may appear upon the drawings, nor upon the wrapper in which designs are delivered, nor upon the outside of the sealed envelope below provided. No competitor directly or indirectly may reveal the identity of his design, or seek to influence in his favor any member of the jury or of the Board.

P 21. THE DRAWINGS ARE TO BE IN PORTFOLIOS securely wrapped and addressed to the Clerk of the Board of ....(city).......... Inside of the wrapper, attached to the outside of portfolio is to be placed an opaque envelope, sealed with wax, and addressed on the outside in typewriting to the Clerk of the Board. Inside of this sealed envelope is to be placed a card bearing the name of the author of the designs which it accompanies. The designs thus prepared and addressed, must be in the hands of the Clerk of the Board, at his address first herein given, not later than twelve o'clock noon on..(date)

P 22. DISPOSAL OF DESIGNS. All designs so delivered, will be turned over to the professional adviser for inspection, by himself and associates of the jury. The sealed envelopes accompanying the portfolios will be retained by the Clerk of the Board, and will not be opened until after the award has been determined by the jury. Any drawings which do not conform with the terms of this program will, upon recommendation of the adviser, be excluded from the competition by the Board.

P 23. THE APPROVED DESIGNS will then be examined by the jury and after due consideration of all conditions of this program, and the site on which the building is to stand, and after due comparison of all designs admitted to competition, the jury will mark each design in the order of its merit as determined by them, No. 1 being the design standing first in merit, No. 2 the design standing second in merit, etc. The jury will then report to the Board the rating of the designs in the order of their merit and will recommend to the Board for its choice, as the first prize design, that one which has been selected by the jury as standing first in merit. The report of the jury as to the relative merit of the designs submitted, and the recommendation as to first prize design, shall constitute the report of the jury to the Board, and a majority vote shall determine such recommendation and selection.

P 24. THE BOARD WILL THEN CONSIDER the said report and make examination of all the designs with the adviser's assistance and immediately take action by selecting that design which may be in its opinion the best; will thereupon open the envelope containing the name of the author of said design, and appoint him the architect of the work described in Section 4 of this program. The Board will then open the remaining envelopes, and award the cash prizes to the architects standing next in merit as shown by the report of the jury, and no especially invited paid competitors shall be eligible to these awards. All votes of the Board in this connection shall be taken and determined in the usual manner as prescribed by law.

P 25. THE PRIZE OF THE COMPETITION will not be awarded to any design which calls for a volume of more than (.....cu. ft.), said volume being computed within the outer face line of all outside walls, comprising all buttresses, columns, porte-cocheres, etc., and comprising the vertical height between basement floor level and the mean level of roofs. In case towers or domes are included in the design, their volume shall be computed at double the actual dimensions.

P 26. PAYMENT SHALL BE MADE after the making of awards as follows: To the appointed architect ($.........) on account of his fee as architect of the work, and to the remaining architects such competitive fees as may be due them. If the appointed architect be among those especially invited or entitled by merit to a competitive fee, such fee shall be liquidated by the above payment on account.

P 27. DRAWINGS SHALL BE RETURNED to the authors of unaccepted designs, and the Board will make no use of any ideas or data contained in them without proper compensation to their authors.

P 28. THE VIOLATION BY ANY COMPETITOR of paragraphs 18, 19 or 20 of this program will thereby exclude him from the competition, and this penalty may be imposed at any time when his identity becomes known.

P 29. IN THE EVENT OF DISAGREEMENT between the Committee and competitor, or the appointed architect, at any time relating to any of the provisions of this program, all parties at interest hereby agree that the judgment of the professional adviser of the Board relating to such disputed question shall be final and binding upon the parties concerned.

SECTION (4)—THE PROBLEM.

Under this head it is impossible in a program for general application to set forth conditions which will apply equally well under all conditions. It will therefore suffice to say that this section should include the fullest and most definite statement possible regarding the building to be constructed. The sections should give full information concerning the following items and all others which may be of value to competitors:

(1). The amount of money which the Board have available for the construction of the building, and a statement whether said amount is fixed or variable;

(2). The number of stories the building is to contain, name each story specifically;

(3). The style of architecture if any preferred by the Board;

(4). The character of materials if any preferred by the Board for the exterior of the building;

(5). The statement whether or not the building is to be fireproof, or ordinary construction, also what type of construction;

(6). A complete list of every room to be contained in the building and as nearly as possible the size required for each room (NOTE: A very convenient way to arrive at satisfactory results in this particular is to adopt an ordinary school room measuring 23x32 feet as a unit, and refer to all other rooms as equal to so many units or portions thereof);

(7). A complete statement as to the method of heating and ventilating to be used in the building;

(8). Definite instructions as to the plan of administration to be followed in the building—that is, whether the study room plan, or separate class room plan is to be followed, etc.;

(9). The method of lighting if any which competitors will be required to observe;

Finally all other information which may be at the disposal of the Board and which will be of value to the competitors in preparing designs.

SECTION (5)—APPOINTED ARCHITECT.

P 40. THE ARCHITECT APPOINTED as herein provided shall revise his competitive design until it meets the approal of the Board, and shall then promptly prepare full working drawings and specifications of the work as a whole, and shall during its construction have and be in full charge and authority of the work.

P 41. THE SAID ARCHITECT shall at his own expense make such revisions and alterations of working drawings and specifications, based upon the approved competitive design, as may be necessary to ensure the proper construction and completion of the building within the cost limit fixed by and substantially as described in this program.

P 42. THE COMPENSATION OF THE APPOINTED ARCHITECT shall be at the rate of six per cent upon the cost of the work committed to his charge. Should expert engineering services be required by the Board the fee therefor shall be paid by the Board, but not in excess of five per cent of that portion of the work. Except as above provided, the architect shall render service and receive compensation in accordance with the schedule and practice of the American Institute of Architects, as shown in statement appended to this program. He shall not in any way transfer, assign or bequeath his appointment or share it with any other person, without the written consent of the Board.

P 43. A CLERK OF THE WORKS shall (or shall not as desired) be employed by the architect as the work may require, said Clerk of the works to be satisfactory to the Board and worthy of a compensation of not less than $100.00 per month.

P 44 ALL DRAWINGS, SPECIFICATIONS AND THEIR COPIES are and shall remain the property of the architect, and shall be used only as instruments of service in the construction of the building; but one copy of the revised competitive design and of each general working drawing and of the specifications shall be permanently left with the Board by the architect.

This program approved this ....(date)........

The Board of Education of.....(City).........

..........................Pres.

......................Secy.

............................Adviser.

THE CANONS OF ETHICS, AMERICAN INSTITUTE OF ARCHITECTS.

The following canons of professional ethics are adopted by the American Institute of Architects as a general guide, yet the enumeration of particular duties should not be construed as a denial of the existence of others equally important although not specifically mentioned.

It is Unprofessional for an Architect.

1. To engage directly or indirectly in any of the building trades.

2. To guarantee an estimate or contract by bond or otherwise.

3. To accept any commission or substantial service from a contractor, or from any disinterested party other than the owner.

4. To advertise.

5. To take part in any competition the terms of which are not in harmony with the principles approved by the Institute.

6. To attempt in any way, except as a duly authoried competitor, to secure work for which a competition is in progress.

7. To attempt to influence, either directly or indirectly, the award of a competition in which he is not a competitor.

8. To accept the commission to do the work for

which a competition has been instituted, if he has acted in an advisory capacity, either in drawing the programme or in making the award.

9. To injure falsely or maliciously, directly or indirectly, the professional reputation, prospects or business of a fellow architect.

10. To undertake a commission while the claim for compensation, or damages, or both, of an architect previously employed, and whose employment has been terminated remains unsatisfied, until such claim has been referred to arbitration or issue has been joined at law, or unless the architect previously employed neglects to press his claim legally.

11. To attempt to supplant a fellow architect after definite steps have been taken toward his employment.

12. To compete knowingly with a fellow architect for employment on the basis of professional charges.

SCHEDULE OF MINIMUM CHARGES.

1. The architect's professional services consist of the necessary conferences, the preparation of preliminary studies, working drawings, specifications, large scale and full size detail drawings, and of the general direction and supervision of the work; for which, except as hereinafter mentioned, the minimum charge, based upon the total cost of the work complete is six percent.

2. On residential work, on alterations to existing buildings, on monuments, furniture, decorative and cabinet work and landscape architecture, it is proper to make a higher charge than above indicated.

3. The architect is entitled to compensation for articles purchased under his direction, even though not designed by him.

4. If an operation is conducted under separate contracts rather than under a general contract, it is proper to charge a special fee in addition to the charges mentioned elsewhere in this schedule.

5. Where the architect is not otherwise retained, consultation fees for professional advice are to be paid in proportion to the importance of the questions involved and services rendered.

6. Where heating, ventilating, mechanical, structural, electrical and sanitary problems are of such a nature as to require the services of a specialist, the owner is to pay for such services. Chemical and mechanical tests and surveys, when required, are to be paid for by the owner.

7. Necessary traveling expenses are to be paid by the owner.

8. If, after a definite scheme has been approved, changes in drawings, specifications or other documents are required by the owner; or if the architect be put to extra labor or expense by the delinquency or insolvency of a contractor, the architect shall be paid for such additional services and expense.

9. Payments to the architect are due as his work progresses in the following order: Upon completion of the preliminary studies, one-fifth of the entire fee; upon completion of specifications and general working drawings (exclusive of details) two-fifths additional, the remainder being due from time to time in proportion to the amount of service rendered. Until an actual estimate is received, charges are based upon the proposed cost of the work and payments received are on account of the entire fee.

10. In case of the abandonment or suspension of the work, the basis of settlement is to be as follows: For preliminary studies, a fee in accordance with the character and magnitude of the work; for preliminary studies, specifications and general working drawings (exclusive of details), three fifths of the fee for complete services.

11. The supervision of an architect (as distinguishd from the continuous personal superintendence which may be secured by the employment of a clerk-of-the-works, or superintendent of construction) means such inspection by the architect or his deputy, of work in studios and shops, or a building or other work in process of erection, completion

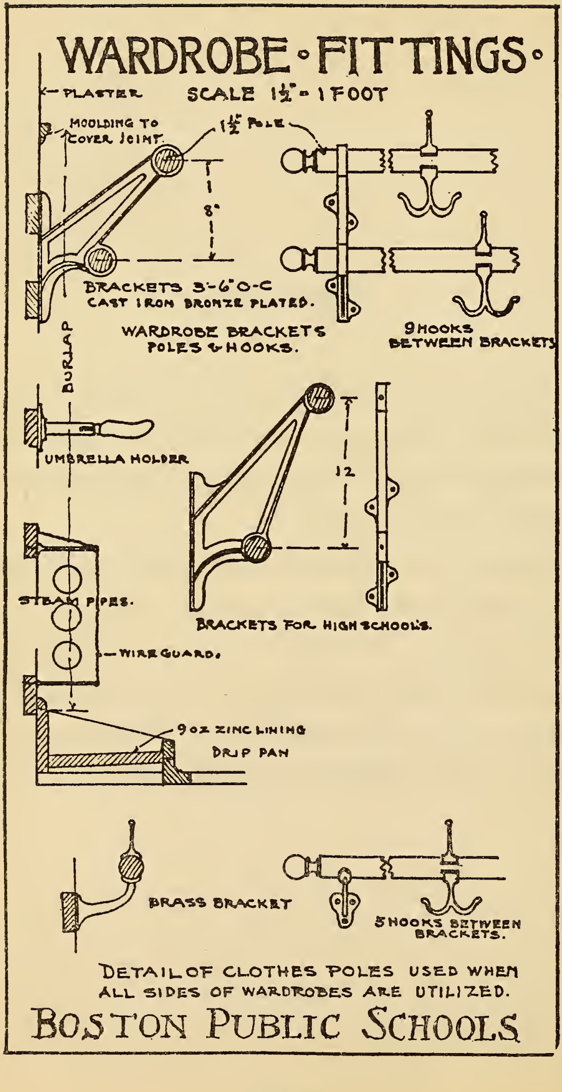
or alteration, as he finds necessary to ascertain whether it is being executed in general conformity with his drawings and specifications or directions. He has authority to reject any part of the work which does not so conform, and to order its removal and reconstruction. He has authority to act in emergencies that may arise in the course of construction, to order necessary changes, and to define the intent and meaning of the drawings and specifications. On operations where a clerk of the works or superintendent of construction is required, the architect shall employ such assistance at the owner's expense.

12. Drawings and specifications, as instruments of service, are the property of the architect.

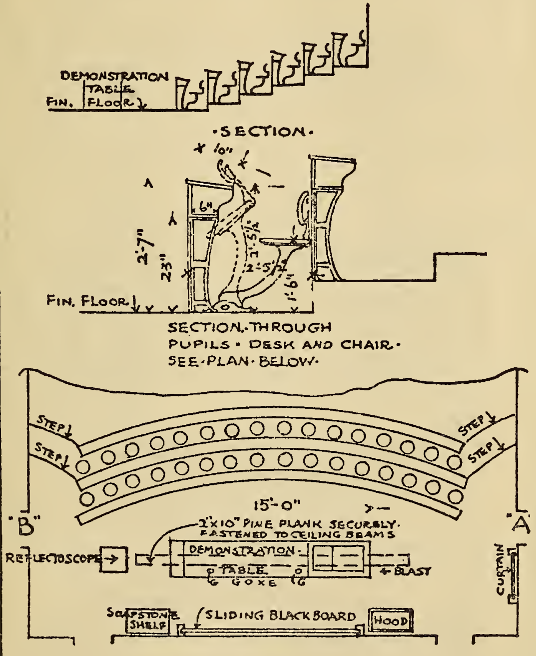
APPENDIX.

In the following pages are given details of school fittings and equipment, also numerous illustrations of sanitary fixtures, correct heating and ventilating apparatus, shower baths, etc.

There are also given the floor plans and illustrations of the best types of present day American school buildings. It would be a pleasure to illustrate many other equally correct and successful buildings, but the scope of the present work limits us to just enough to fully illustrate present day standards.


WARDROBE FITTINGS
SCALE 1½" = 1 FOOT
PLASTER
MOULDING TO COVER JOINT
1½" POLE
8"
BRACKETS 3'-6" O-C
CAST IRON BRONZE PLATED.
WARDROBE BRACKETS
POLES & HOOKS.
9 HOOKS BETWEEN BRACKETS
BURLAP
UMBRELLA HOLDER
12
BRACKETS FOR HIGH SCHOOLS.
STEAM PIPES.
WIRE GUARD.
9 OZ ZINC LINING
DRIP PAN
BRASS BRACKET
5 HOOKS BETWEEN BRACKETS.
DETAIL OF CLOTHES POLES USED WHEN ALL SIDES OF WARDROBES ARE UTILIZED.
BOSTON PUBLIC SCHOOLS

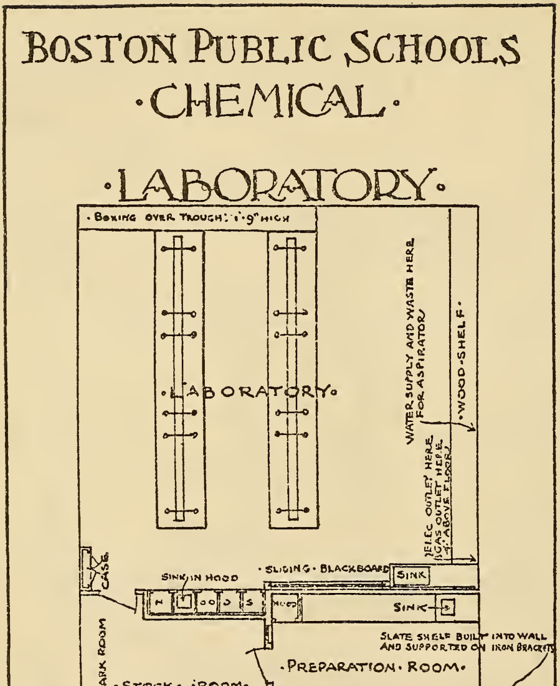
BOSTON PUBLIC SCHOOLS
·LECTURE·

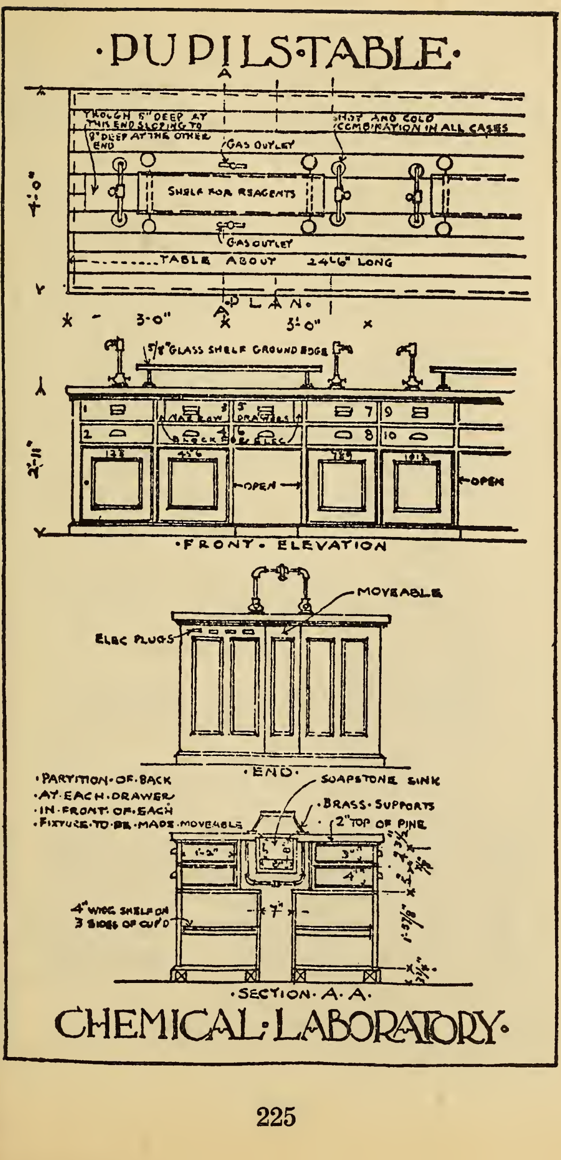


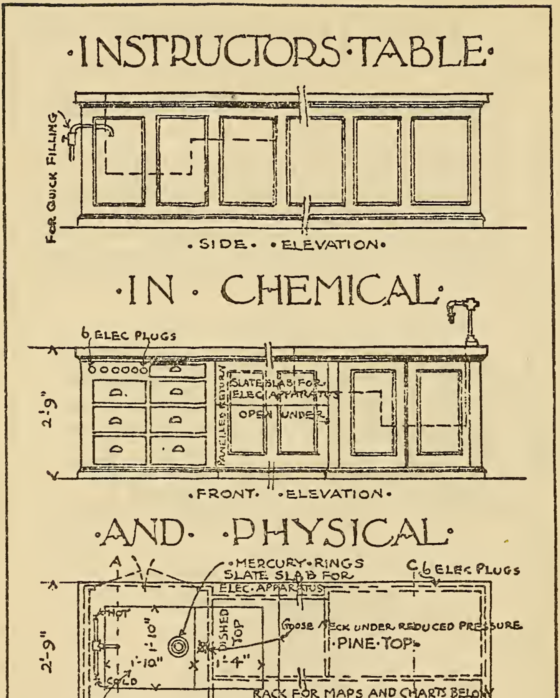
·PLAN·

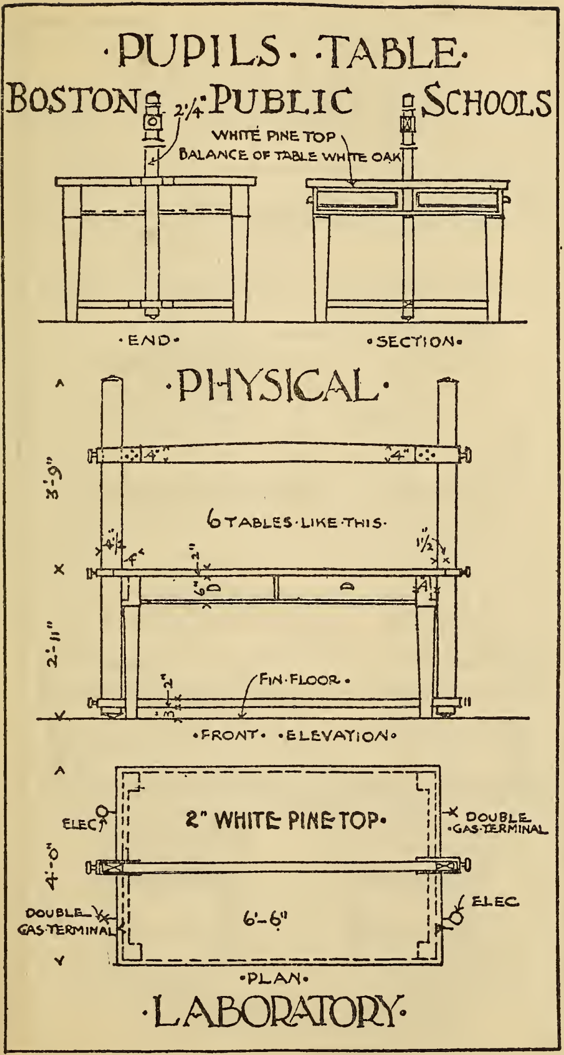
·WINDOWS·AT·REAR·OF·ROOM·

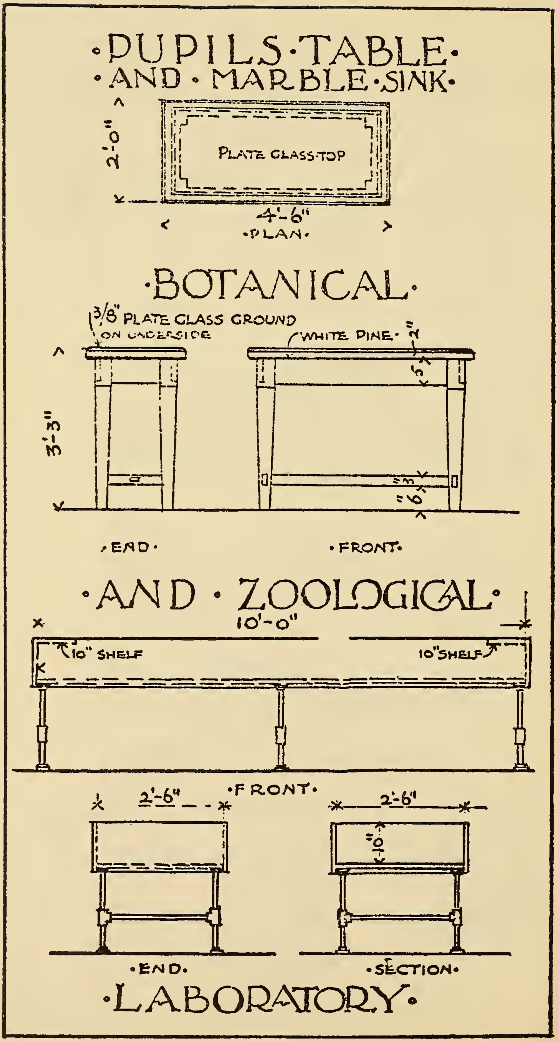
·ROOM·


BOSTON PUBLIC SCHOOLS
·CHEMICAL·
·LABORATORY·
·BOXING OVER TROUGH 1'-9" HIGH
·LABORATORY·
WATER SUPPLY AND WASTE HERE FOR ASPIRATOR
·WOOD·SHELF·
ELEC. OUTLET HERE
GAS OUTLET HERE 4' ABOVE FLOOR
CASE
SINK IN HOOD
·SLIDING·BLACKBOARD
SINK
HOOD
SINK
SLATE SHELF BUILT INTO WALL AND SUPPORTED ON IRON BRACKETS
·PREPARATION·ROOM·
UP TO DARK ROOM
·STOCK· ·ROOM·
CASE
SLATE SHELF
CASE
CASE
OFFICE·
CASE
SCALE FEET
0
5
10
15
20
25
30

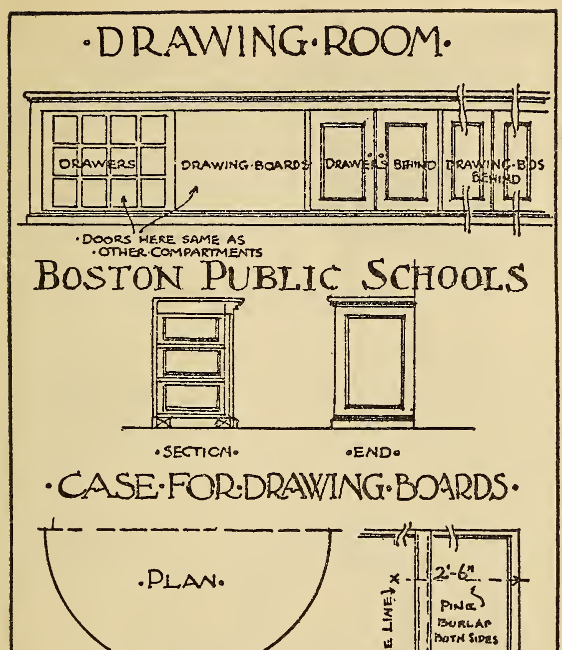

·PUPILS·TABLE·
TROUGH 5" DEEP AT THIS END SLOPING TO 8" DEEP AT THE OTHER END
HOT AND COLD COMBINATION IN ALL CASES
GAS OUTLET
SHELF FOR REAGENTS
GAS OUTLET
TABLE ABOUT 24'-6" LONG
4'-0"
·PLAN·
3'-0"
3'-0"
5/8" GLASS SHELF GROUND EDGE
NARROW DRAWERS
BLOCK FOR ELEC
OPEN
OPEN
2'-11"
·FRONT· ELEVATION
MOVEABLE
ELEC PLUGS
·END·
·PARTITION·OF·BACK
·AT·EACH·DRAWER
·IN·FRONT·OF·EACH
·FIXTURE·TO·BE·MADE·MOVEABLE
SOAPSTONE SINK
·BRASS·SUPPORTS
·2" TOP OF PINE
4" WIDE SHELF ON 3 SIDES OF CUP'D
·SECTION·A·A·
CHEMICAL·LABORATORY·


·INSTRUCTORS·TABLE·
FOR QUICK FILLING
·SIDE· ·ELEVATION·
·IN · CHEMICAL·
6 ELEC PLUGS
2'-9"
PANELLED RETURN
SLATE SLAB FOR ELEC APPARATUS
OPEN UNDER
·FRONT· ·ELEVATION·
·AND· ·PHYSICAL·
A
B
C
D
·MERCURY·RINGS
SLATE SLAB FOR ELEC·APPARATUS
6 ELEC PLUGS
HOT
COLD
1'-10"
1'-10"
DISHED TOP
1'-4"
GOOSE NECK UNDER REDUCED PRESSURE
·PINE·TOP·
RACK FOR MAPS AND CHARTS BELOW
2'-9"
12'-0"
SOAPSTONE·SINK·
PLAN·
·LABORATORIES·
HOT
COLD
1'-8"
RACK FOR MAPS
·SECTION·A·B·
·SECTION·C·D·
·END·
BOSTON PUBLIC SCHOOLS

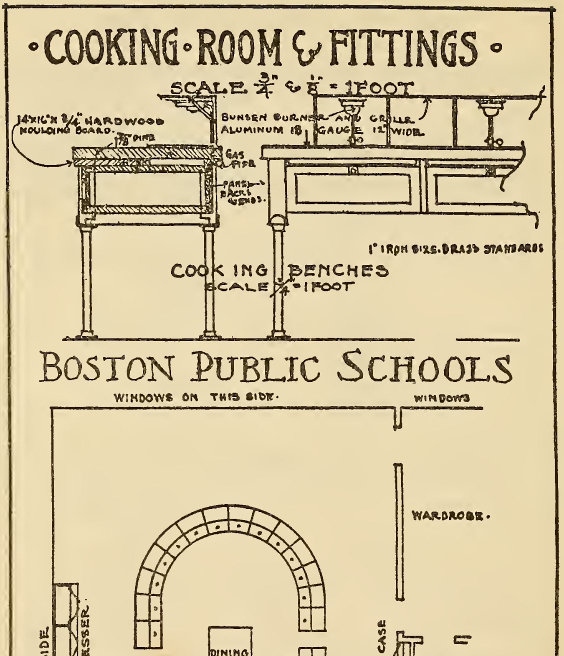

·PUPILS· ·TABLE·
BOSTON ·PUBLIC SCHOOLS
2¼"
WHITE PINE TOP
BALANCE OF TABLE WHITE OAK
·END·
·SECTION·
·PHYSICAL·
4"
4"
6 TABLES·LIKE·THIS·
3'-9"
2'-11"
1½"
FIN·FLOOR·
·FRONT· ·ELEVATION·
2" WHITE PINE TOP·
ELEC
DOUBLE GAS·TERMINAL
4'-0"
6'-6"
ELEC
DOUBLE GAS·TERMINAL
·PLAN·
·LABORATORY·

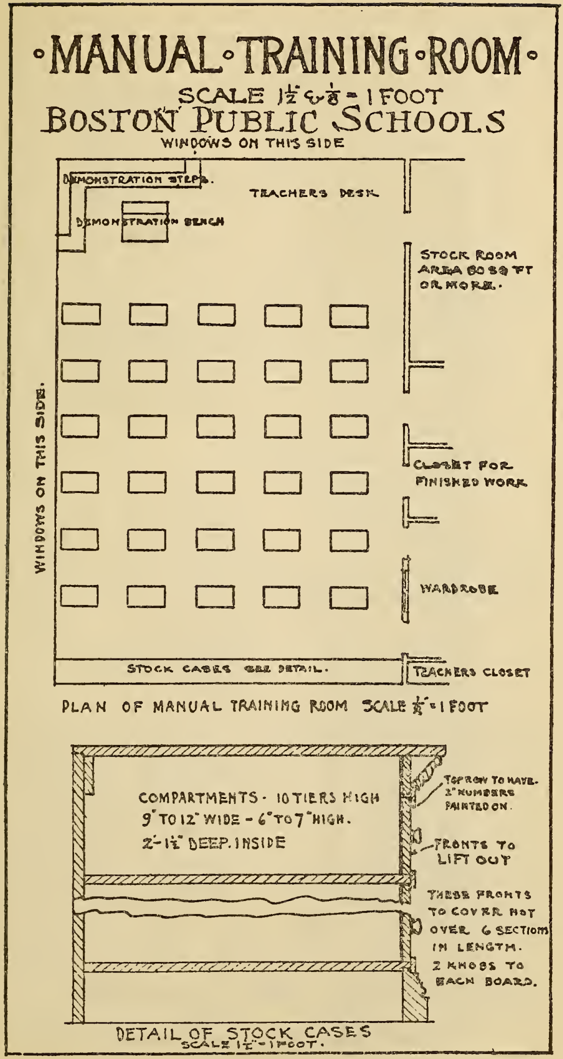


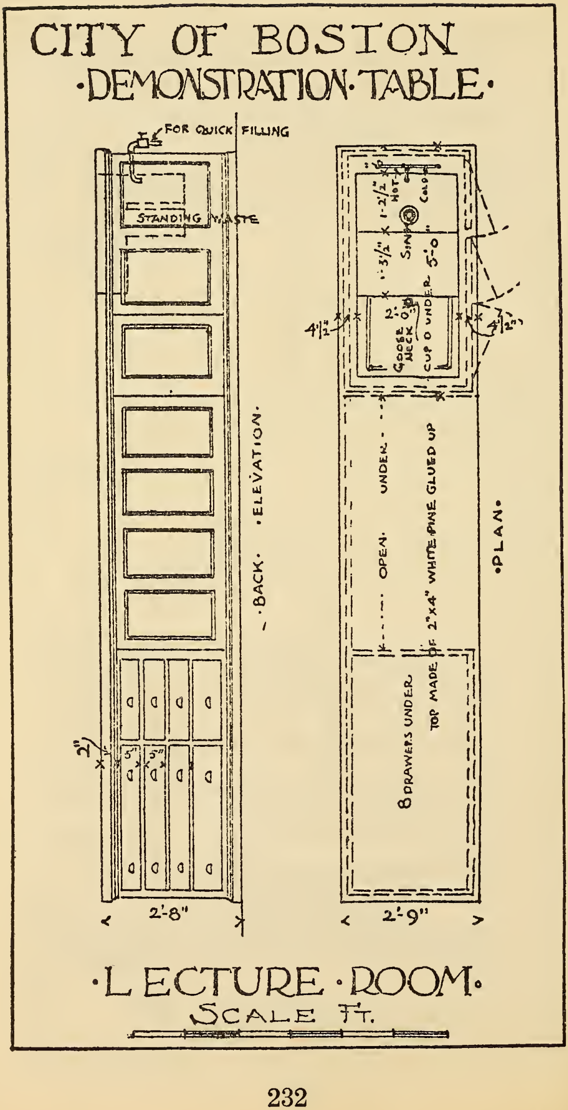
·PUPILS·TABLE·
·AND·MARBLE·SINK·
2'-0"
PLATE GLASS·TOP
4'-6"
·PLAN·
·BOTANICAL·
3/8" PLATE GLASS GROUND ON UNDERSIDE
WHITE PINE·
3'-3"
·END·
·FRONT·
·AND·ZOOLOGICAL·
10'-0"
10" SHELF
10"SHELF
·FRONT·
2'-6"
2'-6"
10"
·END·
·SECTION·
·LABORATORY·



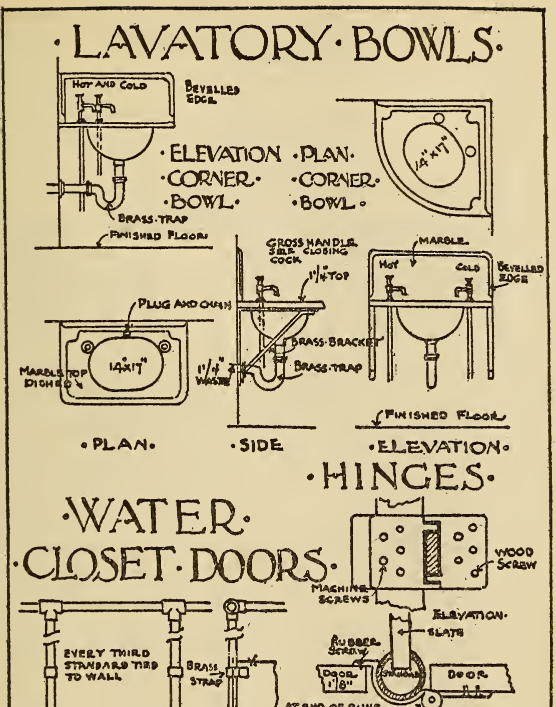
·DRAWING·ROOM·
DRAWERS
DRAWING·BOARDS
DRAWERS BEHIND
DRAWING·BDS BEHIND
·DOORS HERE SAME AS ·OTHER·COMPARTMENTS
BOSTON PUBLIC SCHOOLS
·SECTION·
·END·
·CASE·FOR·DRAWING·BOARDS·
·PLAN·
·MODEL·STAND·
·ELEVATION·
CASTORS
CENTRE LINE
2'-6"
PINE
BURLAP BOTH SIDES
END·
IRON BRACKET
EXHIBITION·BOARD·
OPEN
1¼" PINE TOP.
FRONT·
SECTION.
·PUPILS·TABLE·

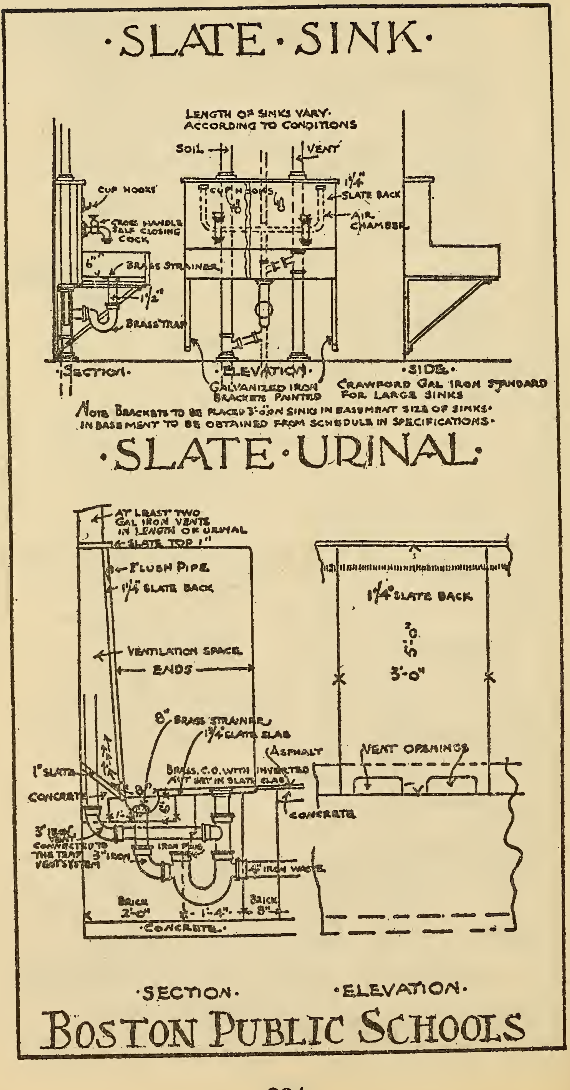

•COOKING•ROOM & FITTINGS•
SCALE 3/4" & 1/8" = 1 FOOT
14"x16"x 3/4" HARDWOOD MOULDING BOARD.
BUNSEN BURNER AND GRILLE
ALUMINUM 18 GAUGE 12" WIDE
GAS PIPE
1" IRON SIZE. BRASS STANDARDS
COOKING BENCHES
SCALE 1/4" = 1 FOOT
BOSTON PUBLIC SCHOOLS
WINDOWS ON THIS SIDE.
WINDOWS
WARDROBE.
WINDOWS ON THIS SIDE
DRESSER.
DINING TABLE
DEMONSTRATION BENCH
3'-0" LONG
BOOK CASE
TEACHERS CLOSET.
STRAIGHT EDGES.
SHELVES
PANTRY
WOOD BOX
RANGE
GAS RANGE
SINK.
TANK
SHELVES
PLAN OF COOKING ROOM
SCALE 1/8" = 1 FOOT

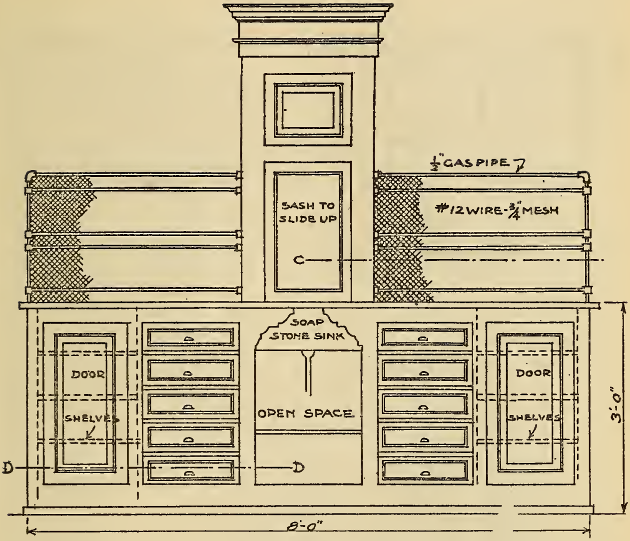

MANUAL TRAINING ROOM
BOSTON PUBLIC SCHOOLS
WINDOWS ON THIS SIDE
DEMONSTRATION STEPS.
TEACHERS DESK
DEMONSTRATION BENCH
STOCK ROOM AREA 80 SQ FT OR MORE.
WINDOWS ON THIS SIDE.
CLOSET FOR FINISHED WORK
WARDROBE
STOCK CASES SEE DETAIL.
TEACHERS CLOSET
PLAN OF MANUAL TRAINING ROOM
COMPARTMENTS - 10 TIERS HIGH
9" TO 12" WIDE - 6" TO 7" HIGH.
2'-1½" DEEP. INSIDE
TOP ROW TO HAVE 2" NUMBERS PAINTED ON.
FRONTS TO LIFT OUT
THESE FRONTS TO COVER NOT OVER 6 SECTIONS IN LENGTH.
2 KNOBS TO EACH BOARD.
DETAIL OF STOCK CASES



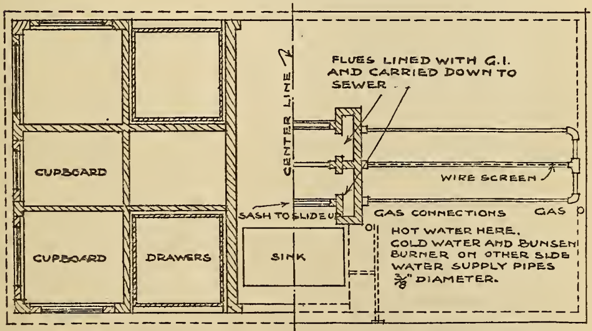
CITY OF BOSTON
·DEMONSTRATION·TABLE·
FOR QUICK FILLING
STANDING WASTE
·BACK· ·ELEVATION·
HOT
COLD
SINK
5'-0
GOOSE NECK
CUP D UNDER
OPEN UNDER
TOP MADE OF 2"x4" WHITE PINE GLUED UP
·PLAN·
8 DRAWERS UNDER
2"
5"
5"
2'-8"
2'-9"
·LECTURE·ROOM·
SCALE FT.


·LAVATORY·BOWLS·
HOT AND COLD
BEVELLED EDGE
·ELEVATION·
·CORNER·
·BOWL·
·PLAN·
·CORNER·
·BOWL·
14"x17"
BRASS·TRAP
FINISHED FLOOR
CROSS HANDLE SELF CLOSING COCK
1¼" TOP
MARBLE
HOT
COLD
BEVELLED EDGE
PLUG AND CHAIN
MARBLE TOP DISHED
14"x17"
BRASS·BRACKET
1¼" WASTE
BRASS·TRAP
FINISHED FLOOR
·PLAN·
·SIDE
·ELEVATION·
·HINGES·
·WATER·
·CLOSET·DOORS·
WOOD SCREW
MACHINE SCREWS
ELEVATION·
SLATE
RUBBER SCREW
DOOR 1'8"
DOOR
AT END OF RUNS OF CLOSET HINGE PORTION TO BE CUT OFF AT THIS POINT
PLAN·OF·UPPER HINGE·SHOWING STOPPER
EVERY THIRD STANDARD TIED TO WALL
BRASS STRAP
HINGE
HINGE
SLATE
SLATE
DOOR
PLAN OF LOWER HINGE
HINGE
HINGE
IRON·PIPE STANDARD
BRASS STRAP
MACHINE SCREWS
WOOD SCREW
ELEVATION OF LOWER HINGE
·ELEVATION·
SECTION·
3" SCALE SHOWING·
BRASS·HINGES·
BOSTON SCHOOLS


·SLATE·SINK·
LENGTH OF SINKS VARY·
ACCORDING TO CONDITIONS
SOIL
VENT
CUP HOOKS
CROSS HANDLE SELF CLOSING COCK
BRASS STRAINER
1½"
BRASS TRAP
CUP HOOKS
1¼"
SLATE BACK
AIR CHAMBER
·SECTION·
·ELEVATION·
·SIDE·
GALVANIZED IRON BRACKETS PAINTED
CRAWFORD GAL IRON STANDARD FOR LARGE SINKS
NOTE BRACKETS TO BE PLACED 3'-0" ON SINKS IN BASEMENT SIZE OF SINKS·
IN BASEMENT TO BE OBTAINED FROM SCHEDULE IN SPECIFICATIONS·
·SLATE·URINAL·
AT LEAST TWO GAL IRON VENTS IN LENGTH OF URINAL
SLATE TOP 1"
FLUSH PIPE
1¼" SLATE BACK
VENTILATION SPACE
ENDS
8" BRASS STRAINER
1¾" SLATE SLAB
ASPHALT
1" SLATE
BRASS C.O. WITH INVERTED NUT SET IN SLATE SLAB
CONCRETE
3" IRON VENT CONNECTED TO THE TRAP
3" IRON VENT SYSTEM
IRON PLUG
4" IRON WASTE
CONCRETE
BRICK 2'-0"
1'-4"
BRICK 8"
·CONCRETE·
1¼" SLATE BACK
5'-0"
3'-0"
VENT OPENINGS
·SECTION·
·ELEVATION·
BOSTON PUBLIC SCHOOLS

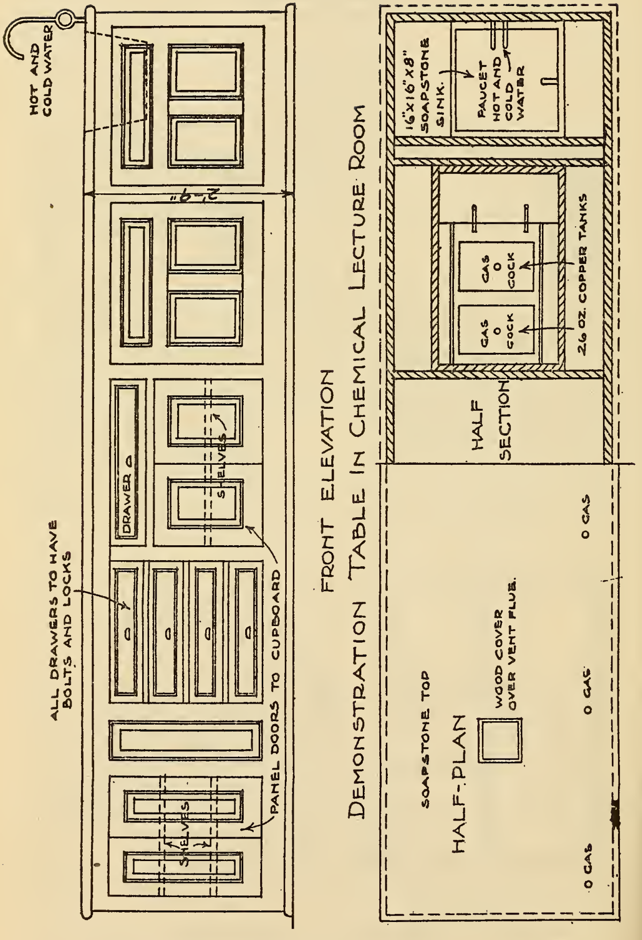


FRONT ELEVATION



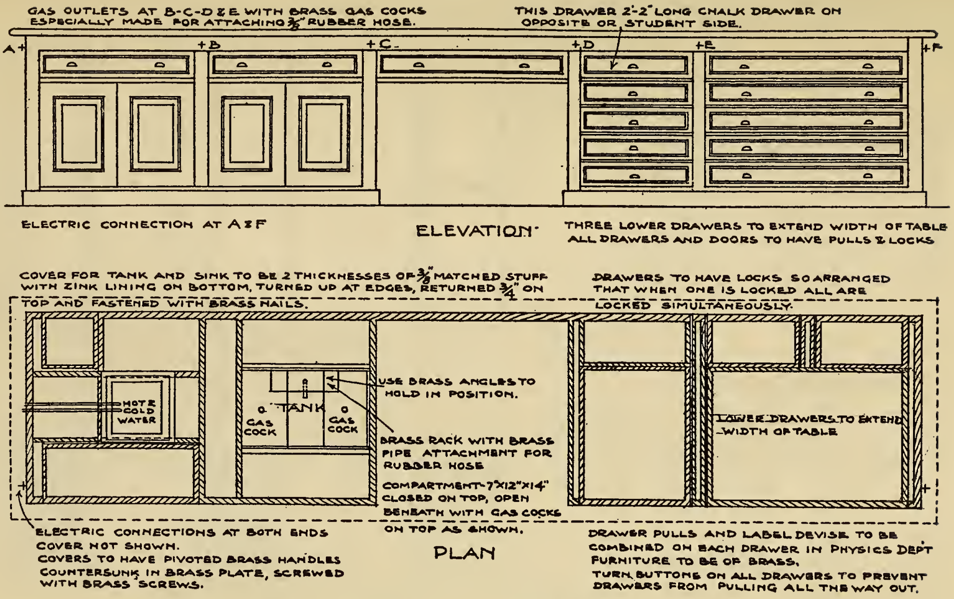
PLAN AT D PLAN AT C

TABLES IN CHEMICAL LABORATORY

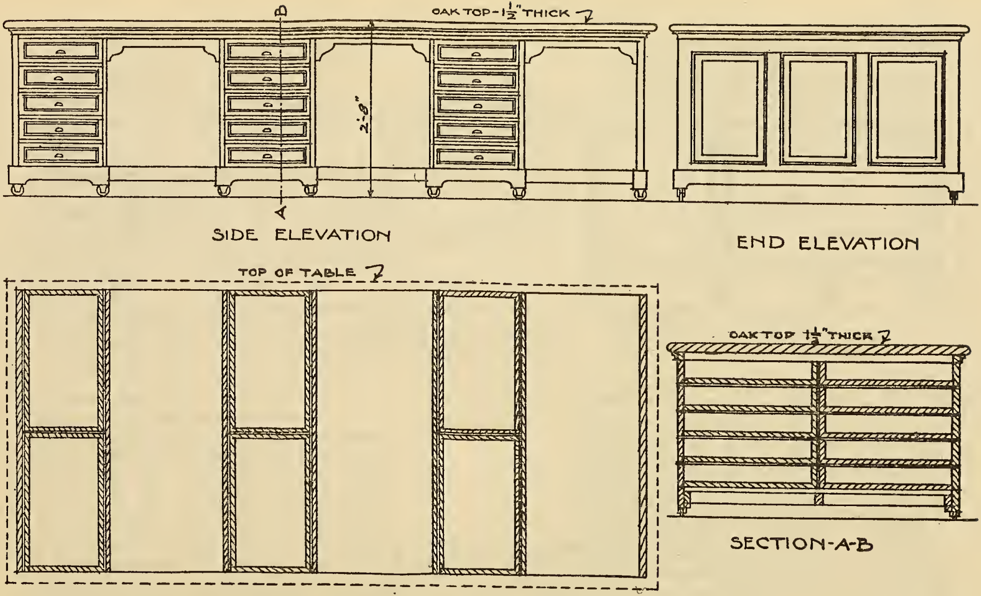


FRONT ELEVATION

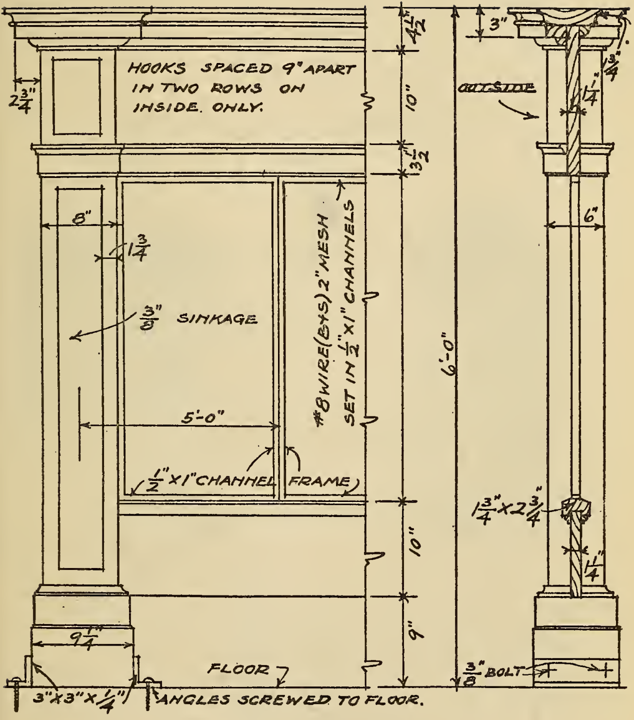
DEMONSTRATION TABLE IN CHEMICAL LECTURE ROOM



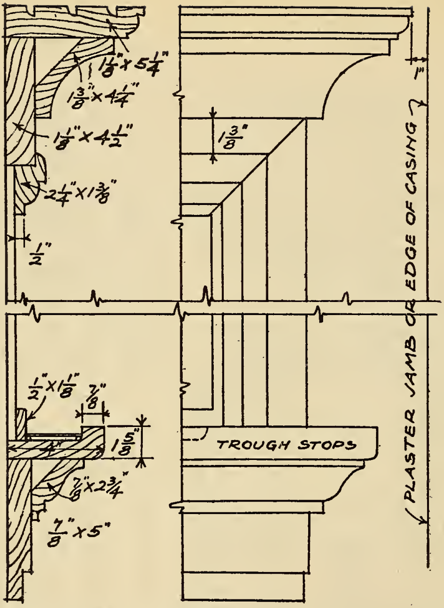
DEMONSTRATION TABLE IN PHYSICS LECTURE ROOM



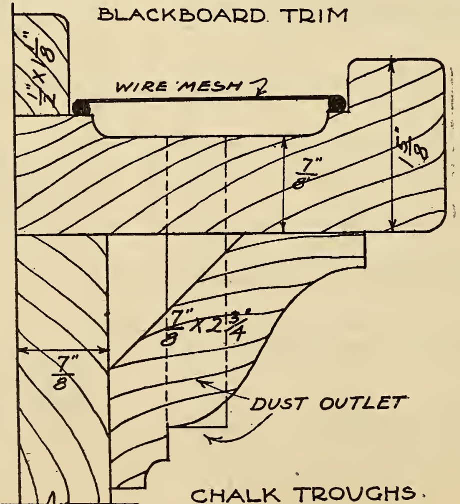
TABLES IN BIOLOGICAL LABORATORY



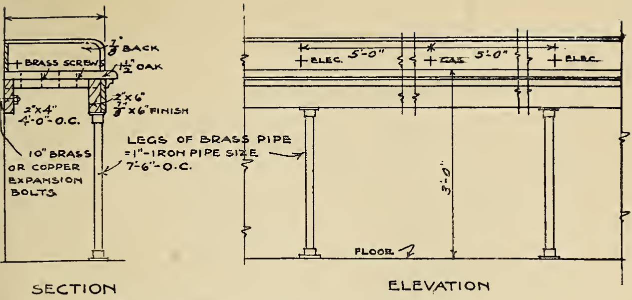
COAT RACKS IN HALLS



BLACKBOARD TRIM



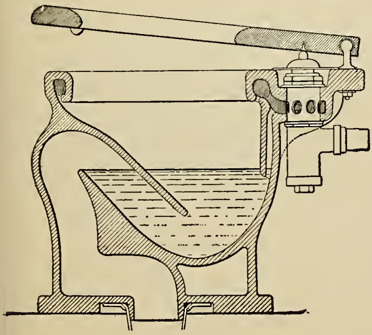
CHALK TROUGHS.



BENCH FOR PHYSICAL LABORATORY

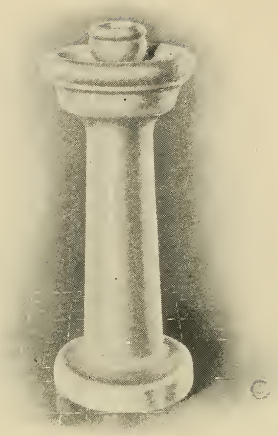
DRINKING FOUNTAIN
Porcelain Mouthpiece.

MODERN
DRINKING FOUNTAIN
With Metal Top.
Courtesy of Jas. B. Clow & Sons, Chicago.

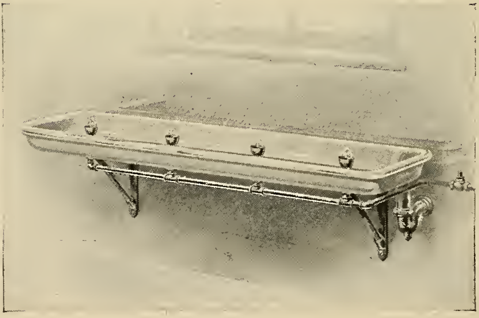


Courtesy of The J. L. Mott Iron Works.

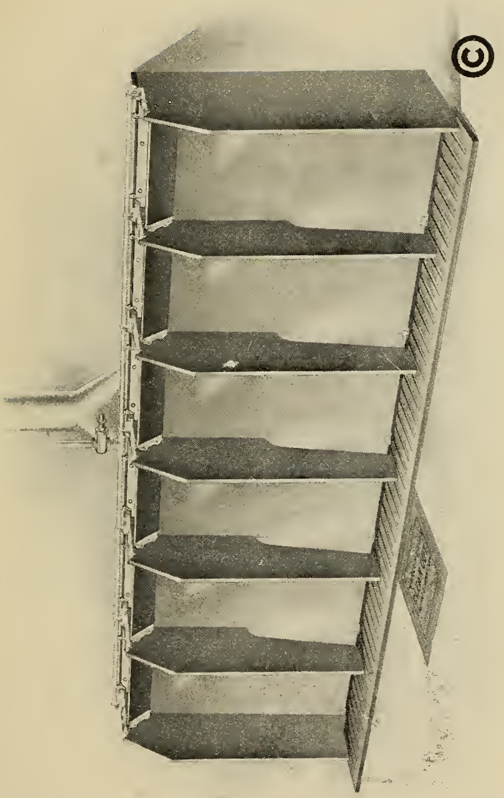
Section of Automatic Water Closet, showing seat-control of water valve.



ALL PORCELAIN DRINKING FOUNTAIN
Courtesy of The J. L. Mott Iron Works.



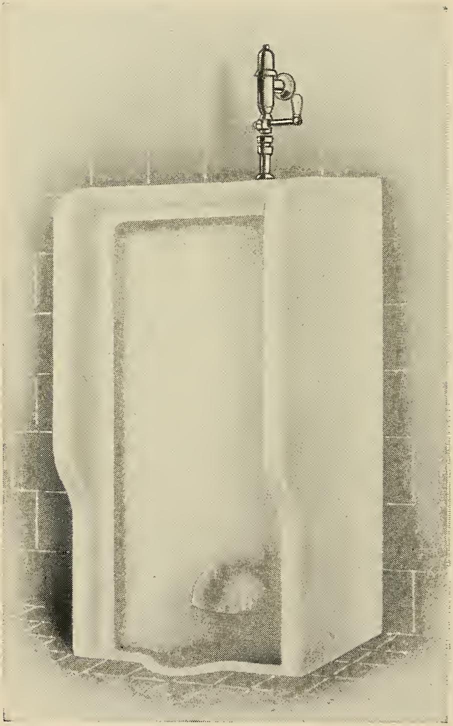
BATTERY OF FOUR DRINKING FOUNTAINS
in Iron Porcelain Enameled Basin.
Courtesy of The J. L. Mott Iron Works.



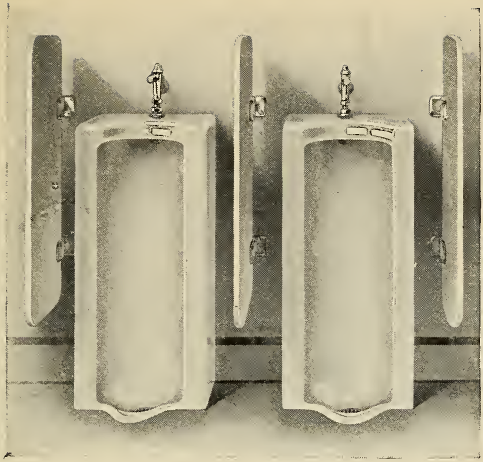
GOOD TYPE OF VENTILATED SLATE URINAL

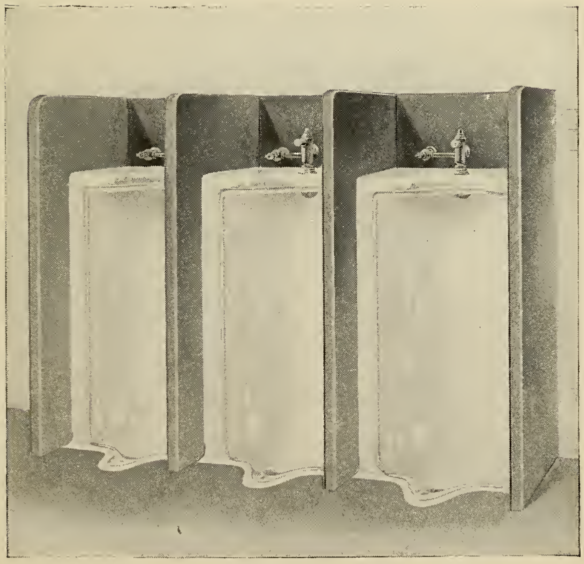
Such as described on page 73.

Courtesy of James B. Clow & Sons, Chicago.



ALL PORCELAIN VENTILATED URINAL
Courtesy of Trenton Potteries Co.
Trenton, N. J.

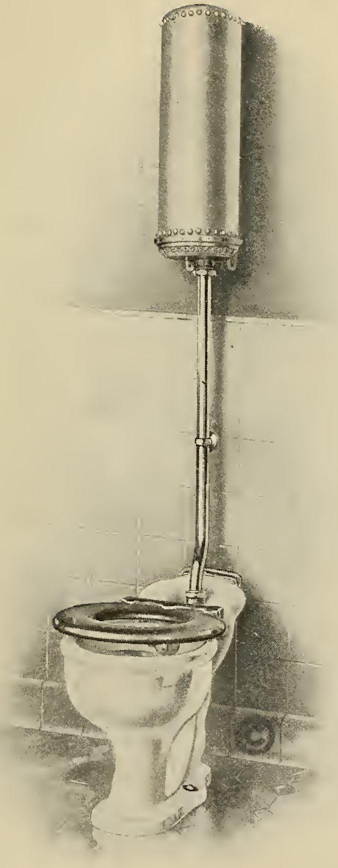




PORCELAIN URINALS IN BATTERIES
Courtesy of The J. L. Mott Iron Works.

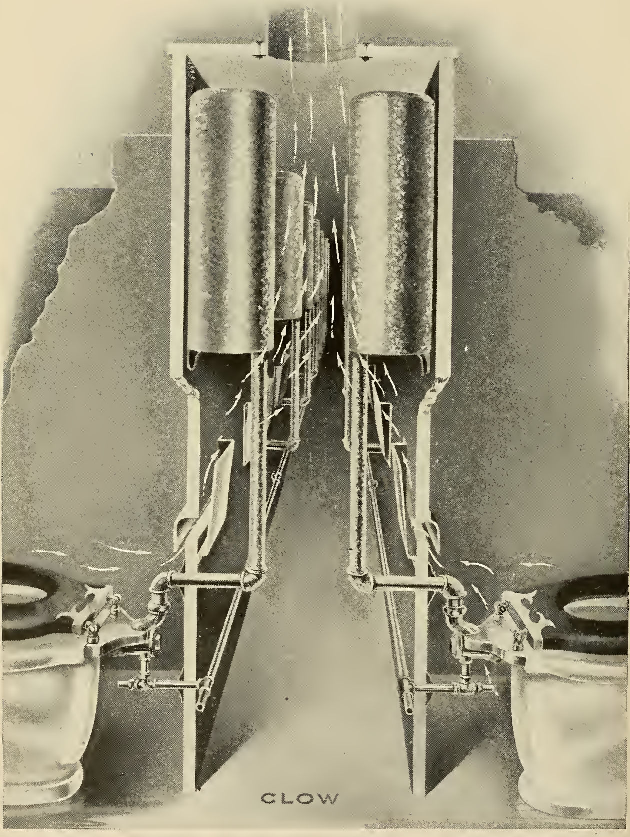
STANDARD DESIGN FOR TOILET
AND STALL PARTITIONS.

Courtesy of The J. L. Mott Iron Works.



VENTILATED AUTOMATIC WATER CLOSET SEAT CONTROL.

Closet vents into wall as shown. Courtesy of James B. Clow & Sons, Chicago.

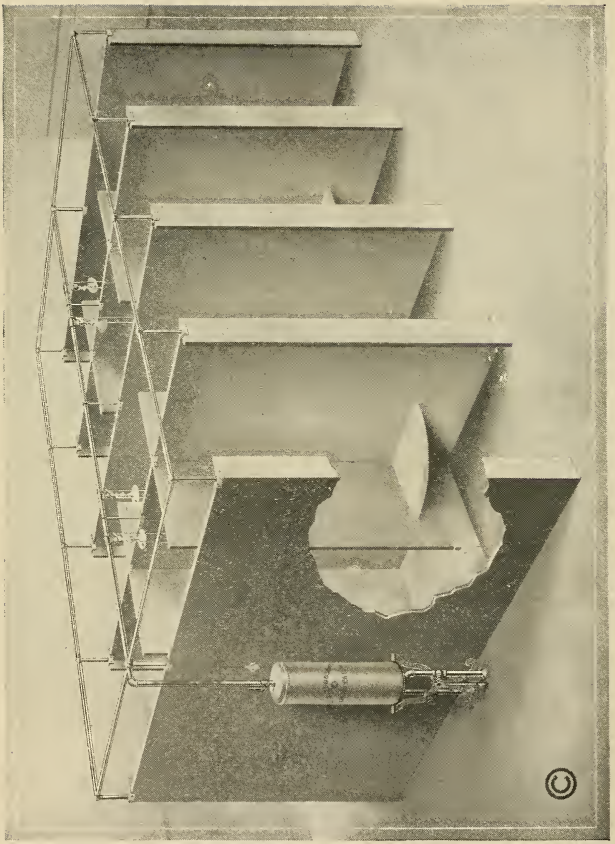


PATENTED BY JAMES B. CLOW & SONS, CHICAGO.

Good arrangement of Closets and Utility Chamber to Ventilate as described on pages 70-76.

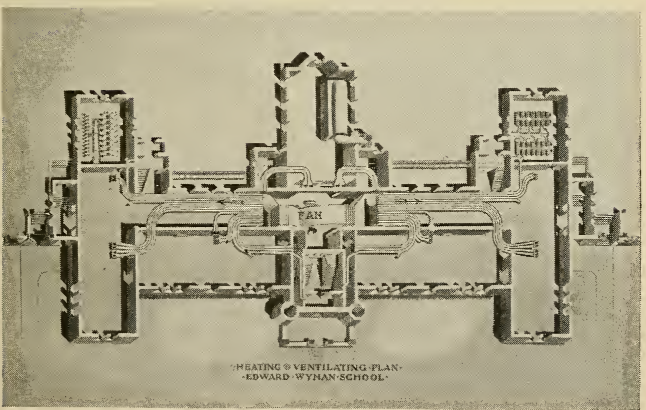
STANDARD SCHOOL LAVATORIES.
Courtesy of The J. L. Mott Iron Works.

AUTOMATIC VENTILATED CLOSET.
Courtesy of The J. L. Mott Iron Works.



STANDARD SHOWER BATH STALLS
AND DRESSING ROOMS.

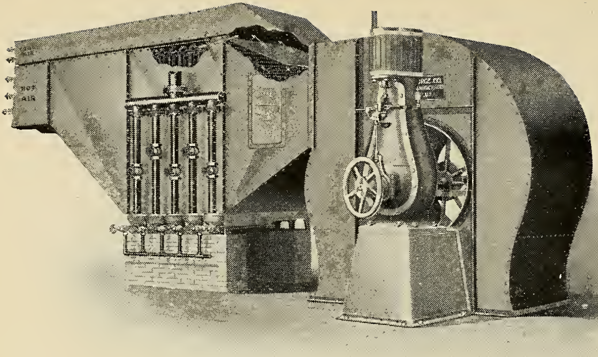
Courtesy of James B. Clow & Sons, Chicago.

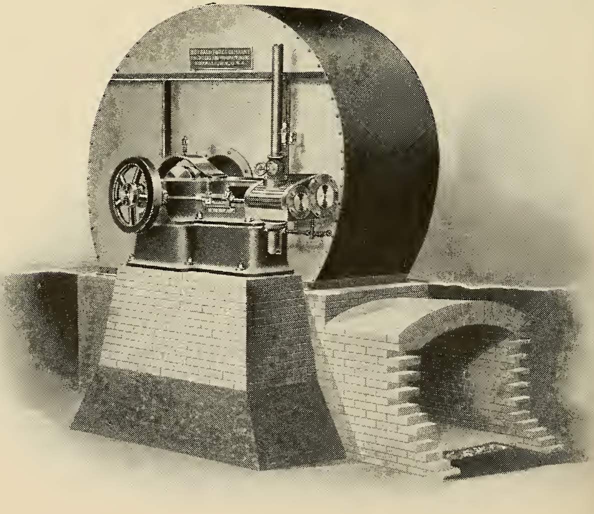


Exterior View and Isometric Section, showing layout of Heating and Ventilating Plant in the Edward Wyman School, St. Louis, Mo.

Wm. B. Ittner, Architect.

Courtesy of The American Blower Co., Detroit.





TWO ILLUSTRATIONS OF BLOWER SYSTEMS.
Courtesy of The American Blower Co., Detroit.

NOTE.—The fan or blower is contained in the circular shaped housing or casing. The upper illustration shows overhead delivery of hot air. The lower shows sub-basement floor ducts for the delivery of hot air.

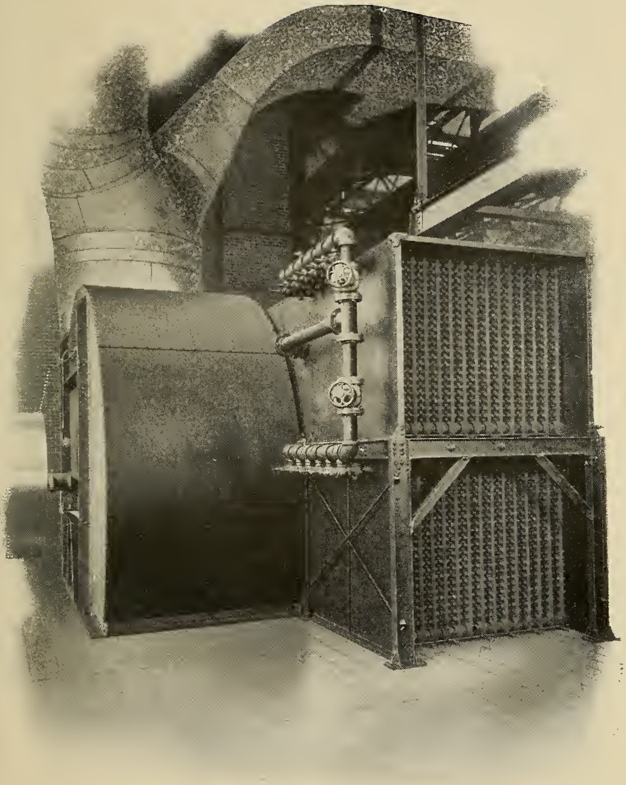
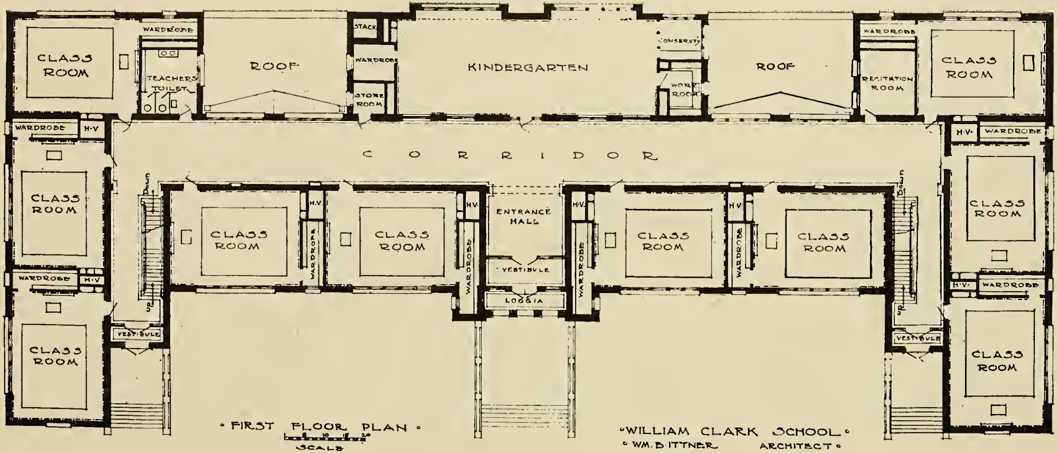


ILLUSTRATION OF MODERN BLOWER SYSTEM.

Courtesy of The American Radiator Co.

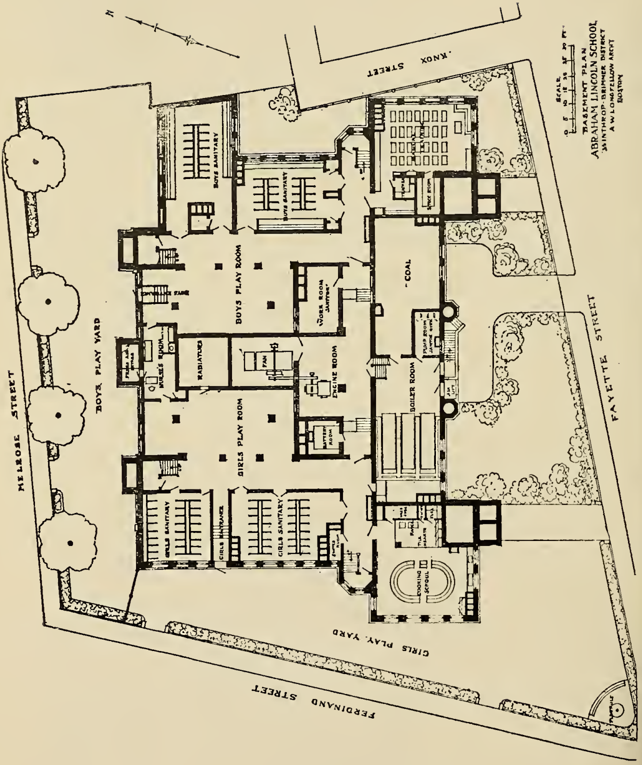
The large rectangular housing or boxes contain Hot "Vento" steam coils, and the curved housing contains the fan or blower. Cold air is drawn through the coils by the fan and forced thence out through the large ducts shown, into all parts of the building.

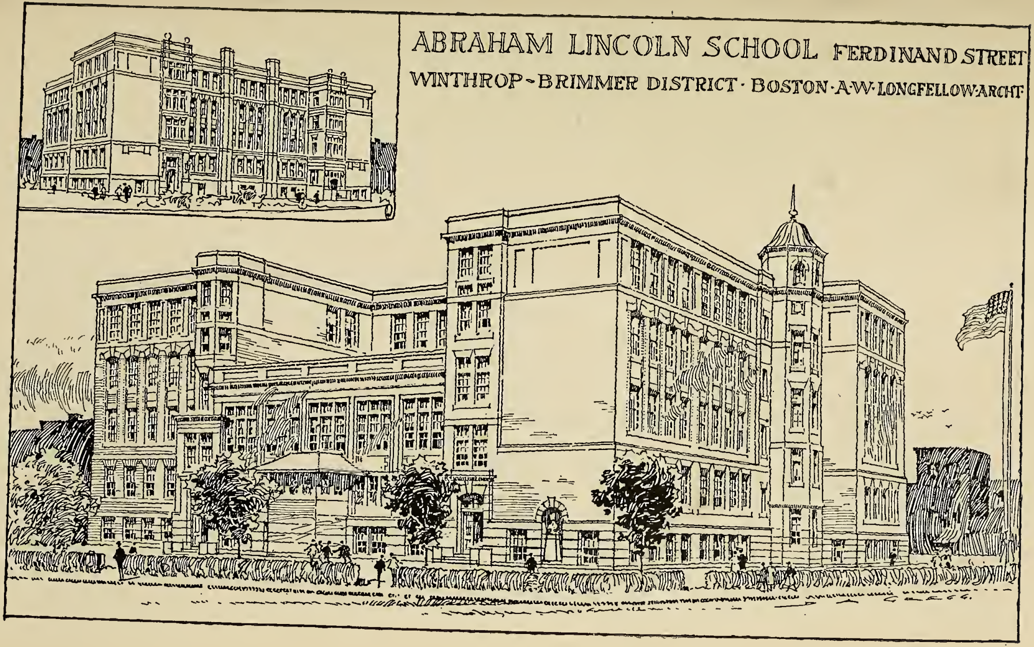


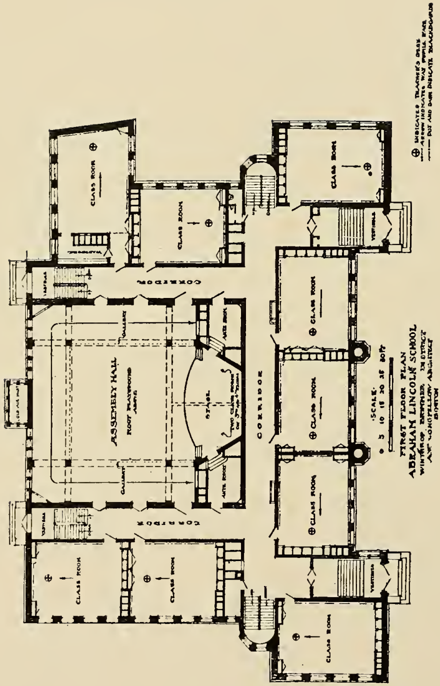
PLAN OF TYPICAL GRADE SCHOOL, ST. LOUIS, MO.
Mr. Wm. B. Ittner, Architect.

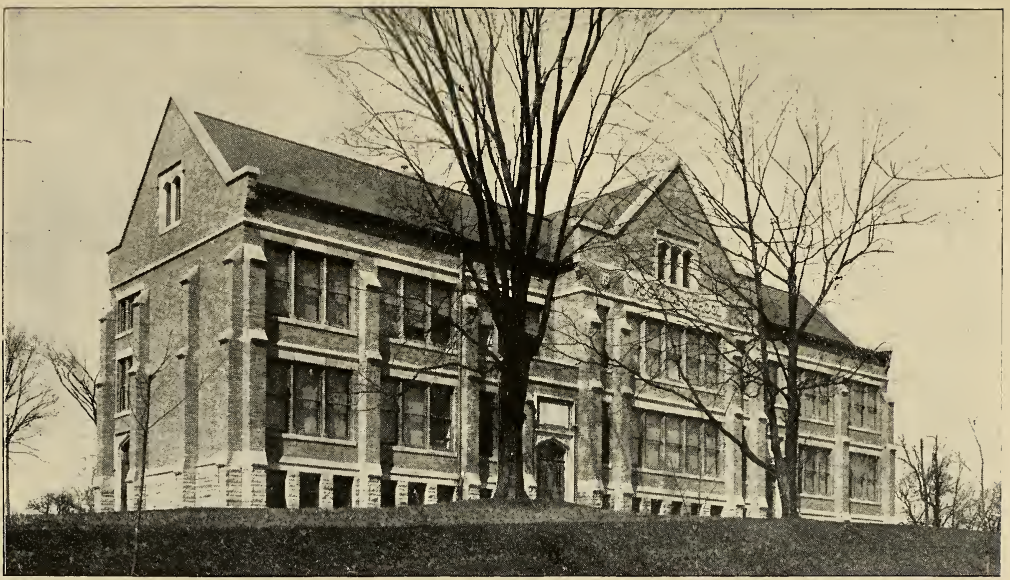
Much of the present day work throughout the country is based on the buildings of Mr. Ittner as models.

WILLIAM CLARKE SCHOOL — WM. B. ITTNER, Architect. — ST. LOUIS, MO.

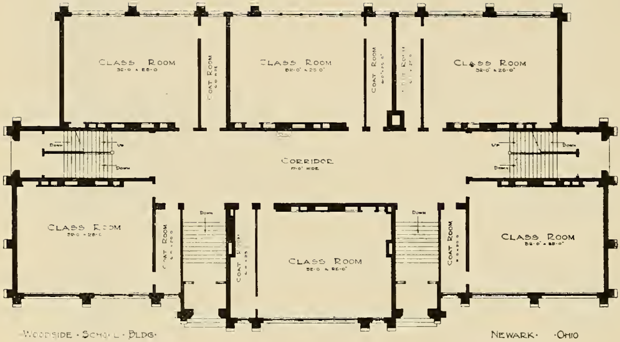

KNOX STREET
BOYS SANITARY
BOYS SANITARY
BOYS PLAY ROOM
WORK ROOM JANITOR
NURSE'S ROOM
RADIATORS
FAN
ENGINE ROOM
BATTERY ROOM
GIRLS PLAY ROOM
GIRLS SANITARY
GIRLS ENTRANCE
GIRLS SANITARY
COAL
BOILER ROOM
PUMP ROOM
COOKING SCHOOL
MELROSE STREET
BOYS PLAY YARD
GIRLS PLAY YARD
FERDINAND STREET
FAYETTE STREET
SCALE
BASEMENT PLAN
ABRAHAM LINCOLN SCHOOL
WINTHROP-BRIMMER DISTRICT
A W LONGFELLOW ARCHT
BOSTON


ABRAHAM LINCOLN SCHOOL FERDINAND STREET
WINTHROP-BRIMMER DISTRICT · BOSTON · A·W·LONGFELLOW·ARCHT·

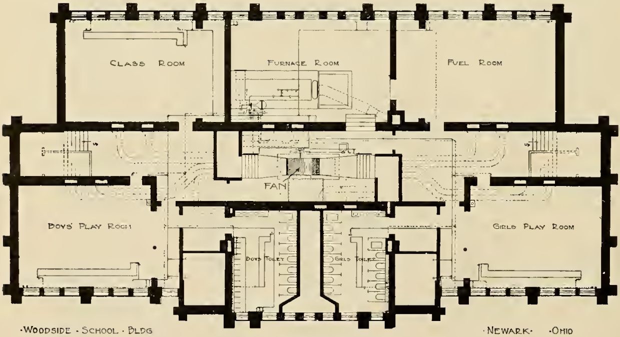

ASSEMBLY HALL
CORRIDOR
CLASS ROOM
STAGE
FIRST FLOOR PLAN
ABRAHAM LINCOLN SCHOOL
BOSTON



Woodside School, Newark, Ohio, Wilbur T. Mills, Architect, Columbus, Ohio.

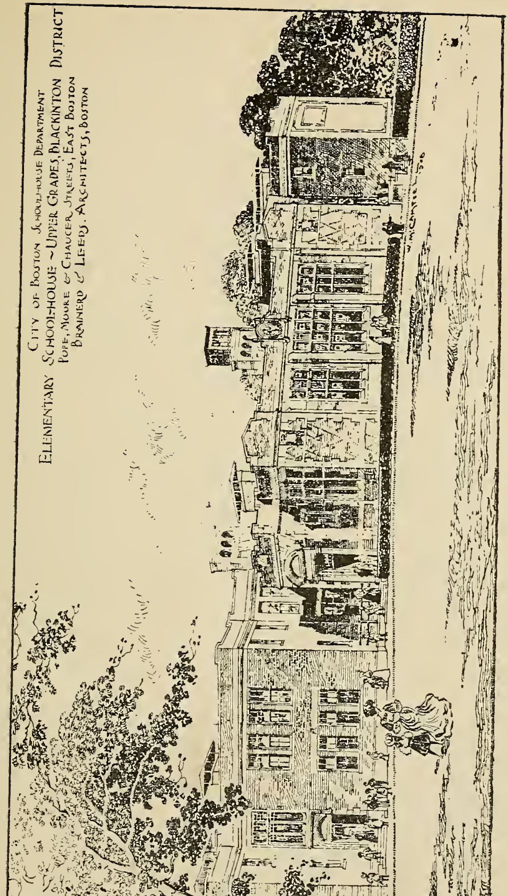


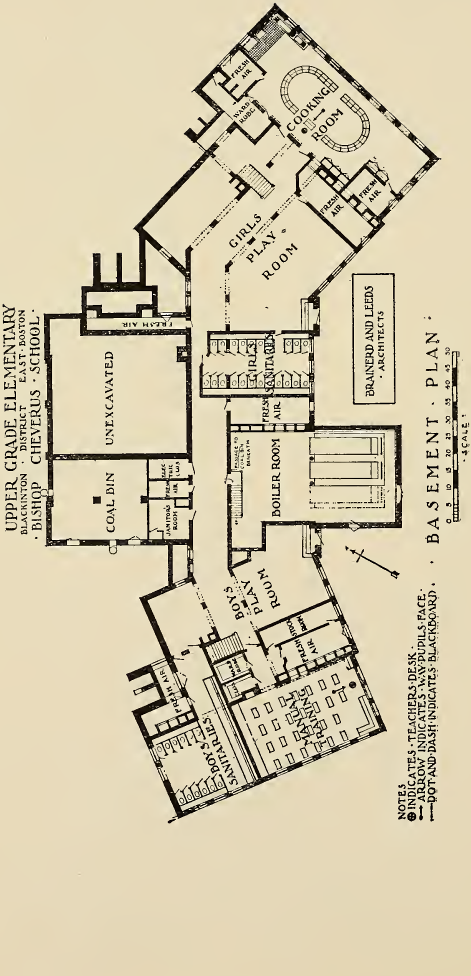
FIRST FLOOR PLAN

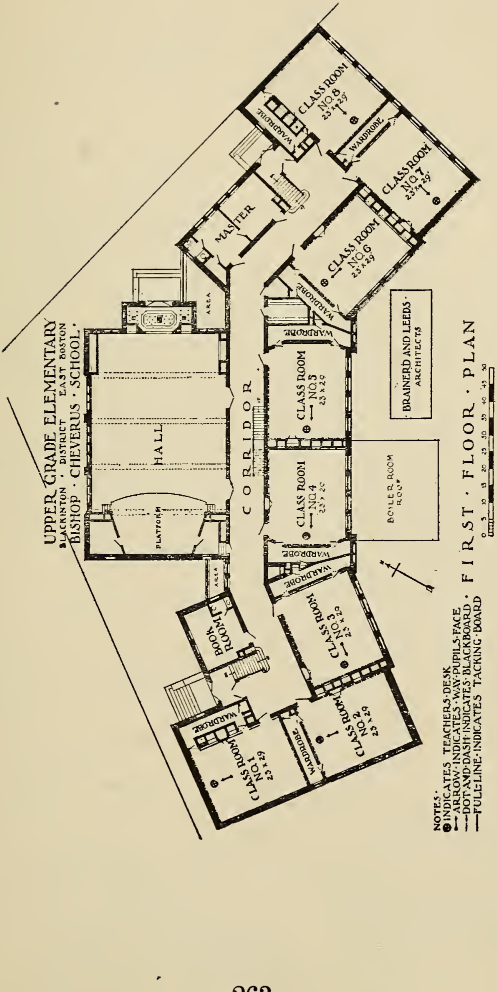


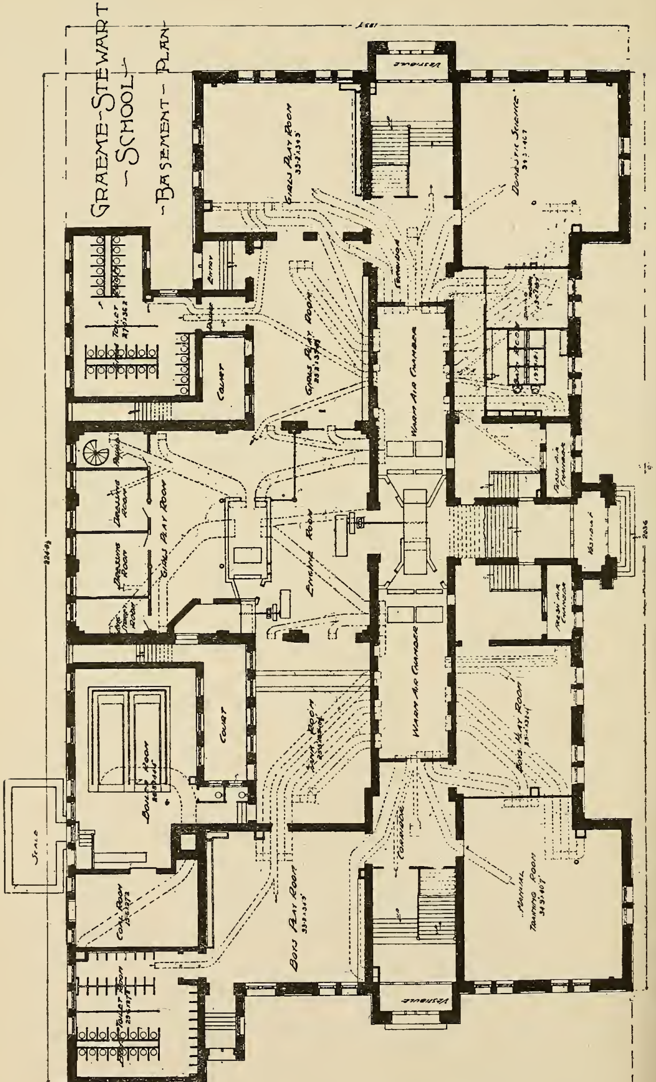
BASEMENT FLOOR PLAN

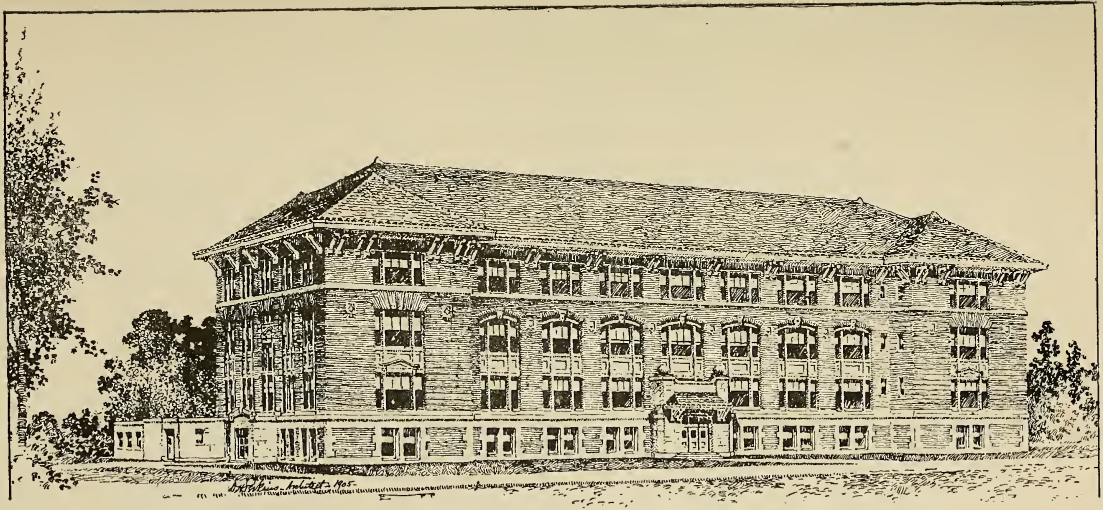
WOODSIDE SCHOOL, NEWARK, OHIO.
WILBUR T. MILLS, Architect.


City of Boston Schoolhouse Department
Elementary School-House ~ Upper Grades, Blackinton District
Pope, Moore & Chaucer Streets, East Boston
Brainerd & Leeds, Architects, Boston


UPPER GRADE ELEMENTARY
BLACKINTON · DISTRICT EAST · BOSTON
· BISHOP CHEVERUS · SCHOOL ·
UNEXCAVATED
COAL BIN
JANITORS ROOM
FRESH AIR
BOILER ROOM
GIRLS PLAY ROOM
GIRLS SANITARIES
COOKING ROOM
WARD-ROBE
BOYS PLAY ROOM
BOYS SANITARIES
MANUAL TRAINING
BRAINERD AND LEEDS
· ARCHITECTS
· BASEMENT · PLAN ·
· SCALE ·
NOTES
INDICATES · TEACHERS · DESK ·
ARROW INDICATES · WAY · PUPILS · FACE ·
DOT AND DASH INDICATES · BLACKBOARD ·


UPPER GRADE ELEMENTARY
BLACKINTON · DISTRICT · EAST BOSTON
BISHOP · CHEVERUS · SCHOOL ·
HALL
PLATFORM
CORRIDOR
AREA
BOOK ROOM
MASTER
CLASS ROOM NO. 1 23 x 29
CLASS ROOM NO. 2 23 x 29
CLASS ROOM NO. 3 23 x 29
CLASS ROOM NO. 4
CLASS ROOM NO. 5 23 x 29
CLASS ROOM NO. 6 23 x 29
CLASS ROOM NO. 7 23 x 29
CLASS ROOM NO. 8 23 x 29
WARDROBE
BOILER ROOM
· BRAINERD AND LEEDS · ARCHITECTS
FIRST · FLOOR · PLAN
· SCALE ·
NOTES ·
INDICATES TEACHERS · DESK
ARROW · INDICATES · WAY · PUPILS · FACE
DOT · AND · DASH · INDICATES · BLACKBOARD ·
FULL · LINE · INDICATES TACKING · BOARD

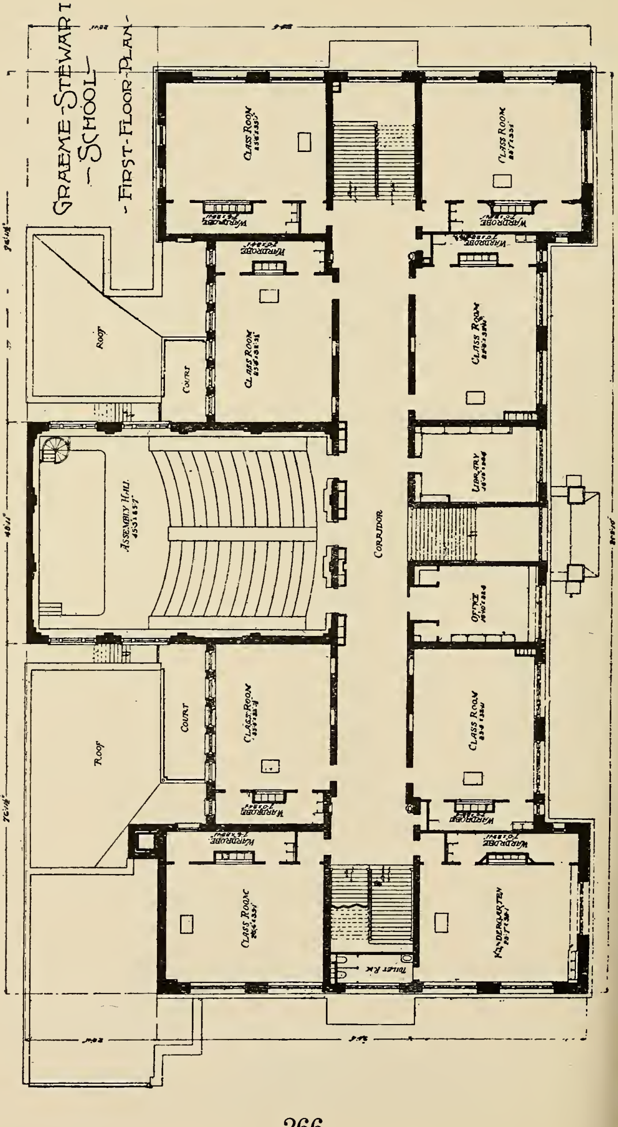

GRAEME-STEWART
-SCHOOL-
-BASEMENT- PLAN-
GIRLS PLAY ROOM
DOMESTIC SCIENCE
ENTRY
COURT
WARM AIR CHAMBER
FRESH AIR CHAMBER
VESTIBULE
DRESSING ROOM
ENGINE ROOM
BOYS PLAY ROOM
BOILER ROOM
COAL ROOM
TOILET ROOM
CORRIDOR
MANUAL TRAINING ROOM
SCALE



GRAEME STEWART SCHOOL, CHICAGO, ILL.

DWIGHT H. PERKINS, Architect.

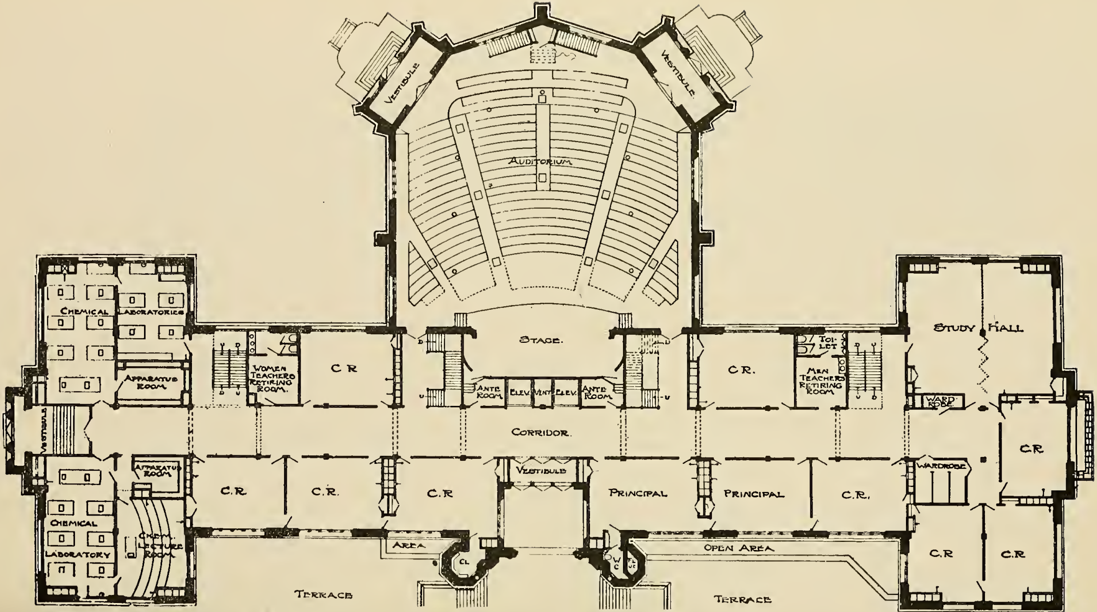
Courtesy of American School Board Journal.



GRAEME-STEWART
-SCHOOL-
-FIRST-FLOOR-PLAN-
CLASS ROOM
WARDROBE
ROOF
COURT
ASSEMBLY HALL
CORRIDOR
LIBRARY
OFFICE
KINDERGARTEN
TOILET RM

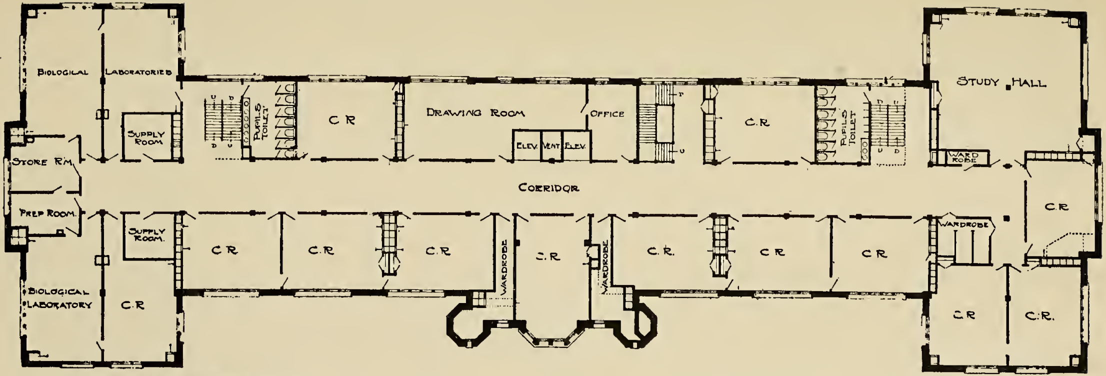
Picture Copyrighted by The American Architect.

MORRIS HIGH SCHOOL, NEW YORK. C. B. J. SNYDER, Architect.

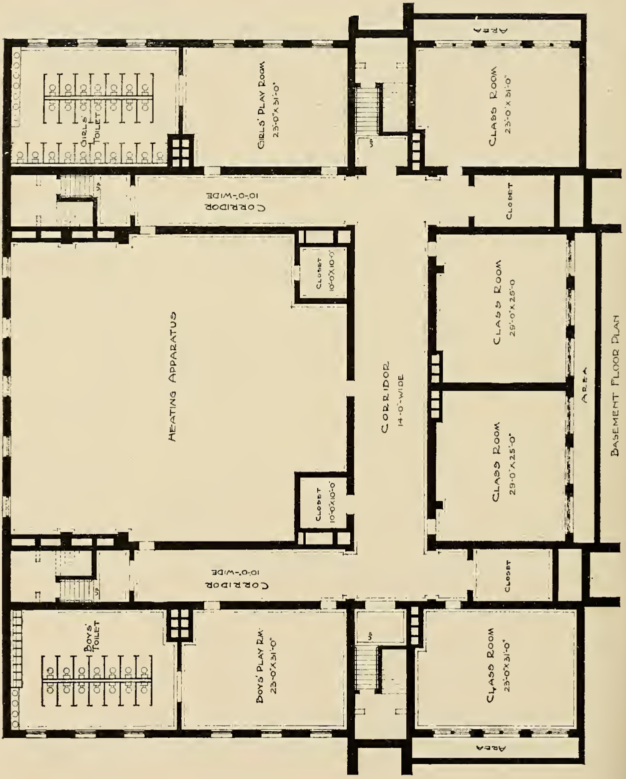


Copyright, American Architect.

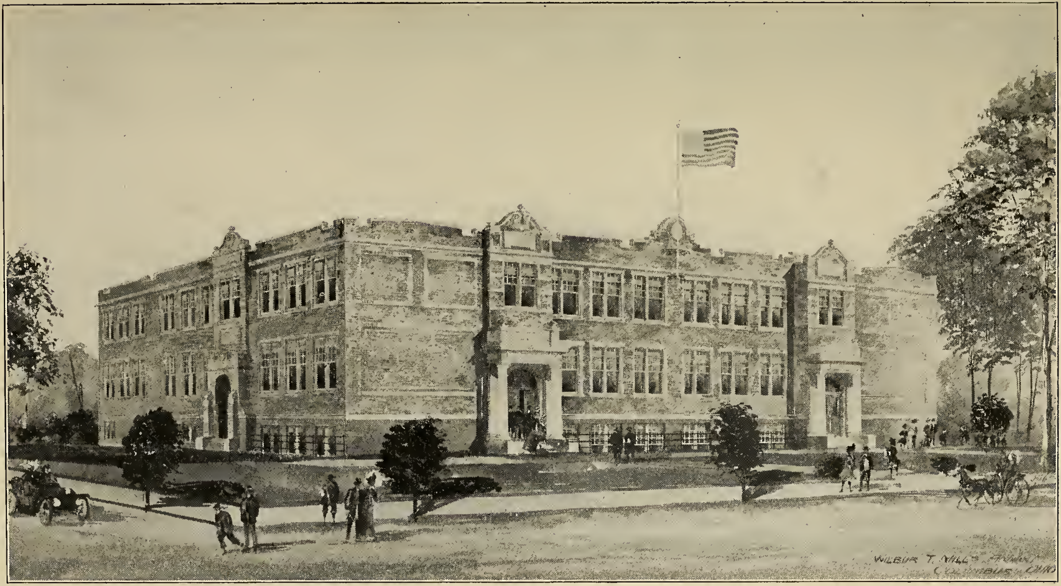
MORRIS HIGH SCHOOL, NEW YORK. C. B. J. SNYDER, Architect.



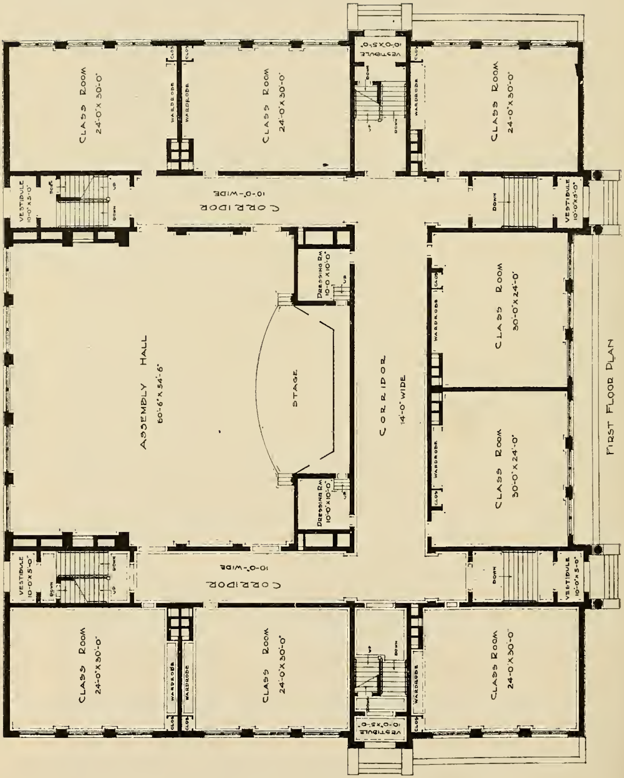
MORRIS HIGH SCHOOL, NEW YORK. C. B. J. SNYDER, Architect.



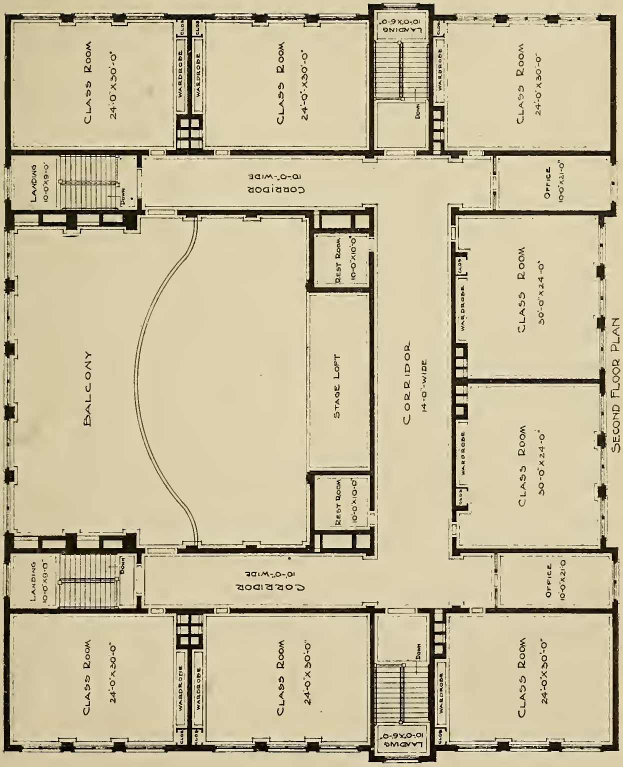
Sixteen Room Fireproof High School
Cost $80,000.00.



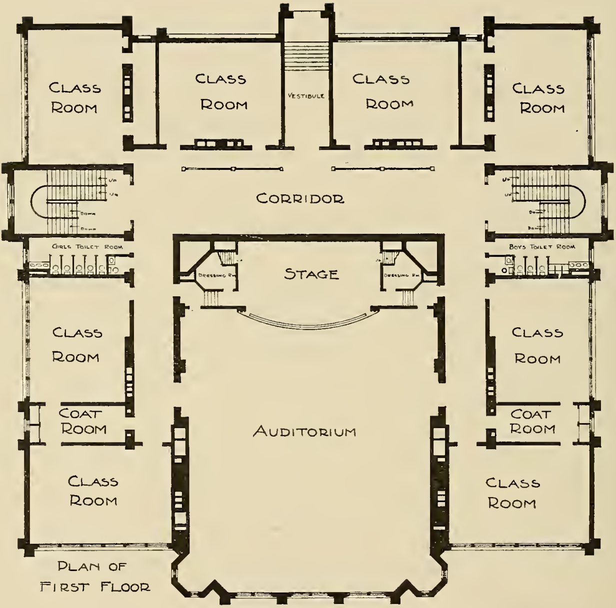
Exterior of Sixteen Room Fireproof School Building.



Sixteen Room Fireproof High School.

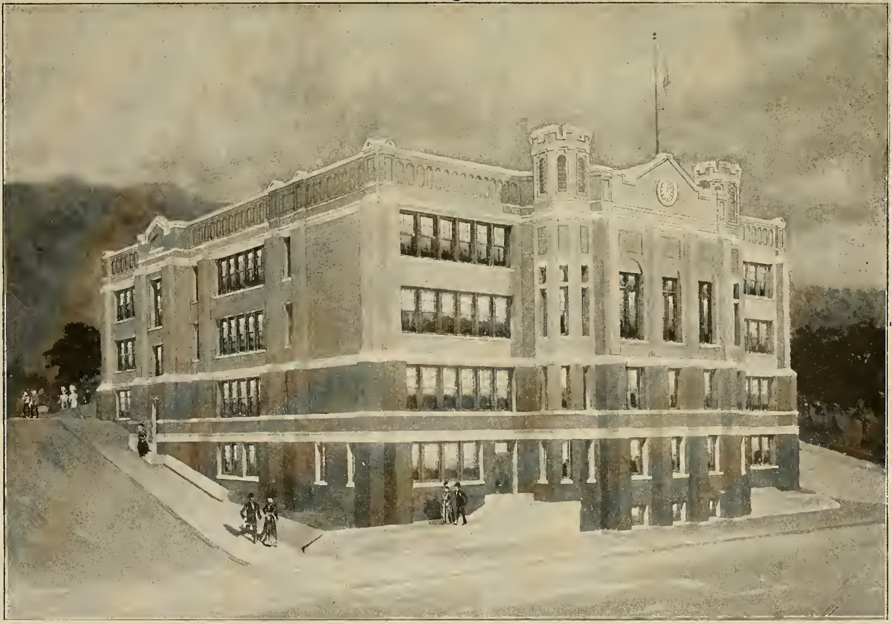


Sixteen Room Fireproof High School.

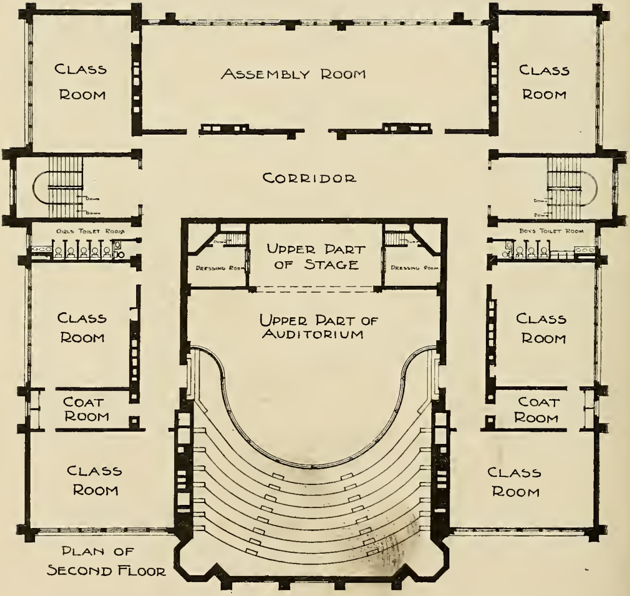


HIGH SCHOOL AT BLUEFIELD, W. VA.
WILBUR T. MILLS, Architect
Columbus, Ohio.

NOTE—This building is erected on the side of a mountain, the upper central entrance being level with the ground, and the side entrances about ten feet lower. The building also has basement and sub-basement floors with additional entrances opening directly onto the ground level from each floor level.



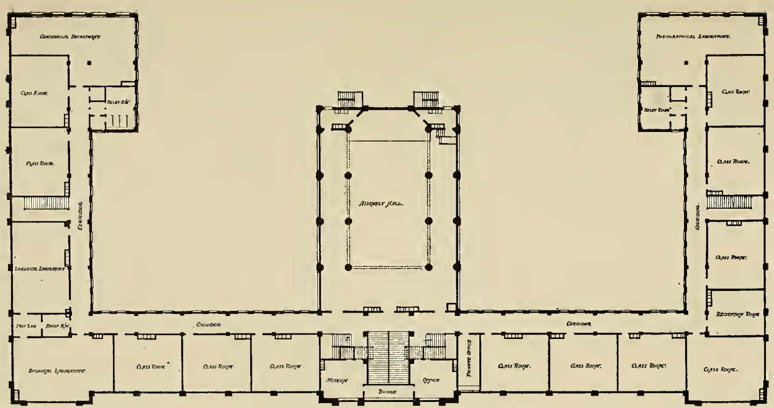
HIGH SCHOOL AT BLUEFIELD, W. VA. WILBUR T. MILLS, Architect, Columbus, O.



HIGH SCHOOL AT BLUEFIELD, W. VA.

WILBUR T. MILLS, Architect

Columbus, Ohio.

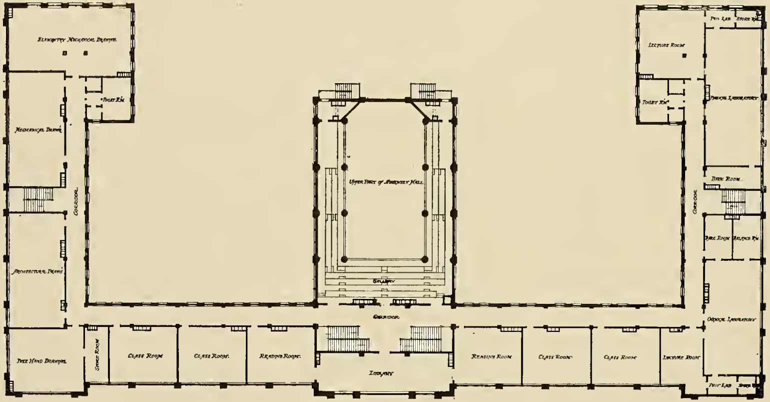


First Floor Plan.
LYMAN TRUMBULL MANUAL TRAINING HIGH SCHOOL.

ALBERT G. LANE TECHNICAL HIGH SCHOOL, CHICAGO, ILL.

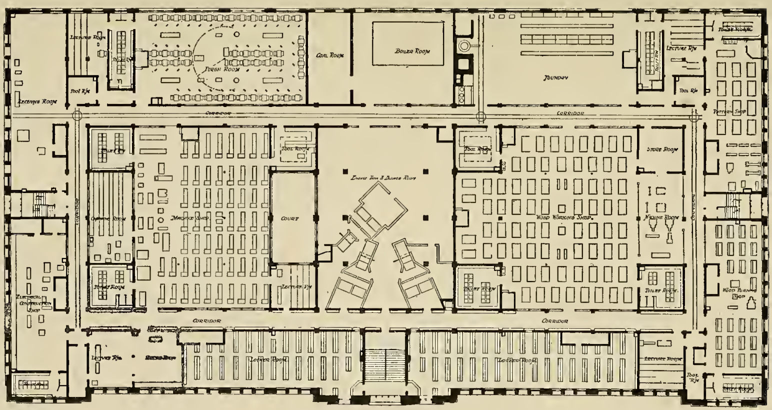
DWIGHT H. PERKINS, Architect.

Courtesy of American School Board Journal.



Second Floor Plan
LYMAN TRUMBULL MANUAL TRAINING HIGH SCHOOL.

ALBERT G. LANE TECHNICAL HIGH SCHOOL, CHICAGO, ILL.
DWIGHT H. PERKINS, Architect.

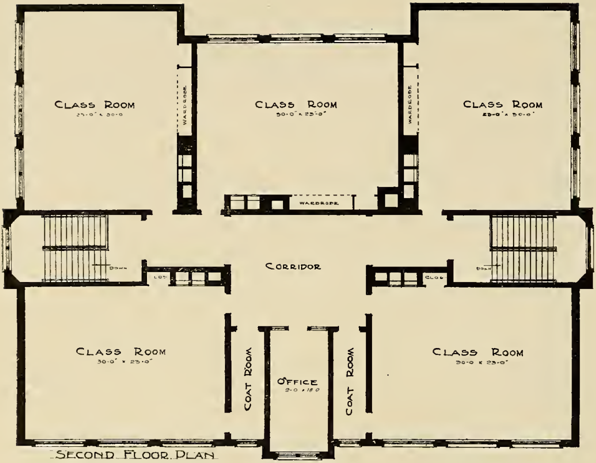


Ground Floor Plan.

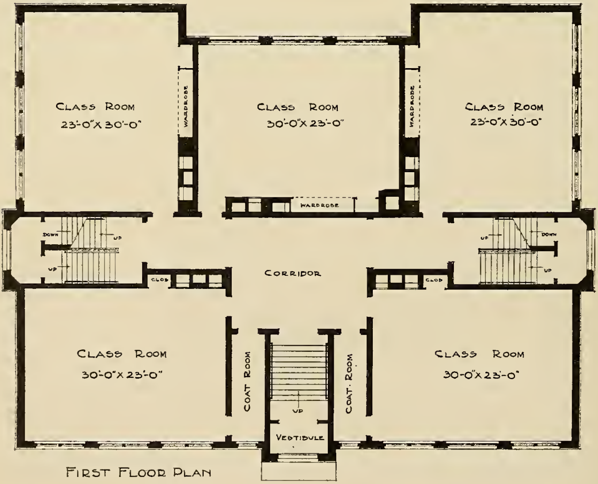
LYMAN TRUMBULL MANUAL TRAINING HIGH SCHOOL

ALBERT G. LANE TECHNICAL HIGH SCHOOL, CHICAGO, ILL.

DWIGHT H. PERKINS, Architect.

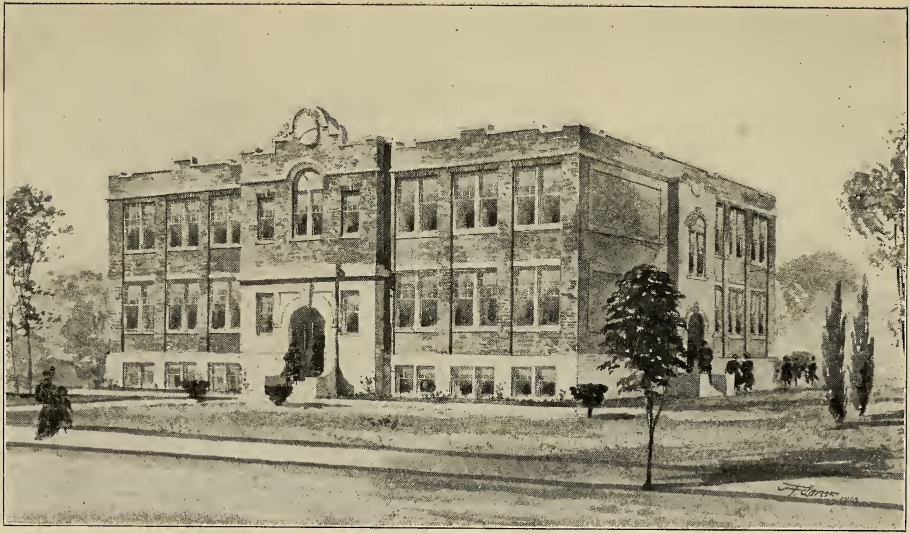


SECOND FLOOR PLAN



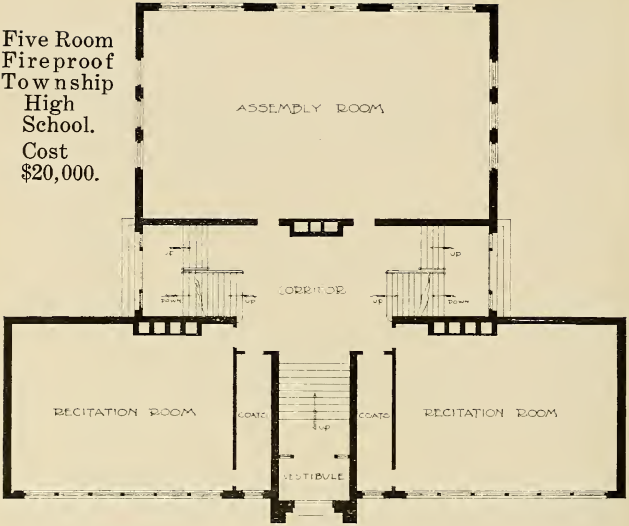
FIRST FLOOR PLAN

Plans of Ten Room Fireproof School Building
Cost $30,000.00.



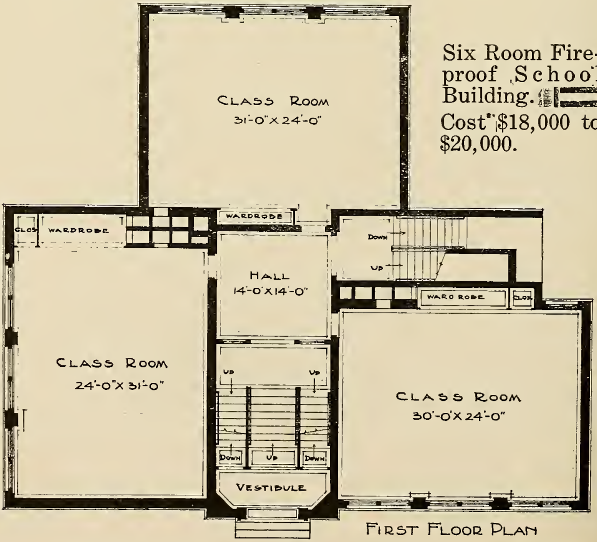
Exterior of Ten Room Fireproof School Building
Cost $30,000.00.

Five Room Fireproof Township High School. Cost $20,000.



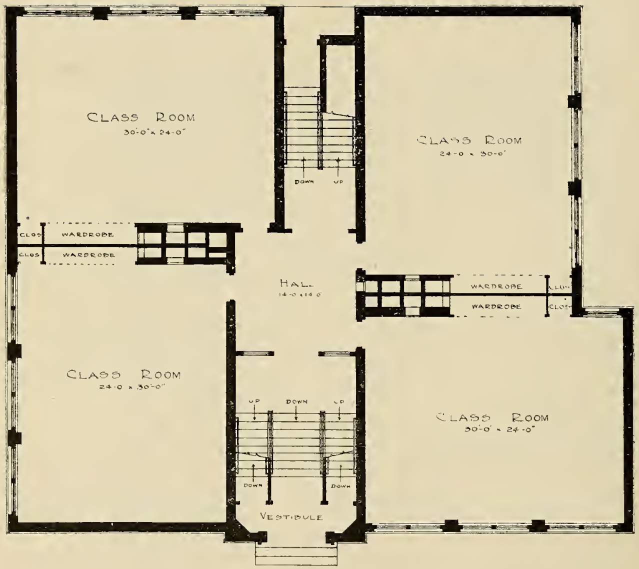
PLAN OF FIRST FLOOR
SCALE $\frac{1}{8}$"=1'-0"

Six Room Fireproof School Building. Cost $18,000 to $20,000.



FIRST FLOOR PLAN

ST. MARY'S (R. C.) SCHOOL, MARION, OHIO.
WILBUR T. MILLS, Architect
Columbus, Ohio.



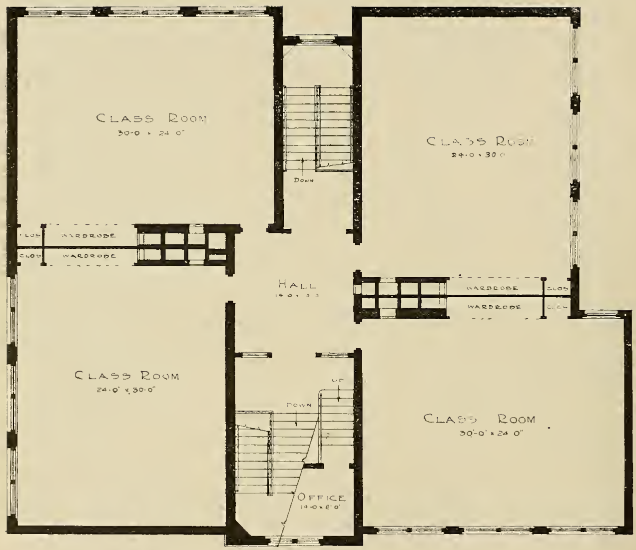
FIRST FLOOR PLAN
SCALE $\frac{1}{8}$" 1-0

EIGHT ROOM FIREPROOF SCHOOL BUILDING
Cost $25,000.00.

Probably more eight room school buildings are erected than any other type. There is almost no limit to the variety of designs employed in these buildings. Economy considered, this is one of the best plans we have ever seen.

System of construction, reinforced concrete.

Exterior of Eight Room Fireproof School Building.

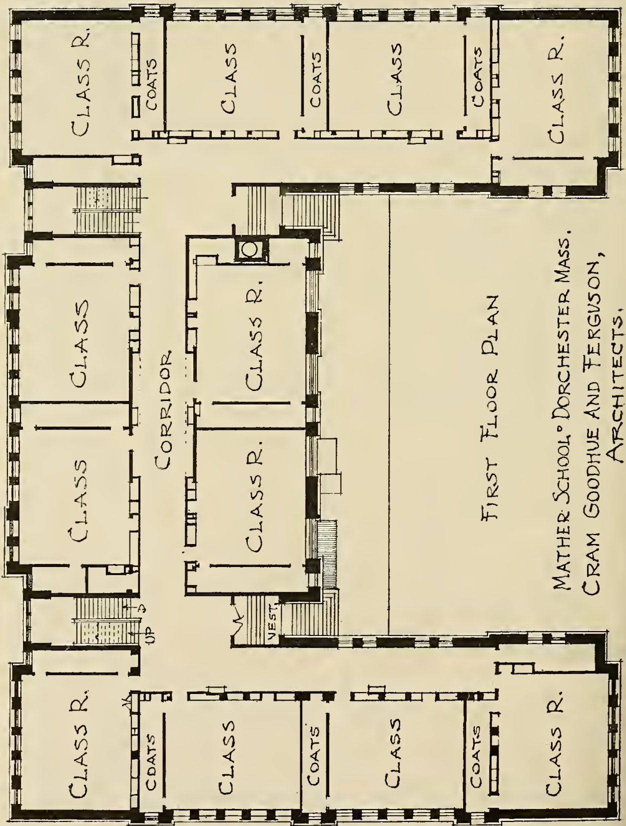


SECOND FLOOR PLAN
SCALE—1/8" 1-0

EIGHT ROOM FIREPROOF SCHOOL BUILDING
Cost $25,000.00.

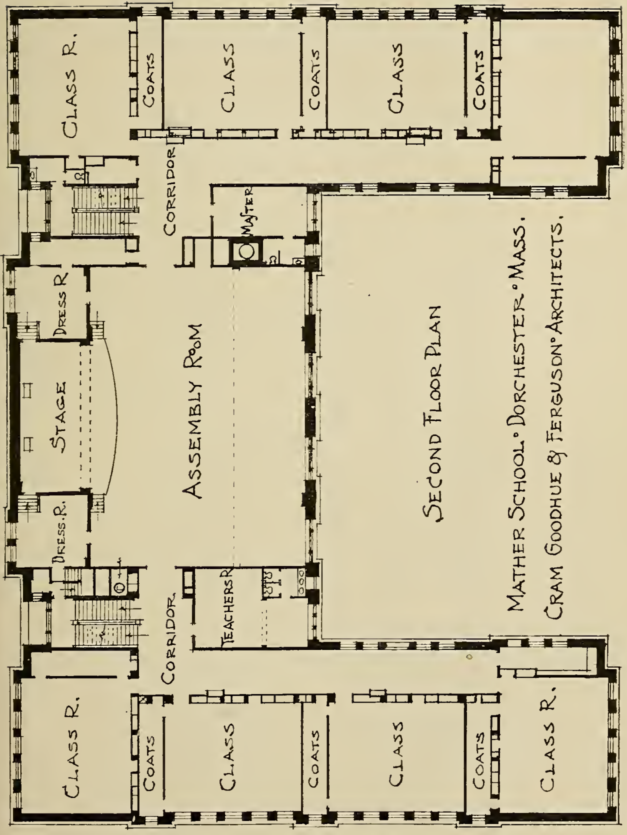
In this plan, what is known as the Chicago Plan for coat rooms is used. For description see pages 43 and 44. Heating and ventilation by hot air furnaces and Plenum fan system, automatically controlled.

Mather School, Dorchester, Mass. Cram, Goodhue & Ferguson, Architects.

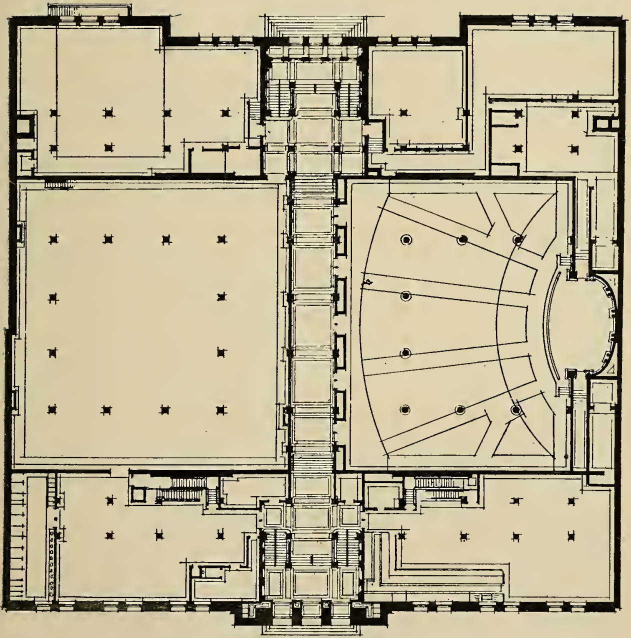


FIRST FLOOR PLAN

MATHER SCHOOL · DORCHESTER MASS.
CRAM GOODHUE AND FERGUSON,
ARCHITECTS.

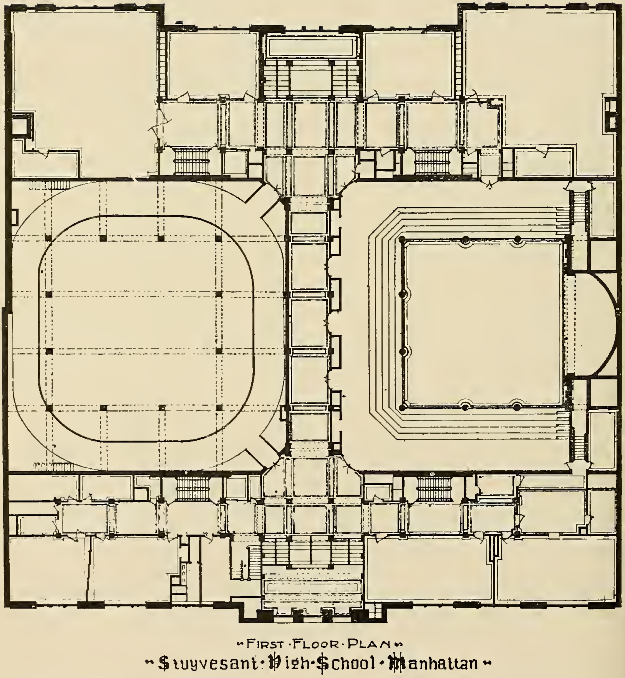

Second Floor Plan
Mather School · Dorchester · Mass.
Cram Goodhue & Ferguson · Architects.
Class R.
Coats
Class
Coats
Class
Coats
Corridor
Master
Dress R
Stage
Dress. R.
Assembly Room
Teachers R
Corridor
Class R.
Coats
Class
Coats
Class
Coats
Class R.

SEMI-DETACHED INTERMEDIATE BUILDINGS, PIQUA, OHIO.
WILBUR T. MILLS, Architect, Columbus, Ohio.

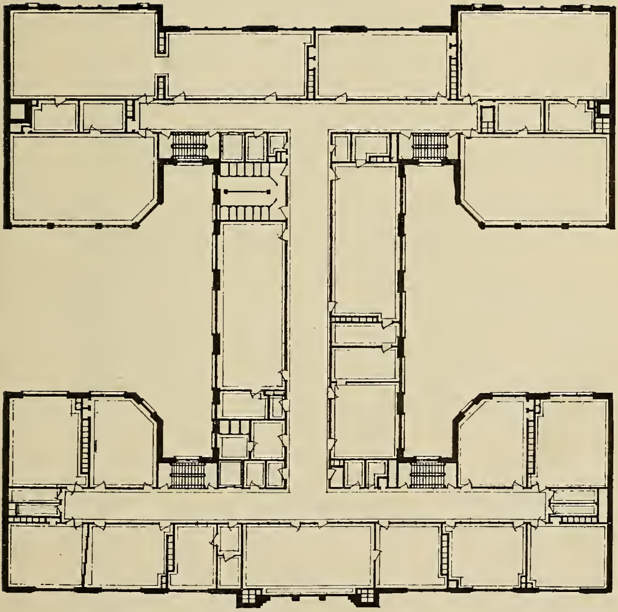


BASEMENT PLAN

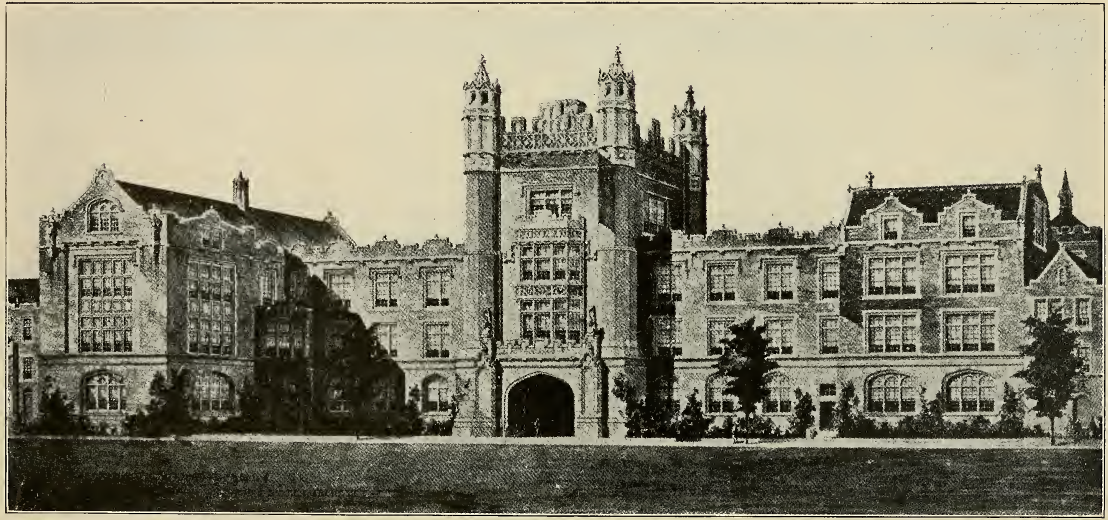
~ Stuyvesant High School ~ Manhattan ~



FIRST · FLOOR · PLAN
Stuyvesant · High · School · Manhattan



~ SECOND FLOOR PLAN ~
~ Stuyvesant High School ~ Manhattan ~



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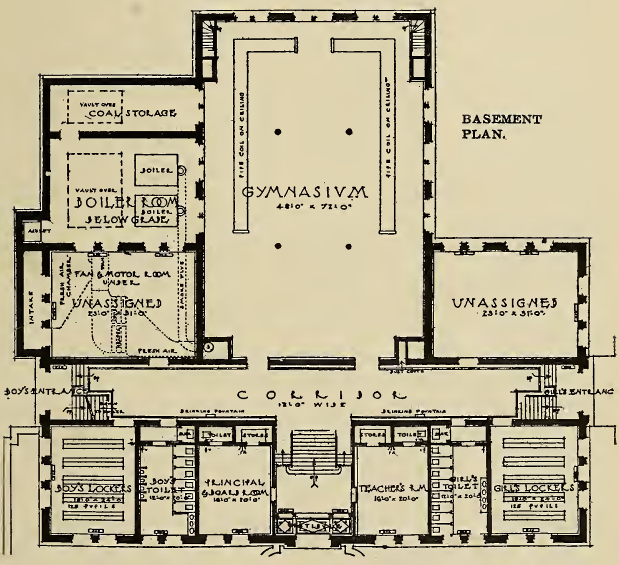
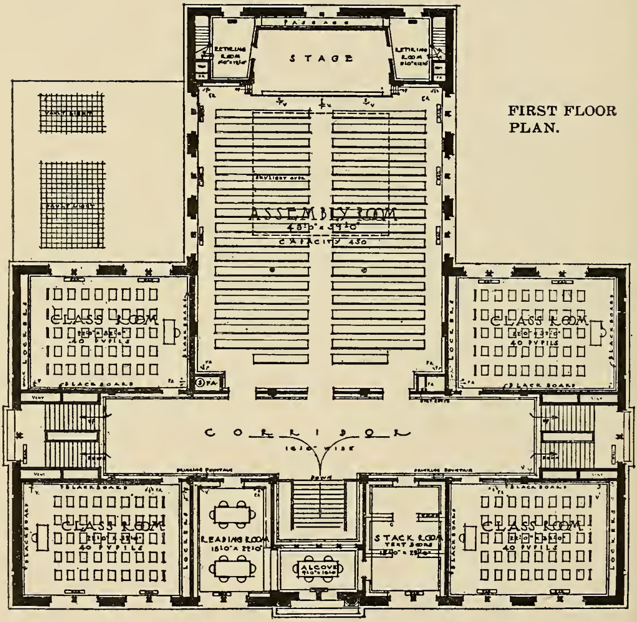
ERASMUS HALL HIGH SCHOOL, NEW YORK. C. B. J. SNYDER, Architect.



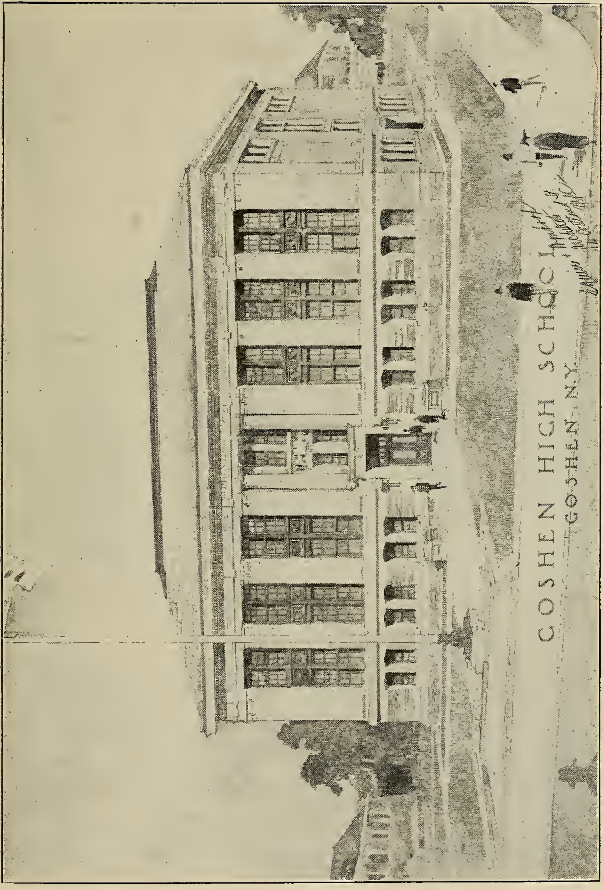
HIGH SCHOOL AT GOSHEN, N. Y.

Squires & Wynkoop, Architects, New York.

FIRST FLOOR PLAN.

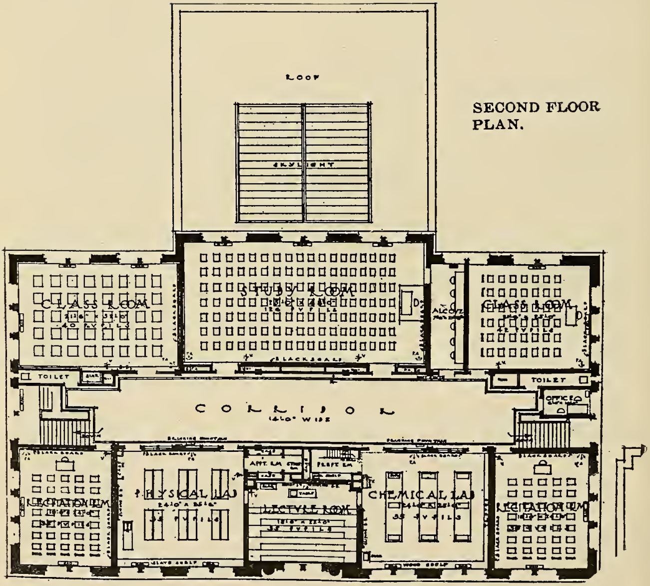


HIGH SCHOOL AT GOSHEN, N. Y.
Squires & Wynkoop, Architects, New York.



HIGH SCHOOL AT GOSHEN, N. Y.
SQUIRES & WYNKOOP, Architects, New York.

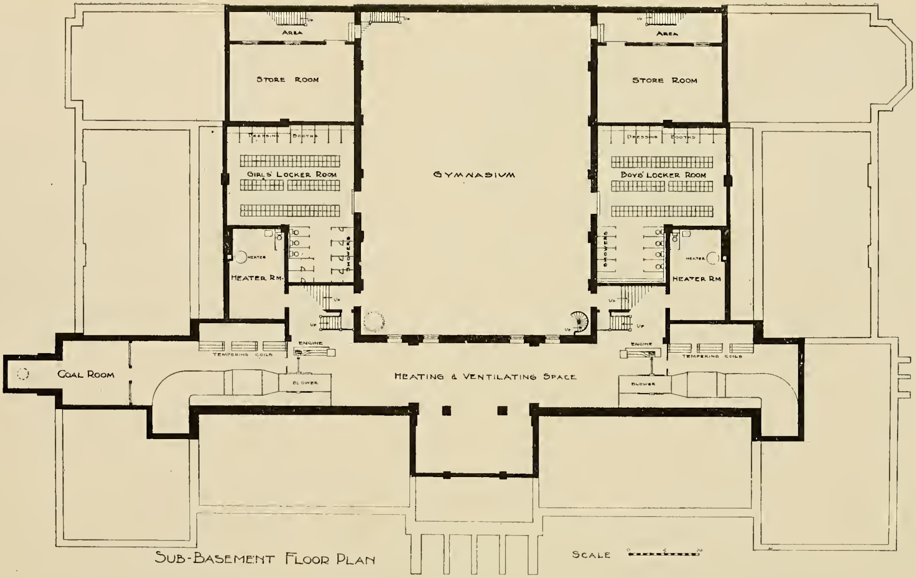
SECOND FLOOR PLAN.



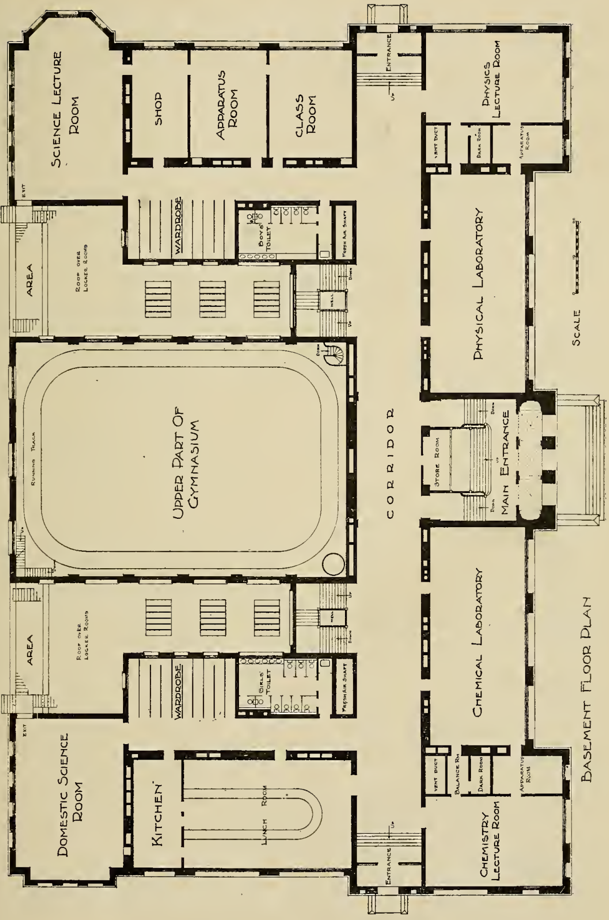
HIGH SCHOOL AT GOSHEN, N. Y.

SQUIRES & WYNKOOP, Architects, New York.

HIGH SCHOOL BUILDING, Battle Creek, Mich. WILBUR T. MILLS, Architect, Columbus, O.



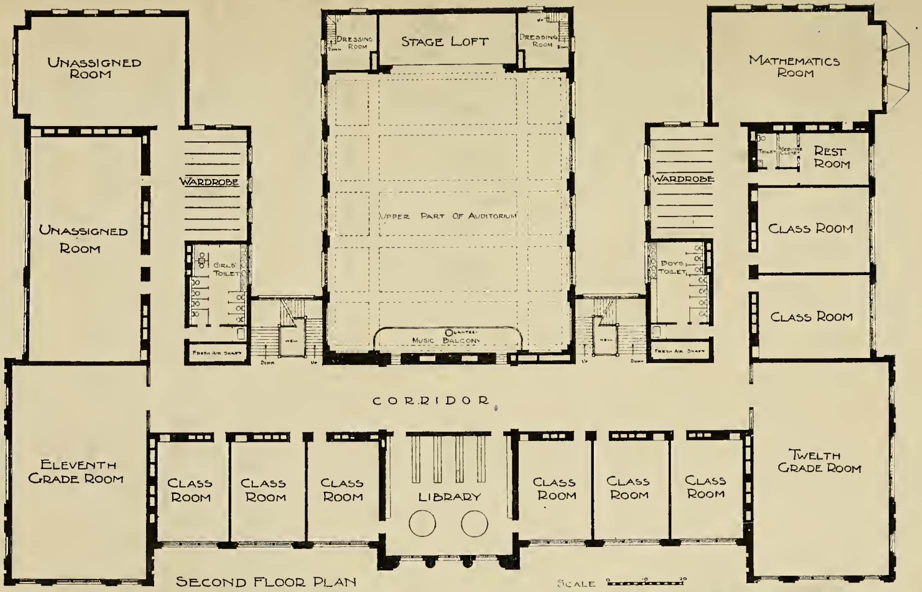
HIGH SCHOOL, Battle Creek, Mich. WILBUR T. MILLS, Architect, Columbus, O.



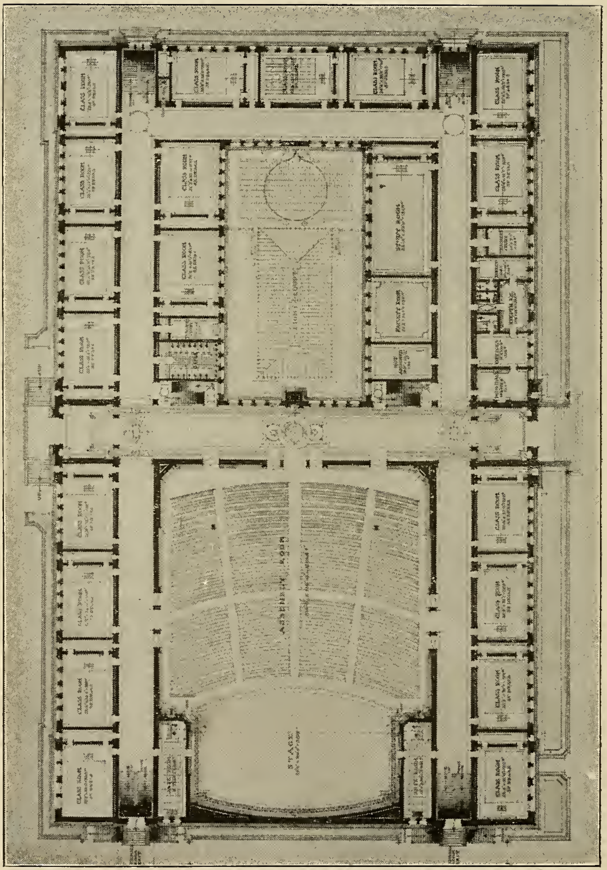
High School, Battle Creek, Mich.
Wilbur T. Mills, Architect
Columbus, Ohio.

First Floor Plan

HIGH SCHOOL, BATTLE CREEK, MICH. WILBUR T. MILLS, Architect, Columbus, O.



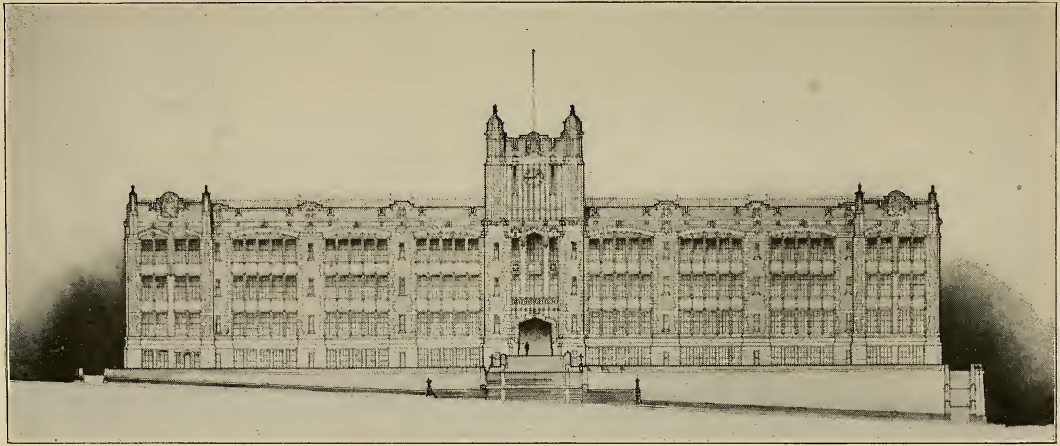
HIGH SCHOOL, BATTLE CREEK, MICH. WILBUR T. MILLS, Architect, Columbus, O.



MAIN FLOOR PLAN.

PRIZE DESIGN FOR PITTSBURG HIGH SCHOOL.

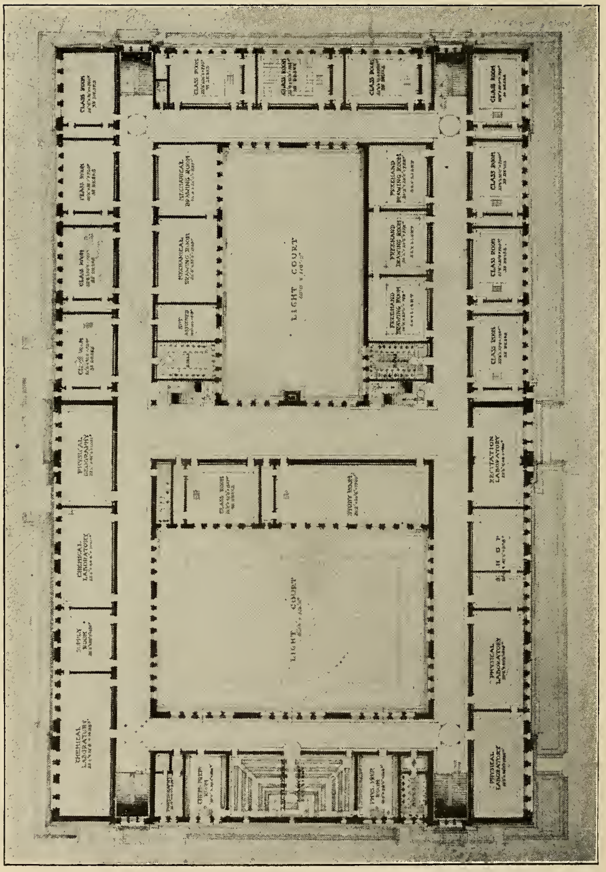
RUTAN & RUSSELL, Architects, Pittsburg, Pa.



FRONT ELEVATION.

PRIZE DESIGN FOR PITTSBURG HIGH SCHOOL.

RUTAN & RUSSELL, Architects, Pittsburg, Pa.

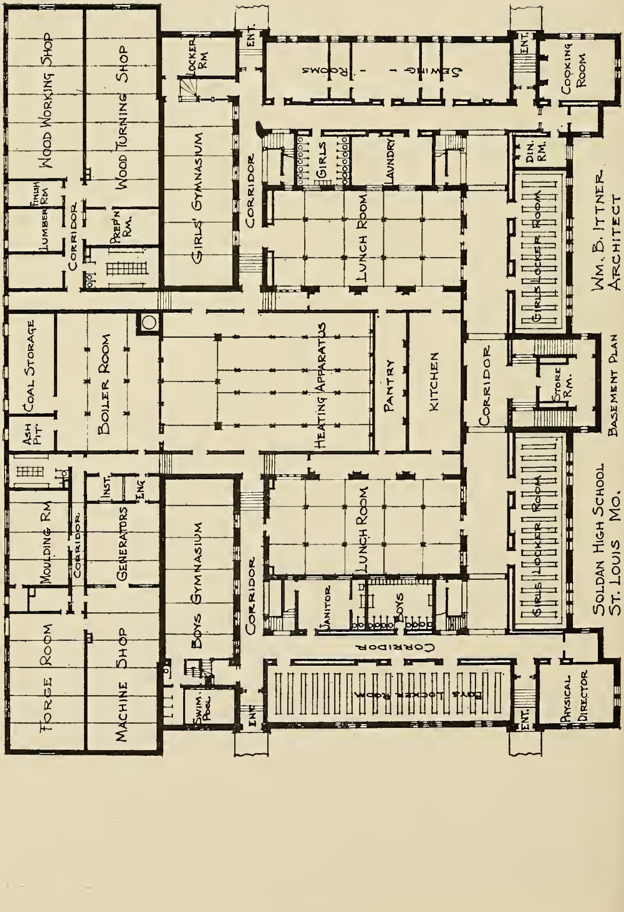


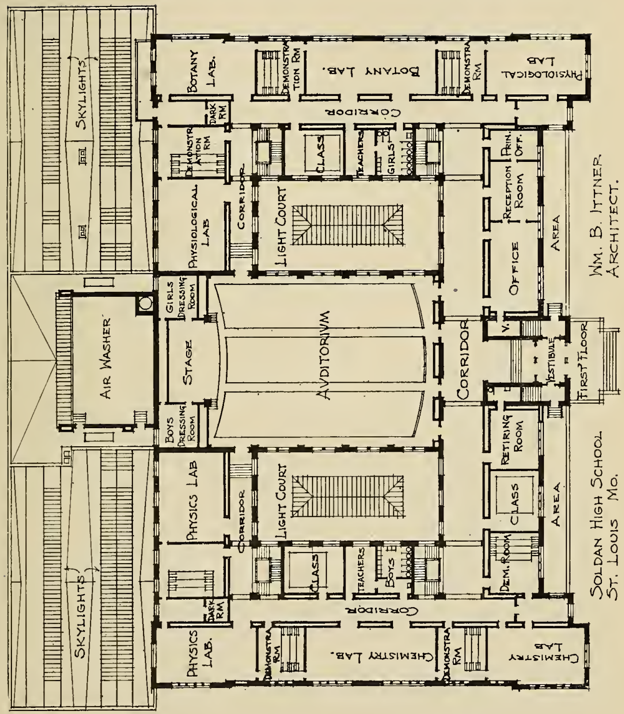
THIRD FLOOR PLAN.

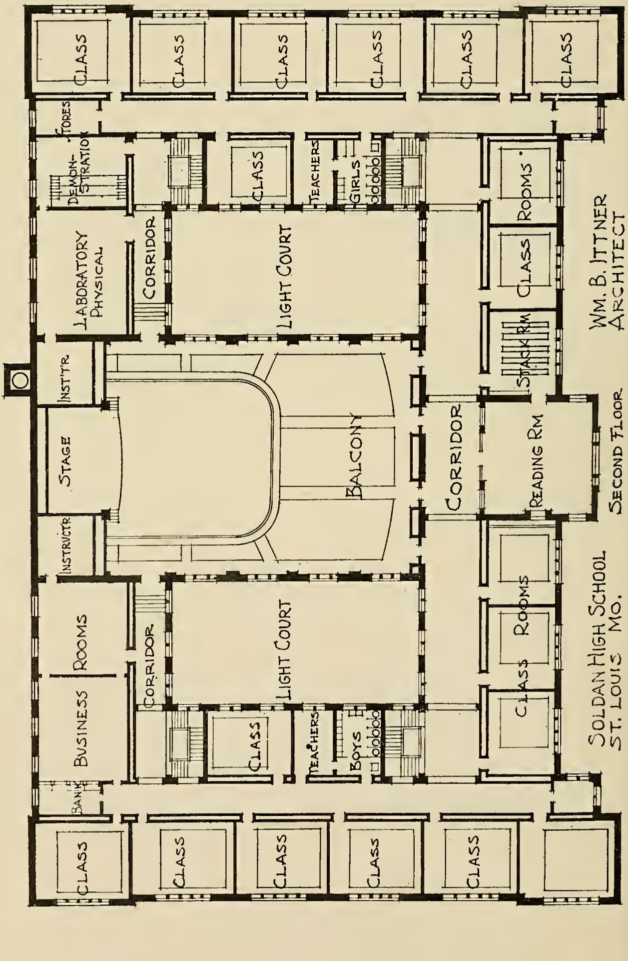
PRIZE DESIGN FOR PITTSBURG HIGH SCHOOL.

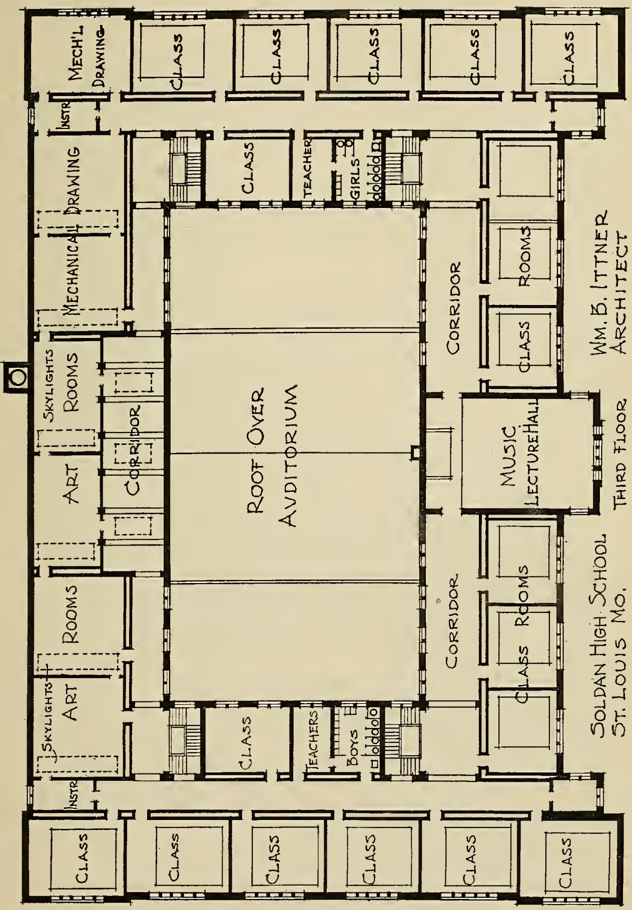
RUTAN & RUSSELL, Architects, Pittsburg, Pa.

SOLDAN HIGH SCHOOL, ST. LOUIS, MO. WM. B. ITTNER, Architect.
A most recent and perfect type of American High School Buildings.


Wood Working Shop
Wood Turning Shop
Finish Rm
Lumber
Corridor
Prep'n Rm.
Girls' Gymnasium
Locker Rm
Ent.
Sewing - - Rooms
Ent.
Cooking Room
Corridor
Girls
Laundry
Lunch Room
Din. Rm.
Girls Locker Room
Wm. B. Ittner Architect
Coal Storage
Ash Pit
Boiler Room
Heating Apparatus
Pantry
Kitchen
Corridor
Store Rm.
Basement Plan
Moulding Rm.
Corridor
Inst.
Eng.
Generators
Boys Gymnasium
Corridor
Lunch Room
Janitor
Boys
Girls Locker Room
Soldan High School
St. Louis Mo.
Forge Room
Machine Shop
Swim. Pool
Ent.
Corridor
Boys Locker Room
Ent.
Physical Director


Skylights
Air Washer
Skylights
Botany Lab.
Dark Rm
Demonstration Rm
Botany Lab.
Demonstra Rm
Physiological Lab
Corridor
Physiological Lab
Corridor
Class
Teachers
Girls
Prin. Off.
Reception Room
Office
Area
Light Court
Girls Dressing Room
Stage
Boys Dressing Room
Auditorium
Corridor
V.
Vestibule
First Floor
Retiring Room
Physics Lab
Corridor
Light Court
Class
Area
Dem. Room
Class
Teachers
Boys
Dark Rm
Corridor
Physics Lab.
Demonstra Rm
Chemistry Lab.
Demonstra Rm
Chemistry Lab
Wm. B. Ittner Architect.
Soldan High School St. Louis Mo.


Soldan High School
St. Louis Mo.
Second Floor
Wm. B. Ittner
Architect
Class
Stores
Demon-stration
Laboratory Physical
Corridor
Inst't'r
Stage
Instructr
Business Rooms
Bank
Light Court
Balcony
Teachers
Girls
Boys
Class Rooms
Stack Rm
Reading Rm


Soldan High School
St. Louis Mo.
Third Floor
Wm. B. Ittner
Architect
Roof Over
Auditorium
Music
Lecture Hall
Corridor
Corridor
Class Rooms
Class Rooms
Mech'l
Drawing
Instr
Mechanical Drawing
Skylights
Rooms
Art
Corridor
Rooms
Skylights
Art
Instr
Class
Teacher
Girls
Class
Teachers
Boys
Class
Class
Class
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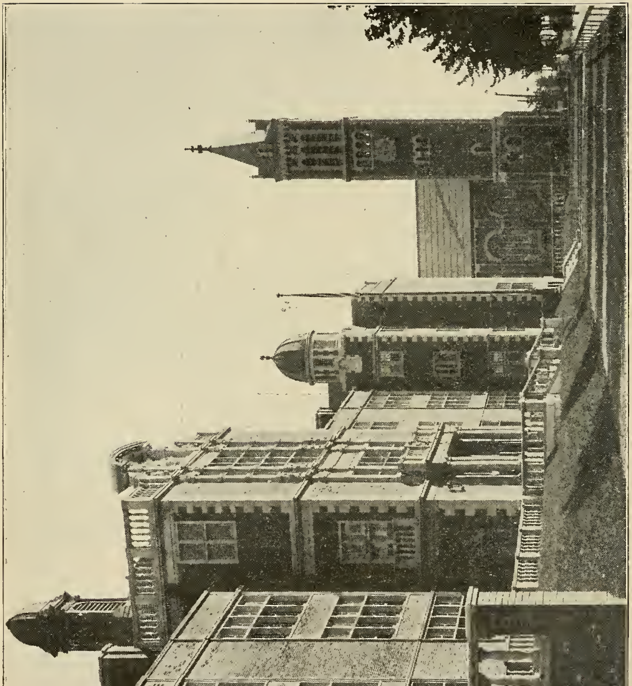
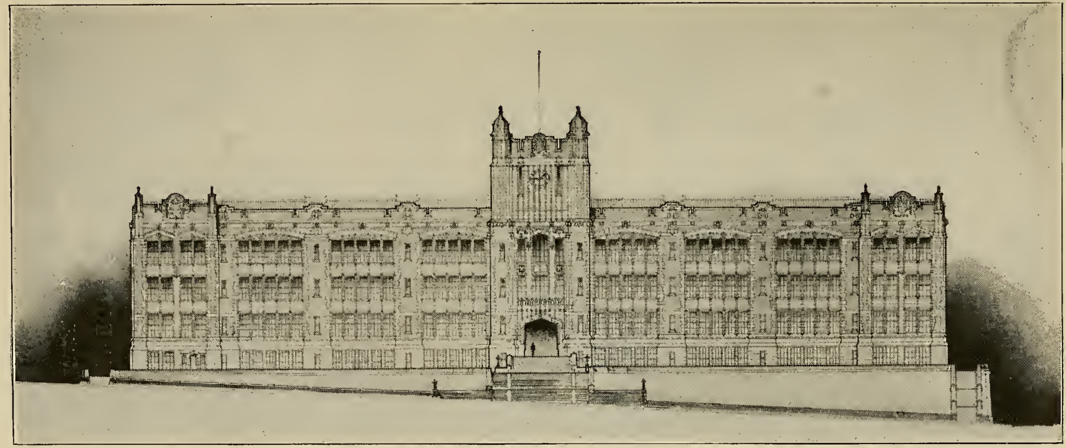
Class



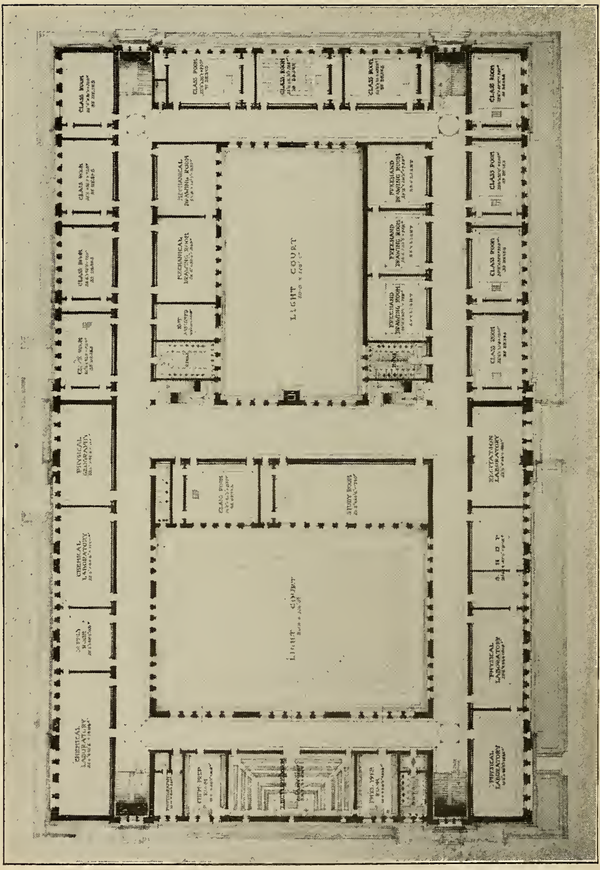
SOLDAN HIGH SCHOOL, ST. LOUIS, MO. WM. B. ITTNER, Architect.



FRONT ELEVATION.

PRIZE DESIGN FOR PITTSBURG HIGH SCHOOL.

RUTAN & RUSSELL, Architects, Pittsburg, Pa.



THIRD FLOOR PLAN.

PRIZE DESIGN FOR PITTSBURG HIGH SCHOOL.

RUTAN & RUSSELL, Architects, Pittsburg, Pa.

SOLDAN HIGH SCHOOL, ST. LOUIS, MO. WM. B. ITTNER, Architect.
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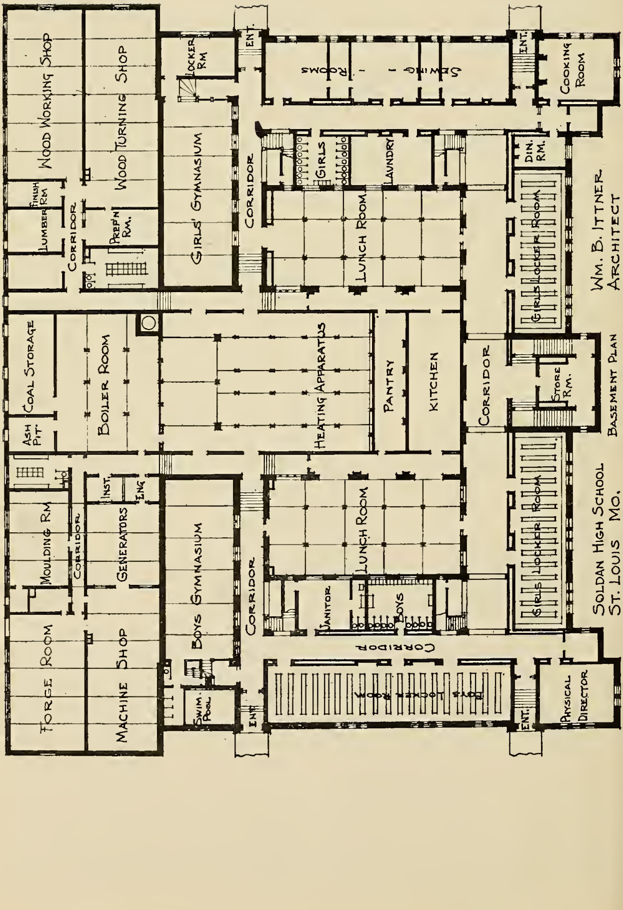
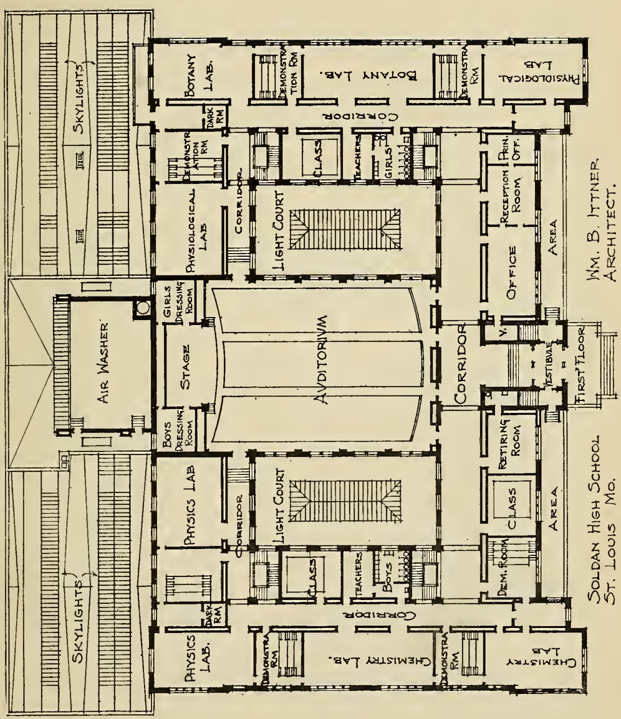
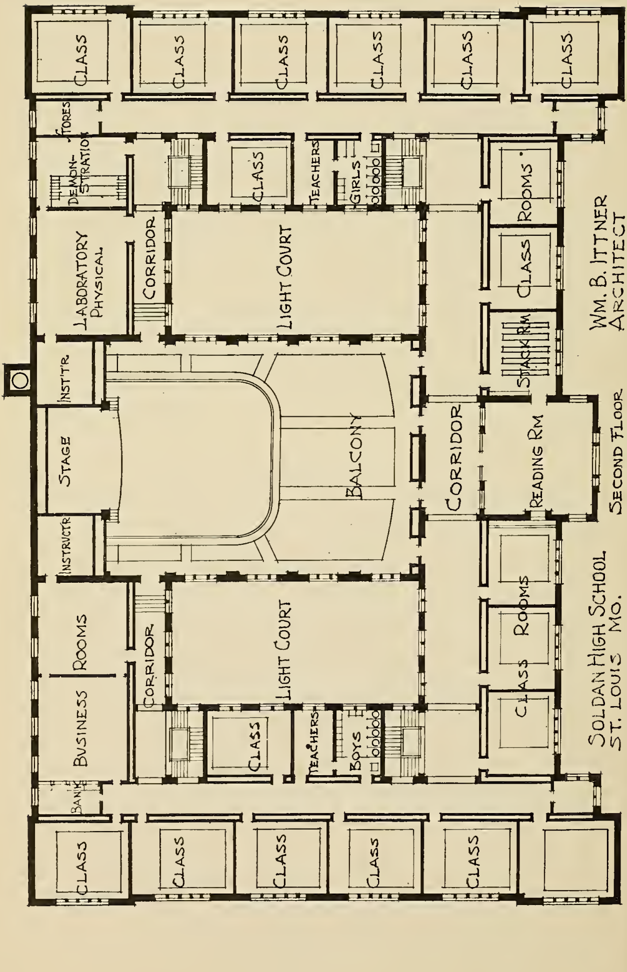
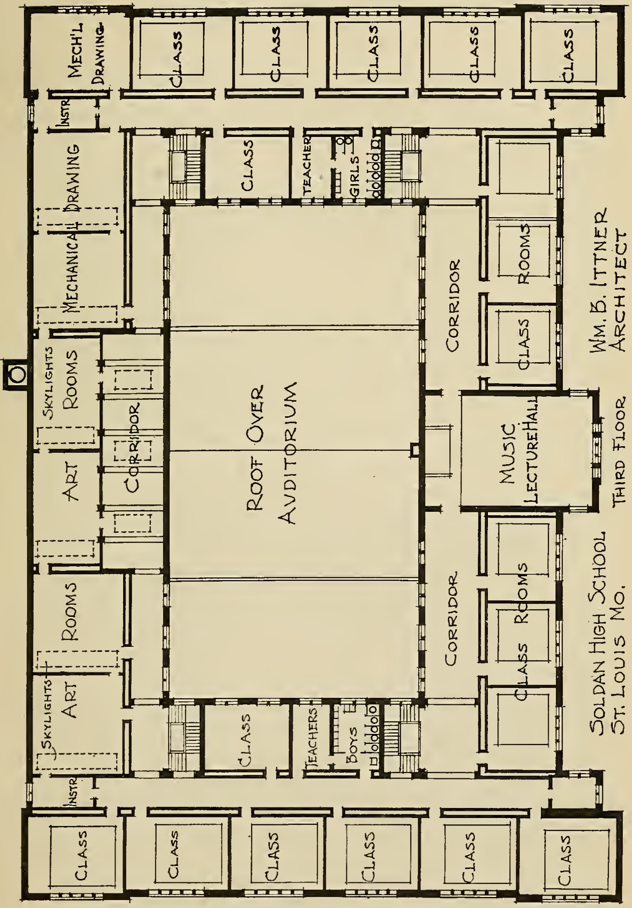
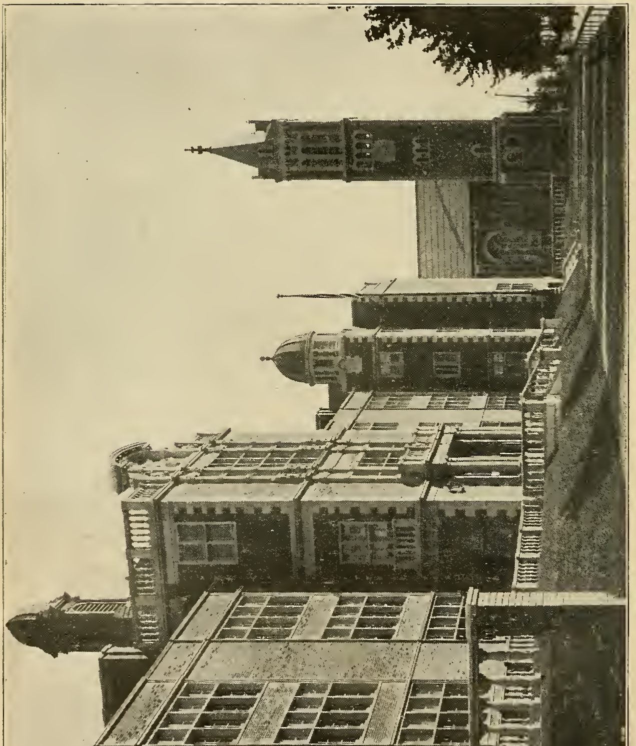

Soldan High School
St. Louis Mo.
Basement Plan
Wm. B. Ittner
Architect
Wood Working Shop
Wood Turning Shop
Finish Rm
Lumber
Corridor
Prep'n Rm.
Locker Rm
Girls' Gymnasium
Corridor
Ent.
Sewing - Rooms
Cooking Room
Girls
Laundry
Din. Rm.
Lunch Room
Girls Locker Room
Coal Storage
Ash Pit
Boiler Room
Heating Apparatus
Pantry
Kitchen
Corridor
Store Rm.
Moulding Rm
Corridor
Generators
Inst.
Eng
Boys Gymnasium
Corridor
Lunch Room
Janitor
Boys
Girls Locker Room
Forge Room
Machine Shop
Swim. Pool
Ent.
Corridor
Boys Locker Room
Physical Director


SOLDAN HIGH SCHOOL
ST. LOUIS MO.
WM. B. ITTNER
ARCHITECT.
FIRST FLOOR
SKYLIGHTS
SKYLIGHTS
AIR WASHER
STAGE
GIRLS DRESSING ROOM
BOYS DRESSING ROOM
AUDITORIUM
CORRIDOR
LIGHT COURT
LIGHT COURT
BOTANY LAB.
BOTANY LAB.
DARK RM
DEMONSTRATION RM
DEMONSTRA TION RM
DEMONSTRA RM
PHYSIOLOGICAL LAB
PHYSIOLOGICAL LAB
CORRIDOR
CLASS
TEACHERS
GIRLS
PRIN. OFF.
RECEPTION ROOM
OFFICE
AREA
V.
VESTIBULE
RETIRING ROOM
CLASS
AREA
DEM. ROOM
PHYSICS LAB
PHYSICS LAB.
DARK RM
CORRIDOR
CLASS
TEACHERS
BOYS
CHEMISTRY LAB.
CHEMISTRY LAB
DEMONSTRA RM



SOLDAN HIGH SCHOOL
ST. LOUIS MO.
SECOND FLOOR
WM. B. ITTNER
ARCHITECT
CLASS
STORES
DEMON-STRATION
LABORATORY PHYSICAL
CORRIDOR
LIGHT COURT
TEACHERS
GIRLS
BOYS
ROOMS
STACK RM
READING RM
BALCONY
STAGE
INST'T'R
INSTRUCT'R
BUSINESS
BANK


Mech'l Drawing
Instr
Mechanical Drawing
Skylights
Art Rooms
Corridor
Art Rooms
Skylights
Instr
Class
Class
Class
Class
Class
Class
Teacher
Girls
Roof Over Auditorium
Teachers
Boys
Corridor
Rooms
Class
Music Lecture Hall
Corridor
Class Rooms
Class Rooms
Soldan High School
St. Louis Mo.
Third Floor
Wm. B. Ittner
Architect



SOLDAN HIGH SCHOOL, ST. LOUIS, MO. WM. B. ITTNER, Architect.

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