MODERN AMERICAN SCHOOL BUILDINGS

WARREN RICHARD BRIGGS

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MODERN AMERICAN SCHOOL BUILDINGS.

BEING

A TREATISE UPON, AND DESIGNS FOR, THE CONSTRUCTION OF SCHOOL BUILDINGS.

BY

WARREN RICHARD BRIGGS, F.A.I.A.

With 89 full-page Illustrations.

FIRST EDITION.

FIRST THOUSAND.

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1899.

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AS A SLIGHT TRIBUTE TO MY WIFE,

Lizzie Beach-Briggs,

AT ALL TIMES A LOVING HELPMATE,
THOUGHTFUL ADVISER, AND
CLEVER AMANUENSIS,

THIS WORK

IS AFFECTIONATELY DEDICATED.

PREFACE.

THE preparation of this work has been fragmentary in the extreme; the several subjects have been treated at intervals, usually wide apart, extending over a period of twenty years; they have, as a rule, been taken up at moments when the machinery of the office was practically at a standstill, or when some special problem or incident had brought forcibly to my mind the need of radical reforms.

The first twelve chapters are here presented for the first time; Chapters XIII and XIV were papers prepared for State Board of Health reports. Chapter XV is composed of the series of papers originally written for *Architecture and Building;* and the last chapter has recently been compiled to complete this series. The illustrations and designs, with some minor exceptions, are entirely new. Their collection and arrangement in book form was suggested by the constant demand for those that had been published, which could not be supplied.

The State Board of Health reports were limited editions, long since exhausted; and, while there are undoubtedly many volumes of *Architecture and Building* containing that series of articles in existence, they are, as a rule, to be found only in the libraries of architects and are not accessible either to the public or those who may be especially interested in school buildings. Under these conditions it was deemed advisable to edit in book form not only those that had already appeared, but such other matter as might be pertinent to the subject, with a hope that the interest taken in the original articles may be intensified and increased.

If the perusal of the pages of this book will tend to improve this most important branch of American architecture and result ultimately in better buildings for our children to pursue their studies in, my efforts in their behalf will not have been in vain.

BRIDGEPORT, CONN., 1899.

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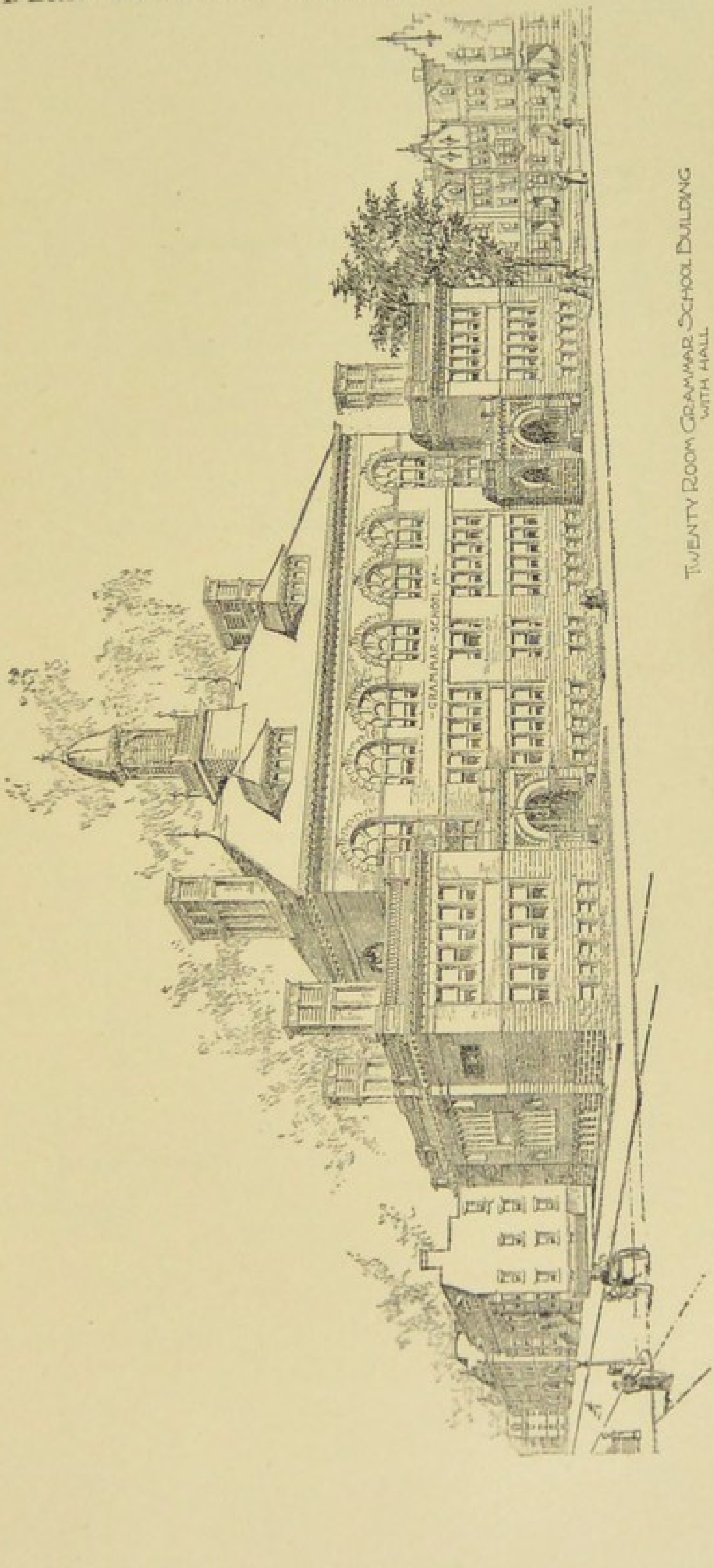
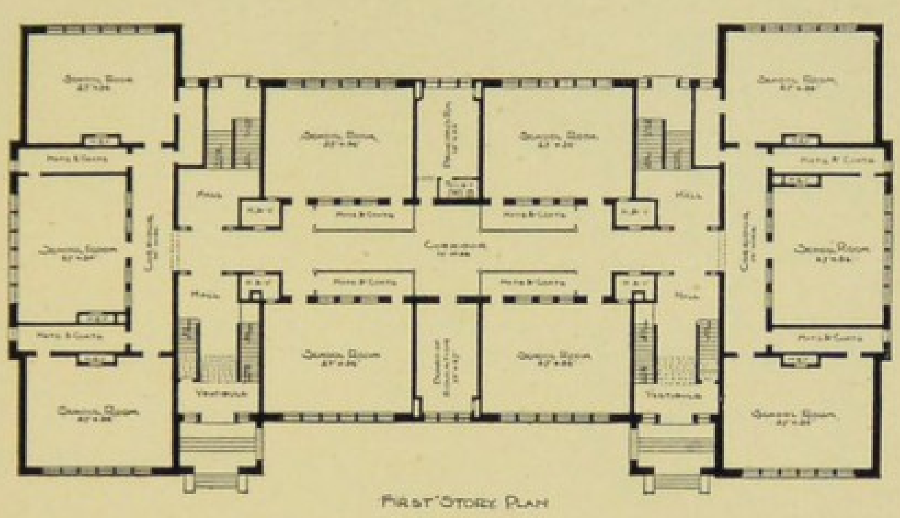


TWENTY ROOM GRAMMAR SCHOOL BUILDING WITH HALL

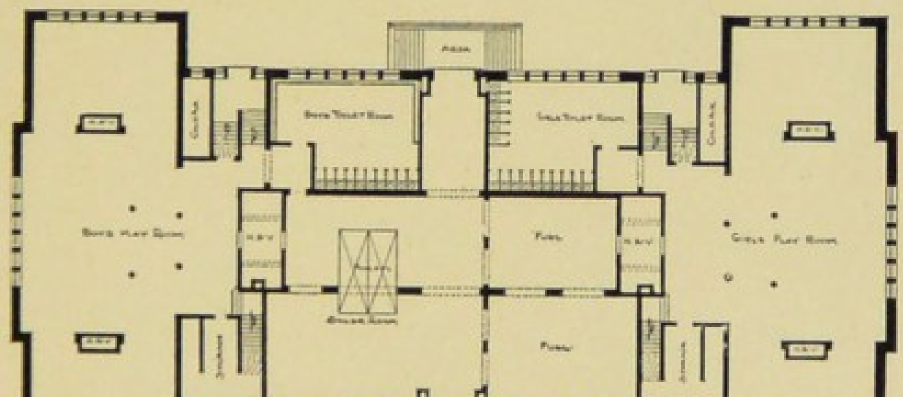
PLATE I

PLATE 2.



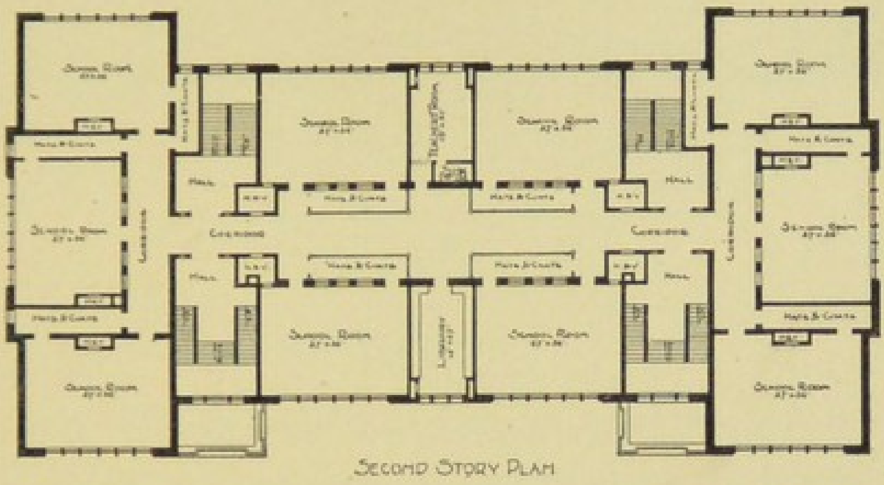
FIRST STORY PLAN

TWENTY-ROOM GRAMMAR SCHOOL BUILDING, WITH HALL



BASEMENT PLAN

PLATE 3.



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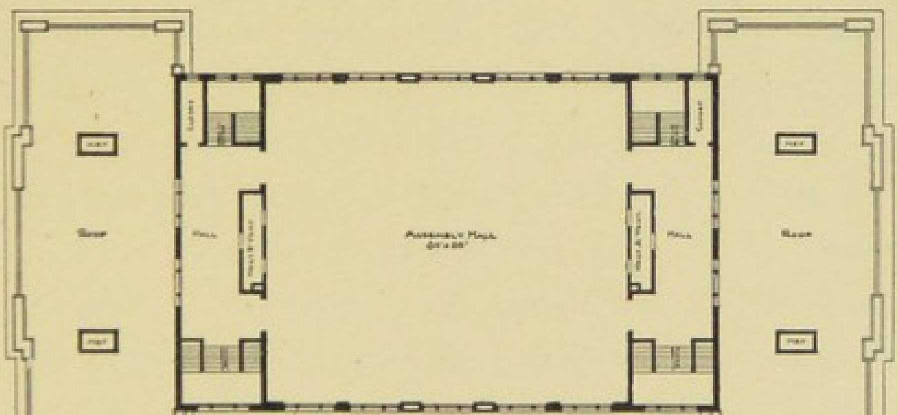
WITH HALL



THIRD STORY PLAN

MODERN AMERICAN SCHOOL BUILDINGS.

CHAPTER I.

IN GENERAL.

It has been said that more money is expended each year in the United States in the construction and maintenance of public-school buildings than is used for a like purpose in all the other countries of the world combined. While this appears to be an exceedingly broad statement, still it may not be an exaggeration, especially when our vast size and wonderful increase in population during the past decade are taken into consideration; for it can be affirmed with assurance that no community of this great nation, be it ever so humble, will long remain without a structure of some kind within which its children can receive at least the rudiments of an education. It is also undisputed that in the West, our greatest field of development, the first substantial public structure evolved from the chaotic mining-camp or land-"boomer's" settlement is the schoolhouse, which thus becomes the pioneer of enlightenment, progress, and knowledge. It is likewise true that these indisputable facts are more noticeable in our own than in any other country, for, however ignorant, lawless, or depraved the native American parents may be, there is found in them, as a rule, an inborn desire not only to improve the condition of their children, but to have them receive wholesome training. This tendency becomes stronger as the ratio of intelligence and prosperity increases, it being recognized intuitively that the surest safeguard that any nation can have is knowledge, and that the best way that it can be imparted to the masses is by the public education of their children.

That the public system of education has been carried in our country during the last half-century to a degree of perfection heretofore unknown to any country of the world no one will deny; and that to-day the United States is far in advance of all other nations in this respect will also be admitted.

Can it be said, however, with equal assurance that our school buildings have kept pace with our educational systems? In other words, are they as complete in their design and construction as the educational system is in its plan and equipment? This question propounded to the average citizen will be answered without hesitancy in the affirmative, and to emphasize he will point with pride to the numerous school buildings of more or less architectural merit to be found in his immediate locality. He assumes that because the building cost a certain amount of money and is pretentious, at least in outward appearance, it possesses all the essential qualifications of a good school structure. In these assumptions he is perfectly sincere and impartial, and, so far as his knowledge extends, has given an honest opinion. Perhaps nothing more should be expected, for the difference between that which is good and bad is often so inconspicuous as to be visible only to the trained eye; yet when the difference is once understood it becomes ever after painfully apparent and obnoxious. It may therefore be in the nature of a blessing that the old adage, "Where ignorance is bliss 'tis folly to be wise," is so directly applicable to the great mass of public opinions expressed in regard to modern school buildings.

But leaving all consideration of the exterior architectural merit of the modern school building—going back, in fact, to the fundamental principle, which is *the uses for which the building is intended*—and remembering that the building is to *live* and *work in*, not to *look at*, how then will it stand searching investigation ? The competent critic—and I claim that the average citizen, however much of an oracle he may be, is not in this class—will tell you that, judged by established and well-known (to the initiated) standards of construction and hygienic excellence, not one old building in fifty, nor new building in ten, comes anywhere near fulfilling the requirements.

That earnest efforts have frequently been made to correct existing evils and prevent their being repeated is true, and that there is an abundance of statistics and data at hand which if it were understandingly used would overcome many, if no tall, of the glaring faults so frequently encountered, is also undisputed; but in spite of this and in the face of the teachings of such men as Cohn, Lincoln, Billings, and Windsor, school buildings are constantly being erected all over this broad land of ours that are full of errors in planning, construction, lighting, heating, and ventilation. If you think this is a wild statement, let me refer you to a paper written by Dr. A. G. Young, Secretary of the Maine state Board of Health, published in its Seventh Annual

Report for the year 1891. He says: "Two years later, or during the fall and winter of 1887–88, the Secretary of this Board personally visited and inspected eighty-four school buildings in twenty-three of the cities and larger villages of the State. The object was to examine a large enough number of the schoolhouses in different parts of the State, so that the results might be considered as fairly representative of the schoolhouses of the State generally, with a like location in cities and villages. The time spent upon each school building ranged from a few minutes, for a hasty survey, to half a day, or a whole day, diligently spent in examining, measuring, and testing, and in making notes. The results were published in full in the Third Annual Report of the Board. The eighty-four buildings examined varied in size from one-room schoolhouses to twelve- and even twenty-four-room buildings, and they contained an aggregate of 284 rooms, excluding recitation-rooms.

"As regards the lighting and ventilation of these rooms the following shows the conditions found:

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

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

"While the window-surface of schoolrooms should be at least one fifth as great as the floor-surface, the ratio actually found was often only one eighth, one tenth, one twelfth, or even in a few cases one sixteenth or one seventeenth,—degrees of lighting so insufficient that they cannot fail to be injurious to the eyes of the scholars.

"A very serious fault found in some schoolhouses was the location of some of the windows directly before the eyes of the scholars as they sat at their studies. Even in one twenty-thousand-dollar schoolhouse, passing as an architecturally fine building, there were found six large windows with a western outlook directly in front of the scholars. The effects upon the eyes of the pupils had been so disastrous that the school officers were seeking to obviate the difficulty, and they have done so in part by a new arrangement of the seats.

"As regards the ventilation, the best results were found in the main room of the Cony high-school building at Augusta. Determined by Wolpert's air-tester, there were found only $8\frac{3}{10}$ parts of carbonic acid in 10,000 parts of air. In this room a large part of the scholars are absent from their seats most of the time in the three recitation-rooms. On the other hand, in many other schoolrooms 12, 14, 16, 18, and 20 parts in 10,000 parts of air were found. In one city high school 29 parts of carbonic acid were found; in another city high school 22 parts; in one fine new building, reached just as the school was dismissed at noon, 18 and 20 parts of carbonic acid respectively were found in two of the rooms one hour after the scholars had left the building, the doors and windows being closed, but the ventilating arrangement in operation meanwhile. In some of the rooms no artificial methods of air-testing were needed, for upon entering them the close, stuffy, and disagreeable smell of polluted air was very unpleasantly perceptible to the sense of smell."

In this connection it will be well to quote: "An exceptionally valuable statement is made by the engineer of the Walker building, of the Massachusetts Institute of Technology, relative to certain atmospheric determinations in the various rooms of that building during the last nine years, as made and recorded four times daily. According to these data the outer air surrounding the institute shows an ordinary proportion of from 3.7 to 4.2 parts of carbonic acid in 10,000 parts of air. In the empty rooms the air shows a rise of carbonic acid of about 0.5 part, due to decomposition of the organic matter present in the flues, the floors, and the walls. The air of the building in general, of the halls, reading-rooms, etc., which are open and in which people are constantly moving about, is, it appears, maintained at about 5 parts as an average of all tests for eight years. The air of most of the lecture-rooms has contained from 6 to 8 parts, rising to 10 or 12 parts for the large and more crowded rooms, according to the state of the weather outside. From this state of things it is argued that students are capable of working well in a clean room with about 7 parts in 10,000 of carbonic acid. It is well added that a greater degree or amount than that is sufficient to cause dulness, and anything in excess of 13 parts is declared to be an almost insuperable obstacle to the full acquisition of knowledge by the classes." It will be readily seen from this that the pupils even in the best heated and ventilated schoolrooms found in the State of Maine were pursuing their studies in an impure atmosphere, and that the great majority were confined in rooms that must have been highly injurious to their health.

The sanitary conditions were found to be equally bad, and, if necessary, I could quote from numerous other reliable sources to show the correctness of my premises. It is reasonable to assume that the public-school buildings of the State of Maine are a fair sample of the buildings devoted to similar purposes in the surrounding States; accepting this assumption, then surely the statements that I have previously made are in no way an exaggeration. Perhaps it will be claimed that better results in heating and ventilation than those obtained in the main room in the Augusta building are impossible without the use of an elaborate mechanical apparatus. In reply to this it is only necessary to say that I know of schoolrooms, tested as long ago as 1883, in a twenty-room structure where the following results were obtained:

Room No. 8. . . . . 55 pupils.

Air at ingress contained 1.25 parts of carbonic acid in 10,000 parts of air.

Air at breathing-point contained 1.256 parts of carbonic acid in 10,000 parts of air.

Air at exit contained 2.948 parts of carbonic acid in 10,000 parts of air.

The tests of the air of the room (which was selected at random) were conducted by an experienced analytical chemist at the request of a certain Board of Education which was at that time deeply interested in the heating and ventilating of school buildings. The method of heating employed was indirect steam, and the apparatus entirely automatic and comparatively inexpensive to construct and to maintain.

If such results have been obtained in one building, they certainly can be duplicated in another with more or less modifications, and there is absolutely no excuse for the existence of such schoolrooms as, according to Dr. Young's paper, comprise the great majority in the State of Maine.

It will be naturally asked why, when the results like those just cited are obtainable, they are not always insisted upon and the standard of excellence raised in every department of schoolhouse construction to the highest obtainable point.

The answers to this and pertinent questions are many and far-reaching, and it is my purpose in this work to point out some of them and suggest practical remedies. I shall consider, first, the methods usually employed to secure the necessary funds for the school building; second, the popular way of selecting the architect (incidentally discussing this phase of the question from several points of view); and finally, describing and illustrating faults of planning, construction, lighting, sanitation, heating, and ventilation that are commonly encountered.

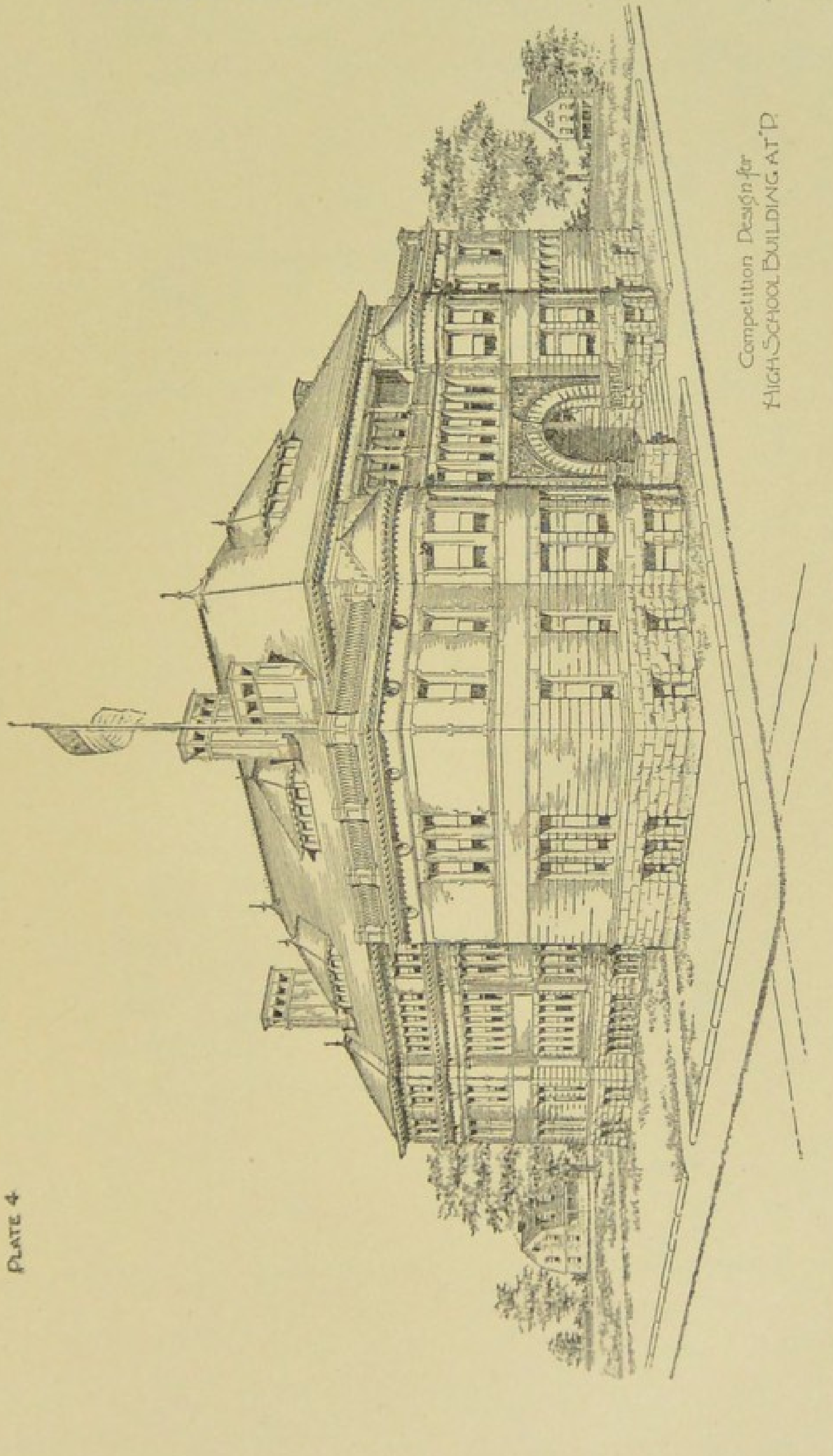


PLATE 4

Competition Design for
HIGH SCHOOL BUILDING AT P.

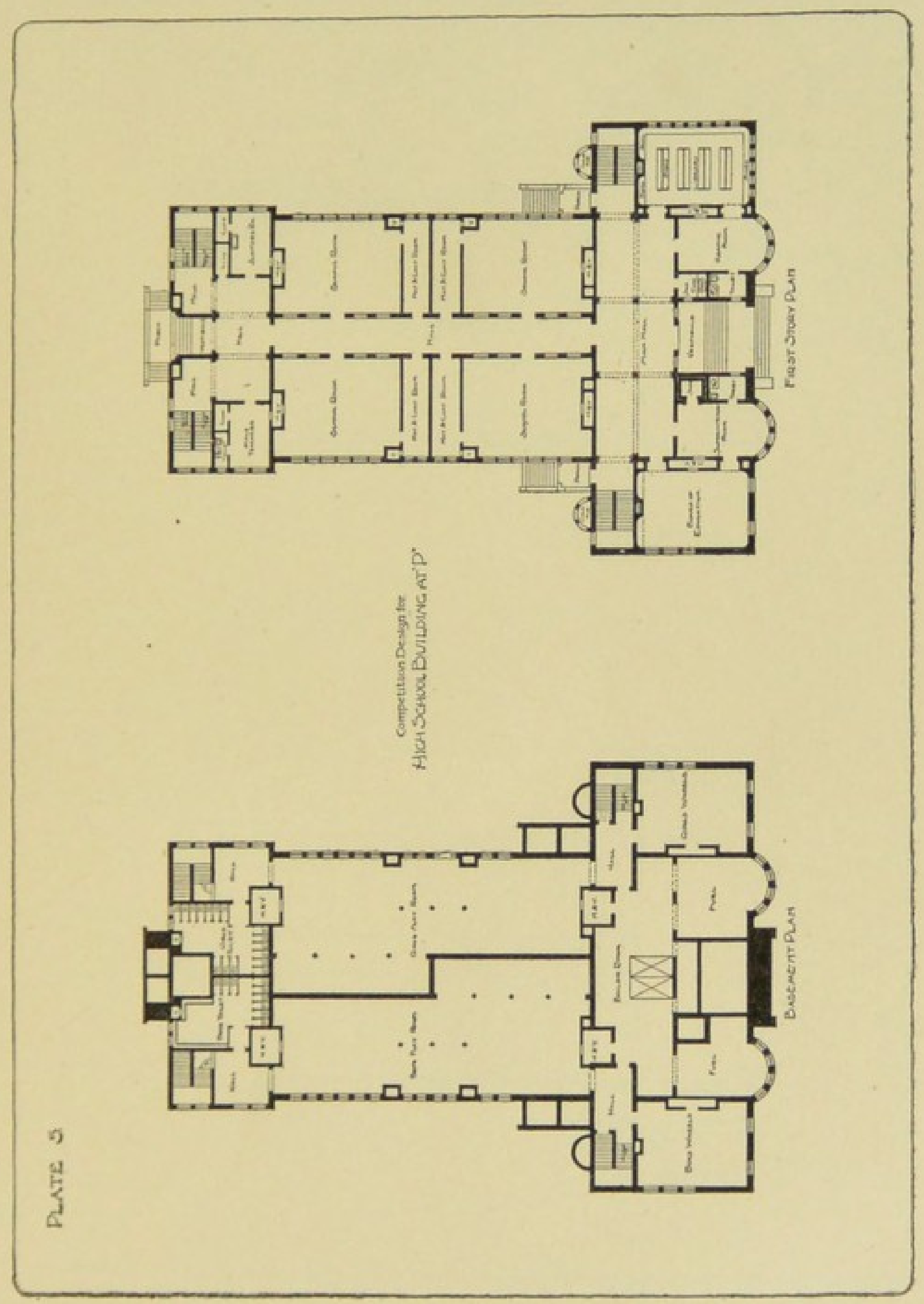


Plate 5
Competition Design for
HIGH SCHOOL BUILDING AT "P"
First Story Plan
Basement Plan

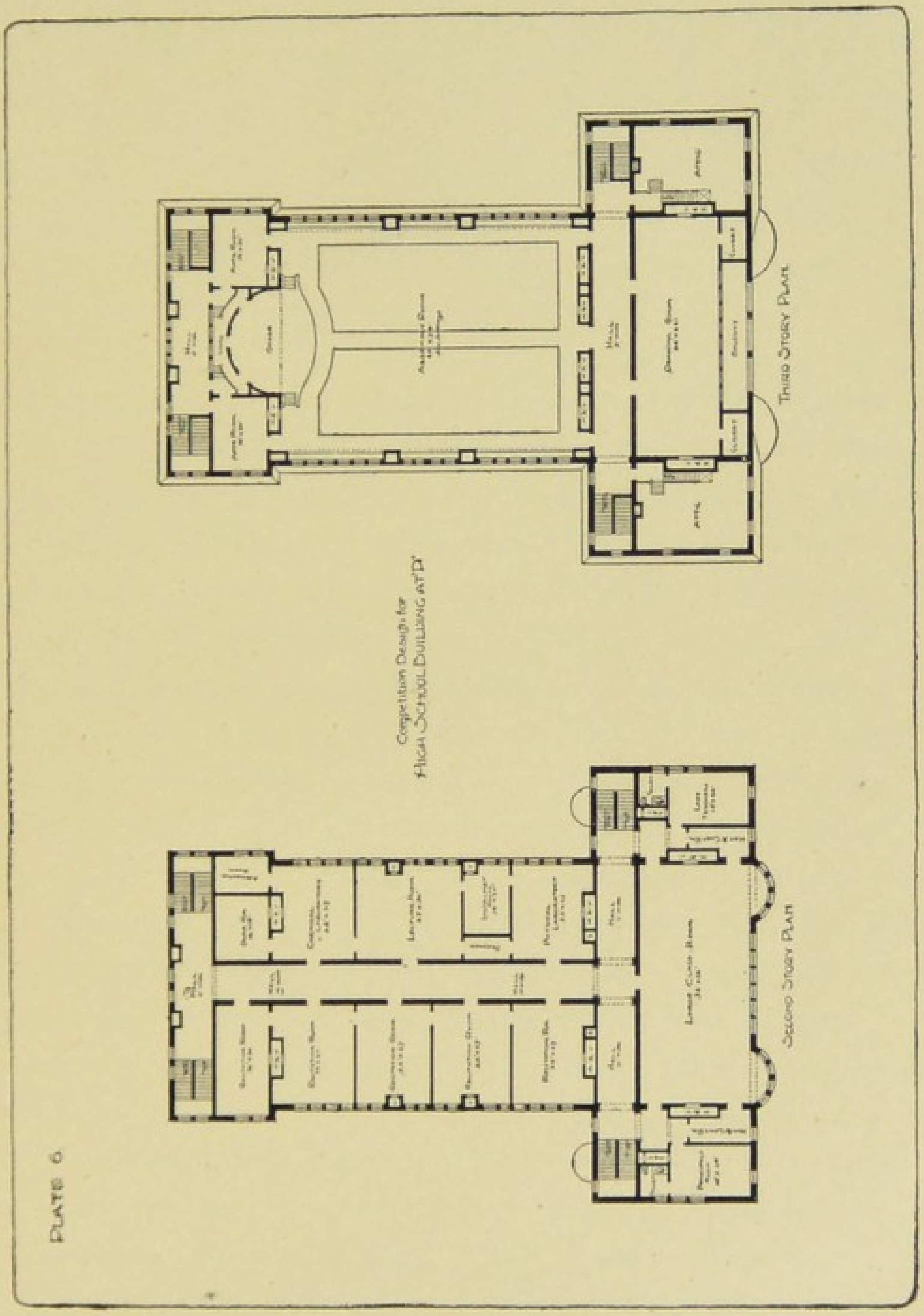


Plate 6
Competition Design for
HIGH SCHOOL BUILDING AT "D"
Third Story Plan
Second Story Plan

CHAPTER II.

APPROPRIATIONS.

ONE of the primary causes of unsatisfactory buildings is the lack of sufficient funds to properly erect and fully equip structures of the required size. It is safe to say that in the great majority of cases the attempt is made to build a building of a certain size for an amount of money totally inadequate. This fault does not, as a rule, lie with the local Board of Education or building committee that may have the matter directly in charge, but primarily with the town or city meeting where the appropriation for the proposed structure has been made. The usual course pursued is something as follows: It has been decided, after considerable agitation, that a certain small city is in need of a new high-school building, and a public meeting is called for the purpose of appointing a committee and to appropriate the necessary funds. No very definite ideas of the size of the building or the accommodations that it must necessarily contain have been formulated, and it is more than probable that a site has not been selected. A few who are directly connected or interested in the school have rather a vague idea that a certain number of pupils must be provided for, and that any one of half a dozen sites that may be suggested will be acceptable. Beyond this there is absolutely no data to guide the meeting either in selecting the site or in determining the amount of money necessary to erect a building suitable to the future needs of the city. The meeting is called to order, its object and purpose stated, and a committee composed of good representative men, in whom the community will place the utmost confidence, is quickly selected.

It is now moved by some level-headed business man that an appropriation of one hundred thousand dollars be made for the purpose of purchasing a site and erecting thereon a building suitable for the use of the high school. A motion of this kind, while strictly legitimate and based upon the soundest business principles, almost invariably precipitates discussion and creates an unreasonable and unwarranted opposition that is both unfortunate and disastrous. A golden opportunity is afforded the local oracle, who usually poses as a reformer and loves to denounce in unmeasured terms any scheme of improvement that may require the use of the city's money. Men of this class are not, as a rule, taxpayers, but they are still very much in evidence and by glib talk and noisy bluster succeed in stirring up so much opposition to the original motion that it is lost and a motion appropriating fifty thousand dollars is substituted and passed. The champions of economy are jubilant; they have won a signal victory, and the people's treasury will not be depleted!

Let us see, however, before passing judgment, what the ultimate result of the action of the meeting will be. The committee goes to work conscientiously and purchases for twenty thousand dollars a site that is satisfactory to the majority. Then with the superintendent of schools and perhaps the principal it visits existing structures in neighboring cities and, after many meetings and much labor, formulates a program of the requirements of the school as they understand them. This is submitted to local, and in some cases to outside, architects with an invitation to present designs for the proposed building in competition,—it being expressly stipulated that the completed structure, including the necessary furniture, shall not exceed in cost the sum of thirty thousand dollars.

What an absurdity such a program is and how unreasonable it is to expect any architect to live up to its provisions! The committee when it issued the program, and the architects when they received it, knew—if they knew anything—that it would be absolutely impossible to erect and equip the simplest kind of a building, containing rooms of the number and size required, for the price so arbitrarily stipulated. The committee, however, should not be severely censured, as it has only carried out its instructions to the best of its ability. In fact it could pursue no other course, for at the outset the action of the meeting prescribed its duties and practically tied its hands.

The invited architects, on the other hand, are in no way bound to accept the invitation, and a few conscientious men will probably decline, and frankly state their reasons for so doing. But will the majority enter a protest, or go to the committee in a body and say: "Gentlemen, it is simply impossible for us to prepare designs for your new building, according to the program which you have sent us, that will come anywhere near the price that you name"? As a rule, a very different course is pursued: the competitors proceed to get up the best-looking design that they are capable of producing, paying little or no attention to the cost, and at the same time institute as complete a system of social and political wire-pulling for the design that they are to present as lies in their power.

The designs are sent in, the committee is besieged by the competitors and their friends, and, after more or less deliberation and without obtaining professional counsel or advice, they, with their profound knowledge of architectural merit, select one of the designs, and the successful competitor is instructed to prepare working drawings and specifications and obtain estimates for the erection of the building. When this has been done it is found that the lowest reliable figure amounts to more than twice the sum at the disposal of the committee. A consultation between the committee and the architect follows, which results in the latter's receiving instructions to revise his design and cut it down to the lowest limit consistent with the requirements and sound construction. This after some delay is accomplished, but still the price of the building, fully equipped, is far in excess of thirty thousand dollars, and so the matter hangs fire, the committee being criticised for not attending to its duties, while the people are clamoring that the work upon the new building shall be commenced. At last the committee is reluctantly forced to call another town-meeting to secure, if possible, an additional appropriation. This meeting is far from harmonious, much ill feeling being manifested on all sides. The committee is condemned for selecting so expensive a design, and the architect still more for presenting a design which he must have known could not be erected for the amount specified. Other competitors, or their friends, contend that their designs could be executed much more cheaply; collusion and fraud, if not openly charged, are strongly hinted, a protracted and heated controversy ensues which is generally ended by the granting of a small additional amount—far too little to erect even the modified design or any building suited to the school's requirements.

The committee again consult the architect, towards whom, by this time, they have not the kindliest feelings, or much confidence in any statements he may make. The plans are again revised, rooms are reduced far below the standard size, halls are contracted, staircases narrowed, ceilings lowered, windows omitted, walls and piers lightened to very near the danger limit, and this or that left out, until finally figures are obtained within the specified limit and the building is erected. But is this the structure that the original program called for, or is it what the committee desired, the school required, and the people expected? Certainly not. The pruning process to which the design has been subjected has eliminated not only whatever artistic merit it may have originally possessed, but that which is still more vital to the successful working of the school and the health and comfort of its occupants—those elements of scientific and hygienic construction that were incorporated in it. The building stands completed, a monument of municipal blundering—a reflection on all those who have had to do with it, and an ignoble example of the pernicious results of the methods usually employed in obtaining an appropriation.

Where now is the triumph of the local reformers, and where is the economy that was so loudly heralded? The building is condemned on all sides, and the very men who defeated the original motion are the most outspoken in their condemnation. Do you think that I have overdrawn the picture in my statement of the ordinary methods of procedure, or mutilated facts in regard to the results obtained?

If you do, investigate a little and you will find scores of examples that will prove the correctness of my statements. Better still, ask some of the gentlemen who may have had the misfortune to serve on such a committee, and I am sure that they will answer that not one half of the obstacles and trials they were called upon to face and surmount have been named. Is it any wonder that buildings constructed under such a system as this, whose functions seem to hamper and impede from the start, when weighed in the scale of true excellence are found wanting? It cannot be otherwise, and there must be a radical change in the way appropriations are made before there can be any marked improvement.

The remedies for the evils depicted are so simple and effective that it seems almost incredible that they are not better known and universally adopted.

In the first place, appoint your committee at a meeting convened for this purpose, instruct it, if you will, to purchase a suitable site, and give it full power to select an architect and obtain the necessary plans and estimates for the proposed building, and *stop right there;* say nothing about the amount to be expended. Do not hamper the committee in any way, but let it find out what the requirements of the school are and what kind of a building is best suited to them and the site. Let the committee choose as its architect one who has had wide experience in the planning and construction of school buildings, a man in whom the utmost confidence can be placed as to his ability and integrity—there are such men and their services can be obtained. Above all, let no local pride nor personal friendship influence the committee in this selection; let it remember that this is not a personal but a public matter, to be governed accordingly.

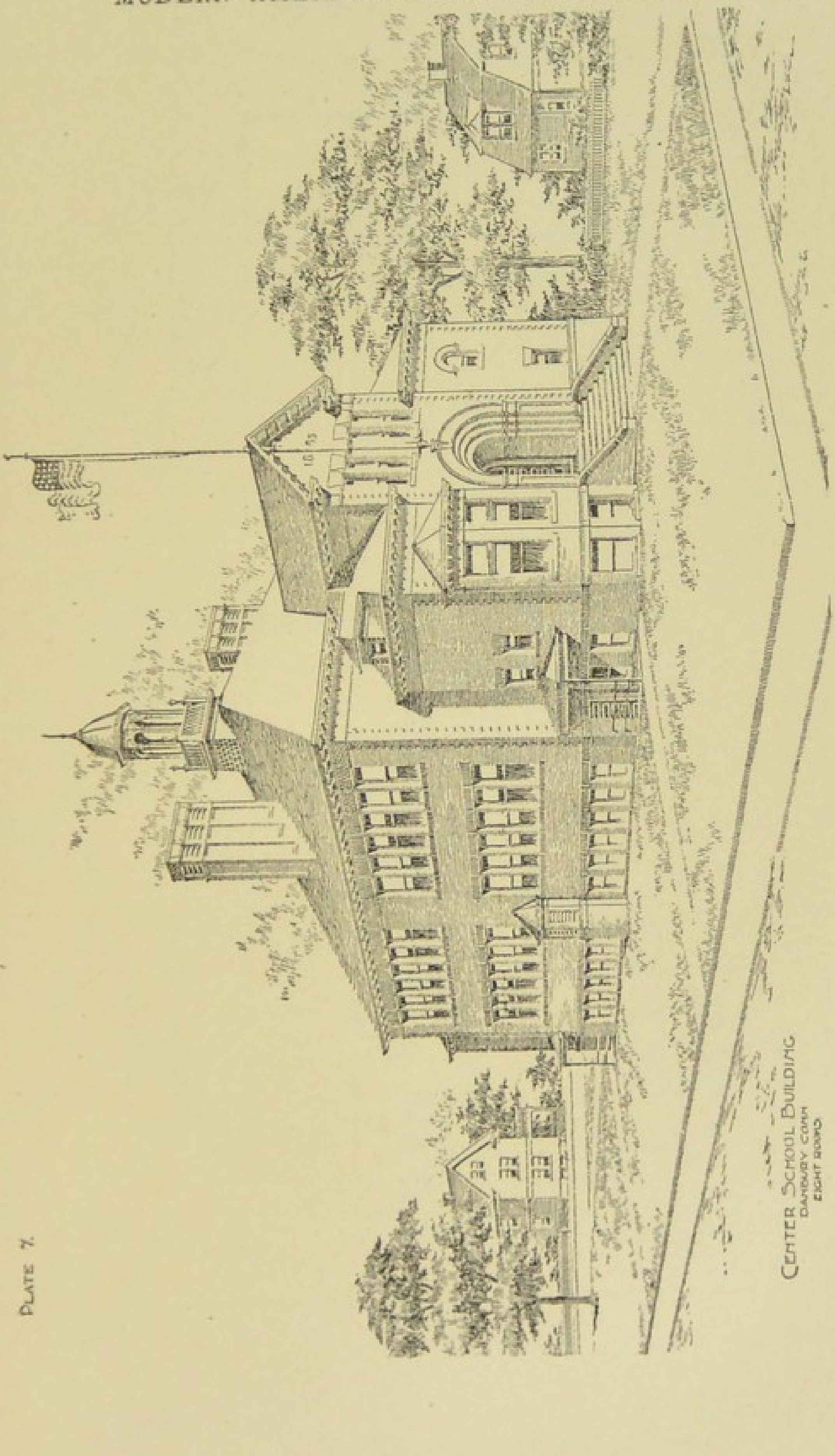
When the architect has been engaged let him meet with the committee, the superintendent and principal of the school, and thoroughly discuss the requirements of the new building. You will find his suggestions and advice of incalculable value to all. When he has obtained their ideas, let him prepare his preliminary sketches. When he has finished these, carefully study and thoroughly discuss them with him, and when they have been revised and made satisfactory to all, let him prepare his working plans and specifications and obtain reliable estimates for what the building can be constructed.

When the figures are obtained and you *know* just what amount is needed to purchase the selected site and erect a building perfectly equipped, which will in every way meet the requirements of the school, *then, and not before,* call a meeting and boldly ask for an appropriation large enough to cover the total expense to be incurred. This is simply a proposition based on true business principles, and nine times out of ten, when this course is pursued and the matter put properly before the meeting by representative men who, by the experience they already have had, are well qualified to speak intelligently on the matter and answer effectively any arguments or opposition that may be promulgated by the "reform" element, the amount asked for will be granted with little or no opposition.

The structure can then be commenced without delay, the work pushed rapidly to completion, and when finished the building will be perfectly adapted to the school's requirements, a credit to all those directly connected with it, and a source of pride to the community in which it stands.

Should it happen to be the tenth time and the meeting refuse, for some reason, to grant the amount asked for, or cut it down, then let the committee resign in a body and wash its hands of the whole affair. Let others, if they choose, adopt the methods first mentioned and obtain the results there faithfully described. But if you want good and improved buildings, erected upon the best known and most scientific principles,—in which your children can improve their minds without injuring their health,—stand for the right principles, and by so doing obtain the respect and lasting gratitude of your fellow men.

PLATE 7.



CENTER SCHOOL BUILDING
DANBURY CONN
EIGHT ROOMS

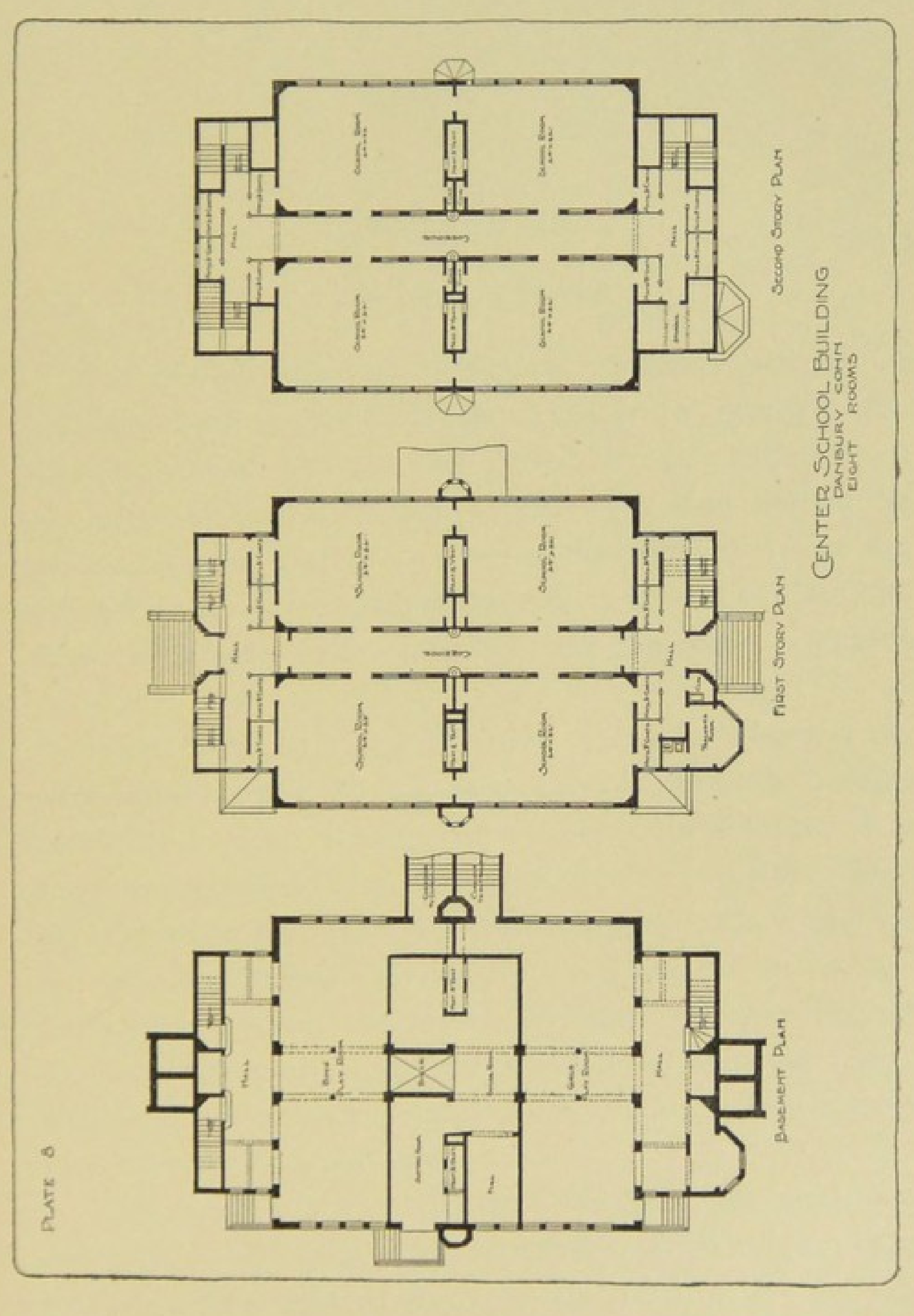


Plate 8
Center School Building
Danbury Conn
Eight Rooms
Second Story Plan
First Story Plan
Basement Plan

CHAPTER III.

COMPETITIONS.

THE almost universal method of obtaining designs for schools or other public buildings cannot be too strongly condemned. I refer to the unrestricted or open competition. No surer way can be devised to prevent the first men of the profession from submitting designs than this; therefore the primary object of the competition, which is to obtain the best talent, is defeated at the very outset by the course ordinarily pursued.

When it has been determined to erect a building it is not unusual to insert in the local papers an advertisement inviting architects to submit competitive designs for a structure of more or less importance. It is stated that the edifice shall not exceed in cost a certain sum, and that further information may be obtained upon application to the chairman of the building committee. No fixed compensation is offered to the successful competitor, nor are they assured that the designs handed in will be judged intelligently according to the architectural merit they may possess.

For a fifty-thousand-dollar building the munificent sum of two hundred dollars will be paid for the design that is placed first, it being stipulated that upon its selection and the payment of the prize to its author it shall become the property of the city, and it is not agreed that the successful architect will even be employed to execute the work. It would seem that conditions of this kind would prevent any sane man from competing; for, in the first place, he has no reason to believe that his design, however meritorious it may be, will even be understood—much less appreciated and judged intelligently; and, in the second, if it should be placed first, and he should receive the paltry premium, what claim has he against the city? Absolutely none, for it is proposed, and he in competing accepted, certain conditions which, having been fulfilled by the payment of the prize, leave him without redress, and the city is at liberty to use the design that it has acquired as it may think best.

In spite of these facts being well known by the profession, committees have no difficulty in obtaining an almost unlimited number of competitors. It is needless to say that these men are not reputable practitioners nor men of high standing in the profession; but what does the average committeeman know about that, or, if he should know, what does he care? He is not going to trouble himself about the ethics of the architectural world nor investigate the professional standing and talents of the various competitors. His city has a certain amount of money to expend for a school building, and the architect who will do the work the cheapest—that is, give him the most for his money—is the man he will advocate and vote for. To the majority of laymen the selection of an architect is purely a commercial transaction. The artistic and scientific elements do not, in their minds, enter into the question at all; or, if they do, it is in so small a degree as to be entirely overwhelmed by its mercenary aspect. From his point of view he must not be too severely censured; his actions are based upon the best of motives. He believes if he can buy the required service cheaply, he is working for the best interests of his city, and that he will be commended for his efforts to be economical with the public funds which have been entrusted to his care. He does not understand nor appreciate that cheap labor, no matter at what price obtained, is sure to be the most expensive in the long run.

In some competitive programs issued by committees, there is a clause inserted in which the architects are requested, when they submit their designs, to state what will be their lowest terms for full professional services; in other words, a double competition is instituted—one architectural and the other financial. It usually results that the financial side is by far the most powerful element in the ultimate decision. Nothing can be more obnoxious or better calculated to drive the best men from the field than such a proposition as this. What practitioner of high standing and wide experience would for a moment think of complying with such requirements? Just think of inviting a score or more of reputable doctors to name a price for what they would cure you if you were ill. Or, if you were in trouble, would you expect eminent lawyers to submit figures naming the price for which they would defend you? Far from it: quacks in one instance and shysters in the other might; and if they did, you would brand them as such as quickly as anybody and have nothing to do with them. Why not, then, pass the same unbiased judgment upon the architects? It is just such a class in their profession who pursue such tactics, and they should be judged accordingly. I do not mean to infer that it is not done continually by men in all the professions who try to pose as respectable practitioners, but what I do maintain, without fear of contradiction, is that such men are not reputable in the true sense of the word, and that they, by their actions, impose upon the people at large, prevent men of ability from competing, and deprive the community of receiving the benefit of the best talent. For it ultimately results in placing the designing and construction of buildings in the hands of men of inferior ability with but one consequence, the completed structure is not so good as it might have been, as it does not represent the highest standard of excellence obtainable.

When the other conditions of a competition are favorable, fear of favoritism many times prevents desirable men from entering, and this fear is usually well grounded. It is no exaggeration to say that fully one half of the ordinary competitions instituted are practically decided before the invitations are issued; that is to say, some one man or firm is known to have the "inside track" and will be the choice of the majority of the committee. It is no unusual thing to be informed, upon inquiring if there is likely to be any preference shown in the selection of an architect, that "all things being equal, we certainly should be in favor of employing Messrs. So-and-so, our local firm." I think that I can truly say that my brethren who have had much experience in such matters find almost invariably that "all things *are* very nearly equal." Innumerable cases can be cited where men of inferior ability and no experience have been selected to execute important commissions when they have had for competitors men of wide experience and brilliant achievements—the selection not having been made upon the merit of the design, but solely for the reason that one man had the local "pull."

Experience has time and again demonstrated that satisfactory results cannot be obtained from the open competition. If this could be impressed upon committees and they would act accordingly, their duties would be lighter and our buildings better.

If competitions must be held, let them be limited, not only in the number of competitors, but as to their professional ability as well. Let only those of the highest standing be invited, and pay them all a sum sufficient to cover the actual expense of preparing the preliminary designs submitted. There can be no greater injustice than that of asking architects to prepare competitive designs for buildings which they have to spend weeks and sometimes months upon, without compensation. The preparation of such designs often necessitates an expenditure of hundreds of dollars without counting the time of the architect as anything. If successful, the usual commission is small enough without deducting the cost of the original sketches; but if unsuccessful, and only one in many can succeed, the expense incurred and labor expended are simply thrown away.

To a layman who does not comprehend these facts, the preparation of a design seems a very trivial affair. A few sheets on which are depicted with more or less skill and fidelity a structure that may be built, has to him no intrinsic value. But to the architect who has created it, it represents just as much in value as a certain amount of merchandise does to the manufacturer, and should, if justice is to be done, be paid for in the same way.

Another measure that should be insisted upon in the limited competition is that all the drawings submitted shall be equal in number, executed at the same scale, and rendered in the same way. The committee should also pledge itself to employ a distinguished, disinterested architect to assist it in the preparation of the program and agree that he shall examine and pass judgment upon the designs when they are sent in, his decision being binding upon the committee.

This may appear an arbitrary and high-handed measure, but I am sure, from a long and wide experience in such matters, that it is the only fair and equitable course to pursue. I have said before, and repeat here, that the average layman is not a competent critic. A clever draughtsman can, in rendering, cover up faults in such a manner as to completely deceive the untrained eye. He will finish his drawing so skilfully that all good points will be emphasized and the bad ones subordinated. It is only the trained eye that will discover these subterfuges and judge the drawing for what it is really worth.

Another thing must also be remembered, and that is, that it does not follow because you may have a pretty and attractive picture presented that the building it illustrates is of good design. A conglomeration of several styles thrown together with some skill may produce that which seems to the uneducated eye a very beautiful composition, when it really contains no real artistic merit and would be most unsatisfactory if carried out. An expert will readily discern these things and prevent the committee from being deceived.

Another reason for employing an expert is that upon almost all committees there will be found men who consider themselves *au fait* in all matters pertaining to architecture and building. It is not uncommon to hear them expatiate upon the beauties of one building and condemning another with equal vehemence, when if the truth were really known they could not even tell you in what style of architecture either was built.

Such criticism is simply laughed at by the professional man; but it is far different to those who do not understand such matters at all. To them the calibre of these blatant critics is unknown; what they say has more or less weight, and if they happen to be serving on a committee together they are sure to be influenced by them. When the true expert is called in the oracle retires within his shell and the harm that he might otherwise do is averted.

If a knotty point of law is to be decided, a severe illness diagnosed, or the stability of an important bridge determined, an eminent lawyer, doctor, or engineer is at once called in. Their criticisms are listened to and followed as closely as possible. Why not then pursue the same course in an architectural competition? I can see no good reason why it should not be done, while innumerable ones present themselves upon the other side. If committees would seriously consider these pertinent points and recognize the great importance of sound professional advice, they would speedily eliminate from the limited competition one of its most objectionable features.

Better far than any competition, no matter how carefully it may be conducted, is the direct selection of an architect. Choose a man of known eminence in his profession and of special skill in the designing and construction of school buildings. Make the selection impartially and without regard to local pride or political influence, and you will find the results will fully justify your action.

No better example of the wisdom of such a course can be cited than the results obtained at the recent Columbian Exposition. When Messrs. Burnham & Root were employed as consulting architects by the Exposition officials and were asked to design the principal buildings, their answer was that no one firm could do the work as it should be done. The first thought was to advertise for competitive designs for the proposed structures. To their lasting credit be it said, Messrs. Burnham & Root strenuously objected, and clearly pointed out that such a course would be detrimental to the best interests of the Exposition. They argued that the commissioners would not only be overwhelmed with worthless designs and pestered beyond measure by the friends of the various competitors, but that much valuable time would be consumed in conducting and deciding such a competition, the results of which would be unsatisfactory, as the very men most desired would not compete.

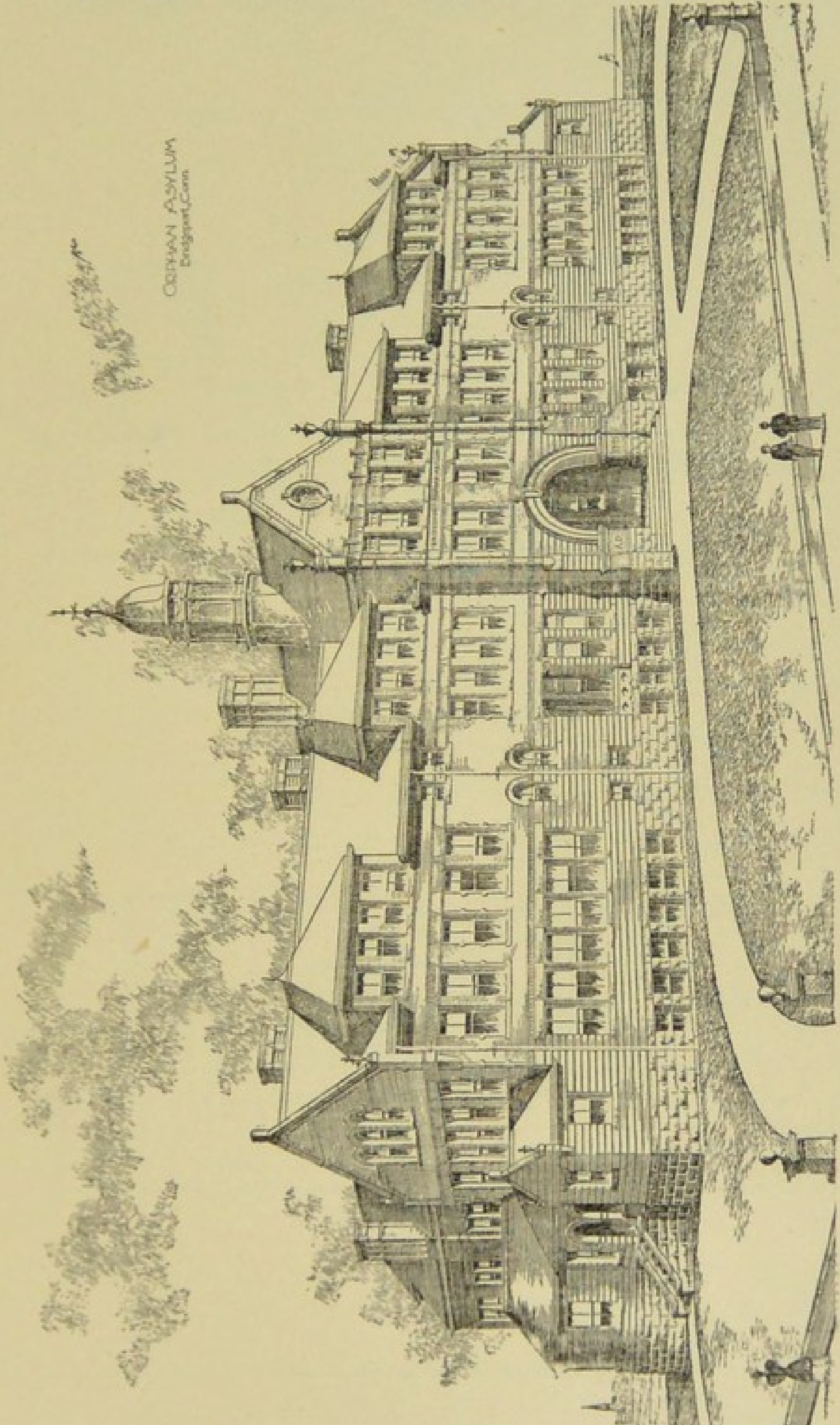
They urged the direct selection of the most prominent men in the profession in various parts of the country, and the allotment to each of one of the great buildings which might be considered as best suited to his capabilities. It was stipulated that the men thus employed should have the entire construction of the buildings in their hands. Most fortunately for all concerned, this advice was heeded, and practically such a course followed with results that all the world knows and has commended. To Richard M. Hunt, the father of American architecture, was allotted the Administration Building; to Geo. B. Post, the great Liberal Arts Building; to Peabody & Stearns, Machinery Hall; to McKim, Mead & White, the Agricultural Building; and to the artistic Atwood, a worthy successor to the lamented Root, the Art Palace and stately Peristyle. These men, with other giants of the profession, produced at Chicago in an incredibly short time the grandest and most beautiful group of exposition buildings that the world has ever seen—structures so well planned and executed, so thoroughly adapted to the requirements, that it has enabled America to say truthfully that her architects are second to none.

Will any one pretend to say that such marvellous results as these could have been obtained by an open competition? Most emphatically, no. If such a course had been adopted, not one of these really great men, whose genius we now admire, would have competed, and their talent and skill would have been lost to the country.

I believe firmly that the results obtained by the employment of men of recognized talent at Chicago has been of the greatest benefit, not only to the architectural profession, but to all those interested in the artistic development of our country. What could be accomplished by architects when working in harmony with each other under favorable conditions, and without undue restraint, was not only a revelation, but a source of pride, to the community at large.

A remarkable fact to be considered in this connection was that, although architects from all parts of the country were employed and came into close connection with each other, there was no jealousy noticeable; everything moved smoothly and rapidly forward, and, while much friendly criticism was indulged in, it was invariably received with the utmost good nature; no bad feeling was shown; but each and every one seemed to be filled with a desire to do the best he could, and to help his neighbor to do the same.

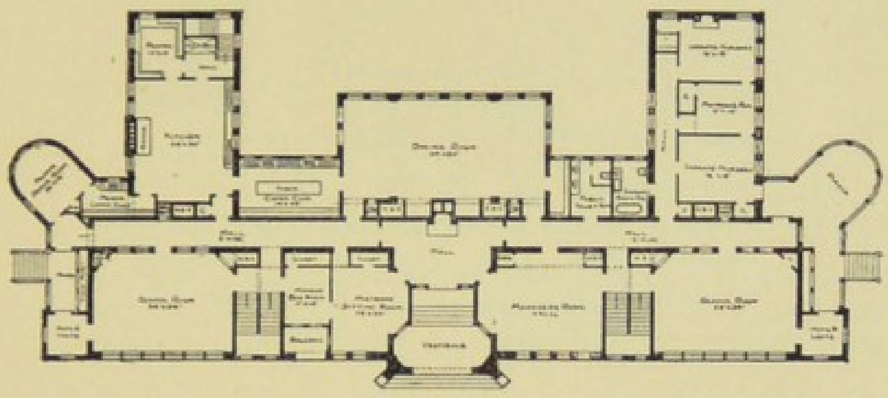
It is to be hoped that the data which can be deduced from this great object-lesson will be applied by committees having the construction of school buildings in their charge, and that in the near future the once popular competition will be condemned to the obscurity it so richly deserves.



ORPHAN ASYLUM
Bridgeport, Conn.

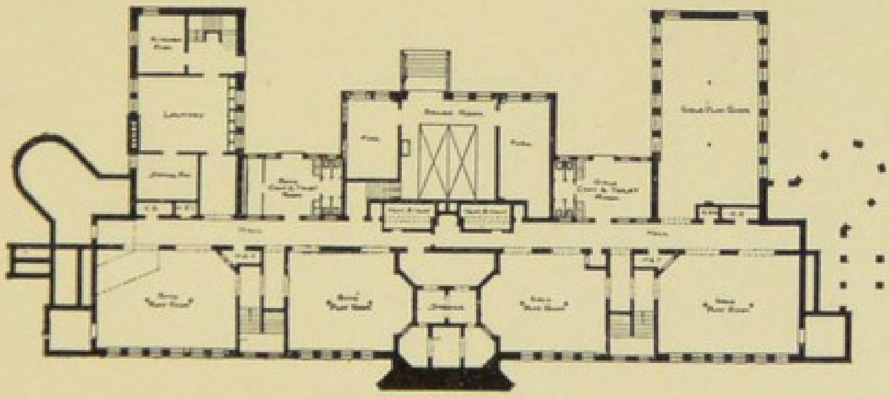
PLATE 9

PLATE 10



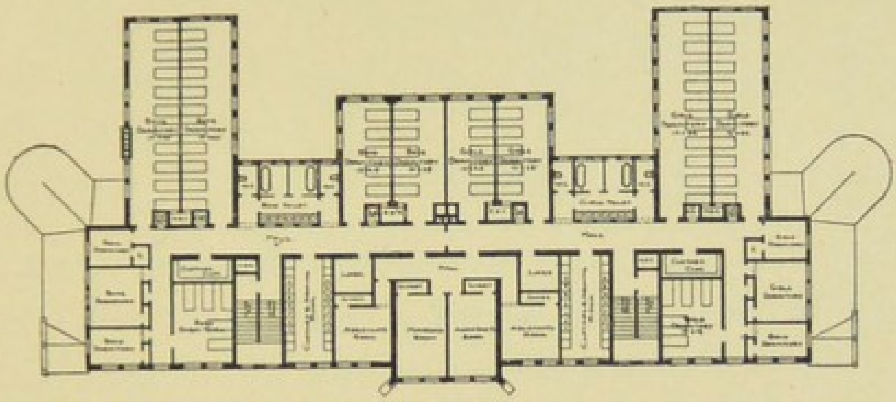
FIRST STORY PLAN

BRIDGEPORT ORPHAN ASYLUM.



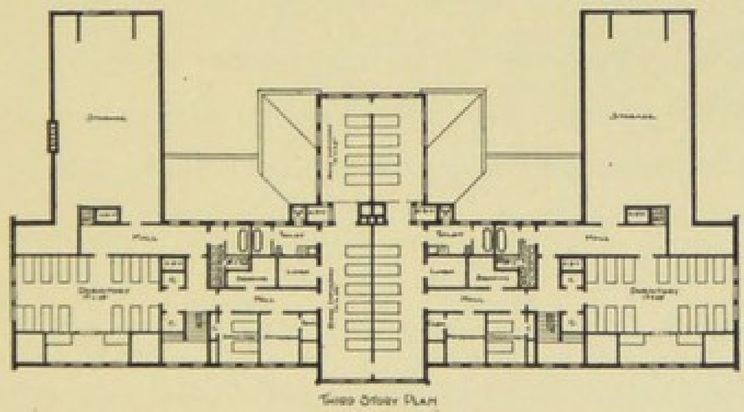
BASEMENT PLAN

PLATE 11.



SECOND STORY PLAN

BRIDGEPORT ORPHAN ASYLUM



THIRD STORY PLAN

CHAPTER IV.

SPECIALISTS.

I AM a thorough believer in specialists. The field of architecture is large, and it seems strange that it has not been subdivided. In law there is the patent lawyer, the corporation lawyer, the criminal lawyer, etc.; in medicine there is the surgeon, the dentist, the oculist, the aurist, and the various doctors for the brain, throat, lungs, etc.; in engineering the civil, mechanical, mining, and electrical engineers. These men rarely leave their chosen path and consequently do better work. It is not uncommon in consulting with one of them to be told that your case is not in his line; that while he might be able to serve you he would prefer to introduce you to some one who was a specialist in the class of work which you wish done. I have never known of anything of this kind occurring in my profession; on the contrary, everything that gets into the architect's net is "fish." It is no unusual thing to find in the office of a busy architect a design for a twenty-story office-building on one board, a suburban cottage on another, a railway station on a third, with possibly a church, a casino, and a schoolhouse sandwiched in between; buildings whose characteristics, requirements, and equipment are entirely different. It is hardly reasonable to assume that any one man can be equally clever in designing them all.

Some one branch he is likely to excel in, and if it were continually cultivated he would gradually become perfected and be justly ranked as a specialist.

It would seem that men endowed with qualifications for certain kinds of work would realize it and devote all their energies to that branch in which they excel; but human nature is perverse, and what others see and know of a man he is loth to believe of himself. Thackeray, while a great novelist, was a ridiculous artist, and yet his vanity was so great that he insisted upon illustrating his writings himself. It is said that among actors there is hardly a good low-comedian who does not consider himself ill-treated when he is assigned parts that are well fitted to his capabilities. His aspirations and conceit lead him to believe that he is well fitted for the leading rôles in tragedy or comedy and he is dissatisfied because he is not cast for them.

It is even so in my profession: men who would shine in some of its walks will not stick to them, but wander off and strive hopelessly for that for which they are entirely unfitted, with results that are disastrous to both client and practitioner. It is but natural that one should wish to do all he can, but if there were more *esprit du corps* among the architects, and if each would keep to his chosen path and help others to keep to theirs, the results would be beneficial to our buildings and to all connected with them.

This, however, is not the only reason there are so few specialists among architects. Many men who have given a great amount of time and study to perfect themselves in some particular branch and who would like to follow it continuously, are prevented from doing so for the reason that their abilities are not sufficiently recognized, and they are forced to do other things than those which they can do the best in order to earn their daily bread. It is very poor satisfaction to the expert to know that however clever he may be in a certain line, his cleverness is not appreciated by the public at large. He may stand well among his professional brethren, but they are not the class that employ him except in consultation or in matters under dispute. If he relied entirely upon this class of work for his commissions, he would simply starve. Doctors and lawyers are paid hundreds and sometimes thousands of dollars for their opinions; but the architect, if he is recognized as a specialist in any particular line, never receives any such fees—in fact, a charge of fifty dollars per day and travelling expenses is enough to make the average client consider him exorbitant in his prices and decline to employ him.

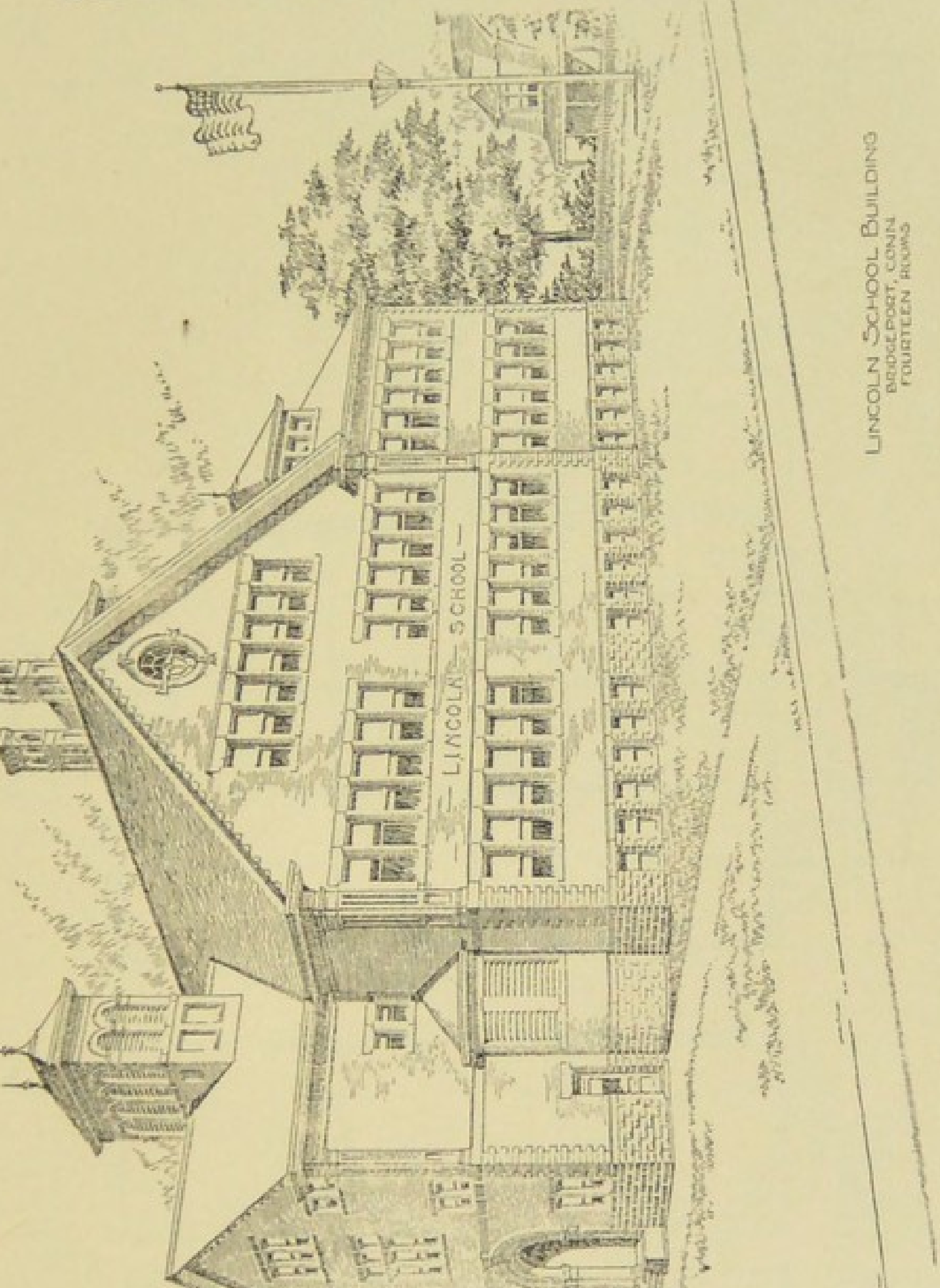
It may be claimed that experts in schoolhouse construction *are* recognized and their abilities appreciated, but I contend to the contrary, nevertheless—that is to say, that while they may be well known, their skill and knowledge are not considered valuable enough by the building public to be made use of and properly paid for. I can refer to innumerable instances to prove the truth of these assertions. To illustrate: a certain prosperous town, situated within one hundred miles of New York, proposed to erect a high-school building. When the committee was appointed to take charge of the matter it was immediately besieged by architects from all parts of the country who desired to submit designs. Several were sent in, and with others afterward received were carefully considered, but none were found satisfactory. At one of the meetings of the committee a member suggested that a well-known specialist in school designing, residing in a distant city, be asked to submit a design. The secretary of the committee communicated with him, and after some correspondence he sent in a rough sketch of what might be done with the problem as he understood it from the data which had been sent to him. The sketch, while not suited to the site, which he had never seen, was very much liked, and the specialist was invited to visit the town, examine the site, and after consultation with the committee prepare a design. This he agreed to do upon the payment of a fee and travelling expenses. His proposition was accepted, the town visited, the site examined, a lengthy consultation held with the committee, and a general scheme of what was to be done mapped out. After the meeting some of the committee accompanied the specialist to his hotel, and one of them said to him, quietly, over a cigar, "I do not know just how this matter will adjust itself: there is an unfortunate element developing itself rapidly which will, I fear, be very hard to counteract. There is a young man, a native of this town, who is employed in the office of a firm of architects in New York; he is young, having had actually no experience—in fact, you may call him simply a student—but he is a fine fellow and extremely popular. He is very anxious to design our building, is preparing sketches, and his family and friends are bringing every influence to bear to have him selected as our architect. The best men of our committee do not want to do this, for while they are friendly to the young man and wish to see him succeed in his chosen profession, they do not believe that it would be wise at this time to put the designing of so important a building into such inexperienced hands." The specialist weighed the matter carefully during his return journey, finally deciding to submit a second sketch. This was received most favorably and was said to have met the requirements of the problem perfectly. Yet when a vote was taken to select an architect, the young native of the town was employed to execute the work. The vote was very close, to be sure, but he had friends enough upon the committee to defeat the experienced man, his only competitor. Here was clearly a case of local popularity and family influence. The questions of merit and capability did not enter into it at all. The desire to help the young man in his profession may have been all right, but to me it seems like zeal applied at the wrong time and at a cost to the community. Do not understand that I am one who wishes to bear too severely upon the young aspirant for fame or who believes in keeping back true talent, but I contend that there are plenty of legitimate channels of progress through which the talented beginner may obtain eminence in good time. I do not believe, however, that a course which enables one totally untried to spring with a bound into that which is popularly supposed to be a prominent position in the architectural profession is either legitimate or beneficial. Under such conditions as these, is it strange that our buildings are not up to the highest known standards? Does any one for a moment admit that this inexperienced boy—he was little more—could or would do as well as the old and tried practitioner, or that he would not be able to do much better ten or fifteen years later in his career? Apropos to this, one of the best-known designers of the day recently said to me that he could not look upon some of his earlier works without having an attack of nightmare and that he would go out of his way several blocks to avoid passing them. "I am simply filled with amazement," said he, "to think I could have done so badly, yet I thought they were beautiful when I did them." All of us have at times feelings akin to this which we guard jealously and to which we never allude. As the older men look backward along the rugged path they have laboriously climbed, they can see many examples of their earlier work which they would gladly obliterate. It takes a great many years to realize how little one really knows. I can truly say that I firmly believed twenty-five years ago, when I commenced practicing, that I knew far more about my profession than I know that I know to-day. That man is a fool whose vanity leads him to believe that any work that he has done or may do cannot be improved upon. We are all, even if successful, simply students; and the one who follows one line the longest and most conscientiously will become the best fitted to do good work in it.

I once heard a well-known architect say in speaking of school buildings: "In all my practice I have never built one —if I were to receive such a commission, I should go to some expert in the planning, heating, lighting, etc., of this class of buildings, and say to him: 'Work out this problem as you think it should be according to the program, and when you have the plans finished, bring them to me and I will work up the elevations without interfering in the least with anything that you may have done.'" I do not know as this gentleman ever put his theory into practice, but he certainly had the right idea. He realized that the specialist could and would do better work than he was capable of, and that if he secured a thoroughly good plan it would be easy for him to make an attractive exterior for it.

So much can be said in favor of and so little against the employment of the specialist that it would seem, if the advantages derived were understood, that he would be called in as a rule and not as an exception. Oftentimes when committees themselves are willing and anxious to have the advice of an expert, vigorous opposition is encountered from would-be competitors and influential citizens.

In these later days the specialist who persistently rides his hobby is very apt to be branded as a crank, and the general public is very shy of cranks. "Yes," it will be said, "he is a bright fellow and all right in theory, but he carries his theories too far and we do not care for them." It is very difficult to maintain a position a little in advance of the times and to have to educate the public in theories which time will prove to be correct. Such, however, is the function of the specialist of to-day, and it should be his endeavor to win by the soundness and practicability of his advice the respect and confidence of the public in general and his client in particular. The results will be immeasurably more beneficial and far-reaching to the progress of good building than can be obtained by simply parading certain qualifications before the eyes of those who are not yet in a position to understand or appreciate them. Therefore I say that the public welfare demands the employment of the best talent in the designing of our school buildings, and the problem before our profession is how to establish public confidence in our fitness to do certain things well. I believe that this can best be accomplished by a thorough and systematic subdivision of the architect's practice. If there could come into existence in the near future classes of practitioners who would devote themselves entirely to certain departments of an architect's work and would do nothing else, they would do that class of work more artistically and practically. Supposing one class devoted itself entirely to church work, another to office and commercial buildings, another to theatres and music-halls, another to court-houses, another to railway stations, another to schoolhouses, and so on. Do not we all believe that these men would ultimately do better work in their chosen lines than they do now? Would not the architecture of the country be improved—in fact, the whole nation benefited thereby? I think there can be no question as to the soundness of this proposition, and it only remains for clients and committees to recognize the best men in the profession in certain classes of work, and by employing them constantly in these classes to enable them to practice what they preach, and so bring about this much-needed reform.

PLATE 12.



LINCOLN SCHOOL BUILDING
BRIDGEPORT, CONN.
FOURTEEN ROOMS

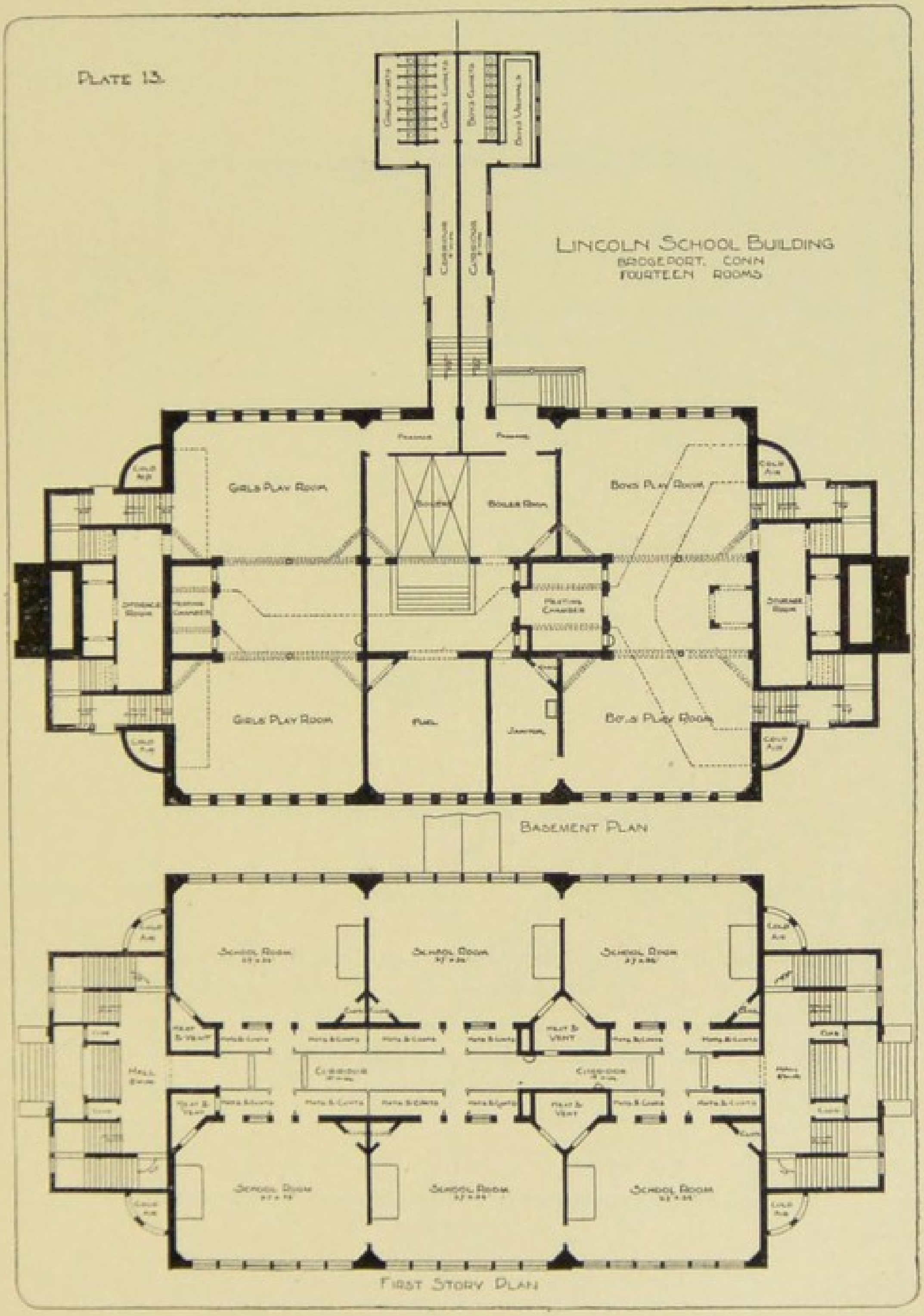
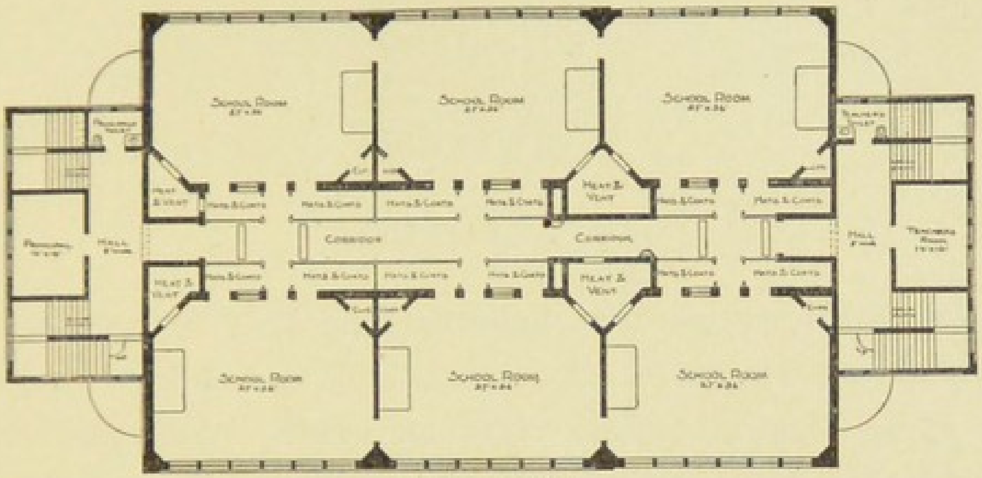


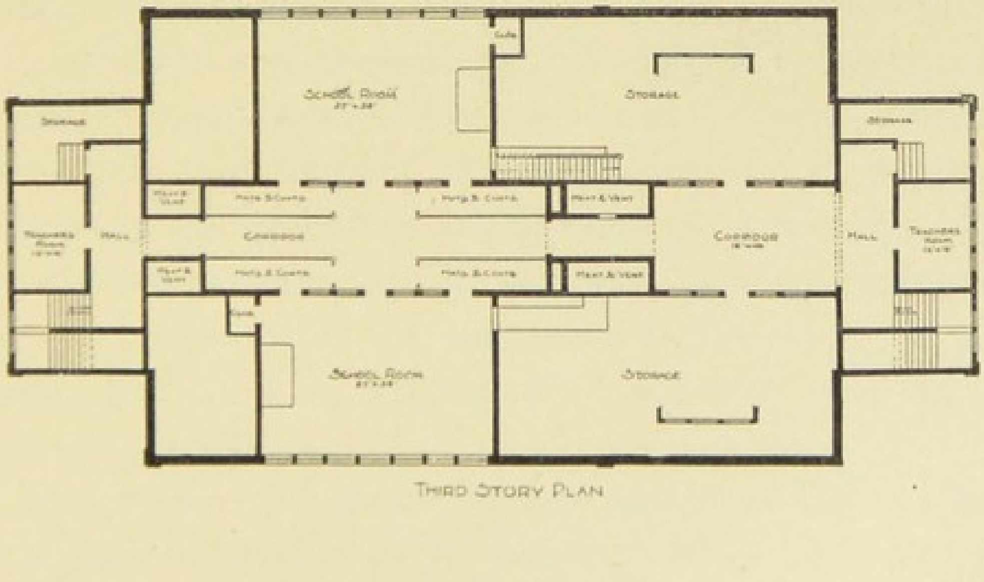
PLATE 13.
LINCOLN SCHOOL BUILDING
BRIDGEPORT, CONN
FOURTEEN ROOMS
GIRLS PLAY ROOM
BOILER ROOM
BOYS PLAY ROOM
HEATING CHAMBER
FUEL
JANITOR
GIRLS PLAY ROOM
BOYS PLAY ROOM
BASEMENT PLAN
SCHOOL ROOM
SCHOOL ROOM
SCHOOL ROOM
HEAT & VENT
HEAT & VENT
HALL
CORRIDOR
CORRIDOR
HEAT & VENT
HEAT & VENT
SCHOOL ROOM
SCHOOL ROOM
SCHOOL ROOM
FIRST STORY PLAN

PLATE 14.



SECOND STORY PLAN

LINCOLN SCHOOL BUILDING
BRIDGEPORT, CONN.
FOURTEEN ROOMS



THIRD STORY PLAN

CHAPTER V.

COMMISSIONS.

ARCHITECTS of high standing and known ability often refuse to present designs on account of the small amount of the commission offered, and men eminently qualified to do the work are frequently not employed for the sole reason that their charges are considered exorbitant.

It is hard to understand just why charges which have almost invariably been allowed as legitimate by the courts, when they have been called to pass upon them, and a schedule which has been officially endorsed by all the architectural societies of the country and adopted by every practitioner of standing, should be considered excessive. Nevertheless, the fact remains that it is the almost universal impression that architects' commissions are enormous while their labor amounts to little or nothing. Consequently architecture is regarded by the uninitiated as the easiest of professions and the busy practitioner is popularly supposed to be coining money.

How unjust and absurd all such assertions are and how utterly devoid of all truth or reason. There is, in fact, no profession more difficult and exacting than that of architecture—that is, if it is practiced in the fullest sense of the word. The true architect not only must spend long years in study and preparation before he is competent to design even the simplest kind of a structure and do it as it should be done, but when in active practice he will be expected to be a clever designer, a good constructor, thoroughly understanding masonry in all its branches, carpentry in every detail, plumbing and sanitary-engineering, tinning and gas-fitting, heating and ventilation, slating and painting, and, in these latter days, iron and steel construction. He must also be able to compute the strength of foundations, walls, piers, columns, girders, beams, and trusses, and write an intelligent and comprehensive specification on all these subjects.

In addition to all these qualifications, to be a successful practitioner he must be a first-class business man, capable of drawing contracts, looking after the interests of his clients, and so alert that he shall not be imposed upon at any time by unscrupulous contractors or unskilled workmen.

Surely his duties are varied and complex enough, demanding, as they do, the closest study and indefatigable attention at all times. Yet for the application of all this knowledge to a greater or less degree, in every problem presented and in every building constructed, the charge of five per cent upon the total amount expended is considered excessive.

Let us analyze a little and see if there be any well-grounded reason for such an opinion. In a speech a few years ago before the Congressional Committee on Grounds and Buildings, at Washington, the much-lamented architect, Mr. Richard M. Hunt of New York, stated that in fifty years of active practice he had *never* been able to produce drawings and specifications and supply the superintendence actually necessary to properly execute the work for a less sum than fifty per cent of the amount of the commission received, and that usually the cost was far in excess of this amount. This, it must be understood, did not include his own services at all, but was what he had actually been obliged to expend for office-rent, material, draughtsmen, and superintendence. It must also be remembered that Mr. Hunt's commissions were of the largest, and that the ratio of the expense of producing drawings increases as the cost of the building decreases. So marked is this increase in small buildings that many prominent architects charge a commission of from seven and a half to ten per cent on all work costing less than ten thousand dollars. The American Institute of Architects has now under consideration a new schedule of charges designed especially to regulate this matter.

Within a year the writer met socially one evening seven prominent New York architects, and in the course of conversation the question of the actual expenses necessarily incurred for drawings, specifications, and superintendence came up and was thoroughly discussed. The gentlemen were all men of wide experience and well qualified to speak intelligently upon the subject. The unanimous verdict was that the cost rarely went below sixty per cent of the amount received and frequently reached as high as seventy-five per cent.

It is but fair, then, to assume that the actual cost to the architect, if his work is properly done, for preparing the drawings, specifications, and details, and attending to the superintendence, will be sixty-five per cent of the five per cent commission that he receives; or, in other words, thirty-five per cent of the five per cent commission will be for his own services. Let it be supposed that he should have on hand and commence at about the same time five school buildings costing respectively $20,000, $40,000, $50,000,

$80,000, and $100,000—a total of $290,000 to be expended. At the customary charge of five per cent made by reputable practitioners, the total commission on this amount would be $14,500. As has been shown, the architect will have to expend sixty-five per cent, or $9,425, of this amount, leaving thirty-five per cent, or $5,075, for his own services. The time required to complete all these buildings from the time preliminary sketches were prepared would be at least two years, therefore the architect's yearly salary would amount to $2,537.50. Surely this sum cannot be called excessive when the amount of labor, skill, and responsibility involved are taken into consideration. In fact, instead of being overpaid, there is no professional man so poorly paid as the architect, public opinion and popular sentiment to the contrary notwithstanding.

Think of a skilled practitioner of twenty years' experience devoting himself almost continually for two years to the construction of five buildings, which he has practically created and is responsible for, for the sum of $2,500 yearly. Compare this with the fees that would be received by a lawyer of equal eminence or a doctor of wide experience and reputation. Yet their training has been no more severe, their labor no harder, and their responsibility not one bit greater. Why is it, then, that the architect is considered an expensive luxury at a five per cent commission, when the lawyer or doctor is often cheerfully paid five times this sum for his services? The principal answer is that the architect's work and duties are not properly understood; the greater portion of his labor the client never sees and does not understand. Meeting the architect in his office, looking at a few plans and one or two pretty elevations, leads him to think that these are all there is to his work. The vast amount of study and detail that it has taken to produce what he sees in a condensed form he knows nothing about and cares less. No amount of explanation can make him fully comprehend it, because he cannot be made to appreciate that which looks very simple when completed, but which may have taken hours, days, or even weeks of hard and persistent study and research to evolve. It is not, as is generally supposed, the time and labor spent in actually executing the final drawings that forms the greater portion of the architect's work, nor what the client is paying for principally; but the vast amount of thought and study expended, often a dozen times repeated, that is essential and necessary in every well-conceived design in order to produce a harmonious whole. All this work never appears on the surface; only the final conception is shown to the clients. When this is satisfactory, it is turned over to the draughtsmen of the office to finish for the contractors, and the labors of the architect, so far as the designing of the structure is concerned, are practically finished. In fact, the larger portion of his labors are accomplished before he becomes closely associated with his client in the erection of the structure. The client, not realizing this fact, counts the time spent by the architect in the superintendence of the construction of the edifice as the greater portion of the services he is paying for, when in reality it is a very small part of it.

I have used the expression, " if the drawings and specifications are properly prepared," and I wish to reiterate and emphasize it here, for it is of vital importance for the best interests of the building and the client that they should be as nearly perfect as it is possible to make them. A contractor, when he figures upon a set of drawings and specifications and signs a contract to execute the work in strict conformity to them, is bound to follow them implicitly. If he does this, in my judgment he has absolutely no responsibility for any faults in the planning or construction that may occur. The author of the plans and specifications is the one to whom to look for redress, and not the man who is employed to execute that which another has laid out. When plans are not properly studied and specifications are carelessly drawn, faults are bound to occur which will cost the client, in the long run, many times the amount of the fee of a first-class architect. When men in my profession cut their just commission in order to secure work, I know that one of two things will occur: either their work will not be properly done or there will be collusion between them and the contractors.

I think it will be admitted that it has been shown by unimpeachable testimony that the expenses that the true architect has to incur is fully sixty-five per cent of his commission; if his commission is reduced one half, his work must be slighted or he must receive money from some other source to secure himself against loss. These are indisputable facts, and should convince the most skeptical of the truth of my assertions.

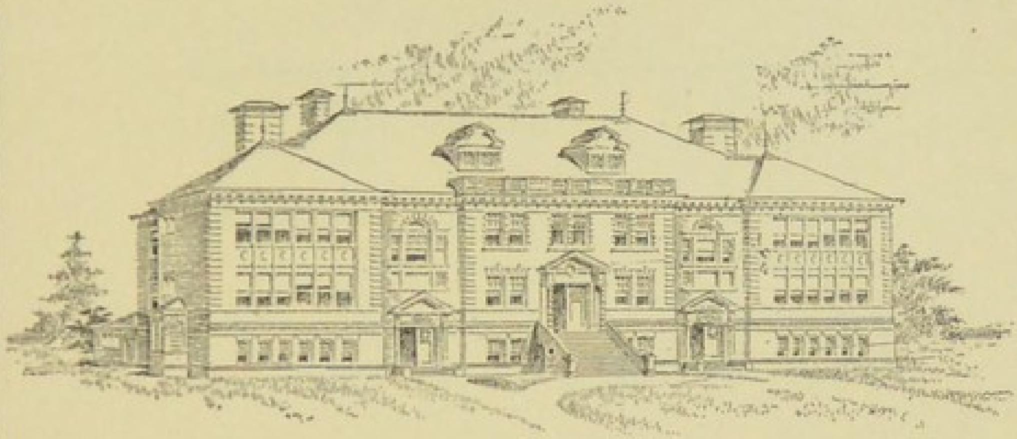
As few drawings as possible are made, these being rushed through without serious study. Specifications are carelessly drawn and the contractors left practically to their own devices —the primary object being to get the structure finished and accepted as quickly as possible. The result is almost invariably that when the work is completed it is unsatisfactory, and large additional expenditures are necessary to complete it as the client expected and had supposed it would be finished. Naturally he is disgusted, and condemns the architect who got him into the scrape in unmeasured terms. In this he is perfectly justified; but he should *stop with the man he has employed*, and not extend his condemnation to others nor malign the whole profession for the faults of one.

Closely allied to inferior work of architects is collusion between them and contractors. This may be accomplished in many ways: by giving a favored contractor a tip as to how the work might be done and what material would be accepted; by permitting the work to be executed in an inferior manner and allowing the introduction of a poorer quality of material than that specified; by specifying special kinds or makes of goods and receiving a commission for so doing. These are a few only of the many ways and means employed, and unless the client is an expert in such matters or more than usually alert, such things pass unnoticed, or if they are discovered are explained by the architect and contractor in some plausible way. Such methods save the contractor considerable sums, and he is very willing to divide the savings with the architect. The architect in this way obtains an amount of money which, when added to the two and a half, three, or three and a half per cent received from the client, will make the total amount of his commission far in excess of what it would have been had he been honorable and charged the full commission of five per cent.

The client, instead of saving money as was his intention, has not only been swindled and hoodwinked, but put to an unwarranted expense. Naturally he is very much dissatisfied and very bitter toward the architect. In his indignation he condemns the whole profession, and concludes that he would have been better off without any architect at all. It is no unusual thing to hear men say that architects are a luxury and they would rather employ a good builder. This usually occurs after experiences similar to those cited—the client in his wrath forgetting that in the first instance his own actions precipitated results that were inevitable. When he invites architects to state a price in competition for their work he drives from the field the very men whose services he would like to secure, and paves the way for those who are not honorable enough in their practice to resist temptation and the consequent corruption.

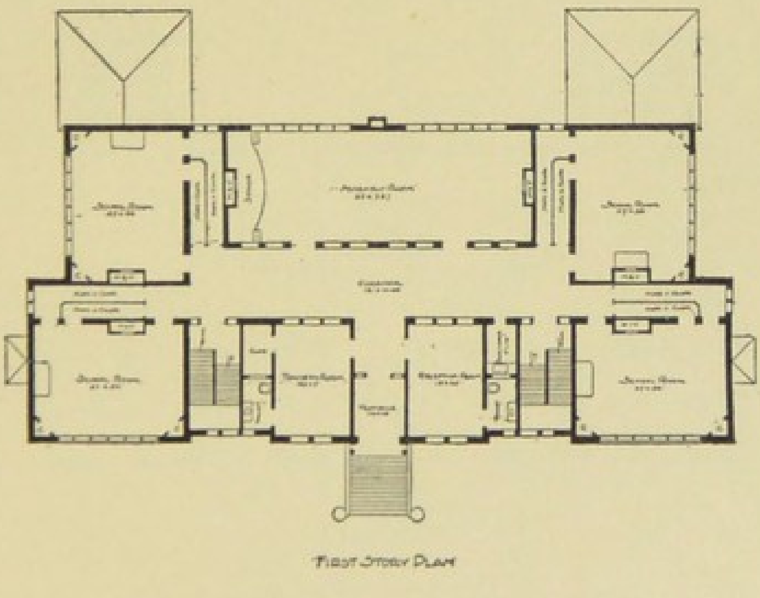
If individuals and committees could be made to realize that in order to secure the best talent they would have to pay that talent a legitimate fee, that in no other way could such services be obtained, they would take a great step in the direction of public improvement. If they would follow these precepts in the selection of the men who are to design and have in charge the construction of their school buildings, they would find that the results obtained would fully meet their fondest expectations and that the completed buildings would contain the best-known principles of scientific and hygienic construction—in fact, they would be "up to date."

PLATE 15.



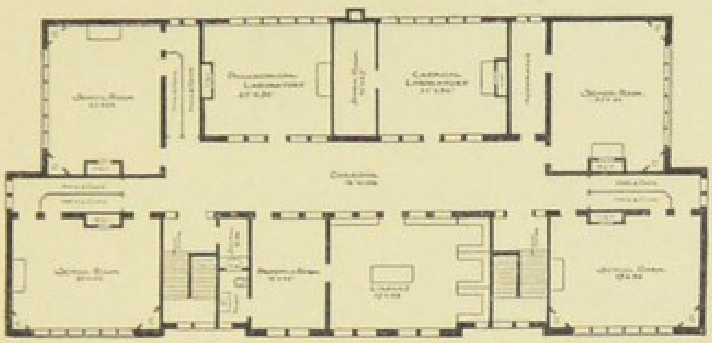
PERSPECTIVE VIEW.

A SMALL HIGH SCHOOL BUILDING.



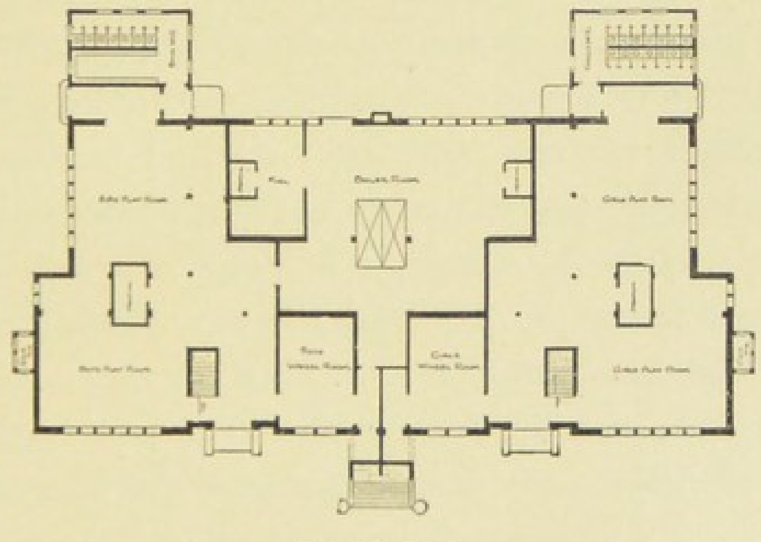
FIRST STORY PLAN

PLATE 16.



SECOND FLOOR PLAN.

A SMALL HIGH SCHOOL BUILDING.



GROUND FLOOR PLAN.

CHAPTER VI.

SUPERINTENDENCE.

I FIND a very widespread and erroneous idea among committees and laymen as to the architect's duties in regard to the superintendence of school or other buildings. Frequently I am asked: "Should you be employed to superintend the construction of our building, how often do you propose to visit it? And how much time will you spend upon it?" And when I answer (if the structure is not in my own city), "Once a week or so, for a few hours only," I am invariably called to account for what is considered inadequate service, and have usually to enter into a lengthy explanation to defend my position. The fact that the building is to be visited but weekly, unless it be that some special contingency arises, seems to many the grossest kind of neglect on the architect's part. It is argued that he cannot know by visits so remote how the work is being done, and that visits daily, or at least once in two days, are absolutely necessary to properly inspect the work and protect the committee's interests. It is hard to make them understand how unnecessary this would be if a reliable contractor were employed, and how utterly impossible such a superintendence would be for a busy practitioner.

These views of the committee, to my mind, arise entirely from a total misconception of an architect's duties, which are confounded with those of a superintendent or inspector kept constantly on the ground, and commonly known as the clerk of the works.

That superintendence of this kind is a good thing, both for the committee and the architect, no one will gainsay, but the idea that such constant surveillance is a part of the architect's duties is entirely erroneous. No matter how willing and conscientious he may be, it is impossible for him to spend more than a few hours a day upon his numerous structures; in fact, when busy, assistants have to do by far the larger part of this work for him. Sometimes he may not be able to see a distant structure for months at a time; even this indicates no neglect of duty on his part, as he is usually ably represented, and, while he may not visit the work himself, is still in close touch with it.

If the contractor is a reputable man, little or no fear need be entertained but that he will live up to the plans and specifications and their evident intentions to the best of his ability. On the other hand, should the contractor be dishonest, and when he took the contract intended to slight the work, no amount of superintendence that the architect can give the building (and do anything else) will entirely eradicate the evil.

There are but two ways to deal with such conditions. The first, by taking the work out of such a man's hands and reletting to trustworthy parties; and the second, by employing the before-mentioned clerk of the works, who is constantly upon the ground.

To explain more fully, this man is employed by the owners to be at the building continuously whenever work of any description is being done; he is to inspect all material delivered, and, if it does not fully meet the requirements of the specifications, report its shortcomings at once to the architect. Likewise in regard to the work, if it should be done in a slovenly or improper manner, or there should be anything about it that, in his judgment, is not as it was evidently intended, the architect should be at once notified, and the work stopped until it has been inspected by him and the defects remedied; then only should the work be allowed to proceed. Obviously such a clerk must be closely allied with the architect, and not with the contractor. He should, in fact, be appointed, or at least selected, by the former; for, to get good results, he must work in perfect harmony with him.

A man of this kind on any job of importance is, to my mind, invaluable for the best interests of all; and I wish that his employment were universally insisted upon. In foreign countries he is very generally found, but in this country, except on government and some of the more important private buildings, his services are rarely made use of. He is not an expensive luxury; good men, fully capable of performing the duties required, can be had for from six to nine hundred dollars per year, and most of our buildings are built within this period of time so it is safe to say that the employment of such a man would not add to the cost of any ordinary building more than one thousand dollars. Under such a system the committee's interests would be fully protected, and I believe it would be commended for adopting such a course, and no one could say but that it was money well expended.

But to return to the architect's duties. The American

Institute of Architects, in its schedule of charges and professional practice, defines the point in question as follows:

SUPERVISION OF WORKS.

"The supervision or superintendence of an architect (as distinguished from the continuous personal superintendence which may be secured by the employment of a clerk of the works) means such inspection by the architect, or his deputy, of a building or other work in process of erection, completion, or alteration as he finds necessary to ascertain whether it is being executed in conformity with his designs and specifications or directions, and to enable him to decide when the successive instalments or payments provided for in the contracts or agreement are due or payable. He is to determine in constructive emergencies, to order necessary changes, and to define the true intent and meaning of the drawings and specifications, and he has authority to stop the progress of the work and order its removal when not in accordance with them."

CLERK OF THE WORKS.

"On buildings where it is deemed necessary to employ a clerk of the works, the remuneration of said clerk is to be paid by the owner or owners, in addition to any commission or fees due the architect. The selection or dismissal of the clerk of the works is to be subject to the approval of the architect."

There is no better authority in the land upon such a subject than the Institute, and it would seem that the duties so clearly defined in these paragraphs could not, under ordinary circumstances, be misinterpreted. Much more might be said in support of the architect's position, but I prefer to leave the subject here, and only add that it will be found an infallible rule: the better and more reliable the contractor is, the less need there is for a clerk of the works.

On the other hand, if the contractor is unreliable, my experience leads me to assert that it will be impossible to have the work executed as the architect intended it should be, unless a clerk of the works is employed.

One other point I wish to touch upon in this connection, and that is to insist that the architect should always have full charge of the work until it is fully completed, unless he is found absolutely incompetent. Committees sometimes, to save money, will make an arrangement by which the architect's superintendence is omitted, and a local man put on to do this part of the work. Once or twice, in my practice, I have had work done in this way, and in each instance it has proved to be most unsatisfactory to both my clients and myself. I have always found that the work was not executed as intended. My designs were either not understood, or wilfully misinterpreted; the superintendent (who is usually some builder) has ideas of his own which he induced the committee to accept with disastrous results—so much so that I have, of late, declined to accept commissions of this character.

If committees have not confidence enough in the architect to place the full designing and construction of the proposed building in his hands, they had better not employ him. If they cannot afford to pay him his full fee, better far abandon the work than try to save in this department.

ETHICS.

The ethics of the architectural profession may not be closely allied with the construction of school buildings, yet it seems to me that these papers would not be complete unless I called the attention of laymen to a phase of our practice that constantly intrudes itself in these modern days.

The question as to whether the architect shall remain in his office and wait for his clients to come to him, or whether he shall solicit his work as a tradesman solicits orders, is one open to grave discussion.

Shall we, in a word, become architectural "drummers," leave our offices and firesides, go out on the road, interview every one who may possibly require architectural service, and, by every means in our power, try to interest prospective clients, and induce them to accept our service?

A common expression of the day, in speaking of a particularly energetic business man, is to designate him a "hustler," and in the trade the qualifications which he possesses are considered admirable. Has it become necessary, in order to be a successful practitioner of to-day, to become an "architectural hustler"?

I cannot think so; the thought is particularly distasteful to me. Yet good friends who are in business insist that it is the only way to do; for, they argue, if you don't do this, some one else will, you may be sure, and you will simply get "left." No doubt they are right in a measure. The successful men of the day have to keep their names and achievements constantly before the people; to be, in a word, in the public eye; they endeavor by every means to do this, working on the theory that no matter what is said of them, either good or bad, it is all beneficial from a business point of view, as long as *some*thing is said. In trade I am willing to grant that all this is true, and am forced to admit, from my observation, that it applies more or less to my own profession. As I write, a case that will illustrate this point comes to my mind. In a limited competition, for a small building, six architects were invited to submit sketches with full description of same; three of the competitors, of whom I was one, were afterwards invited to appear before the committee at different times and still further explain their designs. Meeting a friend some time afterward from the town, and before the competition was decided, I asked if he knew anything about it. "I only know this," said he, "that that man from New York is getting the bulge on you fellows; he has been up here a number of times, has seen every one of the committee more than once, and has talked his plan and abilities into them so that he has the inside track; he's a hustler, he is. You are dead slow. I wouldn't let a fellow get ahead of me that way. I give you the tip; now go in and knock him out." An interview of this kind is pretty apt to arouse all the animosity and latent energy in a man; and it requires, at times, considerable self-control to forbear entering the lists and frightening such a competitor with his own weapons. But this I have never done. I am moulded in the older school, and probably am not up to date in my ways; if this is so, it is simply my own misfortune.

Unquestionably, this man had a perfect right, from a business standpoint, to do just what he did. Ethically, had he an equal right? He would protest that he had done nothing unprofessional; that his methods were legitimate and aboveboard; that he made no secret of seeing the committee; and that others had the same privileges. This is all true, but it is not, to my mind, in the true spirit of a competition. It is, in fact, an attempt to influence, by means other than those prescribed, a jury, for a committee judging plans is just as much of a jury, in one sense, as that of a court of law; and who for a moment, would countenance one of the contestants of a lawsuit interviewing a juryman and trying to influence his judgment. In the latter case, a person caught doing this would be amenable to the law and summarily dealt with. I wish it were possible to apply the same principle to my profession. The coat that fits the juryman does not fit the committeeman, and similar practices which are abhorred in one instance are commended in the other.

I must confess that I do not understand the train of reasoning that enables supposedly reputable men of my profession to satisfy themselves as to the perfect propriety of such proceedings; there must be a screw loose somewhere, or possibly the greed for gain is so intense that it has blunted all other sensibilities.

The case cited referred, of course, to a competition; but this "forcing system" applies equally to all our work. Clients have repeatedly told me that it was no sooner known that they proposed to build than they were besieged by every one in the city who could draw, or thought they could draw, a plan. So persistent, in some cases, were these men that they became positively a nuisance, and harsh measures had to be taken to get rid of them. In far too many instances men of this class have had success; if they did not, they would not continue to practice such methods. The first-come first-taken code, is here applicable, and men who are not in this wild rush for a job are counted slow and behind the times. The mystery is, why these practices should be applied and accepted in our profession and condemned in the kindred ones of law and medicine. Suppose all the doctors in the city should indulge in a wild race to reach you the moment you were known to be sick, or that the legal fraternity should chase you continually and solicit the favor of defending you in a lawsuit. The ethics of their professions proscribe such lapses of dignity, and the public quickly recognizes and denounces any members who may so far forget themselves as to resort to such means to procure clients; but, in the architect's case, it is usually accepted placidly. There is one thing certain, if one does not respect himself, no one else will respect him; and it is largely due to the reprehensible practices of men of my own calling that the low state of ethics among architects exists. But what I want to say to committees and the public generally in this connection is, to beware of the "architectural hustler." Don't employ the men who are chasing you, and who herald their ability from the housetops. Avoid the know-alls. Every problem that confronts the architect requires profound study, and rarely are two solutions alike. Select your architect as you would your lawyer or your physician, not because he can sprint the fastest, talk the loudest, and look the best, but because you know that under that quiet, dignified exterior real worth and merit abide, and that when you place yourself in his hands your interests are safe. Do not be scared away from him by that bugbear so often used that "he is too expensive." It is better, at the start, to pay a good man his price and have your work well done, than it is to employ a cheap man and have the work neglected. You cannot obtain first-class service and the best of material and workmanship unless you are willing to pay for it, and the expenditure had better be for the man who will see that you obtain this, rather than for the incompetent "cheap" one, who is likely to be in collusion with the contractor. Committeemen should particularly heed this warning, and make their selections accordingly; for, by so doing, they secure the best available talent to execute the work entrusted to their hands.

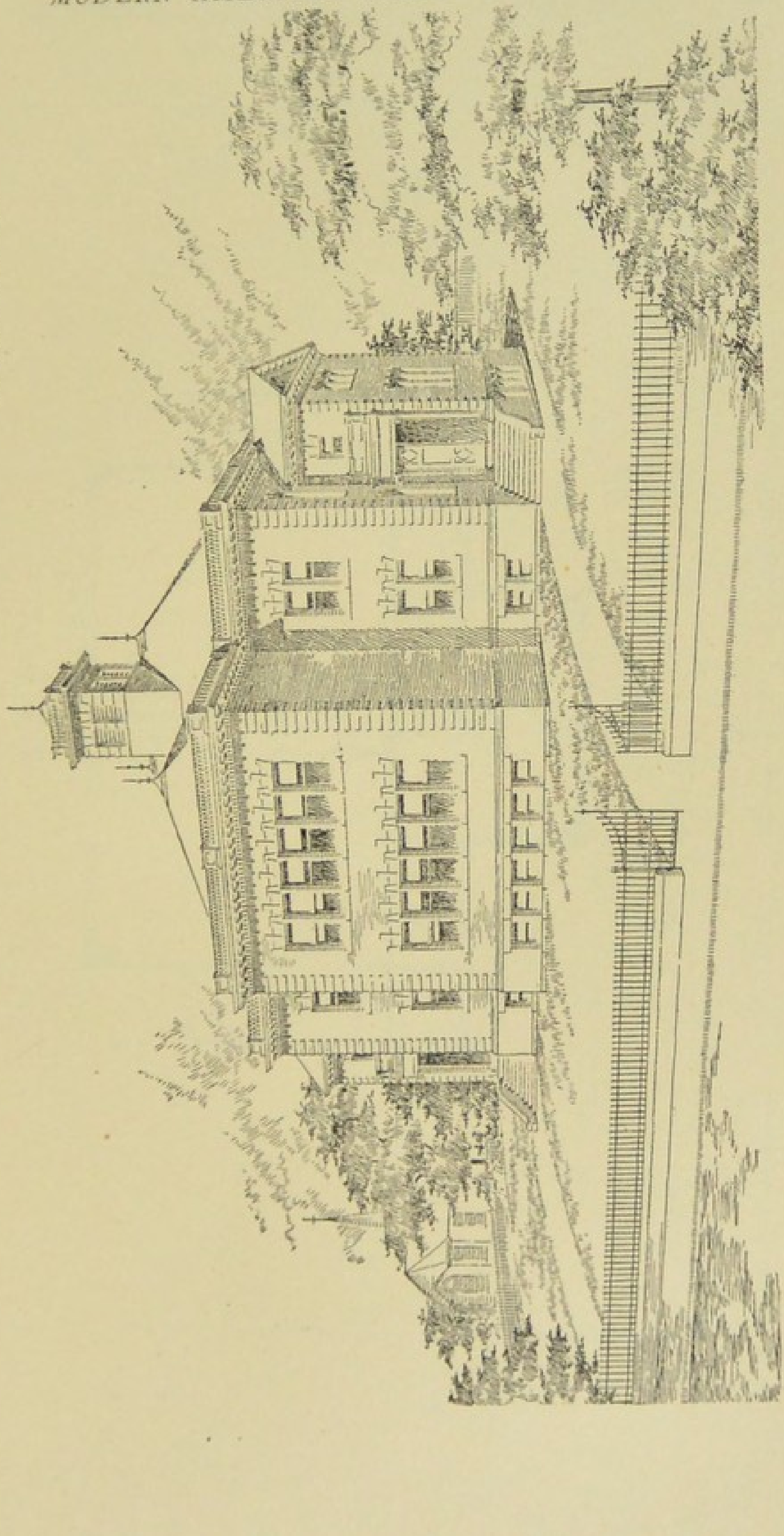
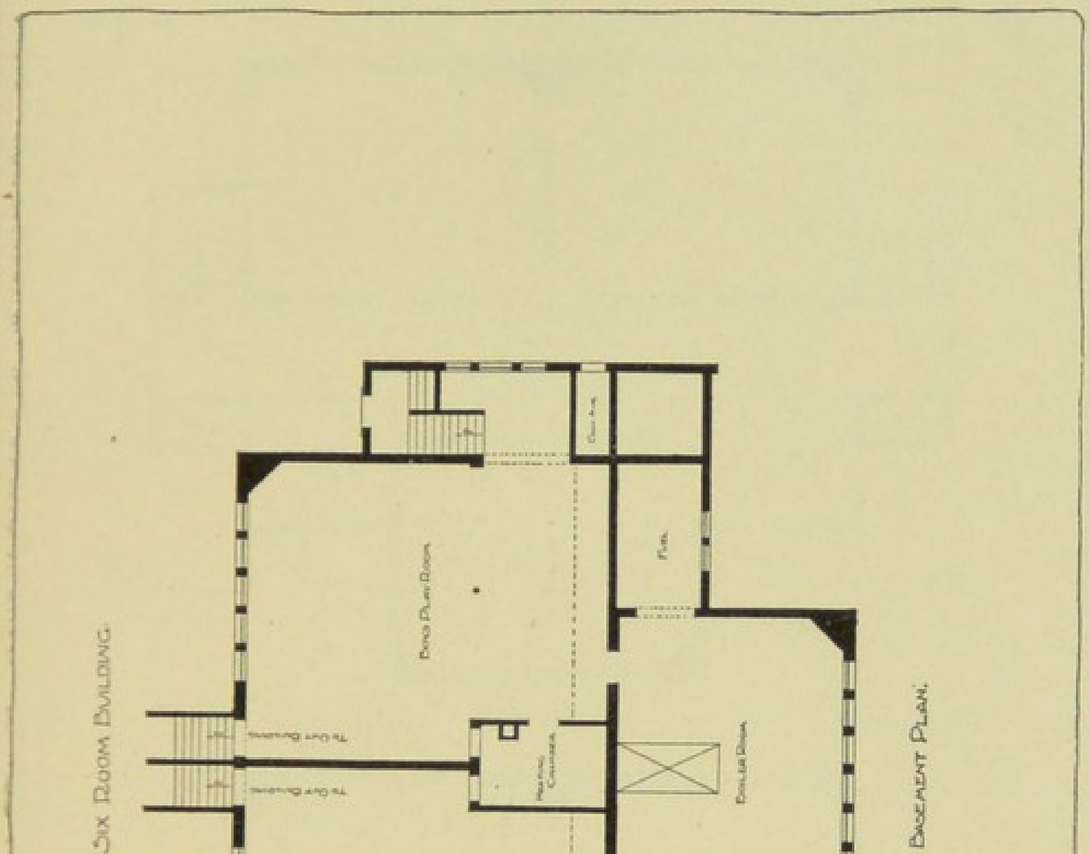


PLATE 17.

A SIX ROOM BUILDING.


A Six Room Building
Boys Play Room
Girls Play Room
Boiler Room
Fuel
Fuel
Basement Plan.

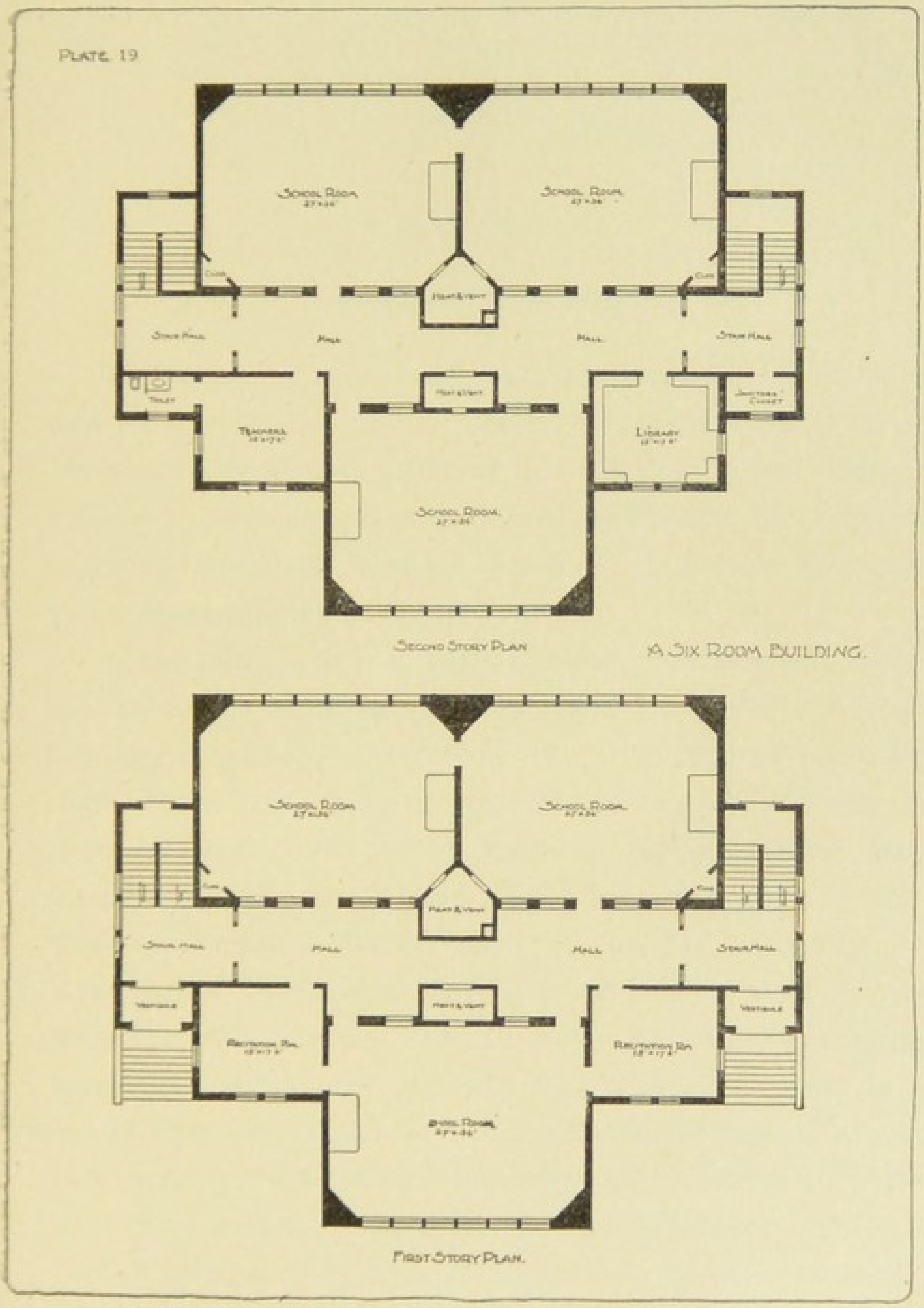


Plate 19
School Room
School Room
Heat & Vent
Stair Hall
Hall
Hall
Stair Hall
Toilet
Heat & Vent
Janitors' Closet
Teachers
Library
School Room
Second Story Plan
A Six Room Building.
School Room
School Room
Heat & Vent
Stair Hall
Hall
Hall
Stair Hall
Vestibule
Heat & Vent
Vestibule
Recitation Rm.
Recitation Rm.
School Room
First Story Plan.

CHAPTER VII.

READY-MADE PLANS.

IN the annual reports of State and local Boards of Health and Education, and in the reports of the Superintendents of Schools from various parts of the country, it has been customary to embody plans of school buildings; these in some instances represent finished buildings, but more frequently those contemplated or suggested.

If the authors or compilers of these reports would be content to simply make use of the plans of completed structures, or those in process of erection, when the reports are issued, and obtain from experts concise criticisms, pointing out defective, and commending desirable, features of the buildings illustrated, much good might be accomplished; for in this way common faults would be forcibly brought to the attention of those most deeply interested in such matters, with the natural result that in future building these defects would be avoided. It seems to me that such a course as this would represent the proper function of these reports as far as they may relate to school buildings and their construction; but when, either to make their reports more attractive, or with a misconceived idea of improving school architecture, they go further and present "ready-made plans," they certainly place themselves in a false and unenviable position, and actually injure instead of benefit the interests that they so unwisely attempt to improve.

Few, indeed, are the architects of good standing in the country who will allow their plans to be published in this manner, unless it be to illustrate some article that has been prepared upon the subject. Even when this is done, sketches are usually all that are furnished, and for purely imaginary structures not intended for any particular locality or condition. Quite likely these sketch designs will be made use of by some zealous building committee who consider the legitimate employment of an architect entirely unnecessary, yet are perfectly willing to appropriate his ideas. Some local contractor will be consulted as to his ability to erect a building like the one illustrated; he will undoubtedly assert that he not only can do this, but will be able to improve very much upon the building shown; so a contract is entered into with him, and the building erected by the contractor, substantially according to his own views, not in any way as the structure was originally intended to be. Not only are changes made in the plans and elevations, but the hygienic and sanitary features, not being understood, are utterly disregarded; probably the building will be placed upon a site and with surroundings that are totally unsuitable for it, no thought having been given to adaptability or harmony.

In this connection it is well to remember that a building to look well when completed must be designed with special reference to the position that it is to occupy, and that structures which are extremely pleasing upon one site will become a blot upon the landscape when injudiciously placed upon another.

In a practice of over twenty years I have never but once attempted to erect two buildings from identically the same plans, upon entirely different sites. The result in this case was disastrous, for the building which looked well upon the lot it was designed for was very unsatisfactory when erected on the site unsuited for it.

Let me say just here that the great majority of the designs of this work have not been studied for any definite site or location, but are presented to illustrate certain principles in which I thoroughly believe. Probably there is not one of them but that would have to be modified to a greater or less degree to properly meet the requirements of a school or the peculiarities of its site. Modifications can undoubtedly be satisfactorily made in any of the designs, provided careful study and thought are given to the problem; but this should invariably be done by the creator of the design, and not by those who cannot be in touch with the true spirit of it.

Ready-made plans, like ready-made clothing, never quite fit, and are just as easy of detection in one case as in the other. It is simply a penny-wise, pound-foolish policy to make use of them. In the beginning money may be saved by not obtaining first-class professional advice, but in the long run this expenditure will be more than balanced by poor planning, careless construction, ignorance in not taking advantage of feasible opportunities, and a general inadaptability of the completed structure. Innumerable cases of this kind occur to me, and I frequently have been consulted in regard to buildings that it was claimed had been erected in strict accordance with a design of a model schoolhouse published in some report. It is hardly necessary to add that upon investigation this was not found to be the case; radical departures had been made in many vitally important details, and the failure of the building was not due to the original design, but to the way it had been mutilated during its erection by unskilled hands.

A notable instance of an attempt to foist "ready-made plans" upon school committees is that of the Department of Public Instruction of the State of New York. Upon application they will furnish free of charge to any resident of the State lithographic copies of plans and specifications of a number of school buildings, ranging in cost from six hundred to sixteen thousand five hundred dollars. These plans, with some others, have also been published in book form and circulated by the State Board of Instruction. The designs were obtained in the year 1888, through a competition instituted by the New York State superintendent of Public Instruction, who, on the 20th of September, 1887, issued a circular inviting the architects of the country to submit competitive plans and specifications for school buildings of different sizes and cost. The superintendent was actuated, he states, by a desire to supply school officials with the most modern and artistic designs for the erection of low-priced schoolhouses. Six classes of buildings were called for, and as I had on hand sketch-plans of buildings that very nearly fulfilled the requirements of each class, I sent them in, and in January, 1888, was notified that I had been awarded special commendation in classes 3, 4, 5, and 6, this notification being accompanied with a request to forward at once complete working plans, details, and specifications for each of the buildings; it was also stated that "special commendation" insured the publication of my designs in the forthcoming report. A reply was immediately sent stating that I did not care to have my designs published and that I would not under any consideration furnish working plans, details, and specifications, and asking, as I had received no prize and therefore was not in any way indebted to the State, that my drawings be returned to me. This request was refused, and in spite of my vehement protestations my drawings were all retained and four of the designs published in the report.

The State Superintendent states in the introduction to the report that full working drawings, details, specifications, directions, contracts, and builders' estimates for eleven of the designs presented will be forwarded upon application, *free of charge*, when the department shall be notified by the proper authorities that a district has voted to erect a school from any of the designs shown. I am glad to say that four others refused with me to furnish the working plans, details, and specifications; so that in eight instances they cannot be obtained except through their authors.

The bait so temptingly offered to school committees is most alluring. The fact that it is possible to obtain free of charge working plans, details, and specifications of a model school building is so very satisfactory that no attention is given to fitness of the design selected; they are taken as they come, and turned over to the local builder, who, as I have before said, does about as he pleases with them.

I have seen some of these buildings after completion, and found them so much changed and mutilated that the good features which they originally contained were completely obliterated; some I found placed in positions that completely ruined their architectural effect, and in no single instance did they come anywhere near that degree of excellence the designer intended to obtain. From the State Superintendent's point of view this would, of course, seem particularly unfortunate; but from my own it appears a just retribution. To me it is a most undignified proceeding for the great State of New York through her paid agents to be "hawking" architect's work and peddling out, free of charge, working plans of buildings that have been designed for no particular location, and that are to be constructed without competent professional advice. If a State is to pursue such a course as this, why confine it to school buildings? Why not establish an architectural mill at Albany and grind out at short notice and, of course, "free of charge," plans and specifications for city and town halls, court-houses, churches, hospitals, libraries, jails, and all other public and private structures? Perhaps in this way a uniform "American style of architecture" might be evolved without expense or trouble.

As to the eight designs published without working plans, details, and specifications, I can say concerning my own four that in the past eleven years innumerable letters have been received inquiring my terms for furnishing that which the State was unable to supply. A reply was always returned stating that my services were at the committee's disposal, at the usual recognized charges, and that I should be pleased to serve them to the best of my ability. Although scores of applications have been received, in not a single instance have my terms been accepted. I am well aware that buildings have been erected from my designs, but not under my supervision nor in a way that I should recommend; and I do not doubt that the other gentlemen who pursued the same course as I have had a similar experience. I shall probably be accused of mercenary motives in my criticisms of the methods of the New York State Board of Instruction. Some may say that through chagrin at non-employment my judgment is too biased to be just. To such charges I simply answer that the competition was entered (very foolishly, I admit) without expectations other than those realized, and that when I was honorably mentioned I was perfectly satisfied, and tried in every possible way to withdraw my designs and let the matter drop. Furthermore, even at this late day I still regret exceedingly that they were published, for the reason that under the conditions with which they are surrounded no good can result from their continued use. Eleven years have elapsed since they were prepared, and I do not believe that there is an architect who submitted a design at that time who would be willing to send in the same thing to-day. We live in a progressive age; improvements are made almost yearly in everything, and the planning and construction of school buildings is no exception to this rule. Those things that we did with complacency yesterday will not satisfy us to-morrow. All of us have skeletons in our closet,—designs prepared or work executed which we are slow to acknowledge as our own. To the progressive man this must always be so, for he who is contented and satisfied with what he has done, and makes no determined effort to improve upon it, is a conceited sluggard who will be left stranded on the wayside by the steady onward march of progress.

Do not let it be inferred that I am opposed to the publication of designs by those interested in school matters. On the contrary, I am very much in favor of it when it is done in a legitimate manner, as I believe, if it is done judiciously, it would be very beneficial. If State and local Boards of Instruction or Health would pay reputable architects a fair compensation for "sketch designs," or if they must do it in the other way, offer suitable prizes for the best "sketch designs" submitted, and publish only these, clearly stating when they are issued that they represent at that time the most advanced ideas of some of the best-known specialists in school construction, and giving their authors full credit for them, they will have taken a great stride in the direction of advancing the standard of excellence in the designing and construction of school buildings. But when they go further, invade the architect's domain, and attempt to furnish the public at large with that which it is his legitimate business to do, they are entirely out of their element and cannot be expected to obtain satisfactory results.

I cannot understand why members of my profession should be foolish enough to furnish working plans, details, and specifications for such a purpose, which are to be reproduced *ad libitum*. It seems to me to be a most impertinent thing to ask them to give away for a paltry consideration their best ideas—in fact, their stock in trade, which they have spent the best years of their life in acquiring. Would it be expected of any other professional man? I think not. Why, then, is the attempt made to impose on the architects and get them to do what would not be expected of others? Simply for the reason that the value of the true architect's services are underestimated; he is deemed a luxury, when he ought to be considered a necessity; the people at large have not learned that it is ultimately much cheaper to pay for first-class professional advice than it is to accept free of cost an inferior article.

Ready-made working plans and specifications furnished in book form by the so-called architects who advertise their wares extensively are to be shunned even more than those already referred to. They are to be classed with the patent-medicine and other nostrums with which the country is flooded; and it is safe to class the authors with the quack doctors who perform such wonderful cures through the newspapers. Who ever heard of eminent physicians, lawyers, or engineers advertising themselves or their doings through the public press? When this course is taken by a member of either of these professions, his true status is at once determined by his brethren: if he is truly skilful or a genius in his special line, he will not require printer's ink to have it become known; that is to say, he need not use it himself—his worth will be quickly recognized and full credit given him for his skill, perhaps not at first by the masses, but by those of his own craft whose opinions he most values.

Every thinking man knows this to be true, and many are fully aware of it when they make use of plans prepared by architects who have had absolutely no training or standing in the profession. Why they do this is a mystery to me, unless it can be explained by the words of that illustrious townsman of mine, the famous Barnum, who always maintained that the American public loved to be "humbugged."

To sum up briefly, avoid, if you would have really good buildings, all ready-made plans. No matter how much they may be recommended, have your building designed by a competent man to meet your wants, and with special reference to the position it will occupy. If you have seen some plan which particularly pleases you, or you know of some building that you think will very nearly meet your requirements, call the attention of the architect you may employ to these points, and let him investigate them. If they are worthy of consideration, he will tell you so; and if they are essential in your new building, he can undoubtedly incorporate them in it. But do not, under any consideration, let some local builder undertake to make over and improve some plan or building that you have in your mind; you can rest assured that such a course will result unsatisfactorily, and that when you have completed the building, it will fall far short of what you had expected it to be. If this course were to be taken with every new school building erected, it would quickly change their complexion, so that in the near future they would be fully up to the standard of our educational systems, in fact outrank any other class of buildings in the country.

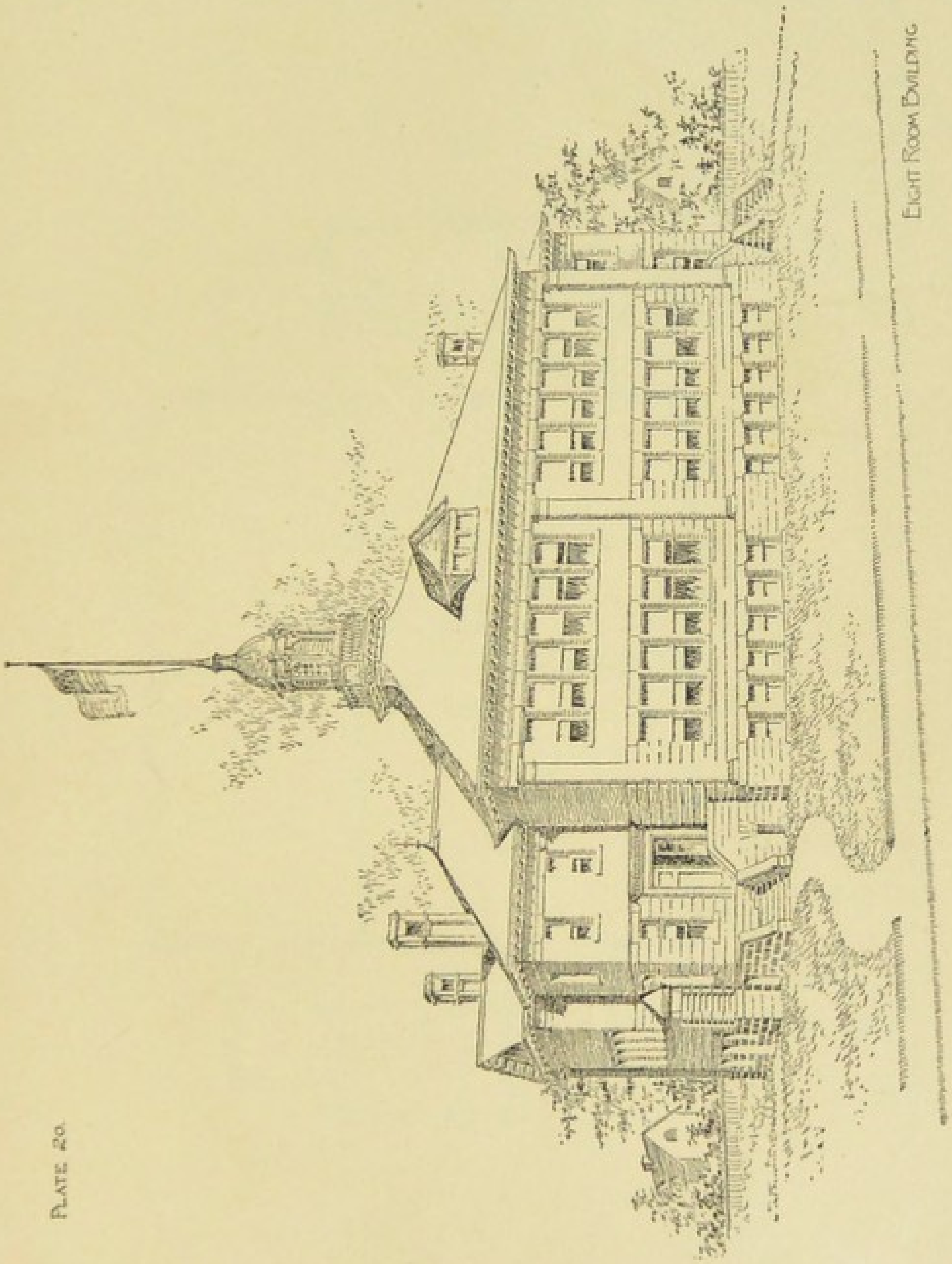


PLATE 20.

EIGHT ROOM BUILDING

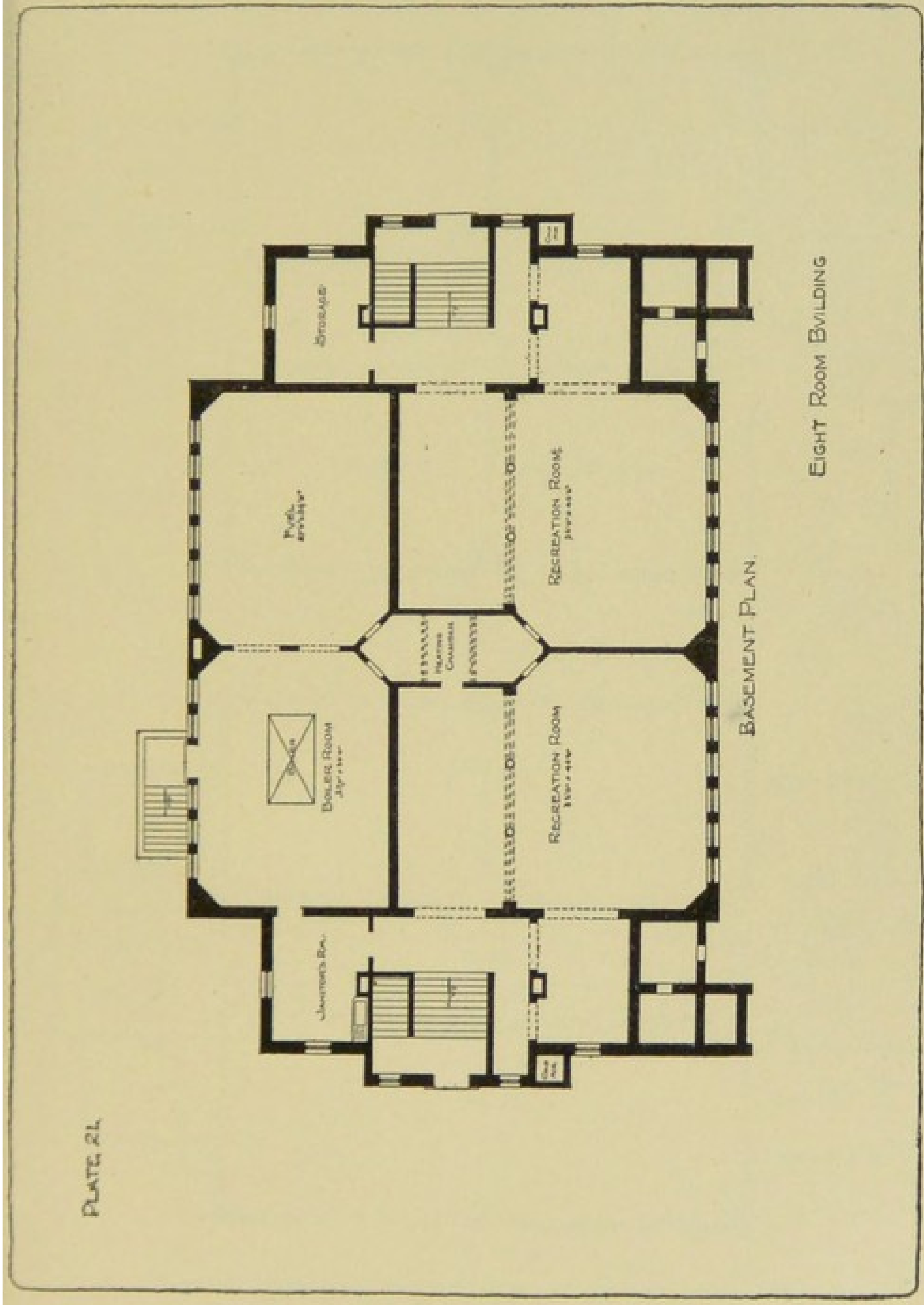
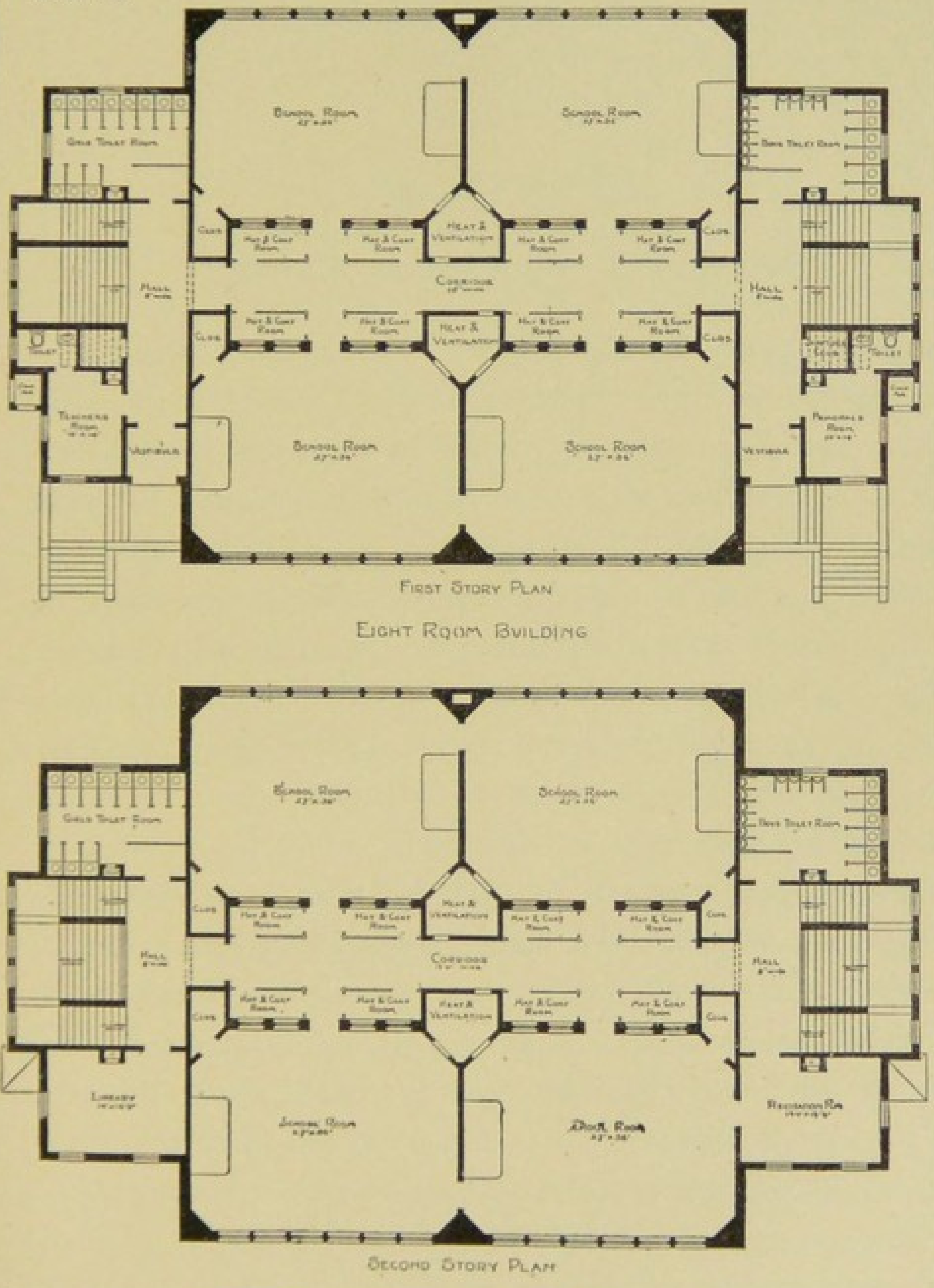


Plate 21
Storage
Fuel
Recreation Room
Heating Chamber
Boiler Room
Recreation Room
Janitor's Rm.
Basement Plan.
Eight Room Building

PLATE 22.



FIRST STORY PLAN

EIGHT ROOM BUILDING

SECOND STORY PLAN

CHAPTER VIII.

ENTRANCE-HALLS AND STAIRCASES.

In former articles I have laid great stress upon the mistakes usually found in this department of school construction, and I wish to take the subject up once again and explain more in detail what I have previously said, and what from my point of view the mistakes consist of, using, to better illustrate my meaning, sketches taken at random from the plans published in the various architectural journals of the day. Should any of these sketches be recognized by their authors, I beg of them not to consider that in making use of them it is my intention to reflect in any way upon their professional skill, but that I am simply using, perhaps in a very free way, existing plans to illustrate certain arrangements of halls and staircases that in my judgment are not the best or most satisfactory way to treat them. It is not necessary to argue that entrances should be liberal and direct, that the halls should lead you as quickly as possible to the staircases, and that the staircases should be well lighted, of easy tread and rise, and as nearly fire-proof as it is possible to make them. All these requirements will be readily admitted, and in many instances it will be confidently asserted that they have been fulfilled. This I do not admit, for it is very rare to find a fully satisfactory arrangement even in the most expensive structures. For example, in Sketch 1, Plate 23, a very common arrangement is shown, which is open to severe criticism. It is obvious that the pupils occupying the second floor, entering the building either at the principal doors, *AA*, or the minor ones, *BB*, will have to traverse more or less the lower halls, *CCC*, in order to reach the staircases, *DDD*, and in so doing either pass directly or in close proximity to the several room-entrances, *EEE*. This mingling of the pupils of the two floors and presumably different departments in the lower halls can only result in confusion and noise, which will be more or less augmented by the rapidity of the pupils' movements and the discipline to which they are subjected. If, as is frequently the case, the pupils of the upper floors are dismissed before those of the lower, they are forced to descend almost directly in the centre of the building and pass through the lower halls before they can reach the outer air; this cannot be accomplished noiselessly, consequently the occupants of the lower rooms are bound to be more or less disturbed. All this is objectionable and can and should be obviated in every well-planned structure. In Sketch 2, Plate 23, there is indicated a somewhat different arrangement, but which has the same faults. Sketch 3, Plate 23, illustrates still another method, which is quite as unsatisfactory as either of the others. None of these studies is especially novel, nor do they differ materially from scores of buildings that can be found in every large community. But while I maintain that the arrangement of the entrances and halls is unsatisfactory, they are not, to my mind, one half as much so as the situation and general construction of the staircases. All of these are of the style known as the open stairs, in which newels, rails, balusters, and open wells are freely made use of. I cannot too strongly condemn the introduction of this method of constructing staircases in school or other public buildings where there are to be large assemblies of people. At their best, they are a constant menace to life and limb; in the case of a sudden rush to them by the occupants of the upper floors, it is almost impossible to restrain the more impetuous from climbing over these flimsy guards in their efforts to get down and out. Moreover, the danger of the rails and balusters giving way entirely when the rush comes is great, as they are seldom built with sufficient stability to resist even a moderate pressure. I have in former articles repeatedly called attention to these evils, and cited one instance, in the city of New York, where a terrible disaster occurred in the middle of an afternoon session by which fifteen lives were sacrificed on just such staircases as I have here illustrated; this, too, when scores of people were passing the very doors of the building, when the fire department, said to be the finest in the world, was called and responded promptly, when willing hands and stout hearts did all that human power could to rescue the little ones, who it is claimed were splendidly disciplined and had been carefully instructed in a fire-drill to meet just such an emergency. But of what avail was all this, when one, more nervous or frightened than the rest, lost her footing and fell headlong on that fatal staircase? Who could prevent the force of those hurrying from above, checked for a moment, spreading out, and in so spreading creating a pressure against the frail stair-rail, causing it to give way with a crash that would have caused the majority of adults to lose their presence of mind? Who can blame the children if they did become frenzied, and those above, in their mad efforts to get down, force those below through the fatal aperture, until they were piled in a struggling mass in the hall below, from which within a few minutes fifteen lifeless little bodies were taken? This terrible disaster occurred more than a dozen years ago, but the fearful lesson has been almost totally disregarded. Stringent laws should have been enacted prohibiting the occupancy of any building for school purposes that was equipped with the open staircase, with its accompanying rails and balusters; and I say that it is simply criminal to permit their continual use and introduction into new buildings. No one will deny but that the disaster just referred to would have been averted had the staircases of that building been constructed upon safe principles. There are hundreds of buildings scattered all over this great country where the same methods of construction have been used and where there needed only similar conditions to produce disasters as terrible as this one. If this is doubted, I would ask you to examine school buildings that you are more or less familiar with, many of them erected since the time mentioned, and by so doing satisfy yourself of the correctness of these assertions.

It is astonishing to me that so few accidents occur, and I can only attribute it to the exceptional care taken by those in whose charge the children are placed, and to the indulgence of a beneficent Providence. Another strong argument against placing the main staircases in the central portion of the building is the increased danger of fire to which this position renders them liable. For good and sufficient reasons the heating apparatus is usually centralized. If a fire occurs, it starts nine times out of ten at or near the boilers or furnaces, and the chances are that the staircases, the principal means of exit, will from their situation become in an incredibly short

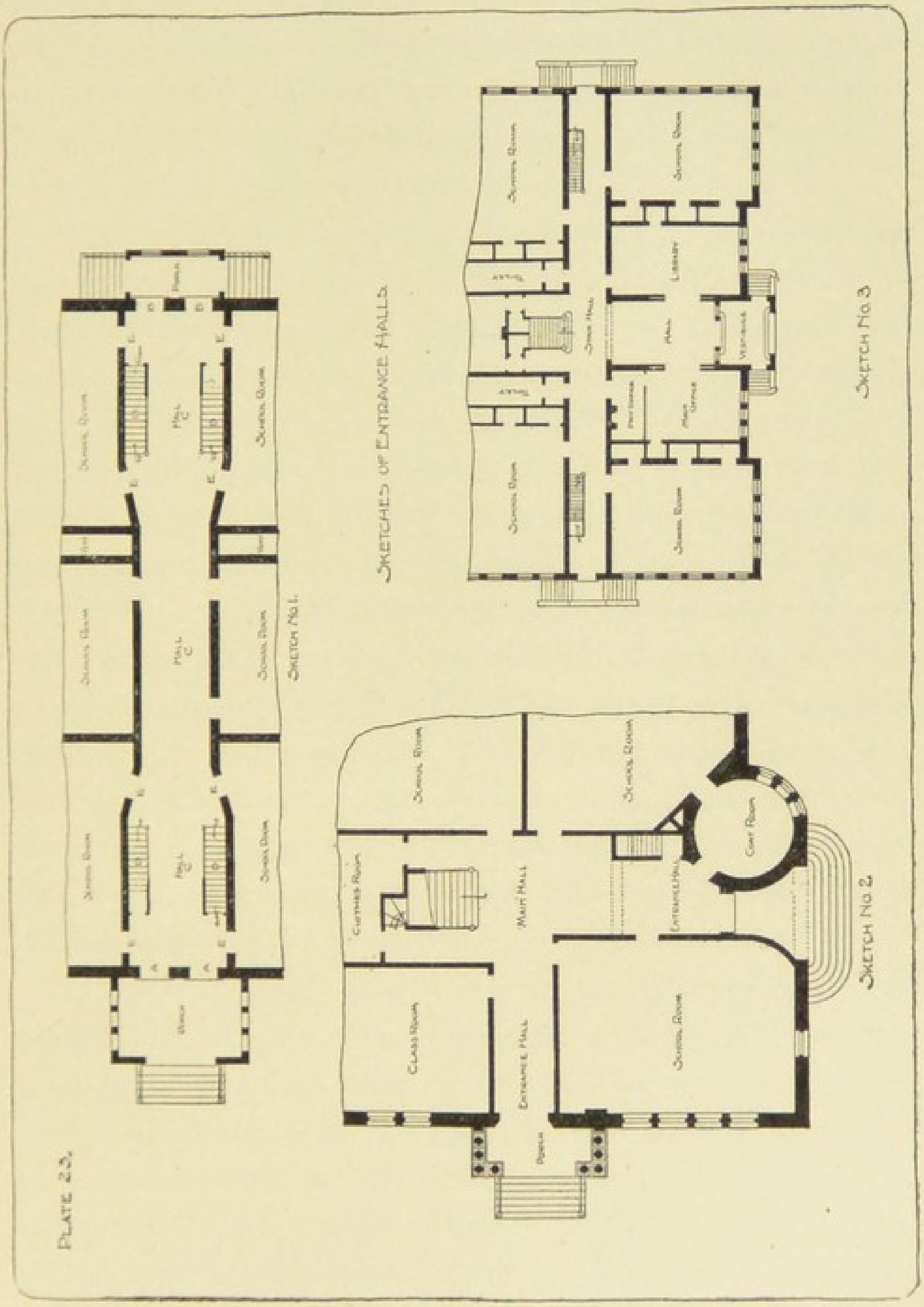


Plate 23.
Sketches of Entrance Halls
Sketch No. 1.
Sketch No. 2
Sketch No. 3
School Room
Hall
Porch
Class Room
Entrance Hall
Main Hall
Clothes Room
Coat Room
Library
Stair Hall
Vestibule
Main Office

space of time enveloped in smoke and flame and rendered useless. The main avenue of escape is thus shut off, and the occupants of the upper floor are forced to seek an exit by narrow minor staircases or fire-escapes, if the building is fortunate enough to be provided with them.

I have said that I believe it is criminal to build and place staircases as they are found in the great mass of school buildings, for there is not the slightest need of it, nor any good reason why they should be so constructed. It is simply the fault of the designer, whose ignorance or total disregard of the true principles of safe construction as applied to school-houses causes him to fall into these errors by which hundreds, yes, thousands of lives are continually jeopardized. Do not infer that I would increase the expense, sacrifice the convenience of the plan, or render the ease of entry or access to any part of the building more difficult by arranging the stairways differently; on the contrary, I would gain decidedly in these respects, as well as in those of sound construction and safety. A careful examination of the various plans shown in this work will, I am sure, convince any one that what I claim is both feasible and true.

There can be no question as to the desirability of prohibiting the introduction of open or centrally located staircases into any school building occupied upon more than one floor, and it seems to me that the best way to accomplish these ends would be by State legislation. If a law were enacted making it a misdemeanor to build or equip a building in this manner, committees would be obliged to insist upon its enforcement, and the architects to govern themselves accordingly. If I were to draw up a code to regulate this matter, it would be formulated somewhat in the following manner:

First. That all staircases shall be built where possible *outside* the main walls of the building.

Second. That stairways shall be placed at both ends or sides of the building, so that in case of fire or accident two independent and isolated exits are available.

Third. Stairways shall be of the style known as box-stairs, with dividing walls or partitions between the runs extending from floor to ceiling, and that there shall be no open wells, rails, or balusters allowed in any building.

Fourth. That all stairways shall have at least one broad platform or landing in the height of any one story, and that there shall be provided, on each side of all runs, neat hand-rails (brass or iron preferred) that shall be supported on strong metal brackets, firmly bolted to the walls.

Fifth. That no stairways shall be less than four feet wide in the clear, where there are more than one hundred pupils on a floor, and that the staircases, unless they are increased in number, shall be added to at the rate of one foot in width for each story, and six inches in width for each additional hundred of pupils.

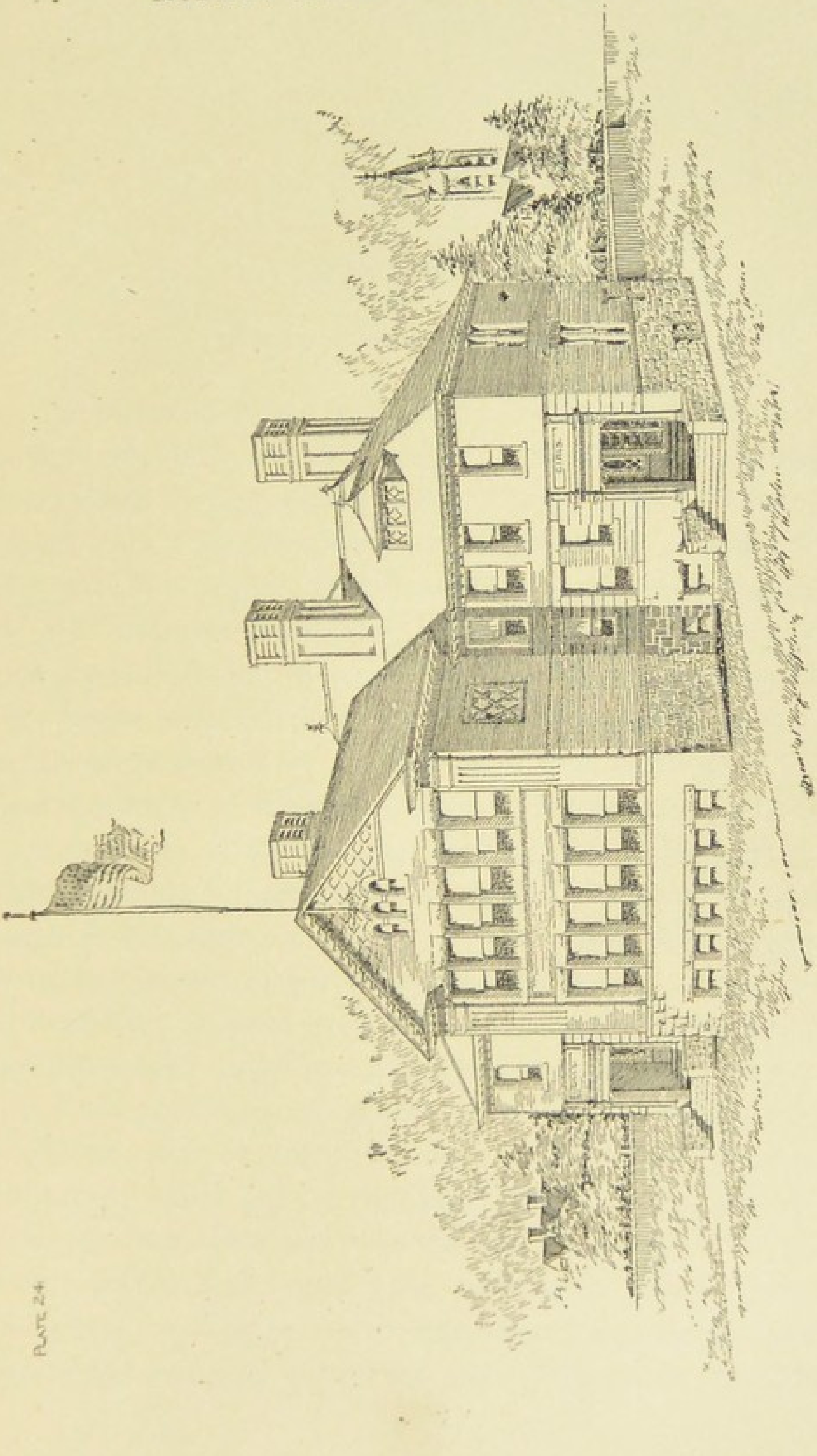
Sixth. That the main staircases in all buildings that are occupied upon more than one floor shall be so arranged that the pupils of the upper floors can enter or leave the building or ascend or descend through it to the toilet- and recreation-rooms without entering or passing through any hall or corridor of the building except that out of which their own rooms open.

Seventh. That all staircases shall be well lighted by direct light, that the windows shall be placed upon the landings if possible, and that the stools of these windows shall be at least four feet from the floor of the landing.

Eighth. That all staircases shall be either fire-proof or constructed on the slow-burning principle.

Build them with solid walls of common brick if you have little money, pressed brick if you have more, and glazed brick if you can afford it. Where possible, use sawed blue-stone or rubbed slate, built directly into the walls, for treads, risers, and platforms, or good smooth castings of iron; if these are too expensive, hard-wood stairs, made extra heavy, with the stringers and supports bolted directly to the walls with expansion-bolts, will answer the purpose. Avoid all studding, furring, and unnecessary sheathing, and, above all things, lath and plaster. Some will claim, undoubtedly, that the theories here advanced cannot be successfully incorporated in all classes of school buildings, but I assure you that in all my practice I have never known of an instance where I could not have introduced all of the features here advocated. That it has not always been done in the buildings entrusted to me, I am free to admit; but it could have been accomplished, and the reason for not doing it was either that I was so hampered by the committee that it was impossible, or that I did not have the means to build properly. By referring to the plates of the larger buildings numerous examples of staircases constructed strictly upon the principles here laid down will be found. If you have a liberal allowance of money at your disposal, use it in making your building safe and sound, and not in undue elaboration or senseless decoration. A schoolhouse, to my mind, is a workshop, or, as the French say, an *atelier*, occupied for a limited period only each day for mental labor more or less severe. This should be impressed as much as possible upon the minds of the pupils, while their surroundings should be, from the hygienic point of view, as perfect as possible, and good taste shown throughout in the furnishing and equipment. There should be no ostentation or vulgarity in ornamentation or decoration, or that which is in any way liable to distract or permanently leave its imprint upon the mind of the pupil.

School buildings, unless the gift of some individual who desires to perpetuate his name, are not monumental in character; and, as they are erected by the taxation of the people for the use of their children, it is obvious that no more money should be expended upon them than is necessary to secure a perfect building inside and a pleasing one outside. It is a hard lesson for the masses to learn, but I hope some day that the great American public may be made to understand that good architecture does not consist of fantastic shapes and sharp contrasts, or that objects that are ornate must necessarily be artistic. For myself, I would rather see a building as plain as the proverbial barn, so it be well planned and soundly constructed, than the most elaborate edifice ever erected that is faulty in these respects. I should much prefer to obtain a reputation for the reason that I had planned well and constructed soundly rather than because I had designed cleverly and disregarded everything else. Of course the ideal architect is the one in whom both functions are happily combined, but they are like angel's visits, few and far between. In choosing an architect, take the practical man, even if you find him less artistic, for the health, comfort, and safety of your children are more to you than the finest artistic effects.



FOUR ROOM BUILDING WITH HALL

PLATE 24

CHAPTER IX.

WINDOWS AND LIGHTING.

PROBABLY more has been written concerning the amount of light required, and the way that it should be introduced into the schoolroom, than about any other feature of school construction. So voluminous and reliable is the data obtainable upon this subject, that it would appear almost impossible that mistakes could occur in this department; but upon critical examination it is found that the average structures are little better in this respect than they have been shown to be in the arrangements of the entrances and stairways. The generally accepted standard of lighting is that there must be an actual area of *exposed glass surface* that shall equal one sixth of the floor-space of the room; and I believe this to be ample if it is arranged properly. It has been the custom of those best posted to introduce the light at the back and left of the pupils. I have in former years advocated this system; but from long experience, close observation of rooms in actual use, and from the opinions obtained from teachers and pupils who have occupied the rooms, I have of late been led to discard where possible the back light entirely, and rely only upon that obtained from the left. My reasons for this I will explain more fully upon subsequent pages. Before doing this it will be well to consider what a well-lighted room for school purposes should be. Unquestionably the light should be introduced into the room as directly as possible; as few obstructions should be placed in its way, in the shape of piers and mullions, as sound construction will allow. The distance it has to traverse to reach the remotest parts of the room should be reduced to a minimum; and I believe it should be concentrated at its introduction. It must not be assumed that because a room may have a certain number of windows whose combined openings equal one sixth the area of the floor-space it is *well* lighted, even when the windows are placed at the left and back of the pupils. This is not always the case, as can be seen by reference to Sketch 1, Plate 27.

Here we have a room 27×36, containing 972 square feet of floor-space, the room being capable of accommodating comfortably 48 pupils. The room is lighted by five windows: three on the left side of the pupils and two at their back. The openings through the walls are each $4' \ 2'' \times 8'$, a little more than one sixth of the floor-space. While the requirements of position and area have in a measure been lived up to in this case, the windows are badly placed and the piers unfortunately arranged. This is equally true of the three rooms shown in Sketch 2, Plate 27. None of these rooms are well lighted, for the following pertinent reasons:

First, the teacher from her position facing the pupils is forced to look directly into the light, which is extremely trying as well as injurious, and entirely unnecessary in a well-arranged room. True, it is possible to draw the shades and thus subdue the light, but in doing this there is a loss of direct light, which is detrimental to the pupils. There has been but one answer given by teachers when questioned as to this arrangement of windows,—it was found to be very objectionable; and if it were possible to obviate this evil, the rooms would be far pleasanter and the work of the teacher much easier.

Second, that large piers or wide spans between the windows not only seriously impede the light, but that the shadows they cast (as can be seen by reference to Sketch 3, Plate 27) are so heavy as to inconvenience the pupils to a greater or less degree.

If you wish to read comfortably, you will naturally seat yourself before or where the direct rays from the window will fall upon your book, and not in the heavy shadow of a large pier. But the pupil whose desk may unfortunately occupy such a position has no choice, and consequently must study in a poorer light than his more favored companion.

Third, that the light should be centralized as much as possible, and that there should be as little obstruction between the windows as is consistent with sound construction. If an artist builds a studio, he concentrates his lighting surface in one space, and would not tolerate piers or heavy mullions. It is the same in the construction of photographic galleries, and even in the modern factories; the whole sides of the structures are practically of glass. In these instances experience has taught the occupants that the best results can be obtained by this method of arranging the windows, and the lessons thus learned can be with advantage applied to the schoolroom.

Fourth, the spaces between the windows usually occupied by blackboards are of little use, and the more the windows are divided the greater number of spaces of this kind there will be. If, however, the windows are grouped together on one side of the room, there are three sides of the room, minus the door openings, available for the blackboards, which can from their position be seen easily from any part of the room.

The windows shown on the inner walls of the rooms in the plans of this work are invariably placed *above* the blackboards, on the same level as the transoms of the doors, and are of the same size and hung and operated in the same way. Their function is not only to light the inner halls, but in the warmer months, when artificial heat is not in use, to provide for a free circulation of air when the outer windows are opened a little at the top, directly across the upper part of the rooms and halls.

It must be admitted that the objections here raised to the ordinary method of lighting are pertinent, and if they can be easily overcome, without unnecessary expense, can there be any valid reason why the ordinary method should not be discarded ? I certainly think not. It will be well, however, in this connection to consider still further the question of piers and their effect upon the light area. It is hardly possible, even in the smaller brick buildings, to construct with safety the brick piers or mullions between windows less than twelve inches in width; in larger structures they need to be sixteen, twenty, twenty-four, twenty-eight inches, and sometimes piers of from three to four feet are required to obtain sufficient strength. To obviate the heavy shadows that these piers must cast, and to obtain the maximum strength with the minimum obstruction, I have recently introduced into my buildings, with marked success, iron mullions cast with heavy flanges or webs, as shown in Sketch 1, Plate 28. The window-frames are bolted directly on to these mullions, the outer portions of which are made wedge-shape, running very

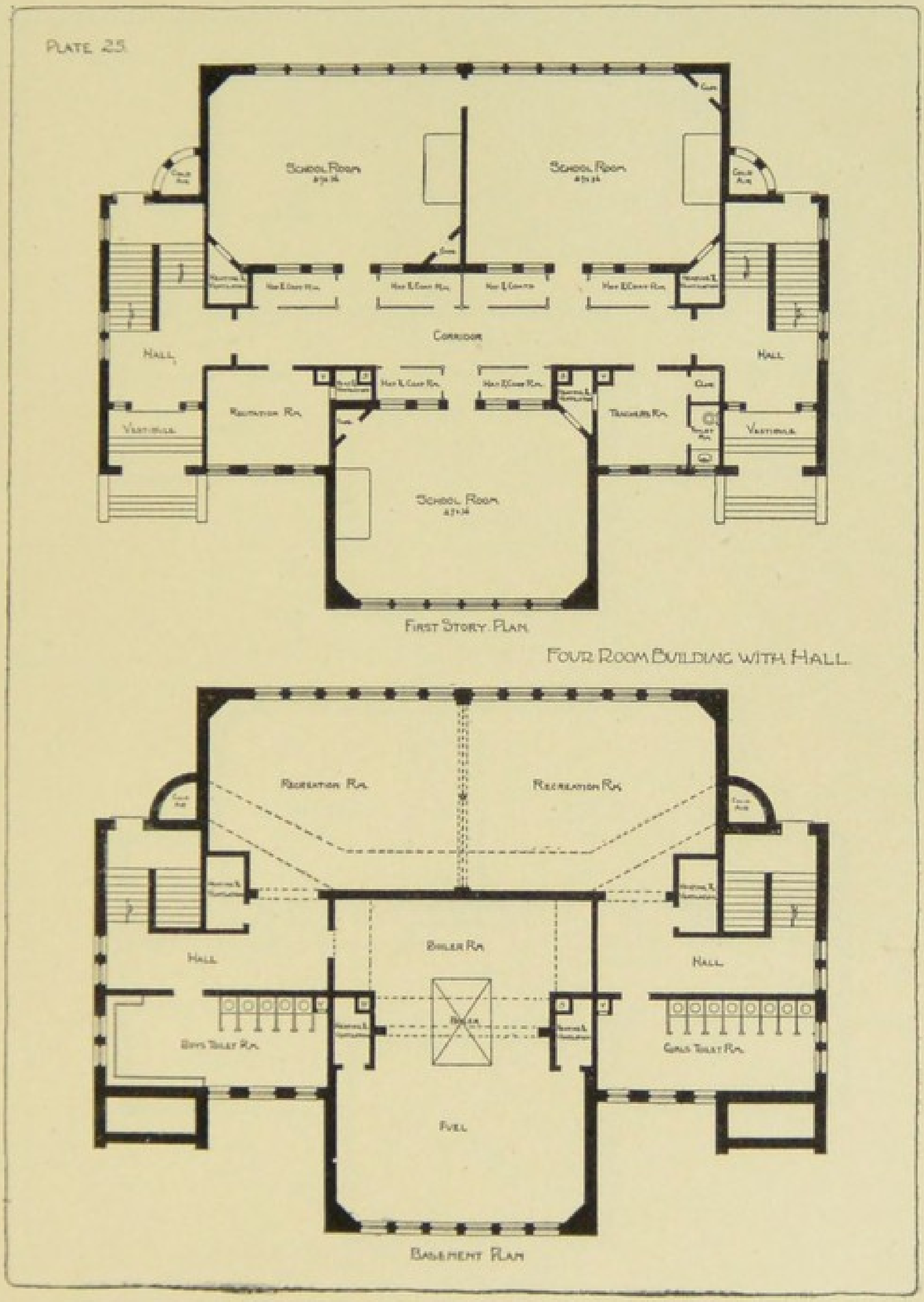


PLATE 25.
School Room
School Room
Corridor
Hall
Hall
Recitation Rm.
Teacher's Rm.
Vestibule
Vestibule
School Room
First Story. Plan.
Four Room Building with Hall.
Recreation Rm.
Recreation Rm.
Hall
Hall
Boiler Rm.
Boys Toilet Rm.
Girls Toilet Rm.
Fuel
Basement Plan

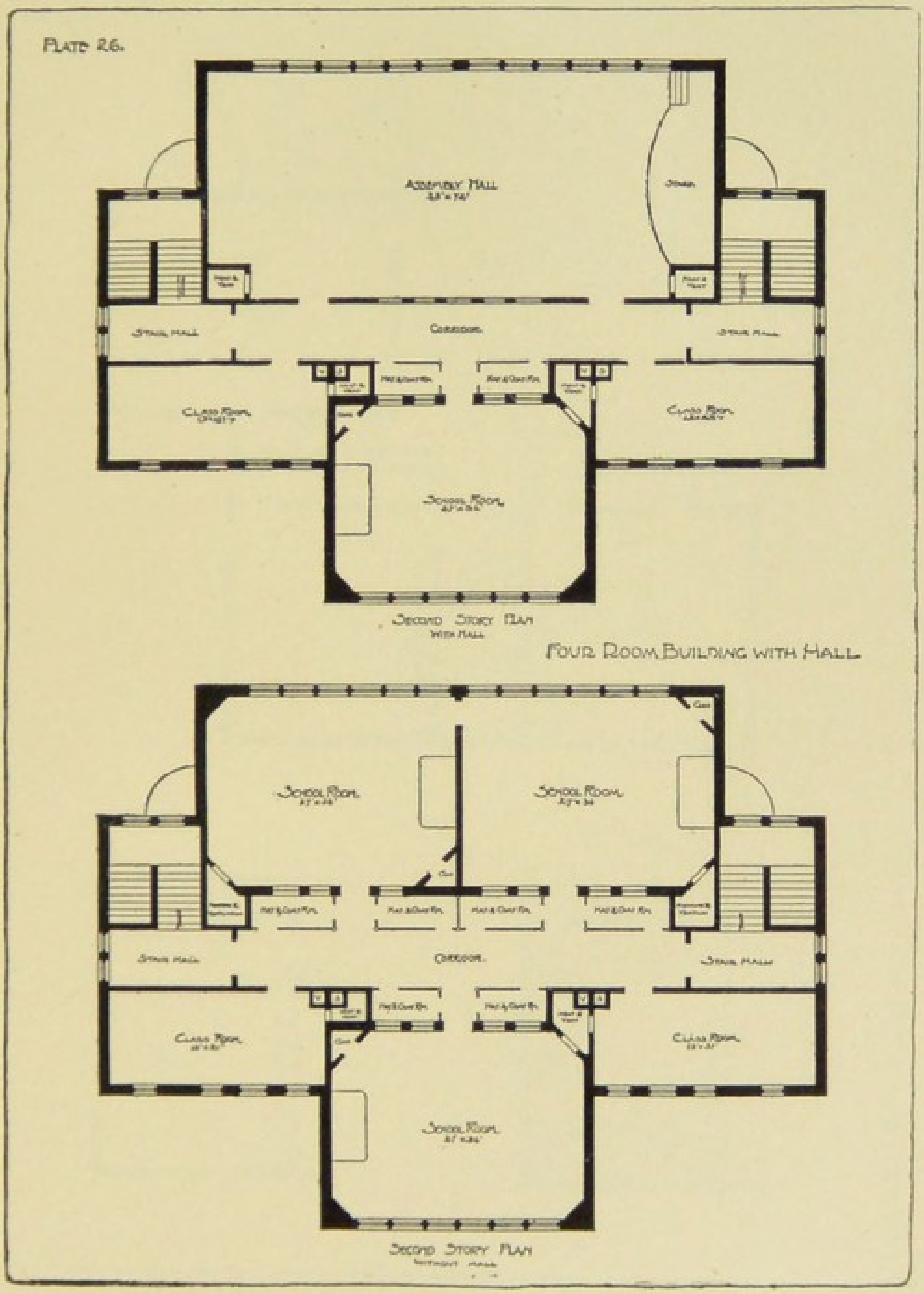
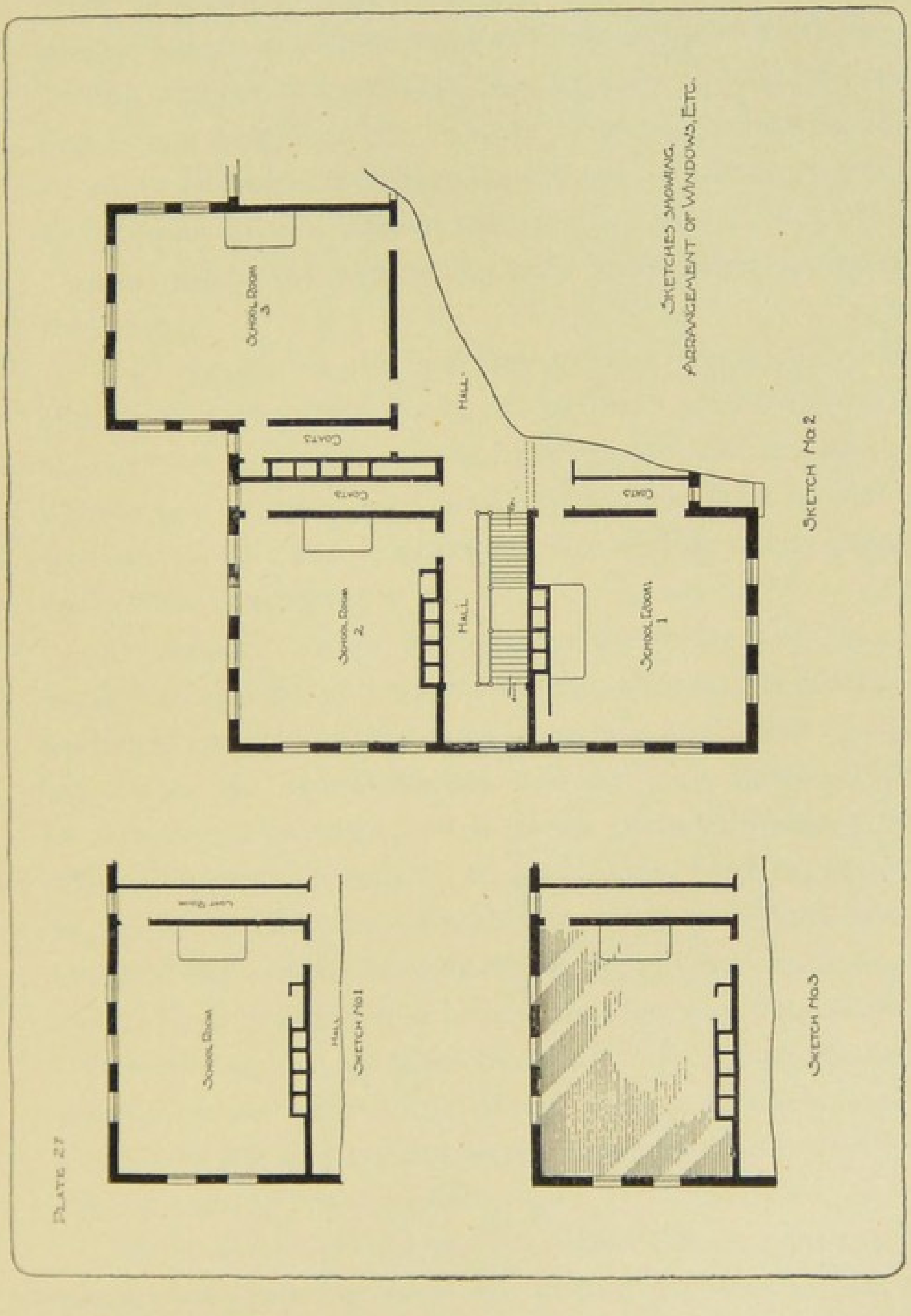


Plate 26.
Assembly Hall
Stage
Stair Hall
Corridor
Stair Hall
Hat & Coat Rm.
Hat & Coat Rm.
Class Room
Class Room
School Room
Second Story Plan
With Hall
Four Room Building with Hall
School Room
School Room
Hat & Coat Rm.
Hat & Coat Rm.
Hat & Coat Rm.
Hat & Coat Rm.
Stair Hall
Corridor
Stair Hall
Hat & Coat Rm.
Hat & Coat Rm.
Class Room
Class Room
School Room
Second Story Plan
Without Hall


Sketches showing Arrangement of Windows, Etc.
School Room 3
Hall
Coats
Coats
School Room 2
Hall
School Room 1
Coats
Sketch No. 2
Coat Room
School Room
Hall
Sketch No. 1
Sketch No. 3
Plate 27

nearly to a sharp edge. It will be readily seen that by this simple device very little more space is occupied by the supporting mullion or pier than that actually required by the frames and weight-boxes; in fact, the saving is so great that six windows can be introduced in the same space which would be occupied by five, having the ordinary 16-inch brick pier between them, the expense in both cases being practically the same.

The strength of the mullions can be regulated by the thickness of the shell and web, so that, with little or no change of outside dimensions, they can be used to support almost any weight. In small frame buildings a similar mullion can be made of hard wood that will be strong enough for ordinary purposes.

Schoolrooms shown in the majority of the plans in this book are constructed with this mullion between the windows, and they are more particularly illustrated in Sketch 2, Plate 28. Note the size of the shadows cast from these mullions as compared with those cast from the piers in Sketch 3, and who will have the hardihood to say that the room constructed as shown in the latter sketch is not better lighted and a better room to work in than those shown in Sketches 1, 2, and 3, Plate 27? I hardly believe that any one who carefully studies the various sketches here shown will contend that a schoolroom can be well lighted if it simply have windows of a sufficient size and number placed at random in the walls at the back and left of the pupils.

About the only valid objection that can be raised to the massing of the windows on one side of the room is that the large glass surface will radiate a vast amount of cold in severe weather, and in this way render the seats occupied by the nearest pupils uncomfortable. This objection can easily be overcome either by the use of the double sash (which I would recommend in the northern portion of our country) or as described in the chapter devoted to heating and ventilation. If double sash are used, they can be fitted in the usual way directly to the blind-stop (Sketch 4, Plate 28). One or two of them in each group of windows should be hinged at the top and operated with a rod and suitable fastenings at the bottom, so that they may be readily opened for flushing purposes (Sketch 4, Plate 28).

It may also be said that inside blinds cannot be used to advantage, and that the ordinary shades will not be satisfactory. As to the former of these objections, the ordinary inside blinds are to my mind unsuitable for use in the school-room; they take up too much room, are noisy, hard to handle, and extremely liable to get out of order. I much prefer good opaque shades, using two for each window, hung as shown in Sketch 4, Plate 28. This method of hanging permits the shades to be raised and lowered from the centre with the sashes, and prevents the flapping that is so annoying when the sashes are lowered from the top in warm weather, where the shades are hung in the ordinary manner.

The exterior effect of buildings with the windows massed is more satisfactory to me than when they are widely separated. Broad wall-spaces are pleasing and restful to the eye, and add, if skilfully handled, strength and dignity to the structure. Besides, the openings for staircase and for assembly-hall windows, which do not need to be grouped, combined with the entrances, and windows that may be used for hat-and-cloak-rooms, will certainly give a variety of line

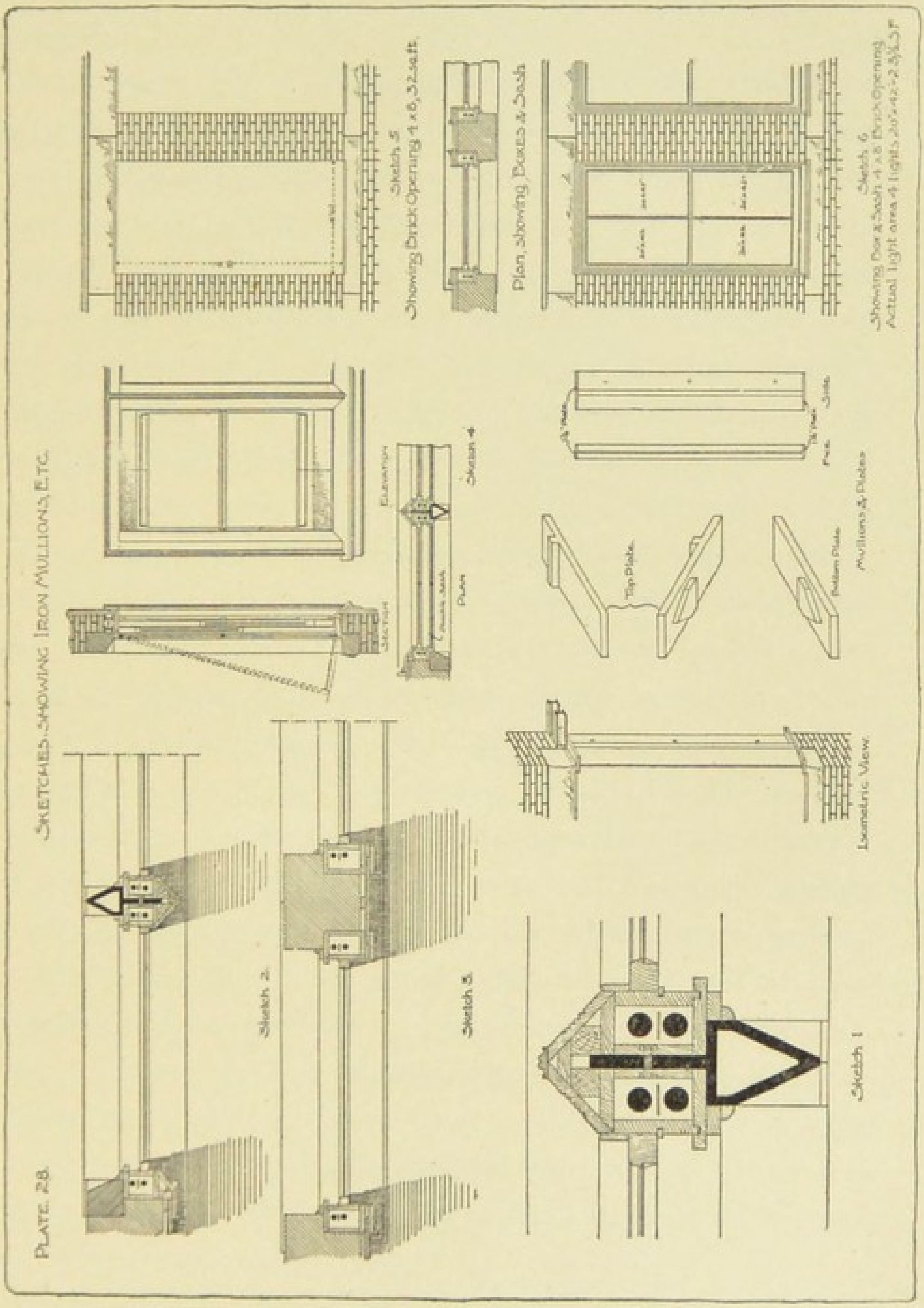


Plate 28.
Sketches Showing Iron Mullions, Etc.
Sketch 1
Sketch 2
Sketch 3
Section
Plan
Elevation
Sketch 4
Isometric View
Top Plate
Bottom Plate
Mullions & Plates
Sketch 5
Showing Brick Opening 4 x 8, 32 sq. ft.
Plan, showing Boxes & Sash
Sketch 6

and detail that will be ample to secure harmonious and artistic results.

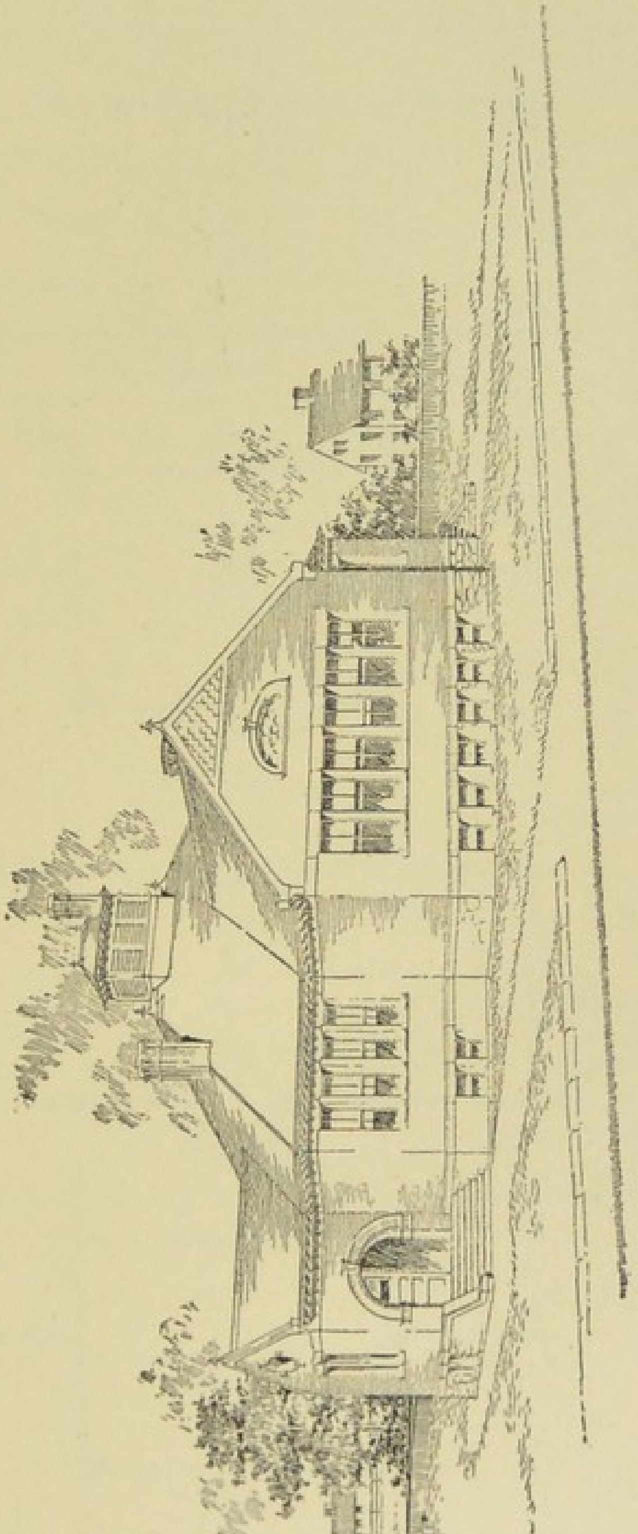
One other and a very important thing which must be remembered in figuring the lighting-surface of a room is that the actual openings through the wall do not represent by any means the true area of the glass surface. This fact is almost invariably lost sight of. I am frequently shown rooms in the best of our buildings where it is confidently asserted that every requirement as refers to the proper lighting has been complied with. "Notice, please," the superintendent or principal will say, "that our rooms, that are 24 × 36 in size, contain five windows, each 4 feet wide by 8 feet high, a total of 160 square feet; so we are in excess of the amount needed." This calculation would be perfectly correct if the whole opening were available, but there must be deducted from this the area of the boxing, frames, and sash, as can be seen by reference to Sketches 5 and 6, Plate 28. This is very considerable, actually reducing the glass-area of each window, as they are ordinarily constructed, to 23⅓ square feet, consequently five openings through the wall instead of having a lighting capacity of 160 square feet have only 116⅔ square feet, so that there is really in the room seven and one half times as much floor-space as there is glass-surface in the windows. It would be well for the so-called experts in figuring lighting-surfaces to consider carefully these points, and to remember that even the size of a light does not represent its actual area that is exposed. If the seemingly small items were heeded, fewer blunders would be made.

Deep reveals should also be avoided, and if they are necessitated by the thickness of the walls, should be cut back both on the outside and inside, as shown on Sketches 2 and

4, Plate 28. The lintels can be treated in the same way, and in cases where the light is in a measure obscured by buildings or heavy foliage, it is not a bad plan to construct the window-stools in the manner shown on Sketch 4, Plate 28.

In fact, I believe that every impediment to the direct entrance of the light should be as far as possible removed.

It may be considered that I am over-zealous in this department of school construction, but if I do err, I certainly wish it to be on the safe rather than on the other side, believing, as I do, that there is no greater blessing than good eyes; and noting the alarming increase of myopia among the younger generation, I do not believe that it is possible to be too careful in this respect in the construction of our school-rooms.



THREE ROOM BUILDING
—IN BRICK—

PLATE 29

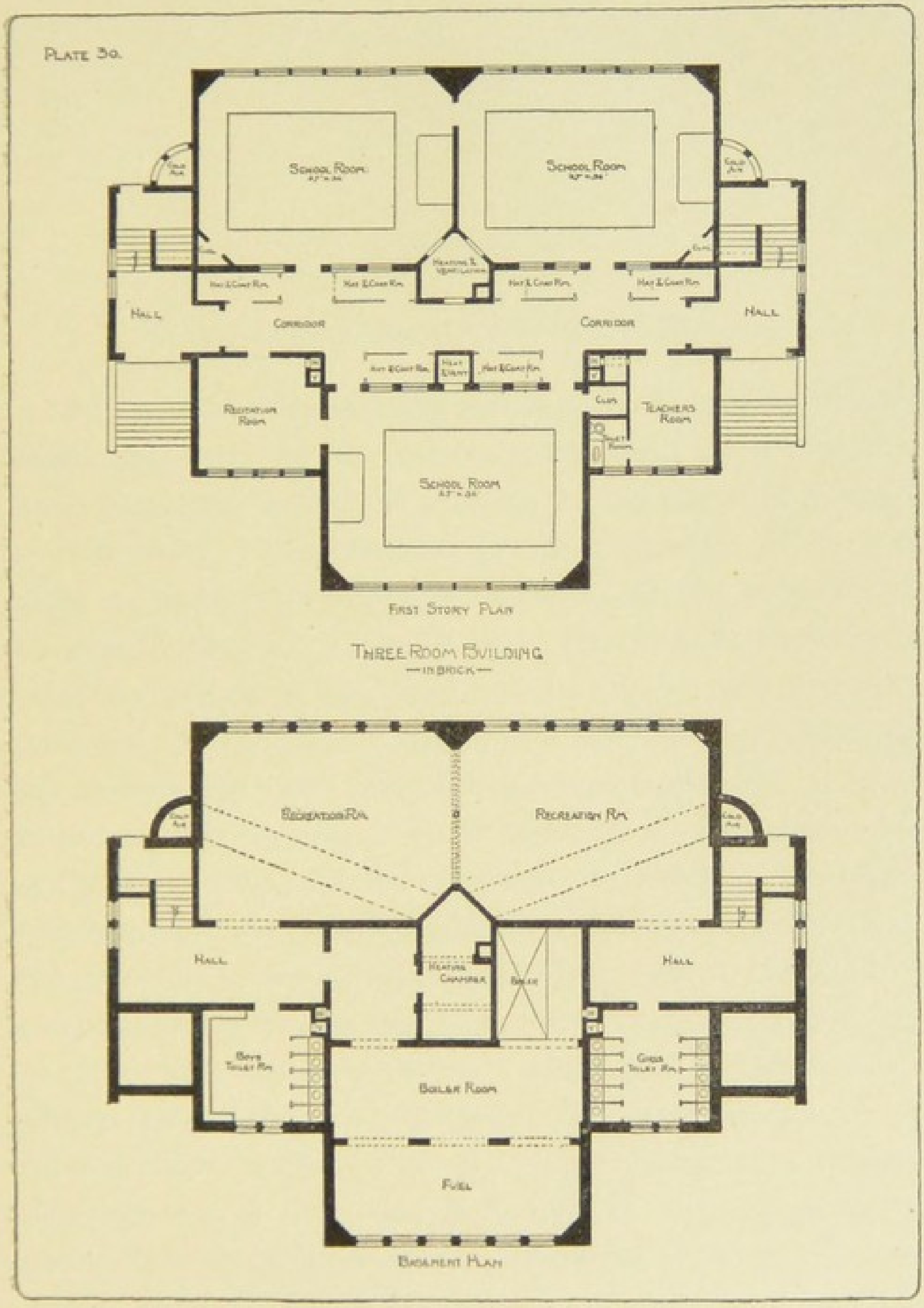


Plate 30.
School Room
School Room
Heating & Ventilation
Hat & Coat Rm.
Hat & Coat Rm.
Hat & Coat Rm.
Hat & Coat Rm.
Hall
Corridor
Corridor
Hall
Hat & Coat Rm.
Hat & Coat Rm.
Recitation Room
Teachers Room
School Room
First Story Plan
Three Room Building
— in brick —
Recreation Rm.
Recreation Rm.
Hall
Heating Chamber
Hall
Boys Toilet Rm.
Boiler Room
Girls Toilet Rm.
Fuel
Basement Plan

CHAPTER X.

HAT-AND-CLOAK-ROOMS.—PLAY-ROOMS.

It is essential that in every school building ample provision should be made for the convenient hanging of the pupil's outer garments, during the sessions, in some kind of a wardrobe or room. Too often far too little thought or study is given to these very important adjuncts of the schoolroom. Frequently they are worked into the plan in most undesirable locations, and, as a rule, they are too contracted; indeed, I frequently find them so cramped that confusion and crowding are unavoidable when the children are dismissed and attempt to secure their clothing. Three methods are in common use at the present time for the reception of clothing. The first, and decidedly the poorest, of these is the concentration of all the garments in one or more large rooms, usually situated in the basement of the building. Children entering the building pass into this room, leave their wraps and ascend to their several classrooms. At dismissal the same routine, in a reverse order, is gone through. This arrangement is very objectionable to me—the gathering of the garments of hundreds of pupils from scores of different localities and conditions in one room, where they must be placed in close proximity to each other, is certainly a very dangerous procedure; if not decidedly unsanitary, the spread of contagious diseases is certainly invited, and the seeds of serious epidemics are likely to be sown. The objections cited in the chapter devoted to entrance-halls and staircases, whereby the pupils from various parts of the building are forced to pass through several halls, apply with equal force to this arrangement of the cloak-rooms. And it must be remembered that pupils from different portions of the building, dismissed at or about the same time, will come together with a rush in the basement at a point far removed from the watchful teacher's eye. They are bound to be, at this time, in a hurry, and a wild scramble ensues that is anything but beneficial to discipline, and seriously detrimental to clothing.

More serious than either of the above-mentioned objections is that of thieving. Principals of large schools have repeatedly stated to me that it was almost impossible to prevent it when the clothing was all placed together. To such an extent did this evil exist that in some instances it had been necessary to employ the police to suppress it. True, it was found upon investigation in many cases that the theft was purely imaginary, the child having in fact lost the article before entering the building, and upon missing it at the close of the session, quickly assumed that it had been stolen. In the majority of cases, however, there was just cause for complaint, as there was no doubt that clothing was systematically purloined. Surely, if these conditions exist, it would be well to remove, as much as possible, their primary cause, and prohibit in new buldings the "general cloak-room."

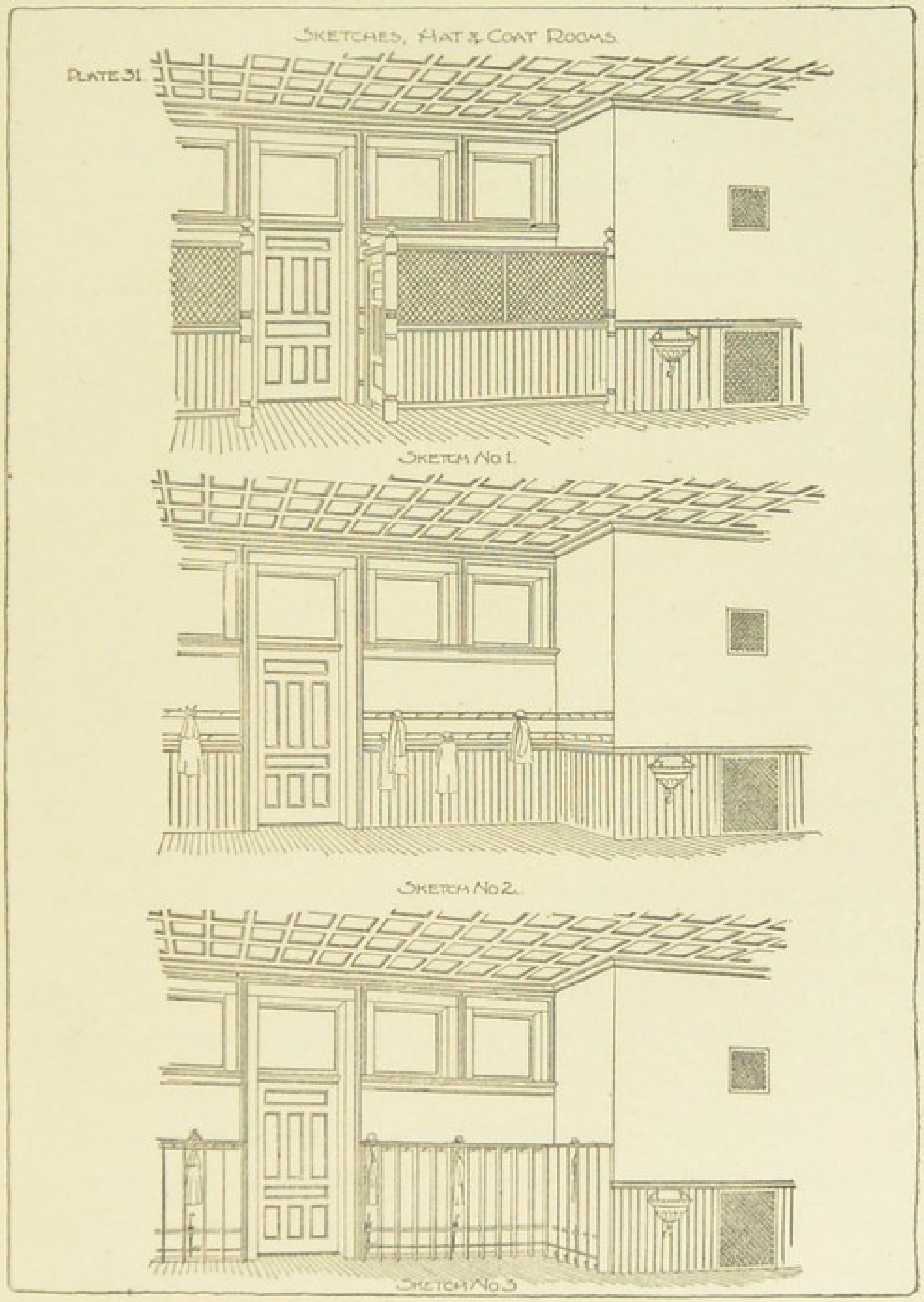
In some instances individual lockers have been introduced into the large basement cloak-rooms, each locker being provided with a key or combination lock, the janitor having a master-key; this system will prevent thieving, but it is expensive and costly to maintain, as the locks are continually out of order and cumbersome and complicated in operation. The average scholar, when through with the session's duties, desires to get out of the building as quickly as possible, and when required to descend into the basement, unlock or work the combination of a lock, is irritated and impatient, and the chances are that the operation will not be gone through without noise, confusion, and a possible mishap to the lock. While I have never used this system, it certainly does not appeal to me, and I should be very loth to make use of it except perhaps in a high- or normal-school building.

The one or more small rooms connected directly with each schoolroom are the most common form of cloak-rooms, and possess decided advantages over methods just described. The main objection to them is their restricted size (the space which they occupy being too valuable to be lavishly used), and, if they are properly constructed with windows, the space on the outer walls occupied by them could be used to better advantage. Usually, too, these rooms are hard to heat and ventilate. Their multiplicity complicates the heating system badly and adds very materially to the cost of construction and maintenance. If, however, they are well placed they are convenient. The principal cause of thieving is removed, as they are under almost constant surveillance, and the detection of wrongdoers is comparatively easy.

For a number of years I have made use of the partitioned hat-and-cloak-rooms placed in the main halls of the buildings, as shown on the majority of the plans in this work. This device has been thoroughly described on other pages, and it is not necessary to enlarge upon it here.

This arrangement of the clothing receptacles has many good and some bad features. They occupy a portion of the building that is not especially valuable; they are handy and easy of access; they can be heated and ventilated with the main halls without complicating the apparatus; and, as they are entirely open at the top and do not run to the floor, there is a free circulation of air through them. On the other hand, as there are two provided for each room, more or less confusion is caused by the pupils entering and leaving them. When I have tried to obviate this by the use of additional doors, I have not only added to the expense of the building, but rather increased the noise and confusion. The greatest objections, however, to these rooms come from the teachers, who complain that the unruly urchin, being necessarily out of their sight for a few moments, inside of the partitions when in quest of his clothing, can create a vast amount of disorder which it is almost impossible to prevent. This fault can largely be done away with by constructing the upper portions of the coat-room of heavy wire netting, so that a fairly clear view could be had at all times of their interior. I have tried several times to introduce this feature, but have never yet succeeded in convincing a building committee of its practical utility. (See Sketch 3, Plate 31.)

From my own point of view I object to this method of construction on account of its unsightliness, while the utility and sanitary features appeal to me. I must confess that I have never yet succeeded in making it either attractive or artistic. It is usually a blot in what would be a well-proportioned and spacious hall without its presence. Should the wire netting be introduced, I fear it would give the appearance of a menagerie; in fact, one of


SKETCHES, HAT & COAT ROOMS.
PLATE 31.
SKETCH NO 1.
SKETCH NO 2.
SKETCH NO 3

my jovial friends once called these enclosures kennels, and with some degree of propriety.

The query naturally arises, As none of these devices are commended, what is the satisfactory solution of the problem? To me it is the construction of the large halls in the same way as if the partitioned rooms were to be used, *but entirely omit the partitions*, using only the side walls of the halls for hanging purposes. Examples of what I mean will be seen on Plate 31, Sketch 2. A teacher standing anywhere in the hall near her room-door has her entire class under surveillance; there is plenty of room for all clothing on the side walls; the heating and ventilation are easily accomplished; there is a large saving of expense in construction; and the architectural effect of the hall is maintained.

I have introduced this method into one or two school buildings with marked success (the idea was orginally suggested by the progressive Superintendent of Schools of the city of Yonkers), and I can see no valid objection to it. The only one raised, as far as I know, is that the clothes are unsightly in the hall, to which I reply that the schoolhouse is not an art-gallery but a workshop, and if the æsthetic senses of our sensitive people are prostrated by the view of children's outer garments hung neatly upon the wall, they had better stay out of the building. I have used the expression "neatly hung" advisedly, for clothing placed in this position would be constantly under the teacher's inspection; carelessness would at once be detected and corrected, and the child would almost unconsciously acquire orderly habits.

This method of caring for the clothing is one of great simplicity, and has none of the objections raised to others. Naturally one is apt to be prejudiced against almost any innovation, but where it has been tried it has not been found wanting; and until some better device presents itself, I most heartily commend it to those who desire a convenient, simple, and thoroughly hygienic system.

A more elaborate plan based upon the same principles is shown in Sketch 3, Plate 31. This gives to each pupil a separate compartment, with space for overshoes below, and a shelf above upon which hats may be laid; the latter being especially useful for the girls. There is also a place for umbrellas which necessitates a drip-trough underneath. Of course this system is much more expensive, but it has the advantage of a certain amount of exclusiveness, and, when the necessary funds can be obtained, is probably the best-known solution of the problem.

PLAYROOMS.

I believe good playrooms are *absolutely* necessary in every well-equipped school building. Manual training is becoming a most important feature in school life; and if we recognize its usefulness, we must provide suitable rooms in which it can be successfully taught. In all the buildings shown in this work, playrooms will be found; usually they are placed in the basement; sometimes on the top stories or roof; in any case they should be large, well lighted, and amply ventilated; when possible there should be windows on two or more sides, so that they may be thoroughly flushed by the outer air. It is not necessary that these rooms be heated to over 60°; in fact, it is better that the temperature should be at a much lower point than in the schoolrooms. These rooms are intended to exercise in, and the pupils, during the limited time that they have, should be impressed with the necessity of exercising as much as possible. Side walls of these rooms are best of brick laid with struck joints and thoroughly painted some light, neutral tint; for the floors I have found a good quality of half-hard asphalt the most satisfactory; and for the ceilings nothing is better than "stamped metal"; this can be painted to harmonize with the side walls, producing a light, airy room that is not easily damaged.

For the heat required, I have used successfully return coil-pipes *hung just below the ceiling;* in this position they are out of the pupil's reach, do not occupy floor-space, and give all the heat required.

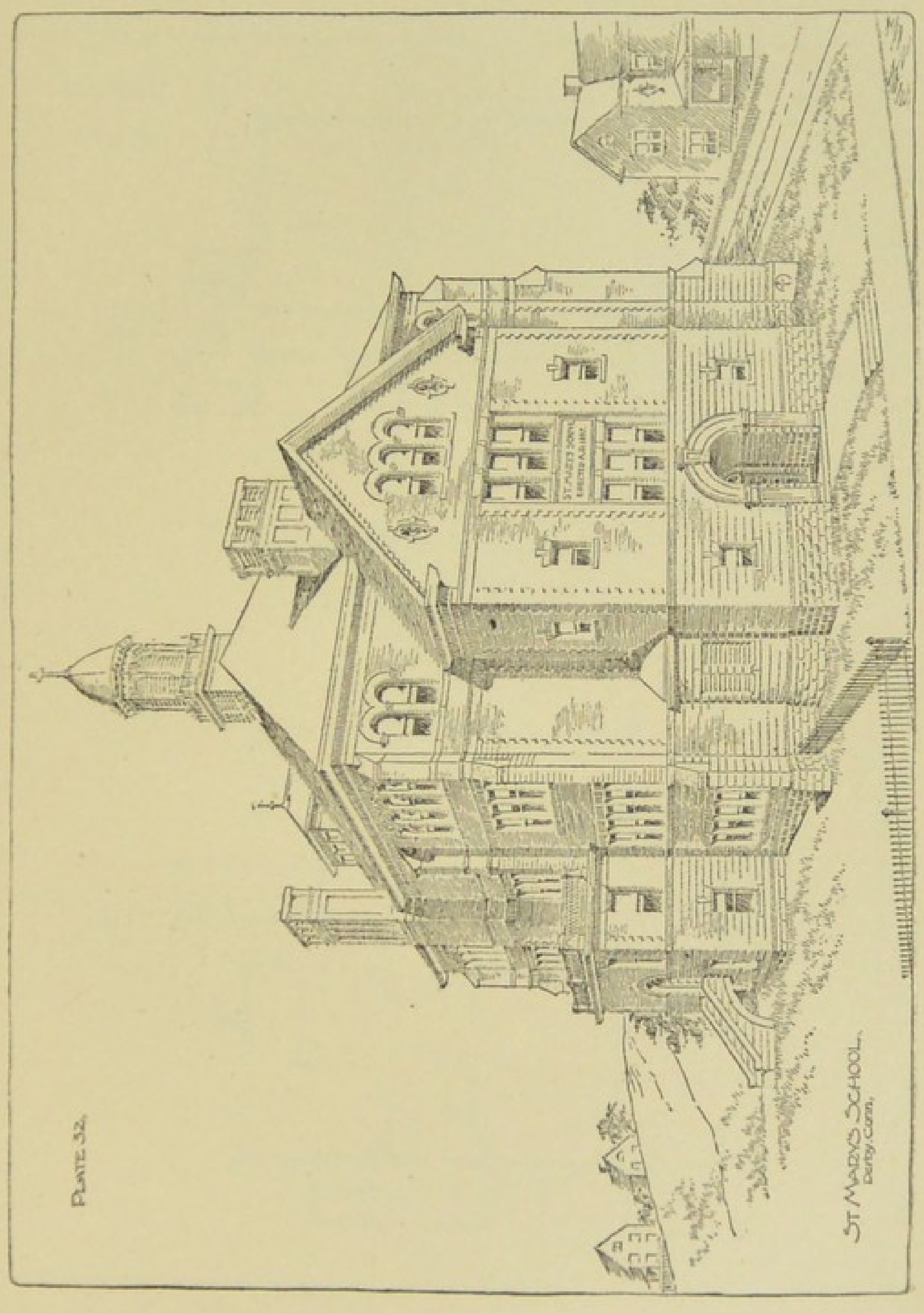
In close connection with the playrooms, if they are situated in the basement, in our latest building it has been found necessary to introduce bicycle-rooms. These, it must be understood, are not intended to ride or exercise in, but simply for the proper storage of wheels during the time the pupils may be occupied in the building.

There should be one of these rooms for each sex, and, if possible, they should be placed near, or in connection with, the playrooms; that is, when the latter are situated in the basement of the building. The general construction and finish of these rooms should conform with that of the playrooms; in fact, in some cases, they may simply be a part of these rooms partitioned off by a heavy wire screen running from floor to ceiling. Wherever they are placed, they should be in direct or nearly direct access with the outside; and there should be arranged, if they are situated above or below the grade, a suitable enclosed "run," up and down which the wheels may easily be trundled.

Rooms of this kind must be so arranged that they can be securely locked during sessions; this is absolutely necessary, not only to prevent actual thieving, but also a system of "borrowing" a wheel for an hour or so without the owner's knowledge which was found to exist in one large building. Pupils without wheels would get dismissed for some trivial cause, secure a wheel and ride till just before the close of the session, and then return it to its place; usually these stealthy expeditions were not beneficial to the wheels.

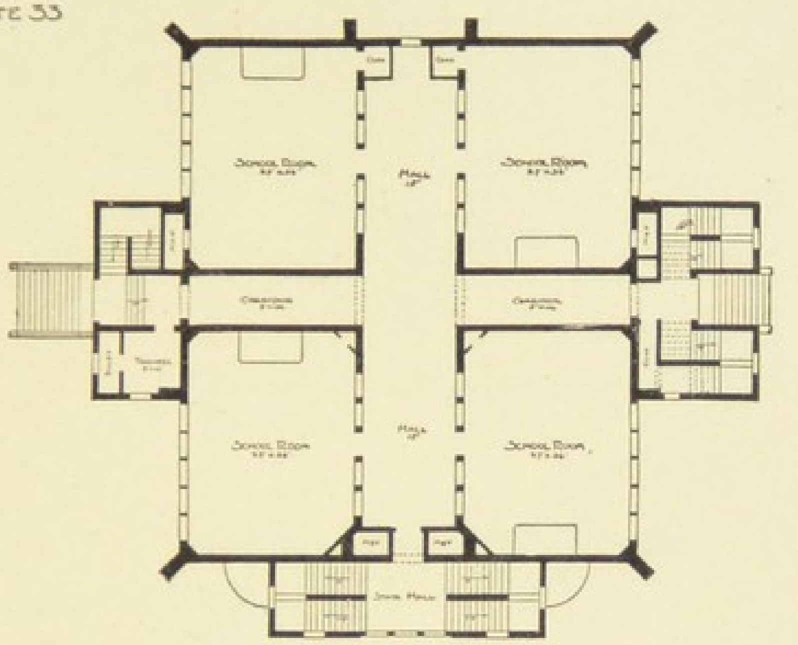
Give plenty of space to these rooms—all you can spare; don't be afraid of getting them too large, for it is astonishing how many wheels, even in the poorer districts, are ridden to the school building.

PLATE 32.

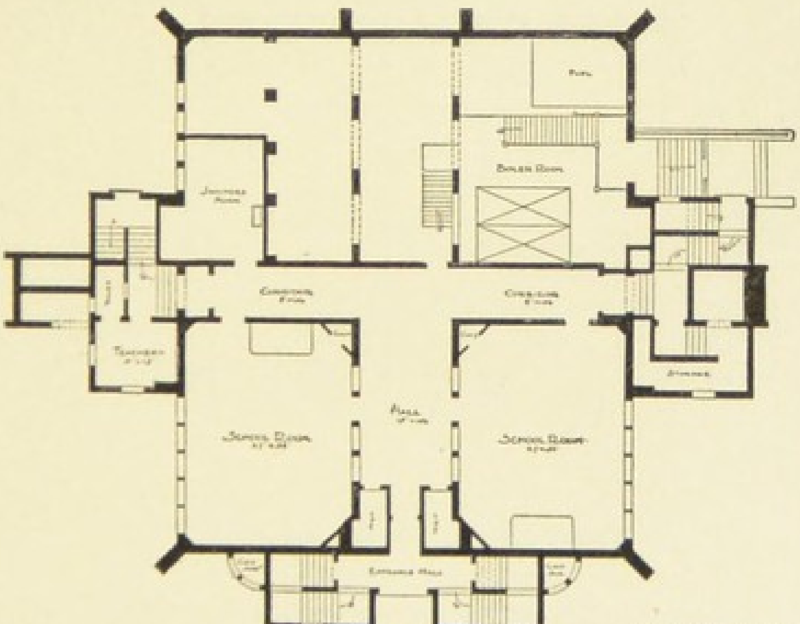


ST. MARY'S SCHOOL.
Derby, Conn.

PLATE 33



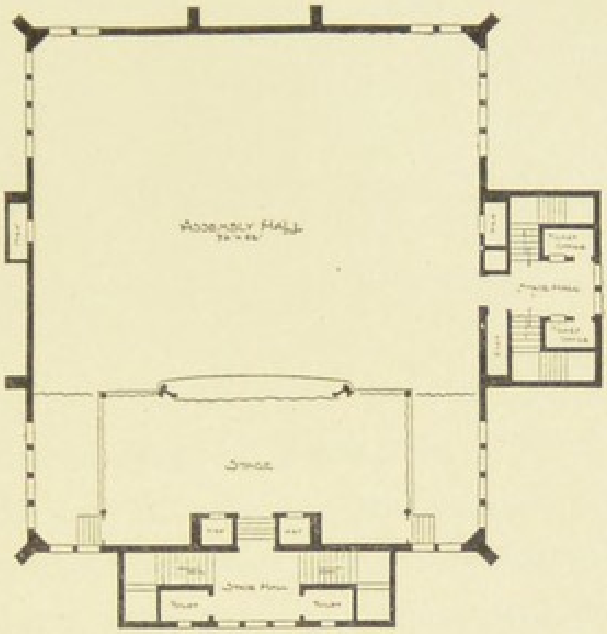
FIRST FLOOR PLAN.



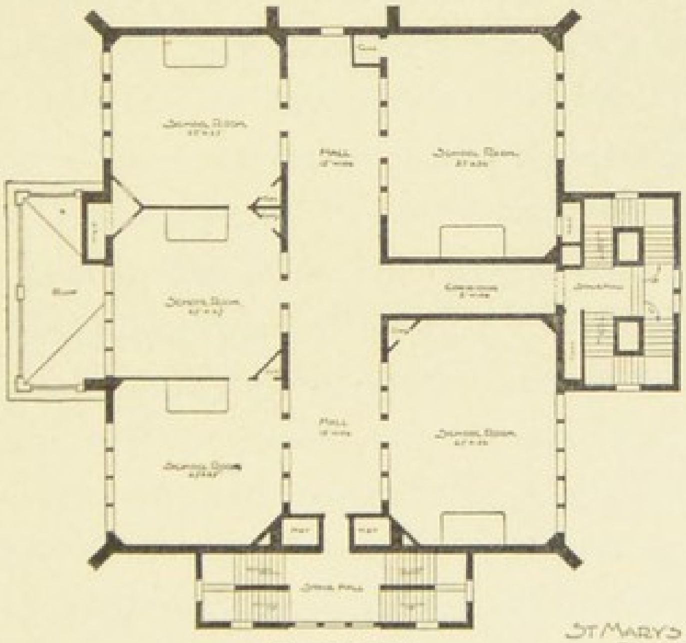
GROUND FLOOR PLAN

ST MARYS SCHOOL
Derby, Conn.

PLATE 34.



THIRD FLOOR PLAN.



SECOND FLOOR PLAN.

ST MARY'S SCHOOL.
Derby CONN

CHAPTER XI.

HEATING AND VENTILATION.

HOWEVER well our building may be planned, constructed, and lighted, if the heating and ventilation system is not successful, it will be unsatisfactory when occupied. No other portion of school construction requires closer attention or more careful study than this, and there will be found an immense amount of printed matter relative to the subject, in the shape of essays, circulars, and advertisements, a greater portion of which is of questionable merit. This being mainly due to the tremendous competition existing between the various firms either directly or indirectly interested in the manufacture and erection of heating and ventilating apparatus. To such an extent has this rivalry been carried, that some firms make a practice of issuing illustrated volumes in which are depicted in flaming colors the perfect working of their apparatus and the astounding result which may be obtained by the use of their goods and systems.

One enterprising and supposedly reputable firm has gone so far as to appropriate and publish in its catalogue, without my knowledge or consent, the cuts used to illustrate the series of experiments made with a model, when the heating and ventilating system of the Bridgeport high-school was being studied in 1879. These cuts were first published in the Report of the Connecticut State Board of Health for that year, and are reproduced in the articles on the Bridgeport high-school (Plate 43 of this work). The firm in question first made use of the cuts in a catalogue issued some eight or ten years ago, and at that time gave me credit for them; but in subsequent catalogues not only has my name been omitted, but the statement of when and where the experiments were made as well. They now appear in color, with this note printed under them: "Illustrating a series of experiments made to determine the direction of air-currents with inlets and outlets, located as indicated, which since has been verified many times by practical experience."

About two years ago an agent of this company came into my office, and was very anxious to introduce their system in a large school building I was about to erect. He opened his catalogue at the page where the cuts mentioned were printed to show me how their system worked and to what pains they had been to perfect it. I asked, "Where did your firm obtain the data for these illustrations?" He answered, "Our engineers have been making extensive and elaborate experiments for a number of years past and these cuts show the results of their investigations." "Are you quite sure," said I, "that the cuts originated with them?" "Most certainly they did," he replied; "why do you ask such a question?" In reply I took down a volume of the Connecticut State Board of Health Report for 1879, before referred to, and turning to my article, asked him to examine critically the cuts there shown, and say if they were not identically the same as his firm were now making use of. After examination he had to admit that they were, but assured me that his firm was not aware that they were my work, for if it had been it would not have made use of them without my knowledge and consent, and would have given me full credit for them. His people had been shamefully imposed upon by their engineers. He should consider it his duty to bring it to their immediate attention and have the matter righted without delay. In reply to this oration I produced one of their earlier catalogues, in which I *was* given credit for the cuts, and in which my article was quoted at some length, and asked him how he accounted for that. I must confess that I was sorry for the man, as he had evidently been sincere in what he had said, and was now so utterly taken aback as to be practically speechless. He could only offer the most profuse apologies, and assure me of his individual innocence. He declared he would communicate with his firm and ask for an explanation. Whether he did this I do not know, as I have never seen another of their representatives.

I have mentioned this incident simply to show to what ends supposedly reputable firms will go to introduce and sell their wares. Agents will strenuously contend that the boiler, radiator, or fan that they may represent will do almost double the amount of work of any other in the market, and that their system is absolutely the only one with which one can successfully heat and ventilate a building. Of course this is all nonsense; but so persistent are their drummers that in many instances they not only obtain great influence over members of committees, but frequently lead them to believe that what they say is true. It should be remembered that there are scores of first-class boilers, radiators, and fans manufactured, any one of which when properly set and operated will give the desired results. It is absurd to claim that the goods of one firm are so vastly superior to those of any other, when in point of fact there is little to choose between them. And it is the same with the best-known automatic systems of heating and ventilation; they are all very nearly alike, and when equipped and handled understandingly are capable of doing excellent work. Beware, then, of the people who assert that one cannot obtain good results unless their goods are used. Rest assured that when such claims are made, it is for the purpose of preventing honest competition and debarring firms from submitting estimates who have apparatus or systems which are just as good, if not better.

I am not in favor of receiving independent estimates from various firms for their own special style of apparatus and system of heating. If this course is adopted, it is simply impossible to judge understandingly between the different bids received; each will specify special wares and claim that its fixtures, workmanship, etc., are so much better than another's that its bid alone should be considered. This will surely result in mystification and confusion, and is quite likely to obtain for a firm with a really inferior system the execution of the contract. A far better way is to decide at the outset the method of heating and ventilation intended to be used, and then employ some competent heating expert to prepare a complete set of working plans and specifications for it, submit these to the various firms who desire to estimate, and make them in their estimates live up to the requirements. In this way bids for the same class and quality of work will be obtained which can be accurately compared, and the contract awarded with judgment to the lowest satisfactory bidder.

As to which method of heating I prefer, long experience enables me to say with decision that under the varying climatic conditions which we encounter I believe steam to be the best medium for all classes of school buildings, and that the automatic system is preferable and more economical in the majority of cases than the fan system. Simplicity is desirable in all things, and nowhere more so than in a heating and ventilating plant. The men, as a class, who have the care of a school heating plant are not of a very high order of intelligence; consequently the more complicated the apparatus, the less likely they are to comprehend it. Too often they will condemn that which they fail to understand, when if they could master readily the true principles of the plant they would have no trouble with it. In recommending the use of steam, it must be understood that I am advocating the indirect and not the direct method; the latter being made use of only as an auxiliary in extreme cases, where very large glass surfaces or unusual exposure may make it necessary.

The system that I have used for the past eighteen years is that which has come to be known as the Wheeler system, so called for the reason that in 1879 the Hon. Nathaniel Wheeler, President of the Wheeler & Wilson Company of Bridgeport, and then a member of the local Board of Education, became deeply interested in the proper heating and ventilating of our city schools. He came to me with certain ideas that he had, and together we developed and worked out the system as it is now used, Mr. Wheeler paying all the expenses of models and of a long series of experiments. In 1883 he patented the system, not to secure pecuniary benefit from it, but to prevent any one who was engaged in trade or manufacture from patenting and controlling it. He used to remark that he believed it was the best-known automatic system of heating and ventilation, and he desired that any one who wished to use it could do so without restraint. The system in question has nothing especially novel in it. It was really the ingenious application of old and well-known principles. A device by which the heat-generating surface for each room could be concentrated and controlled, and the centralization of the entire heating-surface of the building at or near its centre, were its principal features.

The introduction of the warm pure air at a considerable height from, and its removal at, the floor-level upon the same side of the room were well and favorably known. Moran had made use of a similar device in the Hôtel Dieu, Paris, France, years before; and Morel Wyman, in a "Practical Treatise on Ventilation," published in 1846, on page 118, commends such an arrangement of the flues. I do not doubt that many other examples could be found. The insulation of the entire heating-surface required for a room, its enclosure in a metal jacket connected directly with the room by a large-sized pipe, and the subdivision of this heating-surface into three or more parts were, I believe, at that time new. By this arrangement we were enabled to supply any room with the same volume of air at all times, the temperature of the room being regulated by the temperature of the entering pure warmed air, which in turn was controlled and regulated by the use of one or more of the sections of the heating-surface, as the outer temperature might require; or, to speak more plainly, the pure cold air introduced below the coil- or section-boxes at all times passed directly through the entire heating-surface, the degree to which it was heated being regulated by the use of one, two, or three sections of the heating-surface.

It is desirable under almost every condition to "group" all the heating-surface required for a building, and to enclose it in heating-chambers, constructed of brick, as centrally located as is possible, and as far away from the cold outer walls as the construction of the building will allow. Coil-boxes containing the heating-surfaces are placed at the bottom of the ventilation-flues in the heating-chambers, and the metal inlet-pipes running from these boxes to the several rooms pass directly through these flues. This arrangement renders the system perfectly automatic, for the reason that the moment that heat is introduced into the coil-boxes and the warm air commences to pass through the coils and ascend through the metal inlet-pipes on its way to the rooms, heat is of course radiated from them, and, the air of the ventilating-flues being in this way warmed, a strong upward draught is produced, which sucks the colder impure air through the outgoing registers, situated at the floor-level of the several rooms and halls. With the addition of a suction-coil placed near the top of the ventilating-flues, I have found that the heat generated from the coil-boxes and inlet-pipes is sufficient to obtain very satisfactory results; in fact, this is all that is necessary under ordinary conditions.

This system is extremely simple, easy to construct and maintain, and comparatively inexpensive, as it has no highly finished work, patented contrivances, or special fixtures about it. Any well-made boiler or radiator may be used with equal facility, and it can be erected successfully by a good local steam-fitter if he will simply follow the drawings, specifications, and instructions given him.

The success or failure of such an apparatus does not depend upon elaborate detail or finish, *but upon the careful* *proportioning of the incoming and outgoing flues, their relative position, and the amount of heating-surface required for each particular room.* All of these details are of the most vital importance. I have been astonished to find how seriously even a slight departure from formulas which experiments have proved to be correct will affect the working of an apparatus, and how necessary it is to understandingly guard against conditions that may be at variance with those usually encountered. The margin between success and failure is not large enough to be carelessly considered, much less ignored. Many really good plants have failed to do their work because some of the minor details were not properly looked after, and innumerable others could be made to do far better work if every available condition had been made use of. There is apt to be far too much guesswork used in the erection of the ordinary plant; even when a good set of plans and specifications are procured, they are not always carefully followed. This is especially true when the work is executed without supervision. At times I have had the greatest difficulty in getting contractors to work closely to my drawings, when they happened to be, in detail, at variance with what they were accustomed to do. So attached to certain methods do some mechanics become that it requires the greatest amount of patience and firmness to get them out of their well-worn ruts into the paths you wish them to follow. But when you do succeed in getting an intelligent workman to understand the principles of the system and to comprehend the results that it will produce, he is very apt to become enthusiastic over it, and to err in this way to the extent of claiming for it impossibilities.

It is quite as difficult to get a janitor to run an apparatus as it was designed to be run after it has been completed: they are inclined to be stubborn and exasperating in the extreme; they will not give either the fire or heating-surfaces the attention which they require, or regulate properly the supply of cold air furnished, which varies continually under our constant climatic changes. To save themselves a little trouble the apparatus is "set" in a certain way and used week in and week out, no matter what the changes in the outside temperature may be. They cannot in the majority of cases be made to understand that a good heating and ventilating apparatus is really a piece of machinery and must be treated and handled as such, not left to its own devices. Occasionally men are found who are reliable and willing; such men in a very short time master the apparatus in all its details, and by running it in an intelligent manner secure from it the best possible results with little or no trouble.

In a certain well-known structure there was a man of this kind employed as janitor, who for ten years ran the apparatus most successfully. Under his management the school building obtained the name of being one of the best heated and ventilated structures in the country. Suddenly a change in administration occurred and a new janitor was secured; the next fall the moment the apparatus was started there was trouble, which increased to such an extent that about the middle of the winter some rooms of the building had to be closed, as they could not be properly heated. My attention having been called to the matter by an interested friend, I quietly investigated it, and was quickly convinced that the entire fault was with the janitor, who was simply letting the apparatus take care of itself.

Shortly after this I was summoned to appear before the Board of Education, the complexion of which had entirely changed during the ten years that had intervened between the completion of the building and the trouble with the apparatus. In answer to numerous questions, I affirmed that there was nothing wrong with the apparatus, but that the trouble was wholly with the man who was in charge of it. This was quickly refuted by one gentleman in particular, whom I afterwards found to be a relative of the janitor, it being claimed that the new man was a great improvement on the old. "This may be all perfectly true, gentlemen," said I, "but if it is so, will you kindly explain why it is that an apparatus that is in most excellent repair and that has for the past ten years given the best of satisfaction, suddenly and without any known reason utterly fails to do its work. No changes have been made in it or the building; the fuel and general conditions are identically the same, and yet you condemn the system and are thinking seriously of changing it. Consider this matter well before you decide to take it out; and, above all, convince yourselves that I am in error in my statements before going further." This reasoning was so logical that it was impossible to ignore it, and so the new janitor was taken to task and given to understand that if he could not run the apparatus satisfactorily some one would be employed who could. This episode occurred over six years ago; since that time there has been no further complaint, although the same man still holds the position.

I am sorry to have to say that I have quite as much trouble with the principals and teachers as with the janitors. At times it has seemed to be impossible to prevent their doing just what they ought not to do. I have had more than once to remove the fans entirely from both the incoming and outgoing registers, for the reason that I could not make teachers comprehend that by the closing of one or the other they seriously interfered with the free working of the system; that all it was necessary for them to do when the room became too warm or too cold was to notify the janitor, who would at once regulate the temperature of the incoming air, and consequently that of the room. Instead of doing this, they will insist upon closing the incoming-registers and opening the windows when the room was too warm, or closing the outlet-registers when it was too cold,—one course being quite as bad as the other. In the first instance the supply of pure, warmed incoming air is shut off entirely, and the room and its occupants quickly chilled by the rush of cold air through the open windows; in the second, the exit of the foul air is stopped and the entering warmed air banks up until the pressure of air within the room becomes so great as to practically stop its entrance. It should be borne in mind that it is impossible to bring large quantities of air into a room unless there are ample provisions made for its rapid removal. I have frequently had teachers explain, when the outlet-registers have been found partly closed, "We keep them that way purposely; if we did not, all the heat would go up the flue!" In one instance, where remonstrances were found to be useless, an areometric test was made to show how vitally necessary it was to keep all the registers wide open. The results, which were extremely interesting and convincing, were as follows: Outside temperature, 18°; wind light from the N.E.; temperature of air at the inlet-registers, 125°; quantity admitted, 27 cubic feet per minute for each of the fifty occupants; temperature at breathing-level, 70°. Both the supply and temperature were easily maintained when all the registers were kept wide open; but under the same conditions, with one half of the outlet closed, the result was: Temperature of air at inlet, 125°; quantity entering, 16 cubic feet per minute for each occupant; temperature at breathing-level averaging 65°. It was found extremely difficult to maintain an even temperature during the hours in which the test was made, there being a fluctuation of 10°. When the outlet-registers were entirely closed the flow of incoming air varied from 5 to 8 cubic feet per minute for each occupant, and it was impossible to maintain a temperature of over 60° in the room. Demonstrations of this kind are so conclusive that it would seem incredible that they should be ignored; yet in the very room in which these tests were made I afterwards found the registers closed and the windows open!

One inlet- and one outlet-flue are all that are usually necessary in the ordinary-sized room. Additional flues either for the incoming or outgoing air only mean complication, which should be avoided. All flues should be placed upon the protected inner walls of the building, never on the exposed outer walls. The amount of heat lost by placing the pipes or flues in the latter position is enormous, and an immense amount of fuel will be consumed in the effort to force warm pure air through or to take foul air out of flues in exposed positions. The exact position that the flues should occupy in the room, that is to say, on which side or end they should be placed, is immaterial, and may be varied as the construction of the building may demand, provided always they are near together, never contracted, or built otherwise than straight and direct. Crooked or irregular inlet-pipes or outlet-flues must be avoided if you would obtain good results. Bring the warm pure air into, and remove the impure air from, the building as quickly and directly as possible. This is a golden rule that should be rigidly enforced.

I cannot too strongly condemn the practice of scattering the inlet- and outlet-registers all around the room, and of extending inlet- and outlet-pipes in irregular and erratic lines to some central point. Systems constructed in this way will never work uniformly. Some pipes and registers will do better than others; in fact, those situated in particularly exposed positions will do little or no work, and ultimately become simply receptacles for dust and vermin.

The system once so much in vogue, but now, I am glad to say, rapidly being discarded, of exhausting the foul air through small ducts beneath the upper floor, is one of the worst devices ever introduced into a school building, and should never have been tolerated. I am also opposed to the system that collects all the foul air of the building and carries it by various ducts down through it to one central receptacle in the basement before starting it on its final upward and outward journey. I can see no good reason why the foul air should first be carried down and then up, and made to meander through the building in more or less intricate passages. Surely this cannot be done without the expensive construction of suitable ducts, and there must also be employed some mechanical device to produce a steady draft. This cannot be accomplished without power, which means additional expenditure for fuel and attendance. If a quantity of air is required in the basement, it can easily be obtained from the cold-air inlets, and it is not necessary to bring it down through two or three stories.

Flues for both the incoming and the outgoing air should be *very large*, those for the outlets *at least* twice the area of the inlets; this latter point *must be insisted upon*, as it is of paramount importance. Registers should have an actual area of openings through which the air passes considerably larger than the full capacity of the inlet pipe, and I prefer to have the registers without fans, for the reasons before stated.

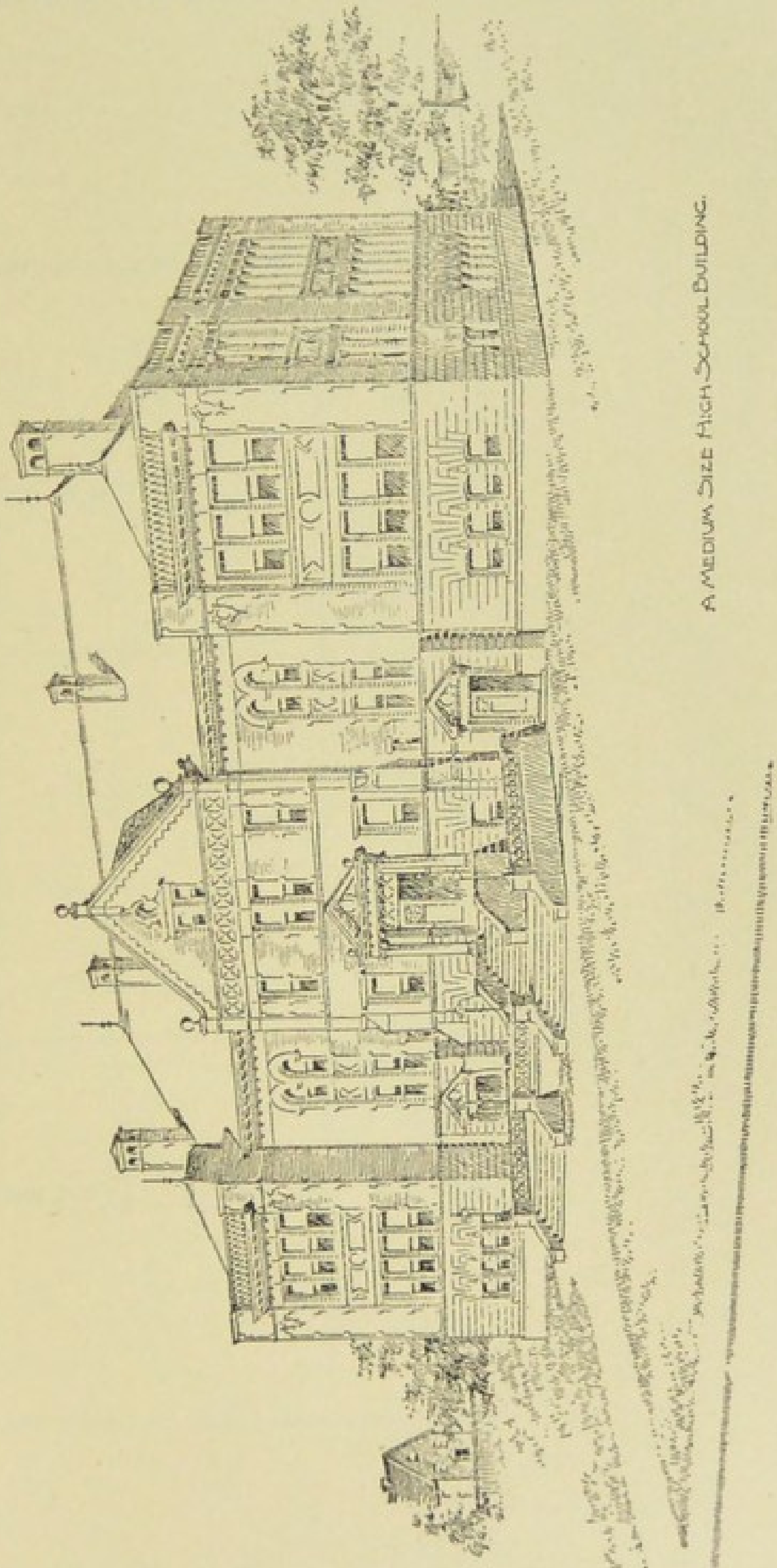
In unusually exposed rooms, in some exceptionally cold localities, it may be found necessary to provide some direct heat upon the cold outer wall. When this is found necessary, my preference is for the simple return-coil placed directly under the windows and running their entire length. These coils can be "set back" in a tin or galvanized-iron receptacle, with register-plates screwed in position over them; this will cover up their unsightliness and remove them from the aisle, where they would be more or less in the way. The cost of this method is little more than when the ordinary radiator is used and is much more satisfactory.

In some instances it will be necessary to use forcing- or suction-fans, although in the great majority of cases their use can be dispensed with. If their use is required, there is nothing about the system which I have described that will interfere in the least with their proper operation. In isolated cases where I have used them, the capacity or principles of construction here advocated have not been changed. The only thing that I have had to guard against is the noise produced by the rapid motion of the fans, which causes a buzzing or humming that is transmitted through the inlet-pipes to the rooms. To sensitive persons this is extremely disagreeable; in some cases so much so as to become almost unbearable. If the fans are to be used, every precaution should be taken to have them placed as far as possible from the inlet-registers, and they should be set upon the solidest of foundations, to reduce their vibration to a minimum. With the suction-fans, which will presumably be placed in the outlet-ducts at the top of the building, less trouble will be had; but they should be so situated as to be easily accessible for oiling and repairs. Of course power of some kind must be used to propel the fans; and this means either a small engine in the building or the use of electricity obtained from the outside. In either case it will increase the expense of running the building unnecessarily, I think, except in very large structures.

It must also be remembered that to properly heat and ventilate a building a large amount of fuel will have to be consumed. This fact is too often lost sight of, and after a plant has been run for a season it is condemned as an extravagant luxury, no matter how well it may have done its work. A room $27' \times 36' \times 13'$ contains 12,536 cubic feet of air. An ordinary cylinder-stove placed in the room will very quickly heat the amount of air it contains to 70° at the breathing-level, but to bring into and remove from this room 27 cubic feet of warmed pure air per minute for each of its fifty occupants means the handling and heating to a degree sufficient to maintain a temperature of 70° at the breathing-line of 81,000 cubic feet of air per hour for each room of the building, or a reheating of all the air the room originally contained over six times an hour; when these indisputable facts are thoroughly understood, it will be seen that it would be impossible to heat such enormous quantities of air unless there were a large consumption of fuel. I firmly believe that money used in this way is *well spent* and that it is the poorest kind of economy to attempt to deprive our children of fresh, pure air and comfortable rooms to study in. Far cheaper it is to be taxed for the maintenance of good school buildings than to pay individual doctors' bills. I wish it were in my power to make the average taxpayer believe this, but alas for the perversity of human nature, I am more often criticised than praised for my efforts in the behalf of good ventilation.

To sum up briefly, I believe there is not the slightest difficulty in heating and ventilating any school building in a perfectly satisfactory manner by a simple, comparatively inexpensive, automatic system which is easily handled and maintained, and that as a rule the less complicated the apparatus is the better the results obtained from it will be.

PLATE 35.



A MEDIUM SIZE HIGH SCHOOL BUILDING.

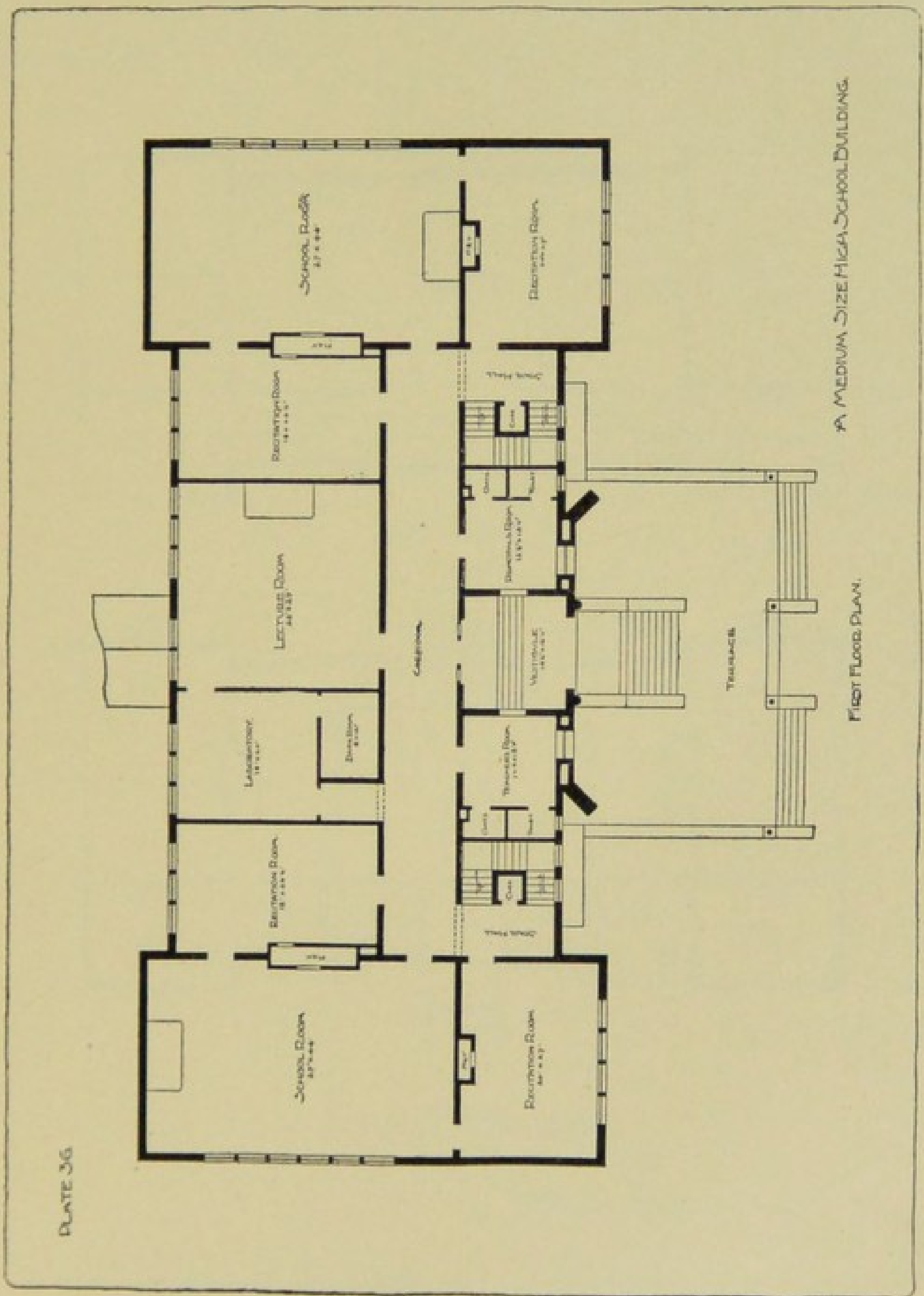
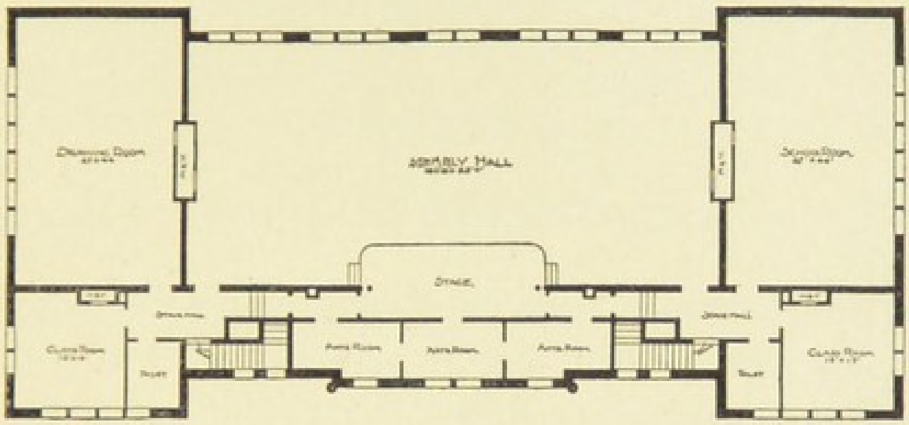
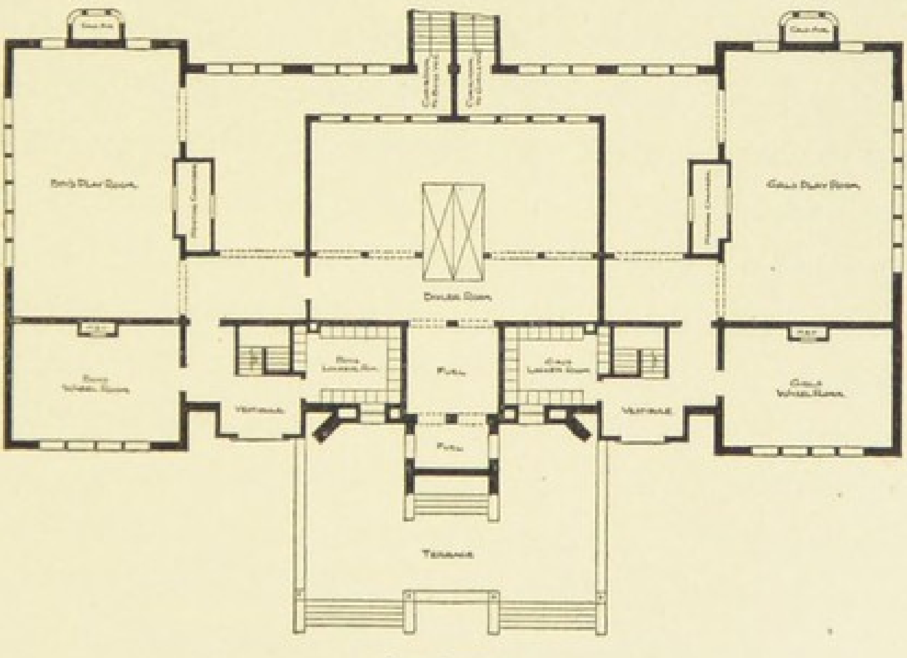

A MEDIUM SIZE HIGH SCHOOL BUILDING
FIRST FLOOR PLAN.
PLATE 36
SCHOOL ROOM
RECITATION ROOM
LECTURE ROOM
LABORATORY
CORRIDOR
VESTIBULE
TERRACE

PLATE 37



SECOND FLOOR PLAN



GROUND FLOOR PLAN

A MEDIUM SIZE HIGH SCHOOL BUILDING

CHAPTER XII.

SANITARY ARRANGEMENT.

I DO not propose under this head to discuss the various systems for the disposal of sewage that are in vogue, or to advocate any special style of fixtures, but rather to consider briefly the position that the pupils' toilet-rooms should occupy in the building and what bearing their location may have upon the comfort and health of the occupants.

At the outset I shall insist that wherever they may be placed they must be conveniently located, and if isolated from the building connected with it by *enclosed halls or pass-ways*, so that the pupils shall not be exposed to the elements in passing to and from them.

There can be no insurmountable difficulty in making this provision in a building without interfering with its general utility or causing an unusual expense. It is simply a humane measure, usually neglected, but which I contend is essential to the health of the pupils; for it is certainly an unnecessary hardship to compel any child to leave a warm schoolroom and traverse a bleak yard in all kinds of weather.

As to the expediency of placing the pupils' toilet-rooms in the basement of the main building, in the basement of wings outside of intervening halls, in isolated buildings more or less removed from the main structure, or to subdivide them and place a certain number on each floor, there is a variety of opinions. Certainly the least desirable of any of these positions is that where they are placed directly under the schoolrooms. This cannot always be avoided, and in some of the plans shown they will be found in this position; but where they occur in such a position it is because the exigencies of the problem allow of no other feasible solution.

When this arrangement becomes imperative, every precaution must be taken not only with the fixtures, but in the construction of the rooms, to have them as nearly perfect from a sanitary standpoint as possible, and eternal vigilance must be exercised after their completion to keep them in first-class condition. If this is done the danger from contamination may be reduced to a minimum, but never quite obliterated.

Some will claim that this or that system can and has been introduced and used in a building in the position under discussion, with perfectly satisfactory results. Any such statement I seriously question. In my varied experiences I have never found toilet-rooms placed under schoolrooms that did not *after a time* become objectionable, and the longer they continued in use the more cause there was for complaint; and I don't see how it could possibly be otherwise. It is true that just after the rooms were completed and when they had been used but a short time I have found everything satisfactory, but upon visiting the same buildings three, five, or ten years later I have invariably found the conditions anything but what they should be, and this, too, without the inmates having the slightest conception that they were living in an unwholesome atmosphere. We are largely creatures of habit, and it is surprising to observe how quickly we become accustomed to our surroundings. That which may be terribly obnoxious if suddenly thrust upon us is taken almost unconsciously in homœopathic doses. In fact, so hardened do our senses become to unsanitary conditions that it is frequently extremely difficult to make the occupants of a building fully realize the dangerous conditions with which they are surrounded.

When a designer fully understands these matters, the danger of placing toilet-rooms under schoolrooms is so forcibly impressed upon him that he will, even at a sacrifice, arrange them elsewhere.

Toilet-rooms placed in the wings with a hall or staircase separating them from the main building are in a much better position. There is little fear of the direct contamination of the schoolrooms where they are properly constructed, but it has been my experience, even when the utmost care had been taken in the construction and maintenance, that after a series of years there was more or less odor perceptible at times in the entrance-halls and staircases, and that no amount of cleansing or disinfecting would entirely remove it. The expression "at times" is used advisedly, for under certain conditions of wind and atmosphere the odors were very marked, while at others they were scarcely perceptible. Many times the conditions cited have not been noticed by the school officials or teachers; or, if they have, have not been commented upon; but they have annoyed me to such an extent, especially in those cases where I have tried to take every precaution and thought I had succeeded, until my nose ruthlessly dispelled the illusion, that I have about made up my mind that it is impossible to place the pupils' toilet-rooms in any part of the basement of a school building without their presence being noticeable.

To effectually overcome this objection, I have of late resorted to the isolated-building system, as shown on Plate 13, and with very satisfactory results. Of course arrangements of this kind require either special heat generated in the outbuilding or heat conveyed from the boiler of the main building; the latter method is usually feasible where steam is the medium of heating, but where hot air is used it will be necessary to use stoves in the outbuildings. An arrangement of this kind is shown on Plate 38. Of course the advantage of placing the toilet-rooms either in the basement or yard is their proximity to the playgrounds and rooms, and this is a very important consideration, especially in suburban buildings or those situated in the smaller cities, where there is plenty of available space devoted to the playgrounds; but in the larger cities, where there is little or no yard room, there is no advantage that I can can see in placing the toilet-room in the basement or yard, provided, of course, that the play-rooms are also removed from the basement. I am thoroughly convinced that the best place for both toilet- and play-rooms in any school building situated in the crowded districts of our larger cities is upon the top floor of the structure, as shown on Plates 86 and 89. Take these necessary requirements of every school building out of the damp, dark, and usually poorly ventilated basement, and put them where sunlight can penetrate and the winds of heaven circulate. Devote the basement entirely to that for which it is best adapted—storage and the heating and ventilating apparatus. To many this very radical departure from the arrangement which precedent has firmly established will be startling; but, after

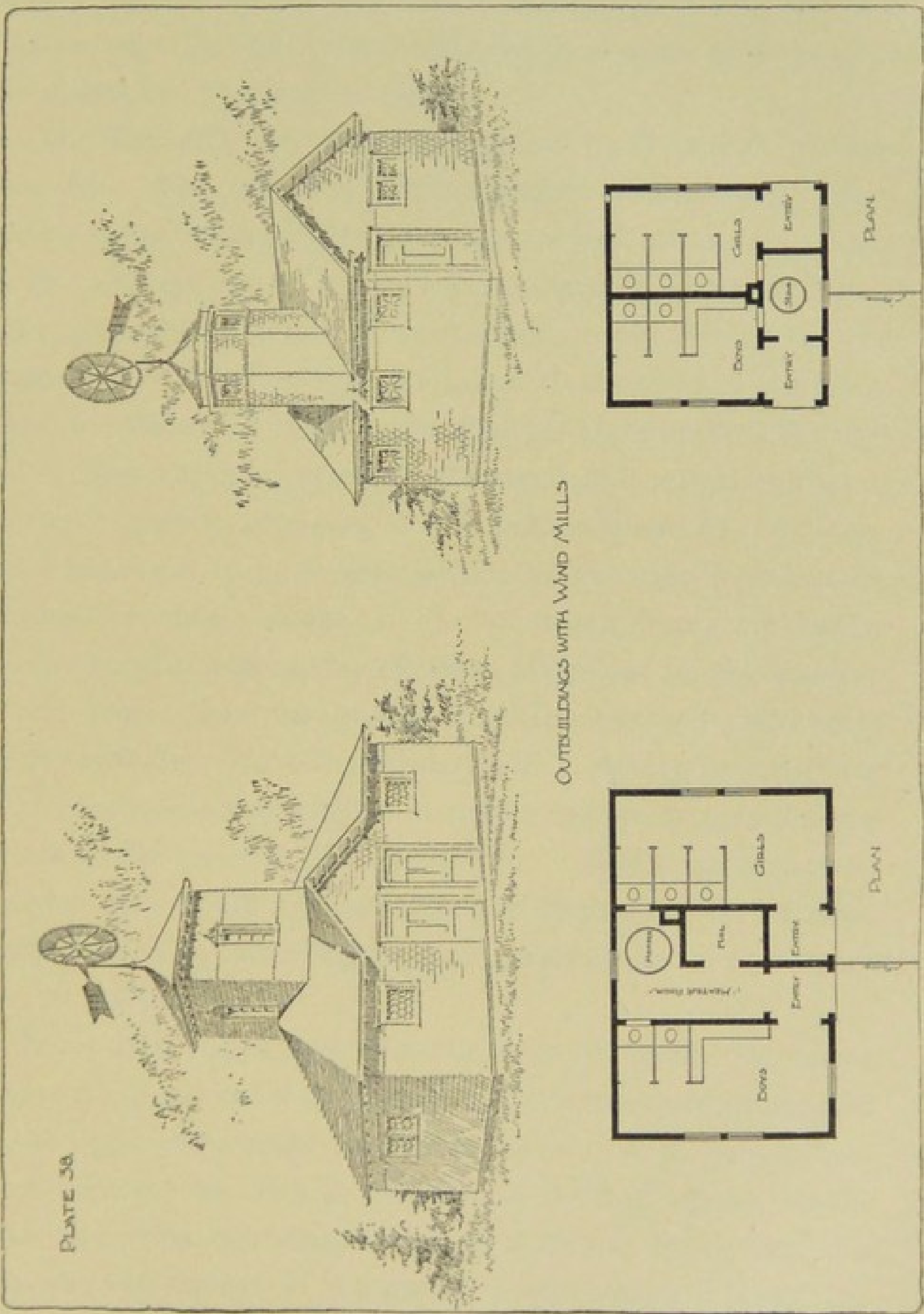


PLATE 38.
OUTBUILDINGS WITH WIND MILLS
PLAN
PLAN
BOYS
GIRLS
ENTRY
ENTRY
BOYS
GIRLS
ENTRY
ENTRY

careful consideration, they will, I think, agree with me and acknowledge that the advantages obtained more than balance the objections that can be raised.

The first difficulty that will suggest itself is that of convenience. The idea that all the pupils of the lower floors must ascend through the building to the toilet- and play-rooms will appear to be an insurmountable obstacle, but I fail to see why it should be considered more natural for the pupils of the third and fourth floors to descend to the basement and return to their rooms than for the pupils of the first and second stories to ascend to the roof and return to theirs. To use a homely expression, it is just as broad as it is long, and I believe it to be a very debatable question whether the presumably older occupants of the upper floors are better able to stand the necessary exertion attendant on this passing to and from their class-rooms than the younger children of the lower floors. In either case it will certainly be easier for all to descend rather than to ascend after the natural fatigue attending the exercise of the playroom. The time consumed in either case would be the same, and there need be no more complications in planning and construction in one instance than in the other.

A possible objection may be that it would be more dangerous in case of fire or panic to have the children massed on the upper floor than upon the lower. With proper fire-proof construction (which should be insisted upon), ample exits, and broad and easy staircases I do not think that this is a valid objection. If the proper precautions are taken, the danger from the causes mentioned can surely be reduced to a minimum; and I should not hesitate a moment, should opportunity present itself, to erect a building arranged in the way here advocated.

Those cited are all the objections that occur to me. Others might develop after such a structure had been occupied; but if they should, I believe they would be trivial and easily surmounted. Such a building would certainly be a novelty in school architecture, and I think the advantage to be obtained under the proposition worthy of serious consideration. All the bad odors emanating from the toilet- and play-rooms would be eliminated from the building, and the danger from contamination effectively removed. Plates 84, 85, 86, 87, 88, and 89 show buildings planned in this manner, which are quite as pleasing architecturally as are any of the others. True, the expense of this method will be somewhat more than if the old way is followed, but not so much so as to prove fatal to introduction. And I believe that if this system is once successfully introduced, its many advantages will assert themselves in so emphatic a manner that buildings in the larger cities constructed in this way will become in the future the rule rather than the exception.

The desirability of subdividing the toilet-rooms and placing a certain number on each floor is at present a mooted question. Much can be said both in favor of and against this system. The objections already cited in regard to the permeation of the air will still exist, perhaps not to so great an extent, but still sufficiently to become in time a menace to the health of the occupants; and as to convenience of access to the playrooms or grounds, there is no question that any of the other arrangements is superior. But the greatest fault of this system to me is its complication. If your building is four stories high, you necessarily have two toilet-rooms on each floor, one for each sex; this means eight separate rooms to be plumbed, kept in repair, and daily taken care of —quite a task in itself if it is properly done; the amount of supply-, vent-, and waste-pipes is largely increased, and the number of traps, valves, and shut-offs multiplied to an alarming extent.

The rule of simplicity applies, to my mind, with equal force to the plumbing as to the heating systems, and I am just as much in favor of grouping in one instance as in the other, and believe that more satisfactory results can be obtained by placing the plumbing in not more than two positions than by scattering it all over the building.

About the only advantage claimed for the subdivided system is the close proximity of the toilet-rooms to the schoolrooms, their consequent accessibility and the little time that is lost in passing to and from them. If the halls and staircases are arranged as I have advocated in other portions of this work, pupils passing to and fro will not disturb the occupants of the rooms any more in one case than in the other. This is true when the school is in session, but at recess or between sessions it ceases to exist. As to the time spent in going to and from the toilet-rooms, I believe it makes little difference whether the rooms are situated on the same floor or two or three stories removed; if in the latter position, the additional exercise incurred will be beneficial rather than detrimental to the health of the pupils, especially to those who are disinclined to take active exercise at recess time.

My own preference at the present time is to place the toilet accommodations of the smaller city and suburban schools in isolated buildings in the yards, as shown on Plates

8 and 13; and for the larger structures in the crowded cities, at the top of the buildings, as shown on Plates 85 and 89. These views are those of mature consideration, arrived at after the most careful study. Possibly at some future time a better method will be devised; but until I am perfectly assured of this, I must urge upon school committees the adoption of either one or the other of these systems as being the best, all things considered, now known to me.

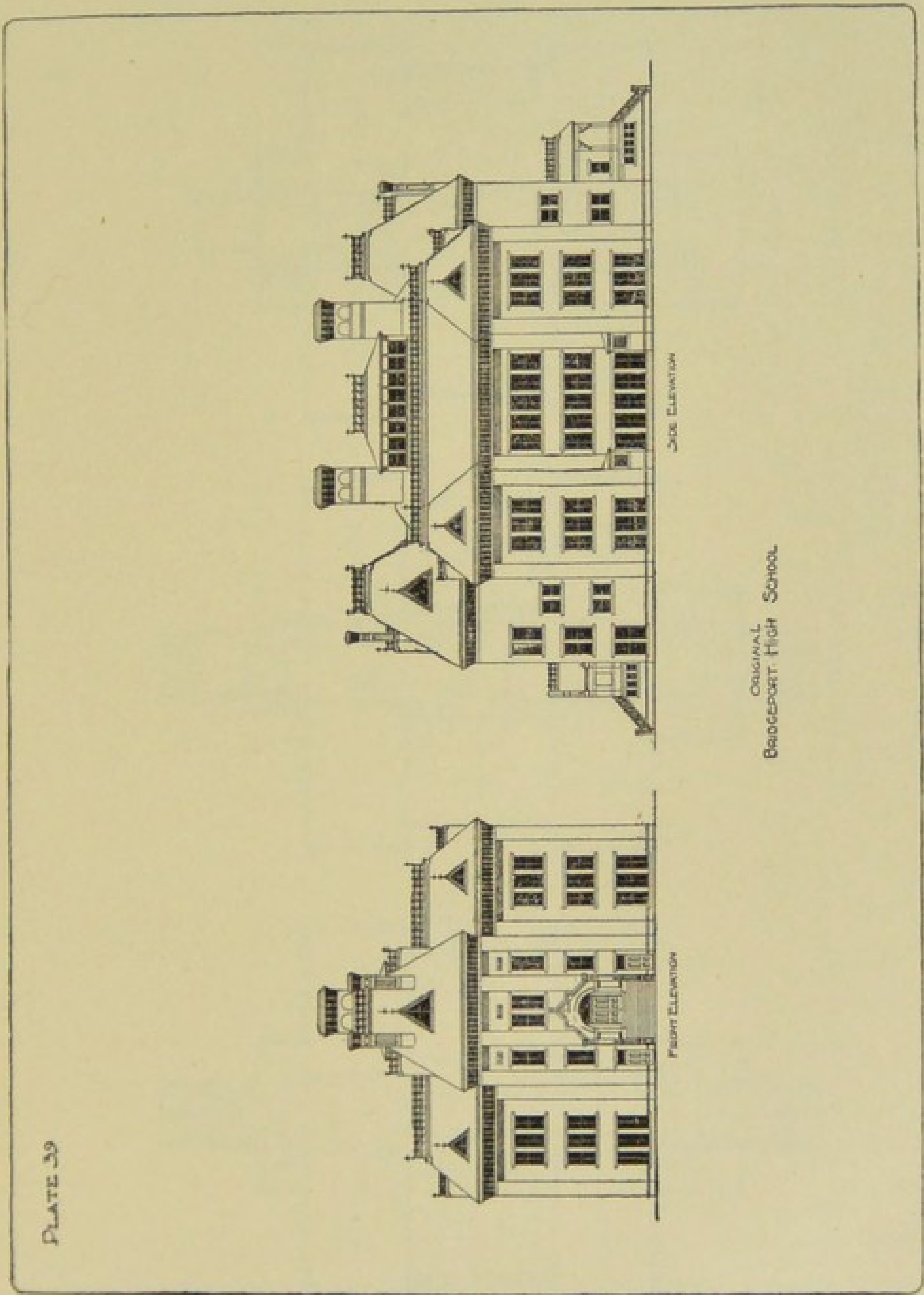


Plate 39
Front Elevation
Side Elevation
Original
Bridgeport High School

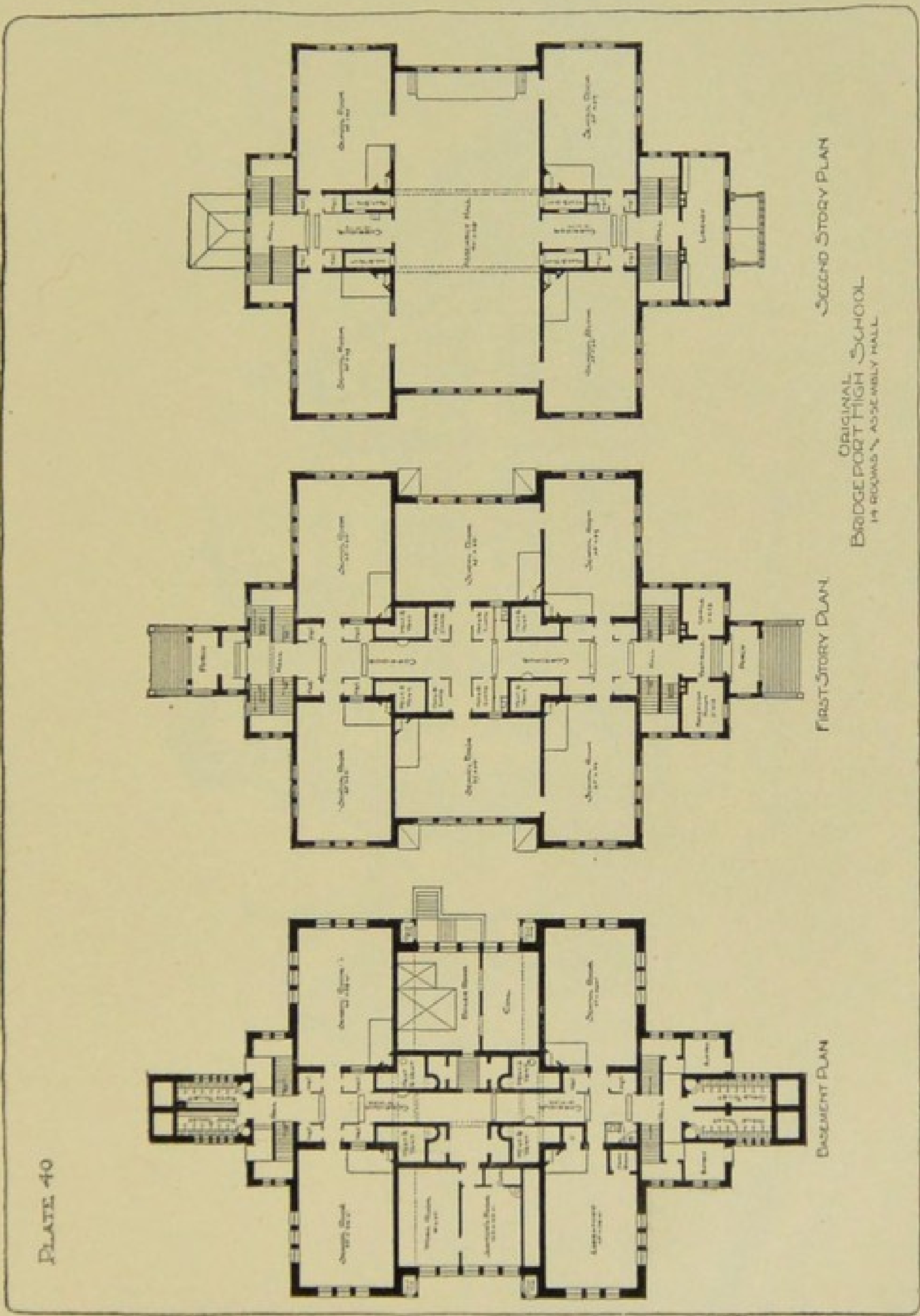
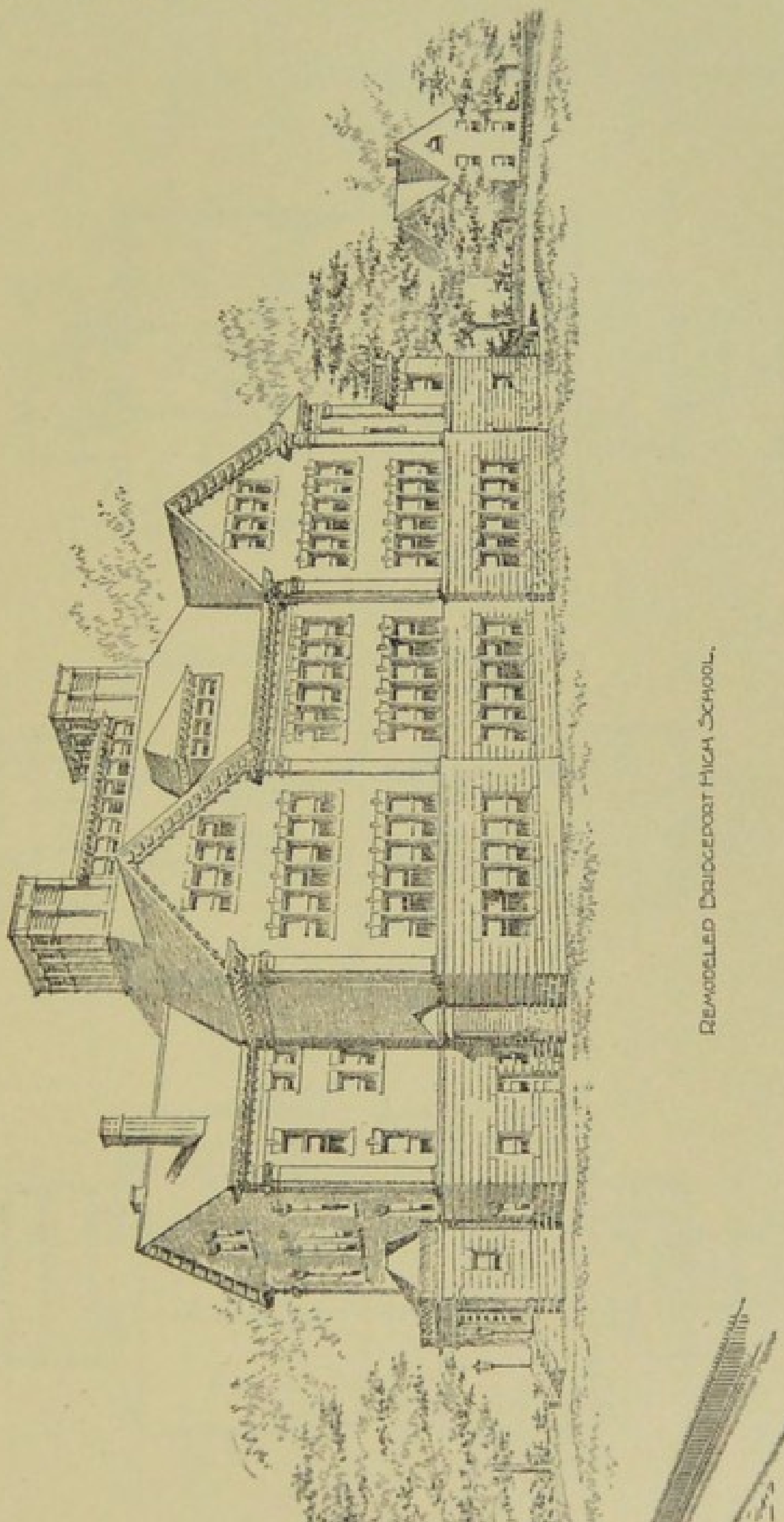


Plate 40
Basement Plan
First-Story Plan
Second Story Plan
Original
Bridgeport High School
14 Rooms & Assembly Hall



REMODELLED BRIDGEPORT HIGH SCHOOL.

PLATE 41.

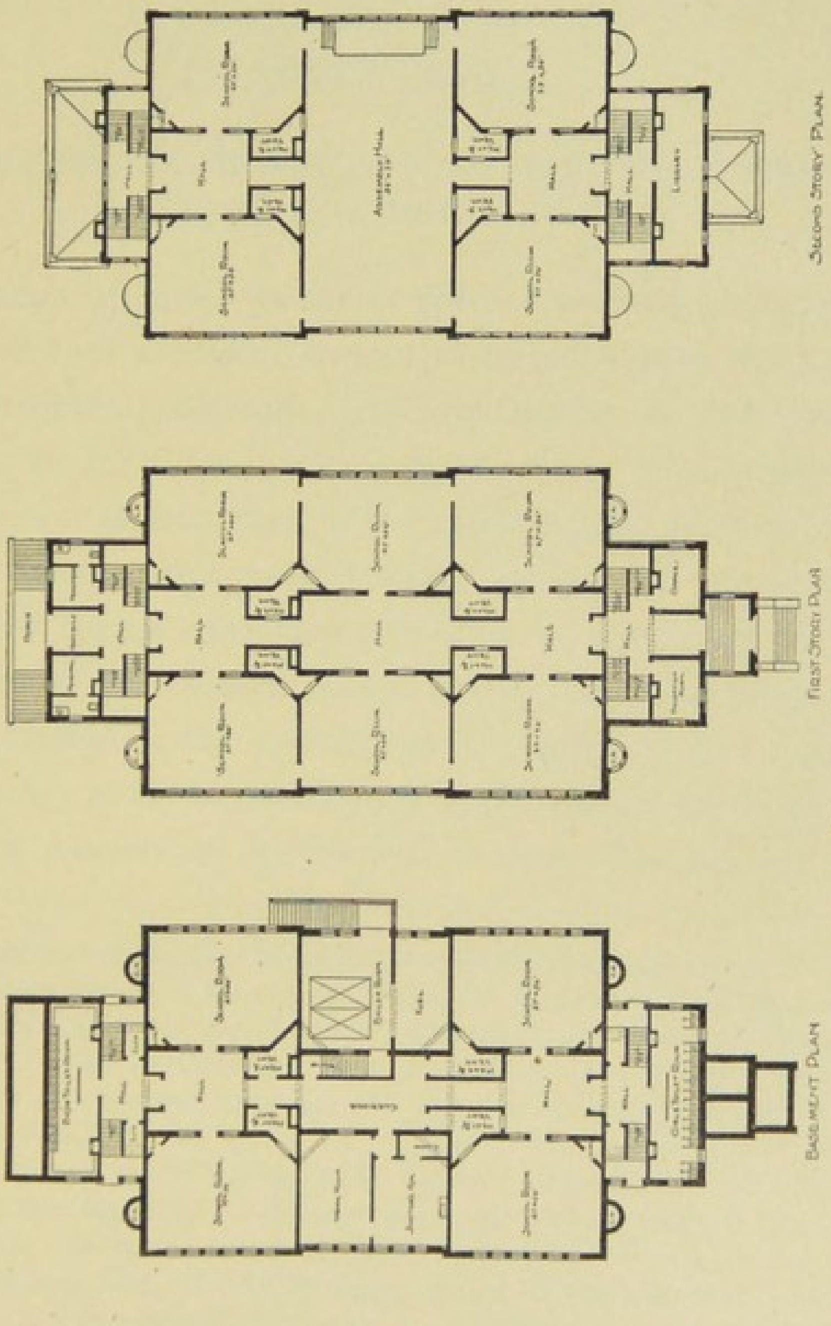


Plate 42.

Remodeled Bridgeport High School

CHAPTER XIII.

THE HYGIENIC CONSTRUCTION OF THE BRIDGEPORT HIGH-SCHOOL BUILDING.*

IN no department of public or private works is there such vital necessity for a perfect system of hygiene as in the planning, construction, drainage, and ventilation of our school buildings. At no time in our lives are we so susceptible to disease as in our school-days. The rapid growth of the child, the mental strain that our forcing system of education requires, and the bad sanitary condition of many homes, all tend to weaken the constitution at this period, and render it particularly liable to the contraction of disease. The necessity of abating, as far as possible, and ultimately exterminating, what is known as preventable disease, has become of

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* This paper was originally prepared for the third annual report of the Connecticut State Board of Health, published in 1879. and was afterwards reprinted in the report of the Board of Education of the city of Bridgeport for 1881. Copies of either of these volumes are exceedingly difficult to obtain. For this reason, coupled with the fact that, even at this late day, frequent demands are made for copies of the paper, it has been reproduced intact in this work, with the original illustrations. Plates 39 and 40 show the building as it was designed and erected in 1878–9. Plates 41 and 42 show the same problem treated in the way I should recommend to-day, after the intervening years of experience in school construction. It has seemed to me that it would be interesting to illustrate a problem in this way, and I hope that a careful comparison of the old with the new ideas will prove of interest to all those into whose hands this work may come.

paramount importance. The alarming spread of malarial diseases and malignant epidemics among children in various parts of the country I attribute, in the majority of cases, to criminal carelessness in sanitary matters. Miserable construction, poor sewerage, bad plumbing, and no system of ventilation, combine to produce among the poor classes hotbeds for the nursing of the germs of pestilential disease, which are then conveyed by the children to our schoolhouses. Much has been accomplished by our State and local boards of health to remedy this evil, but there still remains a vast amount of work to be done. Stringent legislation is needed in all matters pertaining to building, and proper officers appointed by the Governor to see that the laws are enforced are required in all larger cities in the State; when this is done we may hope to see the erection of the miserable shams that greedy speculators and unscrupulous landlords now burden us with, stopped. So long as they enjoy the license which the present laws allow them, we can hope for no improvement.

The schoolhouse, where the child spends from four to six hours each day, demands our direct attention. The majority of the pupils in our public schools come from the poorer classes, and are, as a rule, none too cleanly in their personal habits; coming from homes which have none of the luxuries and barely the necessities of life, they are in no condition to be subjected to either excessive heat or extreme cold. Foul air and poor ventilation they have in plenty at their homes, and we should endeavor in the schoolroom to supply them with pure air, uniform temperature, plenty of sunlight, cheerfulness, refinement, and comfort; our buildings should be so planned as to combine all these requirements.

Dr. Lincoln, in his admirable paper recently published in

Buck's Hygiene, has plainly told us what a school building should be, and the writer has endeavored, as far as lay in his power, to produce a building that should be a model of its kind. He has not only labored long and faithfully himself, but has consulted the leading experts of the country in regard to the heating, ventilation, and general sanitary arrangements of the building, and has always received from them their hearty approval, coupled with the remark: "We have frequently called the attention of the public, in our articles, to what a building should be, and we are glad to see at last a building planned in accordance with our view."

In all the writer's efforts he has been most aoly seconded by the Board of Education of this city, and more especially by the members of the board who comprise the building committee. They are, to a man, whole-souled, enlightened, Christian gentlemen, who have the welfare of the public in view, and although they have been severely criticised and wrongfully assailed, they have unflinchingly put their shoulders to the wheel, and worked with a zeal that cannot be too highly commended to secure for the city a building that can be pointed to with pride when finished.

The site of the new building is admirable. Situated almost in the geographical centre of the city, in one of its best localities, far removed from all noise, dust, or odors arising from factories, stables, or the like, being completely isolated on all sides, having no large buildings or trees to shadow it, and standing within a few feet of the highest ground within the city limits, it presents natural advantages that have never been surpassed, and seldom equalled. The lot has an actual elevation of 61 feet above the average high water in the harbor. It has a frontage on two streets of 200 feet, and an average depth of 256 feet, the lot running from street to street. Not only are great advantages obtained by this frontage, in ease of access to the building, but thus are secured unexceptional facilities for the disposal of sewage, there being a 12-inch main running down the hill in the centre of both streets; the fall of these streets is very rapid, being between 4 and 6 feet in every hundred.

The principal front (there is no rear) of the building faces Congress street, which, running nearly east and west, gives it a southwesterly exposure. This arrangement secures in every room in the building, during a portion of the day, *sunlight* in abundant quantities.

The building is designed to be constructed of brick, with local stone foundations and underpinnings, brownstone caps, sills, and trimmings, exterior steps to be of granite, and roofs of slate. It will consist of three stories, viz., the ground floor, first story, and second story. It contains a total of fourteen school- and recitation-rooms, a chemical laboratory, reception-room, office, library, janitor's room, work- and boiler-room, beside the water-closets.

The height of all rooms in the building, with the exception of the high-school room, is 13 feet, the high-school room having a height of 28 feet in the centre, and 21 feet on the sides.

The writer does not consider it necessary to go into a detailed explanation of each floor-plan, but will simply call attention to some of the novel features and general construction of the building. The plans themselves illustrate sufficiently the general position and arrangement of rooms and halls.

The ground floor is located two steps, or about 15 inches, below the grade of the lot. This, under ordinary circumstances, would be considered an objection, on the plea of dampness, but the floor and side walls have been so carefully prepared that the rooms situated on this floor are expected to be the driest in the building.

In the first place, the ground itself is unusually free from dampness; ample provision has, however, been made for the removal of all surface-water by the introduction of 6-inch drain-pipes, laid with open joints, in trenches filled with loose stone, these stones covering the top of the pipe a few inches. These pipes run all around the building, just outside of the foundation wall, and are then carried to the manholes, where they are connected with the main sewer above the running trap.

The ground under the floor of the schoolrooms situated on the ground floor is first cemented 2½ inches with the best Rosendale cement, and then covered with two coats of asphaltum. This asphalt is put on hot, and not only covers the entire bottom, but runs up on all outside and inside walls to the height of the copings, and is then carried across the top of all interior and exterior walls, forming an impenetrable protection against dampness. Not only is the ground floor and the walls to the height of the coping treated in this manner, but all outside walls in the building—they are all covered to their full height and width with two coats before they are furred. This I believe to be a more perfect safeguard against dampness than the common hollow wall.

STAIRCASES.

The staircases consist of four flights; two at either end of the building. While being convenient and easy of access from all parts of the building, they are yet sufficiently isolated to be free from the usual objection of noise, and are moreover absolutely fire-proof. They are constructed with iron treads and risers, securely fastened to string-pieces, also of iron, that are bolted directly to the brick enclosing-walls. The top surfaces of all treads are to be covered with rubber, to prevent slipping. All platforms and landings are to be formed of granite slabs 8 inches thick. The stairs are formed with two "runs" for each flight, with landings midway, this being done to secure an easy ascent. The stairs are all 5 feet wide; all landings $5' \times 11'$, risers $7\frac{1}{2}$ inches, treads 11 inches; they are well lighted at all points by ample windows placed on each landing. An iron hand-rail, bolted to the walls, runs around on all sides at a suitable height. There is no wood-finish of any kind, with the exception of door- and window-casings, in the staircase halls. The side walls are of face-brick laid in black mortar with struck joints. These walls, when hard, are to be treated with a coat of liquid filler, and then varnished in two coats, thus forming a perfectly hard surface, not easily marred or soiled

HAT-AND-CLOAK-ROOMS.

In all our school buildings of the present day, the hat-and-cloak-rooms have been more or less objectionable, especially in wet weather. Children coming in with wet garments hang them in narrow rooms, poorly heated and lighted, and usually unventilated, where they are allowed to steam in a close and unwholesome atmosphere during the session, and at its close are put on by the child in a worse condition than when taken off. An attempt has been made to remedy this evil in the construction of this building. In the main halls, which are spacious, and which are to be heated and ventilated in the same manner as the schoolrooms, have been placed the hat-and-cloak-rooms—two for each schoolroom. These rooms, instead of being lathed and plastered in the usual manner, are simply partitions of ash 8 feet high, entirely open at the top, and so arranged that only the supporting posts run down to the floor. The portion of the partition between the posts is kept 4 inches from the floor, giving a free circulation of air throughout these rooms. Damp or uncleanly clothing hung in these rooms during the session, instead of being filled with the foulness arising from confined atmosphere, will become purified by the constant circulation of pure air,—the impure air being disposed of through the main-hall ventilators.

LIGHT.

All eminent writers on school hygiene have called attention to, and dwelt with much stress upon, the importance of abundant light properly distributed in our schoolrooms. That the light should come from the left side and be introduced at nearly right angles to the floor-line is an established rule among those versed in school matters. Upon the actual amount of glass required by each pupil, authorities differ. Dr. Lincoln states that the size of the windows, taken collectively, should equal at least one sixth of the floor-space. Cohn, the German writer, requires one fifth, or 30 inches to the foot. Some of the highest authorities require from 300 to 350 square inches of glass for each pupil; this coincides very nearly with Cohn, but Dr. Lincoln does not consider that, in our schoolrooms, which have a greater depth than those referred to by the above-mentioned authorities, the amount mentioned by them is enough.

In the Bridgeport schoolhouse the window-stools have all been kept 4 feet from the floor, and the window openings are carried up to within 1 foot of the ceilings. The size of the windows, taken collectively, equals, in the corner rooms, one sixth of the floor-space, allowing 50 pupils per room, and gives 434 square inches of glass per pupil. In the middle rooms, the floor-space is seven times that of the glass-surface, and, allowing 50 pupils per room, will give to each 403 square inches of glass. In the corner rooms the seats are so arranged that the light comes always from the back and left—in the middle rooms it comes only from the left.

In the high-school room, the glass-surfaces, taken collectively, equal one sixth the floor-space; allowing 200 pupils for this room, will give to each pupil 384 square inches of glass-surface.

FLOOR, AND CUBIC FEET OF SPACE ALLOWED EACH PUPIL.

In the corner rooms, allowing 50 pupils per room, each pupil will have 20.50 square feet of floor-space and 266 cubic feet of air. In the middle rooms each pupil will have 21 square feet of floor-space and 273 cubic feet of air. In the high-school, allowing 200 pupils, each pupil will have 17 square feet of space, and 441 cubic feet of air. While the floor-space in the high-school room is somewhat smaller than the highest authorities require, the cubic contents are largely in excess of the most exacting, and it must be taken into consideration that this room is seldom occupied by the entire number of pupils for more than a few moments at a time, as the recitation-rooms used in connection with it are, during the school session, in constant use. It should also be remembered that the number of pupils calculated for each room is

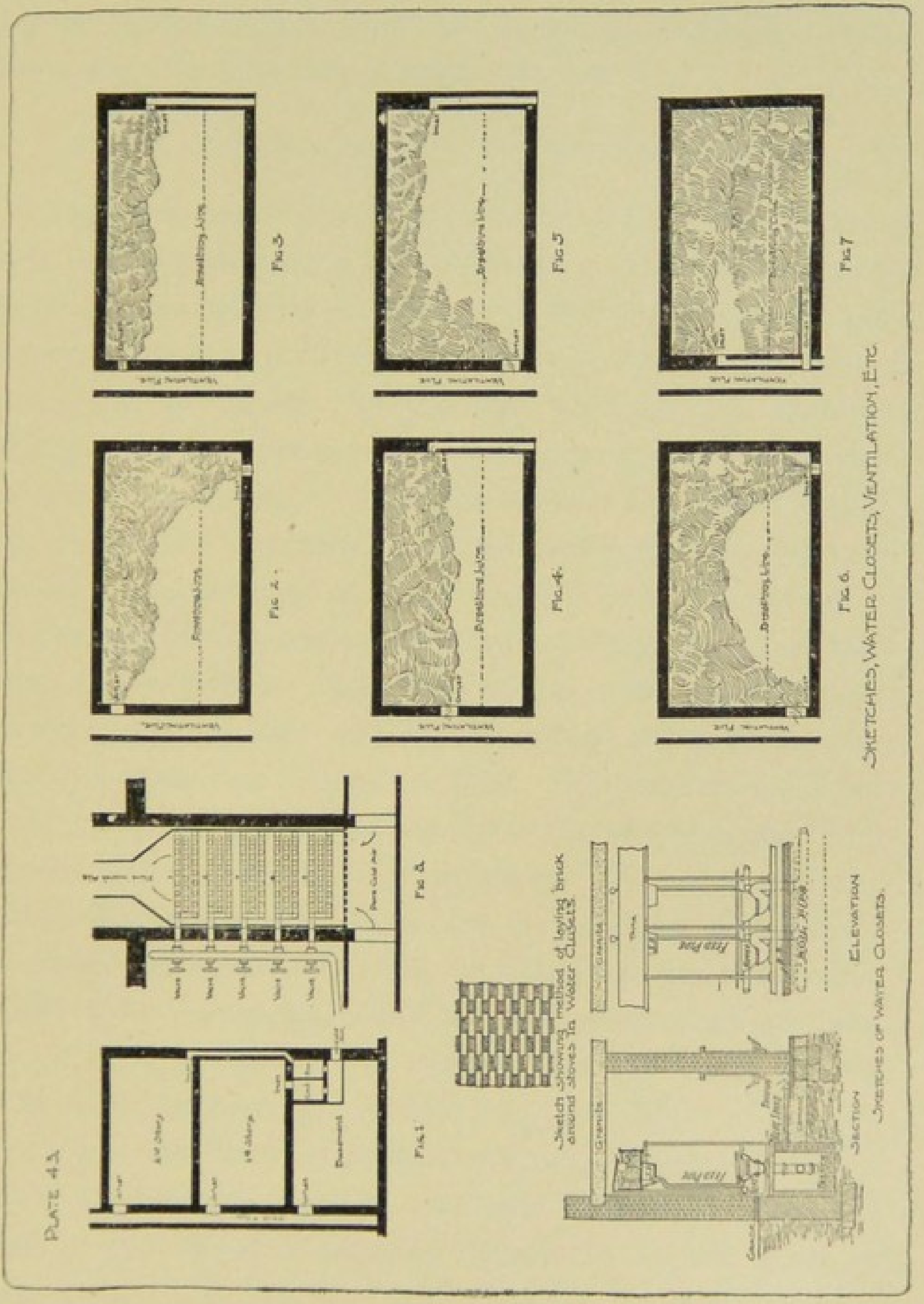
Plate 42
Fig. 1
Basement
1st Story
2nd Story
Fig. 2
Fig. 3
Fig. 4
Fig. 5
Fig. 6
Fig. 7
Breathing Line
Ventilating Flue
Sketch showing method of laying brick around stoves in Water Closets.
Section
Elevation
Sketches of Water Closets.
Sketches, Water Closets, Ventilation, Etc.

their extreme capacity. It is to be hoped that no teacher will be burdened with more than 44 pupils, although I have based my calculations on a larger number.

THE WATER-CLOSETS AND THEIR CONSTRUCTION.

The demands of modern civilization require that we provide, either within our school buildings or in close proximity to them, water-closets for the use of the pupils. There can be no doubt that much harm is done to children, in many schools in our State, by the bad sewerage and careless arrangement of water-closets. It has been said that privies placed under the same roof which shelters the school should not exist for a moment. I do not consider that this rule should be simply applied to privies, but that the groups of water-closets which are required in all our large schools should come under the same head; they should in no case be placed directly under schoolrooms in the basement, as contamination will surely follow sooner or later. They should be, if not wholly, at least partially isolated from the building, and those for the boys removed as far as possible from those for the girls. The teachers' water-closets can, I think with safety, be placed in the building, that is if they are carefully ventilated; these water-closets will be used understandingly and are not liable to become unwholesome; but the pupils' closets, even with the most careful watching, are liable to become foul from the habit so prevalent among children (I wish I could say that the habit was confined to children alone!) of making the closet a common receptacle for all kinds of garbage.

In the Bridgeport schoolhouse (see Plate 43) the closets for the pupils have been placed at either end of the building under the entrance-steps, far removed from each other, securing a complete separation of the sexes. They are also completely shut off from the main school building by the intervening staircase halls; by this arrangement, ease of access is obtained, combined with complete isolation, obviating the danger of contaminating the main school building.

The water-closets have been constructed with a view to having as little woodwork as is possible with the requirements of comfort. The main floor is to be of bluestone flagging 4 inches thick, laid in Portland cement; this is laid on a gentle incline to a certain point, to secure a good drip or wash from all points of the room. The side walls are of brick, treated in the same manner as has been before mentioned in the description of the entrance halls. The ceilings will be formed by the bottom of the granite slabs that are used for the floors of the vestibule, porch, and outer halls. The casings, doors, and seats for the closets comprise the entire woodwork; these are of ash, and are treated to a coat of filler and then varnished in two coats. The partition between each bowl is to be of slate, $1\frac{1}{4}$ inches thick, 7 feet high, by 2 feet 6 inches broad. These slate partitions are held in position by iron floor- and wall-pieces and caps of the same material (see Plate 43). The floor upon which the closets stand is raised one step above the main floor of the closet (see drawing), and is also composed of bluestone flagging 4 inches thick, a hole being cut through this stone for the outlet of the closet. The closet that is intended to be used is the Hellyer short artisan hopper. This closet combines more good points, in the writer's opinion, than any other at present known to him. Its chief point of excellence is its simplicity of working, and the fact that it is entirely of earthenware. There are no pans, valves, or plungers to become foul or get out of order; it is, in fact, an earthen hopper of improved shape, fed by a continuous tank to which is attached for each bowl a serving-box. When the seat is occupied, by a simple device a valve is raised, and the serving-box filled with water from the tank, at the same time a small stream is permitted to trickle into the hopper, wetting the sides and preventing the adhesion of excreta to the bowl. When the seat is relieved of its weight, the valve before referred to is closed, another one opened and the contents of the serving-box (some three gallons) suddenly discharged through a large pipe connected with the flushing-rim into the bowl of the hopper, carrying all solid matter through the trap. As I have said before, these hoppers, both bowl and trap, are of white earthenware; they are to be securely bolted to the bluestone and left entirely open and exposed to view. The seat is supported by the slate partitions, on which are bolted slate cleats. The chain operating the service-box and the feed-pipe are both enclosed in an iron pipe, so as to be completely inaccessible to the pupils.

The tank and service-boxes are of iron, painted. Directly under the platform on which the hoppers are set, there is to be constructed a manhole trench to be built of brick, coated with asphalt; the top is formed of the bluestone that the hoppers rest upon. This manhole is 2 feet broad by 3 feet 6 inches high, and is large enough to permit of a man crawling through it to inspect the pipes. This trench is to have an iron register at one end for the admission of pure air, and at the other is connected directly with the ventilating-shaft. In this trench are to run the soil-pipes from the hoppers; these are to consist of 6-inch cast-iron pipes with 4-inch

Y joints for each hopper. These pipes are caulked with molten lead and then covered with two coats of asphaltum to prevent rust. By the arrangement of this trench the soil-pipe and its connections are always accessible; even should a leak occur in any of its joints which was not at once discovered, the stench arising from such a cause would not enter the building, but pass off through the ventilating-flue. The urinals are placed along the inside division-walls; they are to be constructed with slate backs and troughs put together in the most approved manner, the trough being supported by brass brackets; the back is arranged with a neat cap of slate, under which is run a water-pipe perforated with small holes so as to secure the complete wetting of the entire back at all times. Underneath this trough, in the floor, there is another trough, the bottom and one side being of bluestone and the other formed by the slate back; this trough has an inclined surface and is intended to carry off all drippings or slopping that may occur in or about the closets or urinals. At its outlet it is trapped with a deep running-trap and then connected with the main drain. This arrangement will enable the janitor, at the close of each day's session, to thoroughly wash down with a hose the entire room.

Upon the inside walls of rooms that are occupied by these closets have been placed ventilating-flues, two for each of the closets. These flues are of large size, and run up through the building, entirely independent of all other flues, to a point far above the main-cornice line. Through these flues the extension of the soil-pipes of each section of hoppers is carried, and there is also connected with these flues a vent-pipe, running under the seats just above the trap of each hopper. Lastly, the trench in which the soil-pipe runs is also cemented. The lower portions of the flues,—that is, those parts of them that come directly in the rooms occupied by the water-closets,—are enlarged into a circular form (see plans), this being done to permit of the introduction of a small stove in the bottom of each flue, and this stove is to be kept running ALWAYS, both winter and summer, as the writer believes that this is the ONLY WAY to secure a steady up-current at all times under the varying conditions of the atmosphere. The brickwork around these stoves is laid in open work (see Plate 43), and on the inside covered with wire netting. There is also an iron door provided for each flue. By this arrangement many points are gained; not only are the hoppers and soil-pipes perfectly ventilated, but any stench arising in the rooms is quickly removed by the strong up-current through the flues. Again, in the winter, these two stoves in each room will be ample for heating purposes; while in summer, by a simple device, the direct radiation is shut off from the room, and thrown entirely up the flue.

The teachers' water-closets, situated two on each floor, are to be of the same pattern as those described, fitted up in the same manner as the ordinary house-closets, but with special reference to their construction and ventilation.*

The reader by studying the accompanying plans and

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* The soil-pipes for the teachers' closets in the main building are laid in a trench in the same manner as described above; the main drain runs into a manhole just outside of the building, where the three lines of soil-pipes (one from each section of hoppers, and one from the teachers' closets) are brought together just above a deep running-trap. This manhole is covered with a bluestone flag, is carefully ventilated, and easy of access. There is also connected just above the trap in this manhole the rain-water drains connected with the leaders from the roof, so as to secure during every rain a thorough scouring out of all these drains and their connections.

sketches will be enabled to readily understand the general arrangement and working of this system.

HEAT AND VENTILATION.

It is generally admitted, on all sides, that the most practical, economical, and surest way of heating our buildings, at the present day, is by steam. Granting that steam is to be our medium, it next becomes a question of how it shall be used. There are, at this writing, two methods in general use, these being known respectively as the direct and indirect systems. The direct system means the placing of radiators or circulation-pipes in each and every room required to be heated. The indirect system consists in placing all the pipes or radiators in boxes in the basement. Pure, cold air is brought into these boxes, and by passing through the coils of heated steam-pipes is warmed to the degree required. The heat generated in these boxes is then conveyed to the various rooms through tubes or pipes, in the same way that heat is usually conducted from our ordinary hot-air furnaces. Both systems have many strong advocates, but as far as the writer's investigations and researches have led him, he has found, among men who have simply the heating of a room in view, the direct system in favor; but among those who have not only the actual heating, but the supplying of the room with fresh, pure air at all times, the indirect system is invariably adopted. From the personal investigations and practical experiments the writer has made from time to time, he is convinced that far better results can be obtained by this method than by any other now known to him. It has therefore been adopted in the new building for this city. It may be said in objection to this system that the amount of fuel required to heat a given amount of space is largely in excess of that required by the direct plan. This is in a measure true, but not to the extent supposed. Again, it has been said that it is impossible to heat exposed rooms by the indirect plan without an enormous apparatus. This also is a mistake, for neither is an extravagant use of fuel nor a gigantic apparatus required, *if the apparatus is properly arranged and understandingly handled.* The trouble has been not from the inability to produce heat, but from the extraordinary loss of heat,—this being occasioned in many cases by the position of the introductory-flues, and in other cases by that of the outgoing ventilating-ducts. It should be our aim to utilize every particle of heat entering the room before we allow it to escape; it is certainly folly to bring in vast quantities of pure, warmed air at the floor level of a room, and send it out with equal rapidity at the ceiling level, without having traversed the room, outside of an almost direct line drawn from the incoming to the outgoing register; yet in many cases our registers are so arranged that it is impossible to get any different results.

I have before said that there is a general unity of opinion among experts as to the feasibility of indirect heating, but in regard to the placing of the heating surfaces in the cellar, and the position of the incoming and outgoing registers, there is a wide diversity of opinion.

I shall endeavor briefly to describe some of the principal methods in common use, and the objections that I have to them, before describing the system adopted in the Bridgeport school building; the placing of the coil-boxes in the basement, on the outer walls under the rooms to be heated (Fig. 1, Plate 43), and the introduction of the warmed air at the floor and its removal at the ceiling level upon the opposite side of the room. The objections that I have to this system are:

1. That in a building like the Bridgeport school there would have to be placed in the basement at least six separate coil-boxes for the generation of heat, arranged one under each room; that by placing these boxes in the basement rooms the rooms are rendered entirely unfit for school purposes, and their utility for playrooms greatly crippled.

2. That by placing these boxes far away from the centre of the building, where the boilers are presumably located, a large amount of additional piping becomes necessary throughout the basement.

3. The boxes being placed on the outer walls of the building, there is danger of the pipes freezing; constant watching and attention is required to prevent this and to insure their proper working.

4. That the introduction ducts or flues running up the outer exposed walls of the building lose a great deal of heat by their proximity to the cold; that this loss of heat cannot be wholly obviated even by the most expensive construction; that a large addition to the actually necessary heating-surface is required to overcome this loss of heat, caused by the exposed position of the flues.

Lastly. That the air entering upon the outer wall at the floor, and being removed on the inner wall at the ceiling level, does not benefit the occupants of the room as it should. The action of the air as it enters is rapidly upward to the ceiling, where it stratifies, then along its surface to the outlet, as indicated in Fig. 2, Plate 43. The entering air is warm and light, and naturally rises and flows across the top of the room to the nearest outlet. The foul air of the room, being heavy with impurities, remains at the bottom, becoming constantly more contaminated. There is no doubt a certain amount of radiation or mixing going on, but the great bulk of the pure, warmed air entering the room takes the short cut across it and up the ventilating-flue, as shown in Fig. 2, Plate 43. This action of the warm air occasions, as may be readily seen, an enormous loss of heat, without accomplishing the very points aimed at, the utilization of every particle of heat before it is allowed to escape, and the thorough mixing of the pure incoming air with the air already in the room. If any one doubts the correctness of the action of air as herein described, let him fill the incoming flue with smoke, that can be readily seen, and watch its course as it enters, flows upward and outward, and see where the great mass of it goes. The dotted lines on these sketches indicate the breathing-point of a person sitting.

It may be well to explain that in these experiments the outlets have been at least *twice as large* as the inlets, and that there has always been heat in the outgoing flues to produce a strong up-current, as I believe this to be the *only* sure way to produce a constant outward flow of air. In Fig. 3, Plate 43, the outgoing flue is in the same position, but the incoming flue has been raised about two thirds of the way toward the ceiling. In Fig. 4, Plate 43, the flues have been placed on about the same level, but with no better results. In Fig. 5, Plate 43, the outgoing flue has been placed at the floor with the results shown in the sketch. In Fig. 6, Plate 43, both flues are at the floor level, with better results than have yet been obtained, but still far from satisfactory. I have thus tried to show the general action of incoming and outgoing currents of air by the placing of the introduction-flues on the outer walls.

The second method in general use is the placing of the coil-boxes upon the inner wall and the removal of the foul air at the opposite side of the rooms. I consider the placing of the coil-boxes on the inner walls a great improvement on the other method, as by this plan they are centralized, extensive piping is saved, and the danger of freezing obviated. The placing of the exhaust-flues on the opposite side of the room I believe to be open to the same objections that I have described in the first method. The action of the hot air, from the points where it is introduced toward the various outlets, is the same as in the sketches already shown, and will be readily understood by the reader.

In the Bridgeport school the coil-boxes for the heating of the various rooms have all been placed in the main ventilating-shafts in the *centre* of the building, and the air conveyed from them through these shafts to the rooms by means of metal tubes. The air enters the inner corner of the room about 8 feet from the floor, the corner being clipped (see plans) so as to form a flat surface for the register opening; underneath the register the space is utilized for a closet for the use of the teacher. The outgoing flue has been placed directly under the platform, which is located in the *same corner* as the introduction-flue. This platform measures $6' \times 12'$, and is supplied with casters, so that it can be moved at any time it is necessary to clean under it. Its entire lower edge is kept about 4 inches from the floor, to give a free circulation under it at all points. The action of the incoming air is rapidly upward and outward, stratifying as it goes toward the cooler outer walls, thence flowing down their surfaces to the floor and back across the floor to the outgoing register. By this method all the air entering is made to traverse with a circular motion (see Fig. 7, Plate 43) the entire room before it reaches the exhaust-shaft, and there is a constant movement and mixing of the air in all parts of the room. All the heat entering is utilized, and I believe that if the supply and exhaust-flues are properly balanced as to size, there can be a very small loss of heat.

The inlets are all intended to be large, and the flow of air through them moderate and steady. The air is not intended to be heated to a very high temperature; the large quantity introduced is expected to keep the thermometer at about 68° at the breathing-level. The schoolrooms contain on an average about 13,000 feet of air, or 260 cubic feet per pupil. It is proposed to supply each pupil with 30 cubic feet of air each minute, or 1800 cubic feet per hour. Allowing 50 pupils to each room, this will necessitate the introduction of 90,000 cubic feet of air into the room each hour, and will change the air of the room 6.92 times within the hour, or once in about 8 minutes. These calculations are based on a difference of 30° in the temperature.

In the exhaust-flues there are placed coils to produce a strong up-current at all times; heat is also obtained from radiation from the introduction-flues, which run through the foul-air shafts.

Trouble has always been found in regulating the supply of warmed air obtained by the indirect system, owing to the inability to control the heating-surfaces. The usual way of constructing the apparatus has been to place in the coil-boxes sufficient steam-pipe to heat the room in the coldest weather. The pure, cold air passing over the pipes becomes heated to the desired temperature, and is then carried to the rooms; this answers very well during the coldest weather, but, as the weather moderates and less heat is required, the only way to regulate it has been to close the registers, which not only lowers the temperature of the room, but shuts off the supply of pure air entering. This fault has been remedied in the Bridgeport schoolhouse as follows: The heating-surface for each room is enclosed in separate cases or jackets (see Fig. 8, Plate 43) of metal, and are then subdivided into five sections, so arranged that any number of sections or the whole may be used at pleasure,—that is to say, that any one, two, or three parts may be used at discretion. In extreme cold weather the whole five sections are in use; in moderate weather two or three, and when a small amount of heat is required, only one. By this plan the supply of pure air remains always the same, but the degree to which it is heated is changed by the opening or closing of a valve (Fig. 8, Plate 43).

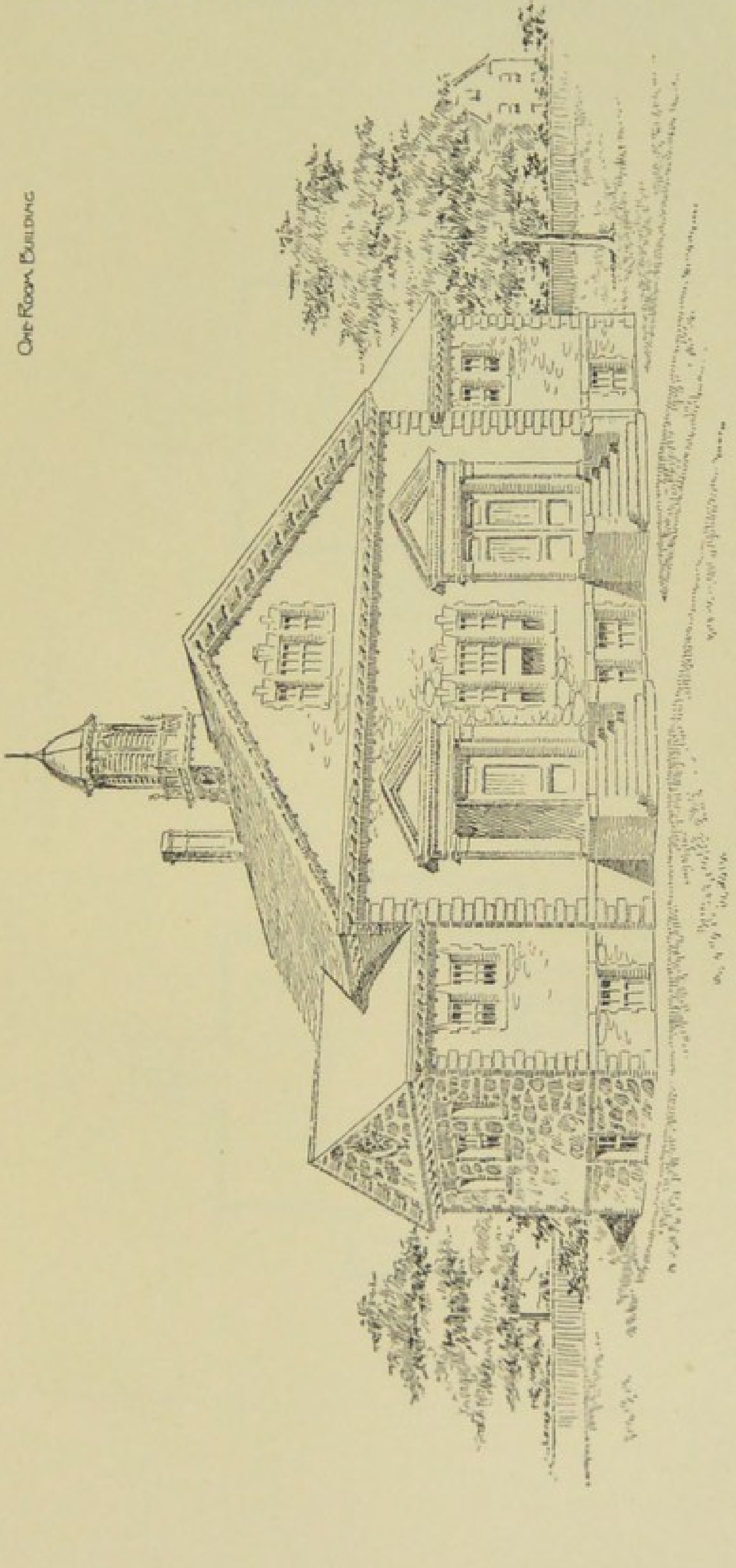
The arrangement of all the heating and ventilating apparatus in the centre of the building renders it convenient and easy to manage, economical in its construction, and effective in working. The advantage is also obtained of having all speaking-tubes, call-bells, and water-pipes run through the ventilating-shafts, where they are always accessible, as each shaft is provided with an iron ladder. This system has not only been introduced into each room, but into the halls as well. There are placed, moreover, in the hall foot-warmers, that are indicated on the plans. These warmers are simple steam-pipes encased in tin boxes arranged between the floor-joists; the pipes are packed in sand to temper the heat, and are covered at the floor level with checkered iron plates set flush with the floor. The tin cases referred to are water-tight and have a drip-pipe running down to the boiler-room, so that in case of a leak no damage may be done to the building.

The boiler-room floor is sunk some 6 feet below the level of the ground floor to insure a drip of all return-pipes from the coils. The cold-air inlets are on four sides of the building, the openings being about 8 feet from the ground; these inlets are connected so that, whatever way the wind may be, a supply of pure, cold air is always assured.

I have thus far spoken only of winter heating and ventilating; for summer ventilation I believe there are no better inlets for the air than the windows. There are many devices that may be arranged in them that are simple and effective. It is not necessary to describe them here. The outlets, however, need a brief description; it is intended not only to use the outlet under the platform, but by a simple device the incoming register for warm air in winter is made to connect with the main outlet in summer, so that two outlets are provided during the warmer months. The up-going current in the ventilating-shafts is maintained in summer, as well as in winter, by heat; there being placed at the bottom of each shaft a stove, which is to be used constantly when the boilers are not in use, insuring an equally strong up-current in winter as in summer.

I would say in conclusion that many interesting experiments have been made and important facts established. These experiments have principally been made with a model of about one sixth the capacity of the schoolrooms. They have always resulted most satisfactorily, and have proved to the writer the correctness of the principles herein advanced against the objections commonly raised that heat brought into the room on the inner walls will not sufficiently warm the outer walls. He would say that in every test yet made the registration of carefully-graded thermometers has been from 1° to 2° warmer near the outer wall than near the inner, showing conclusively that the flow of heated air is rapidly towards cool surfaces, and that if its volume is as it should be it will counteract the cold radiating from the outer walls and render the temperature of the air in their immediate vicinity comfortable. Many other interesting facts have been established and much useful data obtained, but I have neither the time nor the space here to describe them. I have purposely omitted in this paper all figures not actually necessary, aiming to make it a simple statement of the writer's views, fortified by the results of actual experiments. If any should desire more minute details than are here given, by communicating with the author he will willingly furnish all the information required.

The building has been described throughout as it was designed to be built by the architect; some modifications have been found necessary during the progress of the work.



ONE ROOM BUILDING

PLATE 44.

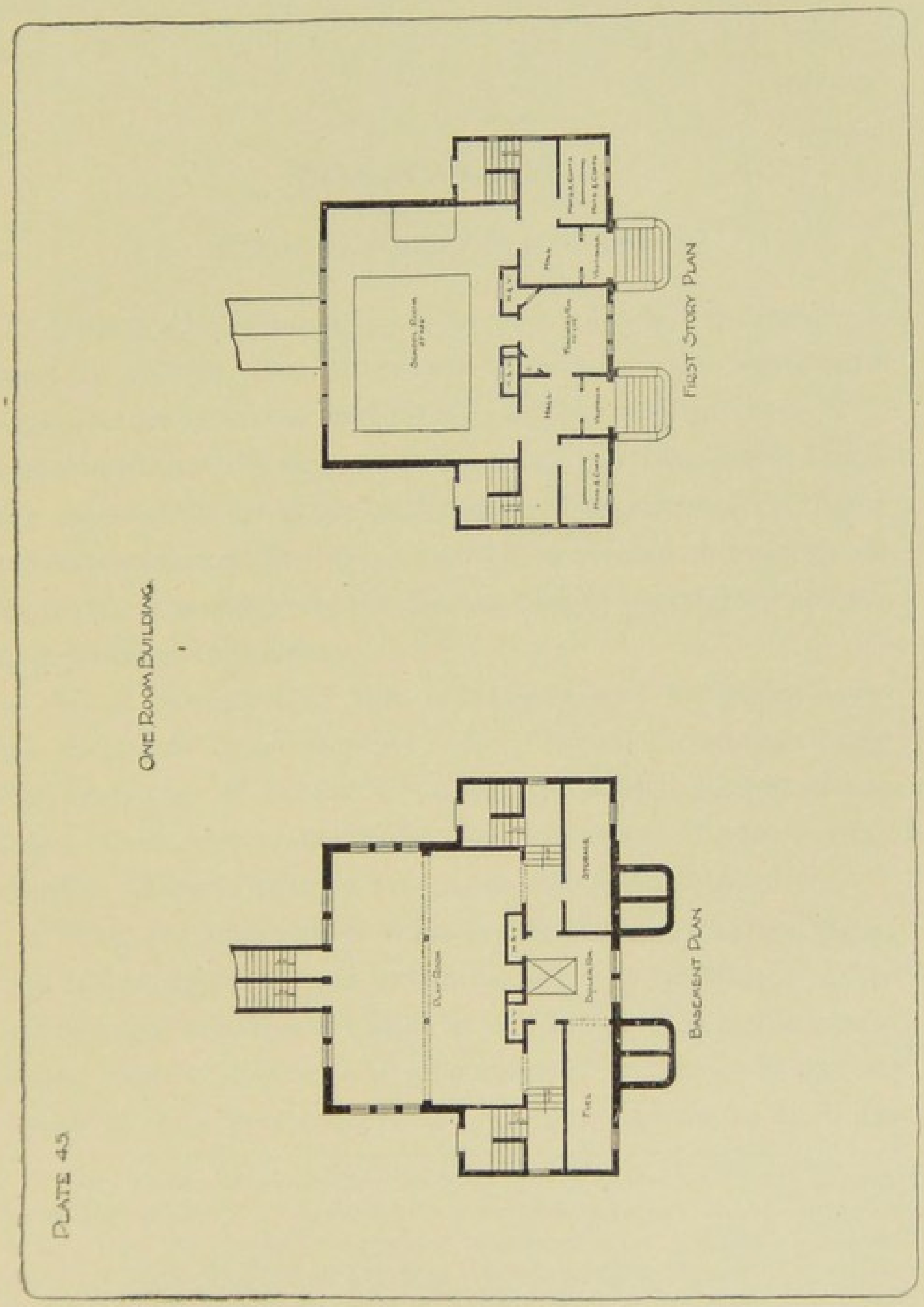


PLATE 45
ONE ROOM BUILDING
BASEMENT PLAN
FIRST STORY PLAN

CHAPTER XIV.

SUBURBAN SCHOOLHOUSES.*

UNDER the stimulating influences of what is known as sanitary reform, the outgrowth mainly of the systematic organization of State and local boards of health, there is in some localities a laudable desire among the school and building committees to improve the general condition of existing schoolhouses, and in those about to be erected to embody, in a greater or less degree, the lessons taught by sanitary science and practical experience.

While the spirit of this movement is to be highly commended, it is to be deplored that, however conscientiously the advocates of better structures for school purposes may labor, they almost invariably fall far short of the desired results. This is directly attributable to several causes.

First, the stereotyped schoolhouse is always before them, and is usually taken as a model for the new building. Committees and teachers are alike slow to depart from the established custom, fearing, if unsuccessful in their efforts to improve, the severe censure they are sure to receive from the

* This paper was written for the State Board of Health of New Hampshire and published in their first annual report issued in the spring of 1882. This edition has long since been exhausted, for which reason mainly I have republished the paper here substantially as it was first written, but with new illustrations which more fully depict the ideas gleaned from a riper experience. Such changes in the text as have been made refer almost exclusively to the plans and their accessories.

community. Many valuable suggestions are not adopted for this reason, it being considered better to leave well enough alone, no matter how bad "well enough" may be.

Second, local prejudice against hygienic reform. The ancient inhabitant classes it with all other modern crazes and new-fangled notions. "In my school-days," he argues, "we had no such nonsense, and children were healthy and hearty enough, I am sure. Why should they not be so to-day, with better buildings, and all the so-called 'modern improvements'?" It is true that we have "modern improvements" of all kinds, not only in our buildings, but in our studies as well. The time has been, when a few months' schooling each year in the rudimentary branches was considered an almost unwarranted luxury. The greater portion of the lives of the youth of both sexes was spent in manual labor, thereby strengthening them physically, without overtaxing their mental powers. They lived, as a rule, in a country thinly populated, and had at all times an abundance of fresh air and exercise. Malarial and contagious diseases were comparatively unknown. Modern civilization and improvements had not contaminated either the soil or the air, as is the case in our day. I venture to say, that, if we could take the healthy, robust children of fifty years ago, and crowd them into our badly-ventilated, poorly-heated, and imperfectly lighted schoolrooms, confine them in the unwholesome atmosphere five or six hours daily, subject them to our forcing system of education, and continue this strain for the greater portion of each year without the least thought of their physical culture, the healthy child of "ye olden time" would quickly be reduced to as unhealthy and puny a stripling as the majority of the city school children of to-day.

The very salvation of the child in those days was the small amount of mental labor, and the vast amount of physical exercise required of him. The state of the community at that time required that it should be so, while in our day it is exactly the reverse. It is as absurd to compare the school system and buildings of those days with what is now required as it would be to put the ancient stage-line in competition with the railroad.

Third, penurious and short-sighted economy in the appropriation of small sums for the construction of buildings.

The average parents will cheerfully provide their children with suitable, and often expensive, clothing; will indulge them with costly toys; obtain for them teachers in music, drawing, etc.,—all without a murmur. But should there be a special tax levied to help pay for a new school building, or should they be asked individually to contribute a certain sum for that purpose, you will usually find them as stingy and close-fisted as misers.

I put it to any thinking man or woman,—which would be most beneficial to children, money spent in useless toys that please for the moment only, or the same sums invested in the construction of healthful schoolrooms in which they may pursue their studies ?

In nine cases out of ten, where first-class professional talent has been secured by a committee to advise and assist in the planning and construction of new buildings, this talent is so hampered by the meagreness of the means at hand that it is impossible to improve much upon what has already been done. Should a request for an additional appropriation be taken before a public meeting, there will be a tremendous outburst of popular indignation, and the useless waste of public funds will be harped upon on all sides. The members of the committee themselves will be looked upon as vultures trying to prey upon the people's treasury, instead of men of common sense, who have the welfare of the rising generation in their minds. Until this niggardly policy is abolished, and public sentiment brought into harmony with the true spirit of reform, we may expect little or no improvement in school buildings.

The fourth obstacle in the way of thorough sanitary reform in school buildings is the difficulty of obtaining satisfactory data. The average layman has very little idea of the requirements of a thoroughly good schoolhouse, and I am sorry to say that a majority of my profession are equally as ignorant. They have yet to learn—many of them—that something more than a showy exterior and rooms large enough to crowd a certain number of pupils into is required. In many cases some local architect of little experience, or master-builder, is employed, having absolutely no insight into hygienic or sanitary science. With an over-confidence in his own ability, he usually opposes the calling in of an expert, on the ground that such a step would involve an uncalled-for expense, and result in no practical good.

For the enlightenment of unprofessional men generally, and more particularly those who are directly interested in schools or school buildings, I have written this article, my aim being to call attetion to existing evils, and to show in a practical way how they may be remedied. I submit for your inspection plans which are based upon correct principles. Objections will probably be raised to them on the score of cost. In answer to this, I would say that nothing has been introduced that is not essential to sound, healthful construction and practical convenience. The details are simple and within the range of ability of the ordinary village craftsman, it being my firm belief that any New England town has home talent enough to construct, under proper guidance, buildings that will embody all that the most exacting exponent of school hygiene may require.

SITE.

The selection of a proper site is of the greatest importance. A lot with an area of an acre will be large enough for a one-room building. While being handy and easy of access, it had better be sufficiently isolated to be unobjectionable to surrounding property owners. It should have, if possible, a southern exposure, be entirely free from dampness, and far removed from stagnant water, or low, marshy ground. Blind drains must be introduced for the drainage of any portion that may be springy, and for the removal of surface-water.

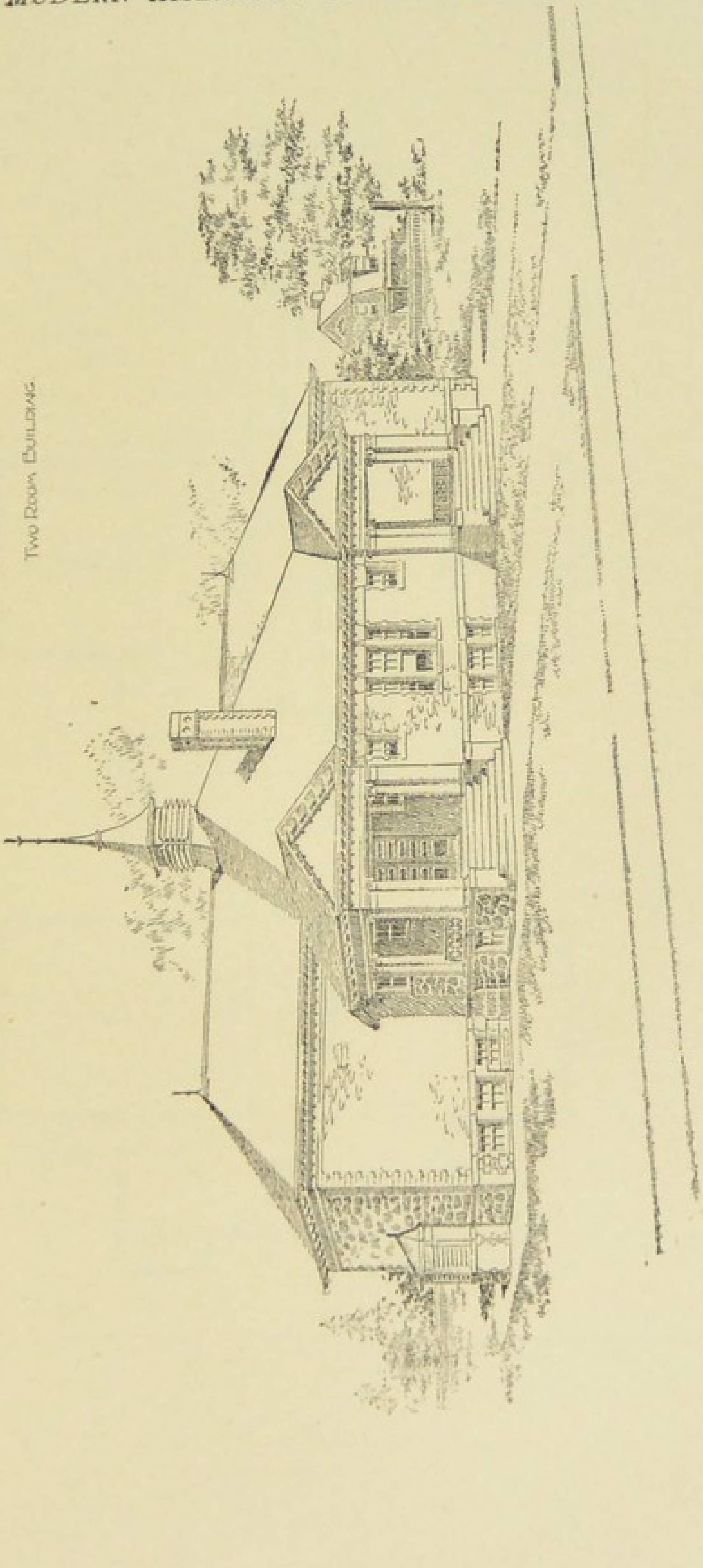
As no public system of water exists in most of our suburban towns, we shall probably be forced to depend upon a well for the supply. This should be situated near at hand, so that water may be pumped from it into the building without difficulty. A force-pump arranged with a two-way connection should be conveniently placed in the building, and some simple pump in the yard. The "two-way cocks" will enable you to draw water directly from the well, or pump it into a tank in the upper portion of the building, from which it can be drawn for the use of closets and bowls. A good windmill placed in some convenient position will do this pumping admirably; it will require little or no attention, and may be so treated as to be a picturesque feature of the landscape (see Plate 38). In connection with the exposure, I would say, that of all lots, I should most prefer one facing the south and west, as by placing your building judiciously you are enabled to obtain not only the coveted north light, but sunlight for the greater part of the day.

MATERIAL.

The only quality that can commend the universal use of wood in the construction of suburban schoolhouses is its cheapness. At the outset, it is unquestionably more economical to build of wood than of other material; but if during a series of years the cost of repairs and a consideration of the health and comfort of the occupants are taken into account, surely it is better to pay the difference in the beginning. Few are the localities where good, cheap brick cannot be obtained; and there is hardly a village in New England that does not contain within its limits quantities of excellent building-stone, easily quarried, and comparatively inexpensive. Why, then, should not these materials be used? A building properly constructed of stone will withstand the storms of centuries; it will be warm in winter and cool in summer, and more pleasing to the eye than the slab-sided abominations that now deface our landscapes. Many people object to stone on the score of dampness; but there is not the slightest danger of this, with proper construction.

I would not have you think that I advocate the use of expensive cut or sand-rubbed stone; all that I require is bold, quarry-faced, random ashler, laid with dark joints, and trimmed, for economy's sake, at angles and around openings, with selected hard-burned common bricks; these materials to be used on all exterior walls.

The roofs may be covered with slate or, what is better



Two Room Building

Plate 46

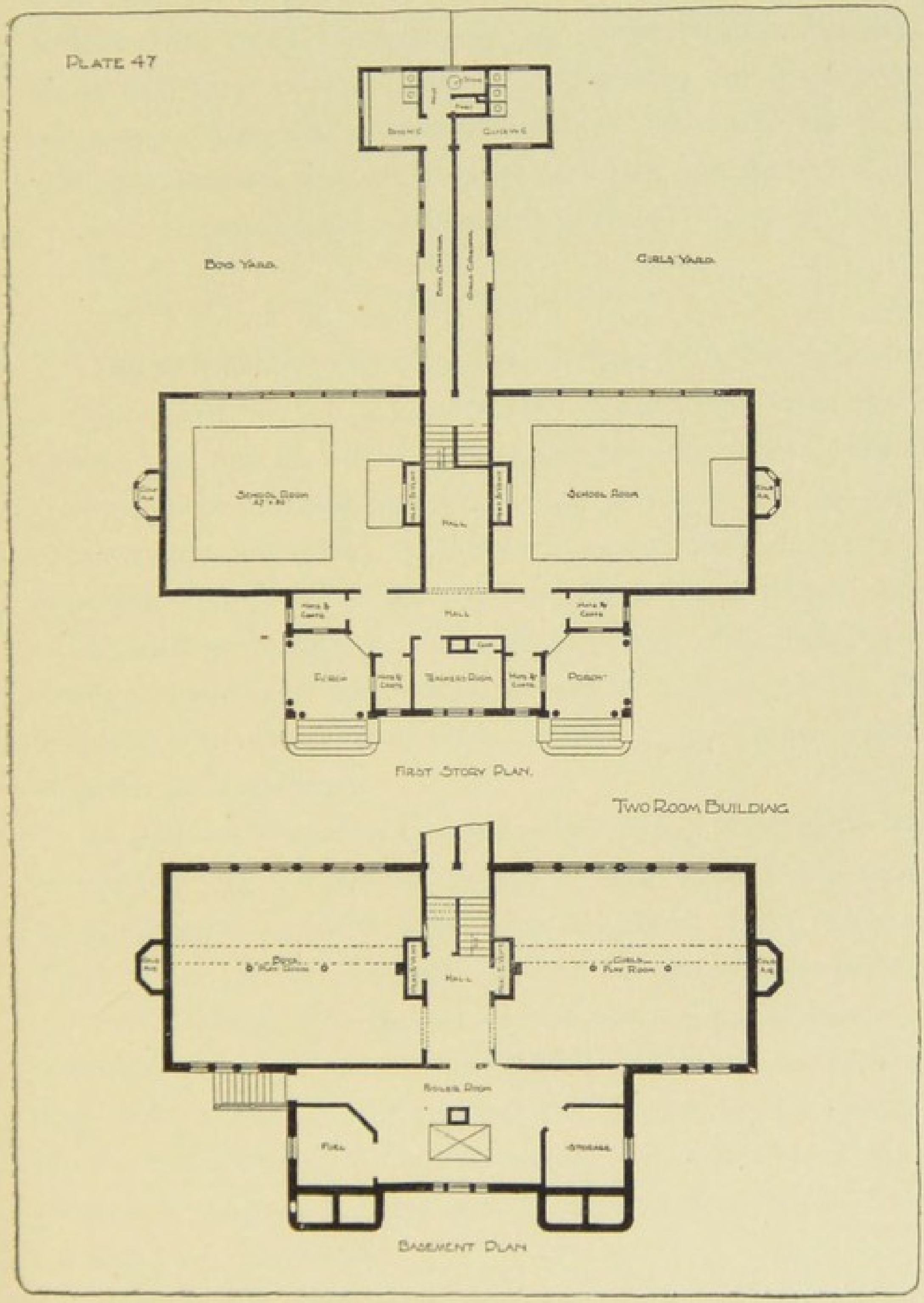


PLATE 47
BOYS YARD
GIRLS' YARD
SCHOOL ROOM
SCHOOL ROOM
HALL
HALL
PORCH
PORCH
TEACHERS ROOM
HATS & COATS
FIRST STORY PLAN.
TWO ROOM BUILDING
BOYS PLAY ROOM
GIRLS PLAY ROOM
HALL
BOILER ROOM
FUEL
STORAGE
BASEMENT PLAN

still, metallic shingles. These are now made in large quantities, and are rapidly growing in favor; they form a durable, tight, and light roof of pleasing appearance, at an expense not greater than that of first-class slate. Some of the composition roofs are very durable, if well laid, and have usually the merit of cheapness to recommend them.

THE PLAN.

The first thing to be considered by the designer is the size and arrangement of the entrances, classrooms, principal's rooms, etc., and their connections with the schoolroom proper. The entrance must be handy and easy of access, the hat-and-cloak-rooms convenient, and so situated as to have direct communication from either the yard, playground, or schoolroom.

The water-closets for the girls and boys, while being perfectly isolated from each other, should be so situated that the children will not have to leave shelter in cold and stormy weather to reach them.

A good, dry basement should always be placed under the entire building. I cannot too strongly condemn the practice of building only trench walls, or setting the building on piers close to the ground, from whence the dampness is transmitted to the building. By the use of the basement a playroom is obtainable, where delicate children can exercise without exposure, and in stormy weather the pupils are not confined to one room during the entire session. No school building is complete without a playroom, and its introduction should always be insisted upon.

The parallelogram form of room, while not arbitrary, is probably the most satisfactory; although at times this form may be varied or departed from with advantageous result.

I am not an advocate of vagaries of any kind, but I fully believe in ingenious, well-studied plans, and am convinced that there are times, especially on irregular and cramped sites, when it will be necessary to depart from the stereotyped form.

The size of the room should be determined by the number of pupils which it is to accommodate. The number that should be assigned to a teacher varies from forty to fifty. Whatever the number may be, at least 20 square feet of floor-space is required for each. Assuming that there are 44 pupils, with the teacher we have 45 times 20, or 900 square feet of floor-space to provide,—this being the smallest permissible amount. I prefer, however, to provide an amount in excess of this, and so have shown in Plate 44 a room containing 972 square feet of surface, or about 21½ per person.

In the design to which I have just referred, sittings are provided for 44 pupils; the aisles between the desks are 20 inches wide, and there is 10 feet between the front desk and the wall back of the teacher, and 4 feet in front of the platform and around the outside of the desks. The windows are all at the left of the pupils, the sills being 4 feet from the floor, and the openings run up to within 1 foot of the ceiling.

By this arrangement of windows there can be no dark corners, as the light has to travel but a short distance to reach the utmost limits of the room. If the building is placed judiciously on the lot, sunlight—so essential to the health and comfort of the occupants—is furnished in abundant quantities, and in warm weather a free circulation of air can be obtained in all parts of the room by the combined use of the windows and the large transoms placed over the entrance doors.

The arrangement of the pupils' desks is convenient and compact, and the situation of the teacher's platform such as to bring the pupils under easy supervision.

A small teacher's room in the front is a convenience that will be appreciated by all who may be connected in any way with the school.

The blackboards are situated back of the teacher's platform, and on the right and in the rear of the pupils. They are easily seen from all parts of the room and are all abundantly lighted.

A study of the plan will clearly show the arrangement of porches, entrances, and hat-and-cloak-rooms. Independent entrances are provided, and the sexes are completely separated by the intervening teacher's room—this, too, without sacrificing in any way the convenience of the plan. Stairs descend from either side to the basement, the whole space under the schoolroom being used as a playroom. Doors in the rear of the playroom lead either to the boys' or girls' water-closets in the yard.

The height of the main schoolroom is 13 feet in the clear, therefore it contains 12,636 cubic feet of air, or an allowance of about 280 cubic feet for each person. This amount, with ample floor- and glass-surface, renders the room, hygienically, as perfect as it is possible to arrange a room without, of course, considering the method of construction or the heating and ventilating. If we are equally thorough with these and the sanitary arrangements, I believe we will have produced a schoolhouse in which children can pursue their studies with perfect safety.

While I always advocate the use of stone or brick for the exterior walls of school buildings, let it be understood that however strongly I might urge their use, it is not absolutely essential that they should be employed to produce a building based upon the same plan, and containing the same floor-space and cubic contents as the one just described; it is perfectly feasible to construct any of the designs herein presented entirely of wood, both exterior and interior. It is in the methods of construction usually employed that I do not believe; and I shall endeavor now to describe a building constructed upon what I consider correct principles and embodied in the designs presented.

FOUNDATIONS.

Great care should be taken with this part of the work, as any settlement will cause cracks and injuries to the structure which it will be almost impossible to remedy. Heavy footing-stones must be placed under all walls. The walls themselves should be laid in half-and-half lime and cement-mortar, with heavy bond-stones running through them once in every six superficial feet. Where basements are used as playrooms, the inner surface of the walls is to be faced with brick, laid with close-struck joints; this surface to be painted with two or three coats of pure lead and oil, either in white or some light neutral tint.

UNDERPINNING.

At the grade level, on top of foundation walls, there should be laid a bluestone coping, $4'' \times 12''$, this to project one inch over foundation walls; the underpinning is built from this coping, and should be rock-faced, random rubble, laid in black mortar, with one inch draft-lines at angles and around all openings.

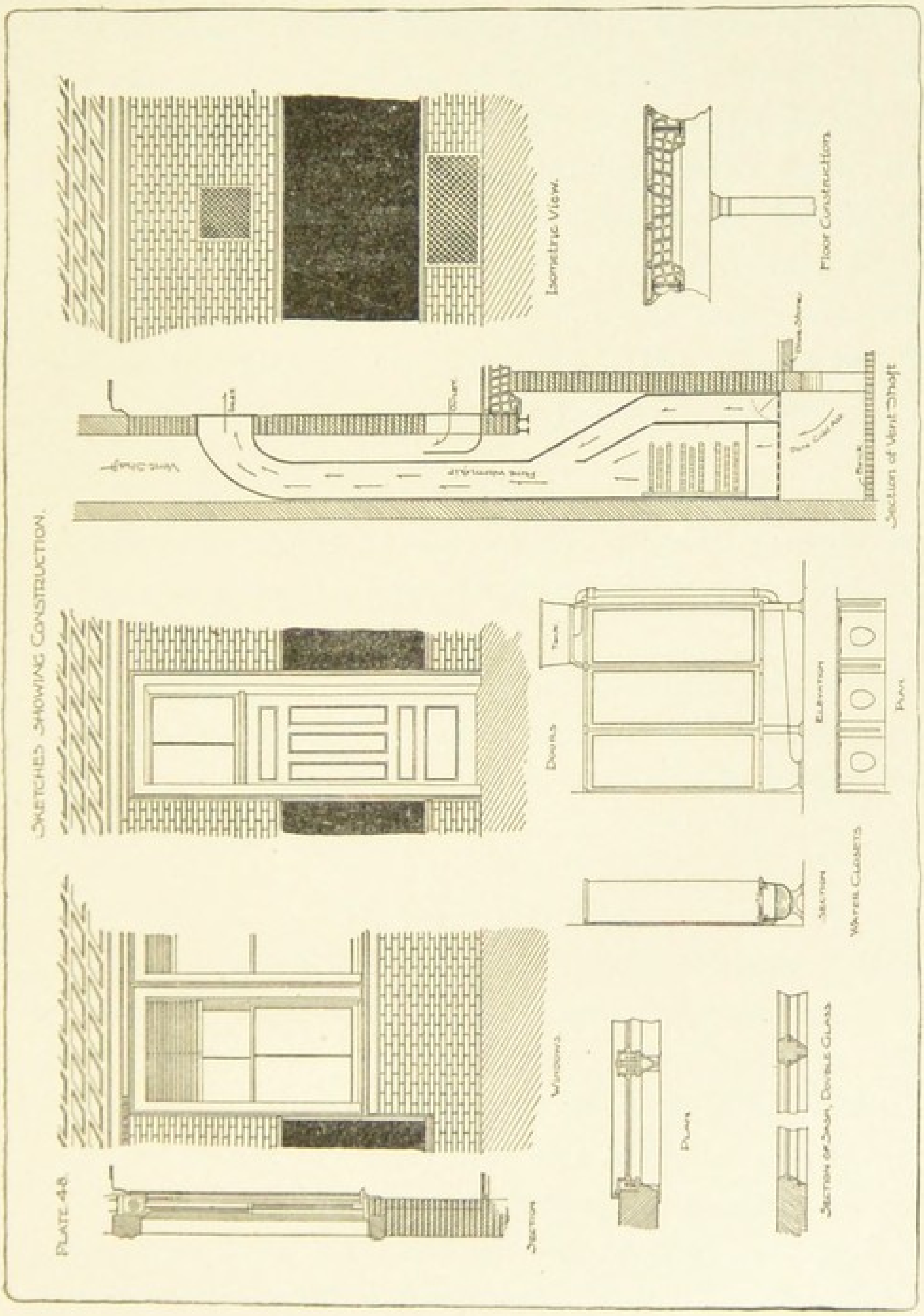


Plate 48.
Sketches Showing Construction.
Isometric View.
Floor Construction.
Section of Vent Shaft
Windows
Section
Plan
Section of Sash, Double Glass
Doors
Elevation
Plan
Section
Water Closets

WALLS.

If stone with brick trimmings is used, the walls should be 26 inches thick; 16 inches of stone work, 2 inches of air-space, and 8-inch brick backing; the backing should be bonded to the outer wall by brick headers, or ties of thin iron or copper;—the latter are much the better, as they do not rust and will not transmit dampness, as is the case with the brick ties. All angles and around openings may be laid with brick, as indicated on the elevations. The cornice may be entirely of stone and brick and the gutters of copper.

ROOFS.

The roofs should be covered with metallic shingles, and the ventilators and cornices constructed of copper, which may also be used for crestings.

With a structure built as above described you will have an exterior practically imperishable; and if the work is well done, it will be many years before any expenditure will have to be made for repairs.

INTERIOR FLOORS.

Wood is almost universally used for floor-beams; indeed, with one or two exceptions, I have never known of iron being used, even in the most expensive school buildings. Far better and more durable floors can be obtained by the use of iron, and costing but little more than first-class woodwork.

The common way of constructing floors is to lath and plaster the under side, and lay flooring over the top of the timbers. No better way could be devised for the circulation of air and fires, and no finer highway for vermin who make use of the receptacles furnished by the builder for the storage of garbage collected on their marauding expeditions. The mischievous urchin also delights to poke rubbish into every convenient knothole he can find. I remember, when a boy, to have seen a venturesome schoolmate cap the climax by introducing a lighted match into a time-honored hole which had received the donations of generations of school children. The result must have been entirely satisfactory to my friend, as he succeeded in breaking up the school for some time, after causing a serious panic and much damage.

To construct a floor of wood suitable for school purposes, extra heavy timbers must be used, which should be strongly bridged and stayed. They should be cross-furred on their under side, and wire netting should be fastened to this, on which to plaster; double floors should be used above, with heavy deadening-felt between. This makes the best wood floor that can be laid, but it is expensive, and is open to all the objections I have mentioned. Sound is easily transmitted, and the spring and oscillation caused by marching or calisthenic exercises produces a jar that is felt throughout the building, often so severe as to cause the walls to crack and ceilings to fall.

Iron floor-beams are far preferable, and for ordinary spans need not be over 10 or 12 inches deep, and can with safety be placed from 5 to 8 feet on centres. Arches of hollow tile should be turned between these beams, so formed as to entirely cover them (see Plate 48).

Strips of wood 2 inches square should be firmly secured to the top of the beams, to which to nail the floor, and the spaces between these strips, on top of the arches, should be carefully leveled up with cement.

A single hard-wood floor may now be laid and firmly nailed to the strips, and the plastering may be applied directly to the under side of the brick arch, without cross-furring, lathing, or any woodwork whatever. If hard-wood ceiling should be desired, it is only necessary to screw strips to the under side of beams, as described for the upper, and nail the ceiling directly to these strips. For playroom or basement ceilings the surface of the hollow tiles is all that is necessary, with carefully struck joints, to make a perfectly neat job. If the holes at the outer ends of the lines of hollow tiles are carefully stopped, as they should be, you will have a floor that is not only absolutely fire-proof, but through which vermin have no chance to circulate; sound cannot be transmitted through it; it is perfectly rigid, and will support five times the weight of a wooden floor without deflection. The flooring-boards should be oak, maple, or rift-grained yellow pine laid in narrow widths and blind-nailed.

INSIDE WALLS.

It is the universal custom to line all our stone or brick walls with wood; that is to say, we fur the inside surfaces of brick or stone with wood strips on which to nail lathing. Even when wire lathing is used, furring-strips cannot be dispensed with. This method of construction introduces highly inflammable material on walls that otherwise would be incombustible. Again: we cover the lathing with a thick coat of plaster—a substance of a most perishable nature, and which is, moreover, an absorbent which becomes loaded with impurities; dampness is often perceptible upon its surface, and it is no rare thing to see mould. However much care may be taken in its preparation, and carefully as it may be applied, it is but a short time before a dirty, grimy appearance is noticeable.

You ask how all this is to be remedied; and I would answer, By the use of enamelled brick. These are made in large quantities and of excellent quality, in all colors; their surface is like porcelain and as hard as adamant; if they are laid with cement to match their color, they form a wall not easily marred, non-absorbent, and very pleasing to the eye. Not only the walls, but the door- and window-casings, may be built of these bricks, and there need be no more wood about the doors and windows than their actual operation requires, which is very little, as may be seen from the detail drawings on Plate 48.

A dado may be carried around the room, of dark-brown or chocolate-colored bricks; above the dado a slate blackboard of suitable size is set, and above this a field of buff or neutral-tinted brick, finished by a frieze, if desired, laid in fancy patterns of different-colored bricks. A picture moulding, from which to suspend maps, etc., should run entirely around the room at a suitable height, this being, with the blackboard band and chalk-rack, all the wood, outside of the doors and window-casings, required on the inside wall. This wood, so far as practicable, should be of ash, filled with a heavy coat of filler, varnished in two coats, and carefully rubbed down.

A room well built, as I have described, would last, with ordinary care, for a century. The walls could at any time be scrubbed down with hot water, or a hose turned upon them, without injury. The effect of a room finished in this way is far more pleasing than the ordinary glaring white walls, and I can see no sustained objection to the introduction of this class of work.

For the ceiling I should recommend, in rooms that have nothing over them, light iron beams, upon which narrow ash ceiling-boards are firmly fastened; where there is room over room, finish them, as I have before mentioned, directly on the hollow flooring-blocks. These wooden ceilings may be panelled and made as elaborate as desired, according to taste and the length of the purse. Or the ceiling may be first covered with rough boards upon which metal ceilings can be laid; these ceilings are now made in many pretty designs and have much to commend them; they are comparatively inexpensive, and if kept painted are extremely durable. By all means, do away with plaster; it is an abomination, and the sooner it is banished from our schoolhouses the better it will be for the health of the children.

The main argument against finishing walls as I have described will be, I presume, the expense; but when it is considered that we do away entirely with the furring, lathing, and grounds, all plastering, wainscoting, and base-boards, surely the difference in cost cannot be great.

MISCELLANEOUS.

It would be well to make the floors of all rooms, except the school-, teacher's, and class-rooms, of encaustic tile, firmly bedded in cement. The entire basement should be treated with a heavy coat of concrete; the playroom and adjacent hall may have an additional covering of asphaltum, such as is used for sidewalks.

The windows of the school- and class-rooms in the extreme Northern States should have two thicknesses of glass, set in the same sash, about one-half inch apart (see Plate 48); this will answer all purposes of outside sashes, is always in place, and between the sessions the room can be flooded with pure external air, which is prevented by the use of the outer sash. Four lights per window are best adapted for school use; a greater number of sash-bars only cast disagreeable shadows and obstruct the light. Sash should be carefully adjusted and balanced, and metal sash-chain used instead of cord; fixtures should be so arranged that they may be easily worked by the teacher at all times.

Outside blinds are not wanted on a schoolhouse, inside blinds are noisy and in the way, and the ordinary Venetian blinds and the common shade are invariably out of order when most needed, and are objectionable on account of flapping and blowing in the wind. The best shade that I have yet seen is what is known as the Wilson Rolling Venetian Blind. It is made of any wood desired, and is light, strong, and durable, noiseless in operation, and cannot blow or flap. While completely screening the room from the sun's rays, it still admits of a free circulation of air. Special provision has to be made for it in the construction of the building, as it coils up neatly either above or below the window-opening. (See Plate 48.)

Doors should always have a transom over them as large as is practicable, operated by cords or rods; the latter is the better method, as the transom can be made stationary at any desired point. Doors should always swing out, so that in case of a panic there may be no obstruction to the effort to leave the building.

It is better to have the teacher's platform movable, so that the floor can be thoroughly cleaned under it; by the use of hooks or bolts it can be firmly fixed in position.

Slate blackboards, although expensive, are by far the best, and cost nothing for repairs.

In seating, I believe in the single desk. While it takes up more room, it is much better for the child in many ways, and the teacher has better control over the school. Each child should be given all the floor-space possible, and there should be a free circulation of air all around him.

I would say a word just here concerning the modern school desk. While there is an unlimited number of patent desks before the public, neat and even elegant in style and finish, I do not know of one in which the seats are even comfortable; the backs are concave where they ought to be convex, and *vice versa;* the seats are usually too high, and their shape is such that only monstrosity would fit them; it is a shame to force any child to occupy, day after day, chairs so ill adapted to the requirements of health and comfort. I am glad to be able to say that, under the direction of the energetic Board of Education of the city in which I write, a large New York firm have undertaken to manufacture desks and chairs for their new school building, designed upon a common-sense principle, combining simplicity, utility, comfort, and elegance.

WATER-CLOSETS, ETC.

Whatever care may be taken in the construction of other parts of the building, the structure, so far as its healthful usefulness is concerned, will be a failure if the sanitary arrangements are neglected.

I am aware that it is an uncommon occurrence to find water-closets in any school building outside of a city. Privies situated in the yard are considered sufficient. They are usually poorly built, and are only accessible by exposure to the weather, and are anything but elevating to the morals of the children. In some instances you will find privy vaults under the same roof that covers the schoolroom—this, too, without any attempt at ventilation. The evils arising from a vault so situated cannot be estimated. In some cases earth-closets have been introduced with success, and if properly built and systematically looked after they work well, and can be placed in such a position that a child need not be exposed to the cold or wet in passing to and from them.

I think there is nothing better than a good water-closet or latrine, properly set, and can see no reason why they should not be generally used in suburban schoolhouses. From the roofs of ordinary structures large quantities of rain-water may be collected and stored in cisterns conveniently located. These, with a good well, should furnish an ample supply of water, that can be pumped by an ordinary force-pump, supplied with a two-way cock, from the well or cistern into a tank in the attic. A few minutes' work by the wind-mill daily will keep the tank properly filled. As the school is closed during the hot, dry months, when sometimes we have a drought, there can be little danger of the water failing, provided a reasonable amount of care is exercised in its use. With a good circulation of water assured, there can be no objection to the use of closets. A simple hopper of porcelain is the best, arranged with iron service- and feed-boxes over-head, the valves in the boxes to be connected with the wooden seat over hoppers in such a manner that the weight of the occupant will cause a flow of water, flushing the closet thoroughly each time it is used.

The floors of the closets, except under hoppers, should be of tiles, and the side walls of enamelled brick, as before described. That portion of the floor upon which the hoppers stand should be of dark-blue slate, about 2 feet wide and 2 inches thick. The hopper should be firmly bolted to the slate with brass bolts, an outlet being cut through the slate for the mouth of the hopper. There should be a slate partition between each hopper about 6 feet high, 2 feet broad, and 1½ inches thick. A light metal frame and capping should hold this in position. The seats should be of wood, resting on cleats that should be bolted through the slate partitions.

The urinals may be simply slate troughs with backs of the same material, or the individual porcelain urinals that are in common use.

A marble wash-bowl should be provided in each dressing-room, and drinking-water pumped directly from the well. The hoppers should be of white porcelain exposed to view. The soil-pipes and traps should run out of the building as quickly as possible, and be easily accessible for inspection at all times. It is well to paint their outer surface white, as any leak or escape of gas quickly causes discoloration and is at once detected.

The utmost care should be taken in the ventilation of the traps, pipes, and drains, as, however costly the fixtures may be, unless they are properly ventilated they will be objectionable.

As no public drainage is likely to exist, a cesspool will probably have to be used for the reception of sewage. Let this be removed as far as possible from the building, and placed in some remote, unfrequented corner of the lot. By all means use a tight cesspool, and do not on any condition use the leaching cesspool, as it is impossible to tell what course may be taken underground by the filth discharged from it. Pollution of well- or spring-water at long distances has often been traced to this cause, while hundreds of undiscovered cases now exist. A tight receptacle of ample size, thoroughly built and properly ventilated, will not be obnoxious, and can be pumped out once or twice a year at a small expense. It would be useless to attempt a system of sub-irrigation for a single building of small size, for while this disposal of liquid waste has much to recommend it when planned upon an extensive scale, I do not consider that it can be practically applied to a single building without a very large expenditure of money.

HEATING AND VENTILATION.

Under this head will be found the true test of the successful hygienic construction of a building. To heat any room to a required temperature in the coldest weather is a very simple matter. To bring into the room a sufficient supply of pure, warm air, to remove the vitiated air, maintaining at all times and in all parts of the room a steady circulation or mixing of the air without causing unpleasant drafts, is a far more difficult thing to do. That it can be satisfactorily done is only a question of understandingly applying the means that are at hand.

In the smaller rooms and the halls of the accompanying plans I would use direct steam. In the main schoolroom the indirect system will be far better.

Before going into the details of the heating apparatus, it would be well to consider briefly the requirements of the schoolroom, the quantity of air that it is necessary to supply, the capacity and position of the incoming and outgoing registers, and the general laws governing the movements of air.

The schoolrooms that are shown in the accompanying plans contain about 12,536 cubic feet of air, an average of about 278½ cubic feet per person. I believe in supplying to each occupant as near 30 cubic feet of pure warmed air per minute as possible. To do this, we shall be obliged to bring into the room every hour 1350 cubic feet per person, or a grand total of 81,000 cubic feet. Of course, if this amount is brought in, proper provision must be made for its removal as soon as it has become vitiated, which will cause the displacement of all the air in the room about 6½ times each hour, or once in about 9 minutes. Some may consider the quantities I have named in excess of the actual requirements, and that it is not possible to introduce and move such quantities of air unless a gigantic apparatus is used and an enormous amount of fuel consumed. In answer to the first objection, I would say that the highest medical authorities insist upon about the same amount as a standard; and to the latter, that if the apparatus is properly constructed and understandingly handled, no unnecessary expense will be incurred.

There is much diversity of opinion among experts as to the position of incoming and outgoing registers. Many advocate placing the incoming registers in the floor, some on the side walls near the floor, and a few high up on the side walls. The latter is the only proper place for them, and it seems to me the worst kind of bigotry, with our knowledge of the action of warmed and cooled air, to insist that the floor is the best place. We all know that warm, pure air is light and will rise rapidly to the top of the room, no matter at what point it is introduced. It is an equally well-established fact that foul air is heavy and settles in the lower part of the room. I cannot understand why, with these facts before us, it is still sometimes argued that the floor is the best place for registers. If you introduce the pure, warmed air there, you are bound by natural laws to carry it through a stratum of impure air before it reaches the top of the room; and I think no one will have the hardihood to claim that it has passed through without becoming contaminated.

Why, then, is it not better to avoid this contamination, and bring the air into the room as near the ceiling as is practicable? Your registers will cost no more, and the additional pipe required is a very small matter.

Another strong objection to floor registers is that dust and dirt are continually deposited in them, especially when not in use: this dust is mixed with the incoming air, and carried directly to the lungs of the occupants of the room. An objection some will make to wall registers is that children cannot warm their feet at them. Much better arrangements for this purpose are "foot-warmers," consisting of coils of steam-pipe placed between the floor-beams, encased in tin, and packed in coarse sand to temper the heat; on the top they are covered with flat iron plates, countersunk, and flush with the top surface of the floor. These plates should have their top surface roughened with some neat pattern to prevent slipping. The plates may be placed with advantage in the entrance-halls and hat-and-cloak-rooms, and by their use a steady, uniform heat is obtained. The tight iron plate renders the collection of dust upon the surface of the pipes impossible.

The outlet-registers should be placed at the floor-level, for the air settles there as it cools and becomes laden with impurities, and it should be our aim to remove it as quickly as possible. Outlets are invariably made too small; it is absurd to attempt to bring large quantities of pure warmed air into a room unless ample provision is made for its removal. It is safe to assume that if the foul air is withdrawn, enough pure air will find its way into the room to supply the vacuum, the greater portion coming, of course, from the heating apparatus.

It has been repeatedly proved by experiments that from two to three times as much air will flow through an outgoing as through an incoming flue, which indicates, in rooms of ordinary construction, a continual suction into them of the outer air. It is a mistaken idea to think that foul air will obligingly meander through the small and intricate passages laid out for it, without some motive power for its propulsion. The exhaust-flues must not only be of large dimensions, running with as few turns as possible directly to the outer air, but some means must be employed to assure a steady outward current. An exhaust- or suction-fan placed in the outlets would undoubtedly be the surest way of accomplishing this, but this must be operated by an expensive apparatus, and can only be successfully applied to a very large building. The simplest and most practical method of maintaining the current is by the introduction of heat into the outgoing ducts. This may be generated from a steam-pipe running through the flue, by a small stove placed at the lower end, with the smoke-pipe running up through it, by a gas-jet kept continually burning during the sessions, or even by a lighted lamp set in the flues.

For the reasons before cited, the outgoing flues should be at least twice as large as the incoming, no matter how large the latter may be; they should be placed on the inside walls of the room at the floor-level.

The hot-air registers, for the introduction of pure warmed air, I have placed directly over the outlet-registers, and high up on the side walls. By this plan I am enabled to concentrate all the heating and ventilating apparatus on one side of the room.

The flues for the introduction of pure warm air are all intended to be large, and the flow of air through them moderate and steady. The pipes, where they enter the room, should be splayed or trumpet-shaped, the register being one third larger than the flue. The flue itself should be of tin or galvanized iron encased in brick, and should extend vertically from the register in the room downward to the heating-surface placed in the basement. This heating-surface may consist of coils of 1-inch pipe staggered, and placed one above the other, or of some one of the many indirect radiators that are in the market.

One great fault that I have to find with most of the radiators now in use is that there is not sufficient provision made for the flow of air through them. The air which does flow through them is usually overheated and while the temperature of the room is easily maintained at the required point, the supply of air furnished is inadequate. I have had great trouble in finding radiators with sufficient air-space, and have resorted to various expedients, more or less successful, to overcome this deficiency. Whatever radiators may be used, they should be enclosed in metal jackets tightly fitted to the flue at the top, extending down over the sides, and closely connected with metal plates on the bottom. These plates should be in direct communication with the cold-air duct, and perforated over their entire surface with 1-inch holes, placed 2 inches on centres, these serving as distributers of the cold air to the radiating-surface, which should not be placed in one mass, but subdivided into at least three sections, having one main supply-pipe, with branches controlled by gate-valves for each radiator. By this arrangement, one, two, or three sections may be used at pleasure, and the supply of air, while remaining always the same, is raised or lowered to the temperature required by the turning of a valve.

The cold-air ducts should be of brick, laid close-jointed in cement, protected at the outer opening with a register-plate or coarse wire netting. The supply of cold air should always be taken at least 6 feet from the ground, and should flow as directly as possible to the heating-surface; the flue should be provided with a damper by which the flow of air may be regulated.

I have not as yet given the size of the incoming and outgoing flues for a room of the capacity of the one here presented. This depends much upon its length. The longer the flue, the greater the velocity of the flow of air through it; consequently its size may be reduced in proportion to its length. The flues in question are about 12 feet long; according to Montgolfier's formula, a flue with a capacity of $2\frac{1}{2}$ feet square, 12 feet long, will discharge into a room, allowing 30° difference in the temperature, 750 cubic feet of air per minute, or 45,000 cubic feet per hour. Two flues of this capacity will introduce 90,000 cubic feet each hour, which is slightly in excess of the amount actually required, but it is better to increase rather than diminish the supply. The introduction of this air will change the atmosphere at least six times each hour, rendering it perfectly healthful at all times. It is safe to assume that, for rooms of the size here shown, one flue with a capacity of 5 square feet, or two flues with a capacity of $2\frac{1}{2}$ square feet each, will be required for the incoming hot air. The outlets must have an area of at least 10 square feet. Both incoming and outgoing registers must be one third larger than the flues or ducts.

The best of our steam-heaters require, for indirect heating, 1 foot of heating-surface to every 40 feet of air. At this ratio it would require about 316 feet of indirect heating-surface for the room of which we are writing. When it is considered, however, that every hour we are introducing 90,000 cubic feet of air, and that this amount must be properly warmed, it can be readily seen that more heating-surface will be required. It will be found that 1 foot of heating-surface to every 20 feet of air will be amply sufficient to heat the room even in the coldest weather. I should prefer to use three 150-foot radiators in each stack, a total of 900 feet of heating-surface for the room. This will give 1 foot of heating-surface for every 100 feet of pure air introduced, or 1 foot for about every 14 feet actually contained in the room. It is to be understood that this amount is not to be used at all times: one third of it will answer for ordinary cool weather, two thirds for sharp winter weather, the whole capacity being called into use only on the coldest days.

It is short-sighted economy to construct a small apparatus to commence with, hoping it will prove of sufficient size. It is better far to have the capacity in excess of what is actually required than below it. Bear in mind that it is cheaper to run a large boiler at two thirds its actual power, than a small one when taxing it.

For the playroom, water-closets, hat-and-cloak-rooms, and halls, direct heat may be used in the form of circulation-pipes. In the basement rooms these should be hung from the ceiling, and be of sufficient quantity to allow 1 foot of heating-surface for every 60 cubic feet of air. By hanging these pipes from the ceiling they will be out of the way, and the heat will be where it should be, at the top of the room. They may be bronzed over, and will not be unpleasant to look at. The outlets for these rooms should be, as in the schoolroom, large and at the floor-level. The teacher's room should have a small direct radiator.

The position of the boiler is clearly shown on the plans. The make should be decided by the architect employed by the committee. There are so many first-class boilers in the market that with ordinary precautions a suitable one may be obtained; only insist upon a large size, and ample grate-surface.

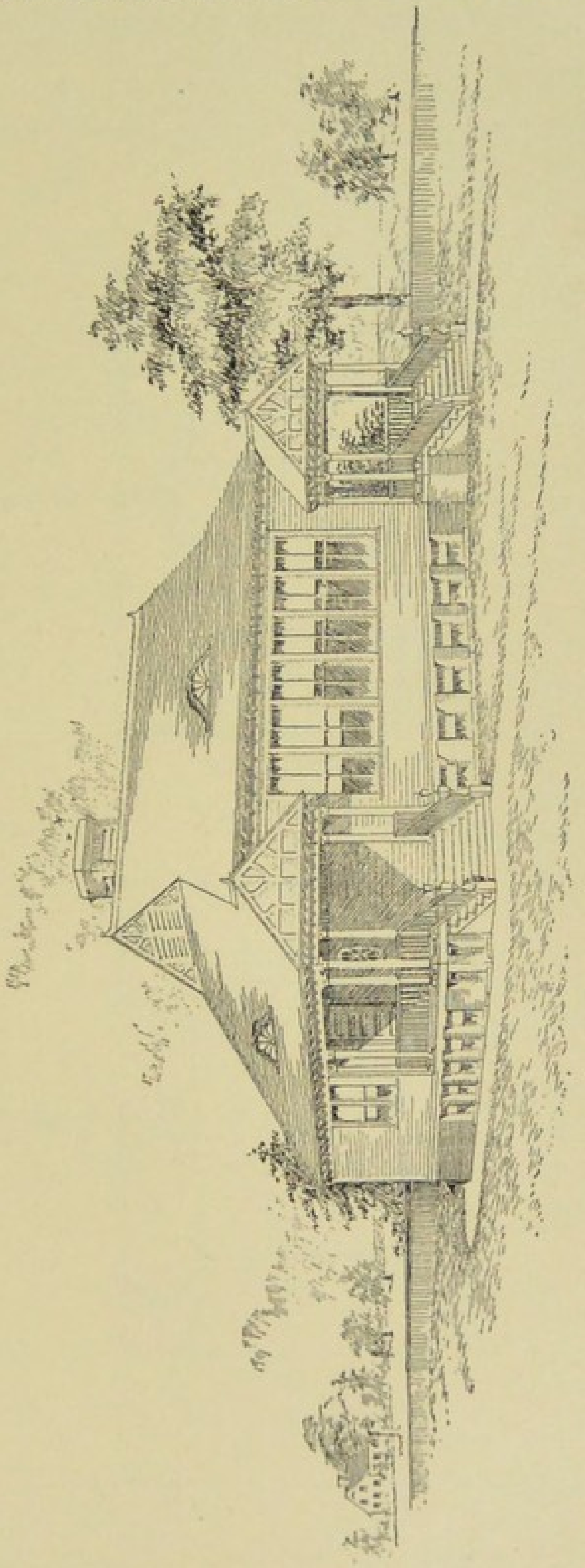
I have not spoken of other methods of heating in this article, for the reason that I consider steam the only suitable one for school buildings. The best of the hot-air furnaces are abominable, and stoves are equally as bad; in the use of either you are debarred from securing even a moderate supply of fresh warmed air. The small amount that it is possible to obtain has all the life burned out of it by contact with overheated surfaces, and enters the room usually laden with gas. The supply of air should always be large, but in no case overheated. The volume introduced should be relied upon to maintain a pleasant temperature. The use of stoves or hot-air furnaces will not permit of this, and for this reason, if for no other, they should be banished from school structures.

I have thus far spoken only of the heating and ventilating of the rooms during cold weather. For that portion of the year when no artificial heat is required there can be no better inlets for fresh air than the windows. There are many simple devices that a little ingenuity will arrange successfully for the outlets. With the windows dropped at the top, and the transoms open, little more will be required in clear weather. On damp and stormy days a large circular register, placed in the centre of the ceiling, and directly connected with the ventilator on the main roof, will be found sufficient. The ceiling registers in the halls and hat-and-cloak-rooms may be connected with the main ventilators by metal pipes, an upgoing current being maintained in them at all times by artificial heat.

A thorough "flushing" of the rooms with outside air should be insisted upon, both in summer and winter, before and after sessions, and at recess. As soon as the children leave the room, all doors and windows should be opened to their fullest extent, and the air be allowed to sweep through them unimpeded. With a proper apparatus the required temperature of the room will be quickly restored.

In conclusion, I would say that the buildings shown in both designs can be easily doubled in capacity by placing a floor above the one now shown. As I said before, I have not tried in either design to produce a cheap building, but have endeavored, by the use of the best materials combined with sound construction and a careful consideration of the requirements of the occupants, to show that structures can be built having all the comforts of ordinary ones without their objectionable features.

While many of the theories I advance may be new, and consequently not looked upon with favor, it will still be acknowledged that an honesty of purpose in my plea for better buildings for the young has alone actuated me. If the perusal of these pages will in any way help to improve the condition of existing schools, or show a better way to construct those about to be built, my aim will be accomplished.



One Room Building.
—in wood—

Plate 49.

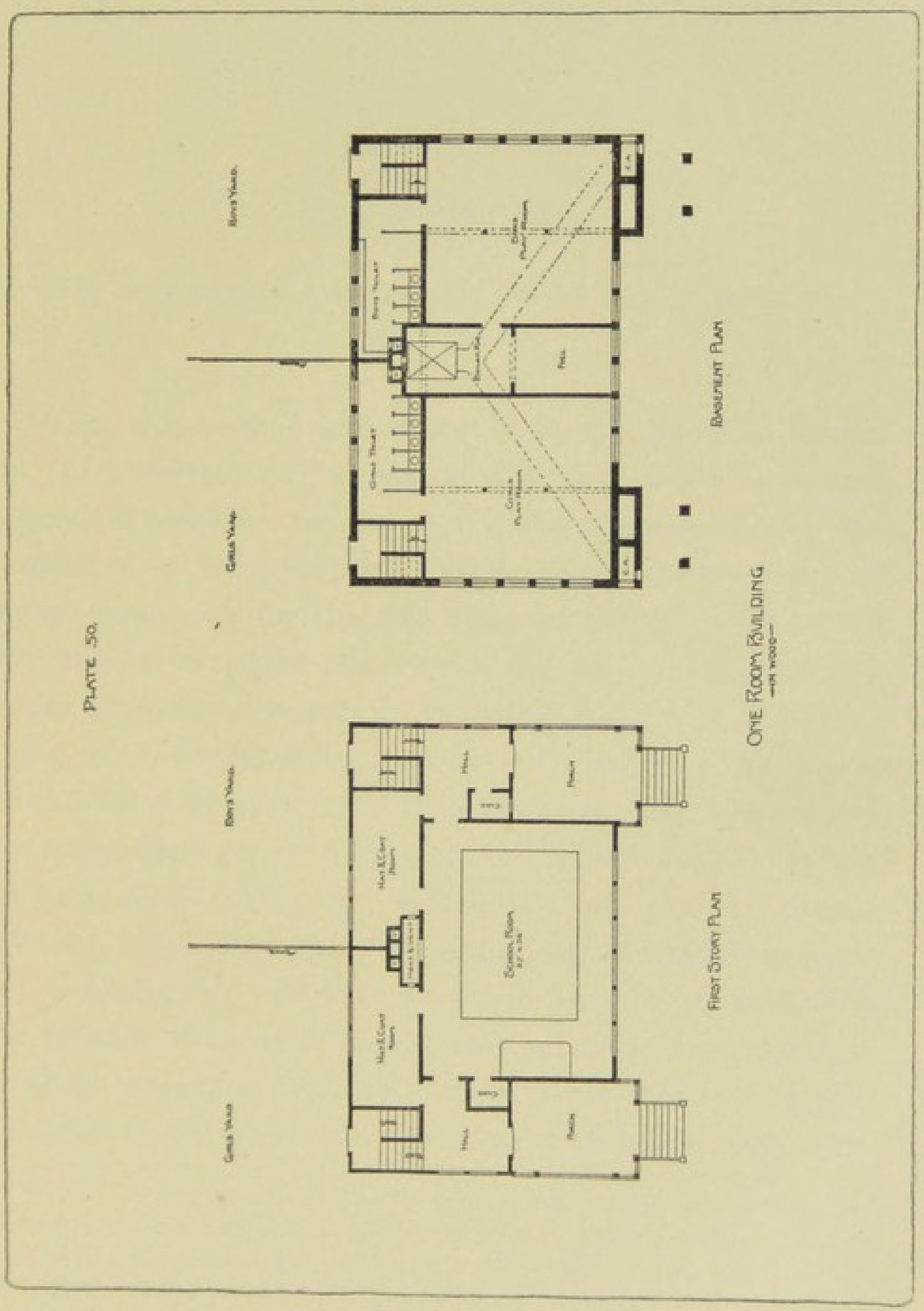


PLATE 50.
ONE ROOM BUILDING
—IN WOOD—
BASEMENT PLAN
FIRST STORY PLAN
BOYS YARD
GIRLS YARD
BOYS YARD
GIRLS YARD

CHAPTER XV.

THE PLANNING AND CONSTRUCTION OF SCHOOL-HOUSES.*

Some years ago I was employed by the Board of Education of a certain city to examine a large schoolhouse and suggest, if possible, some way of improving the heating and ventilation of the structure. While engaged upon this work my attention was for the first time forcibly directed to the evils that exist in the majority of modern school buildings. In my professional career up to the time of which I speak, I had never been called upon to design a building that was to be entirely devoted to educational purposes; in a general way the requirements were known to me, but no special thought or study had been given to the subject. In the present instance, however, I gave the matter my undivided attention and carefully searched not only home but foreign authorities for reliable data that would instruct and enlighten me. Existing structures were examined; superintendents, principals. and teachers were questioned as to their experiences and

* The following pages originally appeared as a series of articles which were written for and published in *Architecture and Building* during the year 1886. They have long since been practically out of print, and, as there is a constant demand for them, it has been deemed wise to republish them in this work; they have been rewritten and reillustrated, and a chapter on city schools added. In their present form they fully embrace the theories that have been advanced in other portions of the work.

conclusions; in short, no pains were spared to learn all that could be learned of practical use. While much valuable information was obtained from these sources, but few, I may say no buildings were found where the principles laid down by experts and suggested by experience had been combined.

So interested did I become in this subject that that which at first was merely a part of the regular routine of office work soon developed into a hobby which is, to-day, being ridden with as much vigor as when it was first mounted. It seems to me that this branch of my calling has not had as many devotees as many others, and I am inclined to the belief that one who makes a specialty of any department of his profession is better qualified in that branch than those who have not devoted the same time and attention to it. As I have gotten into this special "rut," if I may so call it, and have met with success, I feel as if I could intelligibly point out existing defects in school buildings and suggest practical remedies for them.

The principles and theories here advanced are those deduced entirely from practical experience in the construction of school buildings during the last fifteen years; in this time it has been my good fortune to be called upon to design buildings ranging from the one-room village schoolhouse up to the normal-school building of a State. The experience thus gained has been invaluable; and from the very flattering reception given to some former articles of mine on this subject, I am led to believe that a series of illustrated papers will prove of interest not only to those of my own profession, but to all who are interested in the physical and mental welfare of children.

As I purpose to speak only of public-school buildings, and as there are several distinct classes that come under this head, I shall, for convenience' sake, divide them as follows:

First Class.—The normal school, and buildings devoted entirely to the use of what is known as the "high school."

Second Class.—The buildings devoted to both high and grammar schools, and grammar-school buildings containing from twelve rooms upward.

Third Class.—The grammar school proper, containing from six to twelve rooms, and the combined grammar and primary schools, containing from three to six rooms.

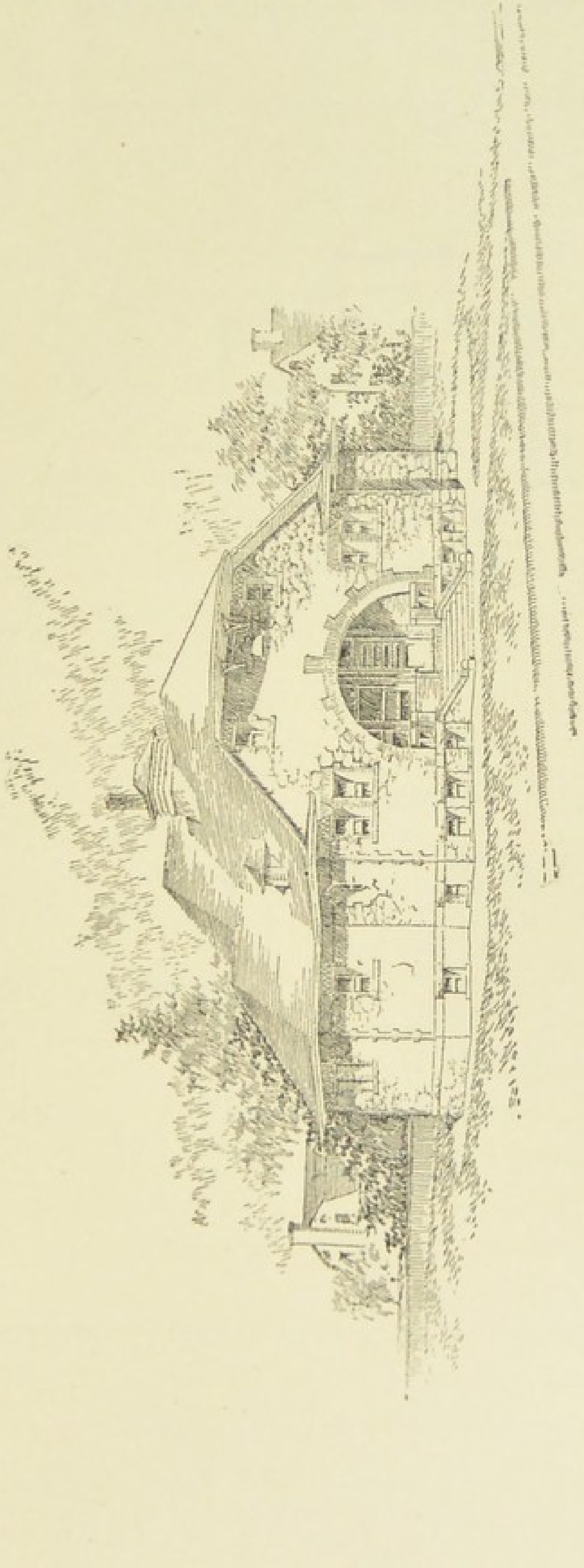
Fourth Class.—The village or district school, containing from one to three rooms.

I shall discuss these various classes, beginning with the last here enumerated; in other words, the first illustrations and descriptions will be of the fourth-class structure, which will be succeeded in regular order by the various classes, until the first is reached and included.

A public schoolhouse differs in many ways from other buildings; no matter in which class it may be placed, it is essentially a working building, although its working hours are short. The ordinary school sessions are from nine to twelve and from two until four, allowing thirty minutes before and after each session for those who voluntarily come early and are involuntarily detained; therefore, out of every twenty-four hours there are seven that the building is being used and seventeen in which it is practically deserted.

In the seven hours that it is in use there are crowded into far too limited a space children from every class in the community; it is, in fact, a heterogeneous assemblage, gathered together for one purpose; for the time being it is expected that each and every one will concentrate his energies upon the task set for him.

We are all proud of the progress our children make in the public schools, but we must know that their rapid advance is only obtained by hard and persistent study. Any thinking man or woman knows that a child cannot do as well nor pursue a continuous course of this hard work in overcrowded, badly ventilated, and poorly lighted rooms without sooner or later feeling their injurious effects. It is generally conceded that factory operatives work in extremely uncomfortable quarters; and yet, in the many factories with which I am familiar, I do not know of one where the occupants have not, as a rule, more square feet of floor-space, a greater number of cubic feet of air, generally an abundance of light, and usually better facilities for heating than can be found in the school buildings situated in the immediate neighborhood. Admitting that the working hours of the factory hands are longer, and that they are older and better able to withstand the strain to which they are subjected, I still have a firm conviction that if they were to be placed in as large numbers within the limited space, and under the same conditions, as the pupils in many schools, and required to work on full time week after week, they would not be able to stand what they do in their homely factory. Neither would you nor I, day after day, be willing to go through what we expect of children. How frequently we complain of the bad atmosphere or the uncomfortable heat or cold that we experience while attending church, lecture, or theatre, although we are being entertained instead of working, and are pleasantly detained, at most, but two or three hours. It may be said that schoolrooms are more comfortable than churches, theatres, or



ONE-ROOM BUILDING IN STONE

PLATE 51

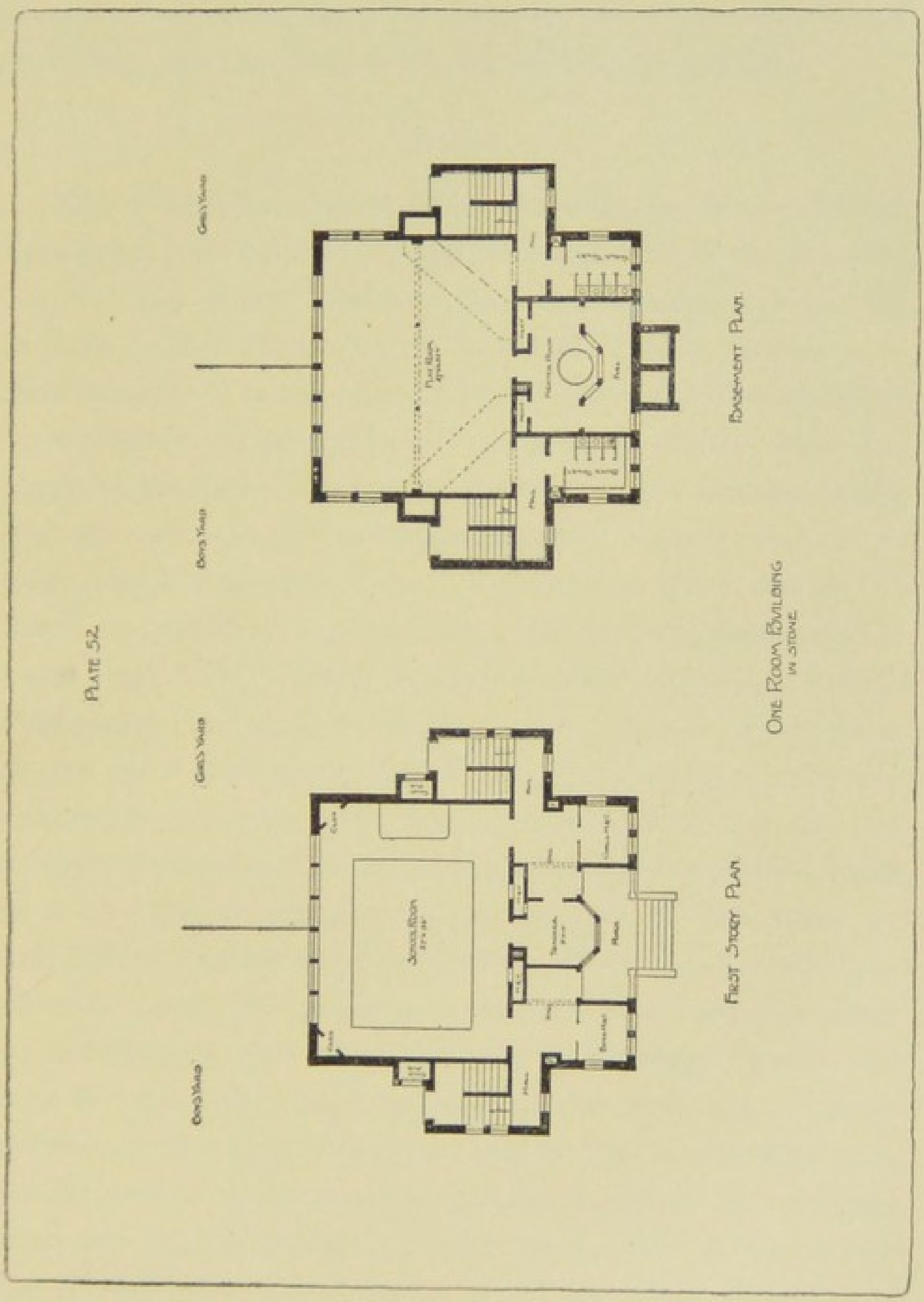


PLATE 52
BASEMENT PLAN
ONE ROOM BUILDING
IN STONE
FIRST STORY PLAN
GIRL'S YARD
BOY'S YARD
GIRL'S YARD
BOY'S YARD

lecture-halls, but I beg to differ with those who take such a view of the case; that they may be made so I am bound to admit, and that they soon will be I sincerely hope.

ROOMS.

One of the first requirements of a schoolroom is sufficient floor-space; to determine what this space shall be we must know at the outset how many pupils the room is to accommodate. This should be an invariable rule in school construction, for it is the master key of the successful planning of a schoolroom on hygienic principles, no matter what the shape of the room may be. I am frequently asked how large I should recommend ordinary grammar schoolrooms to be built, and I invariably reply, "Tell me how many pupils you desire to put into a room and I will tell you how large it should be." My rule is to allow at least 20 square feet of floor-space per pupil, never less—always get as much more as you can. Rooms to contain 46 pupils would require, calculating in this way, 920 square feet of floor-surface, and, as the teacher must be looked after, I should recommend a room 27 × 36; this would give 972 square feet of floor-space, or 21¼ square feet for each occupant. If the reader will take pains to count the pupils and measure the rooms in some of the schools with which he may be familiar, he will find how far short they usually come of this standard. I have given a greater length than breadth to the room mentioned, for the reason that a room so planned is easier to construct than one that is perfectly square, on account of the lessening of the span, and I know of no objection whatever to this shape. I am sorry to say that in most of my buildings I have been obliged to make rooms large enough to accommodate 50 pupils; they contain invariably at least 1064 square feet of floor-surface, being 28 × 38 in size. While the same proportion of space per head is obtained and in the same general form, it is a mistake to burden a teacher with so many pupils; from 40 to 44, I believe, are all to whom they can do justice. I am well aware that this is far below the average number that they are expected to instruct; but because a bad precedent has been created there is no reason why it should be everlastingly followed. A machine is built with a certain capacity, and when that capacity is exceeded one of two things follows: either poor work is produced or there is a breakdown. The thought has often occurred to me, when watching the public-school teachers in their seemingly endless round of routine work, that they are simply human machines whose capacity is far more abused than those constructed by the hands of men. While this subject is only indirectly connected with the construction of schools, to my mind it is an evil that should be eradicated; let there be fewer pupils per teacher, more and larger rooms to put them in, and both teachers and scholars will be benefited thereby.

The floor-space of our room being determined by the number of pupils who are to occupy it, we can, in the same way, obtain the height of ceiling required, for our next consideration must be the amount of cubic space allowed per pupil; there is a wide difference of opinion among experts in regard to this; the minimum space I have found to be variously estimated from 100 to 300 cubic feet per pupil. I have, for my own use, established a minimum of 250 cubic feet of air per pupil. This would require, in a room containing 972 square feet, a ceiling height of 12 feet 6 inches in the clear. I should prefer, however, to give the room the height of 13 feet in the clear and obtain, by so doing, about 275 cubic feet of air per pupil.

Plates 49, 50, 51, and 52 represent structures of the fourth class, each containing one schoolroom, the buildings being constructed in one instance of wood and in the other of fieldstone and brick. While they are entirely different in plan, the rules here advocated have been carefully carried out in both.

LIGHTING.

The mode of determining the size of a room being settled, our next and no less important consideration is its lighting. This, as in the preceding cases, is to be arbitrarily decided by the number of pupils. Long experience has led me to believe that the placing of the windows at the left of the pupil is preferable to all others; I am also convinced that they should be grouped as much as possible, that their stools should be about 4 feet from the floor, and that their opening should extend as near to the ceiling as the proper construction of the buliding will allow. It is asserted by some writers on this subject that no school windows should have a circular head; if this be true and if the teachings of a riper experience prove to me that the introduction of a circular-headed window into a schoolroom is objectionable, I am not so bigoted as not to be open to conviction; but until I have better authority than any now known to me condemning the arch, I shall continue to use it, in its various forms, in my designs.

The position of the windows having been determined, the size of their openings must next be considered. Experts differ as to the amount of glass surface required per pupil;

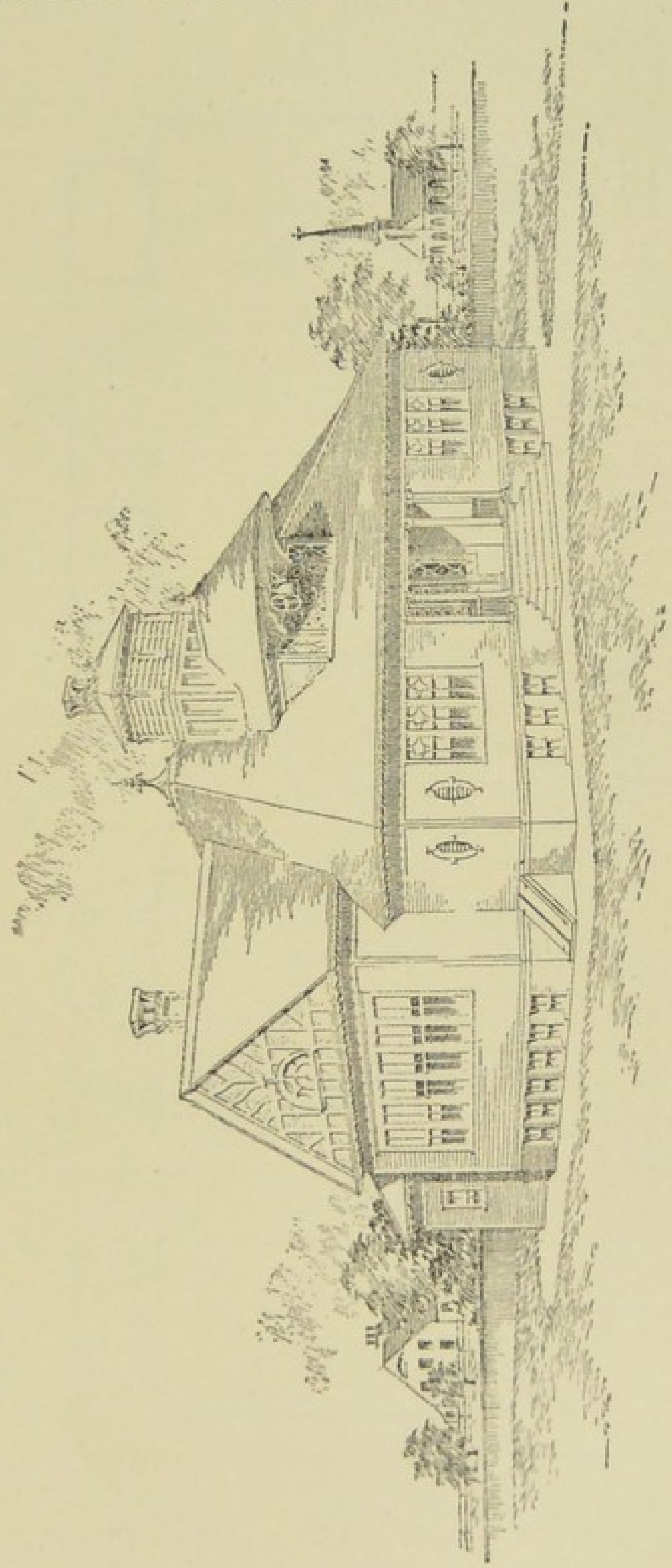
some good authorities require that it should equal one fifth or one sixth of the floor-area, while others state that from 300 to 350 square inches per pupil is sufficient. While I think that one fifth of the floor-area is more than is necessary, unless under the most adverse conditions, I am convinced that 300 square inches is insufficient under the most favorable circumstances. What is meant by "adverse conditions" is rooms that are shadowed, as is often the case in cities, by large buildings, or rooms that are badly planned or situated so as to be masked by some other portion of the building of which they form a part; these errors should not exist in a well-studied structure, but that they do exist is an undeniable fact. Undoubtedly, in well-proportioned rooms with a clear space of at least 100 feet on the sides in which the windows are placed, from 400 to 450 inches of glass surface per pupil is enough for any schoolroom, and I have adopted this as my standard. In the later buildings that I have designed I have increased rather than diminished the size of the windows, and believe that they are improved thereby.

Having fixed upon the floor-area, the cubic space, and the amount of glass surface in such a manner that the highest medical authorities or most exacting exponents of hygiene cannot gainsay their correctness, it would seem that if suitable materials have been used in construction, proper heating and ventilating insured, and the subordinate parts of the structure as carefully studied, a model building would be produced.

ENTRANCES.

Second only in importance to the schoolroom proper are the entrances, halls, and stairways. These are usually far too

PLATE 52.



TWO ROOM BUILDING
—IN WOOD—

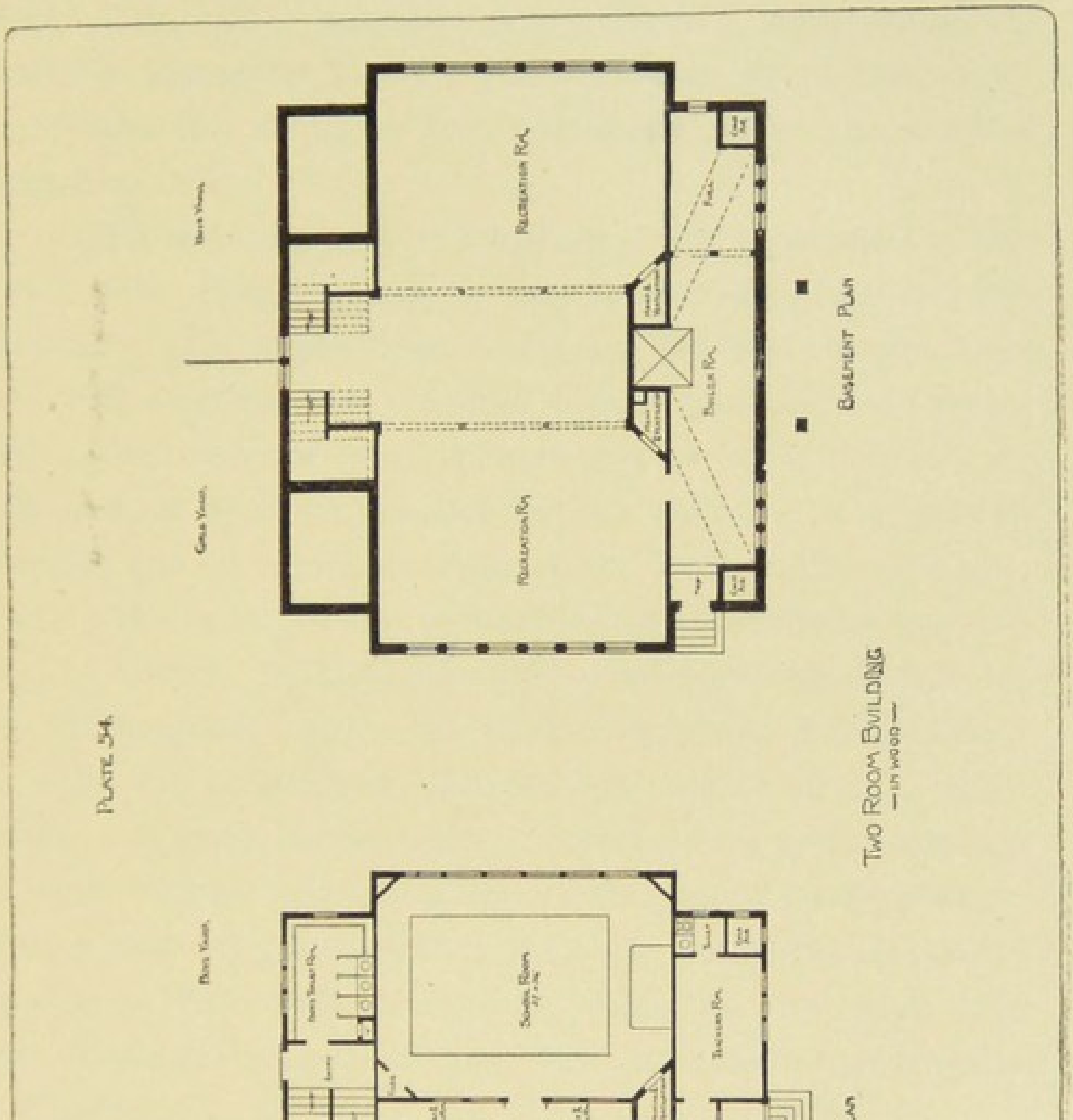


Plate 34.
Basement Plan
Recreation Rm.
Boiler Rm.
Recreation Rm.
Two Room Building
— in wood —
First Story Plan
School Room
School Room
Hall
Teachers Rm.

contracted, badly arranged, poorly lighted, and, almost invariably, *dangerous* in their construction. What I mean by dangerous will be more fully explained under the head of staircases.

As far as is practicable, I believe in the separation of the sexes in our public schools, no matter what the grade may be. Believing this, separate entrances are provided for the boys and girls wherever it is possible, even in the one-room building. The entrances may open onto a porch to be used in common, or separate porches may be planned; it is well to provide one or the other even in the smaller class of buildings. The open porch is a most useful and valuable acquisition to a school building, not only as an architectural feature, but for its general utility, provided always that it is so placed as in no way to interfere with the light and air of the schoolrooms. A good, roomy porch not only serves as a protection to children who may arrive before the doors are opened on stormy mornings, but enables them to stamp the snow and mud from their feet, close their umbrellas, and shake the superfluous moisture from their clothing before entering the hall proper

HALLS.

Even in the smallest building the halls should be wide enough to allow two or more persons to pass without crowding. They should lead as directly as possible from the entrance to the schoolroom door; be easily accessible from the side-entrance halls, hat-and-cloak-rooms, etc., and, above all, be thoroughly lighted and ventilated.

On the floor-plans of the village schools all the above requirements have been fulfilled without wasting room or sacrificing the architectural proportions of the buildings. See Plates 49, 50, 51, 52, 53, 54, 55, and 56.

SIDE AND REAR ENTRANCES AND PORCHES.

In the plans shown, side and rear entrances and porches are introduced leading respectively to the boys' and girls' yards. It is not claimed that these are absolutely necessary, or that the building would be incomplete without them, but that by their use many important and useful features are gained: a direct communication with each yard is obtained, and, if these are properly fenced, pupils are kept from the village street or the highway; there is no commingling of the sexes, as would be the case if it were necessary to use the front entrance; moreover, by the use of these entrances the pupils have no occasion for going to the front door during school hours, unless sent on some special errand by the teacher; the mud and dirt of the playground are not besmeared over the front-entrance porches, and in case of a sudden panic causing a stampede from the schoolroom, two additional exits are provided.

TEACHER'S ROOM.

The introduction of this room will probably be criticised and its practical use doubted. It is by no means superfluous in designs of this class, and good and sufficient reasons for its use can be given. Almost all parents, sooner or later, during the education of their children, have occasion to visit the teacher; if they do not, they should, for not only should there be a perfect understanding between the teacher and the pupil, but also between the teacher and the parent. Those parents who do occasionally visit the teacher or school probably remember how agreeable it is to hold a whispered consultation on the platform before a gaping roomful of pupils, or how satisfactory a tête-à-tête is in an uncomfortable hall where the visitor, perhaps after a long walk, is obliged to stand, and the teacher, holding the schoolroom door ajar, peeps anxiously into the room every few seconds, in the hope of catching an unfortunate urchin in some misdemeanor. If the superintendent, committeemen, or school visitors call, they have to go through the same manœuvres; if a pupil has been especially refractory and has been in some malicious mischief that renders it necessary for him to be brought before the committee in the presence of the teacher and perhaps the parent, would not the schoolhouse where the trouble occurred be the proper place to investigate it, and that, too, during school hours, so that other pupils could be called upon if required? Is there any place provided in the ordinary schoolhouses where such an investigation could be carried on? Again, in the case of punishing a pupil it has either to be done after school hours or before the whole room, unless some place of retirement is provided.

Teacher's rooms, situated as those shown in the plans under discussion, can be used for all the purposes mentioned above and for many others; and they are equally useful for recitation-rooms. When they are placed where indicated on some of the plans, there might be introduced, in the wall, back of the platforms, sashes of moderate size, glazed with clear glass, which would enable the teacher to keep a general supervision over both rooms, no matter which one she might be in; these sashes can be arranged to slide so as to obtain a free circulation of air in summer, and could have a neat curtain to screen them when desirable.

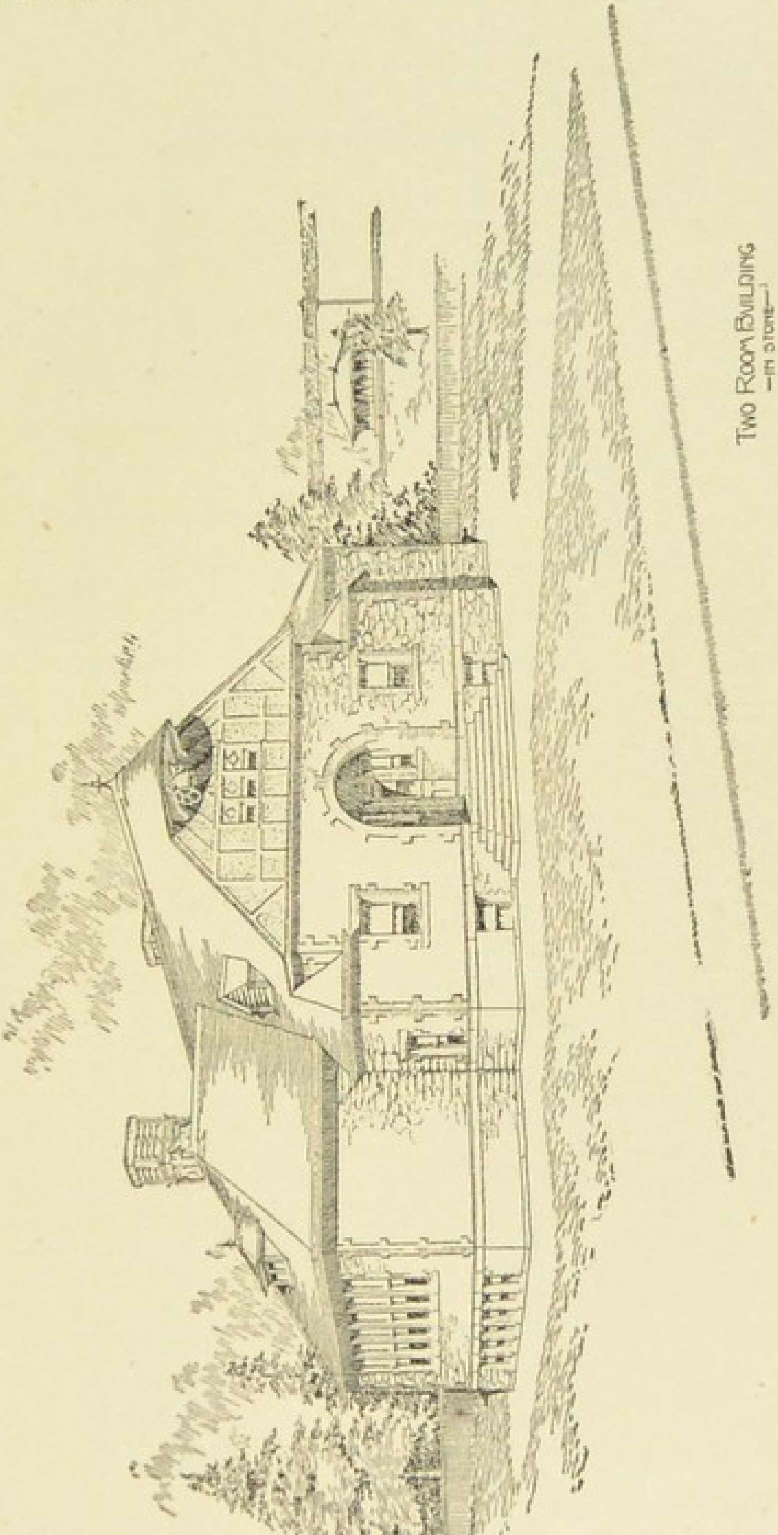
It is not required that there should be a teacher's room for every schoolroom, but that there should be at least one for every building, and where there are male and female teachers employed there should be one for each sex. In the larger buildings, containing four or more rooms on each story, it is well to have such a room on every floor, and, where it is possible, arrangements should be made to have neat toilet-rooms connected. Rooms of this kind add greatly to the comfort of the teachers, and it seems to me absurd to claim that they are an unwarranted luxury.

The stone buildings that are shown on Plates 51 and 55 are intended to be constructed of the common quarry stone, such as may be had in almost every town, and a good quality hard-burned local brick; the workmanship need only be well done, and any good village mason is competent to do it.

Plates 53, 54, 55, and 56 illustrate suburban buildings containing two schoolrooms. It is obvious that either design may be doubled in capacity by the addition of a story directly over those shown, of the same size and arrangement. The stairs would ascend over those that now descend to the basement, and all exterior and interior lines would remain the same, with the exception of being extended vertically.

HAT-AND-CLOAK-ROOMS.

Usually there is but little attention given to these rooms; about all that is required is that they shall be large enough to contain the requisite number of hooks. Frequently we find them long, narrow rooms that should more properly be called passages, connected with the hall at one end and with the schoolroom at the other. As a rule, they are poorly lighted and there is rarely any attempt made to heat or ven-



TWO ROOM BUILDING
—IN STONE—

PLATE 55.

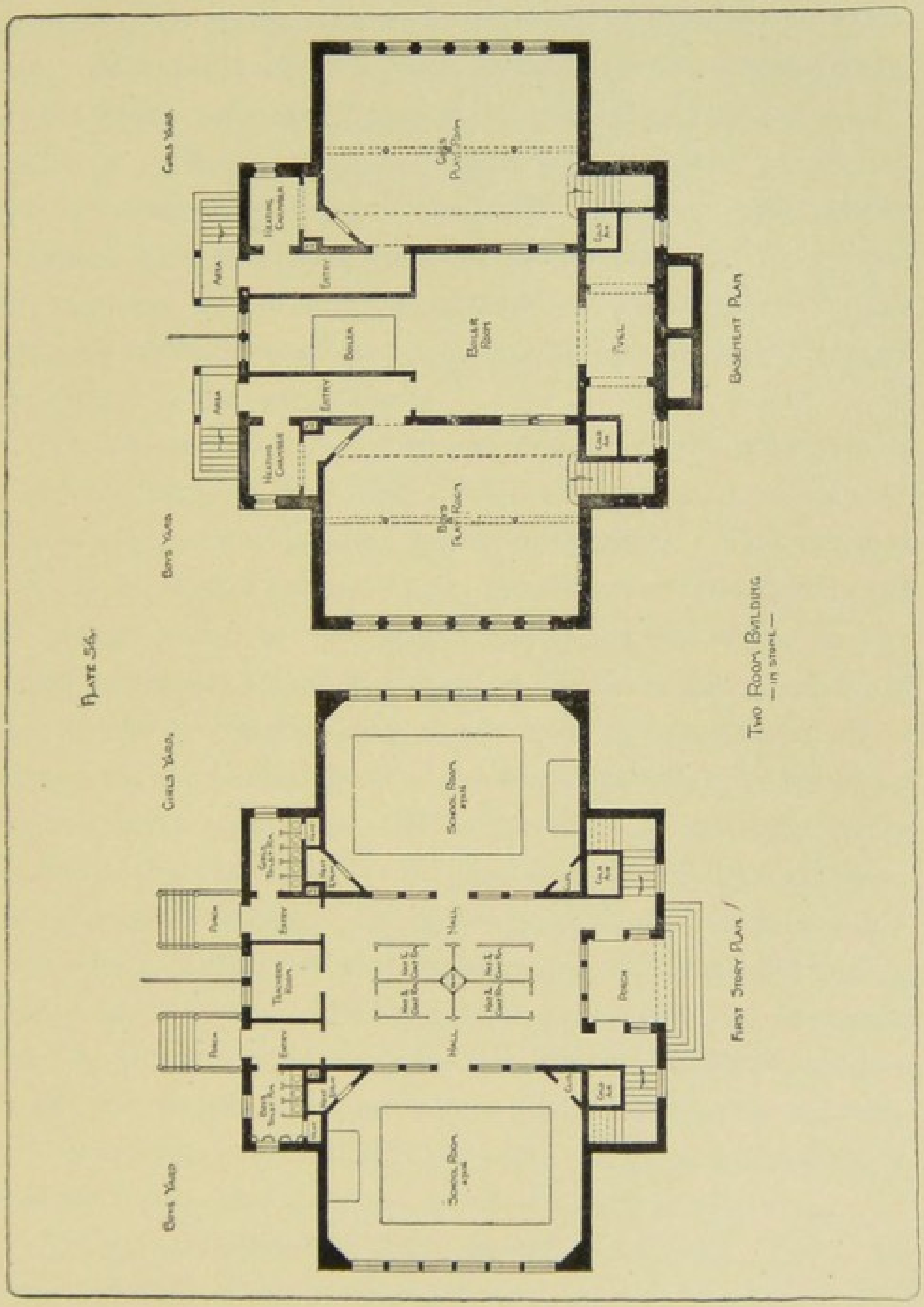


Plate 56.
Two Room Building
— in stone —
Basement Plan
First Story Plan
Girls Yard
Boys Yard
Girls Play Room
Boys Play Room
Boiler Room
Boiler
Fuel
Heating Chamber
Area
Entry
Cold Air
School Room
Hall
Porch
Teachers Room
Girls Toilet Rm.
Boys Toilet Rm.

tilate them, and yet there are no rooms in the building, outside of the water-closets, which are more liable to be offensive. The hat-and-cloak-room of a large public school is not, at its best, particularly agreeable, and when the outer garments of a score or more of pupils, gathered from all classes of the community, are saturated with moisture, hung closely together and permitted to steam hour after hour in a close atmosphere, an effluvium is thrown off which, while not as objectionable as sewer-gas, is sufficiently so to be extremely disagreeable and unhealthy.

In some schools a large room or rooms in the basement is used for hanging hats and cloaks, the garments of two or three hundred pupils being gathered together. This method is open to several serious objections; more or less thieving is bound to occur, as the pupils of the several rooms in the building are not always dismissed at the same time, and those pupils who go out first have access to all the garments; when the pupils are all dismissed at the same time there is apt to be a great deal of confusion. Where there are so many garments gathered together there is also great danger of the transmission of epidemical diseases. It may be said, in answer to the first objections mentioned, that monitors would prevent thieving and preserve order. They might, in a measure; but an urchin who is through with his tasks for the day and has only to cross the threshold to be free is rather an unruly subject, and when you come to multiply him by fifty or a hundred, it can readily be seen that the monitor's duty is no sinecure.

Every one will admit that hat-and-cloak-rooms should be well lighted, carefully heated, and amply ventilated. In some of the accompanying designs hat-and-cloak-rooms of ordinary construction are shown, although special provision for ventilation has been made in the ceiling. In others a very different and far better arrangement is given. The hat-and-cloak-rooms required for the schoolrooms are grouped in the hall, of which, in fact, they form a part. No lath or plaster partitions are used in their construction, they having merely simple light partitions of wood supported by corner posts, with bottom, middle, and top rails running between them. These rooms are entirely open at the top, and only the posts run down to the floor; the bottom rails and doors are kept about 4 inches from the floor, thus securing a free circulation of air throughout. They are heated and ventilated with the halls.

The doors of these rooms or compartments swing both ways. On the inside, at a suitable height, strong hook-strips are placed on which are screwed the hooks.

I have used rooms of this description in all grades of buildings with marked success. Usually they have been constructed of matched and beaded hard wood in narrow strips, but if it is desired they can be made more pleasing to the eye by the use of panel-work. Their great advantage lies in their perfect ventilation, convenience, and the comparatively small amount of space that they occupy.

The illustrations on Plates 57 and 58 show a three-room building constructed of wood. By referring to Plates 29 and 30 a three-room building of brick will be seen.

WATER-CLOSETS, PRIVIES, ETC.

The sanitary arrangements of village and suburban schoolhouses are, with few exceptions, of the most objectionable nature. A carelessly constructed privy, situated at some distance in the rear of the schoolhouse, is the usual accom-

THREE ROOM BUILDING
— IN WOOD —

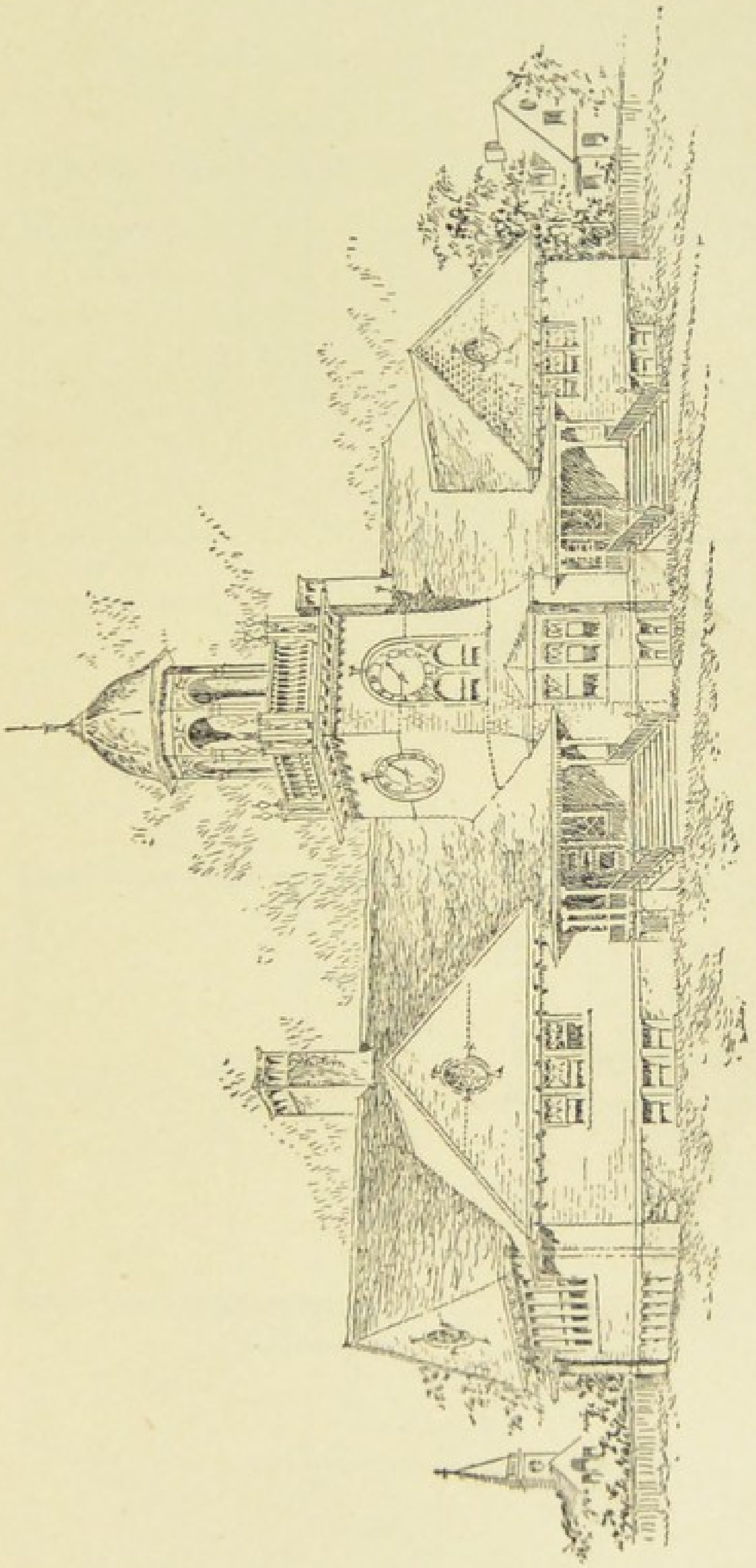


PLATE 57.

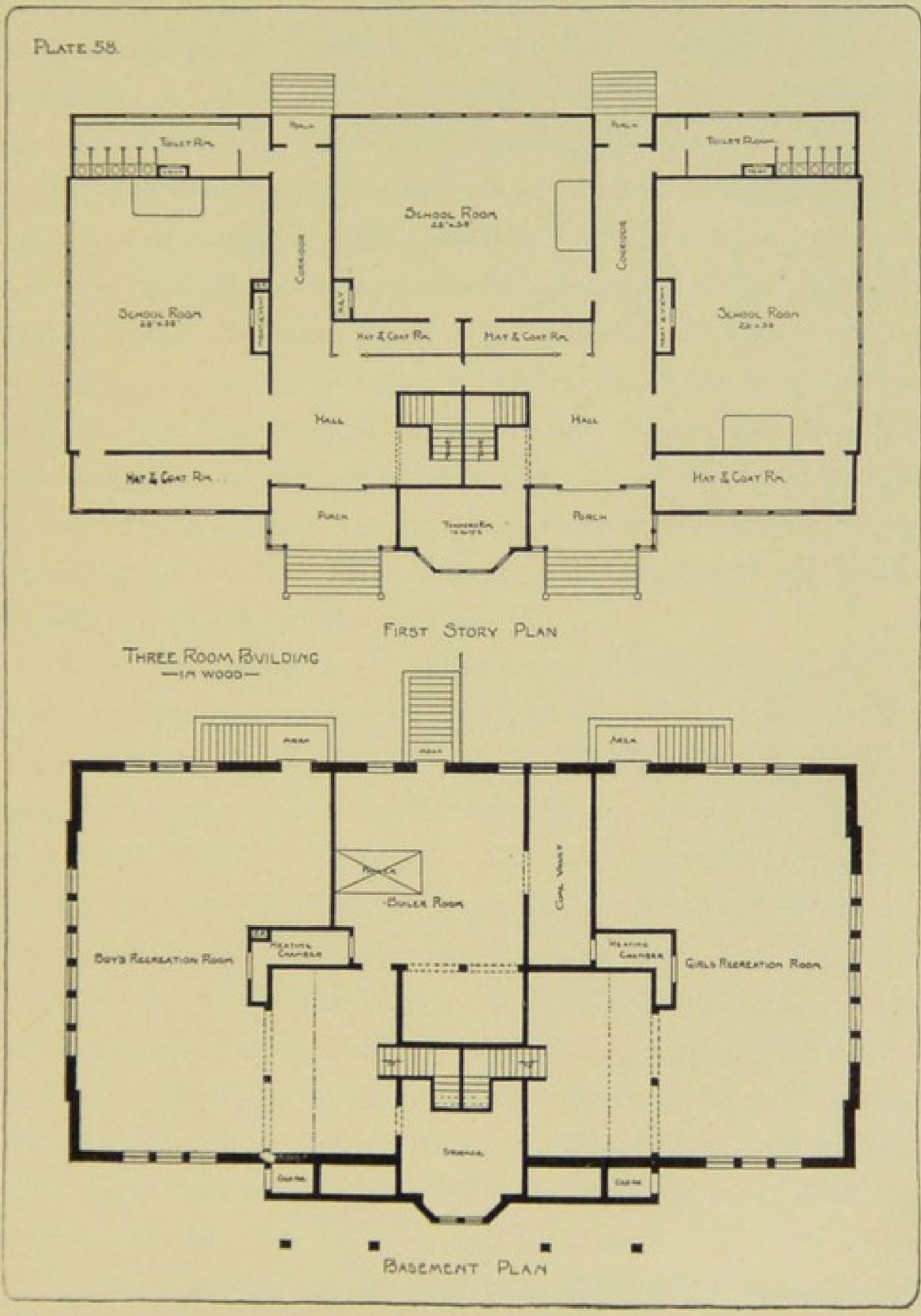


PLATE 58.
Toilet Rm.
Porch
School Room
Corridor
Hat & Coat Rm.
Hall
Porch
Toilet Room
School Room
Corridor
Hat & Coat Rm.
Hall
School Room
Hat & Coat Rm.
Porch
Teachers Rm.
Porch
Hat & Coat Rm.
First Story Plan
Three Room Building
—in wood—
Area
Area
Area
Boiler Room
Coal Vault
Heating Chamber
Boys Recreation Room
Heating Chamber
Girls Recreation Room
Storage
Basement Plan

modation offered. The majority of those that I have examined have been so poorly built, or were in such a dilapidated condition, as to be almost untenantable in cold and stormy weather, even for the short time required for the calls of nature. These miserable shanties, devoid of the simplest comforts, besmeared with nastiness, adorned with obscene scrawls, cannot but be injurious to the morals of the children. No parents, could they see these places, would wish to have a carefully reared child frequent them, but there is no alternative. No matter how repugnant to delicate sensibilities these teeming monuments of filth may be, children are forced to use them day after day, and it is no wonder that their finer instincts are blunted, their modesty corrupted, and the seeds of sensuality and vulgarity sown.

In all seasons and in all weather a child leaves the schoolroom and crosses the playground to these privies. In winter, when the schoolroom is at a temperature of 70° or more, the sudden change from a warm room to a cold outbuilding is enough in itself to be dangerous to the strongest and most robust, and yet thousands upon thousands of children are every day during the winter subjected to this exposure. In warmer weather the conditions are not much better, for, while the frosts of winter are almost unbearable, they still have the power, by freezing, of reducing the stench so that it is not particularly objectionable; under the stimulating influence of heat these beds of pollution are worse in many cases than the foulest pigsties.

Reader, do you think that this picture is overdrawn, or that the statements here made cannot be substantiated? If you do, will you take the trouble to investigate for yourself? Let no false modesty deter you, but go to these places, examine them carefully, and, without prejudice, judge for yourself whether or no the evils which I have depicted exist.

It will probably be said that many of these things are bound to occur where there is a promiscuous gathering of children. This I do not believe. I am convinced that under proper management carefully constructed, conveniently located, well heated and ventilated rooms, in which are placed the required number of water-closets and urinals, can be built, which will be in no way objectionable.

The first step toward a radical reform must be to abolish the privy forever; nothing can be more dangerous to health. Apparently the only reason for its maintenance is the cheapness of its construction and its ability to take care of itself, little or no attention being given to a privy after it is once finished. A superintendent of schools in a flourishing city of about 40,000 inhabitants once told me of a case that came under his personal observation. In one of his outlying districts was a small schoolhouse to which belonged a privy. People occupying adjacent houses grumbled considerably about the outhouse, and finally wrote a letter to my friend calling attention to the nuisance, and requesting that it be remedied. A janitor had charge of the building, and had repeatedly assured the superintendent that the vault was attended to from time to time and put in proper condition. Upon the receipt of the letter, the superintendent, with certain other school officials, went to the building and made a thorough examination; they found that the complaints were well founded; that the vault was in a horrible condition, and had evidently not been cleaned for years. When the janitor was shown the letter and informed of the serious complaints, he was much surprised, and protested that he did not see "why there should be a complaint just now, as the vault had not been touched and was in the same condition that it had been during the ten years he had had charge of the building." Is it a wonder, under such conditions as these, that the general health of modern school children is poor? Can it be otherwise? Medical and sanitary experts are continually pointing out the evil effects that arise from just such instances as those I have mentioned; and yet we go on, year after year, not only tolerating what we have, but making little or no change for the better. I have said that the abolition of the privy was a necessity; I would that it should become a law that no school building should have a privy-vault connected with it. It will be asked, What can be done in small towns or villages where there is no water or sewerage system?

There are two ways open for overcoming this obstacle. The first, and probably the cheapest, is by the use of what are known as "earth-closets." The several ways in which these may be used have been so fully described by able writers that it is not necessary for me to do it here. The second method, and the one that I have usually employed, is the use of the water-closet. Any good closet or latrine may be used—the simpler the mechanism the better. Those known as tank closets are the best for the purpose. These are fed from a tank placed over the closets to which are attached service-boxes, one for each closet. Water can be supplied to this tank from a larger tank, in the attic, which is in turn supplied with water pumped into it either from a cistern or a well. It is folly to say that this is impracticable or that sufficient water cannot be obtained to properly supply the closets; it has been repeatedly demonstrated that water enough can be obtained: the question is only one of storage capacity. Enough water can be collected from the roofs of any ordinary schoolhouse and stored in cisterns to supply the closets and urinals for from two to three weeks. At the time of year when droughts are likely to occur the schools are closed, but, should the cistern supply be exhausted, a two-way pump, pumping either from the well or the cistern, would insure a supply from the well. The pump may be successfully and cheaply operated by a windmill. So with a good force-pump placed in the basement, an ample storage cistern, proper gutters with suitable leaders, an abundant supply of water can be obtained. With this there can be no question that the properly constructed water-closet is the best-known method for the removal of excreta.

In the smaller schoolhouses, situated in towns or villages that have no public system of sewerage, the best plan, probably, will be to use a tight cesspool. This should be situated as far away from the building as the extent of the lot will allow. It should be connected with the schoolhouse by carefully trapped and ventilated drains, and so built that it can easily be cleaned out twice a year. On no condition should a leaching cesspool be used, nor should the excrement be carried into some old ditch and there left to pursue its own course. The sewerage and pipe system should always be easy of access and under complete control. There are so many able sanitarians who have given to the public an abundance of useful data that it is not necessary for me to enlarge on the subject here. I will only say that, no matter how carefully planned or perfectly constructed a building may be, if the sewerage system is defective the structure will be a failure from a sanitary and hygienic standpoint.

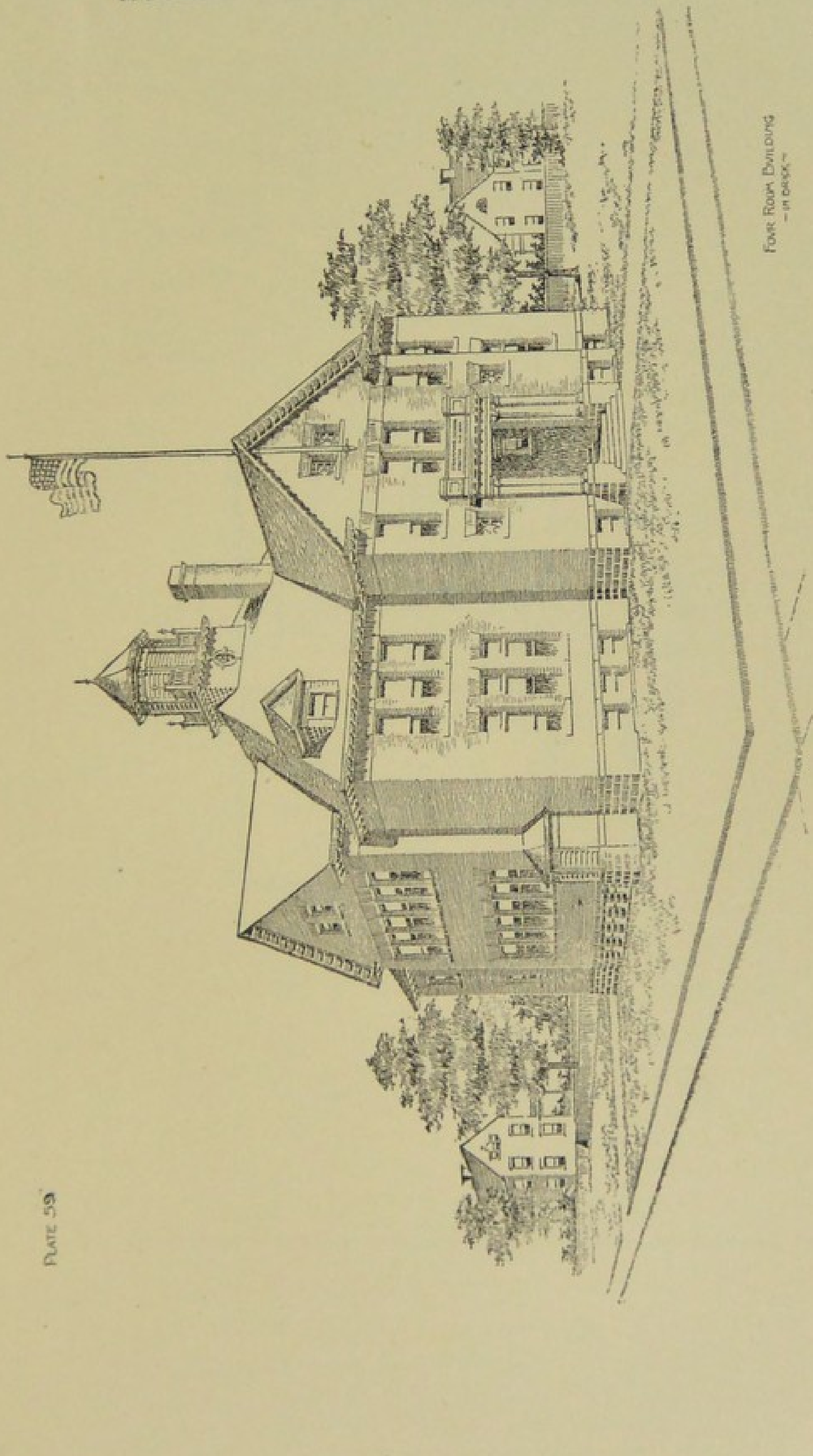
There will probably be those who will not approve of placing the closets where I have indicated on the plans. Their proximity to the schoolrooms is likely to be severely citicised, and any attempt to make these rooms something more than uncomfortable necessities will be met with strong opposition. Squarely in the face of all such antagonistic sentiments, I do maintain that whether earth- or water-closets be used, they should be under the same roof as the school-rooms, or so connected with the building that a child will not have to leave cover in passing to and from them. If closets and urinals are properly constructed and carefully ventilated, I can see no reason why they should not be placed near the school building; they can be isolated enough so as not to be any more objectionable than they are in any large dwelling or office building. No matter where they may be placed, they require constant care; they will not run themselves, as seems to be the popular idea. We do not expect this of any other piece of machinery, and a modern water-closet is a mechanical contrivance operated under the most unfavorable conditions. Such being the case, ought we to expect to obtain satisfactory results unless vigilance and care are used ?

The rooms in which the water-closets are placed should be light, cheerful, and, if possible, sunny. Let the finish of the room be neat and appropriate, and everything about them tend to enlighten and elevate the morals rather than to degrade and pollute them. The feeling that the closets should be placed in some remote corner that is not good enough to be used for anything else, and that a child in going to and from them must skulk along as if he were doing something to be ashamed of, is all a mistake and should not be countenanced. I believe in modesty and decorum as much as any one does, but I do not consider it necessary, in order to be truly modest, that one should cross the border and enter into the realm of prudishness.

The water-closets are one of the important features of a school building. It may be possible to get along with badly planned, poorly lighted, and insufficiently heated rooms, but you cannot gather together a number of pupils without providing conveniences for the calls of nature. Admitting this, we should not underrate the importance of the water-closets, but allot to them the prominent place in the plans that they surely occupy in the school system. By bringing them to light, if I may so speak, and placing them in convenient locations we will obtain more thought and study in their construction, and more inspection and care after they are completed, than if they occupied less conspicuous positions.

I believe it should be not only the duty of the janitor, but of the teacher as well, to daily look after the closets and carefully inspect them. This should also be part of the duty of the school visitors, committeemen, and superintendent whenever they may have occasion to visit the school. The children themselves should be taught to be vigilant, to report at once anything that may be amiss, and be stimulated by rewards, if necessary, to practise neatness and cleanliness. There is no reason why these things cannot be accomplished in a legitimate and pleasant way, and who will say but that, if they are, one of the most objectionable features of public schools will have been removed ?

As to the general construction of these rooms, let there be as little wood about them as is consistent with comfort, and *no* plaster. The floors, even in a simple village school, can be so constructed as to be at once durable, non-absorbent, and cleanly. On each side of the wooden joists, if they are



FOUR ROOM BUILDING
—IN BRICK—

PLATE 59

FOUR ROOM BUILDING
— IN BRICK —

BASEMENT PLAN

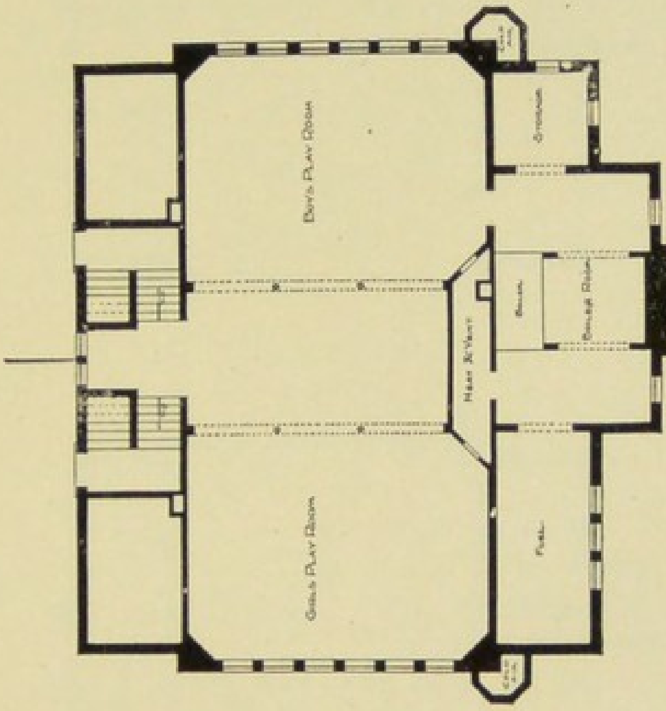


PLATE 60.

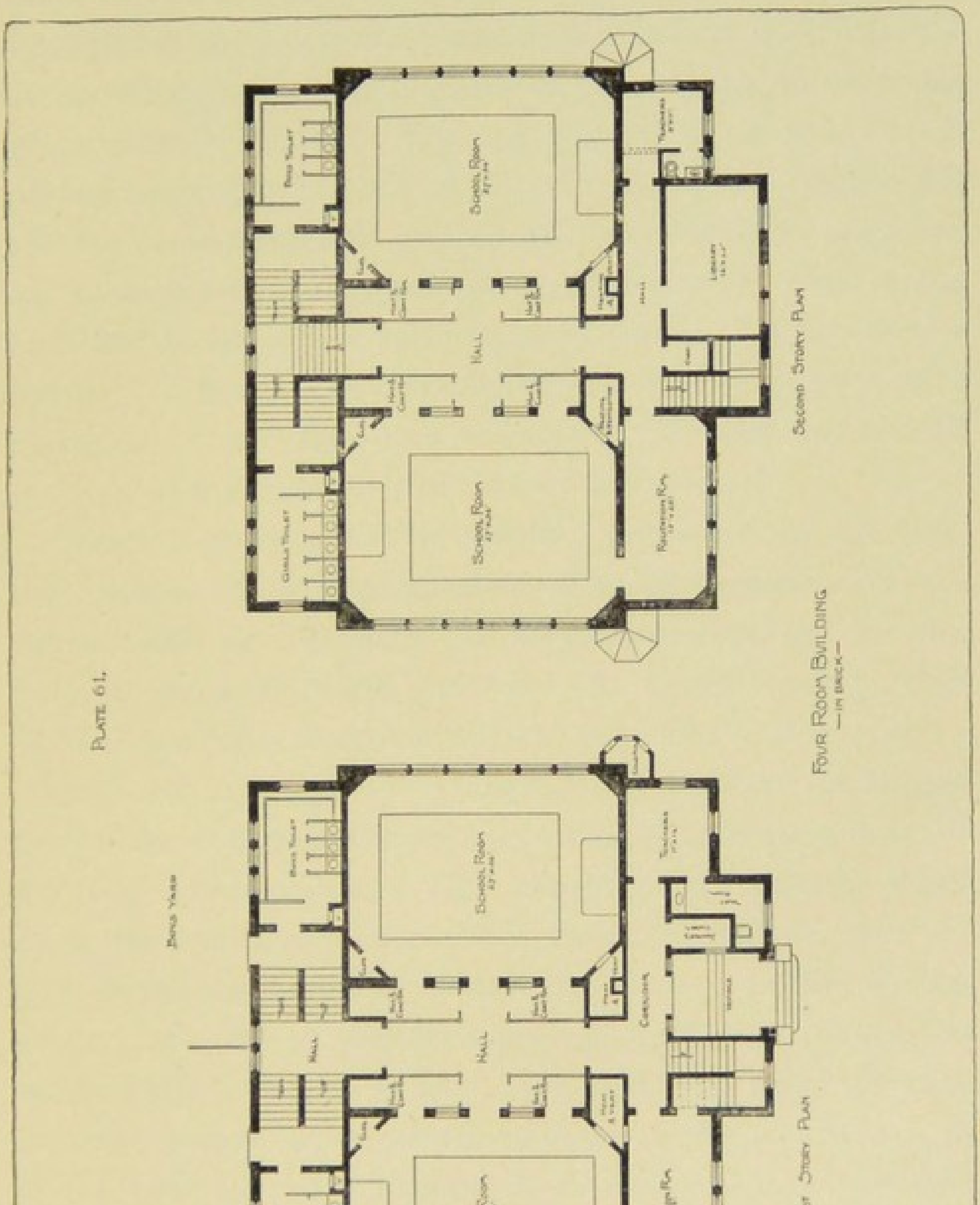


Plate 61.
Four Room Building
—in brick—
Second Story Plan
First Story Plan
School Room
Hall
Recitation Rm.
Library
Teachers
Corridor
Boys Toilet
Girls Toilet
Boys Yard
Girls Yard

used, let there be nailed strong cleats, and on these cleats lay a rough floor between the joists; upon this floor, which should be low enough to admit of it, lay common bricks on edge and grout them in cement. The top edge of the bricks should project about one quarter of an inch above the floor-joists, and the cement when floated up will not only cover them but will fill all crevices between the bricks, forming, when it has had time to harden, a perfectly solid floor. On top of this put down a heavy coat of asphaltum, and you will have, at a reasonable cost, a floor that will answer all purposes as well as one that would cost three times the amount.

The side walls should be of brick; enamelled are the best, but common brick may be used, in which case they may be painted with several coats, as they are too porous for this purpose unless they are painted. As to the ceilings, they will be more fully described in other portions of this work.

There are many good water-closets to be had; the author prefers those made entirely of porcelain, cast in one piece and fed from a service-box. They should be set directly down upon the asphaltum floor before described, and *not cased up.* The partitions between the several closets, in the smaller schools, may be of any close-grained hard wood—cherry or maple I think as good as any. The seats may be of the same material, supported on cleats screwed to the partitions. It is well to make the partitions themselves about 8 feet high and cap them with a neat rail, housed down over them. This rail should run across over the doors in front and will help to steady the partitions. A similar strip should be screwed to the floor for the lower edge of the partitions to rest in. The doors do not need to run to the floor; in fact, it is better to have from 6 to 8 inches of space beneath them; they should be light, and so hung that they will not clash against each other when in operation. Let them be finished in the natural wood, that is to say, filled with some good filler and then varnished. This will give a harder and better surface than any other way, and is more cleanly and pleasing in appearance.

As to the urinals, I have used slate backs in some cases, bolted to the walls with brass bolts; slate floors and troughs of the same material, supported at the required height on brass brackets. Water was supplied through a perforated galvanized-iron pipe, placed under a slate cap above the back. This pipe was so arranged that when the water was turned on, which should be during the time that the building was occupied, a constant flow of minute streams completely wetted the back. In this arrangement there were no partitions forming individual urinals, although they might have been made by using slate slabs bolted to the bricks and floor. After trying several methods, however, I am inclined to give the preference to individual, all-earthenware, Bedfordshire, lipped urinals. If these are used, it is better to bolt them against a slate or marble back, and to have a slate floor properly dished under them. It is also well to have some kind of a partition between them, as it prevents crowding. I have seen a light cast-iron screen of good pattern used, which seemed to answer the purpose. This was firmly screwed against the slate back and did not extend to within a foot of the floor. If these screens are kept properly painted, so as to prevent rust, they would seem to be all that is necessary, and they have the advantage of being cheap. The only other materials fit to use are slate or marble; of these marble is far the best—in fact, there is nothing so good, for use in and about water-closets and urinals, as polished white marble.

Its expense, however, will prevent its general introduction, which is to be regretted. Slate answers the purpose very well, and, considering all things, is the most available. When it is possible it is better to make the back, partitions, and floor immediately under the urinals entirely of slate. It is not necessary to have the entire partition run to the floor; indeed, I should prefer to have only the outer edges run down, for strength, and let the space between be cut out to the height of a foot or 18 inches, in a circular form, to admit of thorough washing and scouring of every part.

Water-closets and urinals constructed as I have described will not be objectionable in any building, provided proper care is given to them.

On Plates 59, 60, and 61 are shown a four-room building of brick. By referring to Plates 24, 25, and 26 a building of the same size of a different style will be found.

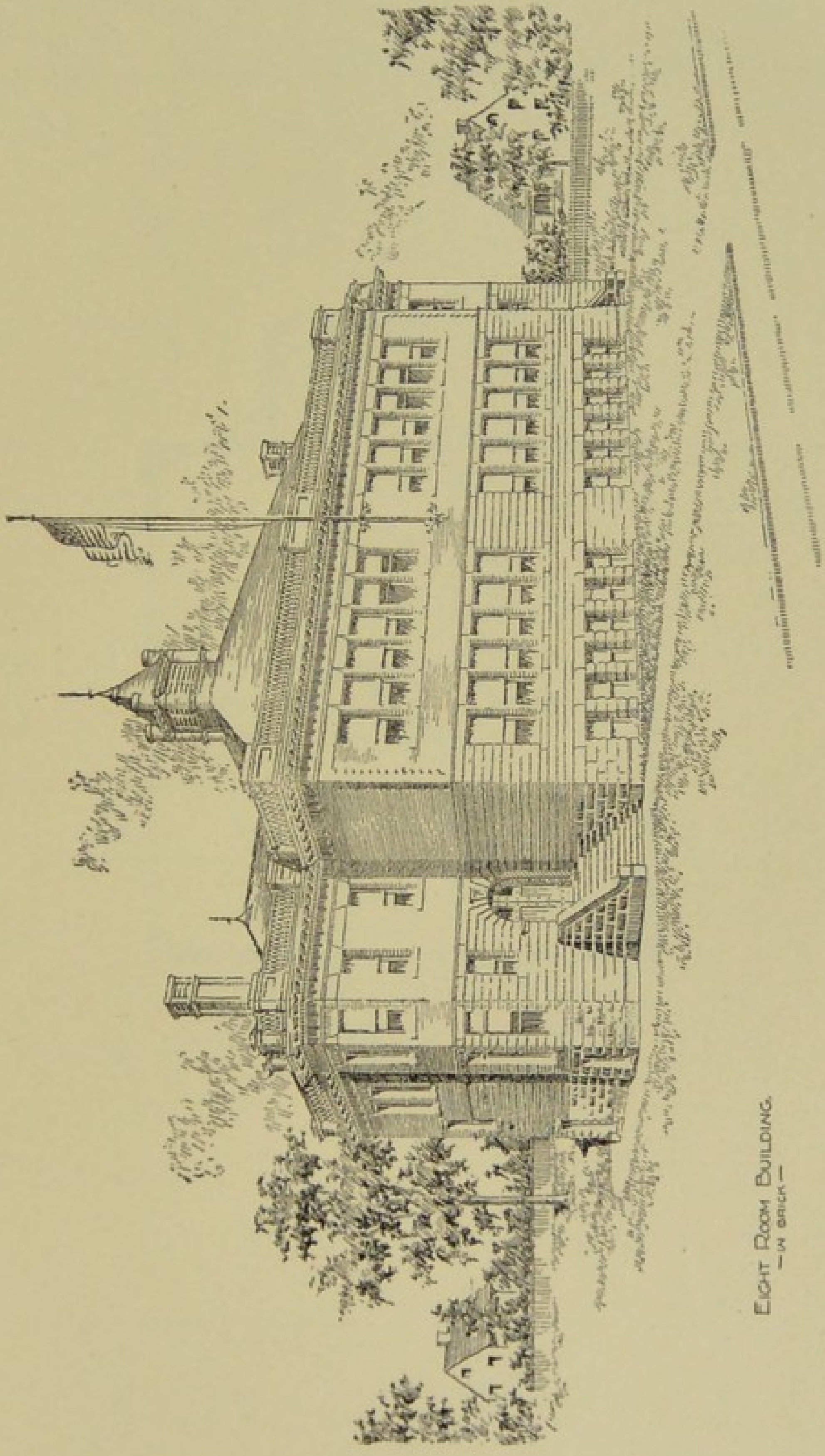
PLAYROOMS.

No matter how small or unpretentious a schoolhouse may be, it should never be constructed without a cellar. Buildings set on piers, or built only with trench walls, are unsuitable for school purposes; dampness cannot be avoided in structures of this kind, and a damp schoolroom is one of the worst places in which a child can be placed. A dry, well-lighted basement or cellar is as essential to a well-planned schoolhouse as are the heating, lighting, or sanitary arrangements. The cellar must extend under the whole of the building, and not under a small portion only, as is frequently found. The extent of such a cellar will be sufficient to provide a proper space for the heater and the necessary fuel cellars; the remaining space should be devoted to playrooms. Let these be as large as possible, and have ample stairways leading to the halls above and to the playgrounds. The floors should not be more than 4 feet below the level of the exterior grade, and the ceilings not less than 10 feet in the clear. With this arrangement windows 5 feet in height can be obtained, assuring abundance of light and air. These rooms should be well heated, carefully ventilated, and kept as neat and clean as any other part of the building. They are invaluable in cold or stormy weather, as they enable the pupils to take the necessary exercise at recess without being exposed to the elements. Sometimes in pleasant weather the playgrounds are muddy, and the rooms can be used then to advantage. Their cost is a small item, when we take into consideration the vast amount of good that they do, and I hope to see the time when it will be compulsory to have these rooms in every school building.

The importance of systematic bodily exercise cannot be overestimated, and it is well to note that there is an increased tendency in communities to recognize this factor in our educational system. That physical culture should be placed shoulder to shoulder with mental education is becoming more and more apparent. A playground of some sort is usually found connected with almost every public or private school, and pupils are expected to take a certain amount of exercise thereon every day that the weather will permit; but there are many times, especially in winter, when the open-air grounds are unfit for use, and how needful then is the indoor playgroom! In fair weather children obtain more or less exercise before, between, and after the school session, of which they are deprived during prolonged storms; then it is that all the time possible and consistent with school duties should be passed in the playrooms. Boys will take more kindly to these minutes of recreation than girls, and there are usually much better provisions made for them. Take, for instance, our institutes, colleges, and universities devoted to the use of the sterner sex. Connected with them will always be found grounds devoted to the use of all kinds of outdoor pastimes, fully equipped gymnasiums, facilities for boating and many other healthful exercises. On the other hand, the same class of institutions, with one or two notable exceptions, that are devoted to the use of the gentler sex are entirely devoid of any such facilities; even if they were provided, I am not sure that the rules and regulations of our "finishing" seminaries would allow a young lady to make free use of them. In the first case, a certain amount of physical exercise is considered necessary and is encouraged by the faculty; in the second, the necessity is not admitted, or, if so, is ignored. Can it be that our girls are stronger and better able to withstand the mental strain of studentship than our boys? Are they so constituted that they require no physical exercise? I think not, nor will any physiologist assert that such is the case. What is true of the young ladies of the seminaries is equally so of the girls of the high and grammar schools. They are usually so impressed, just at this age, with their own importance, and are so afraid that if they indulge in a little healthful play they will be lowering their dignity, that they completely ignore that which is so vitally important to their physical well-being. The fault lies not wholly with the child in this matter; teachers and parents are alike inclined to repress an exuberant spirit, being fearful that the girl will develop into a boisterous hoyden if allowed to give full vent to her feelings. Better far that she should than into a sickly young womanhood, as she will find a healthy body of much more use to her in after-life than the ability to demonstrate a problem in geometry or translate a book of Virgil. Have no fear of the hoyden. When the time comes, the natural good sense of the girl, combined with her education, will prevent her from being anything but what we all admire—a lady. Is this not true of boys? Think of the rough boisterous fellows of our school days—hard players and hard students as well; boys who did everything as well as they could, working always with might and main. Watch them in after-life, and, while you find them toned down and *gentlemen* in every sense of the word, they still possess the push and vim that to-day are the bone and sinew of this great nation. If, on arriving at manhood, a boy can put sufficient restraint upon himself, will this not be equally true of a girl? Encourage, then, I say, all healthful sports and pastimes of our school children, and let every educational building be provided with ample playgrounds and suitable rooms in which exercise may be taken.

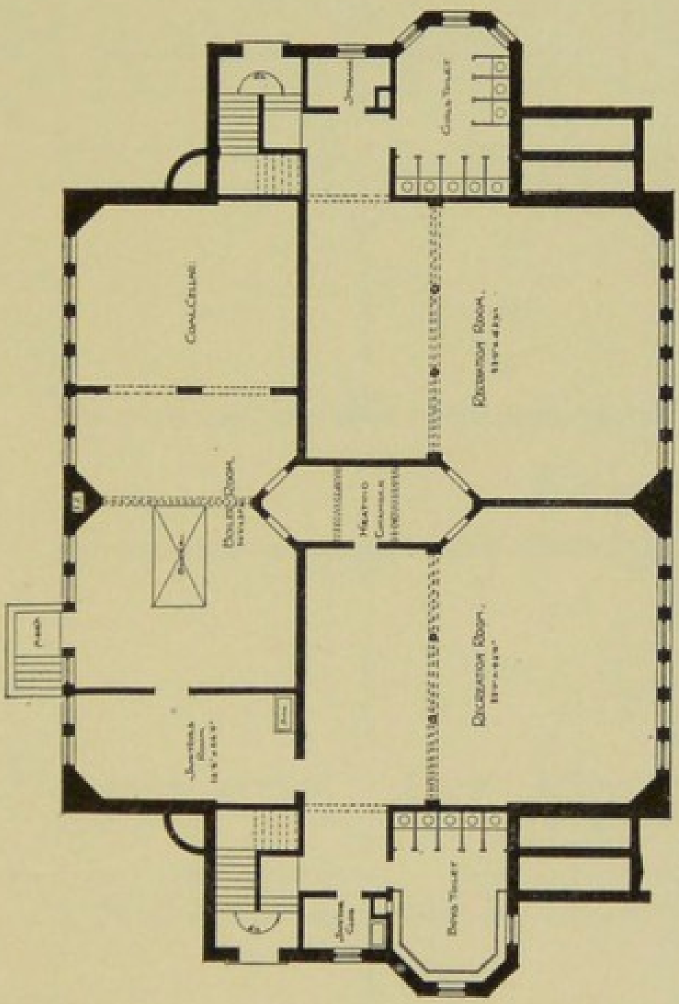
It is best to construct the side walls of such rooms of brick; these can be painted two or three coats of white lead and oil, and a very satisfactory and pleasing surface thus obtained, which can be renewed at any time. There are several methods of treating the floors. I have used asphaltum with excellent results, and I think it is about the best thing that can be had. When it is properly put down it is hard, durable, rough enough to prevent slipping, easily kept in order, and of a pleasing color. Floors of good, hard-burned brick, laid on edge and grouted in cement, when well laid, are

Plate 62.



Eight Room Building
—in brick—

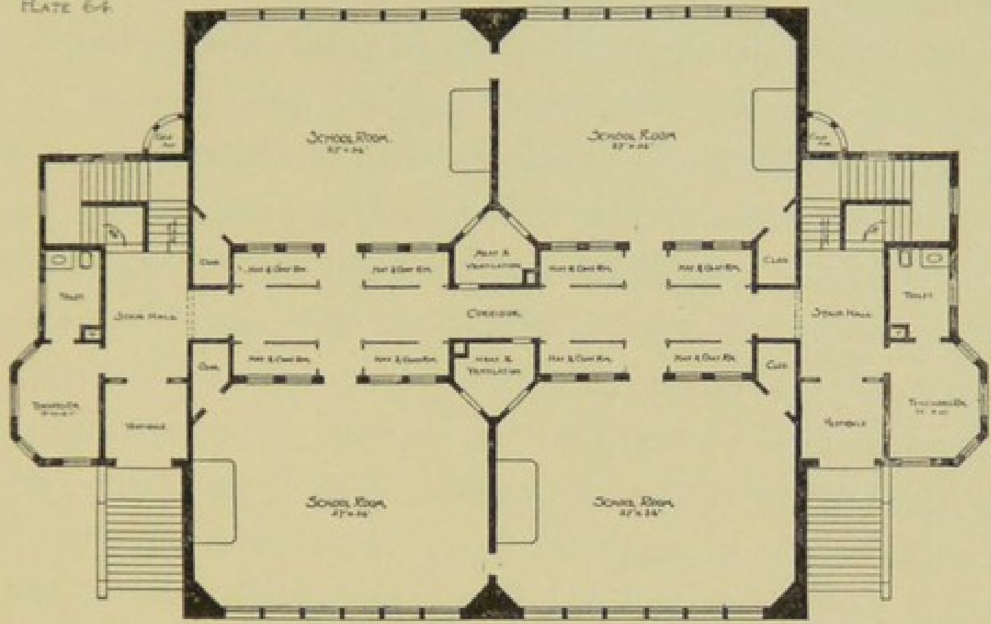
PLATE 63.



BASEMENT PLAN

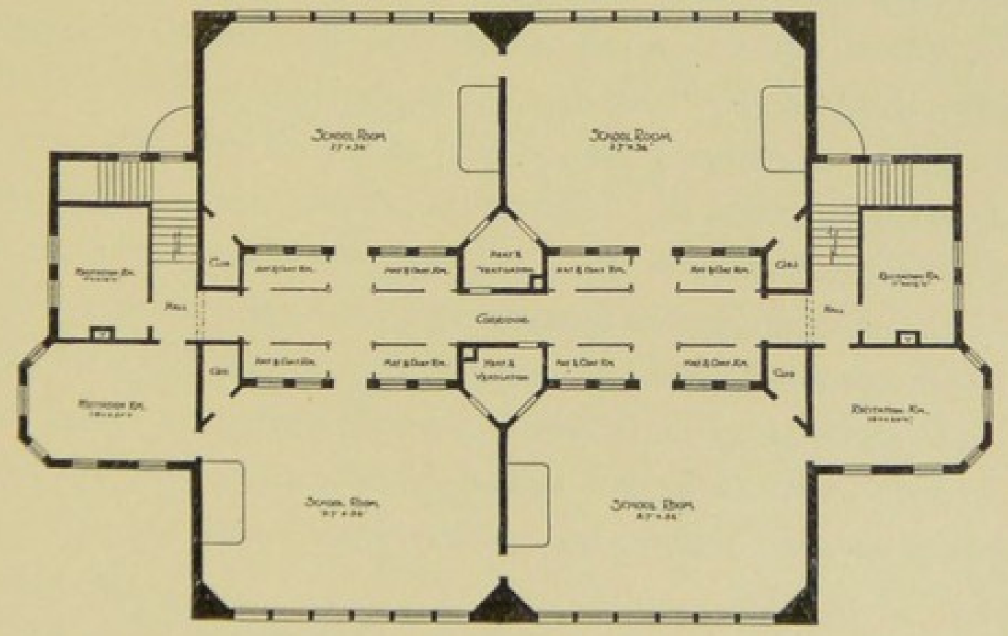
EIGHT ROOM BUILDING
—IN BRICK—

PLATE 64.



FIRST STORY PLAN.

EIGHT ROOM BUILDING
—IN BRICK—



SECOND STORY PLAN

durable, and, while not so smooth as asphaltum, are not too rough for use; their only serious drawback is a fine dust that arises from them, caused by the disintegration of the cement under constant use. This dust gets into the eyes and lungs and is disagreeable, if not unhealthy. This objection can be more forcibly urged against pure cement floors, and I think is the only good reason why they cannot be used. It might be possible, under certain conditions and by the admixture of some other material, to produce a cement floor that would not disintegrate. I understand that there are several patents of this kind, but I know nothing practically of their worth. Whatever material may be used, the floors should be slightly dished or slanted toward a common centre, where a heavy bell-trap can be placed, connected with a drain. This drain must be carried into a blind drain somewhere away from the building. On no condition is it to be in any way connected with the sewerage system of the building. By arranging the floor in this way it can be thoroughly washed down with a hose once or twice a week, which will be of great benefit from a sanitary point of view. Wood I do not consider suitable for a playroom floor, for it necessitates a heavy cement underfloor on which are placed sleepers to carry the wood floor. This leaves a continuous row of spaces under the top floor, which are sure to become highways for all kinds of vermin, and there can be no such washing out of this room as in the former cases.

Let there be as many windows in the playroom as the proper construction of the building will allow. It is well to have them so arranged that they can be easily opened or closed, as these rooms must be thoroughly aired both before and after occupancy. When it is possible, even in stormy weather the windows on the "lee" side of the building should be left open, the object being to have the children take their exercise as much as possible in the outside air without being exposed. It is worse than useless to send pupils out of a schoolroom into a musty, unwholesome basement. What they want is pure air and plenty of it, and a complete change of air and temperature is essential to secure good results. The playrooms need not be heated to the degree that we find necessary in the schoolrooms; a temperature of from 50° to 60° is all that is required, and the pupil should understand that during the few minutes allowed for recess he is expected to take as much exercise as possible. No seats are needed in the playroom—in fact, it is better not to have them, as the scholars sit and lean over desks enough in the schoolrooms. During recess let them strive in every way to relax and invigorate the brain and muscles, which have become wearied by study and confinement. This is what recess is for, and why I advocate a playroom in every school building, so that, no matter what the weather may be, beneficial exercise may be had at stated times during every day of school life.

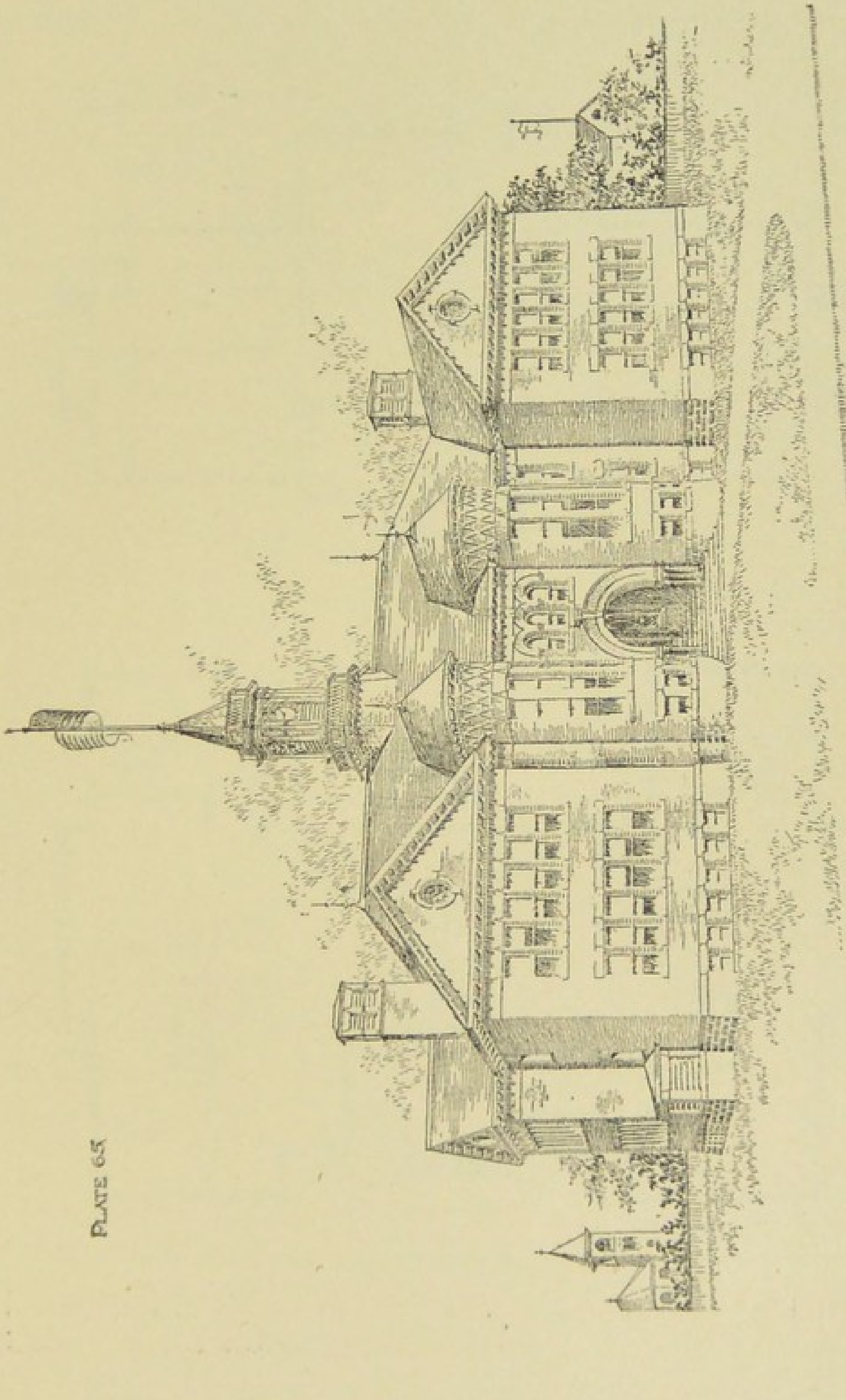
Plates 62, 63, and 64 show an eight-roomed building with the toilet-rooms in the basement; by referring to Plates 20, 21, and 22 an eight-roomed building will be found with toilet-rooms on each floor.

STAIRCASES.

It is a general custom among architects to make a special feature of the staircases, particularly in the larger buildings; and many beautiful examples of their skill in designing can be found in some of the recent large school buildings. There is always a strong temptation for an architect to do this, for in no department of interior work can more taste and skill be shown. There is nothing that I admire more than a noble, well-lighted staircase, leading up through a building, and I am loath to deprive myself of this chance to beautify a school building with handsome, well-studied newels, rails, and balusters, and yet I believe they should all be abolished. I have said in a previous chapter that the majority of staircases were dangerous, and I reiterate it here. To better illustrate my meaning, let me call your attention to the terrible calamity that occurred on February 20, 1883, in the Roman Catholic school of the Most Holy Redeemer, situated on East Fourth Street, in the city of New York. The registered attendance at the school at this time was 900, the pupils ranging from four to fifteen years of age. The Sisters of Notre Dame had charge of the school, and are said to have been very careful with the children, having taken great pains to instruct them in a "fire-drill." In spite of this, in the middle of a winter's afternoon, in the most populous city of the Western Hemisphere, in a city that boasts of the finest and best-equipped fire department of the world, in a building which hundreds of people were passing every hour, there occurred a slight fire—so slight that the firemen had no trouble in mastering it in a few minutes with the use of but little water—and yet within an incredibly short time after the alarm was given fifteen children lost their lives. Not one of these lives need to have been sacrificed had the *staircases* been properly constructed. Should not such a terrible disaster as this teach us that something was radically wrong in their construction? Do you wonder that I claim that the staircases are many times "dangerous," when I tell you that there are hundreds of school buildings that are just as faulty in this respect as the one in which this disaster occurred? All published accounts of the disaster agree that the halls were 6 feet 6 inches wide, and the staircases 3 feet wide. Down one of these narrow staircases, containing twenty steps, an attempt was made to march the children by twos, but in their eagerness to get out they could not be controlled, and there occurred a jam upon the staircase; the children above, alarmed at the delay, pushed forward and caused the rail and balusters at the side to give way, hurling head-foremost to the floor below a struggling mass of children that completely blocked the passage. This pile of frenzied humanity was constantly augmented from above, and, in spite of all efforts of willing hands and brave hearts, fifteen little lives were sacrificed by that fatal stair-railing. I do not pretend to say that if the railing had not given way all would have been saved, because the stairs themselves were about as bad as they could be, but I do believe that many more would have gotten out safely, even with the narrow stairs, had they been walled in on both sides. Even if the railings are strong enough to withstand a pressure, there is still danger of pupils either jumping or being pushed over in case of a panic. I am well aware that the architectural effect of the structure is not as good where boxed or wall stairs are used, but it cannot be disputed that they are safer and better adapted to the requirements of a schoolhouse.

Stairs should not have over 7½ inches rise, and should be built with at least two separate runs to each flight. They should be from 5 to 6 feet in width, with square landings; treads should be fully 12 inches, and the landings as wide as it is possible to have them. Winding or curved stairs should

PLATE 65



TWELVE ROOM BUILDING
— IN BRICK —

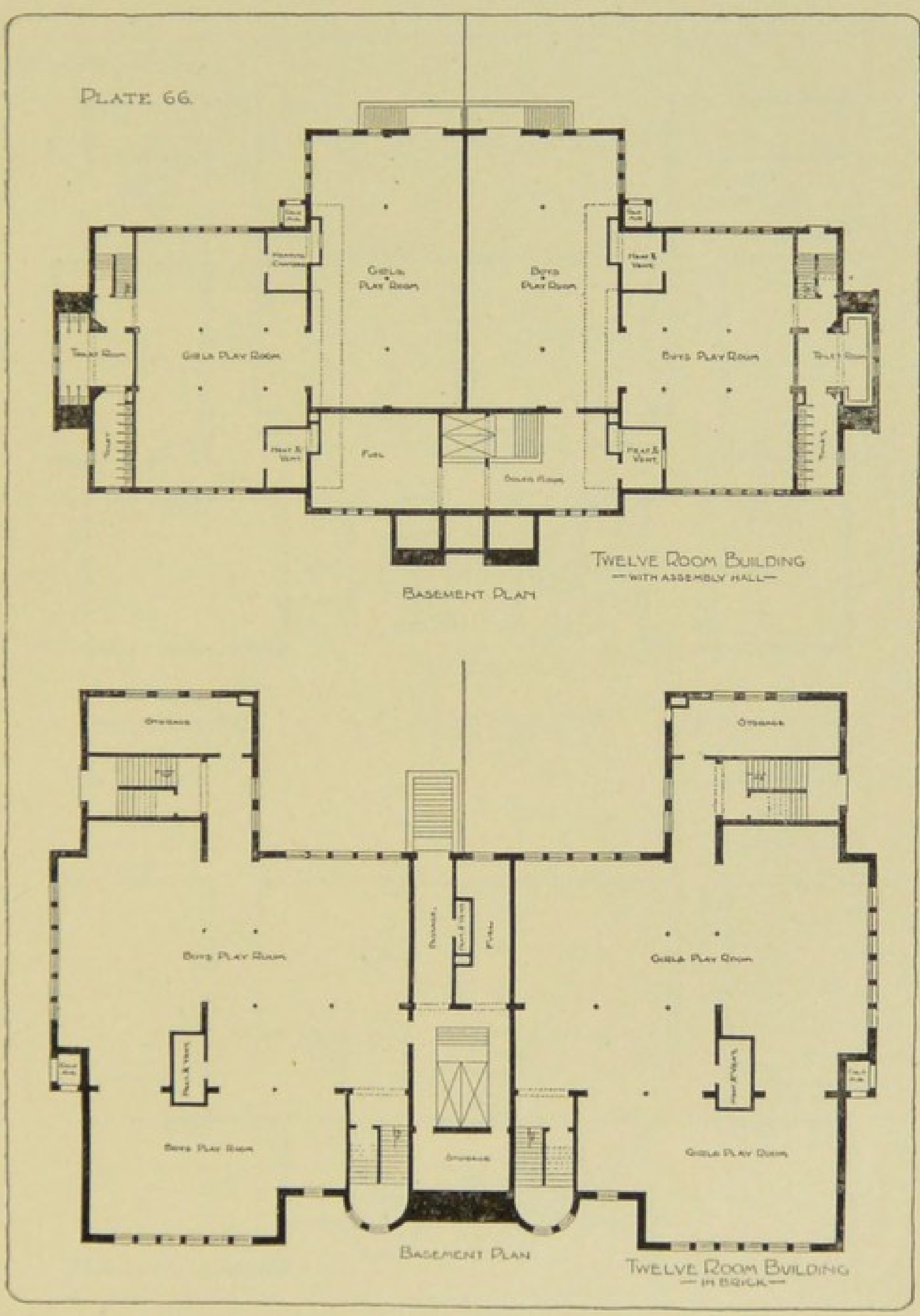


PLATE 66.
Girls Play Room
Boys Play Room
Girls Play Room
Boys Play Room
Fuel
Boiler Room
Basement Plan
Twelve Room Building
—with Assembly Hall—
Boys Play Room
Girls Play Room
Basement Plan
Twelve Room Building
—in Brick—

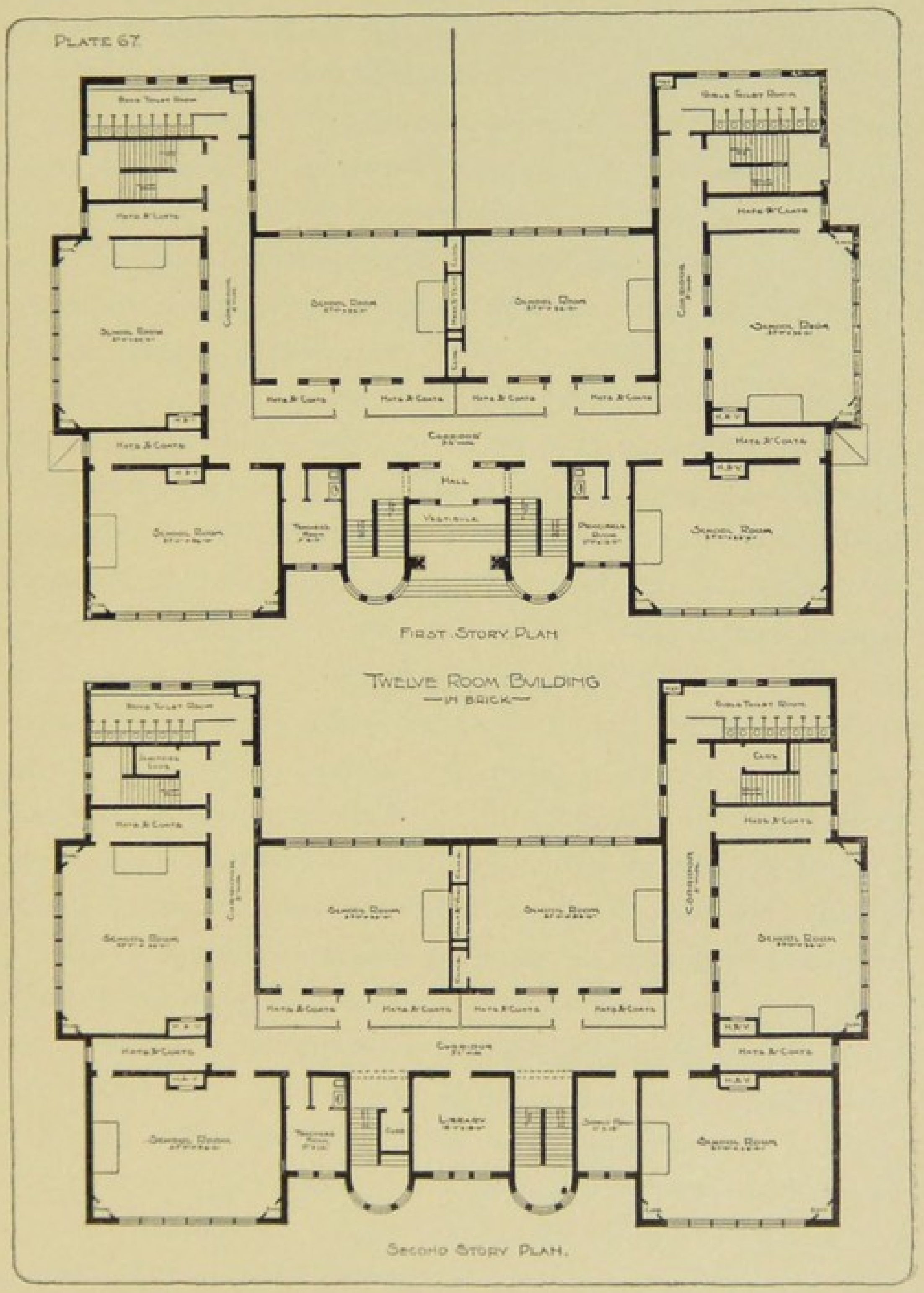


PLATE 67.
FIRST STORY PLAN
TWELVE ROOM BUILDING
—IN BRICK—
SECOND STORY PLAN.

never be used. A strong partition-wall should extend from story to story between the separate runs of stairs, and there should be a strong rail bolted to the wall on both sides at a suitable height. An abundance of light must be obtained, and it is well to keep the windows at a considerable height from the floor; by so doing there is no inducement for a pupil to loiter on the stairs. Stairs of this description are shown in *all* the designs in this book.

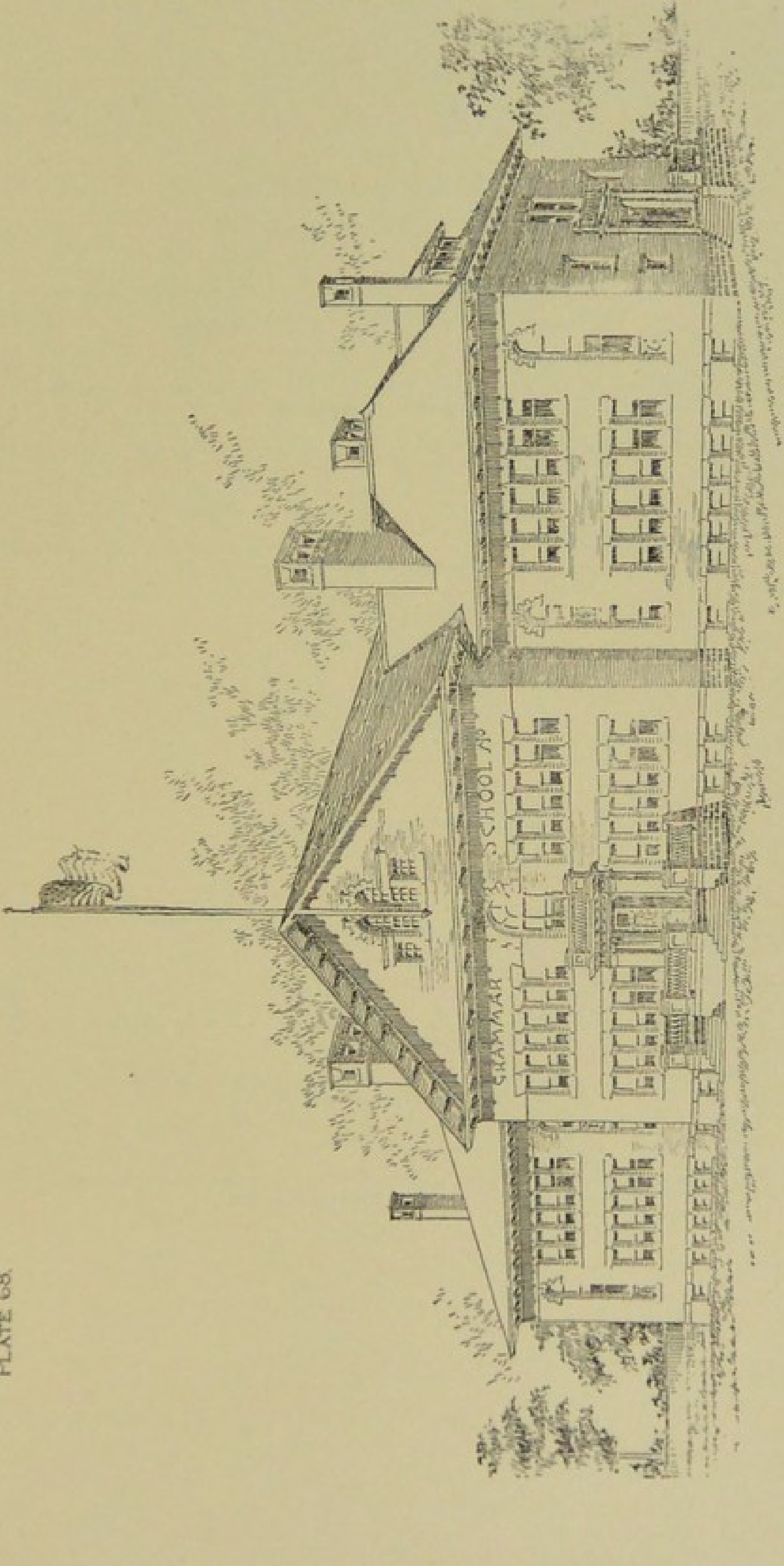
Where stairs are constructed as here shown it is almost impossible for a jam to occur; there is no chance for anything to give way, or of the children falling or being pushed over the railings. When they are placed as shown in the majority of the designs they have the further advantage of being comparatively noiseless to the occupants of the lower rooms. Stairs are a necessity in all buildings, although I think far too many are used; in other words, I do not believe in piling story upon story in school buildings, preferring breadth to height in all places where it can be obtained. In large cities these high buildings cannot be avoided, but in the smaller towns and in the country, where land can be had, no building should be erected for school purposes that has more than two floors to be occupied above the basement.

Eminent physicians have repeatedly pointed out the evils that come to children, especially girls, from constantly ascending long flights of stairs. This, with the constantly increasing danger as we ascend, is a strong argument in favor of breadth instead of height. It is too much, however, to expect that a radical change will be brought about in this respect, although it is a pleasure to be able to say that during the years 1884 and 1885 I built for the city of Taunton, Mass., a high-school building in which the entire space devoted to school use was situated on the first floor; the second floor contained only an exhibition-hall, anterooms, and rooms that could be used for evening drawing-classes. In the basement were placed the chemical laboratory and playrooms.

The illustrations on Plates 35, 36, and 37 show a building very similar. I think it was a pioneer of its kind, and, while by no means perfect, I consider the general arrangement a decided improvement upon the average buildings of this class. It is much easier for the teacher to handle the classes, and the scholars have no stairs to climb in passing to and from recitations. The schoolhouse, upon occupation, fully meets the expectations of those who were interested in it, and I hope it will continue to prove so satisfactory that buildings like it may be multiplied.

Wherever stairs may be used in schools or any other public building, they should be built as strong and substantial as possible, and practically fire-proof. They should be the last thing to burn or fall in the structure. In ordinary construction they are among the first places to catch fire and the most efficient means of rapidly conveying it from floor to floor. That there is no need of this has been repeatedly demonstrated. Staircases can be built at a reasonable outlay that are convenient, easy of ascent, well lighted, and absolutely fire-proof—staircases that, in case of an alarm of fire or sudden panic from any cause, would enable the inmates of the building to get out safely, or at least without finding the staircase already in flames and using its best endeavors to destroy the rest of the building in the shortest time possible. Architects and all others interested in school buildings should encourage the construction of fire-proof staircases. Innu-

PLATE 68.



TWELVE ROOM BUILDING
WITH ASSEMBLY HALL

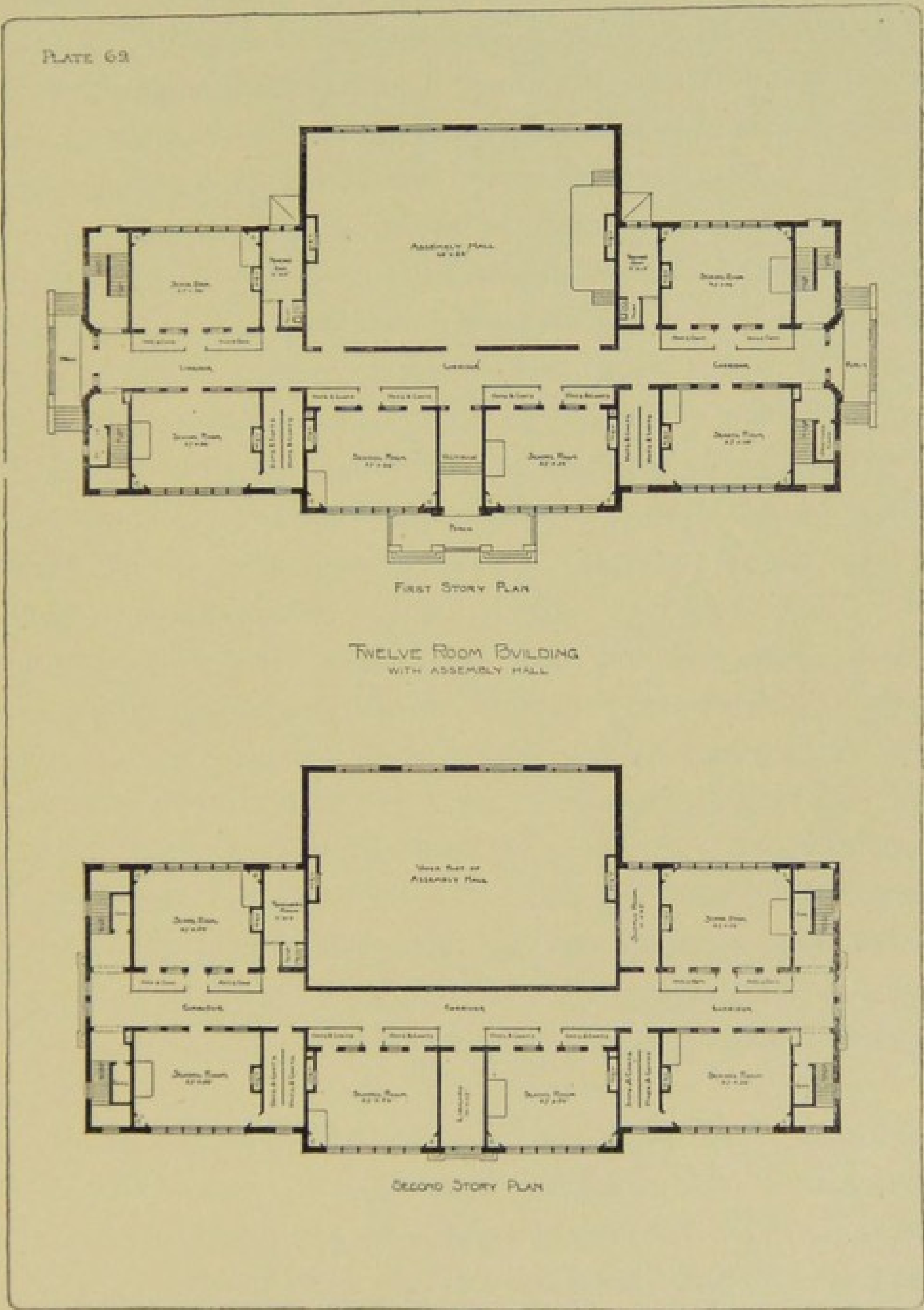


PLATE 69
FIRST STORY PLAN
TWELVE ROOM BUILDING
WITH ASSEMBLY HALL
SECOND STORY PLAN

merable calamities in crowded public buildings, churches, theatres, and schools should have taught the public the conditions that make a panic-stricken multitude of human beings so dangerous to itself. It should be a *law* that ample means of exit should be provided for just such emergencies.

Of what use was the careful training in a fire-drill by the Sisters of Notre Dame of the 900 children entrusted to their care, when these same children were confined in a death-trap, out of which they could not have escaped under the most favorable circumstances, in regular marching order, in less than ten or fifteen minutes? Of what use, I say, is a fire-drill under such circumstances, and what is the use of saying that children or any one else can be controlled when we know that self-preservation is the first law of nature? Under the excitement and fear that such a scene brings on, the majority of people become so frenzied that, for the time being, they are transformed into mere brutes. Better far than all fire-drills is a broad hall and a wide staircase. Better far than money spent in exterior show is a plain building with fire-proof floors and staircases. No one can dispute the soundness of this reasoning; and yet an elaborate and showy exterior will often be selected by a building committee, when real worth and intrinsic merit are concealed under a humble garb.

Let the side walls of school staircases be of enamelled brick (either the imported ones or those made in Philadelphia are the best) and you will have a surface as smooth and hard as glass. These brick can be obtained in a variety of tints, and when properly laid in Portland cement they make the most satisfactory and durable wall that I know of. No wainscot is required, although one can be laid of chocolate-colored bricks; this, with a field of light buff and a frieze of delicate blue, makes a very pleasing combination. Many other tints can be had, and the only thing that prevents their more general introduction is the expense; the enamelling is laid on a first-quality pressed brick, and the labor and material added to this brings the cost of the completed enamelled brick up to \$80 or \$90 per thousand, without laying. While this price may seem high, I believe it is economy in the long-run to use these bricks in school construction, and I strongly recommend them to all who are about to build.

Should the purse not be long enough to bear the expense of enamelled brick, let the ordinary pressed bricks be used; should these be too costly, use the Croton or even the common bricks, carefully selected. The latter can be painted two or three coats of some light neutral tint, and will be at once durable, fire-proof, and pleasing to look at. By all means do away with plaster; it is easily soiled, an absorbent, and far too perishable for the wear and tear of school life.

My favorite material for treads and risers is rubbed slate of a dark-blue or purple color. In case this is used for the treads only, the risers should be of brick, by which a very pleasing contrast is obtained. These slate treads and risers can be built into the brick walls at both ends and supported in the centre by light iron beams and stringers; the under side should not be closed up in the least, but left open, and the iron painted some light neutral tint.

Where slate cannot be had, bluestone may be used in its place, although, unless it be sawed, it is rather rough. Solid granite or other stone steps are very good, but more expensive than those mentioned. Iron is, of course, at all times available and useful; if it be used, the top surface of all platforms and treads should be finished with a checkered pattern to prevent slipping, although even with this precaution it will wear smooth under use and become slippery and dangerous, which is not the case with stone steps. Wood can be used for treads where there are brick walls, although I much prefer any of the first-mentioned materials. It is much cheaper, but cannot be made fire-proof; but, with the walls as described, wood stairways can be so constructed as to be very slow of combustion, and when all the heating apparatus is placed in the centre of the building and the stairways at the extreme ends, as I have shown on the plans of the larger buildings, there can be little danger of the fire getting so far along as to block both staircases at opposite ends of the building at the same time.

It is better, however, not to take even this risk if it can be avoided, but adopt at the outset imperishable materials. It must be remembered, in this connection, that while stairs built as I have described cost more in the first place than when built in the ordinary way, there will be no expenditure for newels, well-posts, or balusters, or for lath and plaster. A hand-rail of brass or iron bolted to each of the side walls with suitable metal brackets is all that is required. Brass is the most pleasing metal and can easily be kept bright. I have also had good success in making these rails of 2-inch wrought-iron pipe, on each end of which are screwed neat cast-iron caps. These rails need not run around the platform, but be simply straight pieces of pipe following the run of the stairs at a suitable height. Rails of this kind are far preferable to wood, as they cannot be marred or easily damaged; they are a vast improvement upon the ordinary rails, supported by balusters and newels, on which it is the delight of the small boy to perform startling gymnastic feats. I can remember when it was the pride of my life to be able to say that I had slid head-foremost from the third to the ground floor of the schoolhouse on a well-remembered stair-rail that curved up through the building. I often wonder, as I look back, why my neck was not broken; but I presume the urchin of to-day can perform just such "stunts" and escape unharmed. Undoubtedly he would be very indignant did he know that I wished to take away from him just such rapid-transit descents.

In spite, however, of running the risk of incurring the displeasure of my young friends, I must urge, as forcibly as I can, the wisdom and necessity of abolishing all except box-stairs in buildings where there are large numbers of pupils gathered together. This is a reform that can be easily effected in almost any school building, and I hope that the custodians of our public schools, when their attention is called to this matter, will see that in all new buildings such an arrangement is adopted, and, where it is possible, have the proper alterations made in existing structures.

Isolation is also of importance in the construction of staircases for school purposes; by this I mean that they should be placed outside of the building proper, if possible. If this cannot be done, let them be kept on the outer walls and so arranged that the passing up and down may be heard as little as possible by the occupants of the rooms. Stairs placed as shown in the various buildings illustrated in these pages are arranged as I like to see them. They are easy of access, well lighted, and allow the occupants of the upper floors to enter or leave the building and to pass to and from the playrooms or water-closets without even entering the hall into which the lower rooms open. If five minutes' difference of time is allowed in the dismission of the pupils of the two floors, there need be no confusion between them. By placing the stairways at either end of the halls as shown, the sexes may be also completely separated.

I decidedly object to placing stairways in the centre of a building, or to having them so placed that the pupils will have to pass the door of any other schoolroom in passing to and from their own room. When stairs are placed in the centre of a building this cannot be avoided; they are invariably noisy, and it is very difficult to light them unless wells, rails, and balusters are used. I have already given my reasons for believing these unsuitable, so that it would seem that the only proper place for the location of staircases is on the exterior walls or in wings devoted exclusively to their use.

The arrangement of the stairways in such a manner that all the pupils must enter one hall, common to all floors, is open to some of the objections cited above, and leads me to believe that the following simple rules can with propriety be adopted in the construction of staircases for school buildings:

1st. All staircases should be constructed with two or more runs with square landings.

2d. No staircase should be less than 4 feet 6 inches wide in the clear, and no winders or circular stairs should be used.

3d. No riser should be over 7½ inches, and all treads should be at least 12 inches.

4th. No wells, rails, newels, or balusters should be used; stairs in all cases to be walled or boxed up.

5th. All stairs should be built on the outside walls of the building or in special wings prepared for them, and so placed that pupils occupying the upper floors of the building may enter and leave the structure without disturbing or interfering with the pupils of the lower floors.

There can be no difficulty in meeting all of these requirements in school buildings situated in the country or in the smaller cities. In large cities, where the space is limited, it is not so easy, although I think the problem was successfully solved some years ago in the *Sanitary Engineer's* model schoolhouse competition, and is fully illustrated on Plates 85, 86, 88, and 89.

The illustrations on Plates 65, 66, 67, 68, and 69 show twelve-room buildings with and without an assembly-hall.

FLOORS.

It is hardly probable that enough money can be obtained, unless under some specially favorable circumstances, to construct the main floors of ordinary schoolhouses in a fire-proof manner. I do not know of a building of this class so constructed. While it may not be of the same importance to have the entire building fire-proof as it is to have the stairs, it is still enough so to enlist our attention, especially where the ordinary methods of stair-construction and heating are used. The increased cost is the only argument that can be used against fire-proof construction, and I am bound to admit that this is a serious obstacle against its general introduction. My own preference would be to reduce the exterior effect of the building to the verge of barrenness, in order to obtain funds enough to render the structure fire-proof—not only in the floor, but in all other portions as well.

I should prefer, of all others, a floor constructed with iron beams and the ordinary hollow, fire-proof brick arch turned between them; upon the top of the beams there can be screwed down strips of wood to which the floor may be nailed, the space between being filled flush with the top of the strips with cement.

The floor itself should be of maple, oak, or yellow pine in narrow widths, $1\frac{1}{8}$ inches thick, matched and blind-nailed to the strips before mentioned. Maple is probably the best wood for the purpose, oak coming next, and yellow pine being the poorest and cheapest of the three.

Where iron beams cannot be used the wooden joists may be made comparatively fire-proof by encasing them with hollow, fire-proof tile; if this is done, the size of the beams will have to be increased, as the additional weight of these tiles must be provided for. In this method of construction a double floor should be used; the rough under floor being laid diagonally and nailed directly to the joists, and the upper floor laid "straight" on top of this with a heavy thickness of deadening-felt between. Asbestos felt is the best for this, on account of its fire-proof qualities.

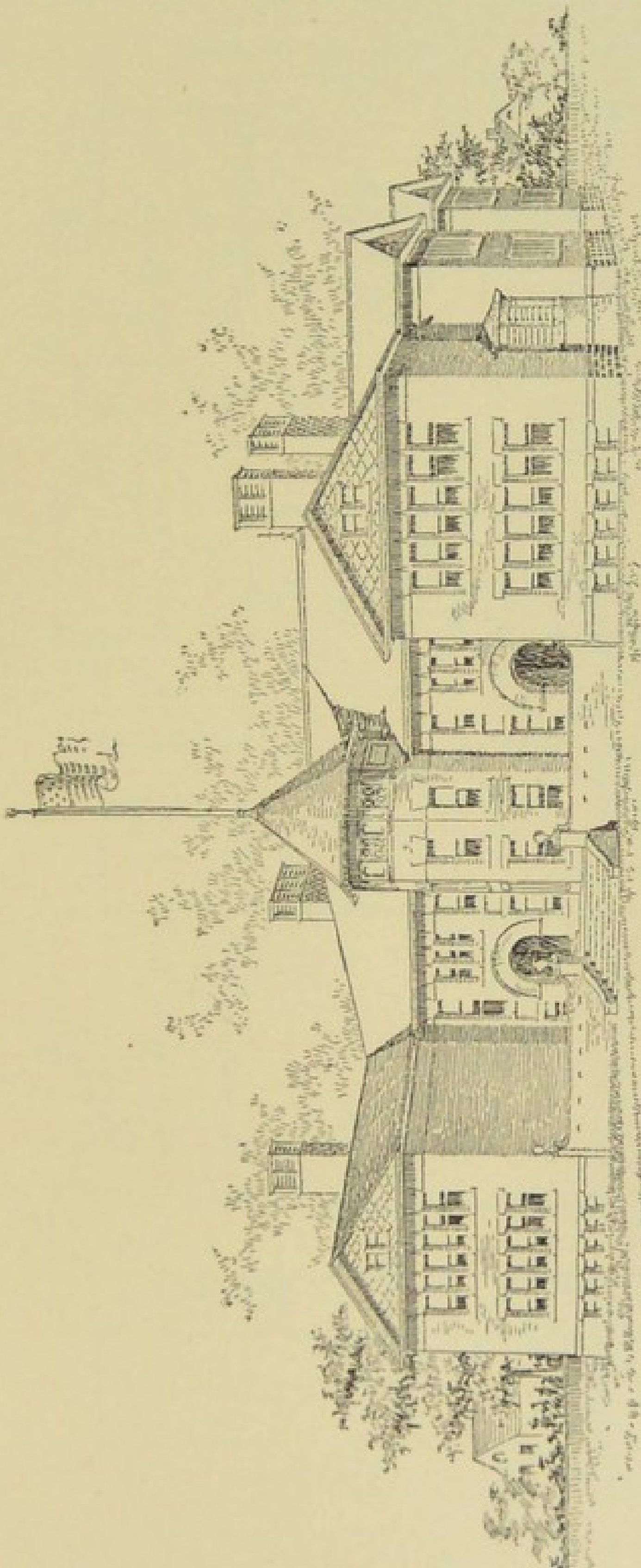
Plaster is commonly used for the ceiling, but I should recommend in place of this perishable material either a wood ceiling of some light-colored hard wood, screwed directly to the iron beams, or a ceiling composed of pure Portland cement applied to the fire-proof flooring-tiles; this makes a most excellent ceiling—hard, non-absorbent, and durable; if the color is found objectionable, it can be painted any light neutral tint. Where wooden joists are used, instead of using wood lath for the ceiling let wire netting or iron lath be employed, and apply the Portland cement directly to this. The open timbered system of the slow-burning construction of floors, used in mills and factories, I am not inclined to favor for schoolrooms; it is most excellent for the purposes mentioned, but hardly suitable for the finished work of a room.

INSIDE WALLS.

In speaking of this subject elsewhere I have urged the use of enamelled bricks for the side walls of schoolrooms, abolishing by this means the use of furring, lath, or plaster. The exterior walls should be built hollow for warmth and dryness. In one or two instances objections have been made to the use of this material on the ground that the rooms would be cold, or that a feeling of chilliness would be produced. Nothing causes me to have the latter sensation more quickly than an unbroken expanse of white, plastered wall, and it seems to me that a pleasing, warm, neutral tint in brick would have the very opposite effect. As to the actual chill produced by the use of this material, it is a well-known fact that whatever the substance contained in a room may be, it takes up the temperature of the room after a certain length of time, so that, in reality, enamelled brick would not make the slightest difference in the temperature of the room when ready for occupancy.

Of course side walls built of these bricks are more expensive, to start with, than those constructed in the ordinary manner; but where their durability is taken into account, and the benefits derived from a sanitary point of view are considered, I believe it safe to say that, in the long-run, it would be economy to introduce them into all our public schoolhouses.

A compromise might be made by introducing these bricks for a dado or wainscot running up under the blackboards and



SIXTEEN ROOM BUILDING
WITH ASSEMBLY HALL

PLATE 70

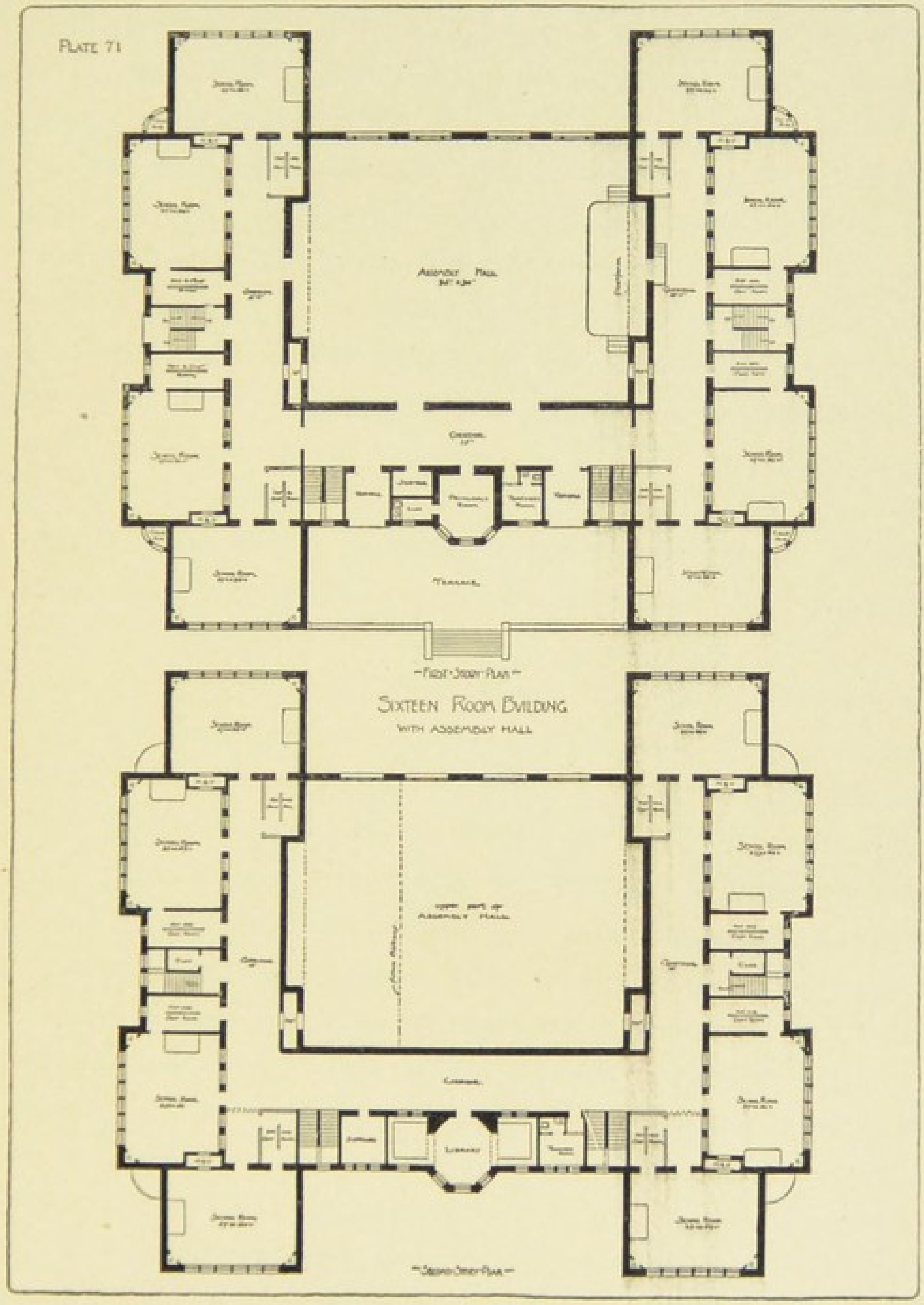


PLATE 71
ASSEMBLY HALL
TERRACE
FIRST STORY PLAN
SIXTEEN ROOM BUILDING
WITH ASSEMBLY HALL
UPPER PART OF
ASSEMBLY HALL
LIBRARY
SECOND STORY PLAN

windows only, above the blackboards using Portland cement applied directly to the brick walls as described for ceilings. This would make a durable and pleasing wall without much, if any, additional expense.

The best blackboards are of slate set in cement directly onto the brick walls. Let them be kept near the floor in the lower rooms, which are usually occupied by the smaller pupils; from 20 to 24 inches from the floor to the top of the chalk-rack is about the right height for these rooms, and from 24 to 30 inches for other rooms. There are numerous compositions in the market for blackboards, but I have never seen one that is perfectly satisfactory; their first cost, combined with the expenditure necessary to keep them in order, renders them, in a very short time, more expensive than those of slate.

As to the general inside finish of schoolhouses, almost any hard wood may be used. Oak, ash, maple, cherry, black birch, and even yellow pine, are all available and pleasing in effect. White pine and whitewood are too soft and easily marred for the rough usage of school life. Whatever wood is used, it should be finished in what is known as the "natural wood"—that is, it is first treated with a heavy coat of some good filler, then varnished with two coats, each coat well rubbed down. This makes a finish not easily defaced, pleasing to the eye, and non-absorbent. Let the details of the woodwork be simple; the fewer quirks and mouldings to catch dust and dirt the better.

If a brick wainscot is not used, vertical matched and beaded sheathing of the same wood as the casings and doors will be found the best. This need not be more than half an inch thick, as it is placed directly on the walls.

By all means arrange transoms over the doors; and where possible let there be inside sash in the walls, between halls and rooms, as shown on the majority of the plans presented with this book. This will insure, by opening the outside windows, a free circulation of air through the rooms and halls in warm weather, and a complete flushing of the rooms at any time it may be required. These windows also give plenty of light in the long halls and hat-and-cloak-rooms; being placed above the blackboards in the schoolrooms, they are above the hooks in the halls and so do not interfere with anything. It is well to have them swing, operating them from the floor, and by the use of some patent transom-fixture they can be opened to any desired point and there locked.

The outer windows of schoolrooms must be screened in some way, especially if we obtain the requisite amount of sunlight. Exterior blinds are unsuitable, and the ordinary inside blinds or the shades in common use are open to many objections; the blinds are noisy and in the way unless they are arranged to shut into pockets, which materially increases the cost of construction. The ordinary shade is eternally out of order and cannot be used with comfort on open windows where there is any circulation of air.

All things considered, the best device known to me at the present time is the "Wilson Rolling Blind"; this is noiseless in operation, cannot blow or flap, and rolls up out of the way when not in use. While thoroughly screening the occupants of the room from the rays of the sun, it still permits of a free circulation of air. If these blinds are to be used, it is better to make special provision for their reception in the early stages of construction, although they can be applied to almost any window by the introduction of a small box cornice over each window into which the blinds will roll or coil up.

One other thing I would recommend for all schoolrooms, and that is a neat picture-moulding placed at a suitable height. This will save the walls from being marred by driving nails or hooks for hanging maps or charts. In case the walls are painted, the space above the picture-moulding may be of a different hue, which will give a good frieze effect without additional expense.

As to the exterior, it seems to me that a school building should show some idea of architectural proportion and symmetry; because a structure is designed for simple and homely purposes it does not follow that it must be surpassingly ugly; yet how few of the village schools that dot the pleasant landscape of our country are pleasing to look upon? It is true that they have the simplest of lines and are usually built of the homeliest materials; but even with these drawbacks, well-studied lines and carefully proportioned masses combined with the plainest materials may in skilful hands make a village school building a thing of beauty. It is not necessary in New England and many other sections of the country to go further than the village field to find, in abundance, excellent material for building; for can anything be more beautiful to the eye, or more durable for the walls of a schoolhouse, than the soft, warm gray of our field and ledge stone? Let this be skilfully laid, and what can be more pleasing and lasting? It is a constant source of wonderment to me that, with such a bountiful supply of material at our very doors, so little use has been made of it. An improvement has been made in this direction within a few years; wood is gradually being supplanted by stone and brick for exterior suburban architecture;

the quicker wood can be entirely banished and it is understood how beautiful artistic combinations of stone and brick can be made, the sooner the most potent charm of the English landscape will be ours.

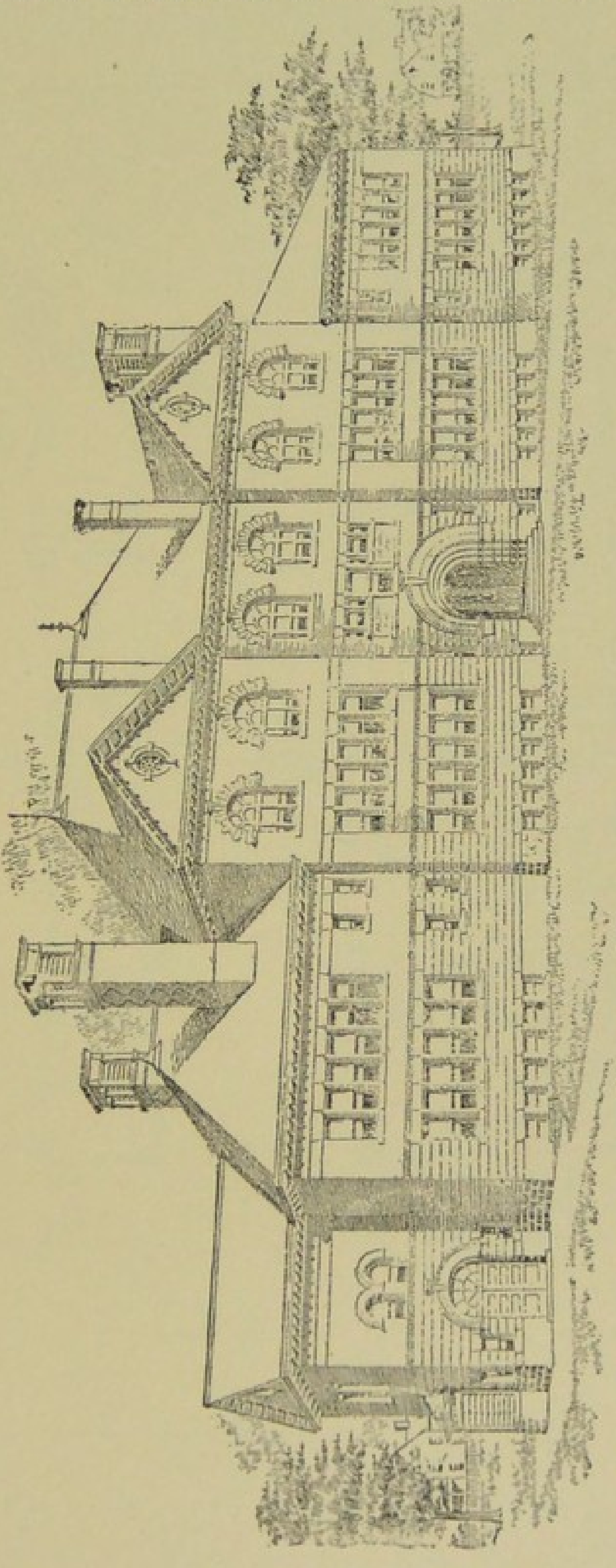
On Plates 70, 71, 72, 73, and 74 are shown sixteen- and seventeen-room buildings.

HEATING AND VENTILATION.

The real utility and success of a school building for practical every-day use may be summarized under this heading. A building may have a beautiful exterior, the plan may be above criticism, the material of the best, and the workmanship unexceptional, but from a hygienic point of view it will be a complete failure if the system of heating and ventilating is faulty.

When I speak of properly heating a building I do not for a moment mean merely the ability to maintain a given temperature, say of 70°, even in the coldest weather; nor when "ventilation" is mentioned is it only with the idea of introducing three or four 8 × 12 outlet-flues in each room, through which the foul air is *supposed* to be obliging enough to flow.

Any firm that makes a business of putting in either steam or hot-air apparatus will present with their bid for the work a written guarantee that their apparatus will heat the building in every part to 70° in the coldest weather, and they will assert, furthermore, that their boiler or furnace is the only one that will do the work in a satisfactory manner without an enormous consumption of coal. It is the same way with radiators. Each manufacturer will claim that his will generate more heat for the amount of surface used than any



SEVENTEEN ROOM BUILDING
WITH HALL

PLATE 72.

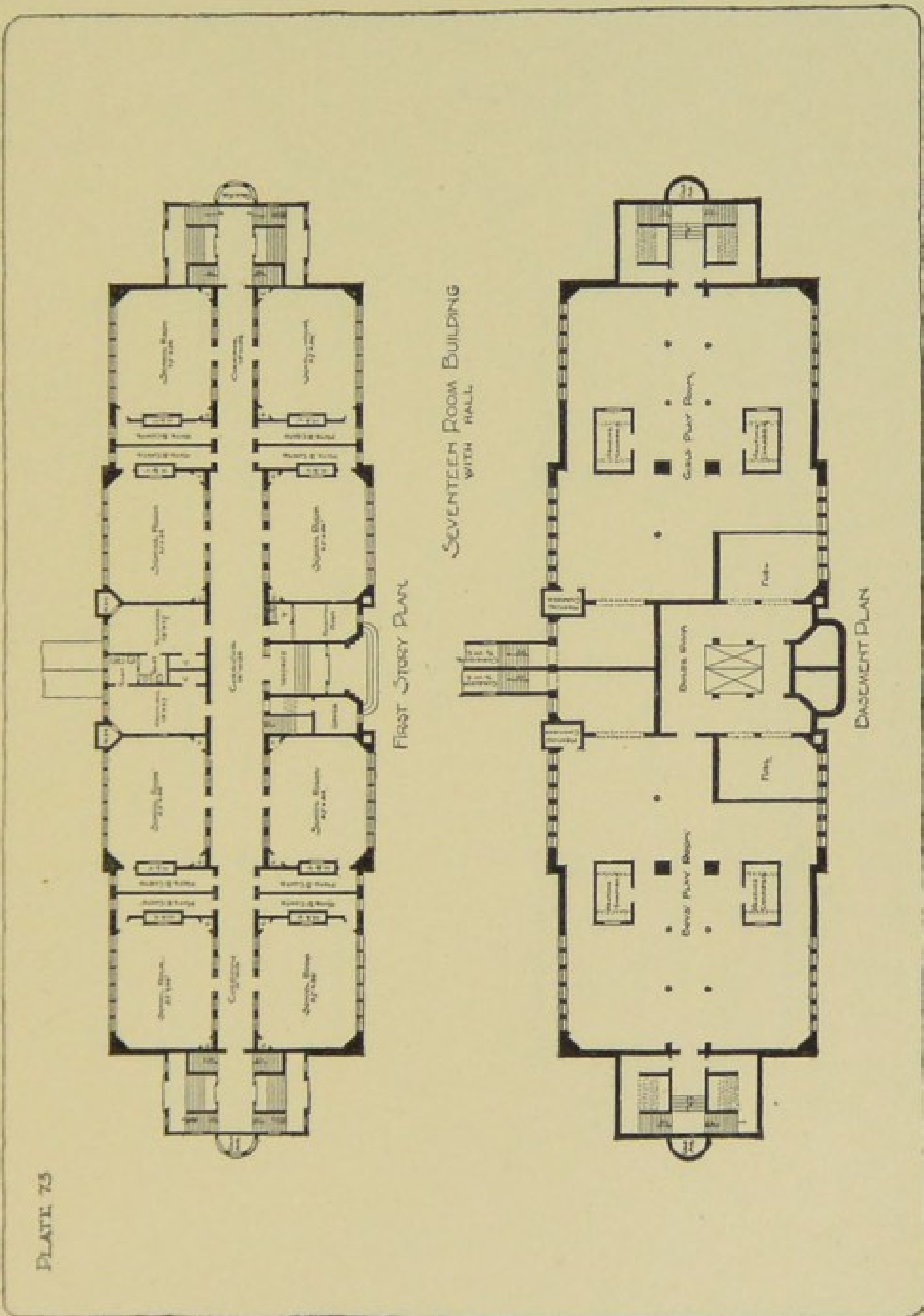
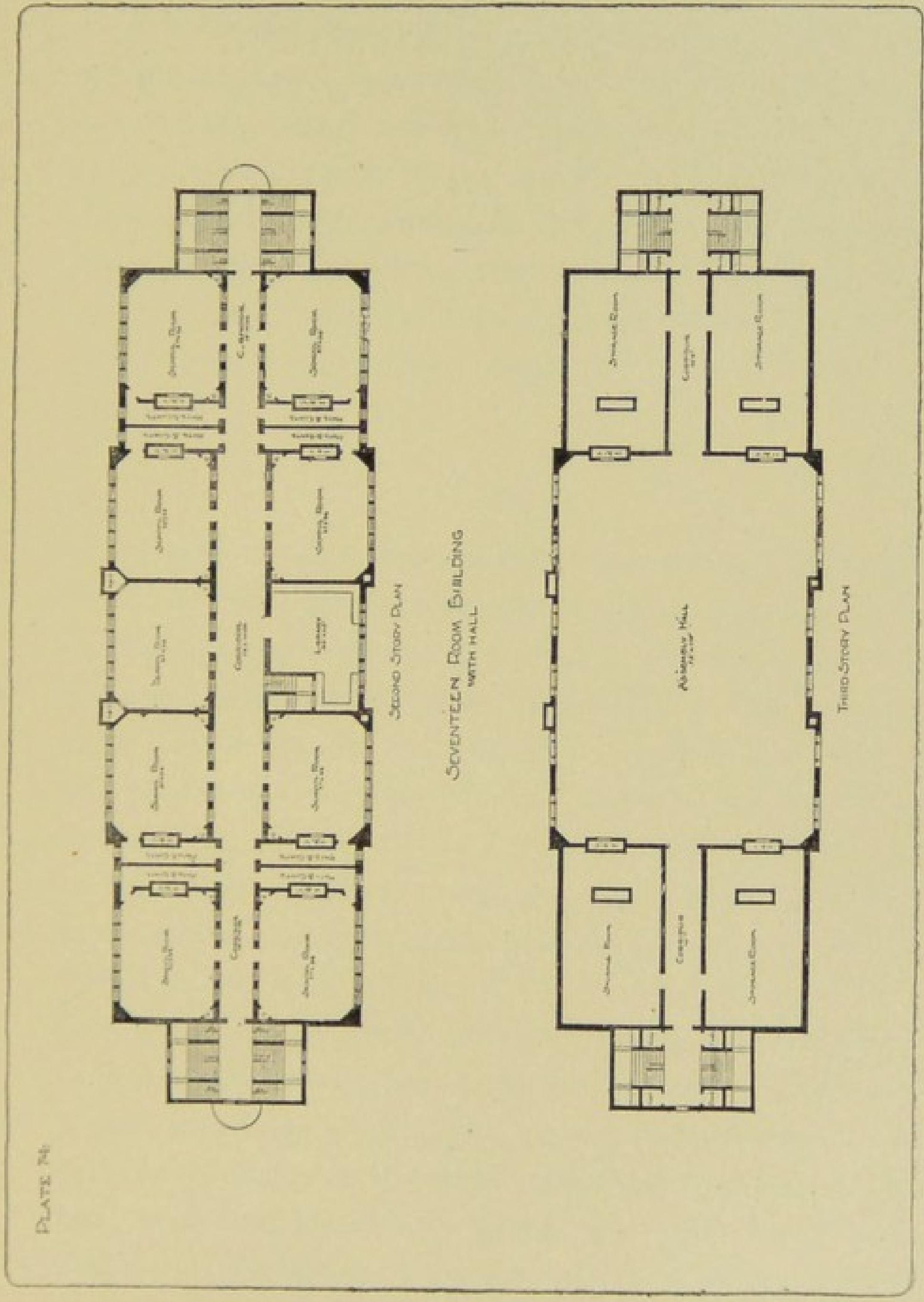

Seventeen Room Building
with Hall
First Story Plan
Basement Plan
Girls' Play Room
Boys' Play Room
Boiler Room
Fuel
Fuel

PLATE 73


SEVENTEEN ROOM BUILDING
WITH HALL
SECOND STORY PLAN
THIRD STORY PLAN
ASSEMBLY HALL

other, on account of some peculiar shape or internal arrangement. He will show you elaborately compiled tables depicting the results of exhaustive tests, in which it is always *his* radiator that heads the list. These tables are all so nearly alike, although presented by parties between whom I know there could be no possible collusion, that I sometimes wonder if some enterprising printer has not set up the results of tests made at some time, and, as occasion demands, obligingly prints the headings required at the top of each column for his customers.

BOILERS.

In point of fact, the market is overstocked with boilers. They are of all patterns, shapes, and sizes, and ingenious inventors are constantly devising new forms which they fondly hope will drive out all competitors. There may be merit in these patent boilers, more, perhaps, than I have ever been able to discover, but my own experience with them teaches me that the plain horizontal tubular boiler is far preferable to any other. I advocate no special make of these boilers, as there are a score of good firms in the country who make first-class boilers of this kind. I believe that these horizontal tubular boilers are better than any patent boilers, that they are more reliable, will do their work better, are less liable to get out of order, will last longer, and will burn no more coal for the amount of steam generated than any other. I have never yet found an engineer who would say that there was any better boiler for the generation of steam, and steam is what we want and must have if we would properly heat a building. The patent-boiler man will tell you that he can get up steam quicker with his boiler. This is doubtless true, but he will lose it quicker also. If his boiler is sensitive, it is as susceptible to cold as to heat, and I know of no special advantage in the ability of a boiler to get up steam in a very short time, unless it be in the case of a fire-engine. If a manufacturer desires to run a factory full of machinery, he will use the boiler out of which he can get the most work; in ninety cases out of every hundred you will find it to be the horizontal tubular, and this is why I advocate so strongly its use.

It is well to put in a larger boiler than is actually required. In other words, it is cheaper to use a boiler at two thirds of its capacity than to force it continually to its utmost limit. The wear and tear of the boiler will be reduced and better general results obtained. I should recommend the boiler to be at least one third larger than the actual requirements. In setting the boiler great care should be used to get it low enough to allow of a rapid return or drip from all coils or radiators. If the cellar is not deep enough to do this properly, set the boiler in a pit two or more steps below the level of the cellar-bottom. A boiler should be so set that there will be plenty of room to fire it in front and a chance to get at it on all sides for cleaning and repairs. Where two boilers are used, they should be so connected that either or both may be used at pleasure.

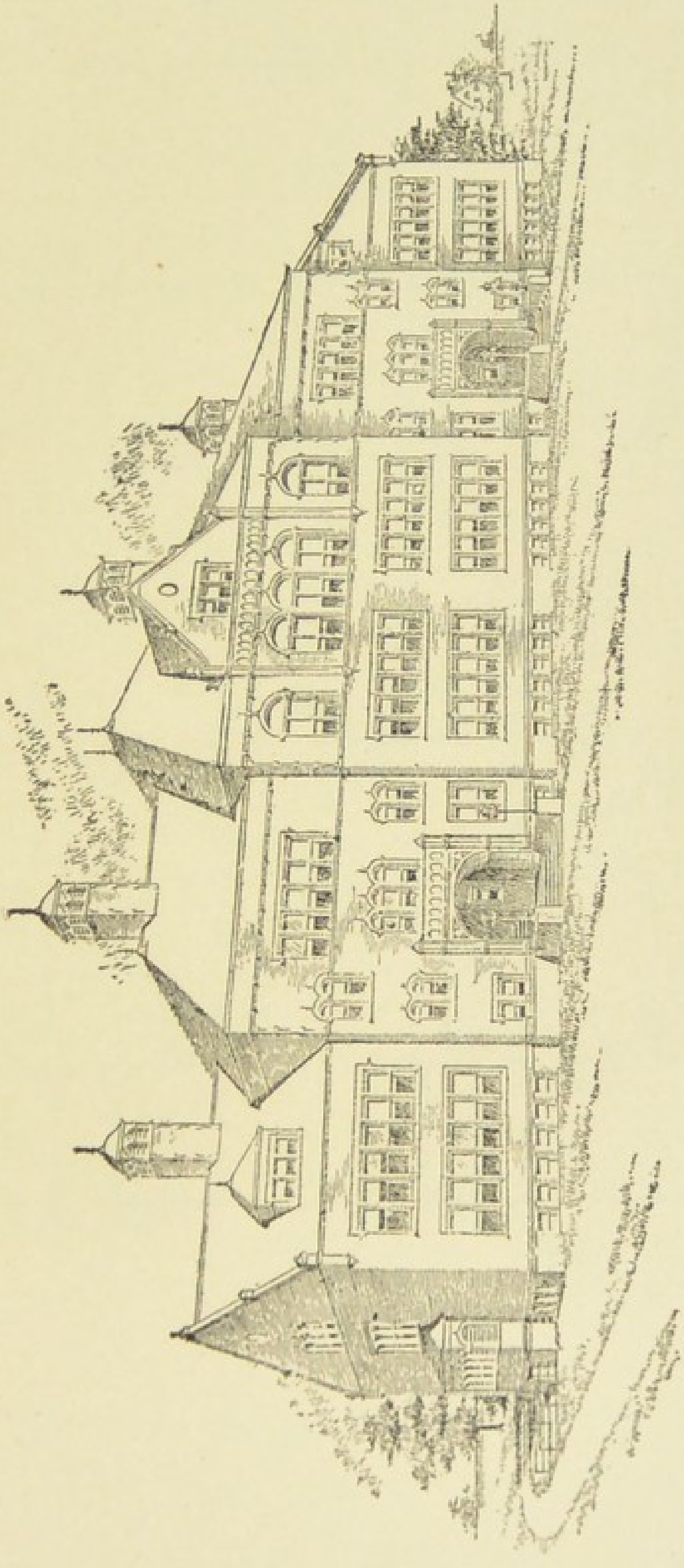
RADIATORS.

It is with radiators as with boilers; there are so many patterns and styles, each claiming to be better than the other, that one is bewildered. In direct heating, by which I mean the placing of the radiators in the rooms to be heated, any first-class cast-iron radiator will do the work satisfactorily, provided it is supplied with plenty of steam. There is little or no difference in the amount of heat that radiators of the same size, fed by the same size pipes, will throw off. Take, for instance, the Bundy, Nason, Gold, or Reedy patents, and I have no choice between them; all are good, and there are many others equally so. In indirect heating, which is the placing of all the heating-surface in stacks in the cellar, the case is different; although all the firms mentioned above make what is known as an indirect radiator. I believe that the best thing to use for this system is the ordinary box-coil, consisting simply of stacks of one-, two-, or three-inch pipes provided with suitable return-headers, and, where more than one tier is used, have them set "staggering." My reason for preferring the box-coils to all others is not their ability to obtain any more heat for the amount of surface used, nor will they heat any better or any quicker. Their superiority consists merely in the fact that the *pipes are further apart and more air can be brought through them.* This is of vital importance in the indirect system of heating. All indirect radiators that I have used or seen, with the exception of the box-coils, are built too closely, and repeated tests have proved that, while the air brought through them is abundantly heated, it cannot be had in sufficient quantities. If the manufacturers would spread the pipes more, so as not to retard the flow of air, I know of no superiority that the box-coils would possess.

HOT-AIR FURNACES.

With one exception I have never seen a hot-air furnace of any description that I considered suitable for school purposes. There are many of them, in fact those of any first-class make, are abundantly able to *heat* a school building, but when you come to the problem of bringing into a room a large amount of fresh, pure, warmed air—say from 20 to 30 cubic feet of air per pupil each minute—*they will not do it.* Yet this is what the highest authorities tell us should be provided. As I said in the beginning of this article, almost any firm will guarantee to heat a building to 70° in zero weather, but where will you find one that will pledge itself to maintain a steady flow into the room of pure, warmed air in sufficient quantities to give each pupil 20 cubic feet per minute? The trouble with these furnaces is that the cold-air feed is not sufficient; and even if it were, their construction is such that the amount required could not be properly heated, and then, too, a flow to any one room cannot be assured on account of the tendency of one room to rob another under certain conditions.

What is needed is a hot-air furnace of large capacity, so constructed that an abundant supply of cold air can be brought into it and properly warmed. The inside of the furnace should be so constructed that the heat generated for any one room should be ample for that room and be completely isolated or cut off from all others; in other words, the cold air should be brought into the furnace, properly heated, and then carried to the room as independently as if only one room were to be heated. I know of such a furnace, a few of which have been made and are now in successful operation. I had hoped to be able to fully describe and illustrate it in this series of articles, but, unfortunately, I have been unable to procure from the patentee suitable drawings or models from which to prepare my cuts.



TWENTY FOUR ROOM BUILDING.
WITH HALL.

PLATE 73.

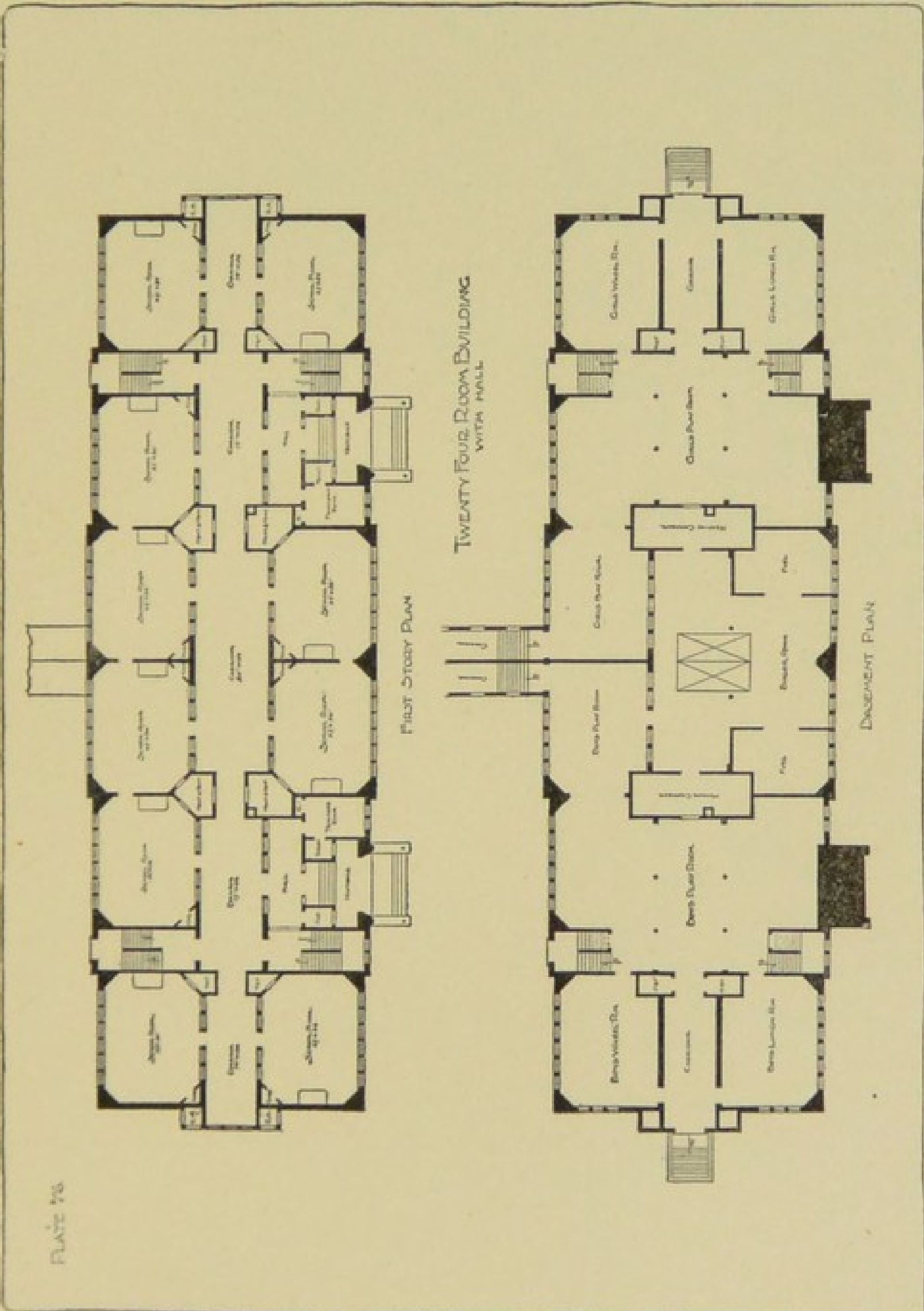
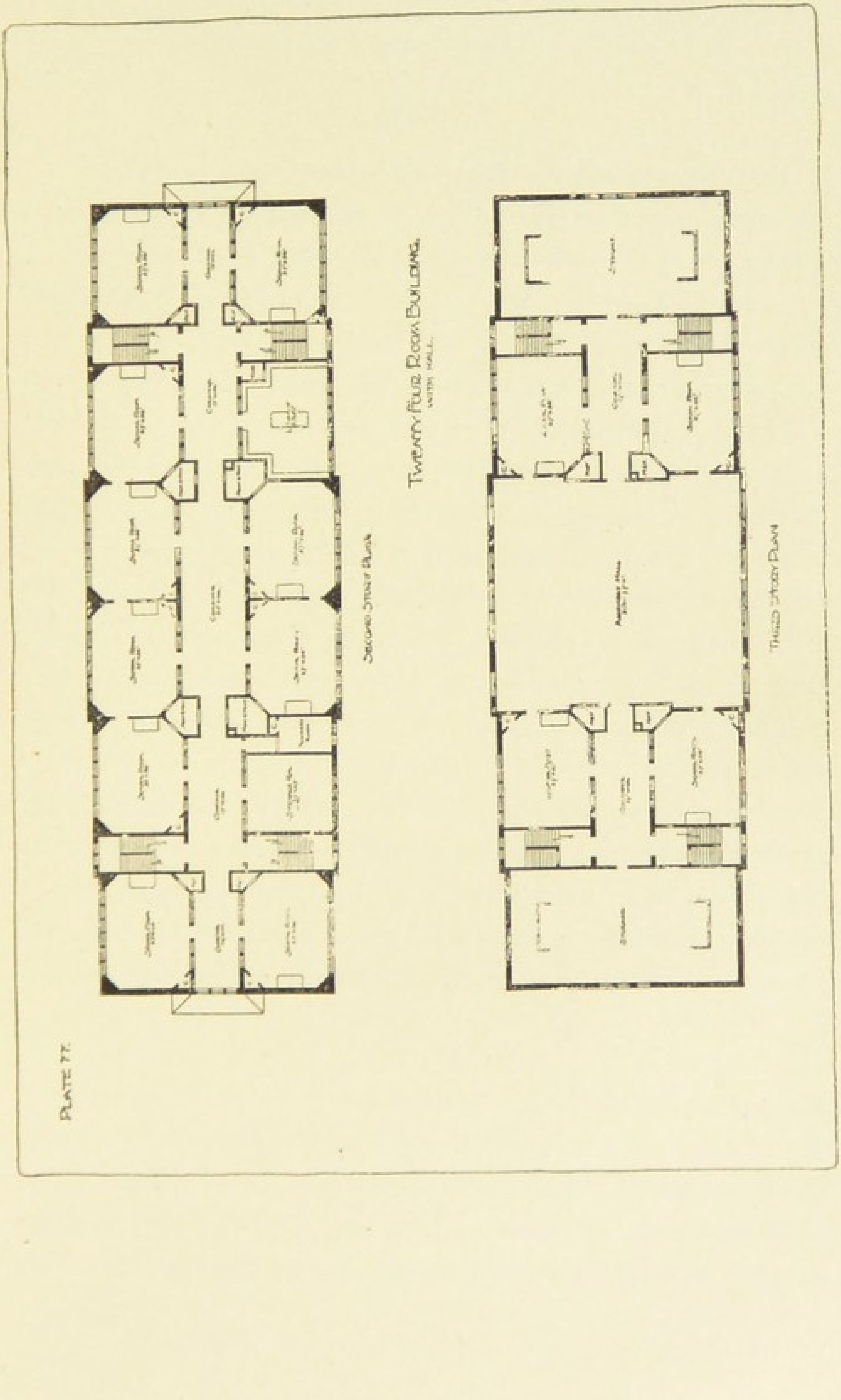


PLATE 78
TWENTY FOUR ROOM BUILDING
WITH HALL
FIRST STORY PLAN
BASEMENT PLAN


Twenty Four Room Building
with Hall
Second Story Plan
Third Story Plan
Plate 77.

The illustrations on Plates 75, 76, and 77 show a twenty-four-room building with assembly-hall.

STOVES.

Except in the smaller one-room buildings, situated in outlying districts, the use of stoves will hardly be required. In case they should be used, the best way to insure a good supply of fresh, pure air, properly heated, will be to build a cold-air box extending from the outside of the building to beneath where the stove will stand and there cut a hole through the floor. In this cold-air box a suitable damper should be arranged so as to regulate the flow of air. The stove itself should be enclosed with a galvanized-iron jacket or drum, fitted tightly to the floor and extending to a height of about 6 feet; there should be a space of about 6 inches between the stove and the jacket all around, and doors arranged in it through which the stove-doors may be operated for feeding, adjusting the dampers, removing ashes, etc. This is the best device I know of for obtaining, by simple means, a fair quantity of pure, warmed air when the ordinary stove is used, and if a proper outlet for foul air is provided the air of the whole room will be kept in a reasonable state of purity. Almost any stove may be used, although I think it is better to have as simple a one as possible.

STEAM-HEATING.

Two methods of steam-heating are in ordinary use—the direct and the indirect; of these, the latter is far superior, in fact I think it is the only method that should be employed in using steam. I object decidedly to heating a school building by the direct method. In placing the radiators or coils of pipe around the sides of the room, as is the ordinary custom, the children who occupy the outside seats are subjected to an undue amount of heat, and if cold air is brought in through the outer walls by small openings and registers that feed directly on to the radiators, the same children are exposed to unpleasant and dangerous drafts of imperfectly warmed air; at times the flow of air through these openings is rapid, again it is slow, and there is no way by which the supply of air introduced can be regulated; with a high wind blowing directly on to these inlets it is plain that the supply of air would be infinitely larger than on a still day, and would come with force enough to be driven directly through the heating-surfaces without being properly warmed. It is true that the registers might be partially closed and the supply regulated in that way, but when this is done the amount of air introduced is far below the required quantity, and I doubt if any arrangement of this kind, working under the most favorable conditions, can be made to bring into a schoolroom 20 to 30 cubic feet of air per minute for each pupil. Another serious objection I have to this system is the number of openings through the walls and the number of registers required; this is sure to result in some being neglected; a multiplicity of drafts and currents is produced, and if the outlet is one common flue (as it should be), air entering from so many different quarters near the floor-level is inclined to take the most direct route to the outlet without doing the work that we expect of it. Again, with inlets and registers placed on the outer walls, if the steam is not kept up constantly, or the register carefully closed on cold nights, you will be troubled with frozen pipes or radiators. I know of one school building in my own city where so much trouble was experienced from this cause that the inlet-flues were finally stopped up as the cnly remedy.

Frequently schoolrooms are heated by direct steam and no provisions are made for the introduction of pure or the removal of foul air. It is little wonder that, under these conditions, serious objections are often made to the introduction of steam into school buildings. Under such a system there can be no doubt that a room can be heated, but who could live, much less work, for any length of time in the stifling atmosphere that will be produced, without being unpleasantly, if not seriously, affected by it? Sometimes a fair amount of space is allowed for the foul air to escape, but no provision is made for pure air to enter; in this case the outlet-flue will not work properly, nor will there be a free circulation of air in the room, for if we expect to remove the air as soon as it becomes vitiated we must constantly supply an abundance of pure air to take its place. There are several ways of introducing steam into rooms by the indirect method, or perhaps I might more properly say that there are many places for its introduction. Some claim that there should be several inlets placed in the outer walls near the floor, so that the incoming air as it rises shall counteract the cold air which penetrates the walls and comes in around the windows. Others claim that the inlet-flues should be carried up near the ceiling on the outer walls. Still others (and the majority, I think) say that the inlets should be on the inner walls near the floor. Many advocate placing them on the inner walls near the ceiling, and there is one firm, I believe, which introduces the air all around the room at regular intervals at the floor-level.

It is the same with the outlet-flues: you will find them in every possible position; and if you ask why they are placed as they are, you will almost always find some one who has a good reason (so he thinks) for placing them in that particular position. I have been more than astonished to find the number of so-called "experts" in the heating of school buildings scattered through the country, unknown men, of course, but nevertheless so impressed by their own importance and so convinced that they have grasped and digested in one supreme mental effort, without any practical investigation or study, all that there is to know about the heating and ventilation of buildings, that it is as useless to attempt to reason with them as it would be to expect the Egyptian Sphinx to answer questions. The utterances of these stupid oracles of school boards and committees cause more trouble and inconvenience and do more to prevent the introduction of good systems than any other one thing that I know of. They hamper and disgust men of sound sense and judgment, who, rather than enter into any controversy, let them have their way to the detriment of the building and the discomfort of its occupants. I have found such cases as this repeatedly, and I believe all others in my profession are troubled in the same way.

But to return to the introduction of air into schoolrooms. There are several objections to the placing of inlet-flues either near the floor or high up on the outer walls. In the first place, the outer walls are cold, and hot-air flues running on or near them lose much of their effectiveness by the loss of heat caused by this chilling influence before the heat reaches the rooms. In the second place, the heating-coils or stacks should be placed in the cellar, as nearly under the flues as possible, to get the best results from them. In large school

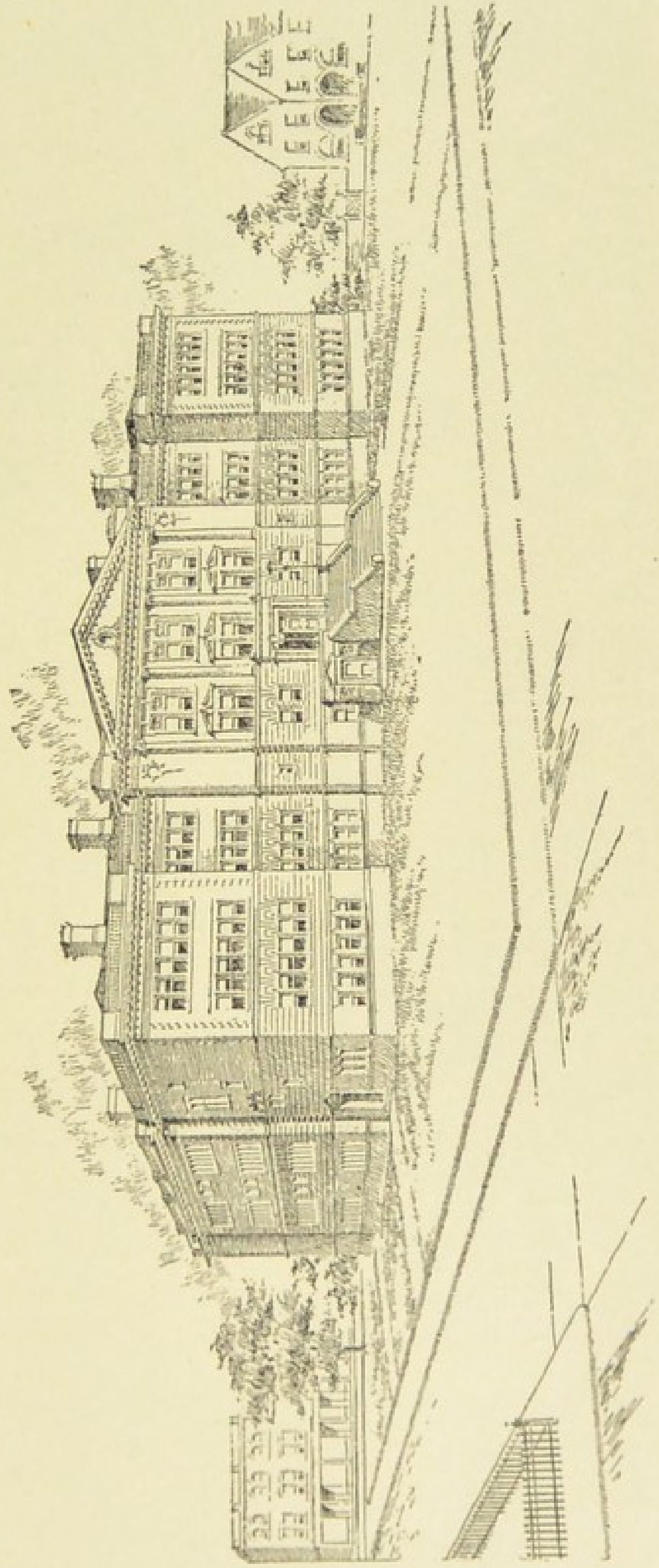
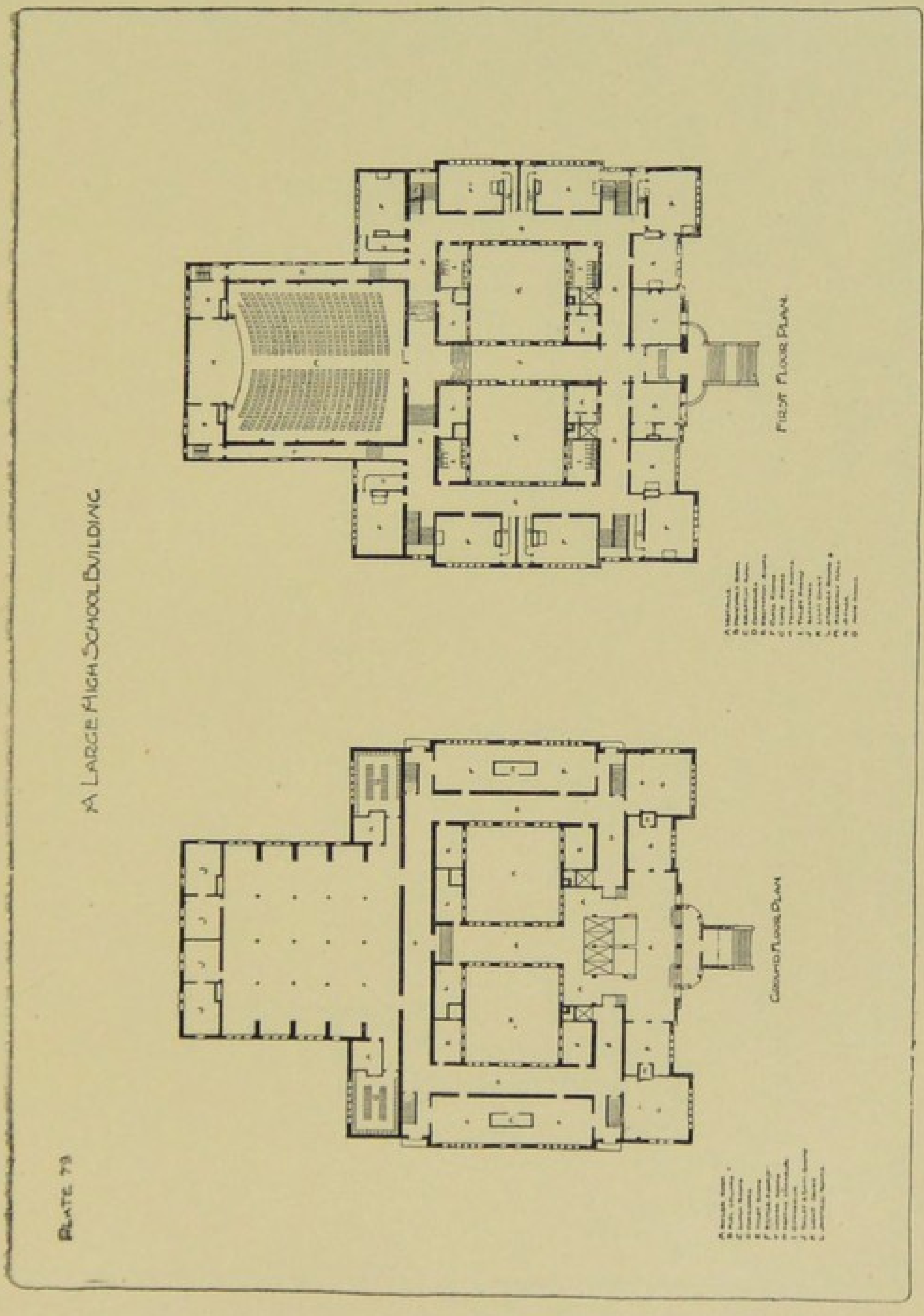
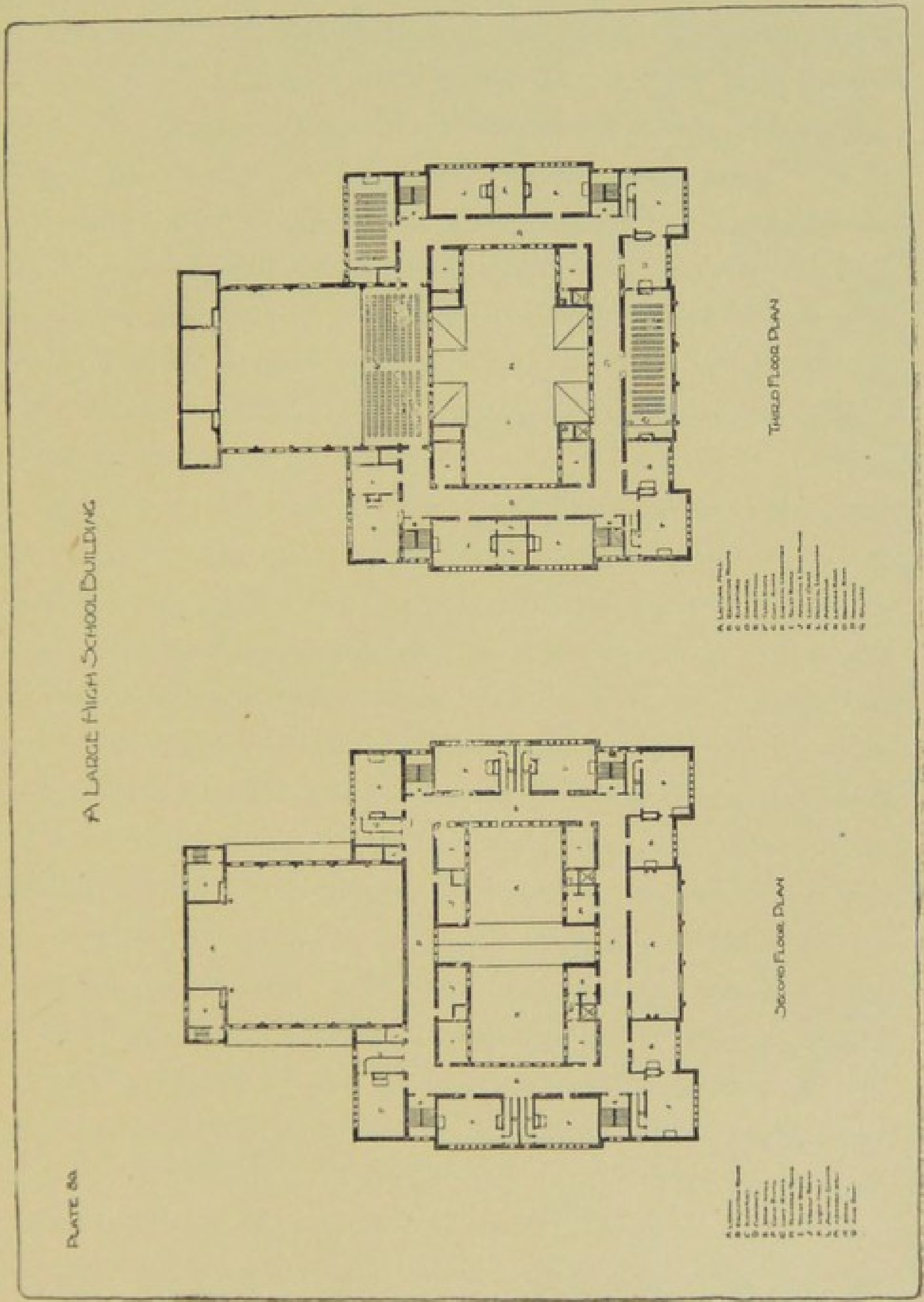


PLATE 78.

A LARGE HIGH SCHOOL BUILDING.


A LARGE HIGH SCHOOL BUILDING
FIRST FLOOR PLAN
GROUND FLOOR PLAN
PLATE 79


A Large High School Building
Third Floor Plan
Second Floor Plan
Plate 8a

buildings these stacks will oftentimes be far away from the boilers, which will necessitate long runs of horizontal feed- and return-pipes, and unless the cellar is very deep or the boiler set very low there will be trouble with the circulation. Then, too, the stacks being scattered, much more time is consumed in their care than if they were concentrated—in fact, they will not be as well cared for. Lastly, a large additional amount of pipe will have to be used and a much more elaborate system of cold-air supply-ducts provided than if the heating-surface were grouped as nearly as possible in the centre of the building.

By placing the incoming flues on the inner walls the chilling effect of the cold outer walls is done away with and usually much shorter runs of pipe are obtainable. As to the actual heating capabilities of the flues, much better results are obtained from those placed on inner walls. Some will argue that a flue so placed will not heat that part of the room nearest to the outer walls, but my experience has been that that part of the room is usually the warmest. I prefer, above all places, the inner corner of the room for my inlet-flues, and it is always my endeavor to group, as much as possible, the entire heating system in or near the centre of the building; of course this is not always practicable, but in most buildings it is only a matter of careful study and skilful planning. In the ordinary eight-, twelve-, sixteen-, or eighteen-room building no difficulty whatever will be encountered if plans similar to those shown in this work are adopted. I have obtained most satisfactory results from buildings so constructed, and I believe that there are no better heated and ventilated school buildings in this country than those to which I refer. If Plate 83 (which is an enlarged drawing of the heating-chambers which I have generally used) is carefully examined it will be seen that the entire heating-surface, for all rooms and halls, is grouped in the centre of the building in close proximity to the boiler-room. The heating-surface for each room is enclosed in a separate metal jacket, completely enveloping it; from the top of this jacket a large pipe extends directly to the room to be heated; this pipe has no connection with any other, so there can be no waste of heat nor any appropriation of heat that should belong to another room. The heating-chambers being placed so near the boilers, there are no long runs of pipe, and the janitor has the whole heating system constantly under his eye.

As to the position of the inlet-registers, my preference is to place them about 8 feet from the floor to the bottom of the inlet in rooms having 13-foot ceilings; this height should be increased in the same proportion that the height of the rooms is increased. My reasons for putting the registers in this position rather than at the floor-level are as follows:

1st. We know that warmed, pure air entering the room at any point below the ceiling-level will, if it is warmer than the air in the room (as it must be to raise or maintain a given temperature), rise rapidly to the ceiling. Such being the case, it seems to me wise to get the warmed, pure air to the ceiling-level as soon as possible without letting it gather impurities, by passing through the strata of foul air near the base of the room, as it is bound to do when it is brought in at or near the floor-level.

2d. I believe in placing the bottom of the register about 8 feet from the floor rather than near to the ceiling, for by this means I am able to maintain the velocity the air has gained in its ascension from the heating-chamber (Sketch 1,

Plate 83) without retarding its flow by concussion, as would be the case if it were brought in at the ceiling-level (Sketch 3, Plate 83). The air should enter the rooms from the heating chambers rapidly and encounter as few obstacles as possible in its course.

3d. I believe that air entering a room, at the point named, with an enlarged or fan-shaped flue at its discharge-point, has a tendency to spread out and flow rapidly across the upper part of the room until it reaches the outer cooler walls, where it descends, stratifying as it falls, and flowing back across the room until the outlets are reached.

4th. I believe that in no other way are as good results obtained as in the clipped-corner rooms shown in the majority of the plans of this work, with the position of the registers as above described.

Let all inlet-pipes be large. From 2 feet 6 inches to 3 feet in diameter is none too much for a room which is to accommodate fifty pupils; have these pipes flare at their outlet at least one third larger, for, if a register-plate is to be used, even with this increase of size we shall not be able to get the full capacity of the pipe through the register-opening. I shonld prefer to use no register-plates, but objection is usually made to their omission on account of looks.

On no condition should there be fans or dampers in the inlet-pipes; they are not of the slightest use, in fact are detrimental to the proper working of the apparatus. It will probably be asked how the heat is to be regulated. Certainly not in the common way, by shutting off our supply of pure, warmed air; this we must always keep if we wish to maintain a healthy atmosphere and a sufficient amount of air for the use of the pupils. Instead of diminishing the amount of air, which is fatal to a really good system, let the entering air be properly tempered before it enters the room, but at all hazards maintain the supply.

By referring to Sketch 1, Plate 83, which is a vertical section through one of the heating-stacks and jacket shown on the plan, it will be seen how this can be easily acccomplished by the teacher without leaving the room: *AAA* is the heating-surface enclosed in the metal jacket *B*. *C* is the main inlet-pipe extending from the jacket to the inlet *D* in the room. *E* is the cold-air duct extending under the jacket; *F* is the damper in each stack, controlled by the janitor, and regulating the supply of air fed to each; *G* is a mixing- or tempering-pipe arranged with a damper *H*, controlled, by means of cords and pulleys in each room, by the teacher. It is obvious that if the temperature in the schoolroom becomes too high, the teacher must open the damper *H*, which will cause a part of the cold air to flow from the duct *E*, through the pipe *G*, around the heating-surface *AAA*, to the main pipe *C*, where it will be mixed with the warmed air coming through the heating-surface *AAA*, thus tempering it without lessening the supply. The degree to which the air in pipe *C* is tempered depends wholly upon the amount of cold air permitted to enter through pipe *G* by the damper *H*. This is really a very simple contrivance, although from the explanation it may seem complicated; by its use the same quantity of air admitted to the room is always maintained and there is no shutting off or turning on of steam. The janitor has only to keep a steady fire and the steam up, and turn on the requisite amount of heating-surface. The teacher, by the use of one damper, controls, at all times, the temperature of the room. I have just said that the janitor should turn on the

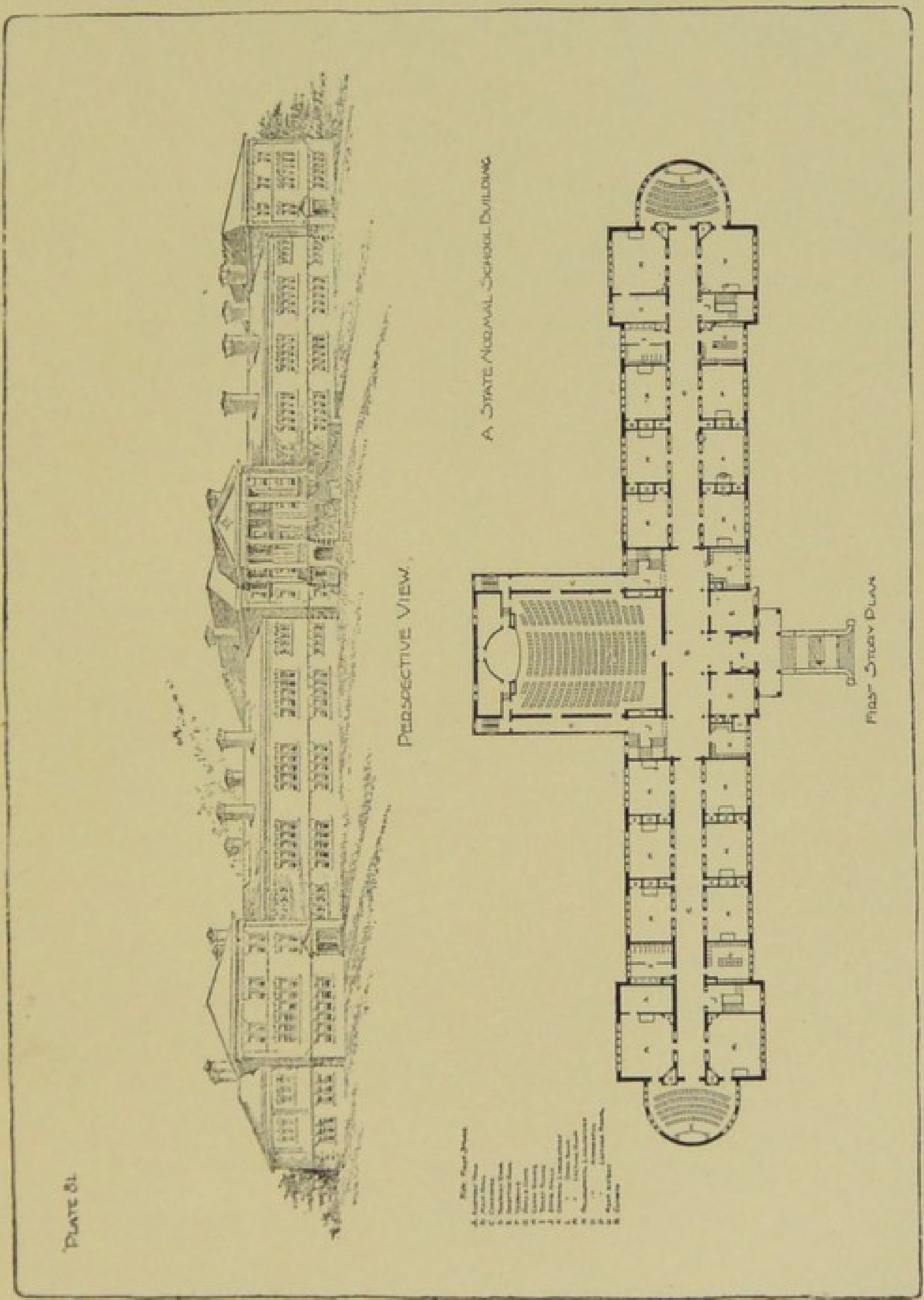
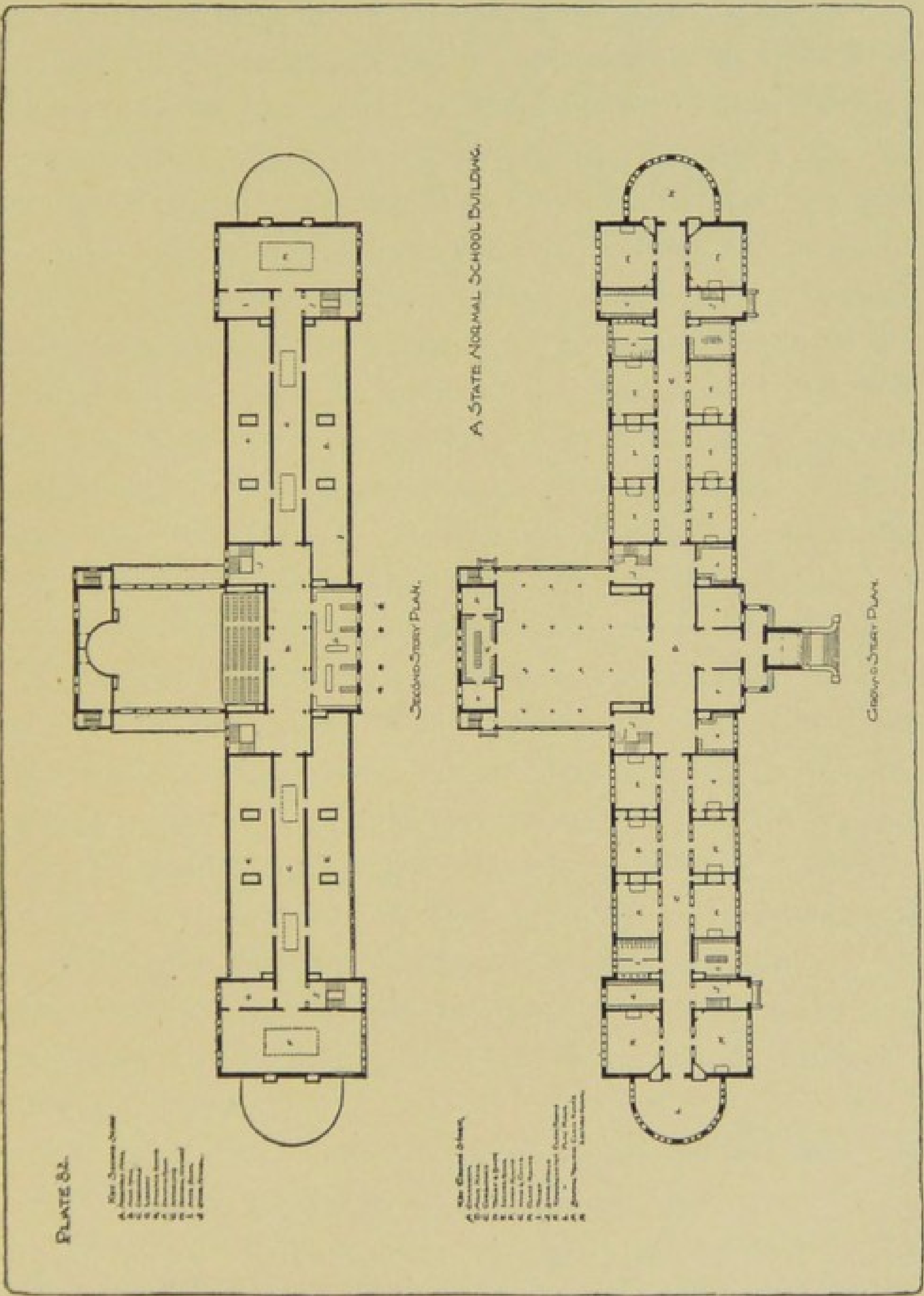


Plate 81
Perspective View.
A State Normal School Building
First Story Plan


A STATE NORMAL SCHOOL BUILDING.
SECOND STORY PLAN.
GROUND STORY PLAN.
PLATE 82.

requisite amount of heating-surface; it will be noticed that in the jacket there are three sections or coils of pipe marked *AAA*; these three independent sections constitute the heating-surface for one room, and the heating-surface for each room in the building is subdivided in the same way; the object of this arrangement is to grade by the use of several sections the amount of heat required by the outer temperature. For example, in the cool days of late spring or early fall one section only would be used; as the cold increases two would be in use, and in extreme winter weather all are used. By this means there is not only a great saving of fuel and steam, but in this variable climate advantage may be taken of the sudden changes. In all cases it must be understood that the flow of air through these sections is the same, but the degree to which it is heated is increased or diminished by the number of sections used. Let me say here that I do not believe in overheating or burning the air introduced into schoolrooms, for by so doing we absolutely destroy its life-giving qualities; I prefer to have a large amount of heating-surface, and the air introduced moderately heated. Let the volume of air brought in contact with the heating-surface be such that the required temperature may be maintained. For this reason I advocate large boilers, pipes of ample size, and an amount of heating-surface largely in excess of what is usually figured.

Outlets should never be placed on the outside walls; let them be built on the inside walls as near the centre of the building as possible, and allow a large space for them. The most serious fault I find in the majority of schoolrooms is the meagre facilities provided for the removal of foul air; sufficient heating-surface is often found and frequently large inlet-flues, but usually, I may say invariably, the outlet-flues are far too small. It is absurd to think that quantities of pure, warmed air can successfully be brought into a room unless abundant provision is made for its rapid removal as it becomes foul. It must be remembered that not only have we to provide for the removal of all the air that we may bring in through the heating-apparatus, but for a vast amount that works its way in around the doors and windows, and even through the walls; the amount so introduced will equal, if not exceed, that which may be brought in by the apparatus. Competent authorities estimate that when a room is closed in the ordinary manner, two and one half times as much foul air will escape from the room, if proper outlets are provided, as there is pure air brought in by mechanical means, showing conclusively that this largely augmented volume is obtained by leakage into the room, as above described.

In view of these facts, what mockery it is to provide one, two, or three 8 × 12 flues for removing the foul air of a schoolroom occupied by fifty or sixty pupils! Moreover, no judgment is used in the placing of these small flues, nor is there any motive power arranged in them to maintain an outgoing current at all times; they are as likely as not to be placed on the outside walls, where the draft will probably be down instead of up. Under such conditions as these can we wonder that the air of schoolrooms is bad, that contagion is not uncommon, and headaches and lassitude are the rule?

To remedy the evil, the outlet-flues must in all cases be large, at least twice the size of the inlet-flues, and if possible two and one half times their size; let them be placed on the inner and warmer walls of the room, and two openings or registers arranged in them, one at the floor and the other at the ceiling-level, the one at the floor-level being used through the cold weather, when artificial heat is used to warm the building, the one at the ceiling-level being used only in warm weather when there are no fires.

No matter what the size of the outgoing flue may be, or where it may be placed, a propelling power of some kind must be arranged in it to maintain a continuous outgoing current. There are two ways of accomplishing this; one by the use of the suction-fan or blower, and the other by the introduction of heat into the flue. If the fan or blower is used, a small engine or motor of some kind will be needed to obtain the propelling force; this will require more or less machinery and some one familiar with it to operate it. This is a decided objection to the fan in ordinary school work, and I prefer, and have used in my own work with marked success, the second method, that of introducing heat into the flues.

The most satisfactory results have always been obtained when I have been able to plan a building with the shafts placed in the centre of the building. When this plan is used the heating and ventilating shaft is combined in one, or, in other words, the heating-pipes for the several rooms run through the ventilating-shaft, as shown in Sketch 2, Plate 83. I also run the smoke-stack of the boilers (which is of boiler-iron) through this shaft. The heat obtained from the inlet-flues leading to the several rooms and halls combined with that obtained from the smoke-pipe is sufficient to obtain, under ordinary circumstances, a strong upward current in the ventilating-shaft; but in order to counteract any back draft that might occur under adverse conditions, a suction-coil is also used at the top of the shaft where indicated by letter *C*. Plate 83 clearly indicates the general construction and arrangement of the heating and ventilating system that I would recommend for an eight-room grammar-school building. By a careful study of these illustrations I think the reader will fully comprehend the system.

The outlet-registers, at the floor-level, should be placed directly under the inlet-registers, and there should be built up on the inside of the flue a galvanized-iron outlet the full size of the outlet-register and extending to a height of about 2 feet above the register-opening. The object of this small pipe or flue extending from the register-opening to the height described in the main shaft is to prevent the air from the lower room or hall being carried into the room above, as might sometimes happen if this barrier were not used. It will be noticed on the drawing that there are dampers placed in the upper part of the main shaft; these are to be used at night and after sessions, being closed to keep the shaft warm and retain the heat in the building. In the morning when the heat is turned on, preparatory to the opening of the school, these dampers should be only partly opened, as the building can be heated quicker by this method; but when the pupils have assembled, they should be opened to their fullest extent. It is well to use swivel-slats in the outlets at the top of the shaft; by this I mean slats that will close automatically on the windward side under a strong wind-pressure. I believe a slat of this kind has been patented, but a modification can be used that will produce the same result without interfering with the patent. A device of this kind will be found very useful in high winds and during storms of snow and sleet.

To recapitulate briefly the system of heating and ventilation herein described:

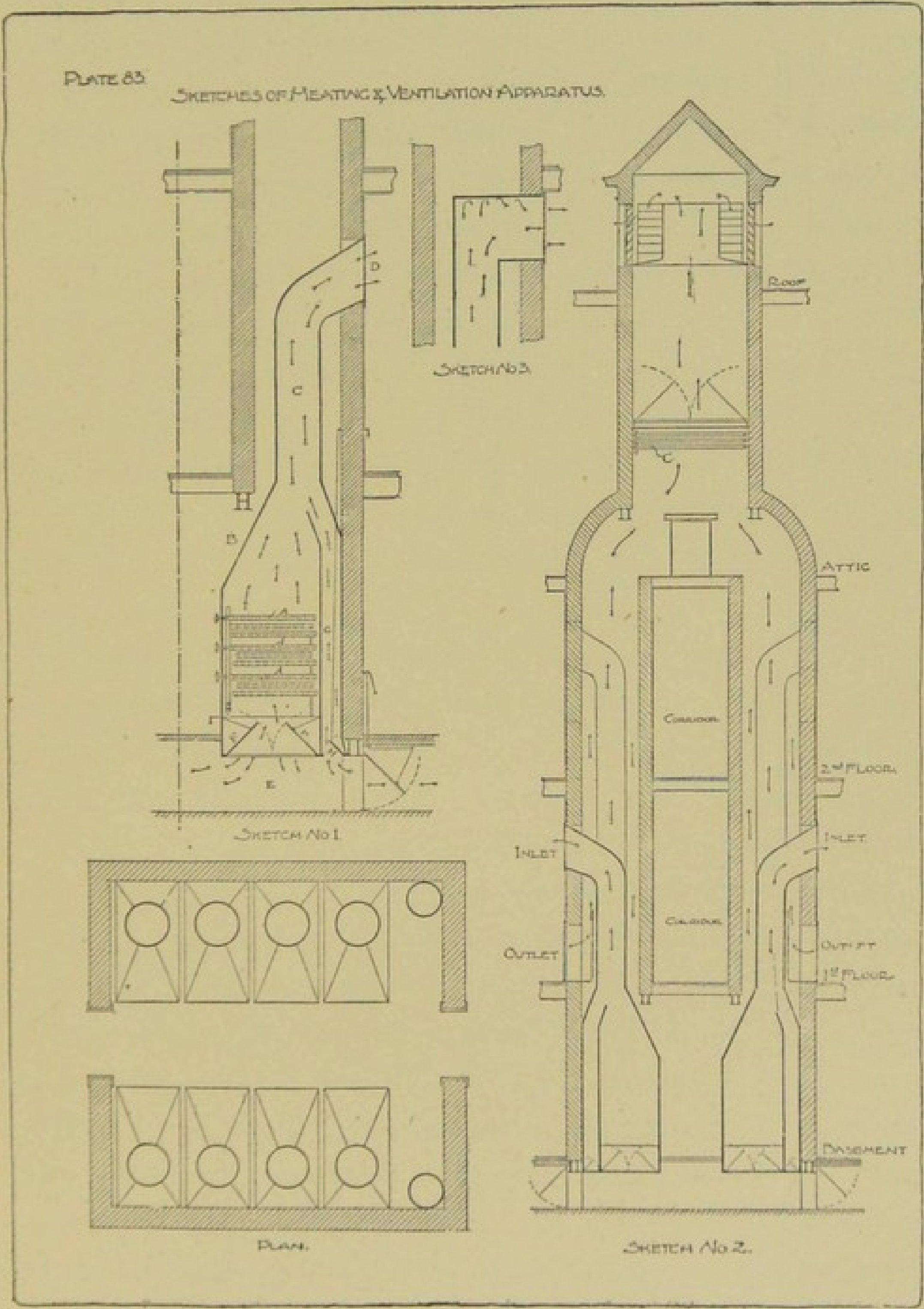


PLATE 83.
SKETCHES OF HEATING & VENTILATION APPARATUS.
SKETCH No 1.
SKETCH No 3.
PLAN.
SKETCH No 2.
ROOF
ATTIC
CORRIDOR
2nd FLOOR
INLET
CORRIDOR
OUTLET
1st FLOOR
BASEMENT

First. It is located in the centre of the building, and there can be no loss of heat.

Second. It is automatic in its action, and one part of the apparatus helps the other—that is, the hot-air pipes warm the air in the outlet-shafts, and the foul air, not being cold as it leaves the room, has no chilling effect on the inlet-pipes.

Third. The apparatus is easy to manage, simple in operation, and can be constructed at a moderate cost.

Fourth. When properly constructed and understandingly handled there is no better system, I believe, for heating and ventilating a building. In asserting this I do not speak from theoretical impressions, but from practical experience during the past ten years in the construction of such apparatus as here described.

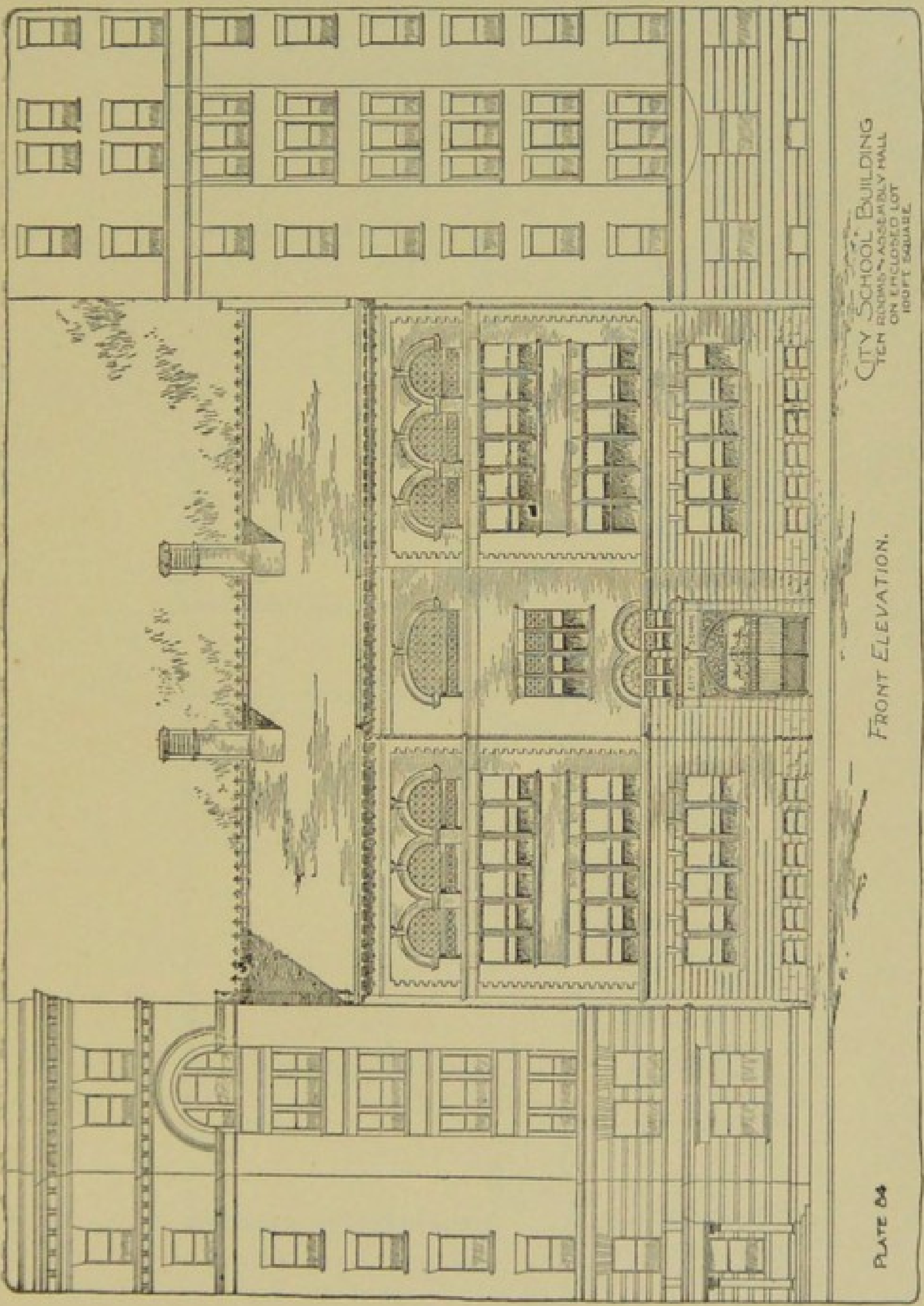
In other portions of this work I have referred to crowded city school buildings, and in the succeeding chapter I shall fully give my ideas as to how such buildings should be constructed on restricted sites.

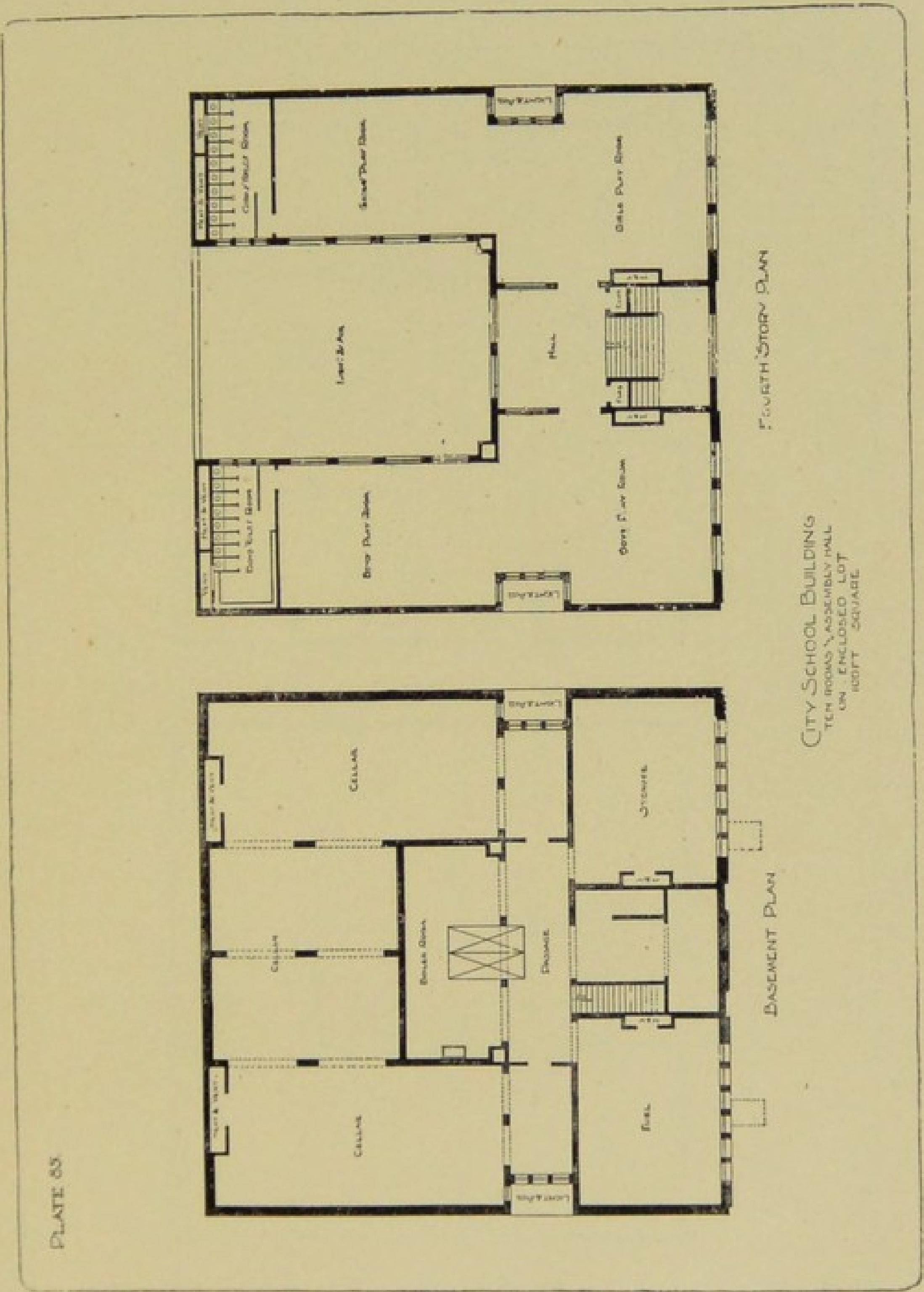
Take, for instance, a problem substantially the same as the one presented some years ago by that most excellent journal, *The Sanitary Engineer*, now known as *The Engineering Record*, viz., a lot 100 feet square enclosed on three sides. While nothing particularly original would be introduced into the plans as a whole, still I would suggest some features which would, I believe, commend themselves to those interested in such matters. The principles advocated in these articles would be embodied in the building, and a radical change introduced in the arrangement of the water-closets and playground. I have always been opposed to placing the water-closets of a large city school building in the basement, directly under all the schoolrooms; also the playrooms, if any are provided in such a building, are usually dark, unwholesome, and directly contaminated by the dirt and foulness of the adjacent streets. When I have protested against this evil I have been met with the assertion that they could not be placed elsewhere. I freely confess that on these occasions I had no suggestions to offer, but after much study and careful consideration of the matter it has occurred to me that there is a feasible solution of this problem. Why not place the playrooms of our crowded city schools on the roof? Build a strong iron and cement floor over the ceilings of the upper rooms, and around this construct a parapet wall about 4 feet high, with piers running up at regular intervals, from which arches could be turned to support the walls that receive the roof-plates. The whole area of the building should have a light roof of iron and slate, tent-shaped on the inside. The openings under the arches should be protected by strong iron grills in summer, and in winter by sashes to keep out cold and snow. With such an arrangement as this the pupils would have an admirable playroom up among the house-tops where there is as pure air as any to be had in our cities, far away from the noise and dirt of the street, away from the foulness and dampness of the cellar, a place where children could have light, sun, and air for at least a few moments of each day.

To go further, take the water-closets from beneath the schoolrooms and place them likewise upon the same level as the playrooms. Get them out of the dark, contracted quarters which they now occupy and place them where they can get the purifying air and sunlight, and thus remove all danger of foul odors penetrating the building. Devote the cellar to the heating and ventilating apparatus and the storage of fuel, but put the water-closets where there is light and air.

I suppose that this scheme will be objected to on the ground that children, in the lower rooms especially, will have to climb too many stairs in going to and from the playroom and water-closets. This is the only objection, I think, that can be made to this arrangement, and I do not consider this serious enough to overcome its manifold advantages. Be this as it may, I should like to see the experiment tried, and I hope by bringing the matter to the attention of architects throughout the country, that abler hands than mine may be led to develop this idea, so that in the near future we may be able, even in the largest city, to point to a building and say with honest pride, "There is America's greatest gift to her young—a perfect school building."

The illustrations on Plates 78, 79, and 80 show a very large high-school building; on Plates 15 and 16 a small building of this class will be found; and on Plates 33, 34, and 35 one of medium size; on Plates 81 and 82 a State normal-school building of ample size has been shown.


CITY SCHOOL BUILDING
TEN ROOMS & ASSEMBLY HALL
ON ENCLOSED LOT
100 FT SQUARE
FRONT ELEVATION.
PLATE 84


Fourth Story Plan
Basement Plan
City School Building
Ten rooms & assembly hall
on enclosed lot
100 ft square
Plate 83

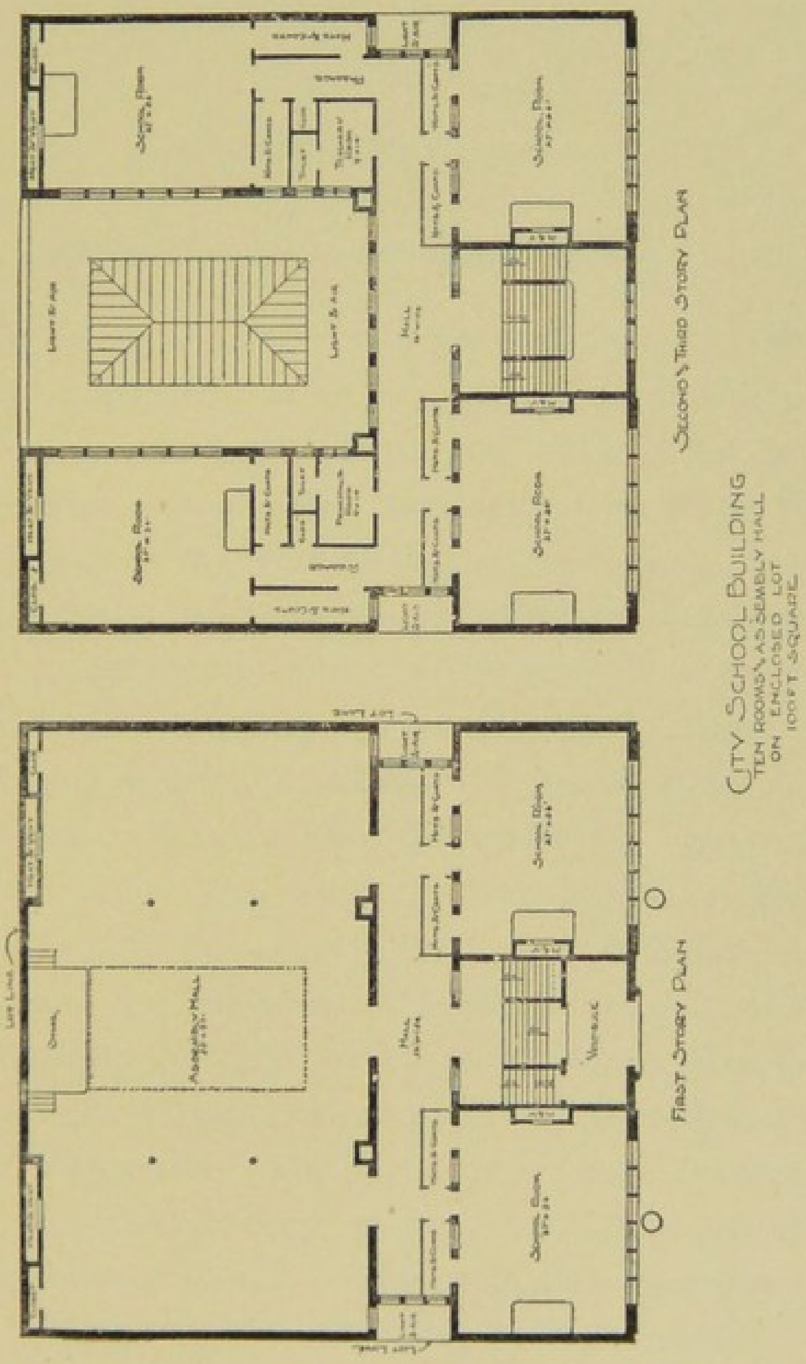

Second & Third Story Plan
First Story Plan
City School Building
Ten Rooms & Assembly Hall
On Enclosed Lot
100 Ft Square

Plate 86.

CHAPTER XVI.

CITY SCHOOLS ON RESTRICTED LOTS.

MORE than fourteen years have elapsed since the last chapter on the Construction of School Buildings was written for *Building*, and although I have frequently been importuned to describe and illustrate the suggestions made for city school buildings at the close of that series, I have, up to the present time, been unable to do so. The subject is not an ideal one by any means, nor one that will be likely to arouse inspiration or enthusiasm in the architect's brain. I am not referring to isolated buildings with ample space for light and air around them, or those fortunate enough to be constructed on "corner lots," but of sites similar to those presented some twenty years ago in the competition referred to near the close of the last chapter, to wit, sites 100 or 150 feet square, enclosed by high buildings on three sides, as shown in Plates 84 and 85—in fact, a great box without a top and one side. These sites were supposed to have northern exposure on comparatively narrow streets; truly, more undesirable situations for school buildings can hardly be conceived; and I believe that the use of any such site should be prohibited by law. But, upon the other hand, if necessity should compel the erection of buildings upon such restricted sites, we must meet the conditions fairly, and endeavor to solve the problem in such a way that the objectionable conditions of the site shall be reduced to a minimum.

The competition above referred to attracted wide-spread attention, and was eminently successful as far as the number and ability of the competitors was concerned. The expert judges' award was just, and their exhaustive report contained many valuable suggestions; their eminence, coupled with their peculiar fitness to pass judgment upon just such a problem, should have made these recommendations arbitrary as far as they might be applied to future buildings constructed under the same conditions; no doubt it was fondly hoped by the projectors of the competition that such would be the case, and that a new era in metropolitan school building would be inaugurated. Alas for such a fallacy. The lessons of the competition were quickly forgotten, its practical teachings ignored; and the same old mill grinds out the city "school buildings" that are almost completely enveloped with tenacious traditions and dogmatic precedents.

But to speak more specifically concerning the proposed structure upon a lot 100 feet square, I believe it is possible, if the building has three floors devoted to school purposes, to introduce successfully ten rooms, an assembly-hall, and the necessary principal's, teacher's, and hat-and-cloak-rooms. By referring to Plates 84, 85, and 86 a building of this description will be found; and on Plates 87, 88, and 89 one on a 150-foot square lot. Note in each instance that the rooms all have external light and air, and the principles of lighting, heating, and ventilation, etc., advocated in other portions of this work are fully carried out here.

The staircases are centrally located, abundantly lighted, strictly fire-proof, and completely isolated from each floor so that the pupils of any one floor may be dismissed without disturbing in the least those of any other. The assembly-hall, 55 × 96, is situated on the ground-floor, and is lighted and ventilated centrally from an immense skylight; this, to my mind, is not objectionable for a room not used for study and occupied only at stated times.

The entire basement of the building is devoted to the heating apparatus, boilers, and fuel.

The arrangement of the several floors, schoolrooms, teacher's rooms, coat-rooms, corridors, etc., require no special description, as they are easily understood.

The most striking feature of the design, however, is the introduction of the elevated play- and toilet-room system; these are placed on the fourth floor, above the uppermost tier of schoolrooms. They are reached by the main staircases through a commodious central hall, and, while being completely isolated, are convenient of access, light, airy, and perfectly safe. It is proposed to cover these rooms with roofs of light steel and slate construction; the openings would be guarded by ornamental wrought-iron grills, and during the colder months protected with portable sash; the floors would be of the same material used in the ordinary basement rooms, half-hard asphalt, and enough heat would be introduced during cold weather to render the rooms comfortable to exercise in. The construction of this building would be fire-proof throughout, and, while no elaboration is intended, all work and finish should be strictly first-class.

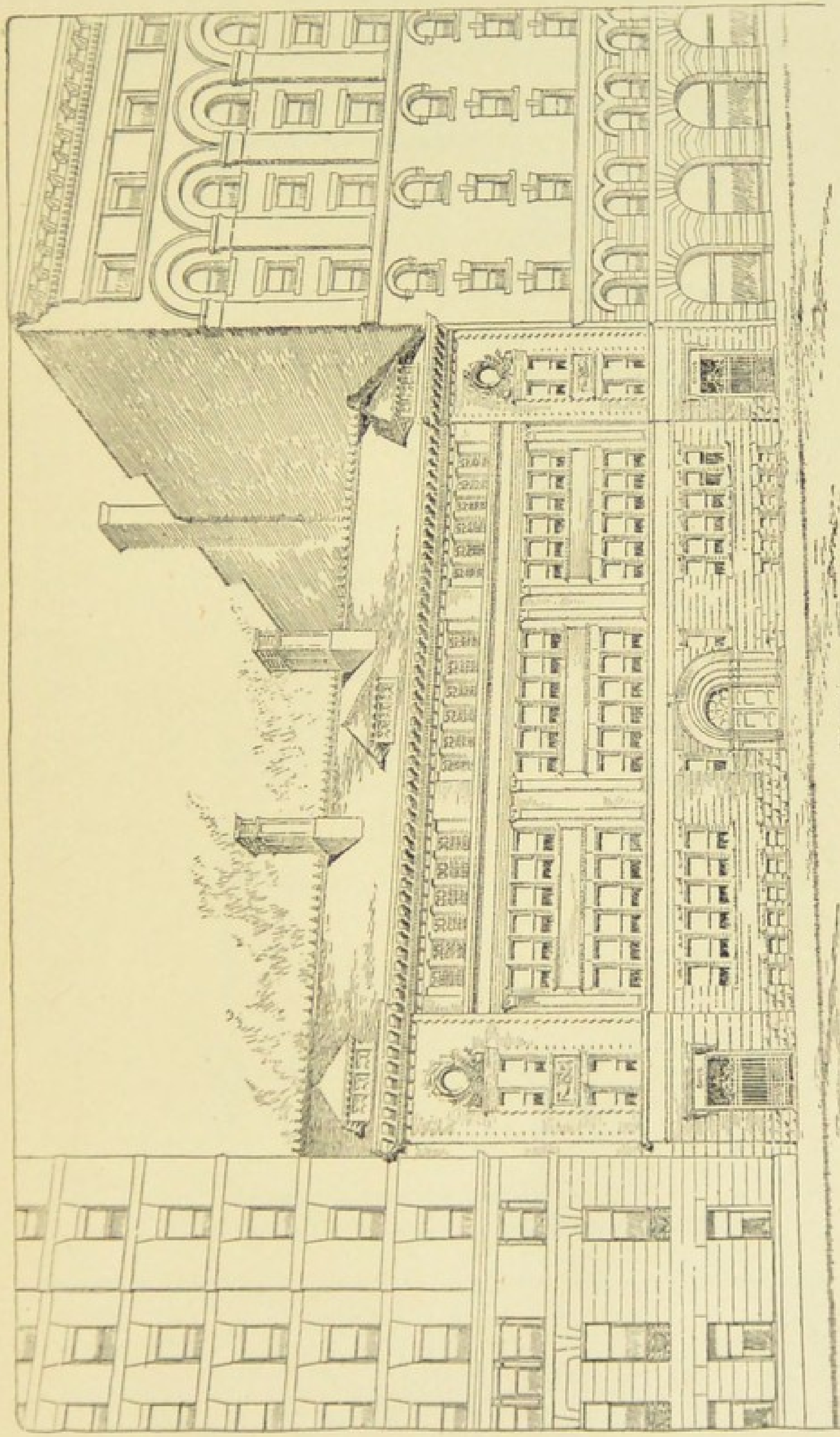
In the larger building designed for the 150-foot-square lot similarly situated and containing sixteen rooms and assembly-hall (Plates 87, 88, and 89) the same principles in regard to planning and construction have been adhered to, and it is not deemed necessary to describe the design in detail. A careful study of these designs by those interested in the subject will clearly show about what the possibilities of restricted sites of this class are. The schoolrooms on the street-front of the building have the advantage of the width of the street for lighting purposes, but the disadvantages of noise and dust. The schoolrooms opening on the light-courts (which should have walls of white enamelled brick), while not having so great a light-area to draw from, have the decided advantage of quietness and are practically free from the annoying dust which arises from the street. While the lighting of these rooms is not as good as could be obtained in buildings that had ample ground-space around them, it is far better than the rooms in any similar class of buildings that I have ever known. The actual glass-area of these rooms is as much as and more than is usually used in isolated buildings; any diminution of light is entirely due to their surroundings, and not to any fault in their planning. The condition that encompasses such a site is the unfortunate one which we cannot entirely overcome, but which can be (as I think I have shown) so modified that buildings that will be perfectly sanitary and so well lighted that children can pursue their studies in them without injury to their eyesight, can be constructed with a reasonable expenditure of money even under these adverse conditions. In this connection, let me say that the buildings shown throughout this work are no more expensive than those of a similar size and class that are being constructed all over the country to-day; that is, if the buildings first referred to have the same area, cubic space, hygienic conditions, and are constructed with equally good material and workmanship, their cost will fully equal that of the buildings here submitted; in other words, there is nothing ornate or unduly elaborate in any design in this work. But to return to our theme. The heating and ventilation of these buildings is very simple, and as the whole basement is at our disposal, we certainly have ample opportunity to introduce any desired apparatus.

As to the sanitary arrangements, I believe the placing of the toilet rooms *above* rather than below the schoolrooms in any city school building is the best possible position for them. I have argued elsewhere in this work, under the head of Sanitary Arrangements, as to the feasibility and accessibility of this system, and it is not necessary to repeat myself here; but what I want to impress the school official with is the adaptability of this system to all classes of city school buildings. It does not require a "restricted site" to make it imperative that such a system should be used; it is better for any building, be it in city or country, to have the water-closets above rather than under the schoolrooms; and the sooner this is realized and practically introduced into school buildings the better they will be for it; the only valid objection that I have ever heard raised to this system is the question of the water-supply; it has been pointed out that as in many instances the school buildings are placed on the highest ground in the city limits, and in fact elevated sites are always preferred, the ordinary pressure of city water would not supply properly these elevated toilet-rooms. This is undoubtedly true; but the difficulty can easily be overcome by the adoption of the tank system used in the larger buildings of all cities; a good force-pump run by steam, gas, or electricity, placed in the boiler-room in the basement, will enable the janitor to keep in the tank a sufficient supply of water at all times. The extra expense and maintenance of a good tank and force-pump is more than balanced by the advantages obtained by the elevated toilet-room system.

I am informed that elevated playrooms have been introduced into some of the new school buildings in New York City; if this is a fact, I am pleased to know that a system advocated by me for more than a dozen years has at last been made use of. Let us hope that the reform will not stop with the playrooms, but extend (if it has not already done so) to the toilet-rooms as well.

The practicability of constructing city school buildings upon restricted sites, as here outlined, cannot be questioned; and if such problems have to be solved, I have as yet failed to find a better solution than here given.

In these modern days, when steel and iron enter so largely into our construction, we are enabled to accomplish that which, a decade ago, would have been considered impossible. No reasonable span is too great to be carried; and walls or piers that under the old régime would have had to be abnormally heavy are reduced by the steel-pier and curtain-wall construction to a minimum. All this is a distinct gain in utility and space, and enables us, if we thoroughly understand the subject, to produce, even under the worst conditions, buildings that are far in advance of anything that has heretofore been done. I have just said, "if we thoroughly understand the subject." This sentence analyzed will be found to contain the real reason why the average municipal school building is not of a higher grade. Politics and favoritism enter so largely into the appointment or selection of the architect that it is rarely that a first-class practitioner is in power long enough as City Architect or Architect of the Board of Education to accomplish much. Even if a thoroughly



CITY SCHOOL BUILDING
SIXTEEN ROOMS & ASSEMBLY HALL:
ON ENCLOSED LOT
120 FT SQUARE

PLATE 87

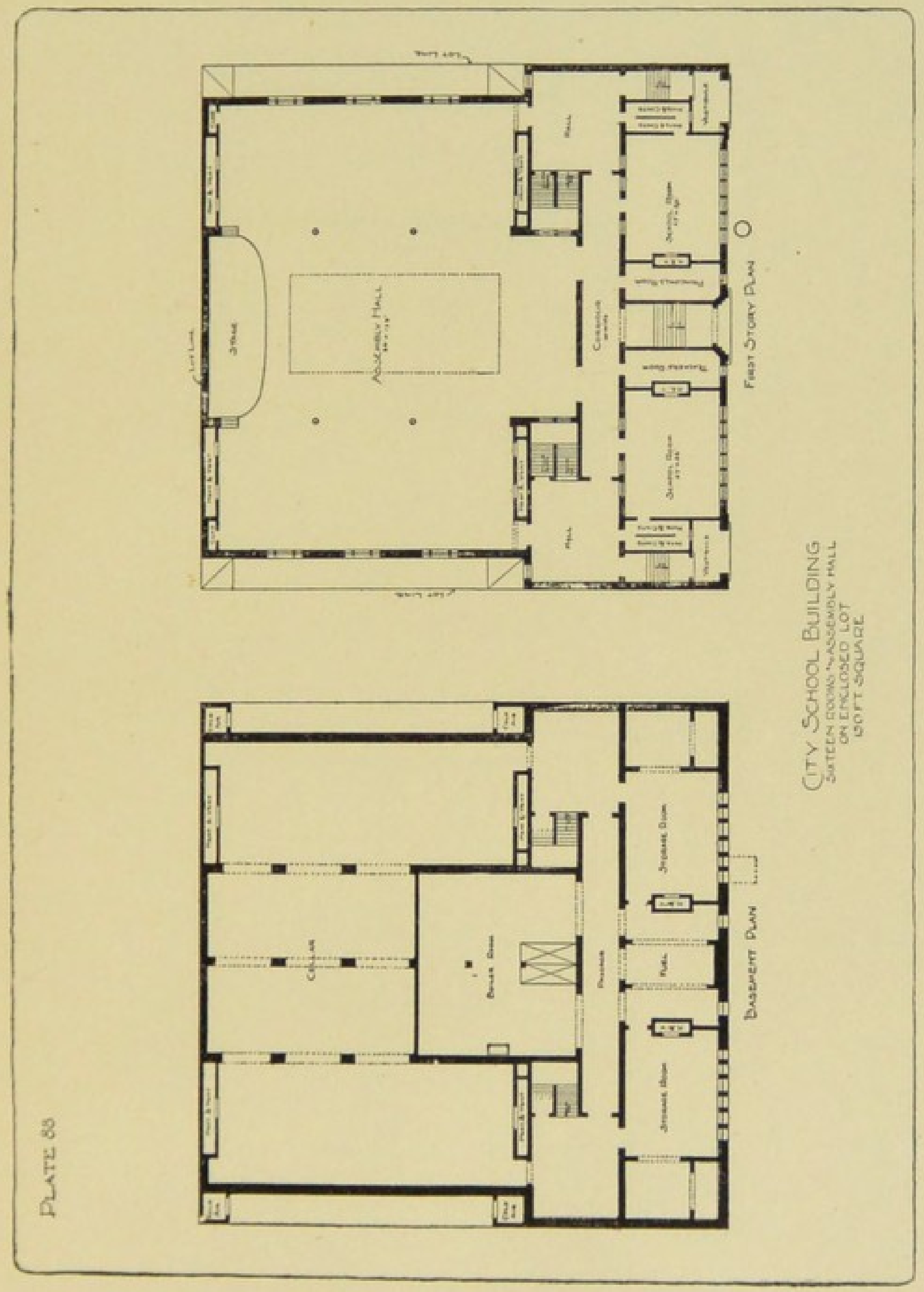
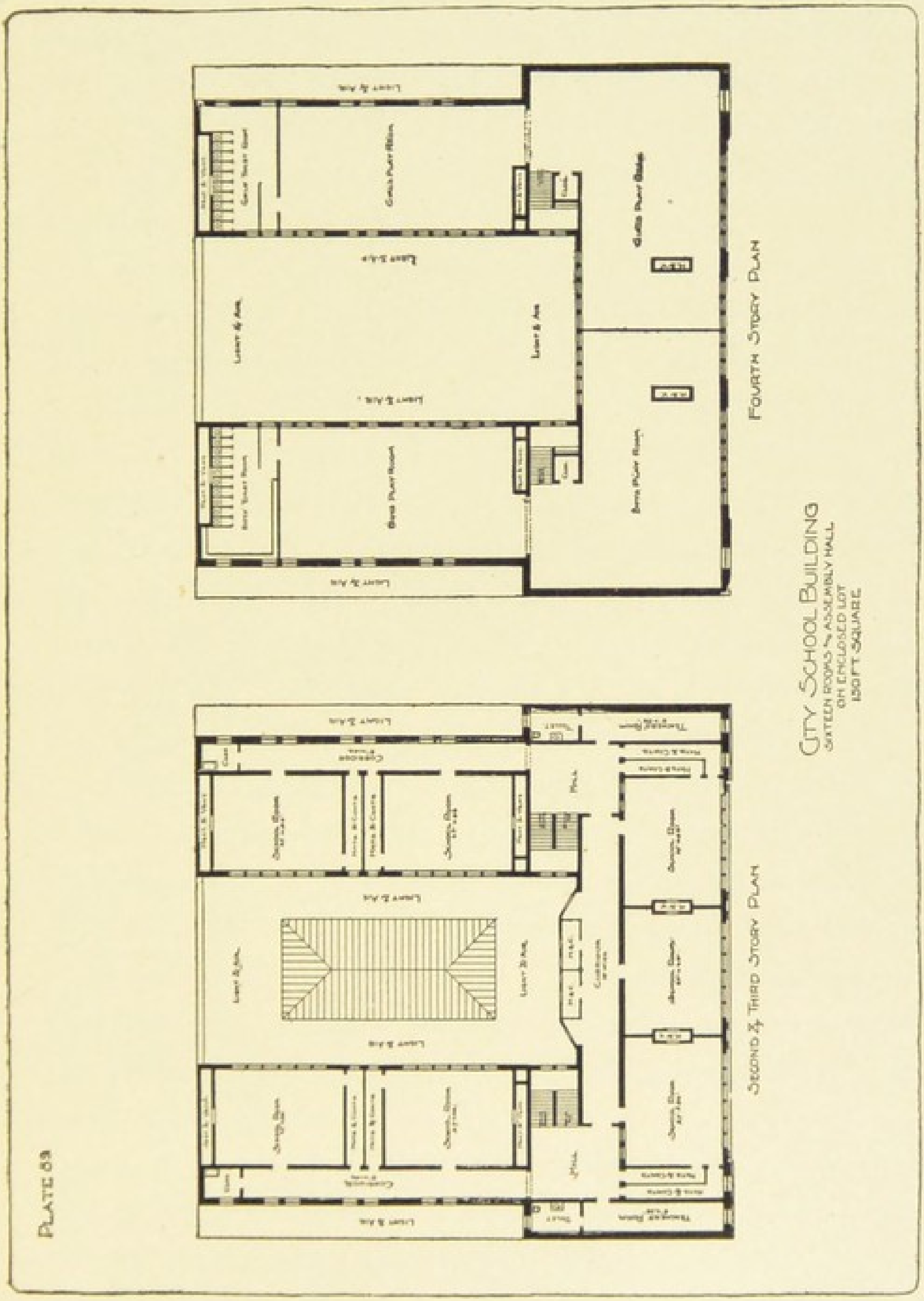


Plate 88
First Story Plan
Assembly Hall
Stage
Corridor
School Room
Principal's Room
Teachers' Room
Hall
Vestibule
Basement Plan
Cellar
Boiler Room
Passage
Storage Room
Fuel
City School Building
Sixteen Rooms & Assembly Hall
On Enclosed Lot
150 Ft Square


Fourth Story Plan
Second & Third Story Plan
City School Building
Sixteen Rooms & Assembly Hall
on Enclosed Lot
150 Ft. Square
Plate 83

competent man is appointed, the chances are that before he is fairly established in his new office the political power will change, and he must make room for another; true, "to the victor belong the spoils," but when this precept is applied to the architectural department of a city it produces the most disastrous results.

I believe that better results would be obtained by any municipality by giving power to its various departments to select architects (without competitors) to do their work. As I have before said, I am an advocate of specialists, and I do not believe that as good work is obtained from any "City Architect's Office" as can be had by entrusting the work to regular practising architects whose qualifications and training have eminently fitted them for some special branch; this theory is particularly applicable to school buildings; and it is hoped by the writer that a reform movement in this department will be inaugurated in the near future.

I could enlarge upon this subject at length, but as I have fulfilled my promise made so many years ago, and described and illustrated city school buildings on restricted lots, it is only necessary for me to say that in all the pleadings and theories advanced in this work I have simply been actuated by an honest endeavor to remedy faults that I continually encounter in my practice. And as I look back over these pages which have been penned at such wide intervals, I am surprised to see how little the theories advanced long ago require to be changed by a riper experience. Many of them will surely be criticised; some possibly condemned; but such as they are I give them to the public; and if they are found wanting, it will not be for the reason that I am not perfectly sincere in my convictions.

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