The
ARCHITECTURAL
FORUM

VOLUME XXXVII | AUGUST 1922 | NUMBER 2

The School Plant in Present-Day Education

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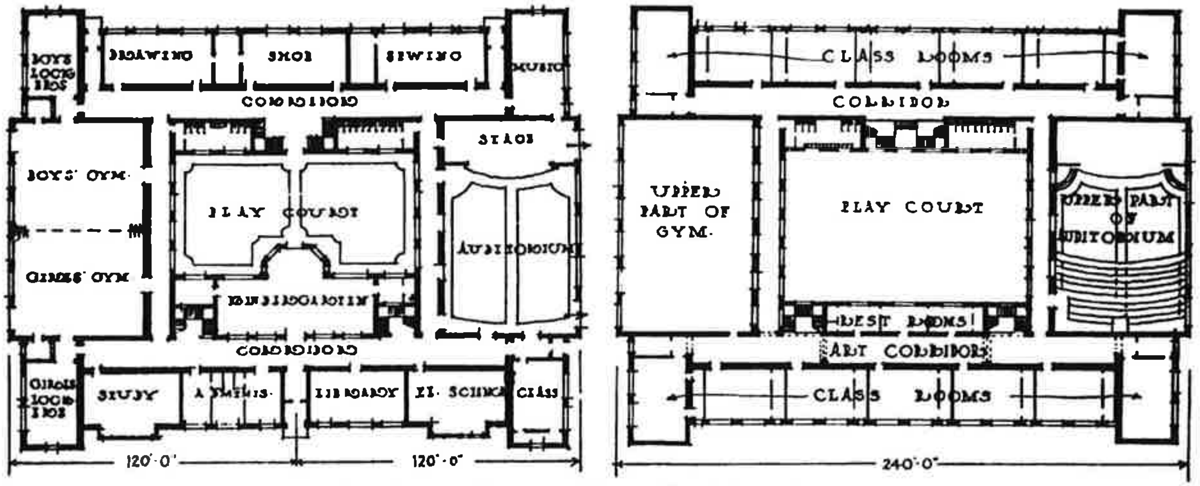
THE present-day educational objectives, health, the fundamental operations, manual skill, citizenship and the worthy use of leisure, have caused a renaissance in public education and in public school building. The shift of emphasis as regards the most vital consideration in education, viz., complete living, has occasioned a demand for a new type of school plant, and the more extended use of schools by the adult citizens of a community has given an impetus to a universal interest in the school environment. Education today is a continuous process, with the public school serving all ages.

Fundamentals in Present-day Education Must Guide the Development of the New School Plant. A school plant developed in harmony with this enriched and expanded curriculum, with the change of emphasis and the increasing demands by grownups, will rapidly become a vital and effective agency for human advancement. Its inviting exterior will represent the best, most thoroughly planned structure in the community, and its interior the best of all places for work, recreation or study. Its architecture will evidence individuality and be indicative of the rich and varied facilities within. As a model for sanitation, lighting and ventilation it will have no peer. What a change, indeed, from the old "schoolhousey" school, with its uninviting, monotonous, dead appearance, its inadequate site, and neglected surroundings!

All Communities Can Afford the Enriched Modern Type of School. Of course the eternal question of cost arises, but with the new science of school organization and management the matter of cost is comparatively favorable to the new type of school, and when the extended service, the enriched facilities and the unlimited possibilities are considered, the new school represents true economy.

Costs are intimately connected with service and efficiency. Architects can plan buildings so that maximum use is made possible and multiple use suggested. After that, however, the buildings' service must depend on skillful organization and adminis-

A Present-Day Elementary School. The Bryan Mullanphy School, St. Louis
Wm. B. Ittner, Architect



Plans of Typical Elementary School. Wm. B. Ittner, Architect

tration. Public school buildings can be planned to meet economically the demands of the enriched curriculum only when, by skillful administrative methods, all parts of the building are brought into complete rather than partial use.

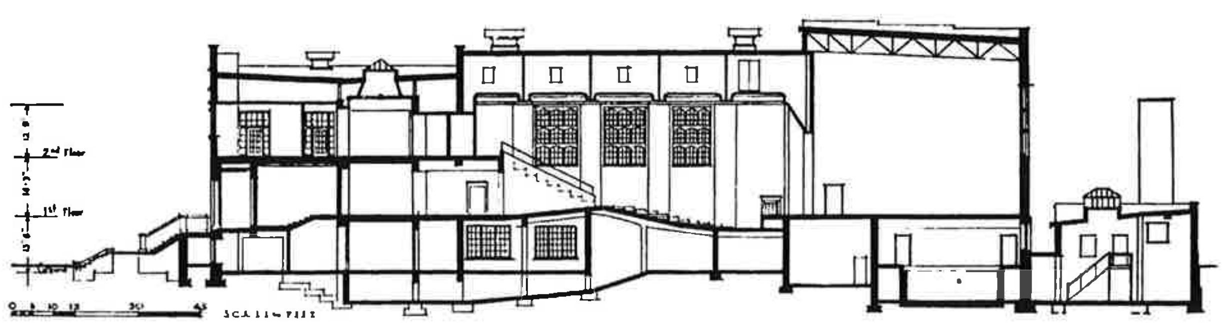
Health as an Educational Objective. The promotion of health of youth and adults is, in general, a community problem. By far the most efficient factor through which the community can work is the public school. The school is the place to which both the pupil and parent body are accustomed. It has the children the greater and best part of the day for all types of activities and is the most logical center for the distribution of all sorts of health propaganda.

Health as a fundamental claims a prominent place in the curriculum as far as time and instructional forces go. Automatically, then, it must receive foremost consideration in the planning of the school. But if the school plant is to serve a complete health program, the schoolhouse planner must have a clear idea as to the nature and extent of the health activities.

Every School Building Should Be a "Hall of Health." The initial requisite to health education is that the complete school environment should be a model for health. To accomplish this desired goal, sanitation, cleanliness, perfect lighting, airiness and cheerfulness must, of necessity, constitute the eternal, unwritten laws of successful school planning. Proper location of the school plant, a generous site, the "open plan" type of building, and efficient administrative and janitorial service ought to result in safe, well lighted and properly ventilated work, study and recreation quarters.

Gymnasiums and Playgrounds Are Essentials in All Types of Schools. All health programs include physical activities in gymnasiums and playgrounds, physical examinations, medical inspection and instruction in personal and community hygiene. Therefore, gymnasiums and playgrounds for boys and girls, showers, medical and consultation rooms are necessary to a complete physical education equipment. Swimming pools, if properly installed and carefully supervised, always add to the educational interest as well as to pleasure. The extent of physical education and recreational quarters naturally varies from one gymnasium and a minimum sized playground in small schools to several specialized gymnasiums with complete accessories and a large acreage for play and athletics. The school plant, however, which offers inadequate health facilities for its needs, cannot claim to be classified as a modern school.

Adequate and Well Planned Physical Education Quarters Are Community Assets. Perhaps no facilities in the school plant are more inviting, more stimulating to the youth of all ages, and more attractive to the adult citizens than spacious, well developed and equipped physical recreational areas, both outdoor and indoor. Certainly no other parts



Longitudinal Section, Fargo High School, Fargo, N. D.

A Junior-Senior School Plant, Fargo High School, Fargo, N. D.

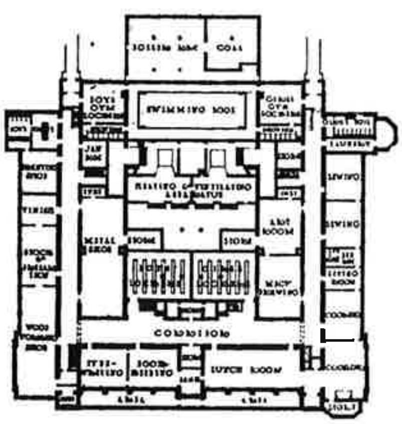
Pupil Capacity 1,450 Cost per Pupil, $261.81 Cost per Cubic Foot, 19.32 cents Built 1917

Wm. B. Ittner, Architect

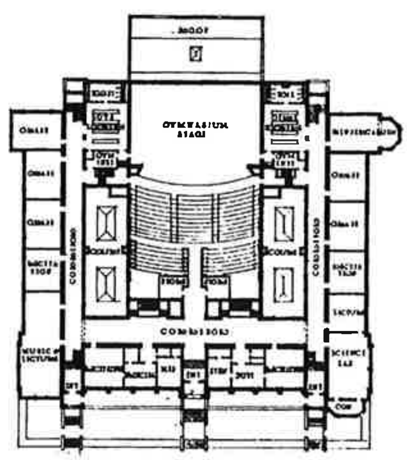
of the school plant can do more to correct delinquency and truancy. Nothing else has so direct an appeal to the expanding physical and mental powers, and with health as an objective the health quarters are no longer luxuries to be added if funds permit; they have become essentials, and communities that can afford to build schools at all can afford the necessary aids to health.

Motor Activities in the Shops and Laboratories Are Also Considered Aids to Health. Aside from the entire school environment and the physical education group, the workshops and laboratories may also be considered health promotion facilities. The activities in the various workshops develop and train more particularly the eye, the arm, the hand and many of the smaller muscles, while the activities of the playgrounds and gymnasiums develop the larger muscles of the trunk and legs. It is granted, of course, that the motor activities in the workshops also have another distinct purpose, but the fact that they also serve for promoting health assures them a prominent place in the curriculum. Such activities, for instance, as wood working, clay modeling, forge, foundry and sheet metal working, nature study, horticulture, gardening and animal husbandry are examples of some of the motor activities that definitely minister to health, aside from their own intrinsic values.

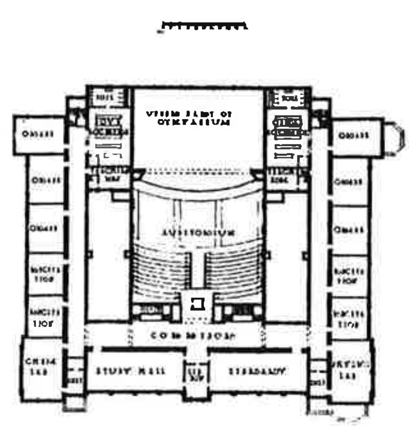
Classrooms Constitute Only a Part of the Educational Equipment of Today. Schools always have, and still do include, classrooms, since textbook instruction will undoubtedly continue to claim an important place in the curriculum. There have been no radical changes in the physical attributes



Ground Floor Plan



First Floor Plan



Second Floor Plan

Fargo High School (Junior-Senior Grades), Fargo, N. D.

of classrooms. An elastic scale as a measuring rod for size of room and type of lighting has been evolved, and considerable improvement as regards interior finish and trim has been accomplished. Otherwise, the chief difference lies in the substitution of newer types of equipment, much of which is movable and adjustable.

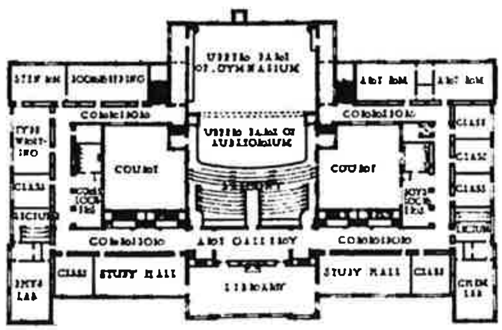
Laboratories Scattered among Classrooms Add Interest and Variety. Laboratories are increasing in number, both in elementary and secondary schools. This is natural, since the very essence of present-day methods of instruction is investigation, organization and interpretation of facts. The laboratory classrooms add materially to the interest of the educational environment and are salient factors in the promotion of the wider use of the school plant.

The Full Educational Possibilities of the Auditorium Have Been Realized in Comparatively Few Schools. The full possibilities of the auditorium as a socializing and community factor are just being realized, but its possibilities as an instructional force must be anticipated by the architect. Auditoriums that give best general service are those of medium size. In a system of schools there may be one or several large central auditoriums, but the majority may be medium sized. If these are planned with stage-gymnasiums, equipped with soundproof, movable partitions, they can always be enlarged for special occasions.

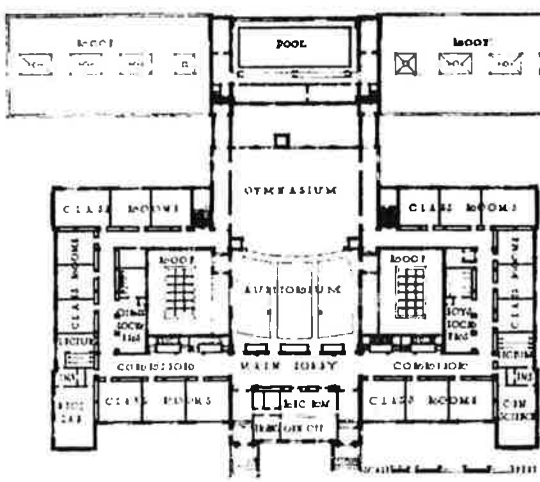
Success in Life Depends Much upon how Leisure Time Is Spent. It is a comparatively new idea to train for the worthy use of leisure, yet the masses of people today have far more leisure than formerly. All classes in the social strata recognize the need for daily leisure time; all recognize the importance of leisure time also in making or marring successes in life, both material and spiritual. Furthermore, all recognize the fact that there are both constructive and destructive forms of recreation and amusement. So it is really a sensible idea for public schools to incorporate as a fundamental, training in the various forms of wholesome recreation, physical, mental and spiritual.

The Enriched Modern School Offers Recreational Opportunities to Children and Adults. The leisure time of young folks is usually devoted to sports, reading, playing with a hobby, or passive entertainment. The desire for active forms of recreation generally leads. The analysis of adult leisure activities is similar to that of the younger folks. If, then, the school includes facilities to care for the leisure time of children, it automatically includes the major requirements for adults. Gymnasiums, playgrounds, pools and showers are probably the most potent factors in ministering to leisure time, since they offer active and attractive forms of recreation. When well correlated and artificially lighted for evening use, their possibilities as centers for wholesome amusement are multiplied.

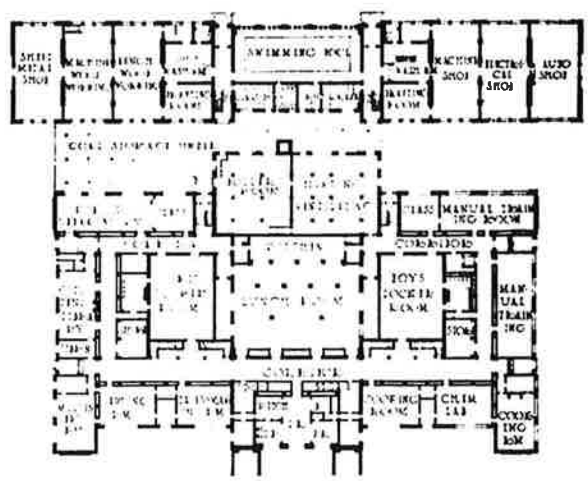
An unusual opportunity is offered to school libraries in extending their services to their immediate communities. Elements in their success include size, attractive interior, location in the building, and equipment. A library undersized, dark, gloomy, ill ventilated and in an obscure location has no community possibilities. It should be equivalent to at least two classrooms in size, should be lighted and ventilated both naturally and artificially, and located in close proximity to the main entrance. It is to the school auditorium that one must look for passive entertainment that will finally override the cheap, tawdry and sensational forms. Much is



Second Floor Plan



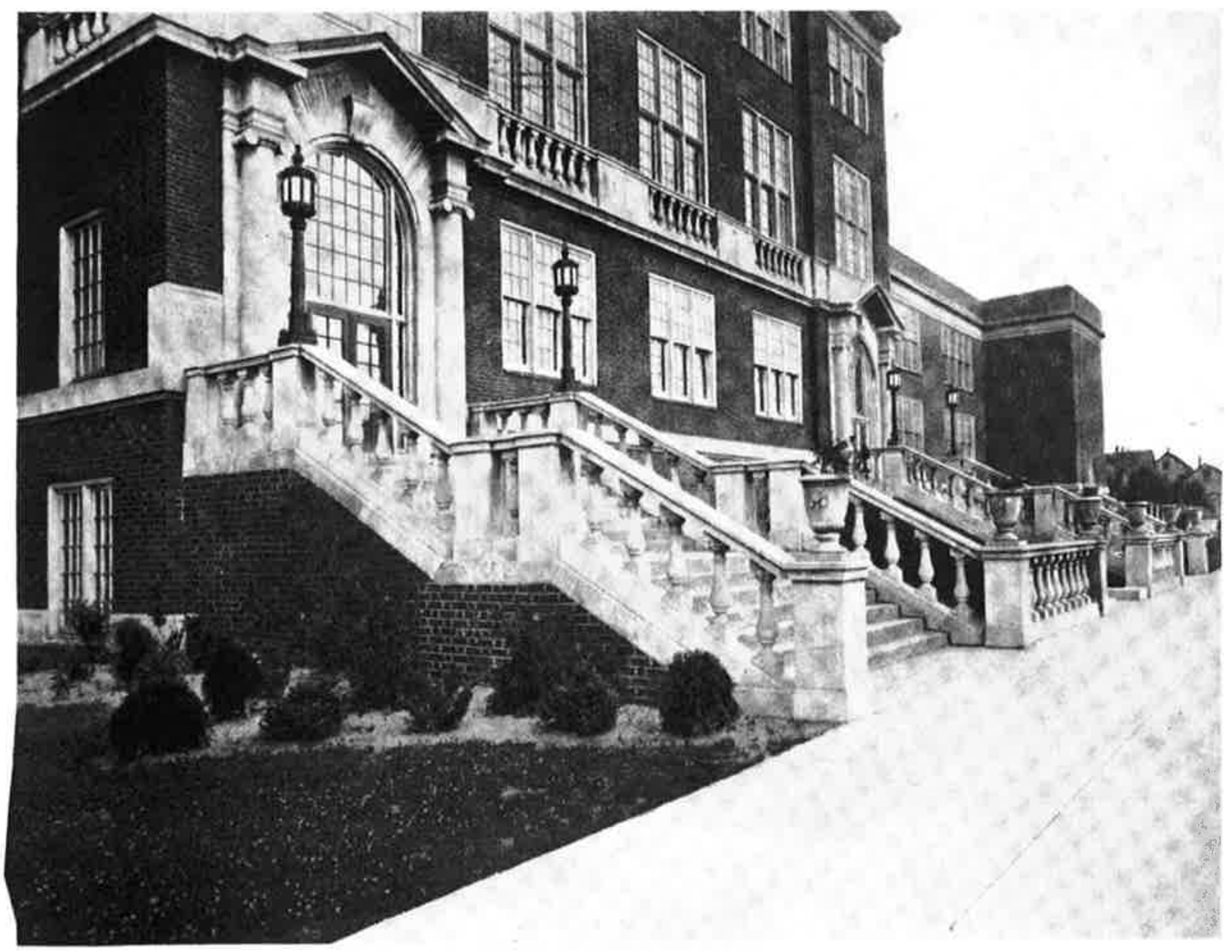
Ground Floor Plan



First Floor Plan

East High School, Erie, Pa., Wm. B. Ittner, Architect

GENERAL VIEW OF FACADE



DETAIL OF ENTRANCE FRONT

EAST HIGH SCHOOL, ERIE, PA.

WM. B. ITTNER, ARCHITECT

EAST HIGH SCHOOL, ERIE, PA.

Illustrations on Plate 17

THIS senior high school was completed in 1919 at a cost of $924,-337. It accommodates 2175 pupils, making a building cost per pupil of $424.98, excluding equipment.

The cost per cubic foot was 30.16 cents.

The exterior of the building is of face brick trimmed with Indiana limestone. The construction is fireproof.

JUNIOR HIGH SCHOOL, SAVANNAH, GA.

WM. B. ITTNER, ARCHITECT

JUNIOR HIGH SCHOOL
SAVANNAH, GA.

Illustrations on Plate 18

THIS school was completed in 1920 at a cost of $401,257.22. It accommodates 1020 pupils, making a building cost per pupil of $393.38, excluding equipment. The cost of equipment per pupil was $54.60.

The cubic foot cost was 38.11 cents.

The exterior of the building is of red face brick. The construction is fireproof.

already being done by means of juvenile plays and activities to accustom the parent body and interested friends to the school auditorium.

A few years ago it was my privilege and pleasure to plan what was probably the first enriched public school plant that gave unlimited opportunities both to elementary and secondary school children. The school became a revelation to me as I made my visits from time to time after its completion. It was the best representative of a people's university that I have seen. Adults were coming and going through the plant at all times, viewing the exhibitions in the spacious and well lighted main corridors, visiting the auditorium activities of the children and actually working in some of the shops, drawing and domestic art quarters. In the evenings it seemed that the whole community was at the school. After school hours and on Saturdays children were distributed of their own volition through the various parts of the plant that they loved best.

The criticism that special talents of children are ignored in public education has been offered. The school with an enriched environment, such as that mentioned here, an elastic organization and administration whereby all quarters count for maximum use, certainly ministers to talents of children. The criticism therefore may be directed toward the school of yesterday.

Variations in Methods of Securing Enriched School Plants. In attempting to secure enriched equipment, school communities adopt varying policies. The usual plan in the larger cities is dependent on what is known as the "6-3-3" organization. This type of school organization calls for a set of elementary schools to care for the first six grades and kindergartens, a set of junior high schools for the seventh, eighth and ninth grades, and a restricted number of senior high schools for the tenth, eleventh and twelfth grades. The zoning plan locates the elementary schools from one-half to three-quarters of a mile apart, the junior schools as central as possible to a group of contributing elementary schools, and the senior schools reasonably central to groups of junior plants. For economical reasons, the elementary and junior schools are planned for a capacity of at least 1,000 pupils. It is recommended that senior schools care for a greater number.

For Smaller Cities the Best Plans Involve a Minimum of Segregation. There are two methods of developing modern educational equipment for smaller cities:

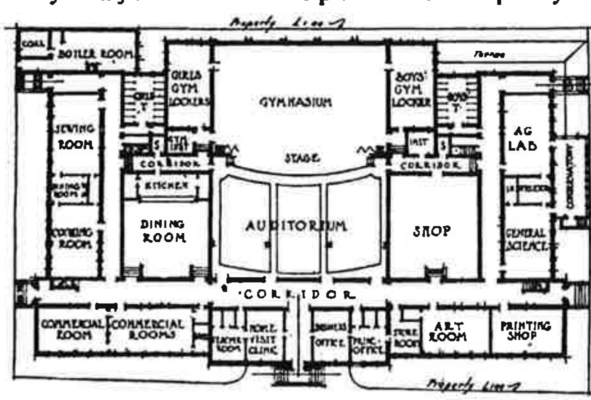
1. A set of elementary schools for the first six grades and kindergartens, together with a set of combined junior-senior plants;

2. Complete, centralized units including both elementary and secondary school grades, thus giving unusual opportunities to all children.

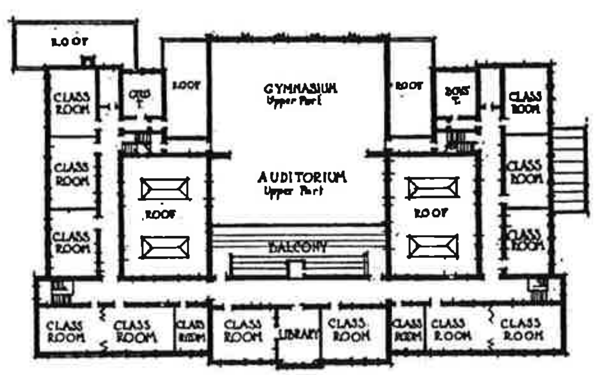
When the first policy is adopted, viz., the segregation plan, the principle of zoning for elementary schools in large cities applies also to small cities. Owing to the deficiency of numbers, the junior and senior grades are combined and these junior-senior plants distributed in proper relationship to the elementary schools. Any high school equipped for senior grade purposes is entirely sufficient for junior school needs. For instance, a senior high school includes more specialized laboratories and shops, a greater expansion of physical education facilities and a larger auditorium. Hence nothing is offered by the junior plant that is not included.

Centralized Complete Units Have Advantages for All Communities, but Especially for Small Cities. The establishment of complete centralized school plants, properly zoned to equalize distances and sufficiently enriched to meet the needs of all grades, has been adopted in comparatively few communities. Economically, the plan is superior to the others, and educationally it insures the fullest possible opportunities for all pupils. The present-day aim of education is social, but certainly there is nothing democratic about segregated groups of schools. If there is no convenient dropping-out place along the school course, perhaps the exodus will not be so great.

A concentration of elementary and secondary grades involves departmentalization of the former, although not to the same extent as the latter. That provision is favorable, however, since it is only by means of some method of departmentalization that elasticity of the school program is secured. Just



First Floor Plan



Second Floor Plan

Junior High School, Savannah, Ga., Wm. B. Ittner, Architect what one of these centralized plants includes may be exemplified by a brief description of one actually in existence.

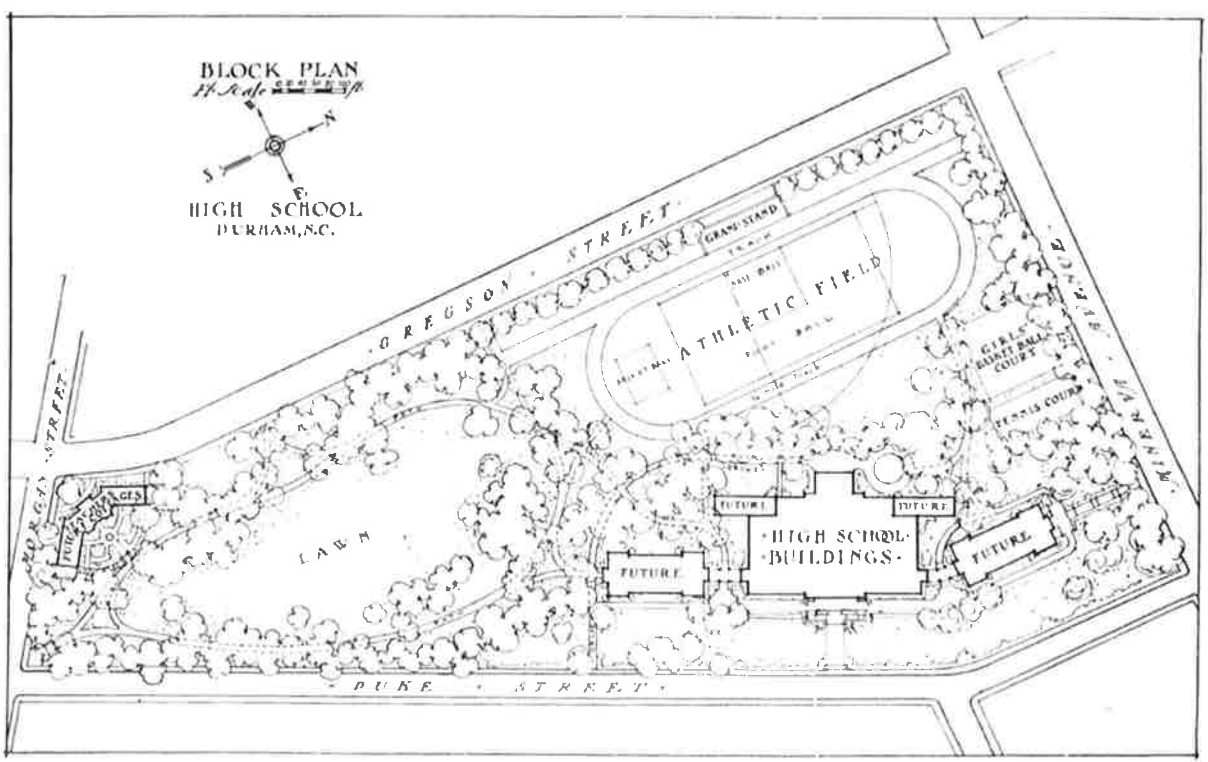
High Lights in a Complete Centralized Unit. The building, two stories in height and with a capacity of 2,000 students, has a favorable setting on a 14-acre site. The foreground is planted and resembles a miniature park where all who pass by may rest and cool themselves on the shaded rustic benches scattered about. Children's gardens are noted in close proximity to school greenhouses, and just beyond an expanse of smooth ground is relieved here and there by playground and athletic apparatus.

On entering the building the first thing that catches the eye across the well lighted corridor is the sunset of the stage—scenery. Indeed, one passes toward it and beholds an auditorium as light and airy as the out-of-doors, rising in amphitheater fashion.

Only a few of the classrooms have desks. Tables and chairs seem to rule, and every room reminds one of a busy laboratory. The boys and girls in the workshops and laboratories do not even notice us. They are all too intent on their projects. Very young boys are in the wood working shops and are occasionally permitted to observe the advanced work of the older boys in machine and metal shops, forge and foundry. Girls may elect sewing and elementary cooking at a very young age, and their enjoyment of this privilege seems unbounded. The greenhouses lead directly to the school gardens.

The physical educational facilities are especially complete. Occasionally there are groups of the younger as well as the older children in the gymnasiums and on the grounds, and in swimming it is not at all unusual for the younger to excel the older pupils. Ascending to the second floor, attention is arrested by the school library located midway between the first and second floors, for accessibility to all classrooms as well as to the main entrance. Again, it is a delight to linger in the corridor, since on the second floor it is a veritable art gallery. The art and music rooms with adjustable equipment for varying sizes are also located on the second floor. Altogether the school is a miniature democracy; high school students and primary pupils mingle in the most natural manner about the building and grounds. If training for citizenship is a fundamental in education, the training, although to a certain extent incidental, is certainly in evidence.

Economically, no other plan can compare with that of centralization. Enriched facilities are demanded, since the secondary schools are included, but the equipment is available to all. Automatically, the plant gives a maximum of service and the per capita cost is correspondingly reduced. There may be certain educational reasons, unknown to the architect, sufficient to abrogate the complete school. Criticisms of the plan, however, should be scrutinized carefully. To all appearances, it constitutes the real American public school of tomorrow.



Site Development, High School, Durham, N. C.

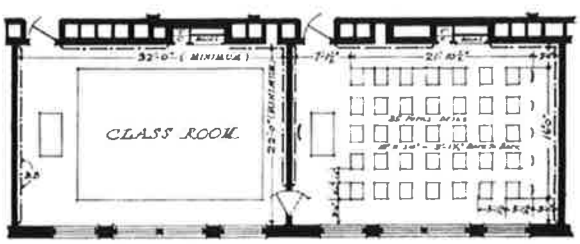
The property consists of 17½ acres with a slope of 12 feet in width permitting daylight basement rooms and minimum of expense in developing athletic field. Teachers' cottages are a unique feature

Milburn & Heister, Architects; Wm. B. Ittner, Consulting Architect; Thomas W. Sears, Landscape Architect

Planning Details of Schools

By WALTER H. KILHAM, F.A.I.A.
Kilham, Hopkins & Greeley, Architects, Boston

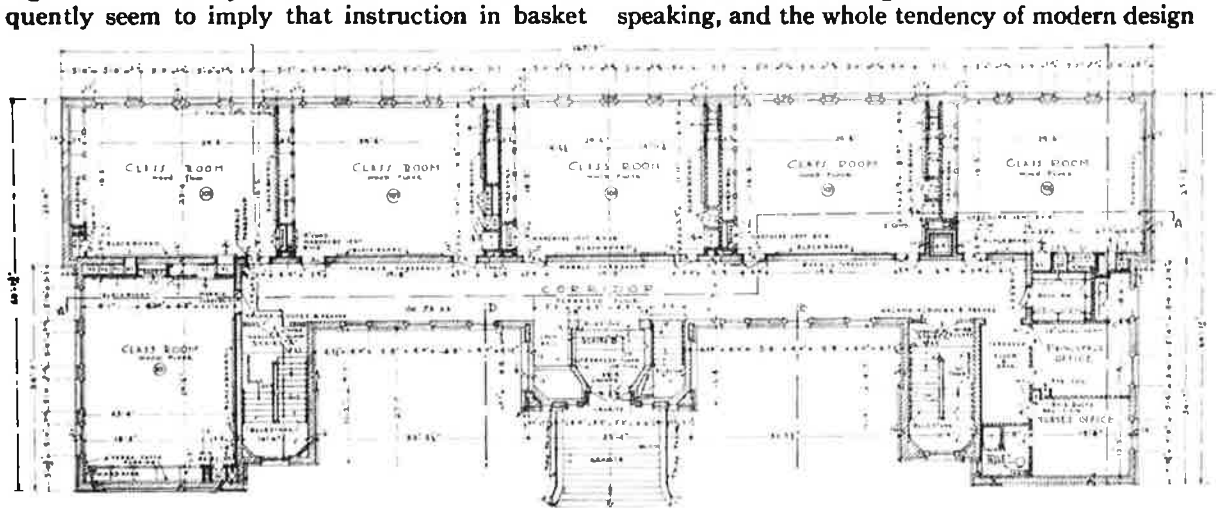
VICE-PRESIDENT Coolidge once wisely said something to the effect that if there were less of the show window in political life and more midnight oil, some distinct advantage might possibly accrue to the general public as well as to the politician himself. The same remark might with some justice be applied to schoolhouse architecture. The designing of school buildings has for a long time been quite generally regarded as a plum to be handed to some favorite son or a political ward leader, rather than as a subject of any careful study by a trained expert; but there are definite signs now that the prevailing high taxes are beginning to cause the taxpayers to look critically at their new school buildings and rather pointedly to express a desire for watertight roofs and walls, substantial, easily cleaned finish which will reduce the cost of upkeep to a minimum instead of tawdry ornaments, and a simple and elastic type of plan which will easily accommodate itself to changing educational fashions; and it is fairly safe to predict that American school architecture for the next decade or so will be obliged to conform rather closely to their theories. These ideas have constituted in a general way the principles which we have followed in our school design for the last 20 years and are expressed more in detail in these pages.



Detail Classroom Plan from Brookline (Mass.) High School Showing Recessed Corridor Doors and Communicating Rooms

Although the programs which enterprising building committees lay before their architects frequently seem to imply that instruction in basket ball and the manufacture of wooden stands for graphophones are more desired than are the "three Rs," there is some ground for the assertion that the humble classroom still remains the backbone of schoolhouse design, just as infantry is said to be the mainstay of an army, and no part of the building should receive more study as to its size, exposure and finish than this apparently simple and prosaic unit.

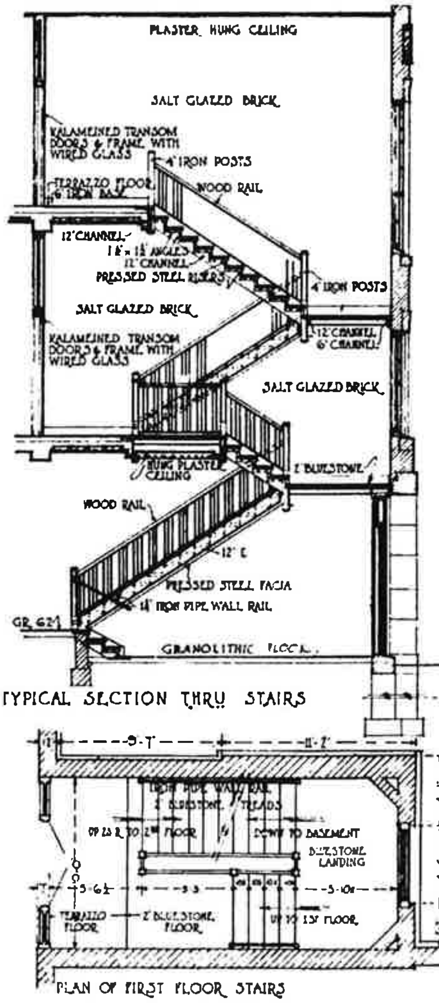
Size of the Classroom. It must, on the average at the present time, accommodate 35 scholars, for the few towns which are holding out for 40 or 42 pupils per teacher are in a diminishing majority, and a few years more will see that factor reduced to 30. Its size and shape then become the architect's first preoccupation, for it will become the dominating unit of the entire building. Given the sizes of desks which are to be used, and supposing them to be arranged five rows deep from the windows and seven rows long, the room, according to Massachusetts standards for a high school, will have a wall aisle on the window side 3 feet wide, four aisles each 1 foot, 6 inches wide and an inner wall aisle of 3 feet. The rear aisle will be 3 feet wide and the desks 3 feet back to back. This totals up like the annexed diagram, and if we allow 7 feet at the front, the room will be 22 x 32 feet, a comfortable size. The committee may prefer to increase this to give a little more feeling of space, but a room over 32 feet long becomes more difficult for speaking, and the whole tendency of modern design



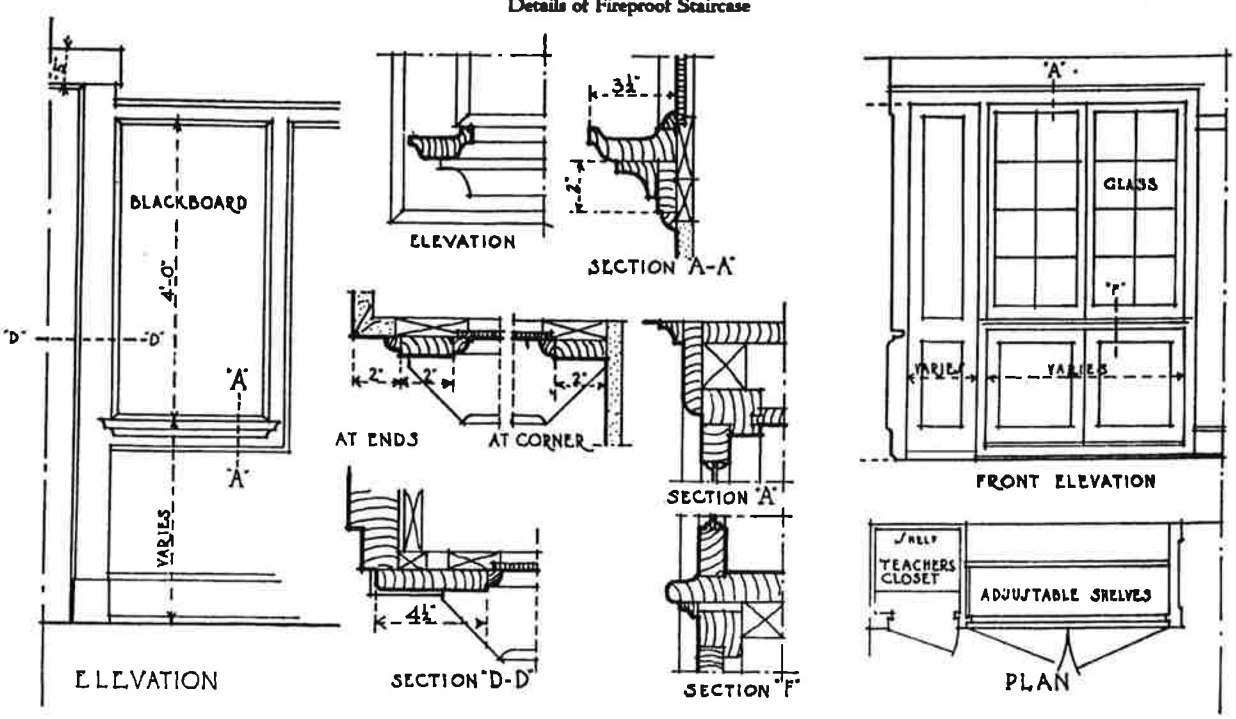
First Floor Plan of Elementary School, Brighton, Mass. Note stairs at ends of corridor with fire-resistive enclosing doors
Kilham, Hopkins & Greeley, Architects

is to keep the rooms as narrow as possible while preserving good proportions so as to get all the seats as near as possible to the windows. Furthermore, there is always the desire of the educational authorities to hold down the size of the room so as to prevent overcrowding — which usually acts to prevent the use of rooms much over the minimum size. It would be a great advantage from the lighting standpoint if it were possible to lay out a room only four rows wide and eight or nine rows long, which would give a room width of only 18 feet, 6 inches, reducing the cost of floor beams and much simplifying the architect's next problem, that of supplying the legal amount of daylight, but such a room is not in favor with educators.

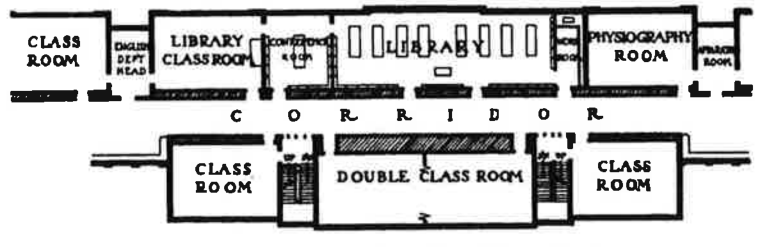
Lighting. Most states are quite particular in requiring that rooms shall be lighted from the left hand side only and that the window wall shall contain a net glass area exclusive of sash and muntins equal to one-fifth the area of the room. This law, like many other schoolhouse regulations, is founded on rather empirical premises, for it entirely fails to take into account the depth of the room from the windows. For example, a room 22 x 30 contains 660 square feet which calls for 132 square feet of glass, but if the room were say 26 x 26 feet, *i.e.*, 4 feet deeper, its area of 676 square feet would, according to law, call for only about the same glass area, a manifest absurdity for the room would be less well lighted. To provide the necessary glass area, the architect is often driven to the use of expensive steel construction for the window wall, particularly if the sub-rule of having no window nearer than 6 feet to the front of the room is followed. I have never been able to see the sense in this rule, as it penalizes the teacher without any corresponding benefit to the scholars, and interviews with several able teachers confirm my own opinion. The windows must be square-headed and run as close as possible to the ceiling, a drop of more than 8 inches not being permissible. Large piers along the window wall are objectionable and should not be used if they inter-



Details of Fireproof Staircase



Details of Blackboard and Classroom Finish
Kilham, Hopkins & Greeley, Architects

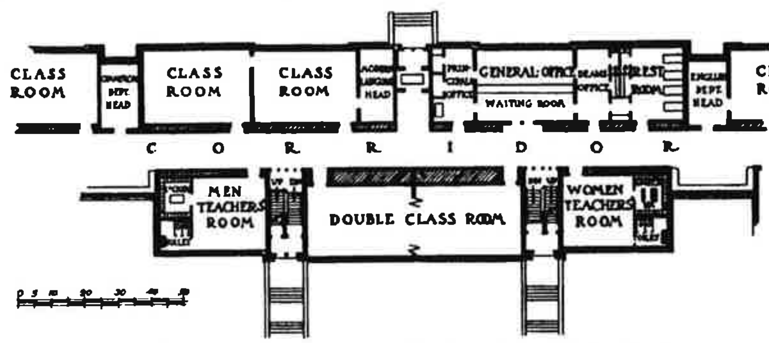


Plan of Library Suite, Brookline (Mass.) High School
Kilham, Hopkins & Greeley, Architects

fere with the diffusion of light, and transoms, on account of the difficulty of cleaning the upper sashes, are generally best omitted. Evidently outside conditions, both of climate and of surrounding objects, have an influence on the lighting of the rooms and must be taken into account; southern California, for example, needs less window space for lighting than Maine, but the 20 per cent rule works fairly well for rooms not over 24 feet deep and less than 12 feet high. I do not consider windows on a second side of the room objectionable for shops, laboratories, or other rooms where the pupils can move about and are not transfixed in one position; in fact, the teachers seldom object to windows at the pupils' backs, even in a classroom.

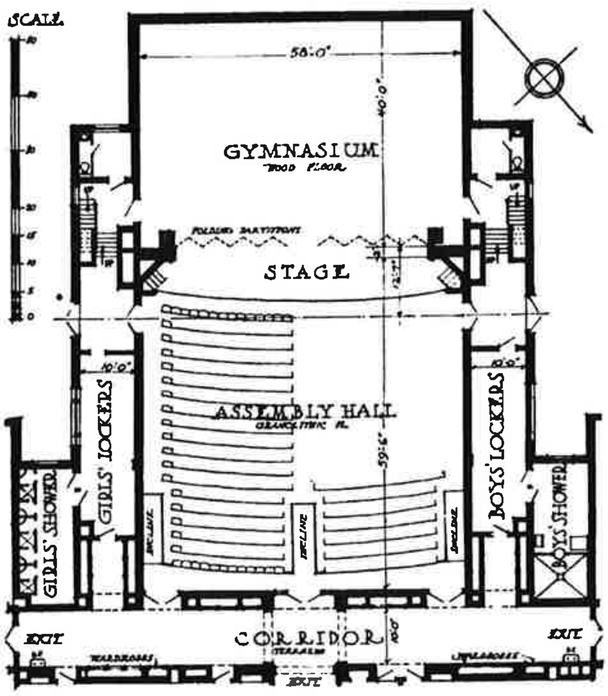
The type of window to be used has next to be decided, whether the ordinary "double hung" or some pivoted type, admitting a free air space equal to the entire window opening. I have found that the teachers generally like the pivoted type in order that they may open them and secure an invigorating flow of outside air, in defiance of the engineer's nicely calculated ventilating system (and the taxpayers' coal bills), while the janitor views them with undisguised contempt because he has to go around and fasten them after school so that they will not be blown open at night and cause possible damage by rain. The custom of dividing the sashes into numerous small panes prevents loss of large panes by breakage, but increases the cost of cleaning. I think that a pane size of perhaps 18 x 24 inches is a good compromise and obviates running into very large sizes which, unless of plate glass, present a poor appearance. Skylighting of classrooms is an expedient of doubtful value for the comfort of the pupils and in cold climates causes undue expense for heating on account of the exposure.

Exposure. The ideal classroom exposure is now held to be southwest, and then west, east and south in the order of preference named. Southwest allows sun to reach the room in the afternoon, after the class has gone without annoying glare during school hours. East and south cause so much glare during the forenoon as to necessitate drawing the shades. Because sunlight is supposed to have some germicidal as well as cheerful influence, north lighting is generally held in disfavor for classrooms, though it is considered allowable for shops, drawing rooms, etc.; nevertheless many teachers favor it on account of its restful effect on the pupils and freedom from eye strain. Some have told me that the amount of "wriggling" noticeable among the pupils was perceptibly less in north lighted rooms. Whatever the points of the compass may be, no room devoted to instruction should ever face on a court, and in fact aside from the wide and open 1-story "patios" used in some California schools no courtyard should ever find a place in a northern 2- or 3-story school building. The theoretical garden treatments of 50- or 60-foot courts with seats, grass plots, etc., with which inexperienced architects sometimes delude committees into accepting an attractive (paper) plan, prove in execution to be dismal failures, impossible to grow anything in and full of dirty snow and ice in winter, while the noise of even a few persons crossing them and talking becomes so intensified as to render the rooms useless. Light courts for toilets, coat rooms, etc., starting at the top of the lower story, are often useful, but are not suitable for lighting classrooms.



Plan of Administration Suite, Brookline (Mass.) High School
Kilham, Hopkins & Greeley, Architects

Opinion now seems to favor a single exit from the classroom in order to afford better control by the teacher. Some states, however, require communicating doors, without locks, between rooms so as to provide a secondary route to another flight of stairs. While this has its disadvantages, it at least allows the pupils, in case they should bolt, to be received by another teacher and not become jammed in the old fashioned coat rooms. A modern building, with fireproof stair towers and smoke doors on the stairs, ought to be panic-proof and probably is, but so far as I know a real test of such a building has not been made. In any event, there should never be more than one door to the same corridor. Classroom doors should open out and contain a good sized area of glass which may well extend the entire length of the door. Transoms are dirt collectors and a useless expense. If the stacks run parallel to the corridors there will be a recess about 3 feet deep at each door,



Detail Plan of Modern Stage-Gymnasium, Wm. G. Crosby High School, Belfast, Me.
Kilham, Hopkins & Greeley, Architects

and if the door is hung on the inside of the recess, flush with the side of the room, the recess will protect it when open, while if hung on the outside it will project into the corridor, causing both an obstruction and a possible source of accidents. These doors generally have a four-lever mortise lock, always free to open from the inside, master keyed, cast brass knobs (not lacquered, as the lacquer wears off unpleasantly), cast brass card holders and 2-inch numbers. The stopwork of the lock is often arranged to be operated by a key.

Other Details of the Classroom. The blackboards will ordinarily occur on the walls back of the teacher and opposite to the windows. The best place for the wardrobes is at the back of the room, opposite the teacher, but this presupposes stacks at right angles to the exterior wall, an arrangement now generally abandoned in favor of carrying them parallel to the corridor. Besides the wardrobes the room will be furnished with a built-in bookcase with glass doors above and drawers below, a small closet for the teacher's wraps, and the usual clock, telephone and ventilating apertures and radiators. The trim is substantial and simple, with all plaster corners well protected.

Corridors. Opinions will vary as to width of corridors. Like a street, they should be able to easily accommodate the population on each side when the classes change periods, but if they are made unnecessarily wide for this purpose there will be a great waste of costly space. Ten feet in the clear is common, and this will appear wider if the open plan is used, with windows along one side, and if wardrobes or lockers are built into the thicknesses of the stacks and the room doors do not open into the corridor space it will be found ample. In any event, corridors should always run towards the light, have floors of noise-absorbing material, and walls durable and easily cleaned. Battleship linoleum for floors and glazed brick for walls fulfill these requirements. Drinking fountains with side-stream bubblers are preferably placed in alcoves in the corridors so as to create no obstruction.

Wardrobes. The separate dressing room and the large locker room in the basement seem to have generally given way to a system of wardrobes arranged around the building on different floors. Some favor alcoves or special rooms for this purpose, but many administrators object to anything which allows space for concealment. In an elementary school, where each pupil has a home desk, the wardrobes may open into the rooms, but in a high school they usually open into the corridors, and if neatly constructed will not disfigure the walls, as the entire wall above the 6-foot line is left clear for pictures, etc. Thus arranged, the entire system is easily supervised, and pilfering, that bane of the school principal's life, may be eliminated.

Stairs, Ramps and Exits. No building or part of a building should have less than two means of egress, entirely independent and located as far apart as possible, and more should be provided in proportion to the building's size. Stairways should be located at the ends of corridors, so as to preclude any dead ends of corridors beyond the stairways which might form traps. They should be enclosed in stair halls, separated from the corridors by fireproof, self-closing doors and located between the corridor and the exterior wall so as to lead directly out of doors. I cannot agree to the practice which prevails in some sections of locating stairways in the interior of a building, with wells open from bottom to top, and delivering the pupils in the main corridor of the first floor from which they have to seek an exit, instead of in the open air. Such stairways may become immediately impassable on account of smoke, even if the building is fireproof and the fire insignificant. It is true that the narrow ends of stair wells do not always compose well on the elevation, but the safety of the pupils should be the paramount consideration.

The rise and tread should be easy, say about 6½ to 7 inches by 10½ or 11 inches, free from winders, and the width from 4 feet, 6 inches to 5 feet. This will easily accommodate two lines of pupils, each within reach of the handrail. A third line would need a center rail. Over 5 feet is too wide. Treads should be of some material which affords a sure footing. My observation shows that at the ordinary rate in changing periods a class completely descended a flight of stairs, marching two abreast, at the rate of one person per second, *i.e.*, a complete class of 40 persons in 40 seconds. Some authorities say that 120 persons, marching 2 abreast, can pass a given point in less than a minute. One of our school buildings, containing over 2,000 pupils where I made observations, is emptied at the fire drill in 2 minutes, using seven exits. If the New York rule, allowing not over 3 minutes for completely vacating a building is followed, this would seem to indicate the need of providing a minimum of one staircase for about every 450 persons, but I should regard this provision as insufficient. Of course this is independent of natural convenience and special locations such as balconies in auditoriums, and in large buildings additional stairways —which may well serve special groups of rooms— should be added. I recently saw the plan of a large high school in which in going from a given point to a corresponding point on a different floor a horizontal travel of over 250 feet was necessary, which is both fatiguing and wasteful of time, and convenience of circulation should be considered as well as safety from fire. It is hardly necessary to say that stairs should be fireproof, or at least fire-resistive, with windows to the outer air and absolutely without closets under the lower landings which are sure accumulators of rubbish.

The railings should be of simple pattern, with mainly vertical members to avoid lodgement of dust, and the newels should be perfectly plain and free from sharply projecting mouldings. Solid balustrades have found some favor in order, theoretically, to avoid embarrassment of girl pupils, though since the prevailing styles have come in it is the boys who seem more likely to be embarrassed.

Ramps. These are undoubtedly of great comfort and value, but on account of the space they occupy are not in common use. Some examples were shown in THE ARCHITECTURAL FORUM for September, 1921. The rise should not be over 1 in 10, and the surface should be treated with some form of non-slip material.

Toilets. Generally toilets are now located in well lighted, single groups (*i.e.*, one boys' and one girls') on each floor, and are equipped with plumbing fixtures in approximately these proportions:

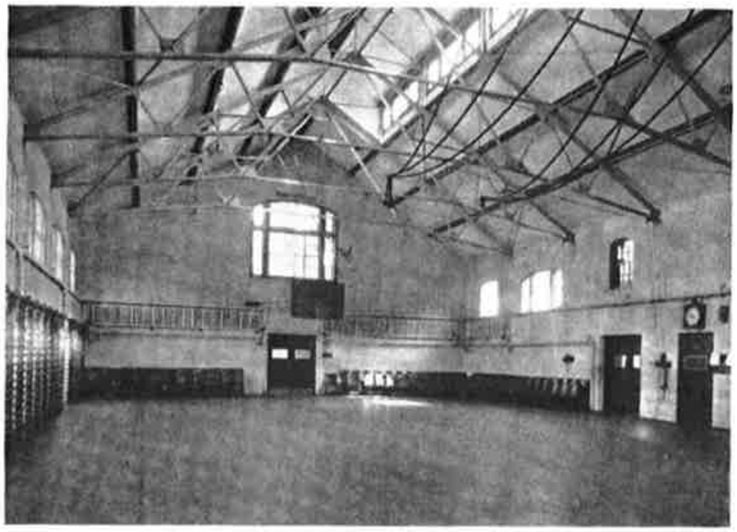
Pupils	Water Closets Girls'	Water Closets Boys'	Urinals	Slabs Ft.	Slabs Ins.
50	3	2	2	2	8
100	4	3	4	5	4
200	6	4	6	8	0
300	8	5	8	10	8
400	12	8	10	13	4
500	14	9	12	16	0

The floors and walls should be non-absorbent and easily cleaned; for example, asphalt floors and glazed brick walls. The water closet stalls must have partitions and doors on legs at least a foot above the floor, and much careful study should be given to the types of fixtures and fittings employed, with a view to the utmost ease of cleaning and inspection, as well as to special exhaust ventilation. A safe rule provides that windows, admitting daylight, be of one-tenth the toilet room's area.

Administration Suite. Ordinarily the administration suite will consist of a private office and toilet for the principal and a room for his secretary and clerks of a size proportionate to the building, with a long counter under which the filing cases are installed to separate them from the public waiting space. A vault and good sized book storage room complete the ordinary equipment, but in a large co-educational school the dean of girls will require an office similar to the principal's, with the school nurse's room or clinic adjoining. While I fully concur in any attempt to give a cheerful and attractive air to a schoolhouse, I feel that such an accessory as a fireplace in the administration suite is unnecessary, as it is never used and occupies valuable space. A retiring room for girls is appropriately placed next to the nurse's room, and a rest room is desirable for girls, while accommodation for boys who may have met with accidents can be made in connection with the clinic or the male teachers' quarters.

Library. The school library is a feature that is only beginning to come into its own. It must be located centrally, particularly in relation to the Eng-

Plan of Gymnasium and Locker Rooms, South Junior High School, Waltham, Mass.
An arrangement showing economy in floor space and simplification of plumbing
Kilham, Hopkins & Greeley, Architects



Gymnasium of High School, Milton, Mass.
Kilham, Hopkins & Greeley, Architects

lish and language departments, and is generally furnished with tables seating not over six. The checking desk is arranged near the entrance. A classroom with stereopticon adjoins the library, and a workroom with good light and a sink is necessary for the attendant who takes care of the books, photographs, etc. The cases will be designed according to the local requirements, but the room is entitled to a little architectural treatment and a fireplace is permissible, and if it could be used only now and then would be desirable.

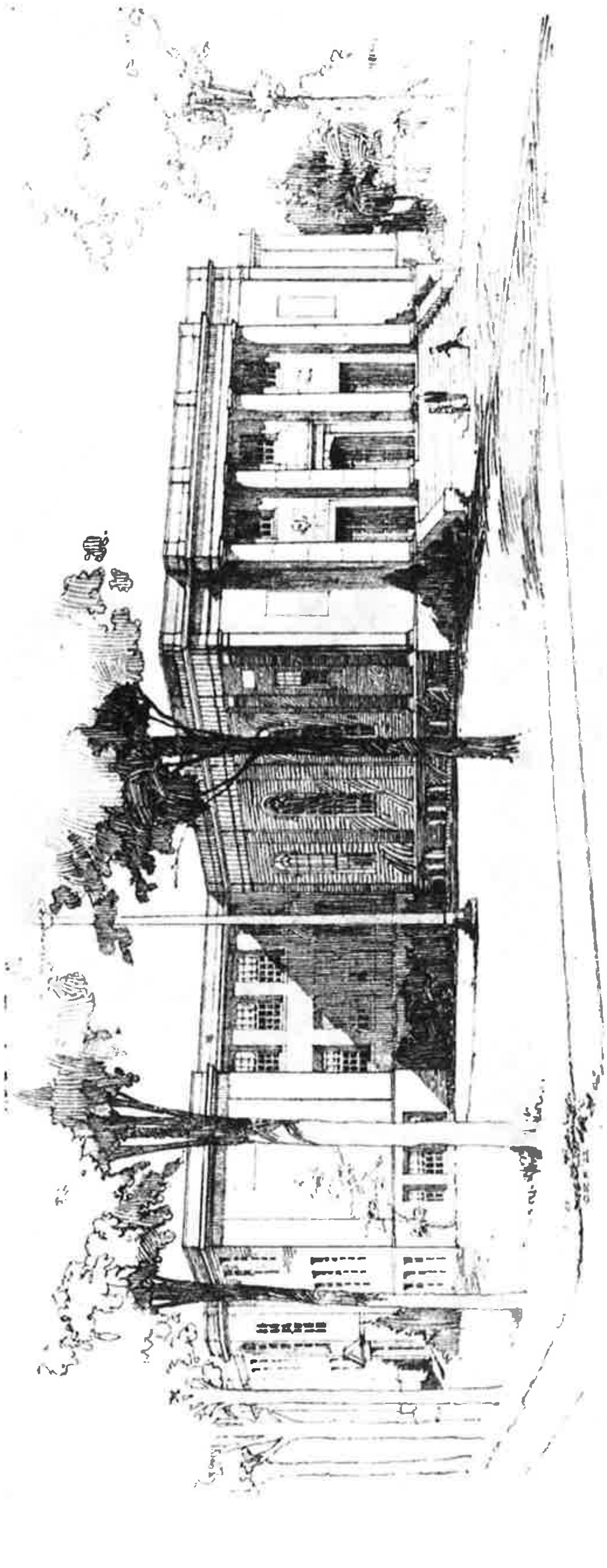
Laboratories. The chemistry laboratory together with the rest of the science department is often located in the top story with the idea of providing easy removal of odors. This involves long runs of drains to the ground, all subject to corrosion and leakage, and there is much to say in favor of placing these rooms on the ground floor where leakage will do no harm, and considering that as many gases are heavier than air as are lighter, the question of odors is at least no more difficult. Furthermore, biology and agriculture are fully as well taught in the lower stories. Because the pupils can move about, the southwest exposure is not essential and a north exposure, excepting for biology or agriculture, will be suitable.

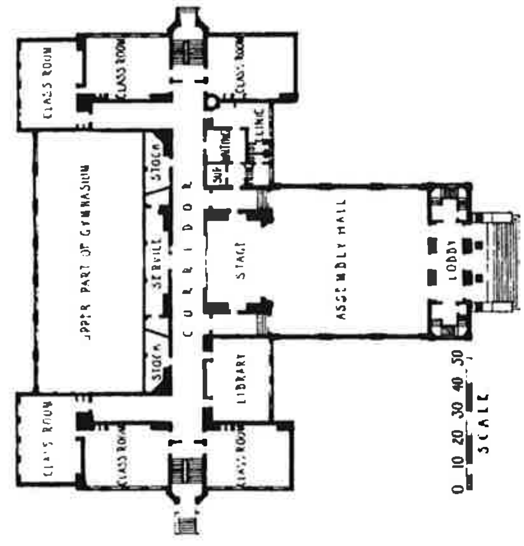
Drawing Rooms. These rooms are best located with a north exposure and a certain amount of skylighting, if of the north-facing, sawtooth variety, is permissible. Cases for drawing boards, paper, etc., are needed and facilities for exhibition of the pupils' work, together with a washbowl and a large sink, will often be found useful.

Auditorium, Gymnasium, etc. It seems now to be necessary to discuss these under one heading. The various attempts to combine the auditorium and gymnasium in one room have not met with much success and are gradually developing into the type of plan in which the gymnasium forms the actual stage, with a proscenium opening of 50 feet or so which may be closed by a more or less soundproof arrangement of doors, and which allows gymnasium exercises, standard basket ball, etc., to be carried on in full view of the audience. The auditorium has a sloping floor, and the stage-gymnasium will provide a place for the school dances. Some cities refuse to accept this idea, but in general there is a demand for larger stage accommodations and a tendency toward providing many of the appurtenances of a theater. Use of the school auditorium by the general public for community purposes is often demanded, especially in smaller cities, and it must be easy of access and provided with special entrances for the public. Location on the ground floor is of course essential, and it may be placed in the center of the building, or even in front if the locality seems to demand it. The deep stage causes a distinct acoustical problem, and the wide rear balcony which has more or less succeeded the narrow side balconies creates a cavernous space underneath which is always likely to be dark and stuffy. The auditorium of the future will probably be amphitheatrical in type, free from balconies and even located below the first floor level, while the passion for "elasticity" may even bring about a system of subdivisions into classroom spaces. The difficulty of making a large auditorium function as well acoustically with a few persons present rehearsing a school play or concert as with a packed audience must eventually affect its type and plan materially, so that I believe the school auditorium at present is in a transition stage between the theater and arena types.

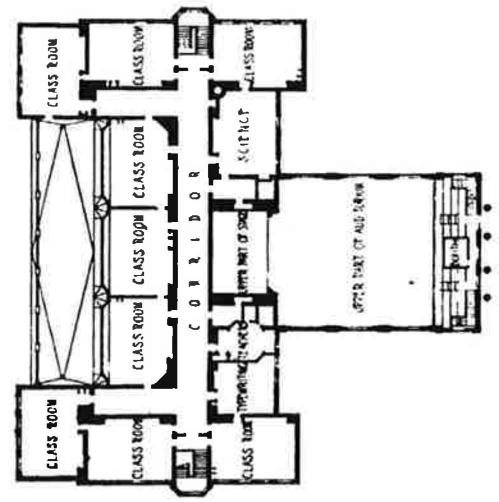
Another influence which affects the auditorium is the question of its adaptability for motion picture shows *vs.* concerts, theatricals, etc. The motion picture side favors a rather long and narrow room in which the spectators in no seats view the screen from too wide an angle, while for general purposes, and particularly for speaking, a wider and shallower hall is preferable.

The fixing of the proportion of seats in the auditorium to the desk seating capacity of the entire building is a question that ought to be regulated, since inexperienced committees in their enthusiasm sometimes make costly mistakes by too greatly increasing its size,—and architects, in their growing capacity of trusted advisers to building committees, will find that this question opens up a promising and useful field for research in the relation of plan to school administration.

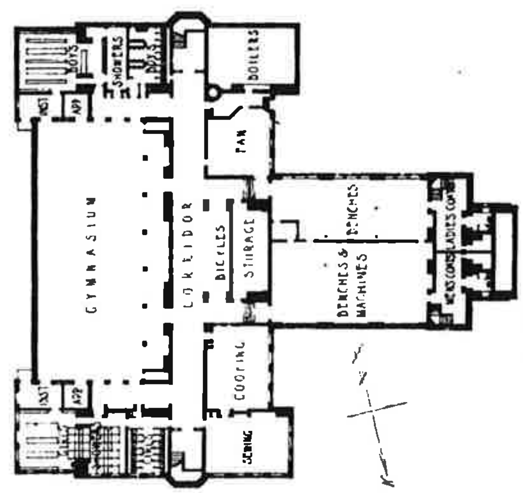




FIRST FLOOR PLAN



SECOND FLOOR PLAN



BASEMENT FLOOR PLAN

SOUTH JUNIOR HIGH SCHOOL, WALTHAM, MASS.

KILHAM, HOPKINS & GREELEY, ARCHITECTS

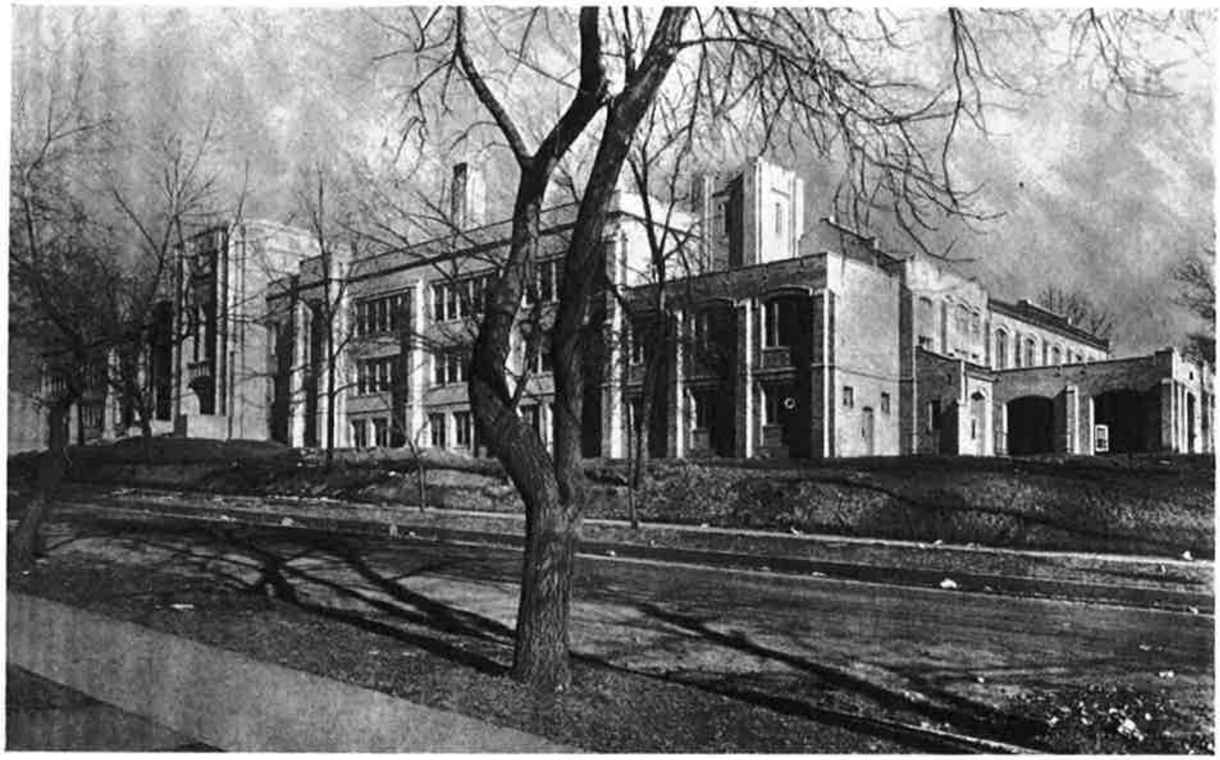
SOUTH JUNIOR HIGH SCHOOL
WALTHAM, MASS.

Illustrations on Plate 19

THIS school is now under construction at a cost of $256,000. It accommodates 640 pupils, making a building cost per pupil of $400.

The cubic foot cost is 32 cents.

The exterior of the building is of red water-struck brick and Indiana limestone. The construction is second class, with fireproof stairs and corridors.



GENERAL VIEW OF EXTERIOR

DETAIL OF ENTRANCE FRONT

WM. N. BYERS JUNIOR HIGH SCHOOL, DENVER

WM. N. BOWMAN CO., ARCHITECTS

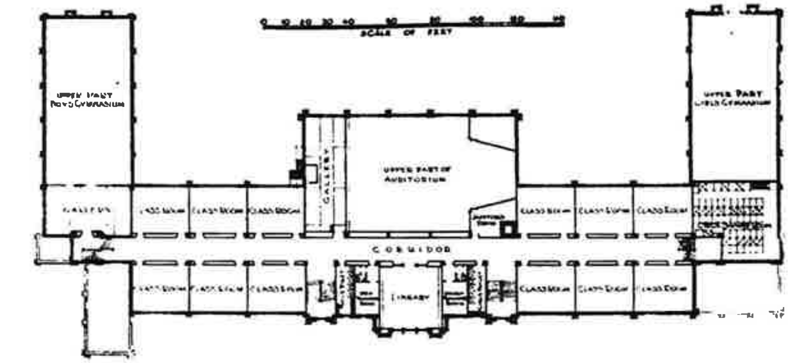
WM. N. BYERS JUNIOR HIGH SCHOOL
DENVER

Illustrations on Plate 20

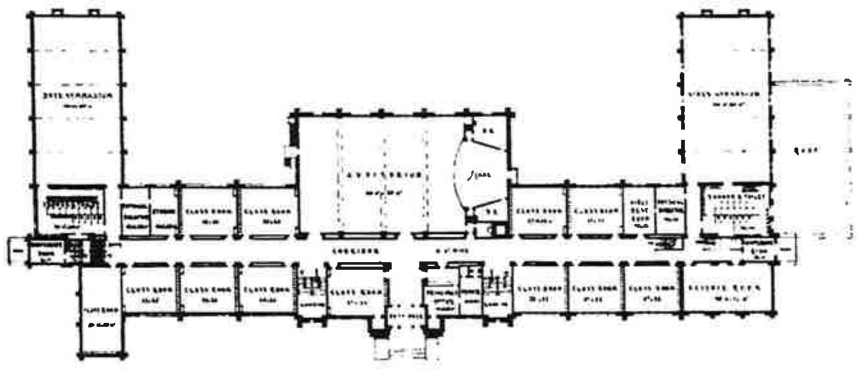
THIS high school was finished in September, 1921, at a cost of $540,000. It accommodates 1150 pupils, excluding equipment, making a building cost per pupil of $470.

The cost per cubic foot was 37 cents.

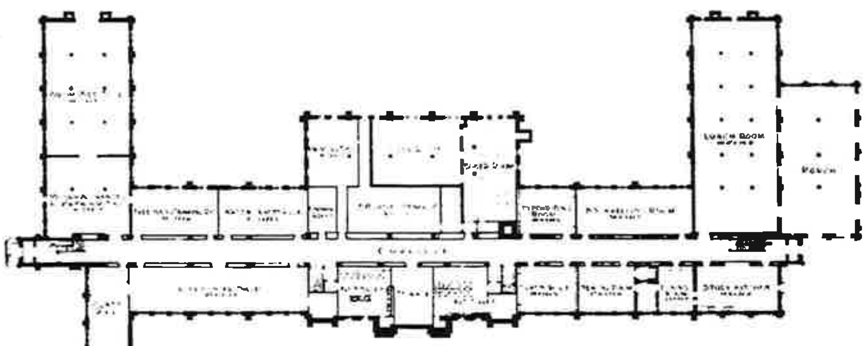
The exterior of the building is of light, rough textured brick trimmed in terra cotta. Construction is fireproof and mechanical ventilation is provided.



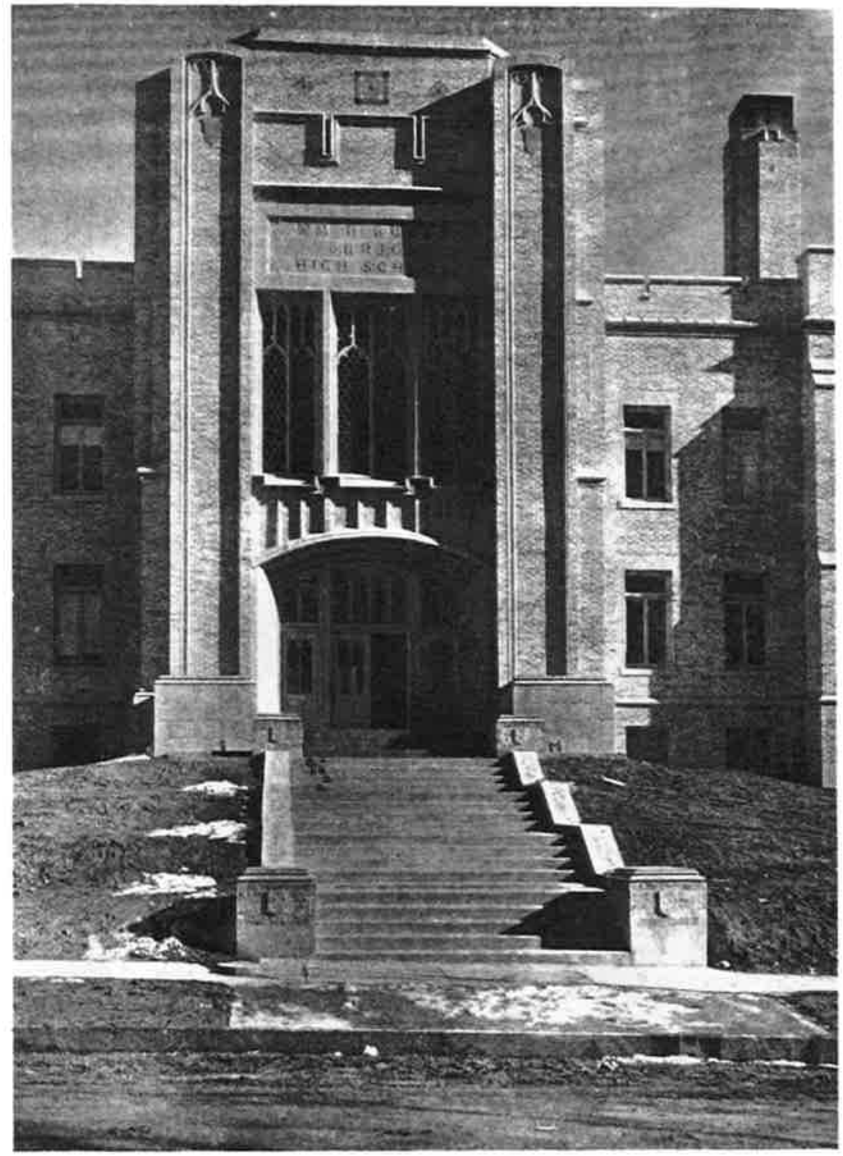
SECOND FLOOR PLAN



FIRST FLOOR PLAN



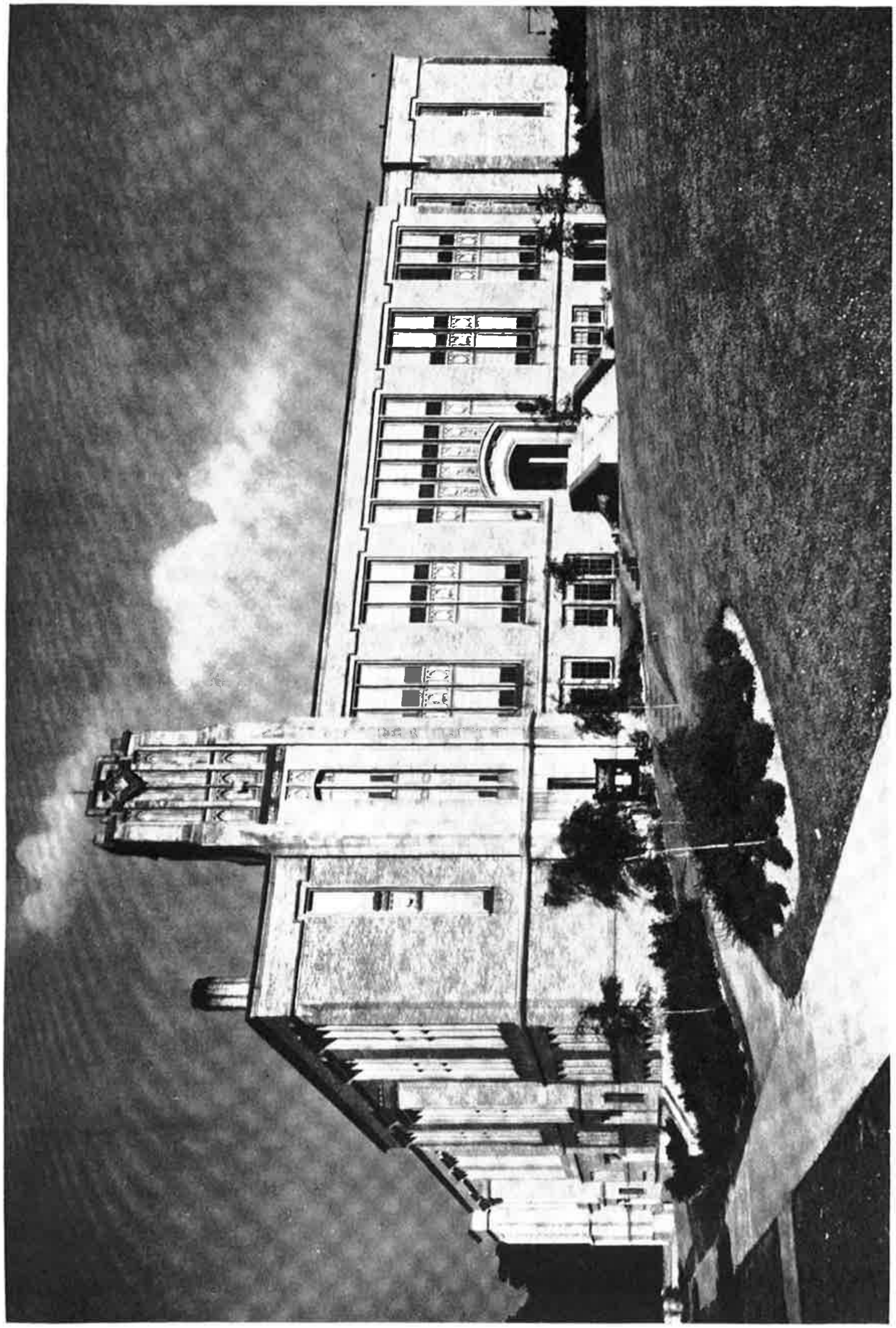
GROUND FLOOR PLAN



DETAIL OF ENTRANCE AND TOWER

WM. N. BYERS JUNIOR HIGH SCHOOL, DENVER

WM. N. BOWMAN CO., ARCHITECTS



GENERAL EXTERIOR VIEW

COVENTRY ELEMENTARY SCHOOL, CLEVELAND HEIGHTS, OHIO

FRANZ C WARNER, ARCHITECT

COVENTRY ELEMENTARY SCHOOL, CLEVELAND HEIGHTS, OHIO

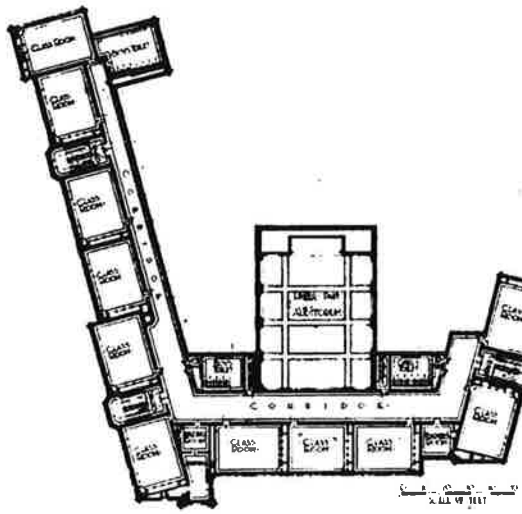
Illustrations on Plate 22

THE contract for the main building of this school was let in November, 1917, and the contract for the addition in January, 1921. The total cost of the building was $519,375. It accommodates 760 pupils, making a building cost per pupil of $683, including equipment.

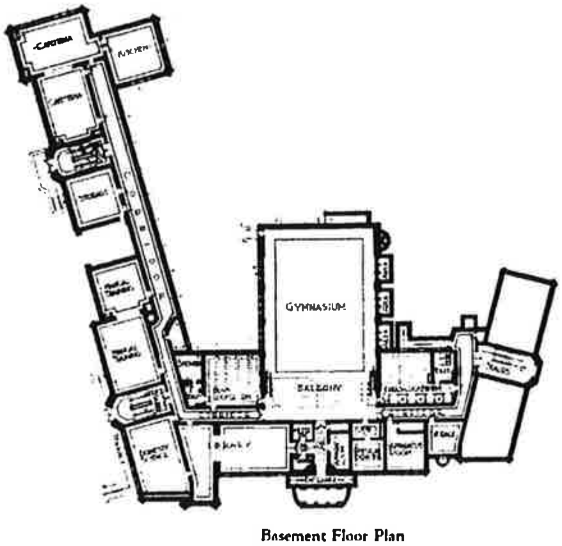
The cubic foot cost of the main building in 1917 was 33 cents and of the addition in 1921, 65.2 cents. The complete building averaged 42.4 cents.

The exterior is of salmon-buff face brick in mingled shades with sandstone trim. Construction is fireproof, with brick bearing walls, reinforced concrete and steel interior framing and concrete floors; composition roof with copper sheet metal.

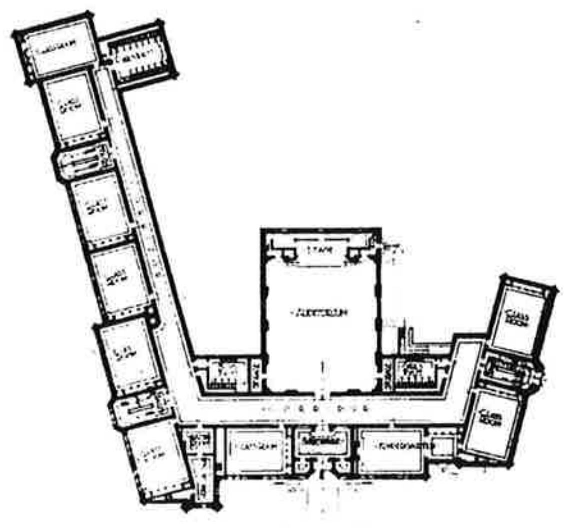
Separate heating and ventilating systems are provided for auditorium, gymnasium and schoolrooms, ventilating systems having both supply and exhaust fans.



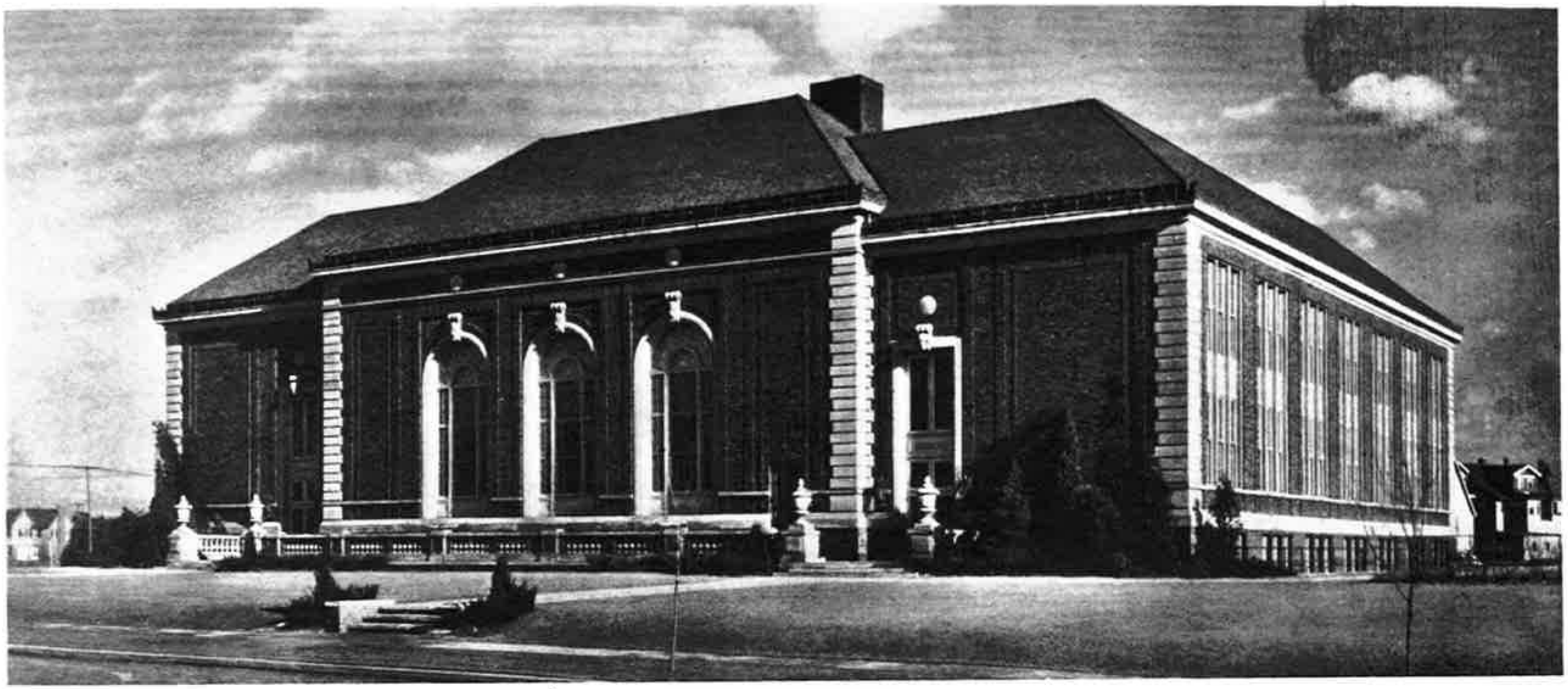
Second Floor Plan



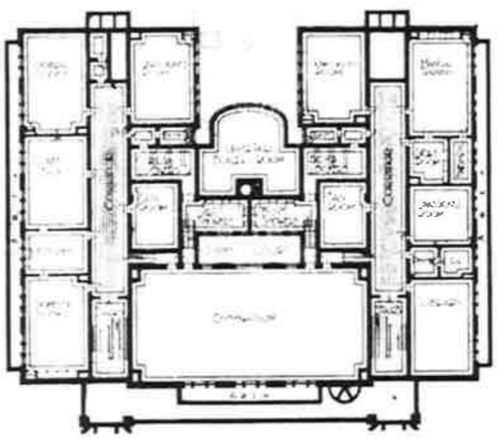
Basement Floor Plan



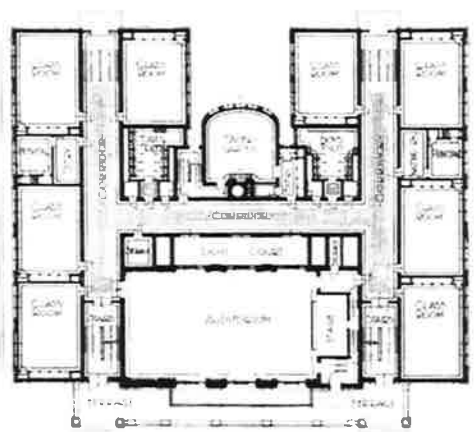
First Floor Plan



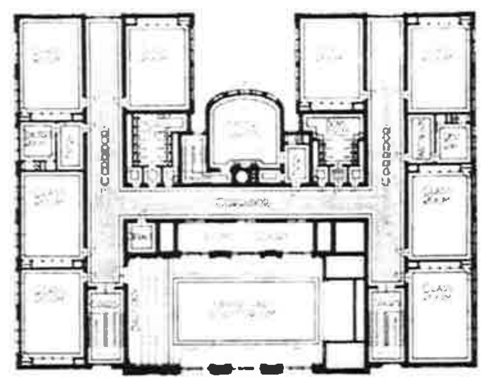
GENERAL EXTERIOR VIEW



BASEMENT FLOOR PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN

ROXBORO ELEMENTARY SCHOOL, CLEVELAND HEIGHTS, OHIO

FRANZ C. WARNER, ARCHITECT

ROXBORO ELEMENTARY SCHOOL
CLEVELAND HEIGHTS, OHIO

Illustrations on Plate 23

THIS school was finished in 1920 at a cost of $494,000. It accommodates 630 pupils, making a building cost per pupil of $785, including equipment.

The cubic foot cost was 49.4 cents.

The exterior of this school is of dark red face brick in mingled shades, with sandstone trim; roof of tile with copper sheet metal work. The construction is fireproof.

The building is heated by the split steam system, with separate heating and ventilating systems for auditorium, gymnasium and classrooms.

Special Room Design and Equipment

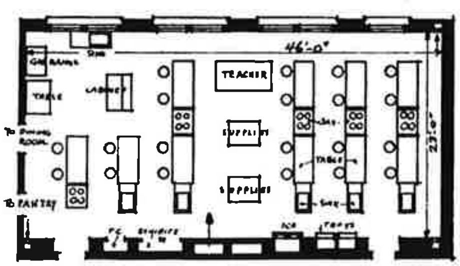
By JOSEPH C. LLEWELLYN, F.A.I.A.
Joseph C. Llewellyn Co., Architects, Chicago

IN all high school buildings special lines are taught for which special floor arrangements and equipment must be provided. These comprise home economics, industrial arts, general science, biology and agriculture, physics and chemistry, and the commercial branches. Add to these departments physical education with its attendant games and contests, and we have one of the chief reasons for the rapid growth in recent years in numbers of pupils and the increase in space requirements.

Planning for an average school, we must keep in mind the fact that schools grow and that one department may grow faster than another, that one study in a group of what may be kindred studies may have more students than another, and that this element of growth must be provided for. An aid to caring for this sometimes unequal growth is found in grouping kindred studies, requiring much the same equipment and space, in the same part of the building so that the rooms can be used interchangeably and extra class periods provided for by using the vacant periods in any of the rooms similarly arranged and equipped for classes in other branches. A further aid to expansion is by grouping the rooms so that new rooms in extensions to the buildings can be grouped with existing departments.

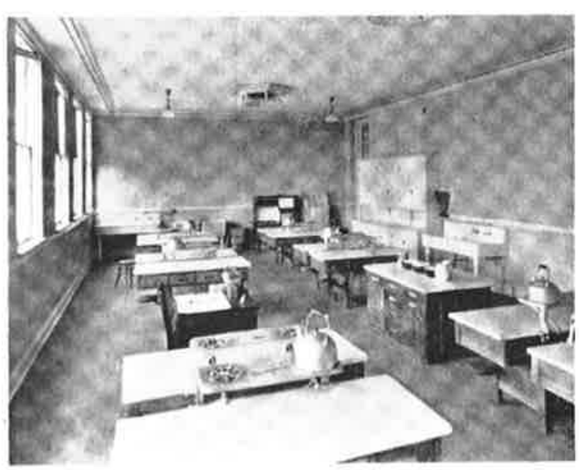
The character of the community in which the school is located will have an effect on the number and type of rooms provided for special branches; the architect, in planning his building, should know the character of the population supporting the school and adapt his building to the needs of the community. For this information the architect has to depend largely on the superintendent of schools and, as far as permitted, upon the heads of the departments. A wideawake superintendent will call upon his department heads for suggestions as to plans and the conduct of their departments. In all cases, however, it is essential to keep in mind the ultimate growth of the school and plan for extensions, as well as to arrange for later installation of equipment wanted but not possible at first. Hence the wisdom of planning first for essentials with allowance for growth, and also provision for still larger growth by later additions.

Taking the departments in the order named, the first is the home economics group—cooking, sewing, millinery, housekeeping and laundering. Cooking and sewing are often the only branches taught at first, while in many schools all are installed. The cooking room is arranged on the unit plan, giving to each four pupils two standard tables, one gas stove with four burners and oven, and a sink with drainboard. Two detached tables with sink and stove form a fifth group. A sixth unit is arranged as a home kitchen with cabinet, sink, range and table. The teacher's desk and supply tables are located in the center of the room. A refrigerator, laundry tubs, teacher's case, and storage or exhibit cases are built within the body of corridor walls or elsewhere. The arrangement is as shown by the sketch plan of the Benjamin Bosse High School, Evansville, Indiana, and reference to illustrations of rooms in earlier schools will show the change from hollow square to detached units in cooking room arrangement within a very few years,—the unit ar-



Plan of Modern Domestic Science Room

Intermediate Type in Evolution from Hollow Square
Senior High School, Benton Harbor, Mich.



Modern Domestic Science Room Arrangement
Junior High School, Beloit, Wis.

Joseph C. Llewellyn Co., Architects

rangement now being in favor. A practice dining room with china and storage pantries is grouped with this cooking room. A living room, bedroom and bath, grouped with the dining room and kitchen of the cooking room, would give opportunity to illustrate and practice other branches of housekeeping.

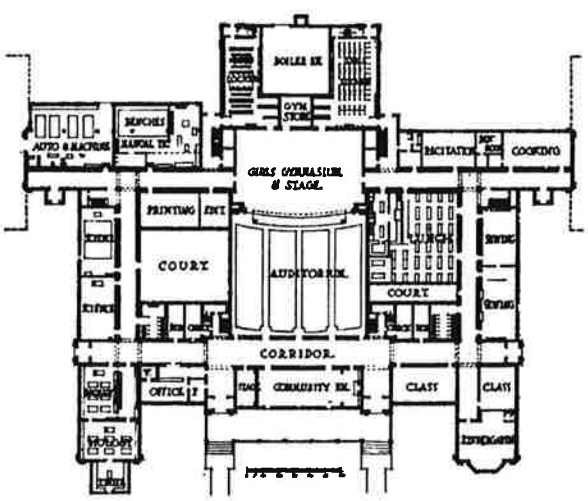
The sewing room is arranged for 24 pupils, all facing one way with light to the left. Teacher's desk and supply and work case are at the front of the room. Sewing machines are arranged along outside wall, and ironing boards at the rear. Tables will accommodate the work of three classes. Provision for extra pupils is provided by cases within the wall or in the case at the front of the room. A large cutting table with drawers for materials gives added provision for work and storage. The fitting room, often built in, gives way to an alcove screened in by the three-part mirror which is set aside when not needed. A second sewing room can be used for classes in millinery as well as for sewing, or it can be used as a classroom until such time as it is needed for sewing.

The lunch room is an important element in the modern school. In smaller schools the lunch room is sometimes managed by the domestic science department, in which case it should be grouped with the cooking department. The school will soon outgrow this arrangement, however, and the lunch room will become a separate unit as far as management is concerned. The scheme of school administration has a bearing on the size of the lunch room. With a two-session day growing in favor in some sections, a large proportion of the pupils go home for lunch and a much smaller floor space will be necessary than in case of the school operating on the single-session plan where all pupils have lunch in the school building. In either case, the floor space necessary to care for all pupils lunching in the building, in not more than three shifts, is the minimum.

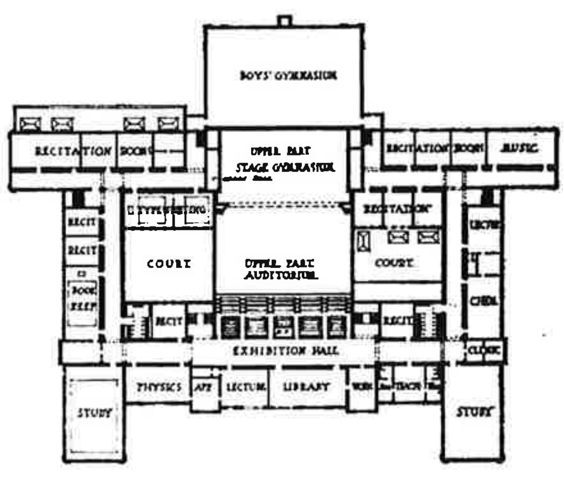
The arrangement will vary for various schools, ranging from the open kitchen and counter in smaller schools to detached and more completely equipped kitchens, with counter only in the lunch room proper, in the larger schools. Kitchen equipment will include ranges, bake oven, steamer, cook's table, vegetable parer, dish-washer and refrigerator. Ventilation of kitchen and lunch rooms should be by exhaust fans. Large kitchens will be similar, with larger units or a duplication of units. The serving counter will contain places for trays, silver, steam table, ice cream, milk cabinet and coffee urns, and the intervening spaces for bread, pastries, etc.—the under portion of the counter, to within 8 inches of the floor being shelved for dishes or other uses.

The equipment for kitchens and lunch rooms, including counters and tables, has been quite thoroughly standardized by houses specializing in this equipment; they use non-absorbent materials in the construction of tables and counters which are difficult to obtain from other dealers. With equipment determined upon, sewer, water, gas and electrical connections properly located must be provided. Impervious floors and walls permitting of frequent flushing or washing are essential in lunch rooms and kitchens, and proper drainage must be provided for this purpose. For table tops, satisfactory use is made by different schools of glass, enameled steel, linoleum glued down to wood base and bordered with neatly fitted hardwood, or wood well finished with waterproof varnish.

The first requirement in an industrial arts department is the woodworking shop. In the upper grades or junior high schools the equipment is often limited to the woodworking benches for the class, variety saw for cutting up of material, and provisions for gluing up of work, the rest of the operations being done by hand. In larger schools the bench room is supplemented by machinery and the work is more advanced. The efficiency of any shop is not in the number of machines installed but in the selection and proper placing of machines so as to give ample floor



First Floor Plan



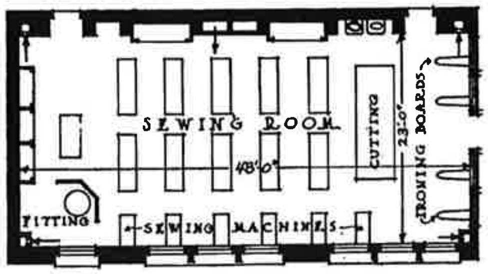
Second Floor Plan

Benjamin Bosse High School, Evansville, Ind.

Joseph C. Llewellyn Co., Architects

space for their operation and a logical sequence to the steps in the process of work. As a basis for the woodworking machine room, this equipment will prove adequate excepting in very large schools or trade schools:

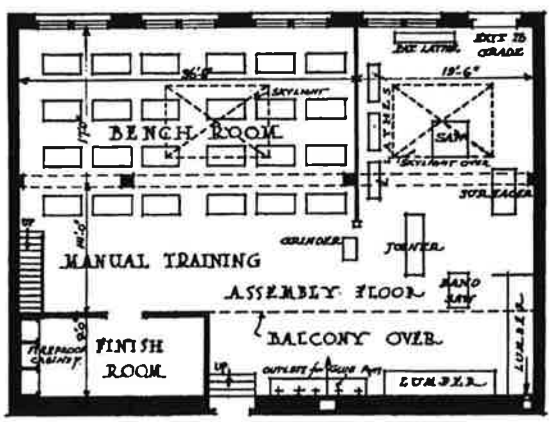
1 24-in. surfacer.
1 16-in. jointer.
1 14-in. variety saw, if mortising and tenoning attachments are desired, or a universal saw if without these attachments.
1 30-in. band saw.
Students' turning lathes as necessary to care for the classes, and possibly a 6-in. pattern-making lathe, all to be located so as to give unobstructed floor space for their operation.
A grinder with two oil stone wheels, with cone and emery wheel and leather strapping wheel, should be placed where convenient to both machine shop and bench room.



Sewing Room Plan for 24 pupils

Any extension in space and in machines should be carefully considered and had only when needed to fit in with a well thought out plan of operation; it may include mortising and tenoning machines, sanders, additional jointers, the whole thought being to furnish only what will fit in with the actual need of the school as developed.

For the bench room, single benches for the class unit are preferable, placed with reference to getting the best lighting for the work. Floor space for the erection and storage of articles under construction is necessary, and a glue bench with an electric or gas glue pot is required. A finishing room, enclosed, and provided with a fireproof storage room or steel cabinet for storing of paints or varnishes will complete the requirements for a woodworking shop. Additional floor space for temporary storing of completed work can be obtained by building a balcony, as indicated on the plan. In the layout of shops the principal thing, as already said, is to have floor space for the various operations. We much prefer to work out the arrangement, both as to the number and disposition of machines and other equipment, with the instructor who will have charge.

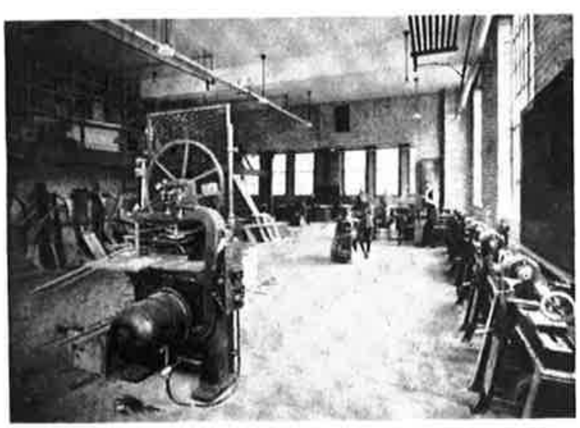


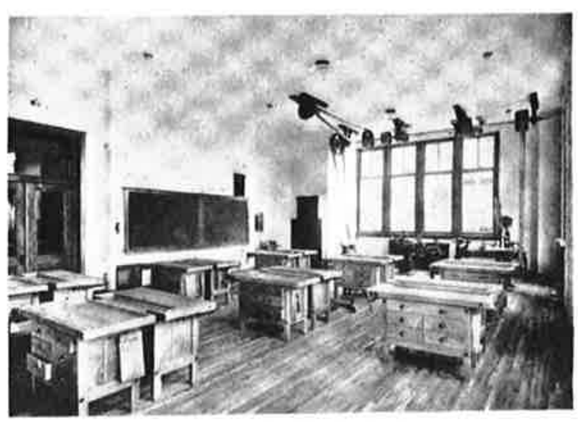
Bench and Wood Machinery Work Combined in One Room

The machine shop in the average school appears to be giving way to a combination auto and machine shop where the study of automobile construction and repair, involving machine operations, will constitute the training in this branch. For this work plenty of space is necessary rather than a large equipment. A shop equipped with these machines will be found to meet most requirements:

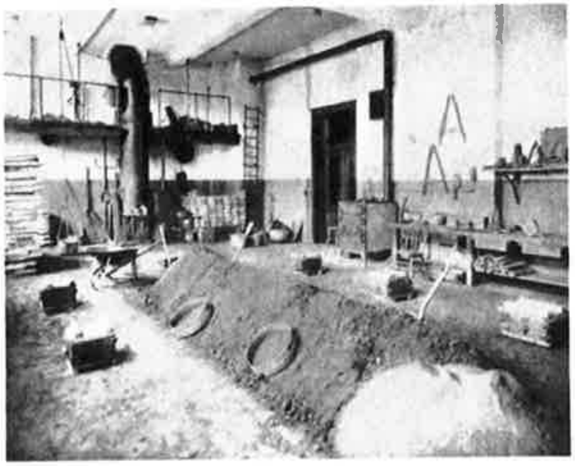
1 6-ft. lathe, 14-in. swing.
1 hydraulic or hand-power press.
1 portable forge, hand-power, with anvil and tools, or this can be equipped with motor plugged into a wall receptacle.
1 grinder with bench tools, vises, etc., as necessary.
1 drill.

Extension of the machine shop for more varied work will depend upon the school and the direction of its growth. Machines probably added would be a shaper, a milling machine, larger lathes, and a

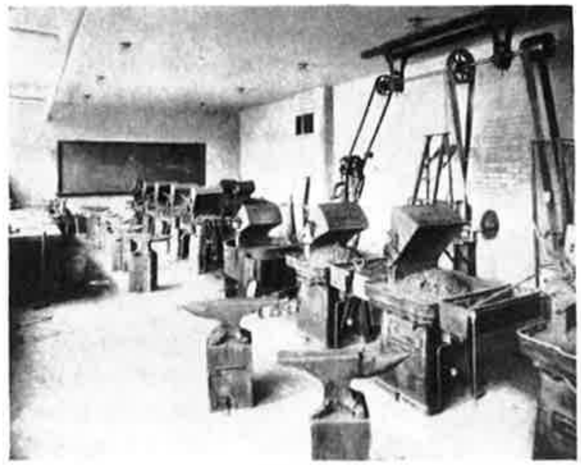

Woodworking Machinery Room
Deerfield-Shields Township High School


Bench Room with Small Machine Equipment
Hixon Annex, High School, La Crosse, Wis.

Joseph C. Llewellyn Co., Architects



Foundry



Forge Room

Hixon Annex, High School, La Crosse, Wis.
Joseph C. Llewellyn Co., Architects

planer—sizes and types depending on conditions.

Foundry and forge rooms, when wanted, will include this basic equipment:

For the foundry:

Cupola (½-ton capacity or larger as required) equipped with blower.

Moulding floor.

Moulding benches.

Flasks.

Core oven.

Brass furnace.

Where the foundry is included, pattern making can be added to the work of the woodworking department.

For the forge room:

Forges in the number desired, connected by underground piping to a blower and also to an exhaust fan.

To the forges can be added:

Small power hammer.

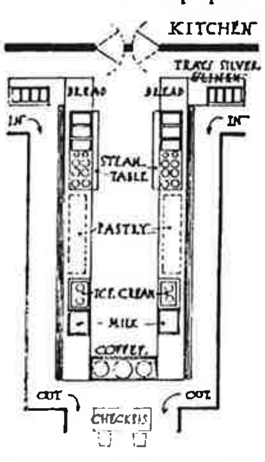
Shear and punch.

Drill press.

Grinder.

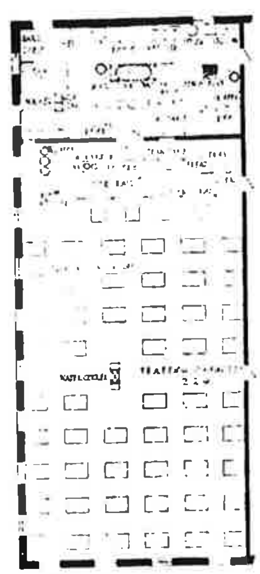
These, with anvils and tools, and bench with vise and hand tool equipment, will complete what is absolutely necessary in the forge room. In all shops the element of safety has to be considered. Requirements are quite thoroughly covered by state regulations, and many of the machines are now manufactured so as to care for this feature quite within the construction of the machine itself. The individual drive of machines by motors eliminates practically all of the danger due to belt-driven machinery and is rapidly growing in favor.

For the science group, the room requirements must give space for tables for a class not to exceed 24 pupils. In this group we place general science, biology, agriculture, physics and chemistry. The room for general science requires only a demonstration table with sink and an extra sink at the wall. The pupils in this branch perform no individual experiments. A stone shelf, secured to the outer wall under the windows and equipped with water, small hosecock, and waste connections, and provided with gas and electric outlets for use if desired, will afford opportunity for placing aquaria or other propagating appliances and for other uses, and adds a degree of flexibility to the



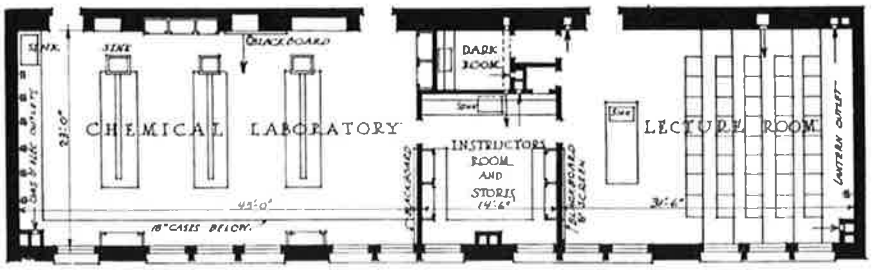
Detail Layout of Double Service Counter

Cafeteria, Academic Building, Berkeley High School, Berkeley, Calif.
William C. Hays, Architect; A. Appleton and Joseph J. Rankin, Associates



Kitchen and Cafeteria Plan for 224 pupils room which is desirable.

For biology, agriculture, physics and chemistry lecture rooms, tables similar to that used in the general science room, but larger, will be required, fitted with water, sink, and connections for gas and electricity. For biology the tables—for four students each—are often plain tables, but tables built with drawers to care for students' work (three or four sections) will avoid necessity of having that much wall case space and are preferable. A wall shelf with water, waste, gas and electric connections also adds to the capacity of the room. The biology rooms should also be equipped with ample storage capacity in the way of shelves and cases for specimens, charts, records of students' work, etc. A conservatory for plants and an aquarium adjoining the biology laboratory will complete the equipment that will be found to meet most requirements. Where more is required, the equipment should be placed in compliance with the demands and program worked out for each individual school.



Plan of Chemical Laboratory, Lecture Room and Instructor's Office

Natural Science Room, Junior High School, Beloit, Wis.
Joseph C. Llewellyn Co., Architects

The agricultural laboratory will be fitted in much the same way, any variations depending upon the special work which it is designed to do. Special tables will be wanted if milk-testing and similar operations are made a part of the course, as in some schools. Also special bins for the storage of various soils, sand, etc. In this laboratory as well, the wall shelf will be found advantageous.

For physics and chemistry, special tables for classes not to exceed 24 pupils will be needed, supplemented by wall shelves and fitted with plugs for gas and electric current. A fume hood will be required in the chemistry laboratory, and a smaller fume hood is often of advantage in the instructor's office and lecture room as well. With the exhaust on these hoods and from the chemical laboratory room, the ventilation is apt to be more positive and better than with individual fume exhausts over chemistry tables, piped with the small piping connections ordinarily used.

For chemistry and physics, lecture rooms are required. In addition to the demonstrator's table just mentioned, these rooms must also have provision for use of stereopticon, electric outlet and screen, and provision for darkening rooms. As already explained, the connection with the small fume hood near the demonstrator's table in the chemical lecture room will be of advantage. For these rooms also the students' seats should be banked.

Between physics and chemistry laboratories and their lecture rooms, we place the instructor's rooms with storage for supplies and apparatus and, adjoining these, darkrooms for each laboratory as well. The darkroom for the physics laboratory can be large, as indicated on the plan, and will afford a place for experimenting in light that is desirable at times. In the physics instructor's room also, there may be space for installation of radio equipment, and permanent standards for aerials and means of bringing down the wires through the construction of the building through fiber conduit should be installed on buildings, thus giving opportunity to install radio apparatus whenever desired. For chemistry tables, the bottle rack, common in former times, is disappearing and the supplies for students are placed in wall cases easy of access. Storage cases also for extra supplies are provided in storerooms, but other cases can be placed in the corridor walls if desired. No part of the planning of schools is capable of more variation in arrangement and equipment than these rooms for special study, in which the requirements are increasing as the studies progress. Hence the need for working with all school administrations, apparatus and supply people in order to anticipate, as far as possible, future requirements.

The development of physical education in school activities has been rapid. In schools of average size, one gymnasium for both boys and girls is often sufficient. In larger schools, separate gymnasiums should be provided for boys and girls. The element of contests in athletics has caused the increasing of the floor requirements very greatly in that seating accommodations for hundreds of spectators are required. A means of supplying this accommodation in an economical way is offered in the combination stage-gymnasium, seen in the arrangement of sev-

Swimming Pool, Hixon Annex, High School, La Crosse, Wis.
Note drain in floor to tile overflow of pool
Joseph C. Llewellyn Co., Architects

eral recent schools. A stage large enough for gymnasium work and to stage a basket ball game or class calisthenics or capable of being set for dramatics, has for the seating of spectators the whole auditorium. The arrangement has some disadvantages, but the evidence of those who have used buildings of this type is generally in favor of it. A means will have to be devised for shutting off the auditorium from the stage or gymnasium in a way approaching soundproofness in order that gymnasium and auditorium can be used simultaneously. Some methods have been devised which are extremely cumbersome and expensive. Collapsible doors, hung in pairs, furnish the best means thus far, and the best results will probably come from improvement in construction and joining in these doors.

In the Benjamin Bosse High School, two gymnasiums were desirable, but at first seemed out of reach. A gymnasium 64 x 100 is provided for boys, which is intended for regular work of the school only. For the girls, the stage-gymnasium—already referred to—will be used, and all contests for both boys and girls will be staged here. The stage is deep enough in case at any time it is desired to set the scene for a play and leave it for a time, and still provide floor space for the girls to do their regular gymnasium work.

Locker rooms for both boys and girls open to the stage and also to the athletic field or playground. Provision is made for dressing rooms in girls' shower room and full size lockers in boys' shower room for classes of approximately 50 each. The rest of the space for lockers, not occupied by showers, is given to cubicals or small lockers, each fitted with a wire basket for holding gymnasium suits. In the locker rooms also are provided lavatories, mirrors, comb and brush shelves and, for the girls especially, electric connections for the installation of hair dryers.

The instructors in physical education for boys and girls are given a suite of offices adjacent to their respective gymnasiums. The arrangements can be varied with the size and needs of the school, but in general there should be provided an outer office and inner office, a workroom, and shower. For the instructor for boys, a storage room for special apparatus or athletic supplies is desirable.

The equipment of the gymnasium is something that can be carried on by degrees and which will vary according to the methods and plans of the athletic directors. As a preliminary to this planning, this equipment will constitute a good beginning:

1. A vaulting bar attached, swinging back to the wall.
2. Wall ladder.
3. 3-section stall bars.
4. Suspended ropes and poles.
5. Flying rings and traveling rings and the mats to meet the equipment requirements.
6. An outfit of Indian clubs, dumb-bells and wands, with the required racks for storage.
7. Volley ball and basket ball outfits.

For the larger schools, a horse, parallel bars, pulley weights if wanted, spring board for jumping, jumping standards and additional mats can be had, with such other equipment as the special work of the gymnasium may suggest.

Boys' Gymnasium, Deerfield-Shields Township High School
Joseph C. Llewellyn Co., Architects

Recent Developments in the Detroit School System

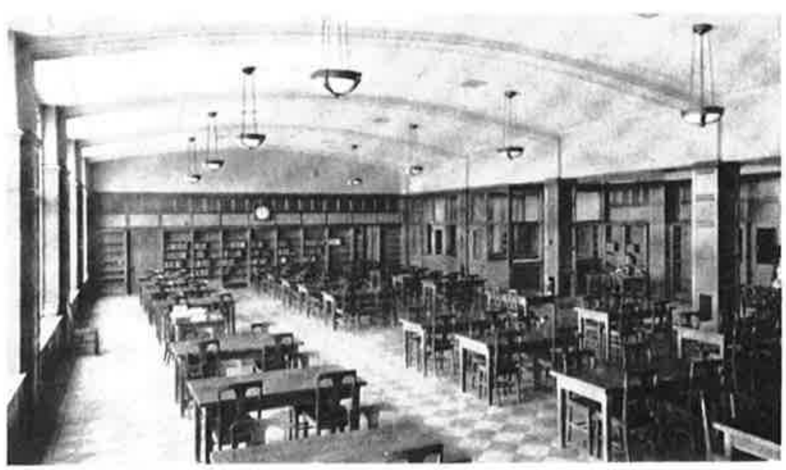
THE necessity of making intensive use of all available school space in Detroit, for a rapidly increasing number of children of school age, led to the adoption of a school administration system of the "platoon" type which has in late months been receiving careful study by school authorities from many parts of the country. It was seen to be necessary that classrooms be made to provide for more than one set of pupils and that the idea of individual, permanent desk and seat be abandoned. To dovetail into this plan was the well recognized importance of varying the work of the school day, and as finally worked out the "platoon system" provides for two entirely separate sets of pupils, one set using the classrooms while the others are engaged with other school work, this latter set using the classrooms when the first set has begun its out-of-classroom session. The intermediate school consists of six 60-minute periods, with an hour for lunch. Each period provides both the recitation and the study activities under the teacher who gives instruction in the subject. Every one of the boys and girls takes an hour daily for exercise and shower bath. An auditorium is in use each period. From 70 to 200 or 300 students assemble each period to listen to lectures on social and civic affairs.

Of course to care properly for the needs of a school organized upon this principle the building must provide, in addition to the usual classrooms, an auditorium, library, gymnasium, nature study room with conservatory, and also indoor play space, to be used by the children in bad weather when the playground is not available. These requirements have necessitated the enlargement or remodeling of a number of existing school buildings.

In developing school buildings to be used for this form of operation the Detroit schools are arranged upon what might be called the 24-section type as being the most effective. A school of this type contains 24 sections accommodating 40 pupils each, or a total of 960 plus 120 in the kindergarten. In planning a new building the school program is first made up, and decision is reached as to exactly how many student hours of instruction the building must take care of. A structure is then erected to definitely fit the requirements, and upon the day the building becomes available the school program and organization are ready to function. During the past two or three years Detroit has erected about 40 auditoriums and gymnasiums as additions to existing buildings and has also built 9 entirely new schools. There are now in operation 44 "platoon" schools, enrolling about 40,000 pupils, and other buildings now being erected will make a total of 51 ready for use in September.

For successful ventilation it is necessary that the air be evenly distributed to avoid excess in ventilation at some points and to give the required amount in others. The ventilation of the recent Detroit schools is done by the projection system, by which the air is distributed by virtue of its velocity where it is needed. They had used ceiling outlets for air delivery many years ago, and it was decided to come back to this system in an improved way provided the architects could solve the problem of installation of proper ducts in the fireproof buildings. The co-operation of the architects in using the steel pan type of concrete floor construction simplified the problem, making it possible to utilize the void spaces between the concrete floor joists for ducts, these being laid out for the proper locations.

The system as worked out has proved very simple and inexpensive. This was made possible partly by the fact that the Board of Education has started to build schools without basement classrooms, Detroit being one of the last of the large cities to adopt this policy. It is therefore possible to utilize a basement corridor under the first floor corridor as a large distributing plenum chamber for tempered air. This chamber is made of sufficient height for one to walk through and is equipped with hose connections and floor drains so that it can be easily washed down and kept sanitary. It also serves as a space for carrying steam and return lines, electric conduits, etc. The results obtained from Detroit's latest system with ceiling distribution of air have proved very satisfactory, not only as to first cost, but in the efficiency and uniformity of air distribution. The systems are planned for 30 cubic feet of fresh air per minute, but it is expected to cut this to 20 and possibly to 15 feet per minute.



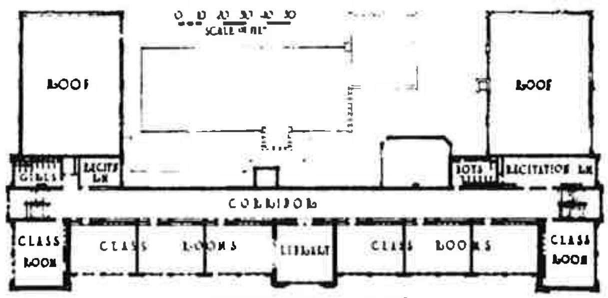
Library of Levi T. Barbour Intermediate School, Detroit
An essential feature of the "Platoon System"
Malcomson, Higginbotham & Palmer, Architects

George M. Balch Intermediate School, Detroit

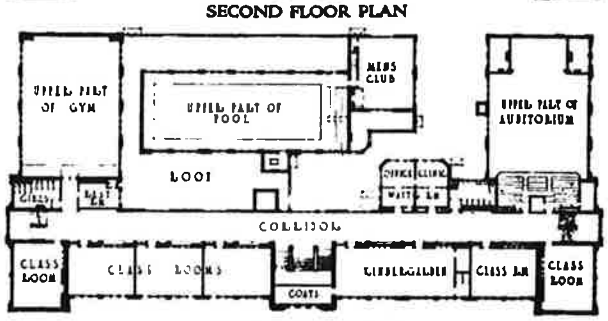
MALCOMSON, HIGGINBOTHAM & PALMER, ARCHITECTS

GENERAL VIEW OF MAIN FACADE

THIS is one of the recent Detroit schools to be planned for operation on the "platoon system." It is of fireproof construction, with concrete and hollow tile floors. The exterior is of mingled shades of mat face brick with Indiana limestone trimmings. The building accommodates 1,080 pupils and was erected in 1920, when the cost of building was at its height, for $608 per pupil, or 55½ cents per cubic foot. The heating and ventilating are provided in the manner described on the preceding page.

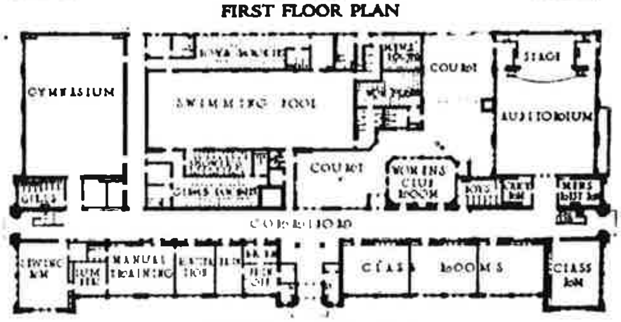


SECOND FLOOR PLAN



FIRST FLOOR PLAN

DETAIL OF MAIN ENTRANCE



GROUND FLOOR PLAN

Community Features of the Modern School

By **DWIGHT H. PERKINS, F. A. I. A.**
Perkins, Fellows & Hamilton, Architects, Chicago

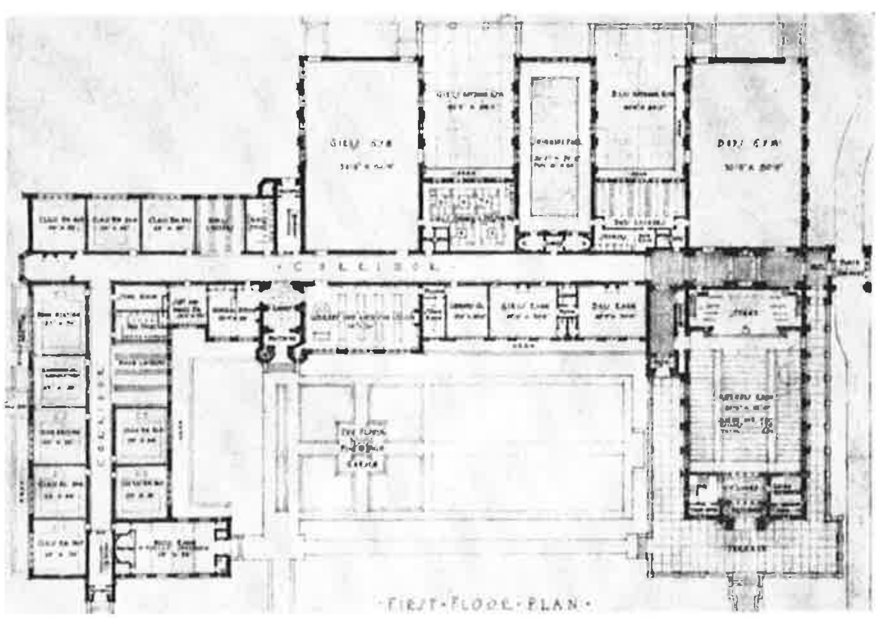
IN the modern public school building the neighborhood has the most effective means of centering and developing community life. In recent years, this has caused much study to be given to the design of these buildings in order to arrange them for the most satisfactory use for such purposes. The features of the school which are most in demand for this use are the auditorium, the gymnasium, the library, the natatorium, shops, and the domestic science cooking rooms or other provision for serving refreshments.

The use of these facilities is a subject of many phases and constantly changing aspects. It differs as the community use grows and expands in its character. Formerly we thought of community use merely as a gathering of citizens in the auditorium for entertainment or lecture purposes; now we regard it as incorporating the educational and recreational activities of every resident of the district. All classes in the community may come to the school outside of school hours for physical training and for group meetings, for use of the natatorium and for enjoyment of the athletic field, either as spectators or performers. A "school," now, in order to be complete, must include grounds, a field, and out-of-door facilities as well as a building with various rooms and equipment.

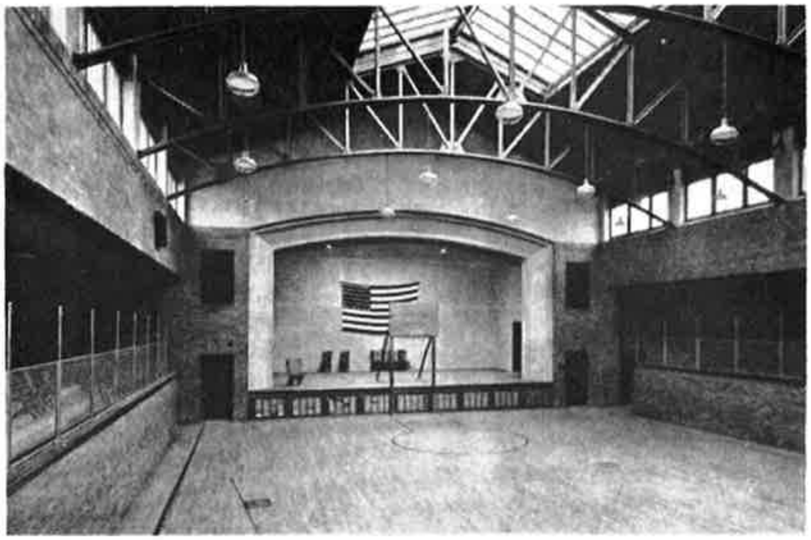
The community is beginning to use the school for women's clubs and men's clubs, library reference, forums, reading and study circles in groups of from 20 to 50, and they use either the library or large classrooms or study halls or rooms which have been provided for public speaking and instruction in music. It is, therefore, impracticable to discuss the phase of this subject which has been given me without overlapping and taking up almost every feature of a modern school plan. As other contributors to this symposium will cover such features, it will suffice to explain under this heading that community facilities are very largely a matter of program and arrangement, a matter of suggestion and invitation by the board of education and the officials of the school on one hand, and response and receptivity by the publicon the other. When it is suggested to a progressive administration to offer the use of the school plant to its owner, the public, for such purposes, and when this offer is met by desire and acceptance by the public, it is usually found necessary to organize and operate continuously an active agency for the promotion of community activities of all varieties and to arrange and carry out programs for amusement, recreation and social functions as well as public education.

Another contributor to this symposium will discuss gymnasiums; I shall simply direct attention to two problems which have a community bearing and which relate to gymnasiums. One is the changing order in gymnastic work from individual drill to competitive team athletics. This latter development involves to an increasing degree the presence of spectators, and the whole results in an almost complete elimination of fixed gymnastic apparatus. Floors are left clear for competitive athletics, and the demand for spectators' space necessitates from 300 to 1,500 seats. Compliance with this demand is clearly a provision for community use. The public must be accommodated. Admission fees must be collected, and the galleries must be warmed and at least partially ventilated by mechanical methods. Of course, they must be rendered free from danger from fire or panic, so that in this feature many of the elements of an auditorium are required.

The second community feature relating to gymnasiums is generally temporary. Frequently on account of restricted funds schools must for a time use gymnasiums for auditorium purposes. If large



First Floor Plan of High School and Community Building, Bernard Township, N. J.
A complete development of community facilities
Guilbert & Betelle, Architects

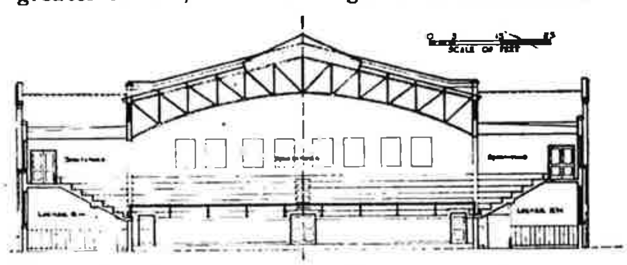


Combined Auditorium-Gymnasium, Elmer R. Webster School, Pontiac, Mich.
Perkins, Fellows & Hamilton, Architects

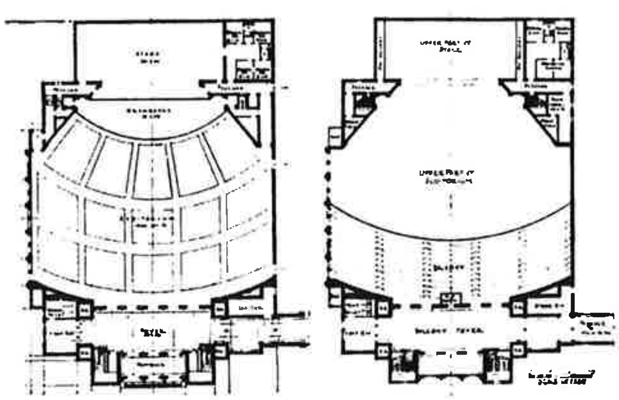
provision is made for spectators, this provision with the playing floor covered with portable chairs gives adequate capacity of seating though, of course, the flat floor is not so good as the banked floor for auditorium purposes. Such a gymnasium is shown by illustrations included with this text. It is next to impossible to make an adequate stage for auditorium purposes in a gymnasium, and this feature is, therefore, supplied by a temporary platform occupying a part of the playing floor and separated therefrom by curtains. Even for temporary use, proper provisions for safety and for free and easy access and exit must be made. A combination auditorium-gymnasium, permanent in character, is shown by the illustration of the Elmer R. Webster gymnasium, Pontiac, Mich. This does not, however, conform to the curriculum most frequently adopted, which generally requires simultaneous use of the gymnasium and auditorium.

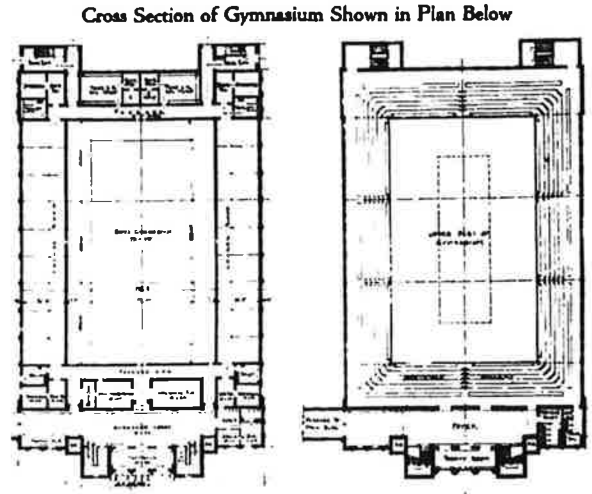
We now come to a consideration of the details of the auditorium. School auditoriums vary from the small assembly halls of 200 or 300 seats with adequate stages for dramatic purposes, or the hall of 500-capacity such as is being developed in Detroit with reference to the platoon plan, to the large high school auditorium of 1,000 to 2,000 seats. Although large auditoriums where 4,000 or 5,000 people may be seated have been built for theaters, it can be safely approximated for schools that the range, the carrying distance of the ordinary unprofessional speaker's voice, is not over 120 feet. Under the best arrangements it is not safe to assume that an ordinary speaker can be heard by all of the hearers if some are placed more than 120 feet distant from the front of the platform, and 100 feet is better. This makes a preferable limitation of 2,000 seats, and even then involves the use of a balcony.

We illustrate these points by a sketch of an auditorium for a school which will ultimately have an attendance of between 3,000 and 4,000 pupils. It has been regarded by some authorities as inadvisable to attempt to provide seats for all of the students in a high school when the attendance is greater than 2,000. The stages in all auditoriums



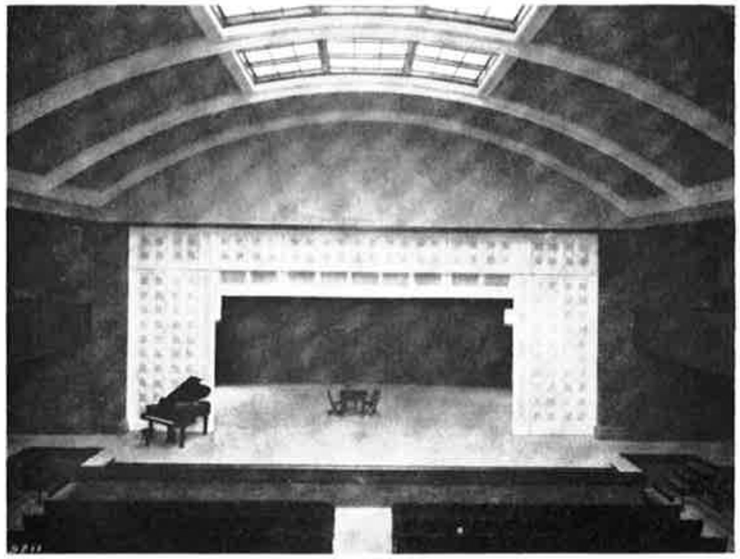
Cross Section of Gymnasium Shown in Plan Below





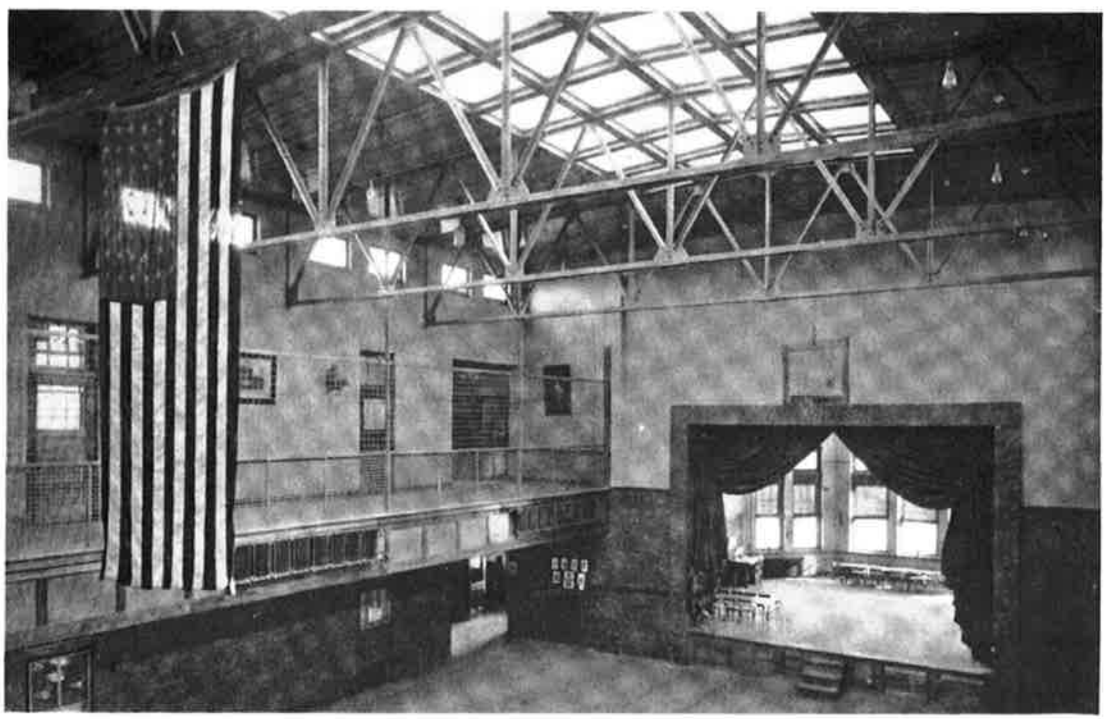
Floor Plans of Auditorium and Gymnasium Wings of School for 3,500 Pupils
These units are arranged for both school and public use
Perkins, Fellows & Hamilton, Architects

should be so designed that these activities may be provided for: lectures, concerts, moving picture and stereopticon shows, orchestra concerts, band concerts, operas, plays, pageants, graduation exercises, athletic or calisthenic exhibitions; in short, any or all kinds of shows. Such a stage must have an opening capable of expansion and reduction. The maximum width of proscenium opening desired for theater or dramatic productions is 24 to 30 feet, but for gymnastic exhibitions or for graduation purposes the opening must be much greater, and provision must be made for these widely different demands. One solution of this problem is indicated by the illustration of the New Trier auditorium stage included herewith.



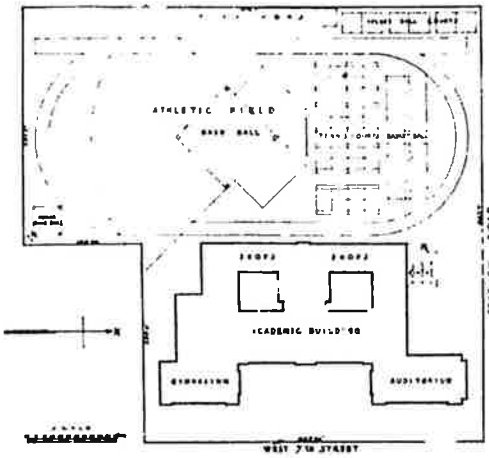
Stage in Auditorium of New Trier Township High School
Proscenium opening may be increased to full width between brick piers by folding back hinged sides

Stages should have, first of all, adequate floor space; the width of the stage should be equal to that of the hall, and its depth should be from 25 to 40 feet back of the proscenium curtain. It is well to have seating space for 200 people on the stage of a hall seating 1,000 or more auditors. The floor should be flat, but provision should be made for the installation of "bleachers" for the use of choruses at the back of the stage as well as for graduating classes. Considerable space, from 8 to 12 feet, should be given in front of the curtain so that an ordinary lecture, concert or stereopticon performance can be given without raising the curtain. The floor of the stage should be placed about 3 feet 6 inches above the lowest seated floor level in the hall, and in large auditoriums an orchestra pit should be provided large enough for 40 musicians and just deep enough that their heads and instruments shall not be above the level of the stage floor.



Auditorium-Gymnasium, Edward S. Bragg School, Fond du Lac, Wis.
An interesting solution where economy was paramount. The stage is also the kindergarten; the gymnasium floor serves as corridors, and the upper corridors may be used as balconies
Perkins, Fellows & Hamilton, Architects

It should be possible to heat and use the stage when the auditorium is not in use. Band concerts, chorus practices and debating societies all find the skylighted stage an admirable place for their activities. It would require a separate article to go into the full details for stage equipment for dramatic purposes. Every large high school stage should have a loft and gridiron for the storage, handling and control of scenery. This is a theatrical detail, and it differs in no essential respect from a theater.

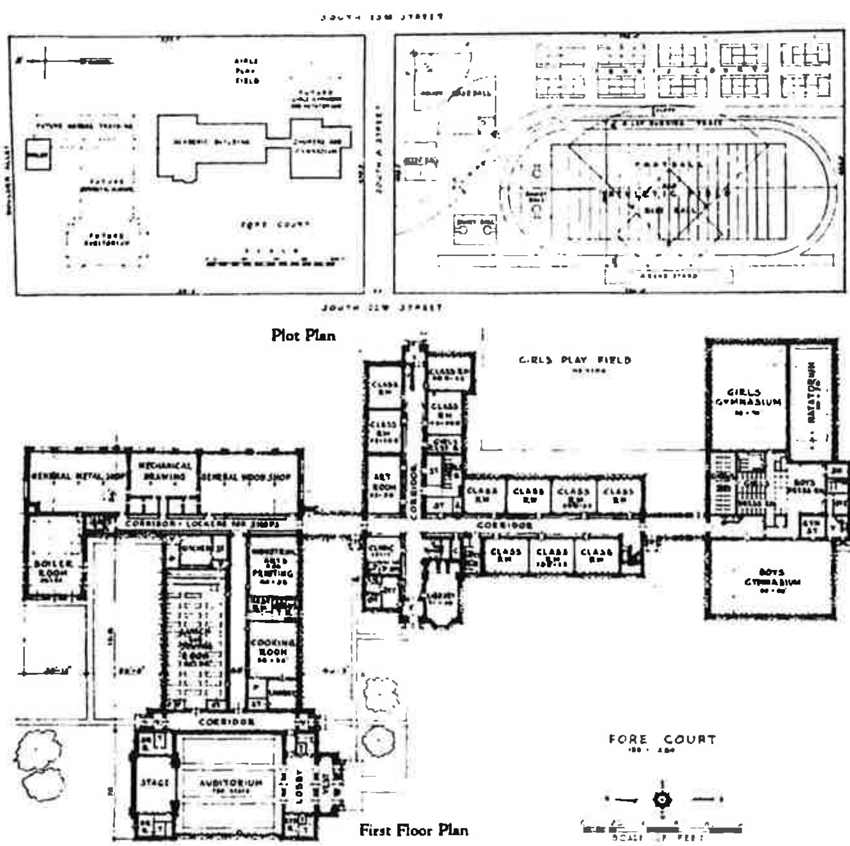


Plot Plan, David Worth Dennis Junior High School Richmond, Ind.

The view of the stage at the New Trier shows the opening arranged for dramatic purposes. At either side is a door of fireproof construction (steel and asbestos) which may be opened in against the proscenium wall. As these doors are each 8 feet wide, their opening enlarges the stage opening by 16 feet and provides in a simple manner for the various purposes just referred to.

The illustration shown here of the plot plan of the David Worth Dennis School, Richmond, Ind., will, with the floor plans and exterior views shown in the plate section, illustrate one solution of the junior high school community center problem, on a scale which was suitable, in that instance, for all of the requirements just enumerated. One of the other illustrations—the interior of the Edward S. Bragg School in Fond du Lac—shows a solution where both space and money were extremely limited and where corridors, kindergarten, gymnasium and auditorium have all been made to occupy the same space. Numerous kinds of use are provided for, and all that is required (not an impossible condition) is an adjustable program so that one use does not interfere with another.

There is no longer any mystery concerning the acoustic properties of auditoriums or the materials entering into their construction and equipment. The work of the late Professor Wallace Clement Sabine of Harvard University, which is now being continued at the Riverbank Laboratories in Geneva, Ill., has reduced acoustics to a mathematical science and has made it possible to design and construct auditoriums for any desired acoustic requirements with reasonable certainty of success.

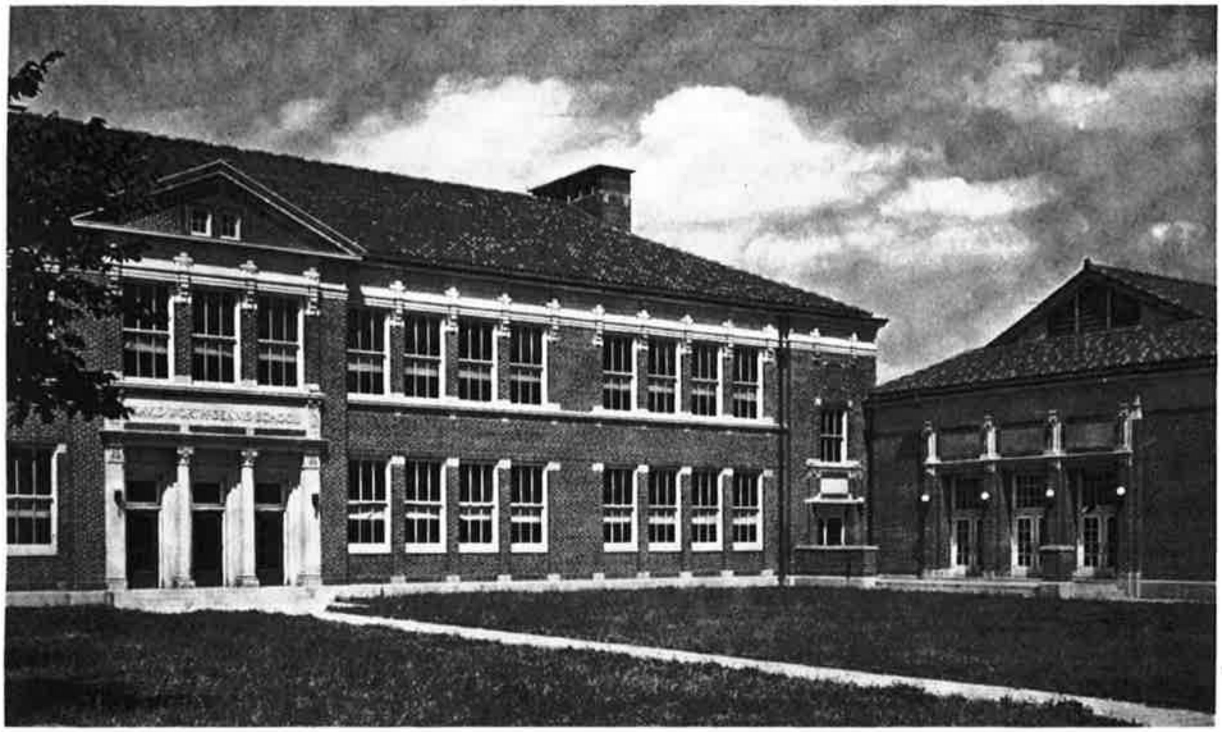


Proposed East Side Junior High School, Richmond, Ind., showing a widely different solution of similar requirements to Dennis School because of site conditions

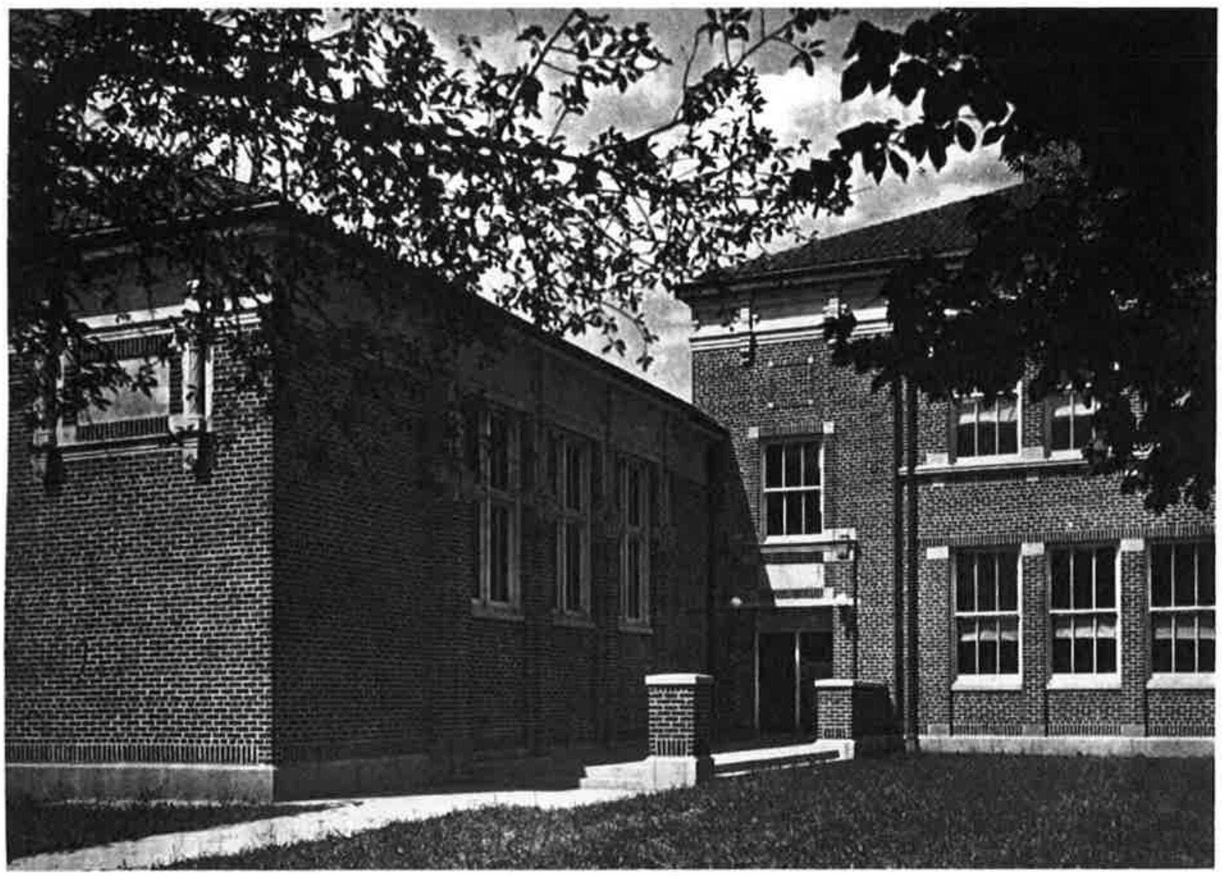
Perkins, Fellows & Hamilton, Architects

Community uses are demanding and causing the equipment of large sites even for small schools. The most distinctive gauge of progress is the site which is now considered essential. The site indicated by the plot plan of the David Worth Dennis School may now be regarded as a minimum. It comprises between six and seven acres. It is not unusual nowadays to provide for junior high schools from eight to fifteen acres, and for senior high schools from ten to forty acres.

There is no influence of, or effect from, the inclusion of community facilities on the exterior design of buildings which does not necessarily result from the proper conception and designing of school buildings themselves.



FACADES OF SCHOOL AND AUDITORIUM



DETAIL OF GYMNASIUM WING

DAVID WORTH DENNIS JUNIOR HIGH SCHOOL, RICHMOND, IND.

PERKINS, FELLOWS & HAMILTON, ARCHITECTS

DAVID WORTH DENNIS JUNIOR HIGH SCHOOL RICHMOND, IND.

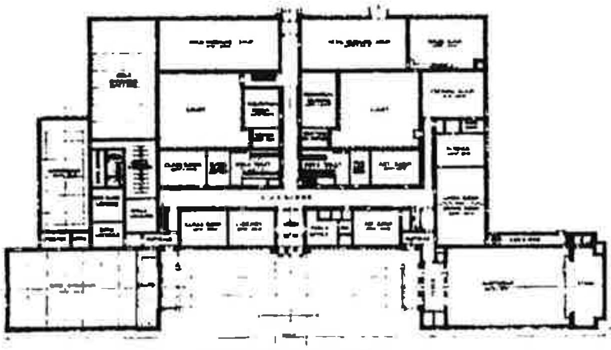
Illustrations on Plate 24

THIS building was completed in 1922 at a cost of $398,000. It accommodates 500 pupils, making a building cost per pupil of $797, including equipment.

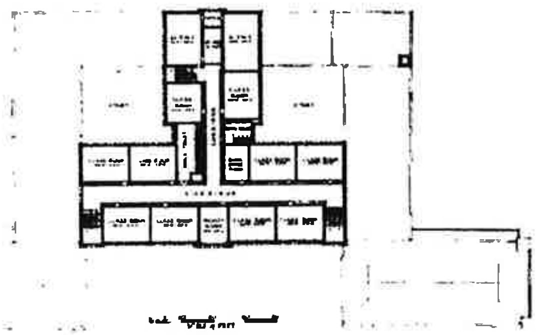
The cubic foot cost was 39.5 cents.

The construction is fireproof, being of reinforced concrete with exterior walls of brick and hollow tile with Indiana limestone trim. Partitions are of gypsum block and roof of Spanish tile.

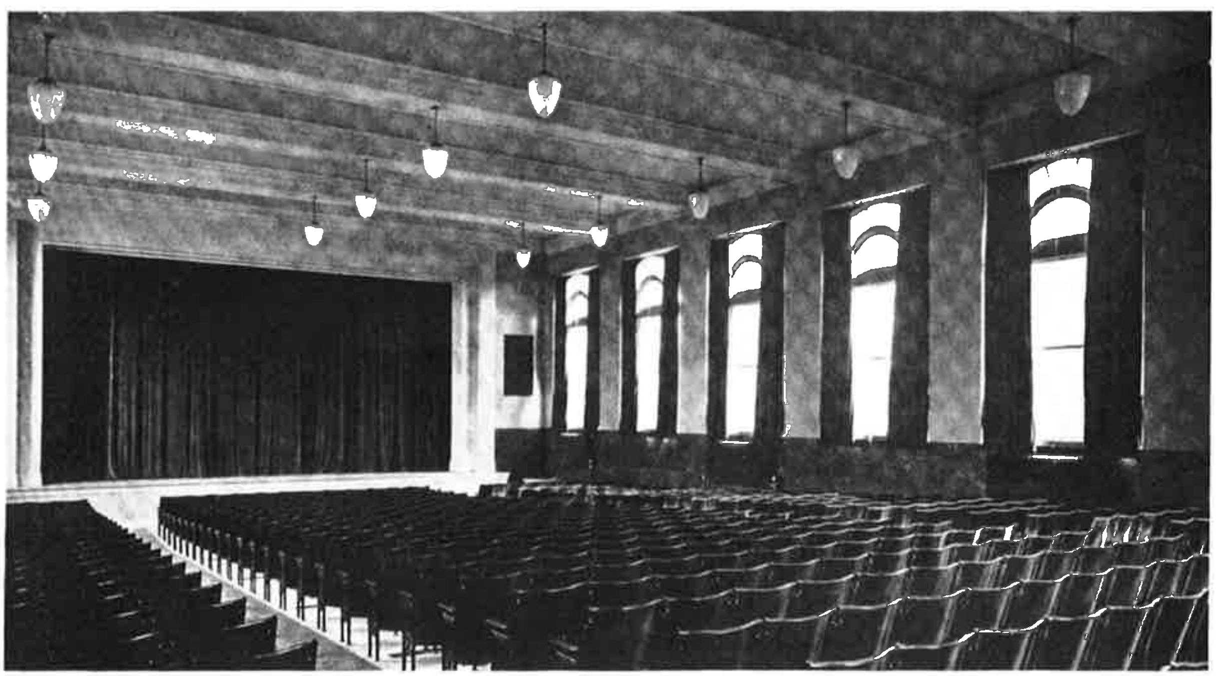
GENERAL VIEW WITH AUDITORIUM IN FOREGROUND



FIRST FLOOR PLAN



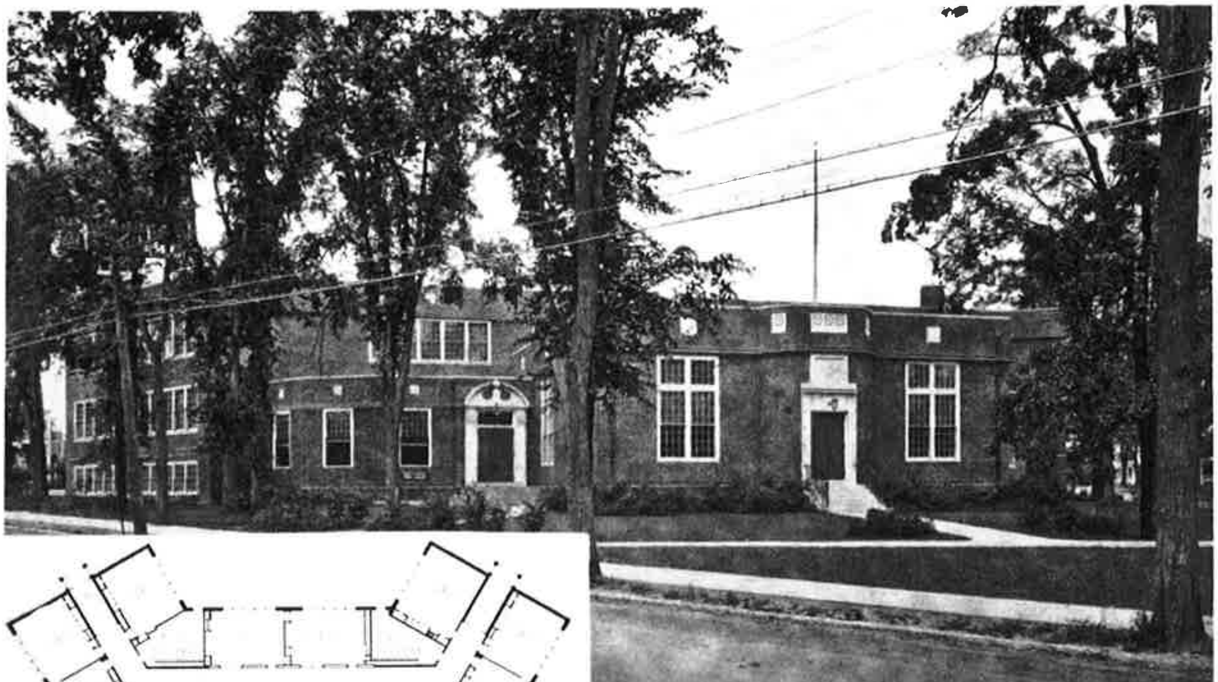
SECOND FLOOR PLAN



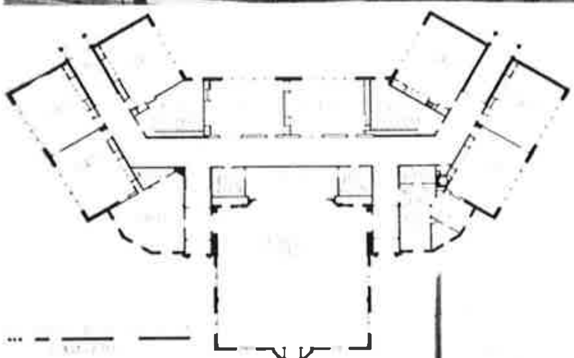
INTERIOR OF AUDITORIUM

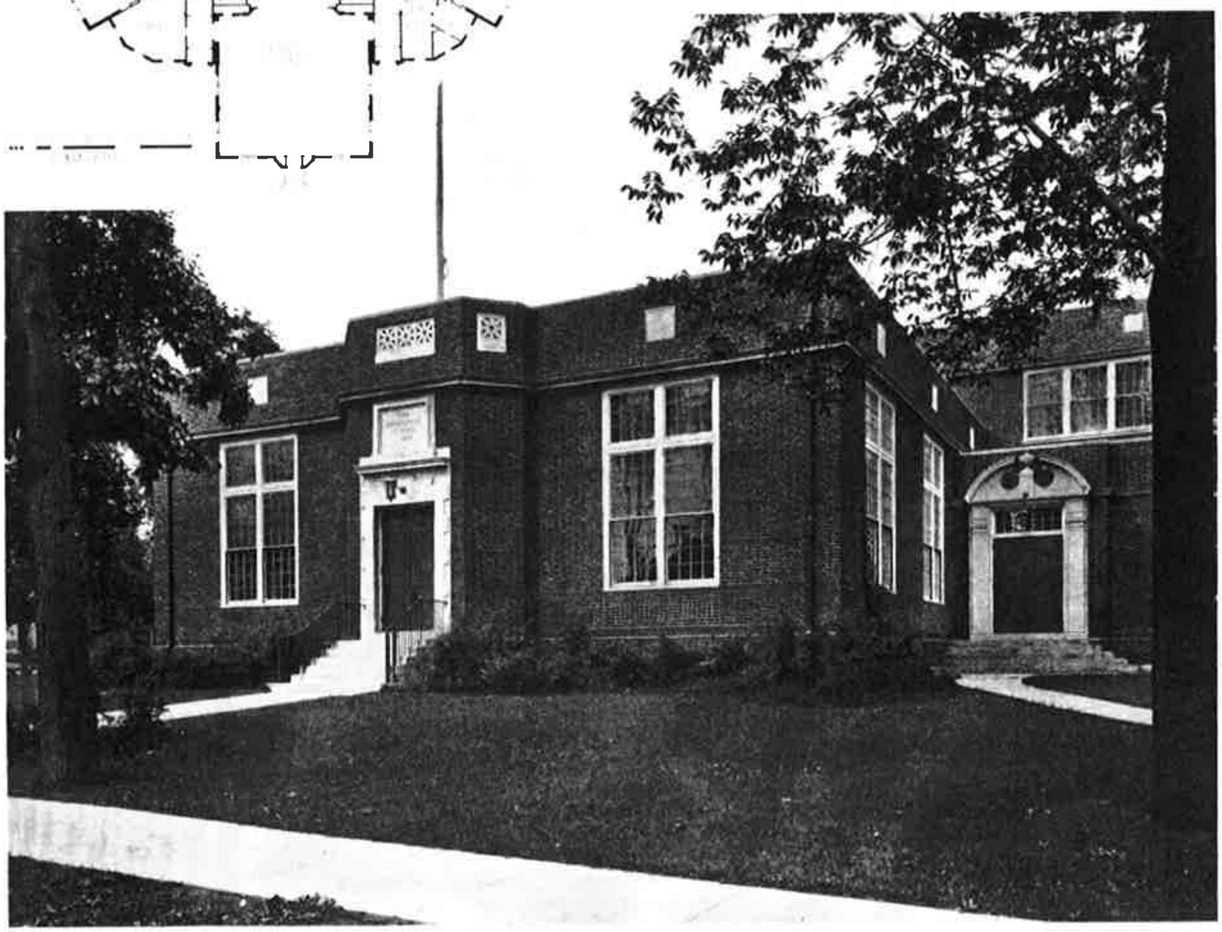
DAVID WORTH DENNIS JUNIOR HIGH SCHOOL, RICHMOND, IND.

PERKINS, FELLOWS & HAMILTON, ARCHITECTS



GENERAL EXTERIOR VIEW





DETAIL OF AUDITORIUM WING

MEMORIAL SCHOOL (ELEMENTARY), FRAMINGHAM, MASS.

CHARLES M BAKER, ARCHITECT

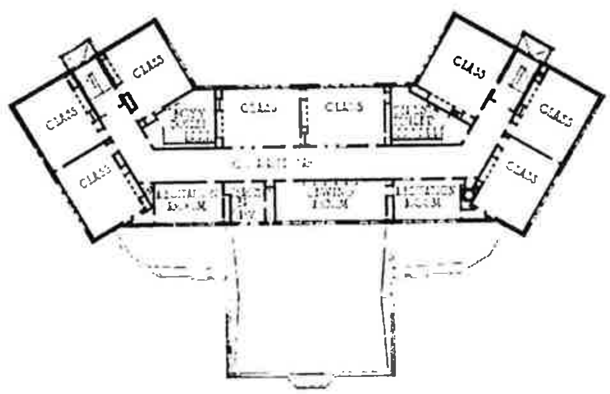
MEMORIAL SCHOOL
ELEMENTARY
FRAMINGHAM, MASS.

Illustrations on Plate 26

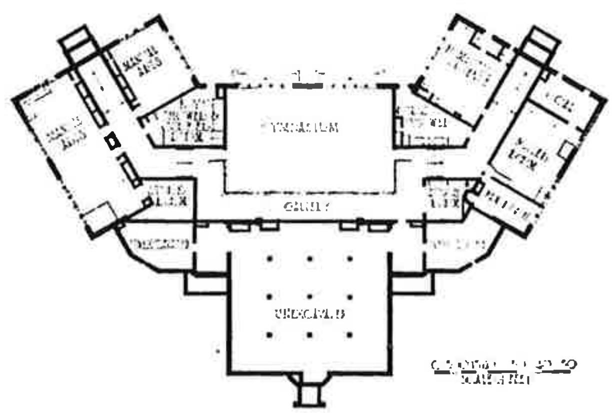
THIS school was finished in 1920 at a cost of $202,000. It accommodates 583 pupils, making a building cost per pupil of $345.

The cubic foot cost was 32 cents.

The exterior of the building is of selected common brick with trim of cast concrete. The construction is of the second class, with fireproof partitions enclosing all stairs and corridors and fireproof floors in corridors.

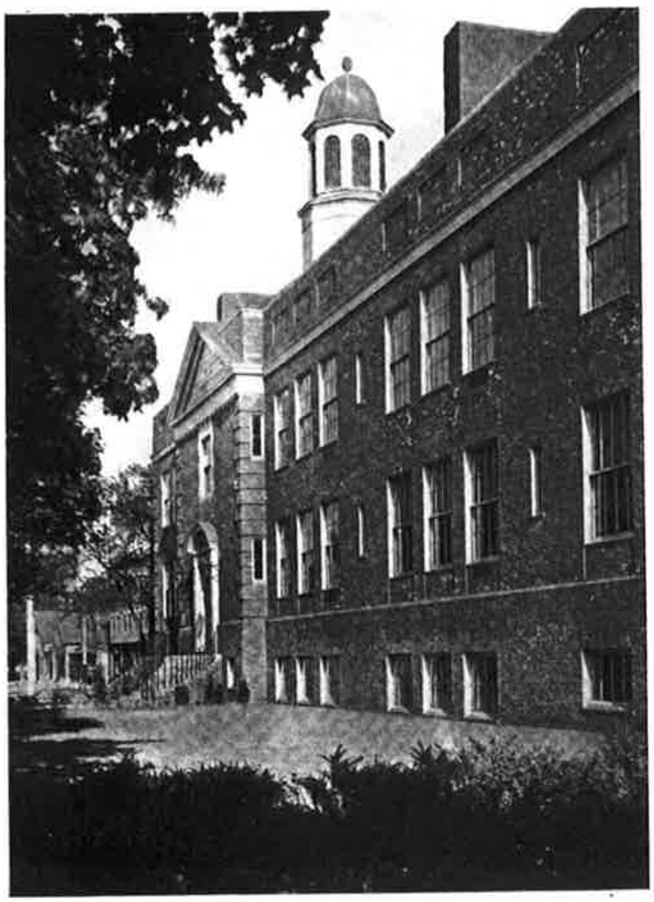


Second Floor Plan

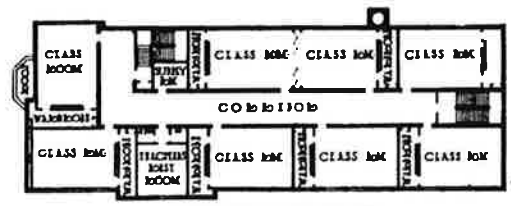


Basement Floor Plan

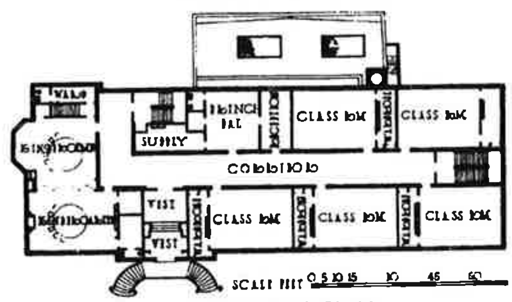
DETAIL OF MAIN ENTRANCE



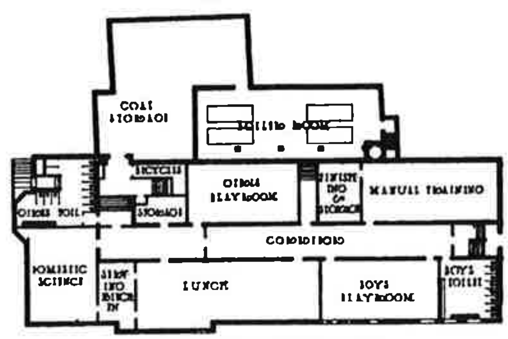
VIEW OF ENTRANCE FRONT



SECOND FLOOR PLAN



FIRST FLOOR PLAN



BASEMENT FLOOR PLAN

VILLAGE ELEMENTARY SCHOOL, GREAT NECK, N. Y.

WESLEY S BESSELL, ARCHITECT

VILLAGE ELEMENTARY SCHOOL
GREAT NECK, N. Y.

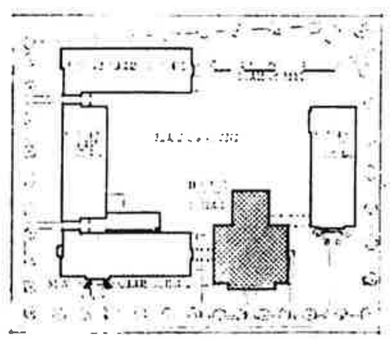
Illustrations on Plate 27

THIS school was completed in 1921. It accommodates 640 pupils.

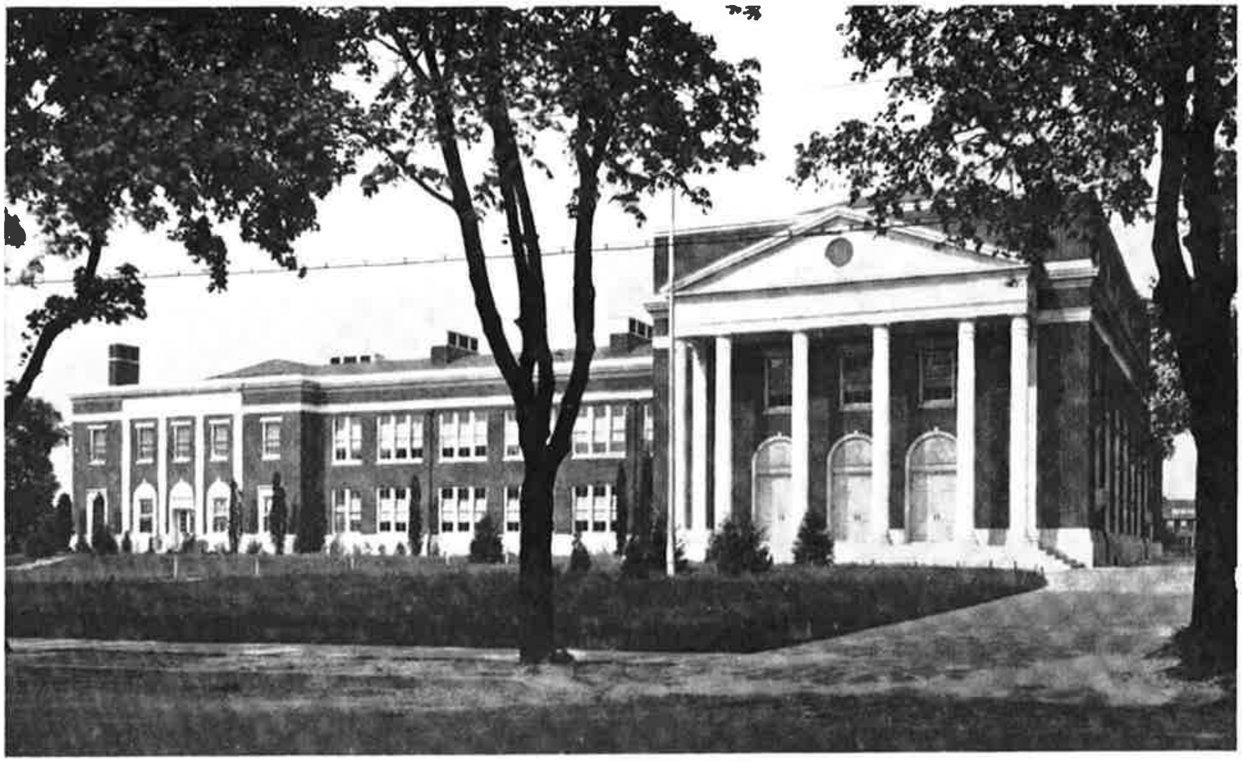
The cubic foot cost was 42 cents.

The exterior of the building is of selected common brick in variegated color and texture, and terra cotta. The roof is of slate and metal work of copper. The construction is fireproof.

This is one of several buildings which are being developed under a group plan which provides for future expansion.

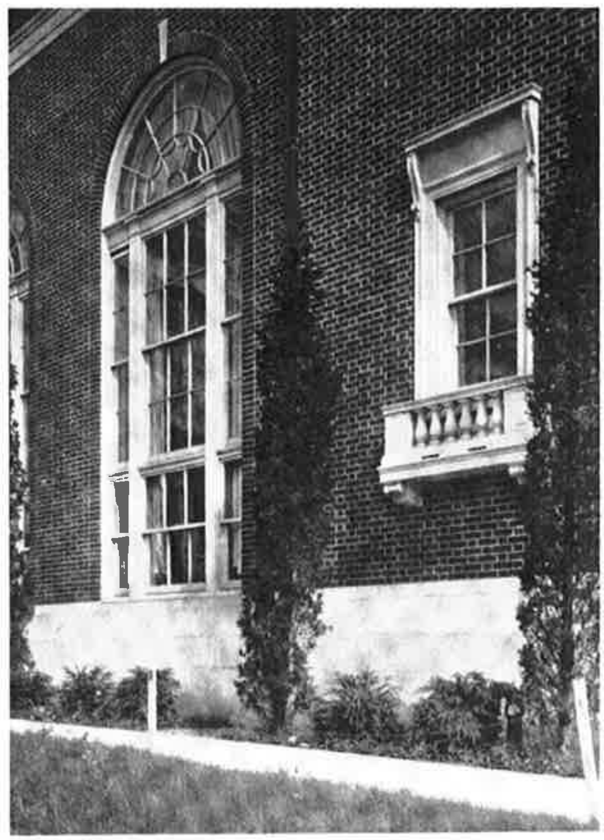


Plot Plan



GENERAL EXTERIOR VIEW

DETAIL OF SCHOOL ENTRANCE



DETAIL OF AUDITORIUM FACADE

HEMPSTEAD HIGH SCHOOL, HEMPSTEAD, N. Y.

ERNEST SIBLEY, ARCHITECT

HEMPSTEAD HIGH SCHOOL
HEMPSTEAD, N. Y.

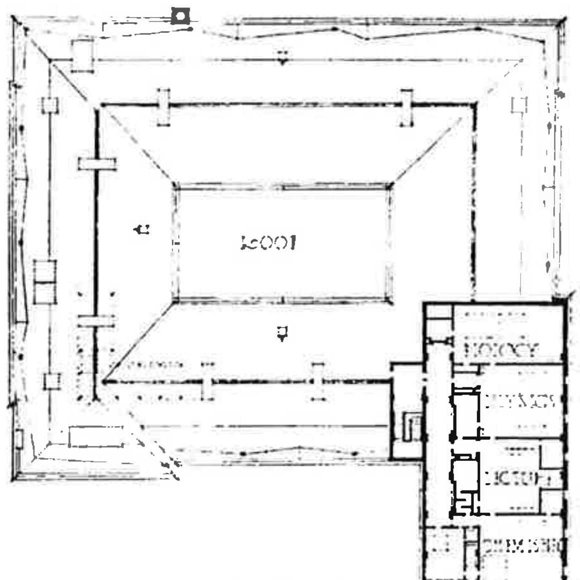
Illustrations on Plate 28

THIS high school was completed in 1921 at a cost of $654,000. It accommodates 1200 pupils, making a building cost per pupil of $445 exclusive of equipment. Equipment cost $55,000, or about 8.4 per cent of the cost of the building.

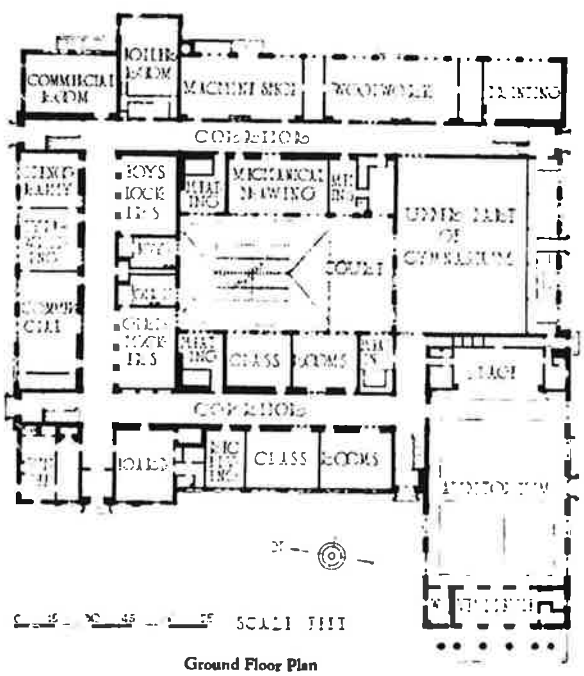
The cubic foot cost was 37.4 cents.

The exterior of this school is of red rough textured brick trimmed in cast concrete with white crushed marble aggregate. The construction is fireproof with roof of fading green slate.

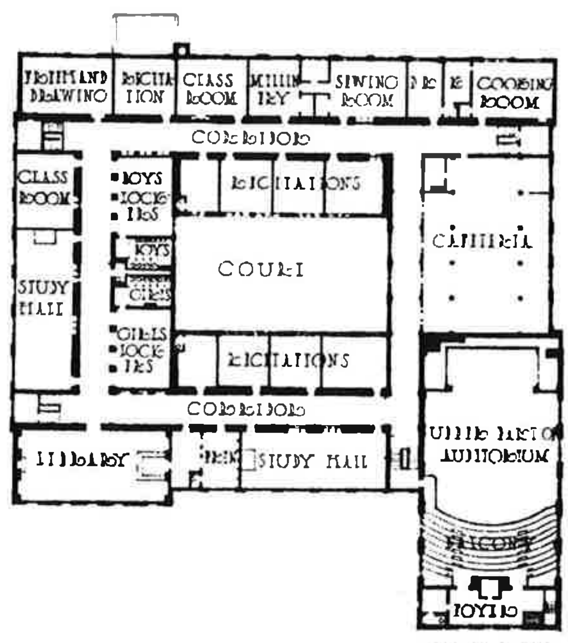
The building is heated and ventilated by low pressure steam system, including thermostatic control and humidifying apparatus.



Second Floor Plan



Ground Floor Plan



First Floor Plan

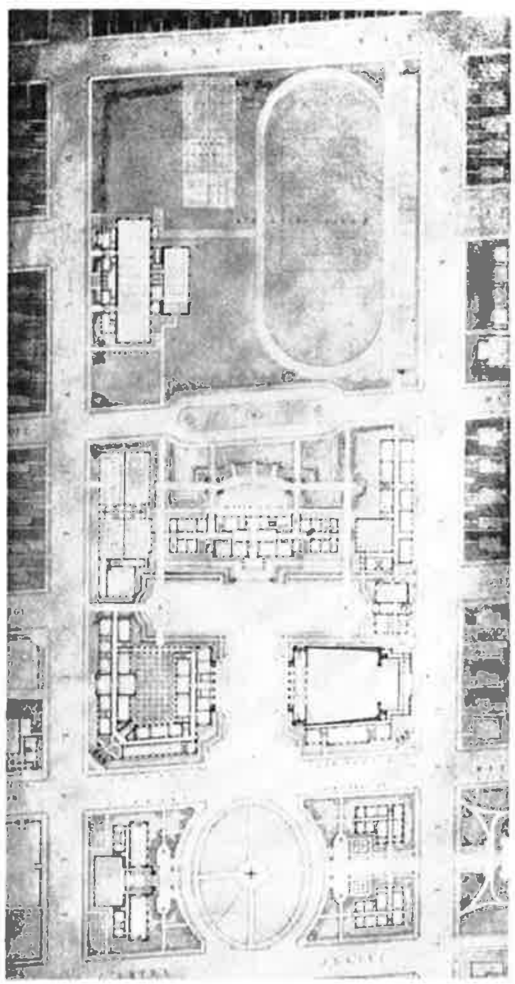
The Architecture of Schools

By WILLIAM C. HAYS, A. I. A., *Architect, San Francisco*

NOT without some self-pity sighs the banished duke in Arden, "Sweet are the uses of adversity!" At heart is he not elder brother to the small boy who, alone on the dark road, whistles to keep up his courage?

Those architects have known "the uses of adversity" who lately have had to stretch budgets of shrunken dollars to provide rooms for rapidly increasing school enrollments. Against their better convictions they have had to condense plans and build *passé* types. Some have willingly studied every possible economy within the limits of sound structure and have curtailed enrichment to the verge of poverty. Dependence has been placed on modeling in masses, purity of proportions and quality of color for whatever was to be produced in architectural effect. Has the facing of adversity brought some reward? Not in money, for the application of one's skill in effecting savings for his client costs the architect more heavily in disbursements, while its direct result is to reduce his fees. But in many a community there has come into being a respect for common materials which heretofore have been ignored or held in low repute. In the town which has put up new schools, who has not seen the influence exerted by them upon other buildings—here the use of local color, there the adoption of some other effective device?

It is always incumbent on the architect charged with spending school funds to steer clear of wasteful practices. If he is conscientious he accepts being limited to those materials and local practices which will be inexpensive in both first cost and upkeep. If the architect harbors resentment at this limitation, he is no fit man for the work. If he accepts the challenge cheerfully he is taking upon himself an interesting task, for his success or failure will lie mainly in his point of view.



General Plan, Berkeley High School, Berkeley, Calif.
William C. Hays, Architect
A. Appleton and Joseph J. Rankin, Associates

Buildings on left reading up are: Library, Science, Shops, Gymnasium. On right: Administration, Auditorium, Arts. Center: Academic Building

Myron Warner, driving a Cadillac on his own side of the concrete highway, was crowded off into deep mud by a farmer who zigzagged along in a Ford. Instead of bursting out in rage, the victim laughed back, "Stick to it, Old Timer!" Yes, the attitude of mind is important.

In considering the architecture of schools, we can best do so in the light of those limitations which the available materials impose, and since the judgment of the passerby is based upon the exterior wall surfaces, our attention to materials can be similarly narrowed down. The cheapest material in all parts of our country, wood, has many advocates who present strong arguments. "Quickly," they tell us, "the schoolhouse becomes antiquated, no matter how 'permanent' its construction may be. So why waste good money for masonry?" "Fire trap," comes back the reply. "The fire hazard in schoolhouses depends less on general construction than on mechanical equipment," is the answer, "and well planned schools have ample exit provisions, anyway, to take care of panic conditions." "Furthermore, unless schools are located in congested districts of large cities, they should be low in type and cover much land, regardless of their structural materials."

But what of wooden buildings, æsthetically considered? Occasional draftsmen's competitions for schoolhouses of frame construction have surely demonstrated the art values inherent in the proper architectural use of wood. One of the best elementary schools that has come within the writer's ken is built of unabashed "rustic" walls and shingle roofs.

Perhaps less may be said in favor of the frame building covered with cement plaster. Not frank; it masquerades as a masonry type, and its cost is often higher proportionately than people realize. But who would resist the possible architectural effects that can be had, at relatively slight cost, by means of color, texture and play of shadows over plain plastered walls, even if a structure more permanent than woodwork cannot be afforded? On the whole, though, if money enough can be had to pay for a backing of common bricks, hollow tile, rubble stone or concrete (whichever may be locally available), the greater degree of permanency is worth having.

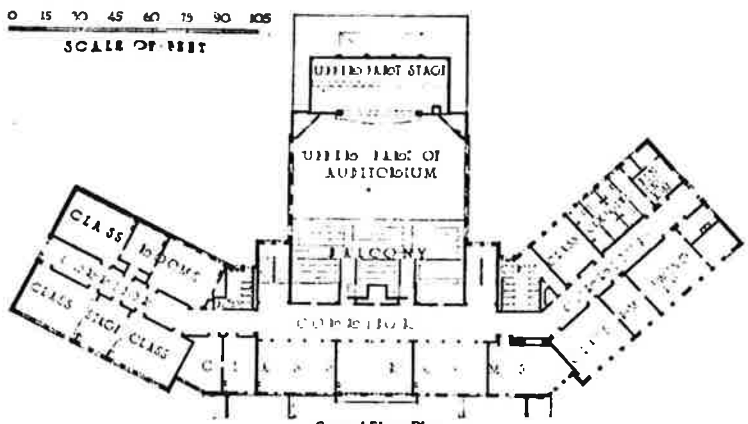
Of the experiments which have been made in special surface treatments directly on concrete walls, there has been little yet produced of a convincing nature. The attempts have been at least as expensive as plastering; they roughen the surface and catch dirt.

A most useful material for finished walls is common brick—or shall we say "uncommon brick"? It used to be a simple matter, and cheap, to specify "run of the kiln" bricks, and by selection on the job produce a wall the face of which had fine color and texture. Nowadays the bricks finest in color are sorted out at the yard and have to be bought under a special classification at high prices. However, an architect of taste can build of selected common bricks a wall of high artistic quality, and the consideration of expensive brick is not essential excepting in occasional instances.

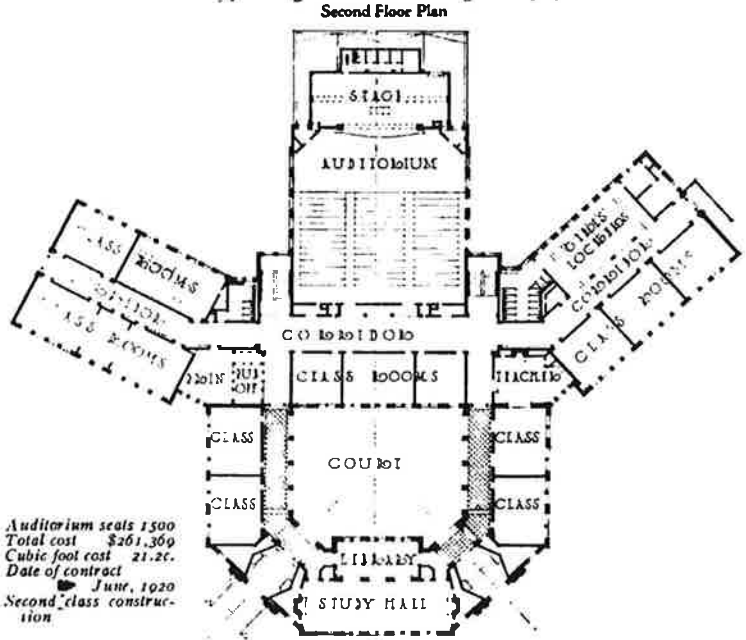
Walls of local stone can be built at low cost in some localities and are admirable if the buildings are not too large. But mere size sometimes demands more sophistication, bringing in the need for cut stone trimmings. Formal treatments, entirely of cut stone, are appropriate, even if not demanded in certain special cases, as when the schoolhouse is one of several monumental buildings, grouped around an open square or occupying an axial or terminal position.

Just as the materials for wall surfaces must be inexpensive, so should decorative features be confined to such as are low in cost. In some neighborhoods this principle will not prevent the use of a modest amount of cut stone; in other districts, where clay products are plentiful and good building stone scarce, terra cotta comes to the aid of the designer. Still another possibility is cast cement, in which pigment will control the color. For surface treatments on plastered walls there are the lately revived possibilities found in the use of applied color. The reservation must be made, of course, that climatic conditions permit. A few skilled men have produced some notably fine examples of the old Italian renaissance art of "sgraffito," but not many are masters of its difficult technique. Some experiments have been made, with varying success, in the use of painted stencil designs in well protected places. Jules Guerin produced some fine effects in this way at the San Francisco Exposition, and his lead has been followed by other adventurers. Since painted exterior decorations have long withstood the weather on the exposed hillside houses of Genoa, it is not unreasonable to expect durability under similar conditions in America.

Style is another phase of the subject, "Architecture of Schools." The meaning of the word "style" is vague. By it do we mean the defined historic periods and types?—or do we mean fitting expression of the special qualities in given materials?—or might we accept the less common use of the term and let it signify response to certain dominant physical needs of the problem? The writer's prefer-

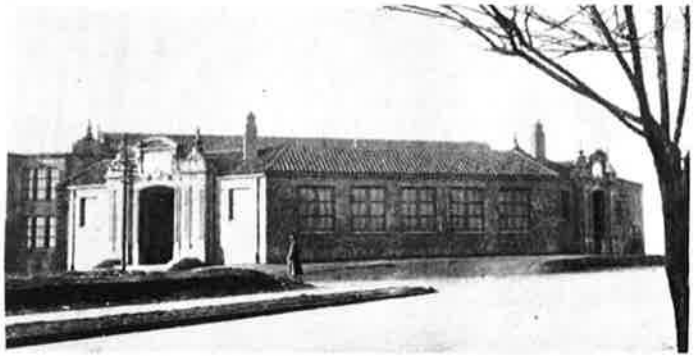


Second Floor Plan

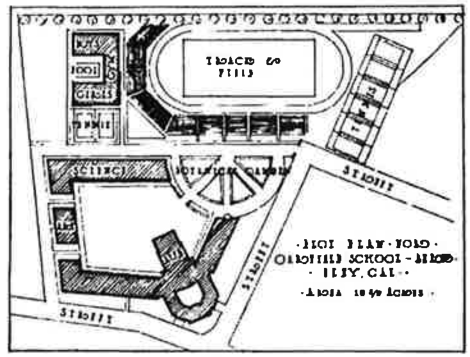


Auditorium seats 1500
Total cost $261,369
Cubic foot cost 21.2c.
Date of contract June, 1920
Second class construction

First Floor Plan
Garfield Junior High School, Berkeley, Calif.
William C. Hays, Architect
A. Appleton and Joseph J. Rankin, Associates



View of Entrance Front



Plot Plan

Garfield Junior High School, Berkeley, Calif.

ence would be to attach relatively little importance to the accepted style designations such as "English Gothic" and "French renaissance," for the very definite reason that our problems are so new and complex as to make close adaptations of the old types impracticable. Why not "Mediterranean coast styles," "north country styles" and the like, with the very definite connotations of such terms?

As far as facade is concerned, we must accept one feature of school buildings as dominant: that is the classroom window, and because a school building consists mainly of classroom units its design becomes a composition of voids and solids. Now no classroom can be good unless it has plenty of light and air, combined with desirable exposure. Perhaps school statisticians go too far in claiming empirical proportions between floor areas and glass areas, without giving thought to special or local conditions. There is no use in attempting to provide daylight for the darkest overcast days, for artificial light will then be needed, anyway, along the inner halves of all the classrooms. May it not be poor practice to accord with theoretical generalizations at the risk of a glare during the other parts of the year? Is it reasonable to apply the same measure to window areas of buildings in the bright sun of Florida or California as in the more sober light of New England? But even if we reduce the glass areas of the standardizers to suit conditions in the San Joaquin Valley or at Key West, we will still have rooms each of which will have one of its long sides largely of glass. Then, too, classrooms being unilaterally lighted, any which occur in the angles of the plan will demand unpenetrated surfaces "around the corner."

However, the modern school facade is not all classroom windows; large parts of the building are given up to other purposes, and some rooms are best lighted by windows more nearly in the scale of domestic architecture. Indeed one of the school architect's greatest difficulties is the solution of this conflict in scales of the various openings. In design the typical bank of classroom windows is a group composition inherently awkward in proportion, its width being generally two or more times its height. The commonest solution of this problem is by a strong marking of the vertical divisions with either mullions or piers. Of the old architecture in Europe, those buildings which most nearly approximate these present conditions are the Tudor structures, and it is for this reason, probably more than any other, that the type has been so generally adopted. The result of common use of this modified Tudor type in districts geographically separated and climatically unlike has been to make it commonplace and to rob it of any local quality. Looking through magazine files, one finds virtually the same thing in the city of Washington, the state of Washington, Washington County, Missouri, and the Lord knows where not. The type is readily distinguishable as the "schoolhouse," but not as, say, the "El Paso school."

At the beginning of the architect's study there

Detail of Entrance

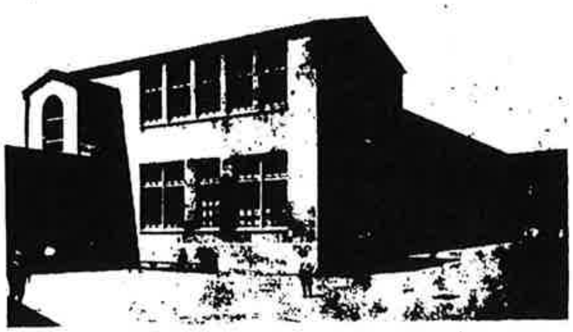
Garfield Junior High School, Berkeley, Calif.

must be determined the type of plan—whether compact and high, or free and open. A present administrative policy tending toward large school units, with high salaried principals in charge of many teachers, may promote efficiency and lessen administrative costs, but it brings up a serious architectural problem in the mere bulk of the buildings. Size is not of itself a drawback; in the congested parts of great cities, on the contrary, it may count as a help by giving right scale in relation to adjoining buildings. But locations in such districts should be avoided when possible, and the best type of schoolhouse stands free among neighboring buildings which are small in both mass and scale. Here the twofold problem of bringing the school into some modest relationship to its neighbors, while maintaining its significance and dignity, is no light task for the designer.

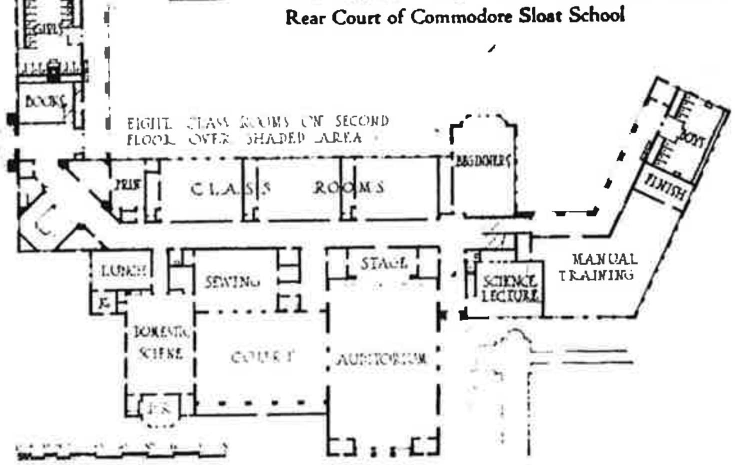
Group composition rather than simple mass appeals strongly as a solution of this problem. The group plan has its virtues and its disadvantages. It is flexible, may be easily added to, separates unrelated functions and gathers for sub-administration those elements which cohere. Its several departments may be operated inexpensively at night or during normal vacation periods. The group plan has a few disadvantages, much over-estimated by those not used to the type. The "proof of the pudding is in the eating," and it is rare that any comment (but in praise) is made of group-plan schools by those who pass their days in them.

The school architect may be fully converted to a progressive type, however, yet have few chances to prove his convictions. Practically, as a public school system is organized, the board seeks a trained administrator for superintendent and passes to him a responsibility which he will accept only, and properly, if his technical judgment is to be in effect final. Similarly (but often with less informed judgment) the board in conference with the superintendent engages an architect. Now it happens that the profession of architecture requires for any degree of stability that its practitioner must stay "fixed" in one locality, while school administrators are great shifters, for they have no clients and they carry much of their equipment "under their hats." So there may come about the anomalous condition wherein an architect of national reputation, established in his community for decades and knowing well all local conditions, finds himself in double harness with a superintendent whose general qualifications may be equally high in his specialty as an administrator, but whose architectural prejudices, perhaps brought from a distant part of the country, are accepted without question by the board. Furthermore, the superintendent finds himself in straits, for he must be the diplomat, first, last and all the time, with the several school communities within his city, with principals, teachers, parents, amateur critics and the town meddler. He dare not, if he would, risk the progressive things that might sometimes be adversely criticized as eccentric or as favoring one school above another. Where conditions have been right, the group-plan school has been the outcome. As the successful ones win approval and become talked about, the proponents of the type have to do a little less pioneering.

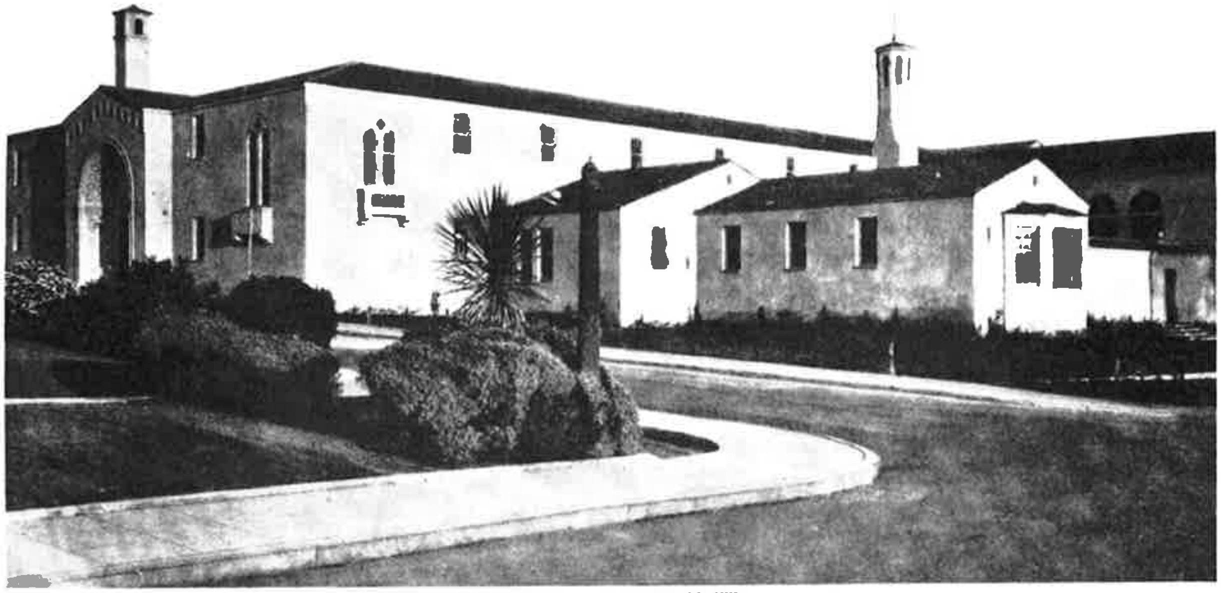
"Group types" vary to suit the nature of the school's work. In common, however, the groups contain special elements for administration, assemblage and physical culture (these two sometimes combined), community work, lunch facilities and special activities, such as domestic science and manual training. Several of these, when logically correlated, are combined under one roof; the units thus created are placed in relation one to the other so as to give plenty of light, air and sunshine. Some portions are logically one-story, and others multiple-story structures. Ensemble is studied with connecting links of open arcades or closed corridors, as climatic conditions necessitate, always keeping the travel distances down to a reasonable minimum.



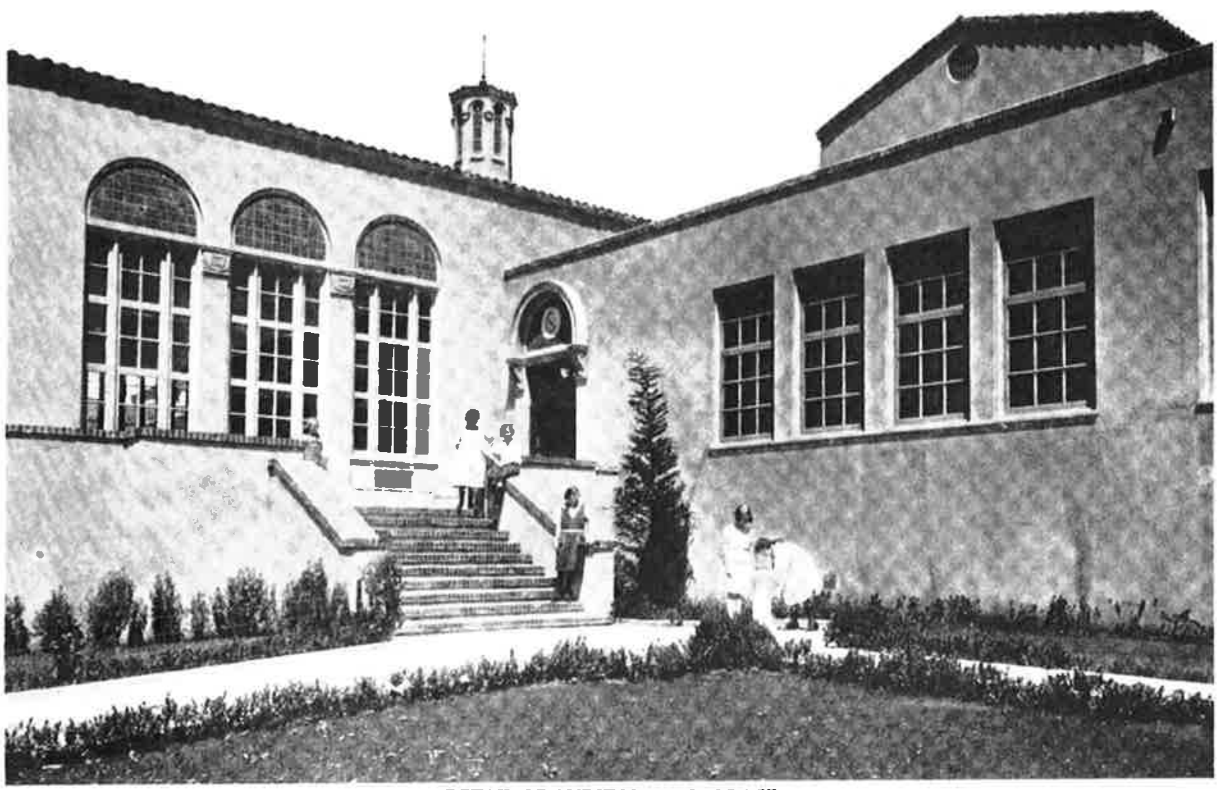
Rear Court of Commodore Sloat School



Floor Plan, Commodore Sloat Elementary School, San Francisco, Calif.
John Reid, Jr., Architect



GENERAL EXTERIOR VIEW

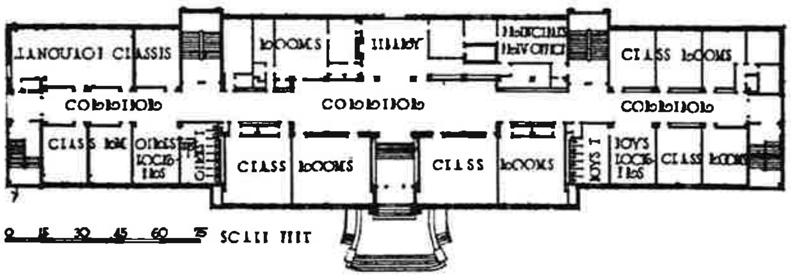


DETAIL OF AUDITORIUM TERRACE

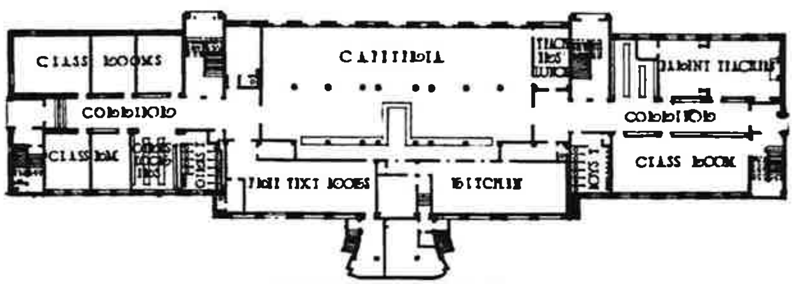
COMMODORE SLOAT ELEMENTARY SCHOOL, SAN FRANCISCO

JOHN REID, JR., ARCHITECT

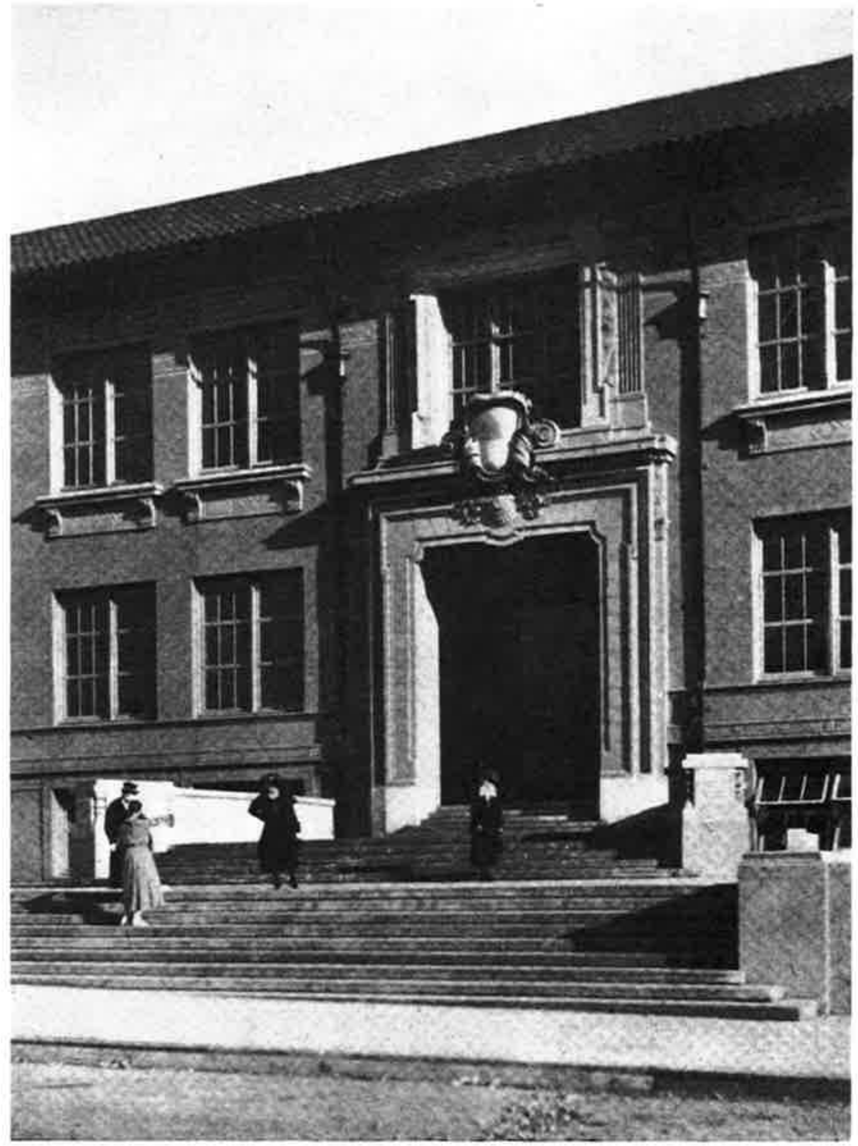
GENERAL EXTERIOR VIEW



FIRST FLOOR PLAN



BASEMENT FLOOR PLAN



DETAIL OF MAIN ENTRANCE

ACADEMIC BUILDING, BERKELEY HIGH SCHOOL GROUP, BERKELEY, CALIF.

WM. C. HAYS, ARCHITECT; A. APPLETON AND JOSEPH J. RANKIN, ASSOCIATES

ACADEMIC BUILDING
BERKELEY HIGH SCHOOL
BERKELEY, CALIF.

Illustrations on Plate 30

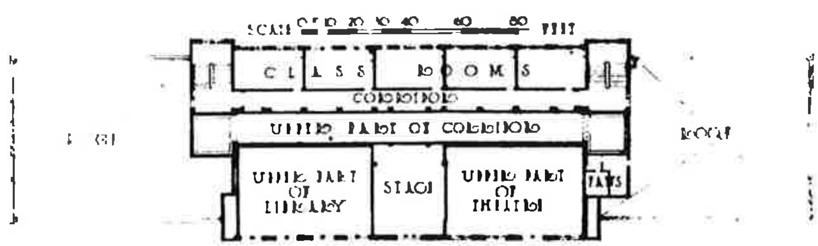
THIS school was finished in 1920 at a cost of $361,623.

The cubic foot cost was 34.6 cents.

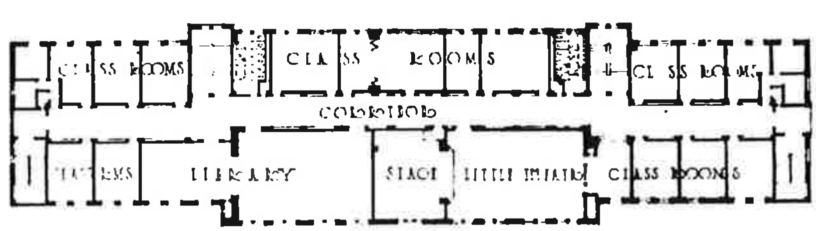
The cost of equipment was 10 per cent of the cost of the building.

The exterior walls of the building are of terra cotta tile and stucco; the roof is of clay tile. The construction is fireproof, of reinforced concrete.

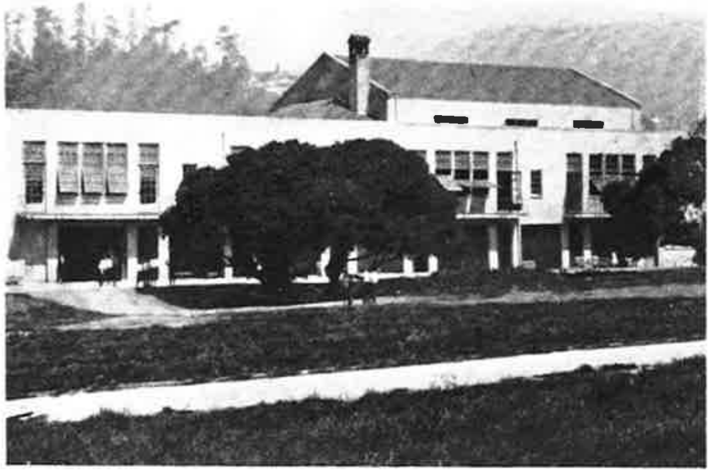
This is the first building of an extensive group planned in conjunction with a civic center development as shown in the plan on page 69.



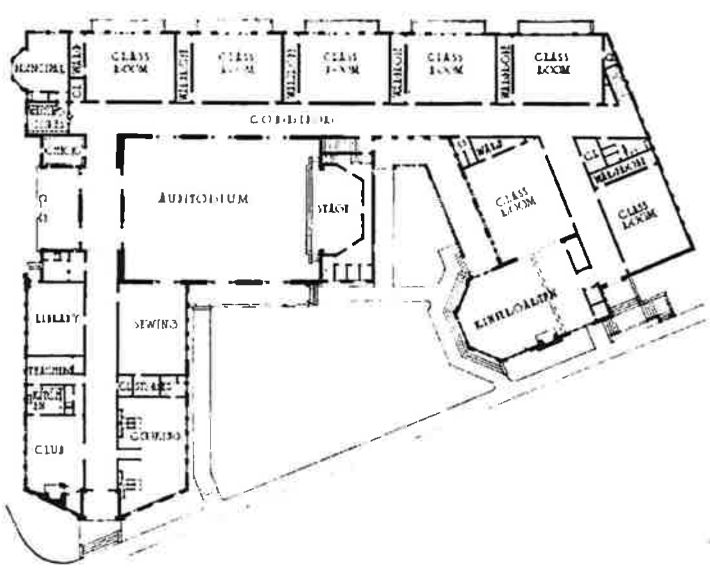
Third Floor Plan



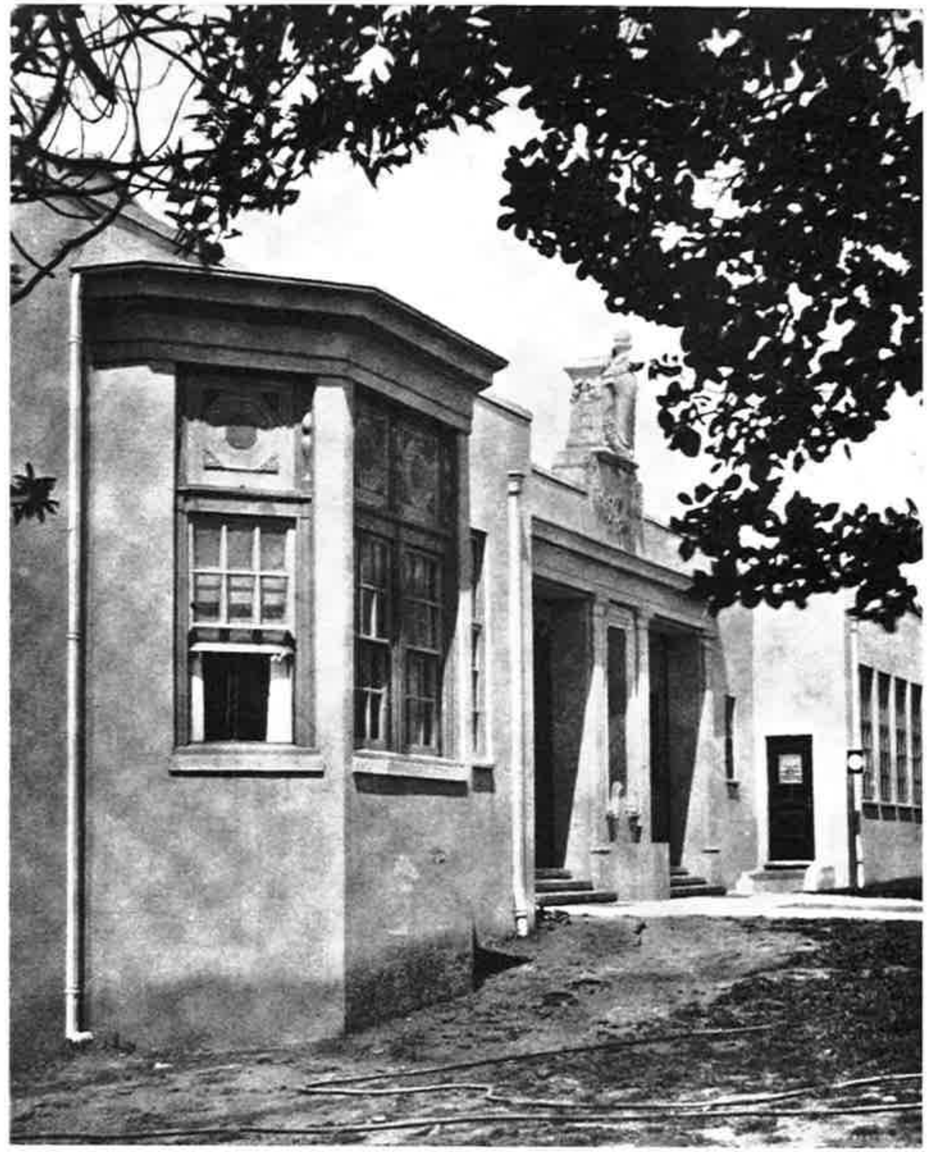
Second Floor Plan



VIEW OF REAR



GROUND FLOOR PLAN



DETAIL OF ENTRANCE FRONT

THOUSAND OAKS ELEMENTARY SCHOOL, BERKELEY, CALIF.

WM. C. HAYS, ARCHITECT.; A. APPLETON AND JOSEPH J. RANKIN, ASSOCIATES

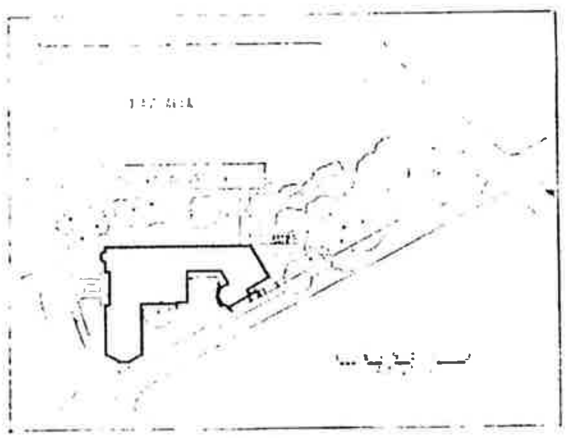
THOUSAND OAKS ELEMENTARY SCHOOL
BERKELEY, CALIF.

Illustrations on Plate 31

THIS school was finished in November, 1919, at a cost of $102,264.

The cubic foot cost was 18.7 cents.

The construction is of frame with stucco exterior and concrete foundations, designed to carry an extra story. The roof is of clay tile.



Plot Plan

Interior Finish and Decoration of Schools

By CHARLES M. BAKER, A. I. A., *Architect, Boston*

VERY little has ever been written concerning the interior finish and decoration of schoolhouses, and when one starts to search for material one is confronted with a paucity of information on this subject; and in the absence of any information or standard of procedure, I shall assume that my opinion on this subject is authoritative and proceed as if it were not to be questioned. Naturally, the interior treatment of the building logically follows the expression of the exterior. One is impressed with the thought of how rarely a schoolhouse suits its environment and is of pleasing design, which perhaps is explained by the fact that many architects are selected by political preference rather than from demonstrated ability to design and construct a satisfactory building.

In all probability, the strongest influence on the exterior design of the building has been the necessity of grouping the windows, which has led naturally, by the line of least resistance, to the adoption of Elizabethan, collegiate Gothic, or some similar free style, and it is apparent to the designer who attempts to work in a style which requires large wall surfaces with relatively small penetrations for the window openings, that this grouping is a distinct embarrassment.

Let us first consider the entrance hall as being the place where the first impression of the building is gained and where we consciously or unconsciously form our opinion of the entire school. Here at least we are not unduly hampered in architectural design or by style. Reasonable latitude is possible in the use of cornices, pilasters and similar details, and with the fireproof construction of the corridors in many buildings, even though of second class construction elsewhere, the opportunity to use tile and other permanent floor materials should not be neglected. Figure 1 shows a well designed corridor and entrance hall, with a breadth of treatment highly commendable. Many times the most unpretentious buildings may be enhanced in beauty by some simple device, such as a niche in the vestibule, or tablets on the walls, giving the history of the school or other matters of similar interest. It is possible that the juncture of the main corridor with the main entrance hall may be slightly enlarged and treated as a small rotunda to give added interest. The corridor, which is used so distinctly for purposes of service, should be treated in the most matter of fact way to bear the brunt of the wear and tear occasioned by constant use. Here may well be hung pictures, framed to harmonize with the general finish.

While the use of brick, painted or glazed, for walls, is to be found in many instances, it must be admitted that this treatment falls far short of the mark toward making a cheerful or homelike interior, and

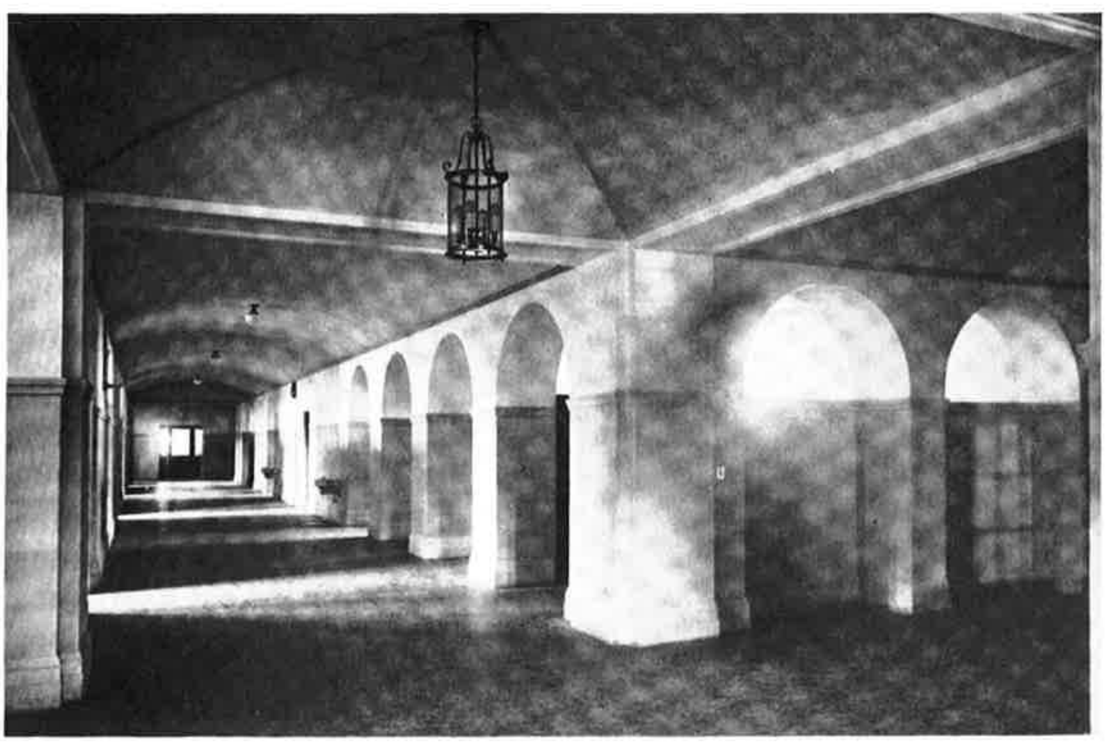


Fig. 1. Ground Floor Corridor of Hempstead High School, Hempstead, N. Y.
The arched openings are entrances to locker aisles
Ernest Sibley, Architect

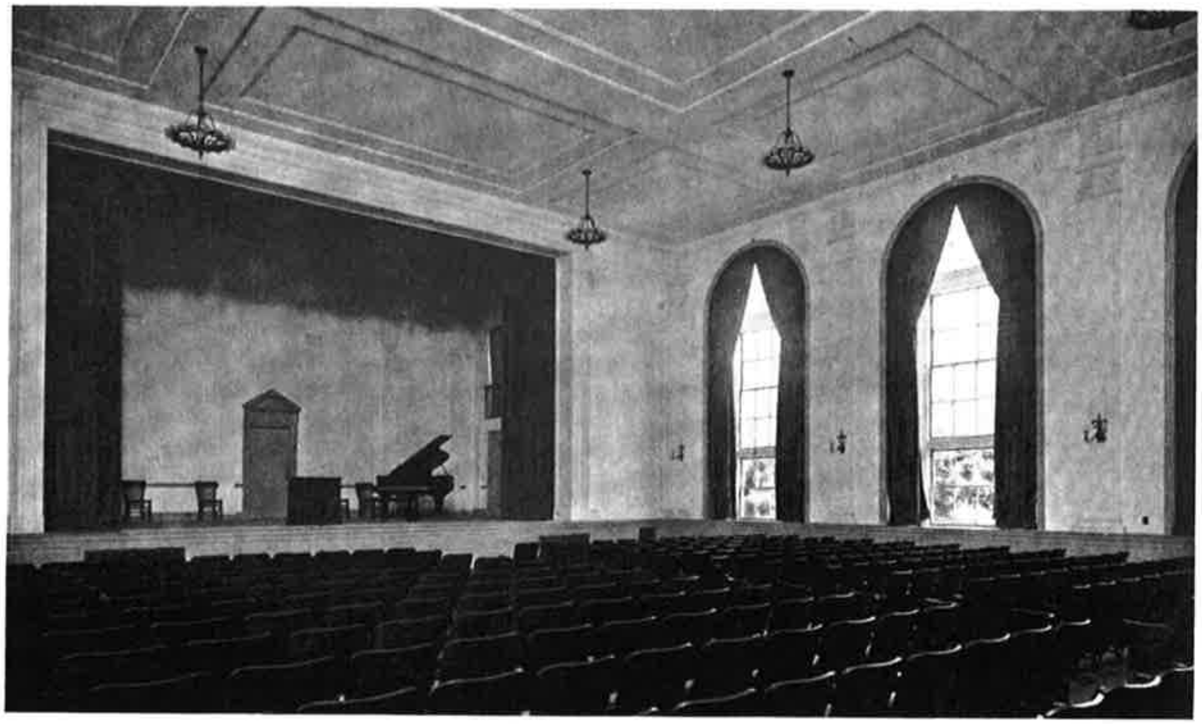


Fig. 2. Auditorium of Hempstead High School, Hempstead, N. Y.
Ernest Sibley, Architect

savors rather of the factory or prison. It would seem to be logical that the schoolhouse, especially the smaller example, might well be treated at a scale as near that of domestic work as possible, that the transition from the home to the school may not be sudden or abrupt and thrust an entirely new element into the lives and thoughts of the pupils.

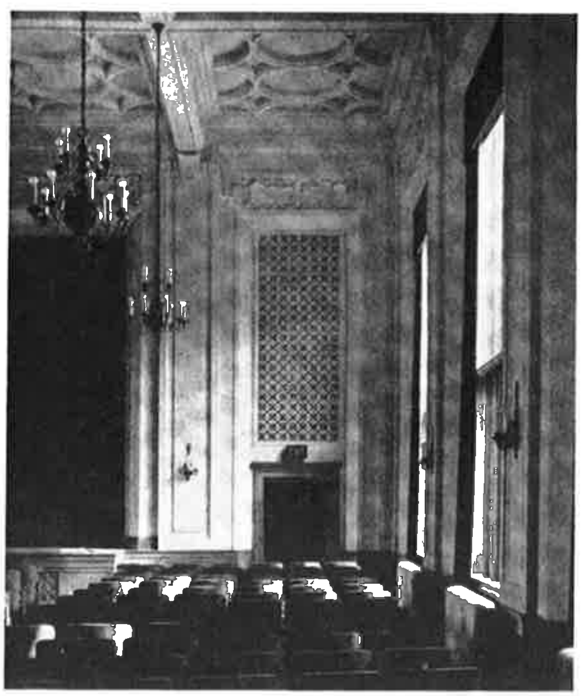


Fig. 3. Detail of Auditorium, Coventry School
Cleveland Heights, Ohio
Franz C. Warner, Architect

Staircases are often made uninteresting and dull by the use of detail which is much more commendable from the standpoint of service than from that of attractiveness. I have found in my experience that an iron staircase can be relieved of its prison-like aspect by the introduction of details of posts and balustrades similar in design to many of the straightforward staircases found in fine old colonial buildings, the posts to be made round with square blocks to receive the rails and stringers and finished with turned finials, attractive in form and suitable for use; a plain balustrade, one-half inch by one inch square rods, with a channel iron stringer, improved by the use of face plate and metal mouldings, all painted gray with black slate treads or the gray of concrete, gives an effect of considerable charm. Corridor and staircase would naturally be painted a warm buff tone, with a view of creating an effect of sunlight in parts of the building which are of necessity apt to be dark.

In the auditorium, if the building possesses one, the architect has the greatest latitude in architectural design in which he is allowed to display his ability, for this usually is a fine, high space warranting embellishment. Plaster casts are often used as decoration in the auditorium, and in the form of busts and plaster statues, or bas reliefs relatively large, provided suitable places are arranged for them, will give a scholastic atmosphere to the room which is admirable. Plaster ceilings, moulded and strapped, with moulded cornices and beams, find a logical use in the auditorium. Figures 2 and 3 show two auditoriums, much different in general treatment, but both worthy of study. Figure 4 is a pencil sketch showing a dignified interior given a classical treatment. The widest latitude is possible in the selection of color for the walls, but it is natural that they should be kept light and cheerful; perhaps tones of gray are to be preferred, contrasted with white. Then, in treating the auditorium, we are confronted immediately by the necessity of adding furniture for the seating, and usually we must add seats which are ugly and inappropriate to an otherwise well designed room; this seems to be a necessary evil, and up to the present time the only way to mitigate it is to select for the stage, furniture of appropriate form and design, which it need not be difficult to do.

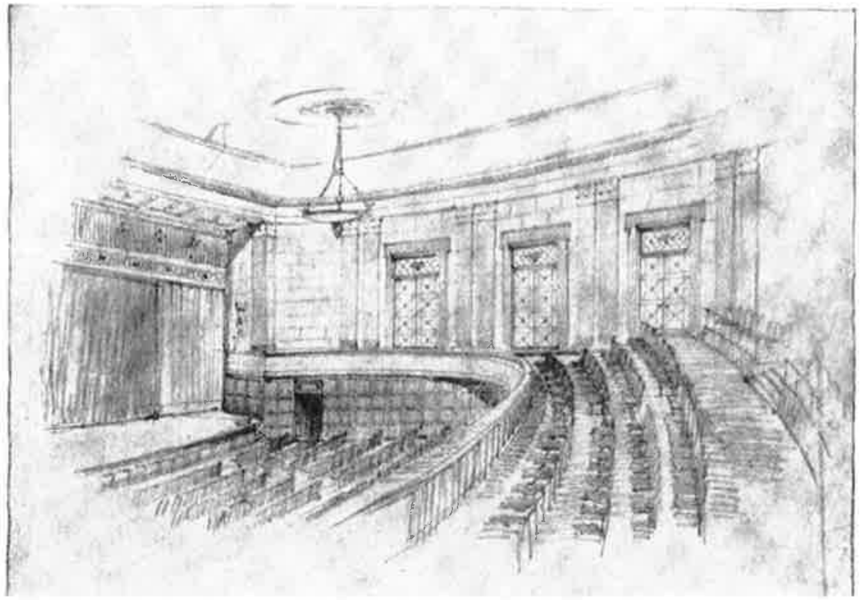


Fig. 4. Sketch for Auditorium of East High School, Columbus, Ohio
Howell & Thomas, Architects

Perhaps the room which has received least consideration in architectural design, but which really deserves the most, is the classroom, for in this room the pupils spend the greater part of the school day, and since they are most closely associated with it, what more appropriate place could be found for intelligent treatment than the room which exerts the greatest influence on character and temperament of the children who are the future fathers and mothers of the generations to come? Here their ideas are formed and perhaps their whole lives shaped. Again, could we not endeavor to design our classrooms so that they might be more domestic in scale? The classroom, it must be admitted, is so hedged about by law, convention and standardization that it leaves very little to the impulse or the imagination of the architect. Fixed in height, restricted as to its window area and locations, the necessity of having blackboards on practically all sides, the dividing of its vertical wall into two equal spaces made by the top of the blackboard, and then filled with stupid and uninteresting furniture, ugly in design, the ironwork of which assumes fantastic shapes and has nothing to commend it on the side of the artistic—we are confronted with a problem which might well make us discouraged.

Fig. 5. Kindergarten, Madison School, Syracuse, N. J.
James A. Randall, Architect

Due to the necessity of lowering costs during the last few years, yellow pine has become a much used material, and this again adds to our limitations. There are few stains that are durable and effective at the same time, when used in conjunction with yellow pine. We are almost restricted to the two colors, green and brown, the brown being often toned with gray, and it would seem to be the lesser of two evils to use brown, which at least has the virtue of being serviceable, and then perhaps somewhat mitigate the ugliness of the school desks, at a slight increase in cost, by staining them to correspond to the finish of the room. A slight touch of good taste and interest may be added in the selection of the teacher's desk and table, and further by utilizing for the teacher's desk chair and side chairs some of the forms used in our ancestral furniture. As for color on the walls, buff or yellow seems to be logical to harmonize with the brown treatment of the woodwork, at the same time giving an air of sunshine and cheerfulness to the room, contrasting pleasingly as it does with burlap, where used in tack boards and below the chalk rails.

Fig. 6. Superintendent's Office, Hempstead High School
Ernest Sibley, Architect

In Massachusetts the law prevents the use of beams on the ceilings of classrooms for fear of its influence on the heating and ventilating systems; still, it would seem that we might resort to some method of ceiling treatment to increase the attractiveness of the room. Low relief design or strapwork would hardly be considered an interference with the heating system, and the now largely discarded cove ceiling might be brought back to use with a view to decreasing the apparent height of the classroom, giving a more pleasing vertical subdivision of the wall space.

The special rooms in a school building perhaps give us the best opportunity to use some decorative method, and possibly best of all would be the kindergarten, with fireplace, if it has one, and an opportunity for the use of stenciled designs and patterns in the form of foliage or animals, or in any other interesting subject, approaching somewhat the typical treatment of nursery walls.

Often in visiting schools in operation one is impressed by the attractive appearance of a few plants growing in pots on the sills of the windows, or by the suggested flowers drawn on the window glass. Is there not a thought here? Build flower boxes as a part of the window detail, and encourage the growing of plants in classrooms.

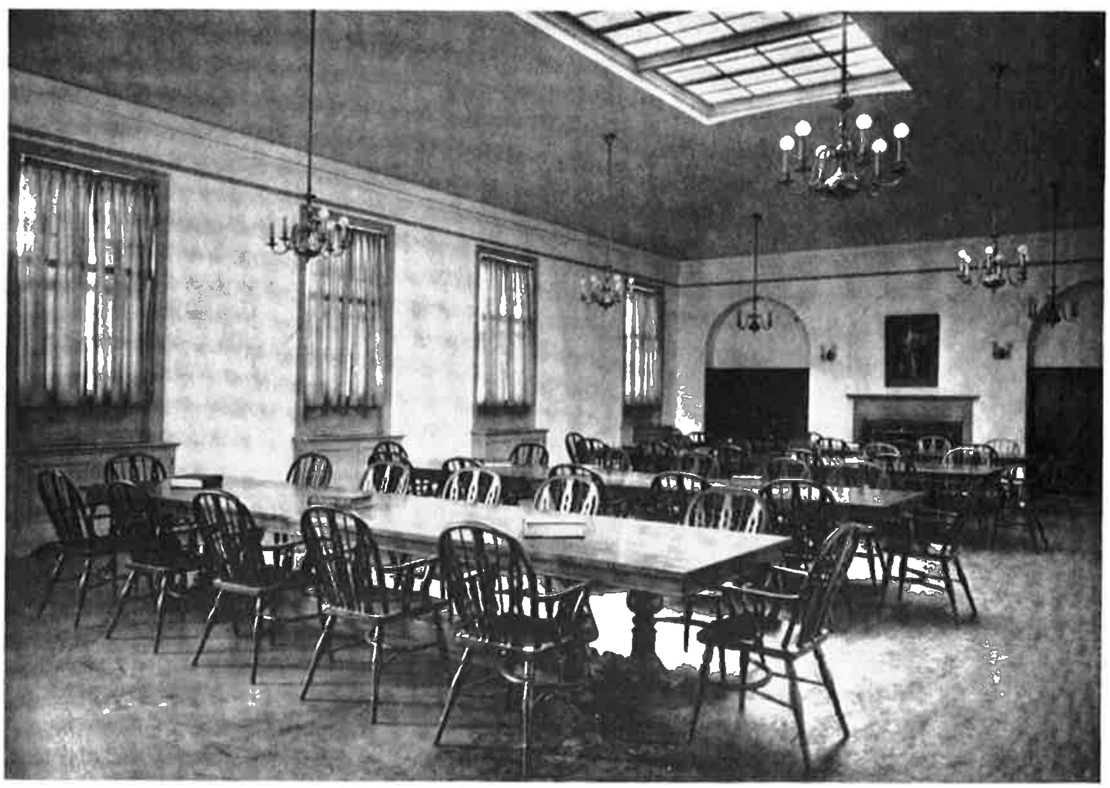
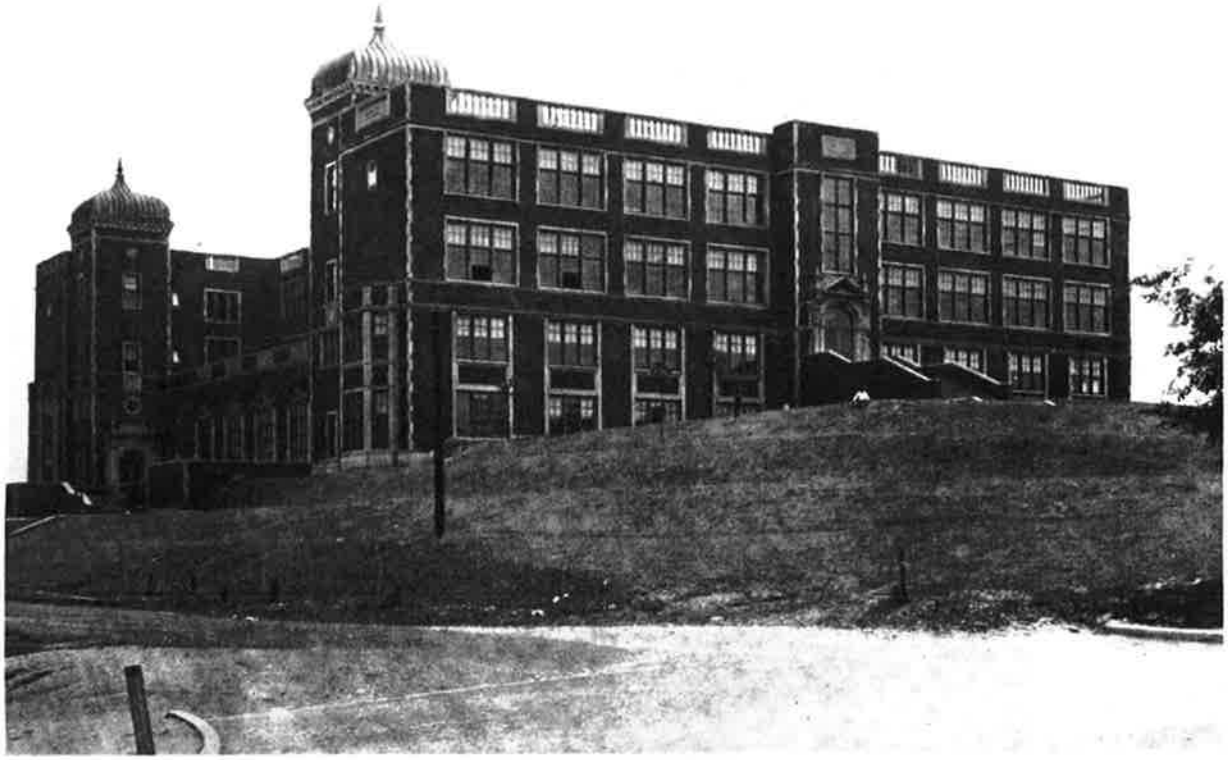
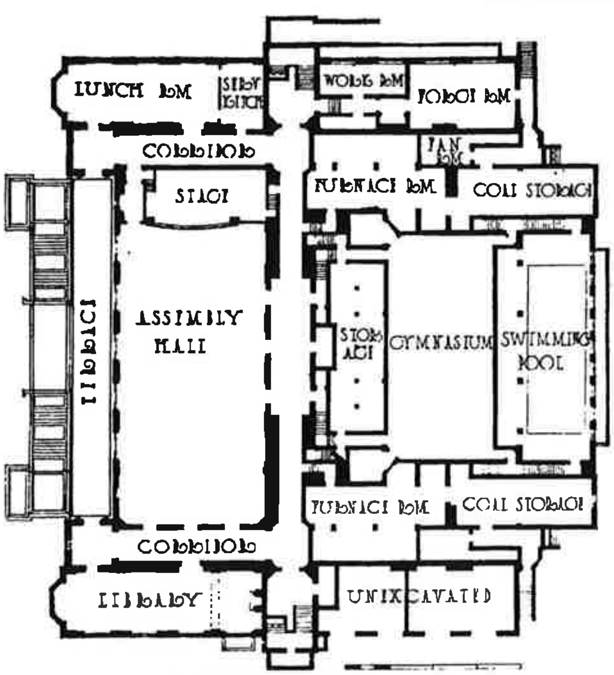


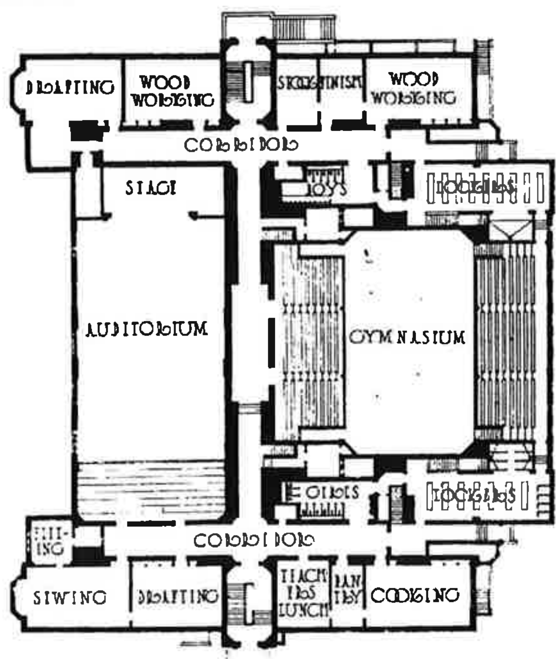
Fig. 7. Library of Hempstead High School, Hempstead, N. Y.
Ernest Sibley, Architect



GENERAL EXTERIOR VIEW



BASEMENT FLOOR PLAN



FIRST FLOOR PLAN

EAST HIGH SCHOOL, AKRON, OHIO

FRANK L. PACKARD, ARCHITECT

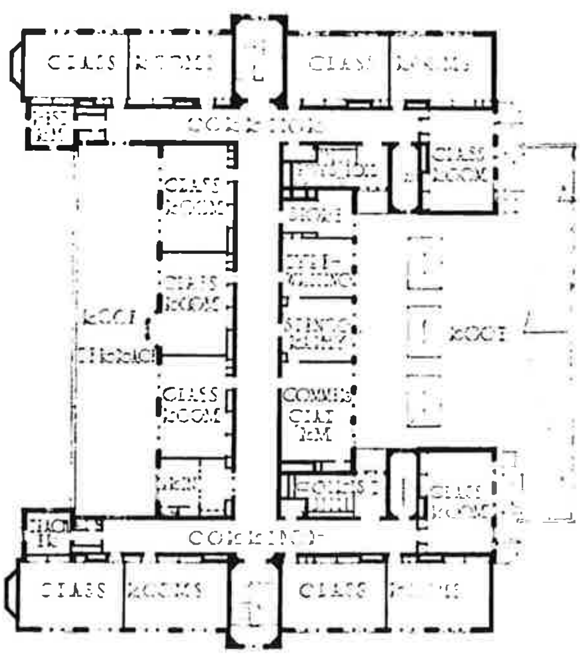
EAST HIGH SCHOOL, AKRON, OHIO

Illustrations on Plate 32

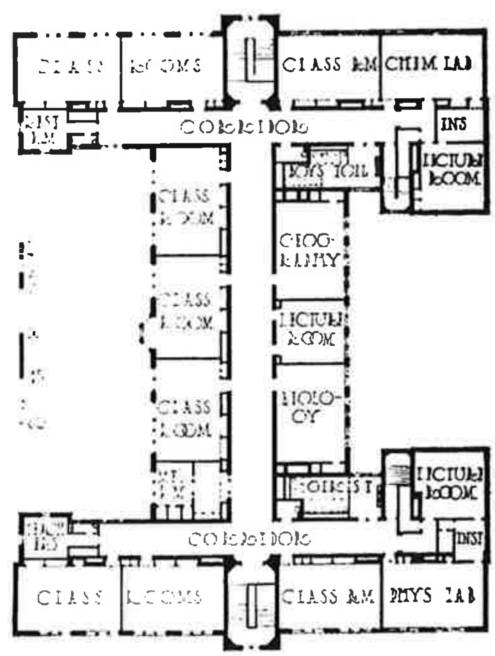
THIS high school was completed in 1917 at a cost of $384,111.39. It accommodates 1691 pupils, making a building cost per pupil of $231.29.

The cubic foot cost, exclusive of equipment, is 24.67 cents.

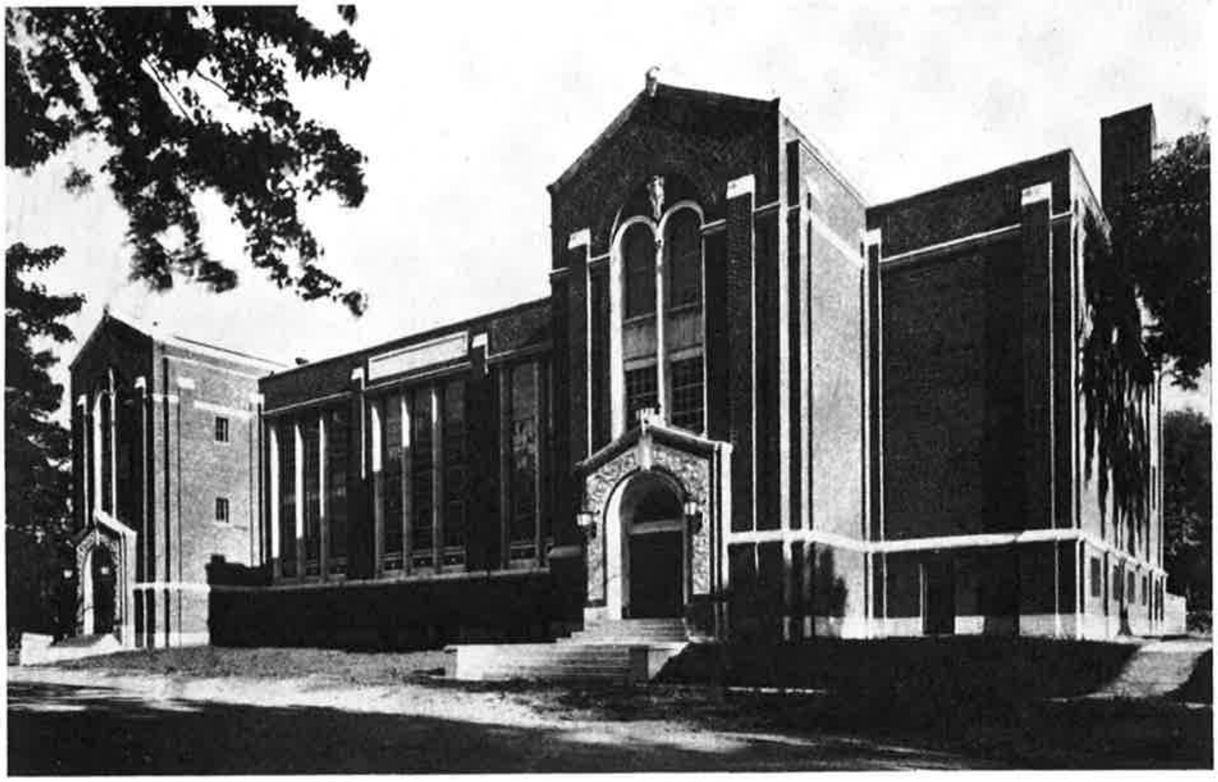
The exterior walls of the building are of brick and Indiana limestone. The construction is fireproof.



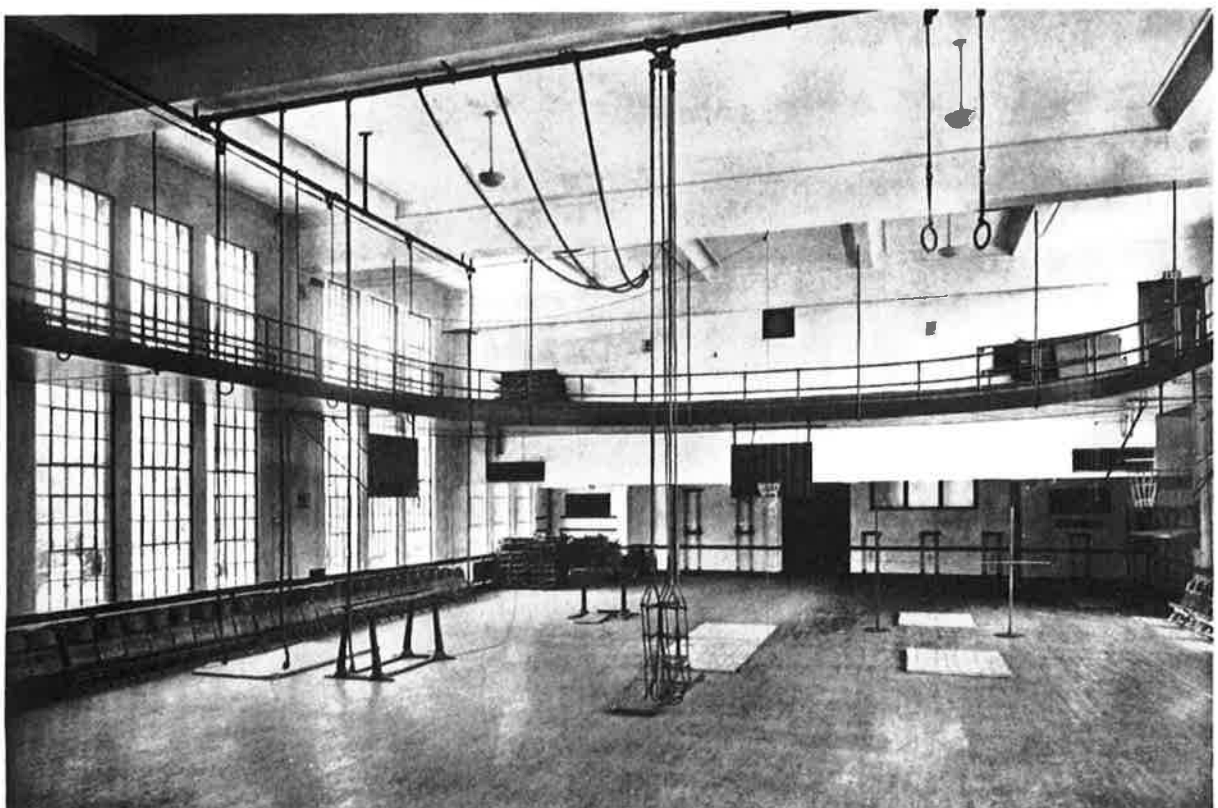
Second Floor Plan



Third Floor Plan



VIEW OF GYMNASIUM FACADE



INTERIOR OF AUDITORIUM-GYMNASIUM

BALDWIN HIGH SCHOOL, BIRMINGHAM, MICH.

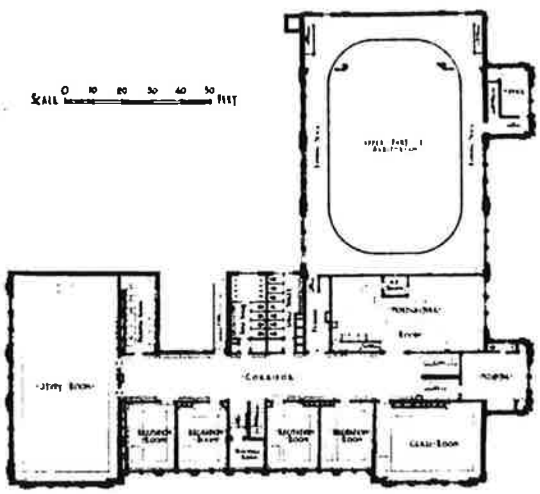
VAN LEYEN, SCHILLING, KEOUGH & REYNOLDS, ARCHITECTS

BALDWIN HIGH SCHOOL
BIRMINGHAM, MICH.

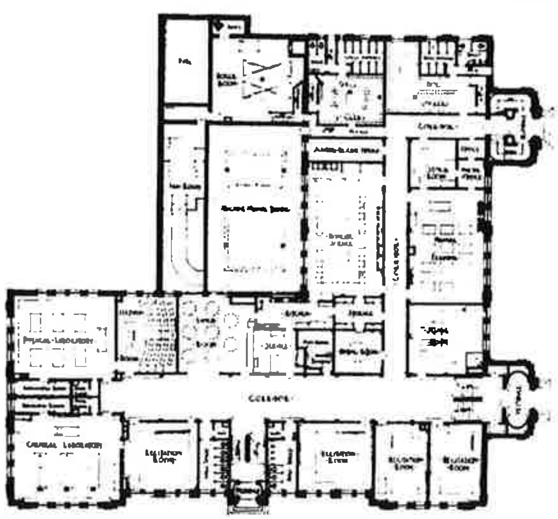
Illustrations on Plate 33

THIS school is constructed of rough surfaced face brick trimmed with terra cotta. It is of fireproof construction and is planned to be added to at the rear of the space occupied as a study room. A combination auditorium-gymnasium is included. Note two large study rooms required by the type of school administration.

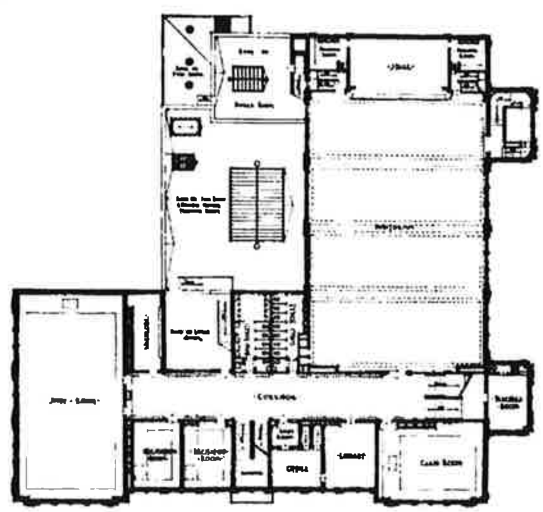
Heating by direct steam; ventilation by indirect method using fresh air room, plenum chamber, fans, etc. Erected in 1917 at approximate cost of 24 cents per cubic foot, or $417 per pupil for 600 pupils.



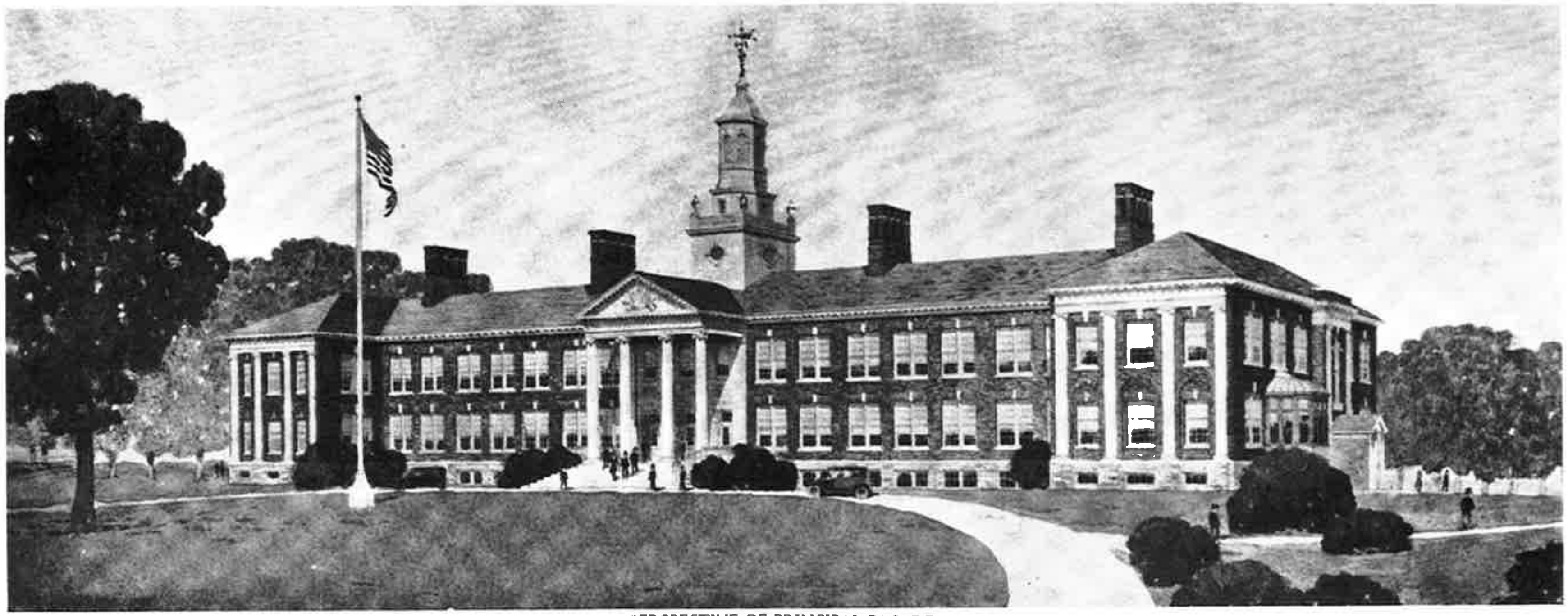
Second Floor Plan



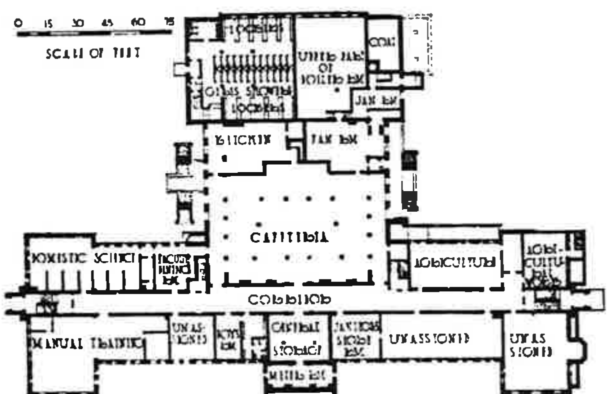
Ground Floor Plan



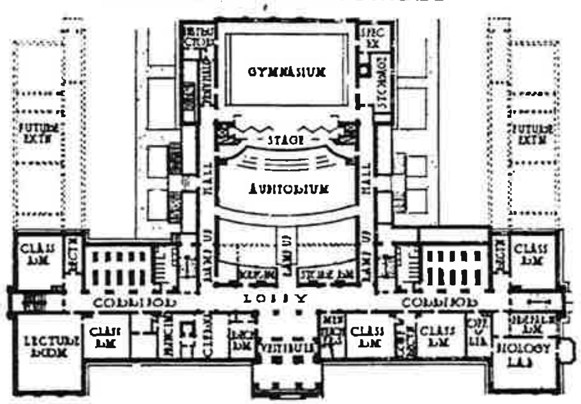
First Floor Plan



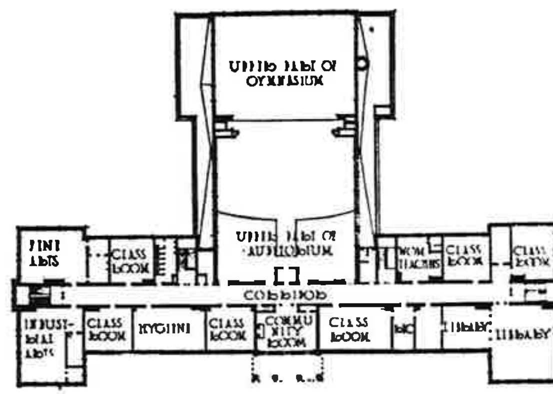
PERSPECTIVE OF PRINCIPAL FACADE



BASEMENT FLOOR PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN

STATE NORMAL SCHOOL, GLASSBORO, N. J.

GUILBERT & BETELLE AND ARNOLD H. MOSES, ASSOCIATE ARCHITECTS

STATE NORMAL SCHOOL
GLASSBORO, N. J.

Illustrations on Plate 34

THE contract for this school was let in the spring of 1922 at a cost of $476,703.

The cubic foot cost was 37.2 cents.

The exterior of the building is face brick with Indiana limestone trim. The construction is fireproof.

School Building Construction Costs

By JAMES O. BETELLE, A.I.A.
Guilbert & Betelle, Architects, Newark, N. J.

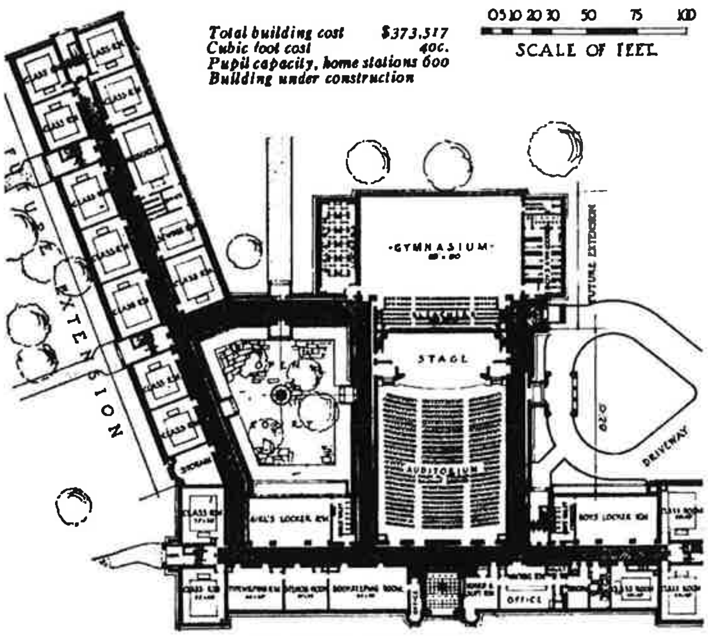
BEFORE the world war the architect interested in school building construction costs could draw upon the experience of years, during which prices were stable and cost data, covering numerous buildings of different sizes, construction and location, was available; it was therefore possible to predetermine very quickly and accurately the approximate cost of a given building in a certain location. This cost data, which was the accumulation of years, has all been swept into the discard and is of no use whatever excepting as a historical curiosity, showing how much we could build for little money in bygone days.

While we have passed the peak of high prices and have come considerably down the scale, prices are not stable and the pendulum will undoubtedly swing back and forth for some years to come, depending upon supply and demand. Therefore, no costs compiled at this time will hold good very long. At this writing (August, 1922) prices are stiffening and in the eastern part of this country they are about 10 per cent higher than they were three or four months ago. The cost of each building must be determined upon its own merits, and this is where the judgment, ability and experience of the architect come in for a severe test. In the class of public work, such as school buildings, it is absolutely necessary for the architect to keep within the appropriation available. Unlike private work, the amount appropriated cannot be easily increased at the option of an individual owner. No matter how small the extra amount needed may be, it must be formally and publicly voted upon, and this is not only difficult but often humiliating and embarrassing. It is encouraging to note that there is a marked tendency on the part of school boards to approach the problem of the cost of their proposed buildings in a more intelligent way than heretofore. The majority of them no longer guess at an arbitrary amount, such a° they feel they would like to spend, but they call in their architects for guidance and advice as to the size of the buildings and their probable cost.

Too many architects are inclined to see how cheaply they can construct their buildings, without keeping in mind that cheap first cost always means deterioration and high upkeep charges later on. How much better it is to insist upon sufficient money's being provided or the size of the structure's being reduced, so that a building of the best construction can be erected! Schools are subjected to extremely hard usage and often to abuse. In addition to the use of the building for school purposes it is also used nights and Sundays for community purposes; only the most substantial and practical construction and finish will stand up under such excessive use. In an architect's early practice he undoubtedly has succumbed to the temptation or pressure to erect a building which has not the quality of materials which longer experience teaches him to insist upon. These early buildings are always a thorn in the flesh and appear time after time to plague and torment their designer. This is a plea to the younger practitioner to stand out for what he knows to be proper construction and not be sponsor for a building he will be ashamed to visit or to admit that he designed after a few years have passed. It is not only how *much* we can build for a given sum, but also how *well* we can build it. There is always a minimum below which no self-respecting architect will undertake the work. These facts are admitted by all and they are as old as the profession itself, but they are worth repeating in these days of high construction costs when the pressure for new buildings is so great and the temptation to undertake to do more than the funds will properly permit is almost irresistible.

To determine the probable cost of a school building from preliminary sketches and to keep a check on them during the period when contract working drawings are being prepared, several methods are familiar to the architect, although only the price per cubic foot approaches any degree of accuracy. It might be said that few if any architects make up a detailed quantity survey, price these quantities and arrive at the cost in this way. That method is too laborious, and other means are quicker and nearly enough correct to answer all ordinary requirements. Approximate estimates obtained from building contractors are not sufficiently accurate to be depended upon. Experience has demonstrated that the contractor cannot afford the time to do anything more than make a rough guess; he cannot be expected to obtain sub-bids and go through the routine of preparing a regular estimate when there is no contract in sight and when it is only done as a favor to the architect. Approximate estimates from builders are usually too high or too low to be of any use, so that in the last analysis the architect has to use his own judgment as to the cost of the proposed building, and stand or fall on the results.

In earlier days, when a school consisted of four walls and a roof, divided on the interior into classrooms of equal size, the cost was given as a certain amount per classroom. The question is still often asked, by educators who should know better, what schools are now costing per classroom. With the modern school building, containing an auditorium, gymnasium, locker and shower rooms, lunch room, large shops, study halls and rooms of varying sizes, it can easily be seen that it is not possible to use the classroom as a unit of cost. Sometimes schools have been quoted as costing a certain amount per square foot; this is also not a satisfactory unit to use as a



First Floor Plan and Perspective
Summit High School, Summit, N. J.
Guilbert & Betelle, Architects

measure of cost, because different schools vary as to ceiling heights and rooms; even in the same building, rooms vary in heights, as for instance, the auditorium and gymnasium. Cost per pupil is also difficult and misleading, as authorities have not yet agreed upon a uniform basis for counting the pupil capacity of schools with home stations and special rooms. It resolves itself into the use of the cubic foot as the only accurate unit of cost that will apply to any kind of building irrespective of its size or interior arrangement.

The other important factor governing the cost of school buildings is the type of construction. For the purpose of this article only two classes of construction are considered—fireproof and semi-fireproof. The usual fireproof type is understood to include masonry walls and floors, wood trim, and either a masonry or a heavy timber roof. There is not a great deal of difference in cost between a short span, reinforced concrete roof and one of timber, or at least not sufficient difference to materially affect the cost here given per cubic foot. The semi-fireproof building is intended to mean a building having masonry exterior and corridor walls and other supporting walls, but with stud partitions dividing individual rooms; floors in corridors and over boiler and coal rooms to be of fireproof construction, but all floors of ordinary classrooms as well as roof construction of heavy timber.

Information received in reply to inquiries sent out to leading architects who have fireproof school buildings under construction at this time indicates the cost for various localities to be about as given here, architects' fees not being included in these costs:

For the district around New York, fireproof schools are costing from 35c. to 40c. per cubic foot. A good building can be produced for 38c. It is interesting to note that the same type of building that costs 35c. and 40c. per cubic foot when built around New York can be built in the central part of New York state for 30c. to 35c. per cubic foot.

The work being done by the Bureau of Construction and Maintenance, Department of Education, New York, for the entire work costs 55c. per cubic foot. Of this amount 70 per cent of the total, or 38c., is for the general construction, and the remainder for heating and ventilating, plumbing and electrical work. This apparently high cost is due to the multi-story buildings and restrictive regulations applying to school buildings in New York, as well as to the excellent quality of the buildings erected.

The work being done by the Construction Department of the Philadelphia Board of Education is costing from 33c. to 36c. for the entire work.

Costs in the Chicago district are averaging 30c. per cubic foot for semi-fireproof construction, while fireproof construction is averaging 35c.

The cost of the schools built by the Construction Department of the Cleveland Board of Education was 15c. in 1912; in 1920 it reached the peak, costing 70c. per cubic foot, and in 1922 the cost dropped to 35c.

Costs of new fireproof schools for Columbus and the Ohio district generally are averaging 30c.

In the New England district semi-fireproof buildings are costing 32c. per cubic foot, while fireproof buildings cost 36c. to 38c.

No definite data was received from the middle west, but the California replies indicated that around San Francisco semi-fireproof schools cost 22c. to 25c., while fireproof buildings cost 30c. to 35c. per cubic foot. Replies from southern California indicate that the type of semi-fireproof building erected in that district is now costing from 22c. to 23c. per cubic foot.

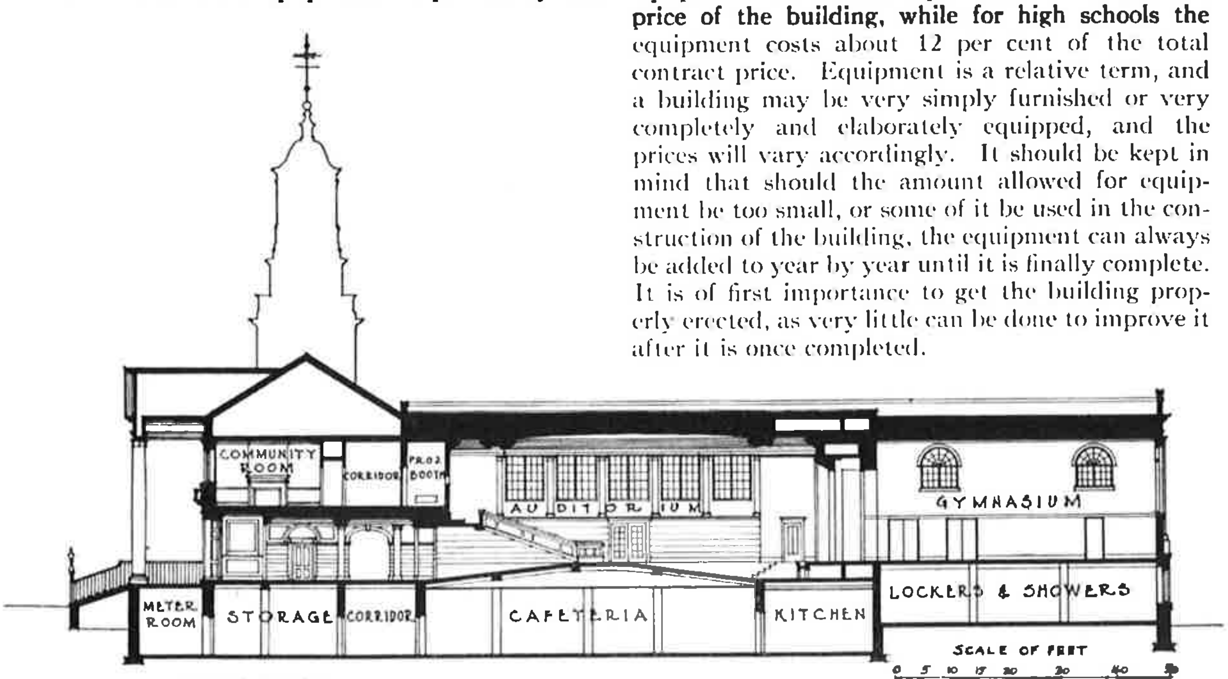
It costs slightly more to erect a high school than it does a grade school. This is principally on account of there being more plumbing, electrical work, heating and ventilating required in the special rooms, as well as the more elaborate and pretentious building required for a high school.

The difference in cost between a semi-fireproof and a fireproof building does not amount to as much as formerly, in these days of high priced lumber and comparatively low priced steel and cement. Practically all school buildings of any size are being built fireproof, excepting possibly the roof construction which makes it come under the class of a fireproof school building in some states. Roughly speaking, a completely fireproof building will cost about 8 per cent more than one which is semi-fireproof. Even in a so-called semi-fireproof building a great deal of the floors are fireproof, such as those of corridors, those over boiler rooms, coal rooms, manual training rooms and the like. It remains only to fireproof the floors of the regular classrooms, and the difference between the costs of a floor built of 3 x 14 joists and a reinforced concrete slab is not very great.

The mechanical equipment is practically the same in any school, irrespective of its type of construction or its costs. Obviously, it costs as much to heat a semi-fireproof building to 70° Fahr. in zero weather and to provide 30 cubic feet of fresh air per pupil per minute in a semi-fireproof building as it does in a fireproof structure when both are the same size; therefore it is often misleading to say that the mechanical equipment cost a certain percentage of the total cost of the building, excepting when the buildings are of the same quality. In a good type of fireproof building, costing say 40c. per cubic foot, the heating and ventilating will average 4½c., the plumbing 2c., and the electrical work 1½c. per cubic foot, the general construction making up the difference, or 32c., which all equal the total of 40c.

If, for the sake of argument, we wish to express the figures on mechanical equipment in terms of percentage on a 40c. per cubic foot fireproof building, the general construction equals 80 per cent of the contract, heating and ventilating 10 to 12 per cent, electrical work 3 and plumbing 5 per cent. In a cheaper semi-fireproof building these relative percentages would change; the mechanical equipment would increase in proportion while the general construction percentage would decrease. This is on account of installing the same mechanical equipment in a cheaper type of building.

With regard to equipment, the architect is often asked by the school board or the superintendent of schools how much to allow in their budget for equipment. It is quite an undertaking to itemize and price the equipment piece by piece, so that a quick rule for close approximation is often very useful. For grade schools it is found that complete equipment costs about 8 per cent of the contract price of the building, while for high schools the equipment costs about 12 per cent of the total contract price. Equipment is a relative term, and a building may be very simply furnished or very completely and elaborately equipped, and the prices will vary accordingly. It should be kept in mind that should the amount allowed for equipment be too small, or some of it be used in the construction of the building, the equipment can always be added to year by year until it is finally complete. It is of first importance to get the building properly erected, as very little can be done to improve it after it is once completed.



Longitudinal Section

State Normal School, Glassboro, N. J.

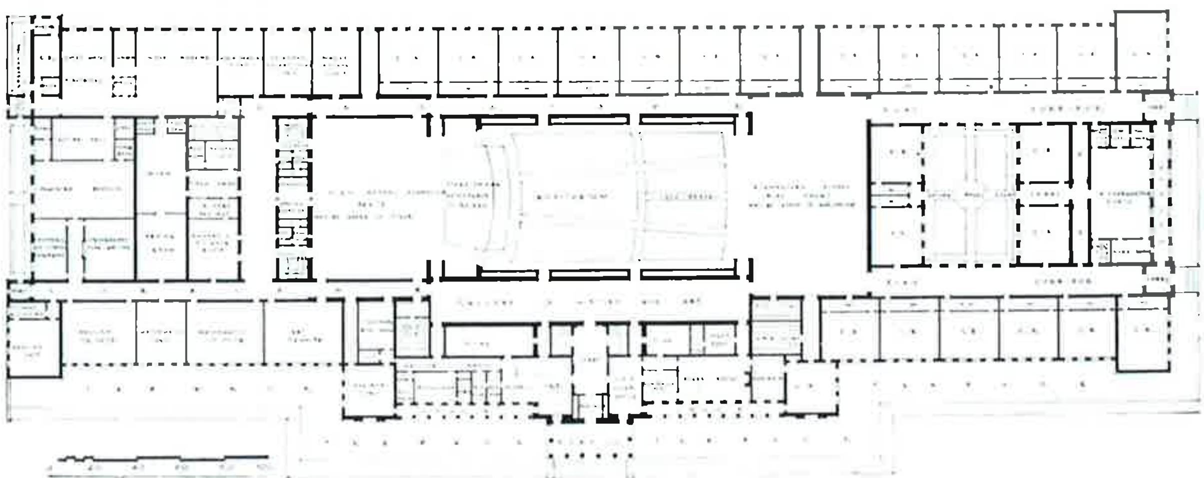
Guilbert & Betelle and Arnold H. Moses, Associate Architects

The Handley School, Winchester, Va.

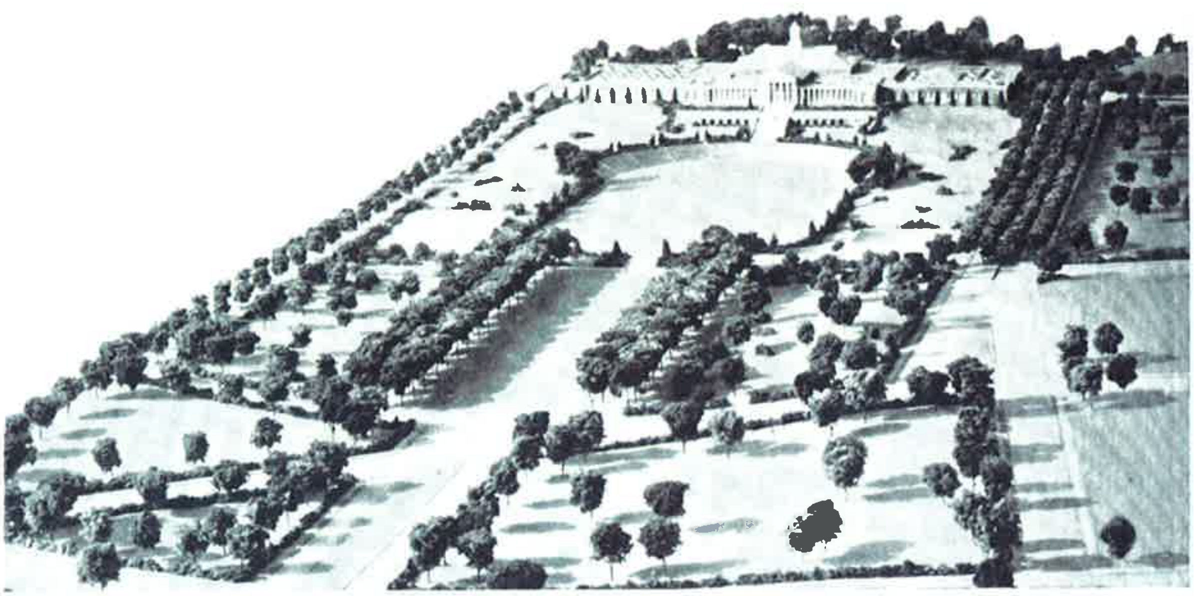
W. R. McCORNACK, ARCHITECT

THIS school, built from a bequest by the late Judge John Handley, is a memorial school conducted under the auspices of the local public school board, and is located in a tract of some 80 acres which is to be laid out with every possible provision for athletics, including tennis courts, an athletic field and stadium, wading pool, playgrounds for little children, golf course and a park for adults.

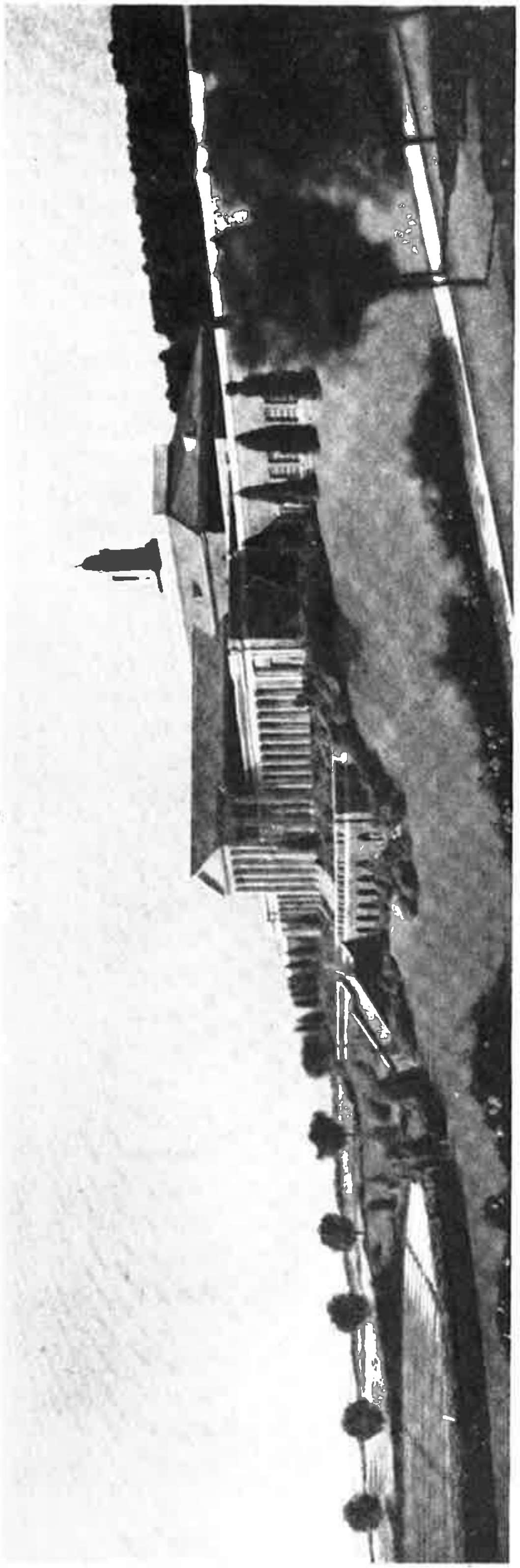
Within the school building, which is designed in the form of a letter H and on the one-story, unit plan, with an outside exit from each classroom, are taught the usual kindergarten, elementary, junior high and senior high grades, and in addition to the requisite classrooms with overhead light the structure includes the necessary laboratories, shops, an assembly room which seats 2,000 when extended to include the play court, and also a gymnasium, nature study hall, a swimming pool, cafeteria and a number of other adjuncts not often to be found in even the best equipped school building. Carrying out the wishes of its founder, the school is intended to be not only the most completely equipped of public schools but is also to be a community building so broad in its scope as to care for not only the regular school curriculum but to meet also the vocational and recreational needs of all the people in the community.

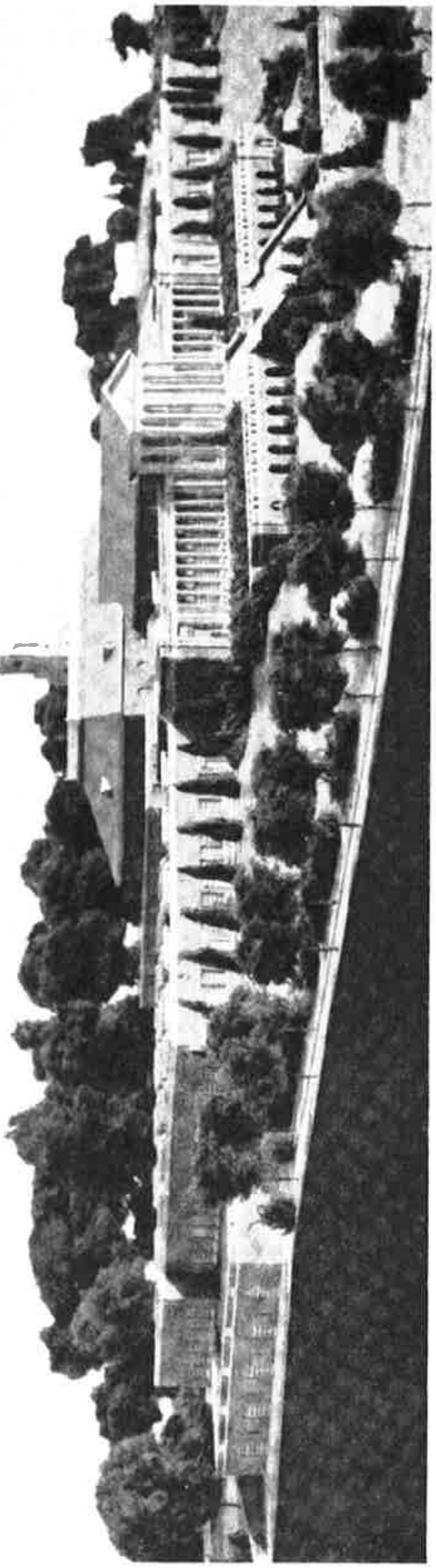


Ground Floor Plan of the Handley School



General View of Model Showing Landscape Treatment of Extensive Site





HANDLEY CONSOLIDATED PUBLIC SCHOOLS, WINCHESTER, VA.

W. R. McCORNACK, ARCHITECT
GEORGE FOX, ASSOCIATE ARCHITECT

Economies in Cleveland School Plans

BASED ON STUDIES OF W. R. McCORNACK, ARCHITECT FOR THE BOARD OF EDUCATION

By GEORGE M. HOPKINSON, *Associate Member, A.S.C.E.*

WASTE in the form of unnecessary expenditure of funds by various school boards throughout the country extends into millions of dollars, due to the fact that too little consideration has been given in the past to the application of economical principles of schoolhouse planning. The average tendency in a great many cases is to consider a school building as so many classrooms together with necessary corridors and stairs for gaining access to the various different rooms; whether space which is not actually used for instruction purposes can be eliminated is not as seriously considered as is the case when a commercial venture is undertaken, such as an office building, wherein the architect strives to eliminate every square foot of space that does not produce revenue or that is not necessary for the functioning of the building.

The matter of the waste of space in school buildings was brought to the attention of the school officials in Cleveland through School Architect W. R. McCornack of the Cleveland system, who took upon himself the task of thoroughly investigating the reasons for the difference in cost of two buildings which were bid upon at the same time, and contained practically the same building requirements, but so arranged that the layouts formed different types of schoolhouse design. This investigation revealed to the Cleveland school officials the secret of eliminating school building waste.

The school buildings referred to are the Empire and Rawlings elementary schools, which were built at the same time in the summer of 1914, when building costs were at their lowest pre-war ebb. These buildings are two stories in height, and both are of the same fireproof construction throughout and contain these departments:

Twenty standard classrooms.	Principal's office.
Kindergarten.	Auditorium, seating 500.
Manual training rooms.	Girls' playroom.
Domestic science department.	Boys' playroom.
Dispensary.	Swimming pool.
Two rest rooms.	Usual toilet facilities and heating plant.
Teachers' lunch room.	

It was suggested in the interests of economy that the Rawlings School be given much the more simple treatment on the exterior and that a common brick facing be used throughout, without any limestone trimming. This was done, and when the estimates were received the prices per cubic foot were thus figured:

Rawlings School, with common brick exterior, 15 8/10 cents.

Empire School, with more ornate exterior, 16 3/10 cents.

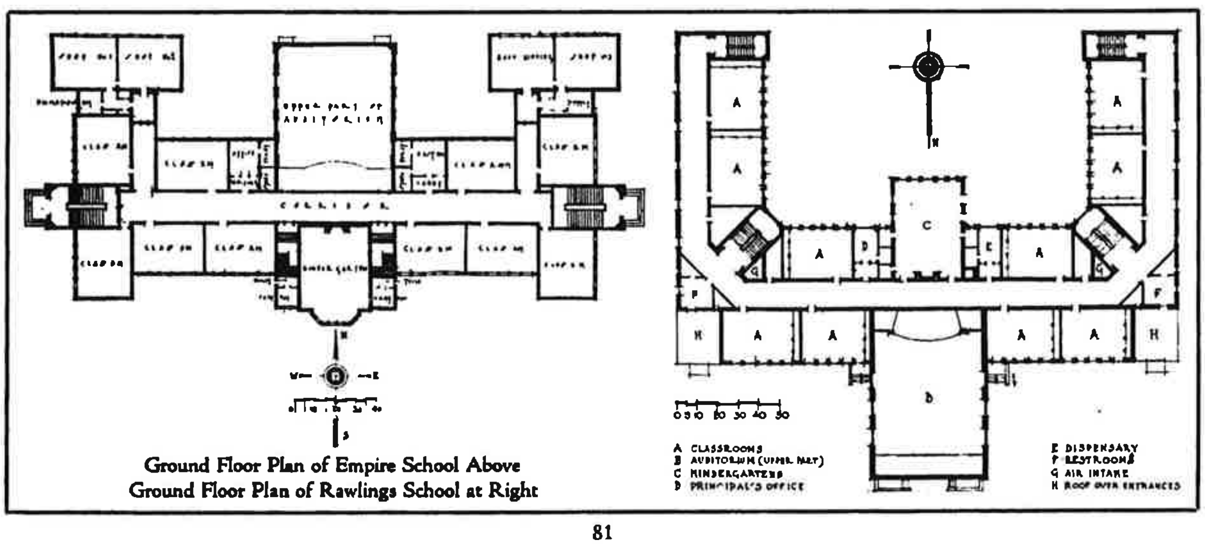
Further analysis of the estimates brought out the fact that the Rawlings School, showing the lower cost per cubic foot, indicated a cost of $15,640 in excess of the Empire School.

The research division of the architectural department immediately started to analyze the plans and obtained these results:

Total gross area of the buildings:	
Empire School	62,435 sq. ft.
Rawlings School	64,485 " "
Total area of corridors, lobbies and stairs:	
Empire School	10,386 sq. ft.
Rawlings School	22,976 " "

The investigation revealed the fact that the excess cost of the Rawlings over the Empire was due to the waste in corridors, stairs and lobbies.

The reader's attention is called to the accompanying plans and elevations of the two buildings under discussion. Investigations were continued in connection with other schools by gathering all available



Ground Floor Plan of Empire School Above
Ground Floor Plan of Rawlings School at Right

Entrance Front of Rawlings School, Cleveland

data and information bearing upon the question of saving space not actually needed for instruction purposes in school buildings. From a careful examination by measurements of every building in the Cleveland school system it was found that there are 1,250,000 square feet of floor space in Cleveland schools devoted to stairs and corridors. This is an area equivalent to 1,650 classrooms or enough to accommodate 62,400 children, and at the present cost of building construction it would require $30,000,000 to construct this number of classrooms. This is cited to show what a large amount of money could be used for providing space for instruction could a saving in corridor, stair and lobby space be brought about in standard schoolhouse design.

A study of a few examples of other types of buildings reveals the fact that hotels and office buildings have approximately 15 per cent of the gross floor area in stairs and corridors, while banks, stores and manufacturing plants, libraries and other buildings show a much smaller amount. It is to be expected that the percentage of space devoted to stairs, corridors and lobbies in hotels and office buildings should be large because of the small units contained therein, each of which must be reached independently, but at the same time school buildings are being planned with a much larger area of waste space. If an architect designed his commercial building with the same percentage of waste space that he does in a school building, he would not survive to design any more.

The architectural department of the Cleveland Board of Education has continued studies of the question with the idea of eliminating absolutely all waste space possible, and the result has been the development of these three types of building:

1. The one-story, corridorless, elementary school, with 8 per cent of the floor area in corridors.

(Similar to the Brett Memorial and Miles Standish Schools.)

2. The three-story, corridorless, elementary school, with 12 per cent of the area in stairs and corridors.

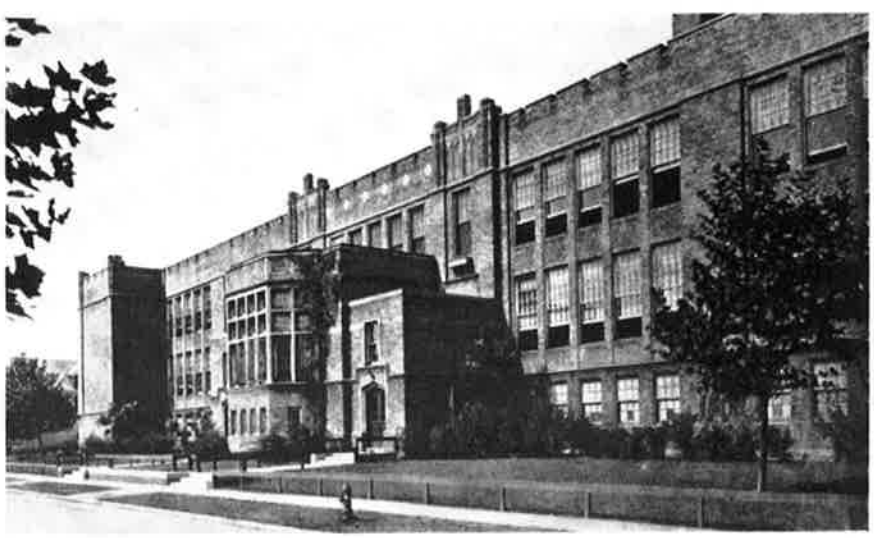
(No contracts have as yet been awarded for this type.)

3. Junior and senior high school combination one and three-story building, with 15 per cent of the floor area in stairs and corridors.

(Buildings of this type are under construction.)

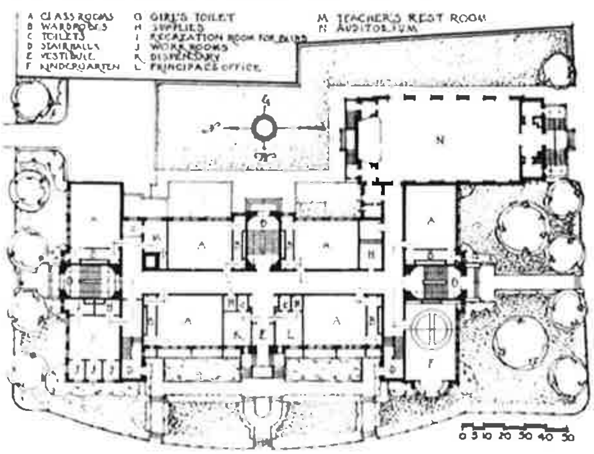
Assuming 15 per cent to be the amount of unusable space lost in planning a school building, there would still be a saving of 10 per cent over the amount of unusable space in the Cleveland schools of the past. This means that 40 per cent of the 1,250,000 square feet of stair and corridor space in the Cleveland system could have been saved in the past and the space devoted to educational space. This is equivalent to 625 classrooms and represents seating accommodations for 250,000 children, and these 625 classrooms at present-day prices would cost $10,000,000 to build.

The first type of one-story buildings mentioned here will no doubt prove to be the solution of the elimination of waste and the first step toward an entirely new type of school building. The advantages claimed for this one-story type school are:



Entrance Front of Empire School, Cleveland

1. *Cost.* It was proved in Cleveland in August, 1918, when bids were taken for the Wm. H. Brett Memorial School and a duplicate of the Gladstone School, simultaneously, that the first type, one-story Wm. H. Brett School was the cheaper of the two.



Exterior and First Floor Plan of Gladstone School, Cleveland

The Wm. H. Brett School contains 24 classrooms,
Two play courts,
Auditorium, etc.

The Gladstone School contains 27 classrooms,
Two play courts,
Auditorium, etc.

The costs were:

	Wm. H. Brett School	*Gladstone School*
Cost per cu. ft.	38 cents	42 cents
Cost per classroom	$14,007	$18,876

The opponents of the one-story school idea have claimed that the bids for the duplicate of the Gladstone School were submitted by the contractors without going into careful detail, as they thought these bids were for checking purposes only; however that may be, it is an indisputable fact that the original Gladstone School was erected 13 months earlier, in July, 1917, at a cost of $16,072 per classroom or $2,000 in excess of the actual cost of the Wm. H. Brett School.

Additional facts are evident upon making a survey of two one-story buildings and two three-story buildings, and these figures are furnished for the purpose of comparison:

One-story types of buildings:

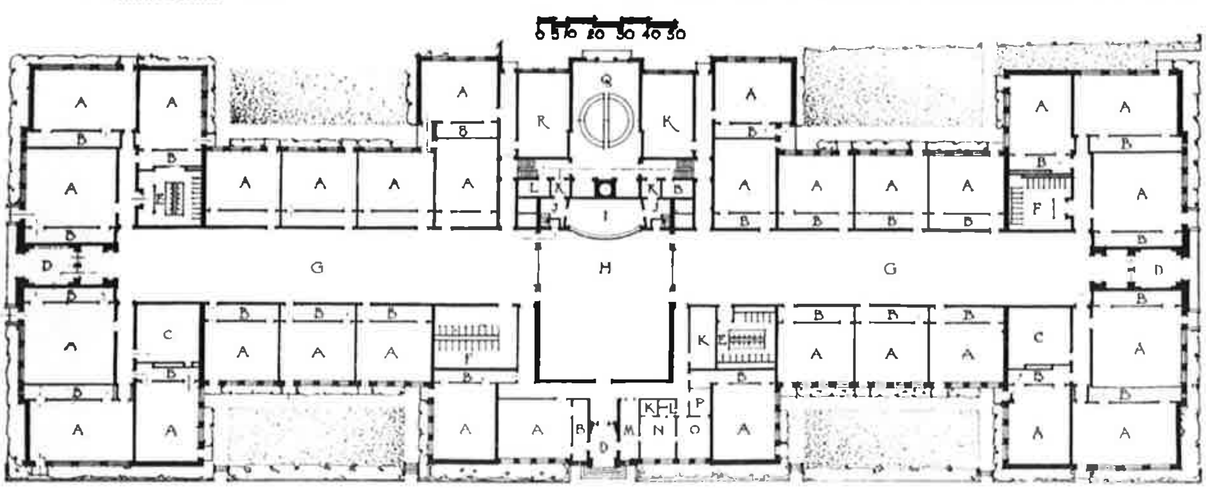
Wm. H. Brett School. .31,770 cu. ft. proportioned to classroom
Miles Standish . . . . . . .44,754 " " " " "

Other types of buildings:

Gladstone . . . . .44,340 " " " " "
Almira . . . . .45,325 " " " " "

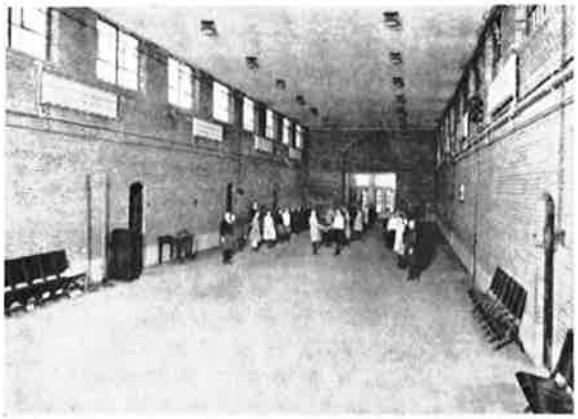
The figures given are arrived at by taking the total number of classrooms in the building and dividing them into the total cubic feet in the building.

The argument is also advanced that the cost of the land required for a one-story school is considerably in excess of the land for other types, which increases the total cost of the entire undertaking. However,

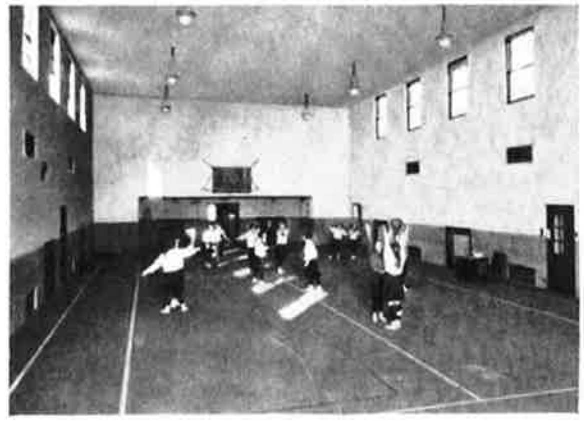


A. Classrooms
B. Wardrobes
C. Conference Rooms
E. Boys' Toilet
F. Girls' Toilet
G. Play Courts
H. Gymnasium
N. Principal's Office
O. Dispensary
P. Rest Room
Q. Kindergarten
R. Mezzanine

Ground Floor Plan of Wm. H. Brett Memorial School, Cleveland
Division of Architect, Board of Education, Cleveland
W. R. McCornack, Architect; George Fox, Associate Architect



Playcourt of Wm. H. Brett Memorial School



Playcourt of Miles Standish School

this point was investigated in the case of the Brett and the Gladstone Schools, and it was found that the difference in cost was very slight and that the additional land required to build the Brett School to cover same number of square feet of plot ground per pupil was only $7,500 more than the amount of land required to build the Gladstone School at the same area of plot ground per pupil.

2. *Safety.* The one-story building with the exits direct from each classroom to the ground is absolutely safe from fire and panic,—much more so than multi-story buildings.

3. *Administration.* The one-story building is easier to administer, and this fact is vouched for by those having charge of buildings of this type.

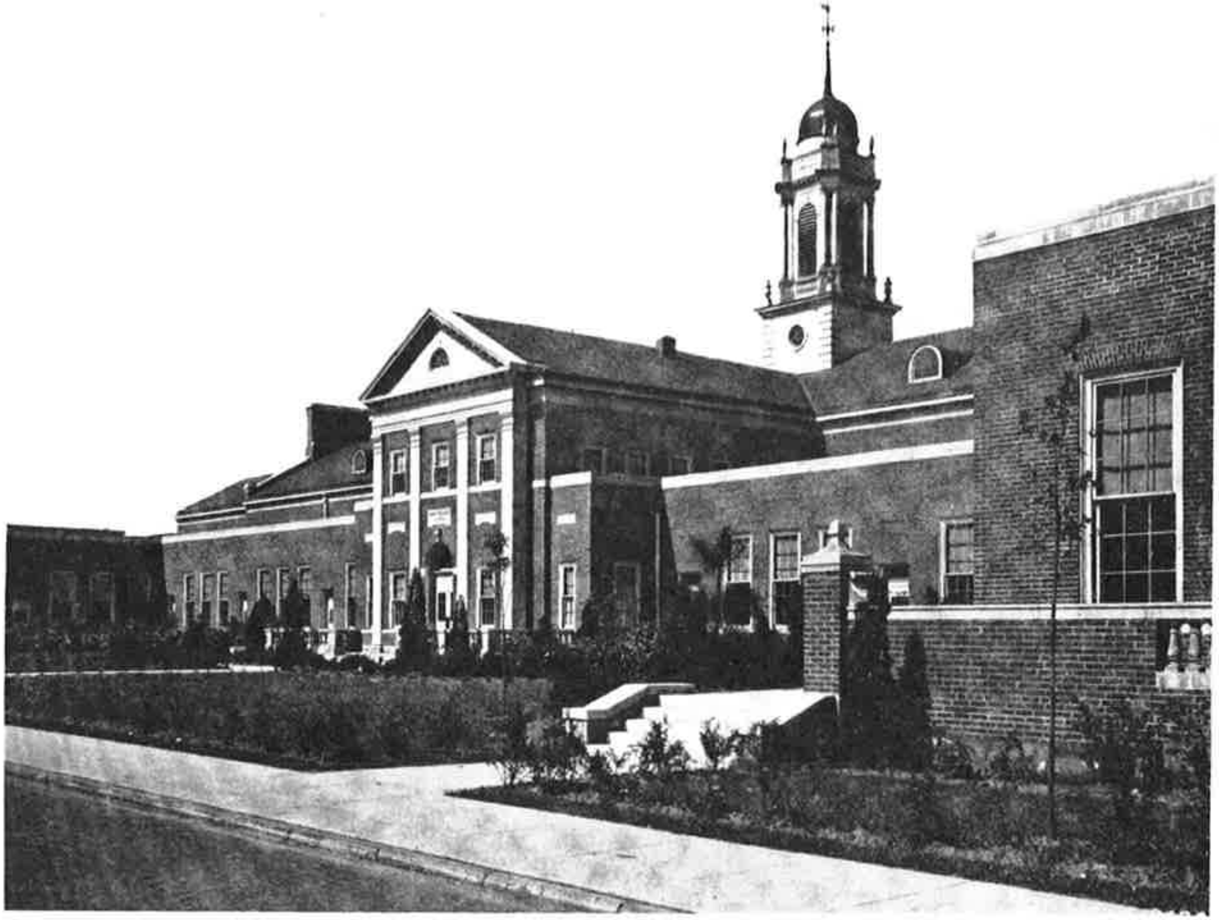
The distances may seem great on one floor, yet measurements were taken, starting at the principals' offices in both the Brett and Gladstone Schools, allowing a stop at the door of each room requiring supervision, and it was found that the horizontal travel in the Brett School was 90 feet less than in the Gladstone School, and that the vertical stairway travel in the Gladstone School was equivalent to climbing from the first floor of a 10-story office building to the top.

4. *Lighting.* The one-story type of building is much more adaptable to proper lighting distribution than any other type. For example, in the Miles Standish School there is a combination of top and side lighting in the classrooms, and curves plotted by illuminating engineers from tests made in both the Miles Standish and Gladstone Schools show conclusively that the light is practically uniform throughout at Miles Standish, while the opposite condition exists at the Gladstone School. To be able to reduce the size of the side windows, as was done in the Miles Standish School, is a great asset both from architectural and practical standpoints; this reduces the glare in the eyes of pupils next to the windows, and this reduction is only possible when top lighting is used.

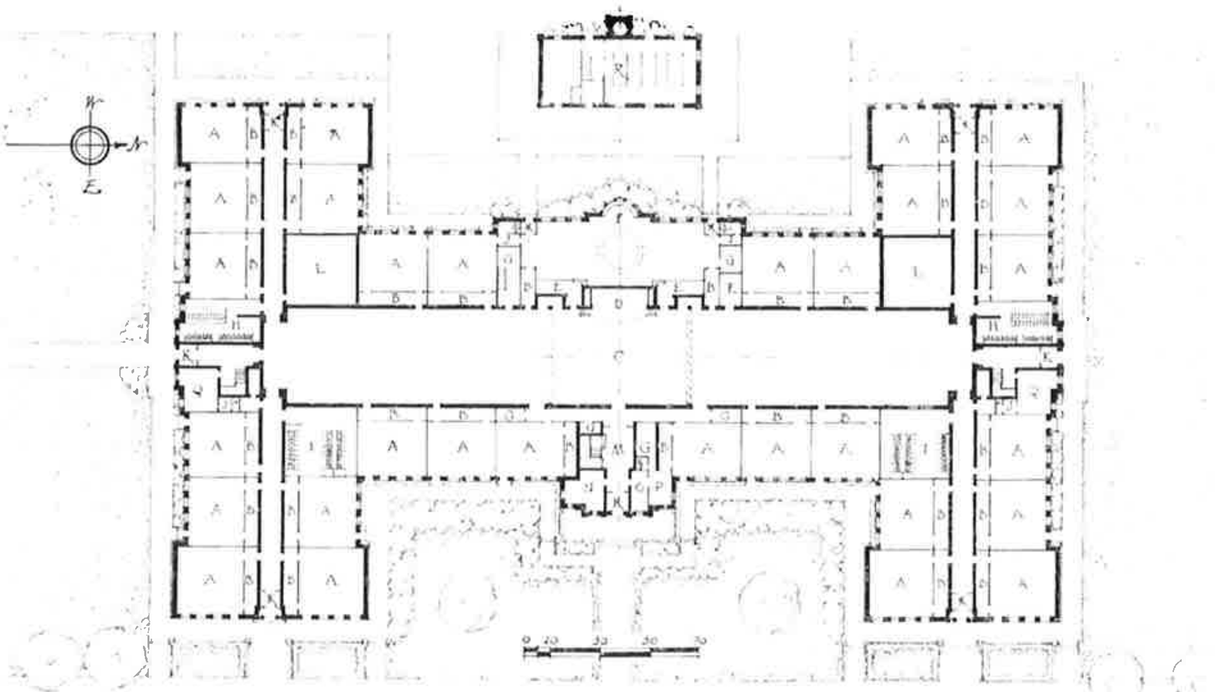
There is a great saving in the cost of materials used in the construction of the one-story type of building, due to the fact that the materials used need only be of the semi-fireproof kind and not absolutely fireproof, as are required in a multi-story type. The semi-fireproof construction is, of course, absolutely justifiable on account of the direct exits at grade level from all classrooms. One-story buildings may have the exterior walls constructed of 4-inch exterior face brick, backed up with terra cotta wall tile; roofs of wood joists and sheathing. Interior partitions should be built of terra cotta partition blocks for the purpose of acting as a temporary firestop and for soundproofing qualities. Corridor walls should be of brick construction to act as bearing walls and firestops. Steel trusses should be used across the playcourts, with steel rafters.

It may be thought by some that there may be annoyance to classes receiving instruction, or interference with the use of the central auditorium, due to the noise from the interior playcourts which economical planning places within school buildings. This trouble, however, has been avoided by careful study. The ceilings of the Miles Standish School were designed to absorb all noise made by the children in the playcourts, and additional precautions were taken to prevent the passage of sound through the folding doors between the auditorium and playcourts, also by the use of sound-absorbing materials.

The suspended metal lath ceiling between the roof trusses was treated with the standard felt and membrane method of acoustical treatment, and the folding doors were built double with an air space between. The back faces of the panels of the doors facing the playcourt side were filled with felt and burlap, and the back faces of the doors on the auditorium side of the opening were covered with galvanized iron, the principle being that any sound that might pass through the first set of doors and not absorbed by the felt and burlap would be reflected by the galvanized backs to the felt surfaces. The Cleveland Symphony Orchestra has given a concert in the auditorium of the Miles Standish School with very satisfactory results from an acoustical standpoint. The playcourts and the auditorium are continuously occupied during all periods of the day, and each takes care of five classes. This means that the capacity of the school is increased at least one-third by this arrangement.



DETAIL OF ENTRANCE FRONT



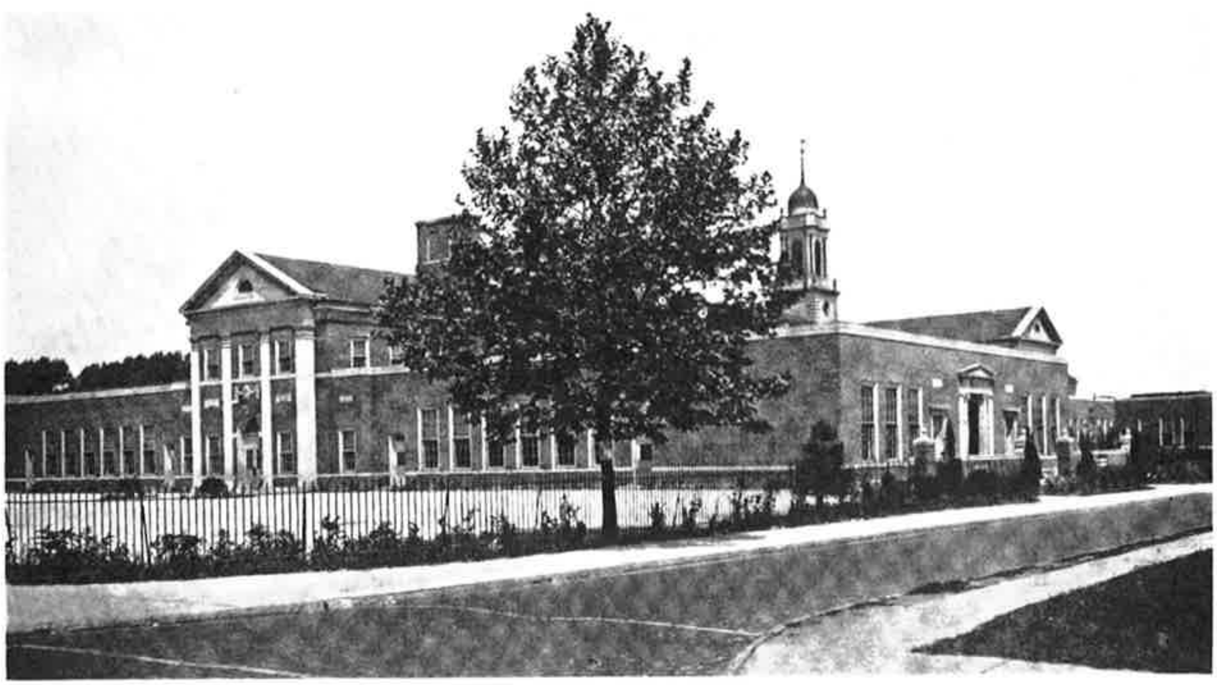
A. Classrooms
C. Assembly Play Court
E. Chair Storage
F. Kindergarten
H. Boys' Toilets
I. Girls' Toilets
L. Fan Rooms
N. Dispensary
P. Principal's Room
Q. Teachers' Room

MILES STANDISH ELEMENTARY SCHOOL, CLEVELAND

DIVISION OF ARCHITECT, BOARD OF EDUCATION, CLEVELAND

W. R. McCORNACK, ARCHITECT; GEORGE FOX, ASSOCIATE ARCHITECT

VIEW IN REAR COURT

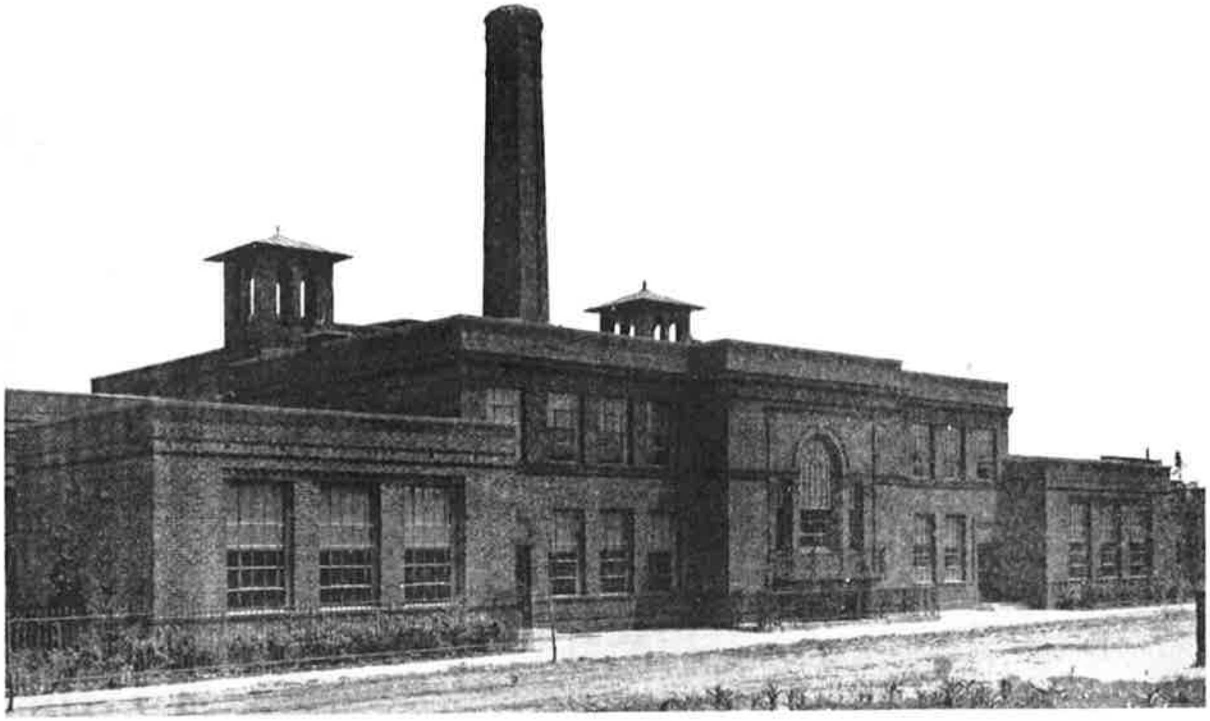


VIEW OF SIDE AND FRONT

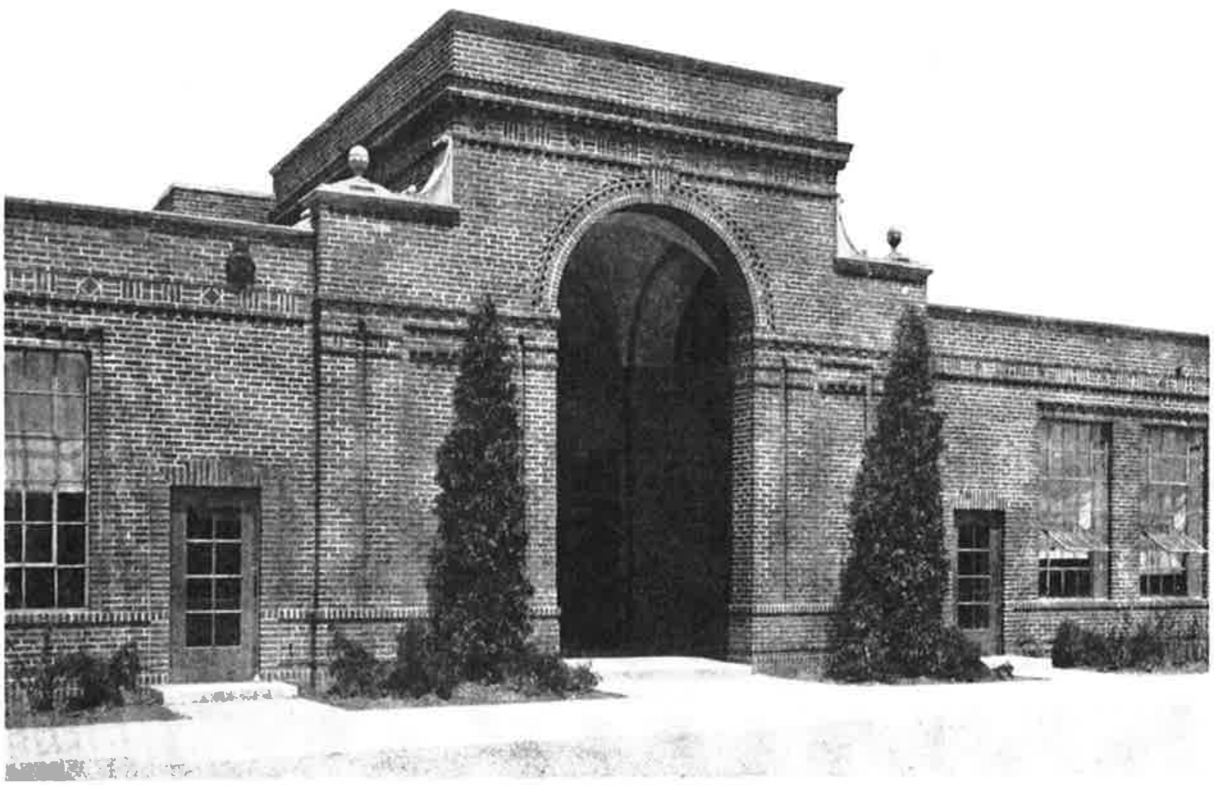
MILES STANDISH ELEMENTARY SCHOOL, CLEVELAND

DIVISION OF ARCHITECT, BOARD OF EDUCATION, CLEVELAND

W R. McCORNACK, ARCHITECT; GEORGE FOX, ASSOCIATE ARCHITECT



VIEW OF SIDE



DETAIL OF ENTRANCE FRONT

WM. H. BRETT MEMORIAL SCHOOL (ELEMENTARY), CLEVELAND

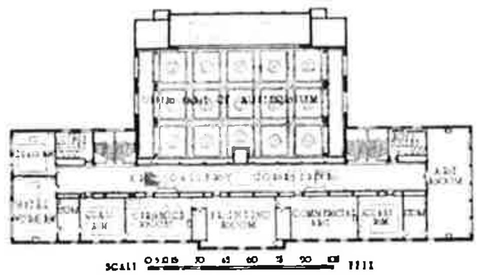
DIVISION OF ARCHITECT, BOARD OF EDUCATION, CLEVELAND

W. R. McCORNACK, ARCHITECT; GEORGE FOX, ASSOCIATE ARCHITECT

The School Building Program of Columbus, Ohio

By HOWARD DWIGHT SMITH, A.I.A.
Architect for Board of Education

THE magnitude of the public educational movement in our country may be realized when the size of its annual budget is considered. In Columbus, Ohio, for instance, the budget of the Board of Education is equal to the combined budgets of all other departments of city government. Public demand for educational advantages and public response to opportunities offered have made the business of public education one of the greatest of our governmental enterprises. The problem of providing housing for public instruction is not ordinarily the most important part of the school problem, but the curtailment of building programs during the world war has confronted many cities with such serious school housing problems that it will be years before any degree of "normalcy" will be reached in seating accommodations.



Third Floor Plan
Washington Gladden High School

The method of procedure adopted by the Board of Education of Columbus in its present building program, involving the expenditure of over $7,000,000, is perhaps unique. Seeking to avoid the mistakes which are so commonly made by boards of education, due not to wrong intent or lack of vision but to unfamiliarity with architecture and with building methods, the Columbus board proceeded to consult the local chapter of the American Institute of Architects before contracting for architectural service for the four new high schools which form the major portion of the present building program. While the plan suggested by the Columbus chapter was not adopted by the board, it is now recognized, by the architects and by the members of the board as well, that the open and frank discussions between them developed certain lines of thought in the minds of the board and presented to them certain fundamental ideas and ideals of professional service which the layman seldom grasps until too late. The Columbus board has for years maintained the office of School Architect for the performance of all architectural service and has realized the soundness of such a policy. When properly administered such an office provides efficient, economical service and assurance of continuous sympathetic study of local school housing problems and an opportunity for valuable co-operation between new building work and maintenance.

As developed to the present time, therefore, the essential features of the so-called "Columbus plan" are three:

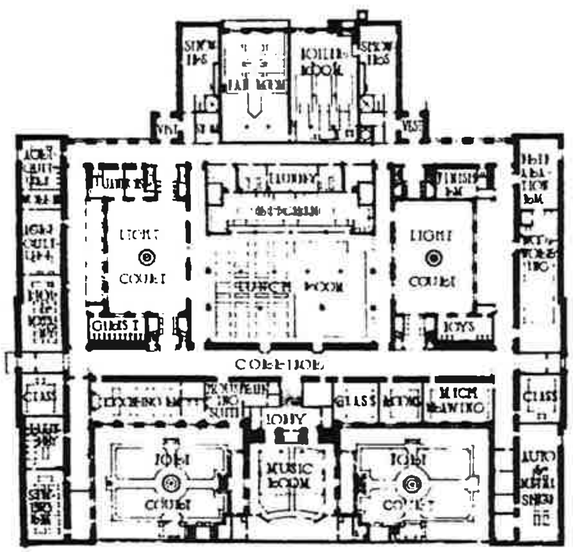
(1) The maintenance of the office of School Architect as a regular part of the school administrative organization, retained on salary to:
  (*a*) Act as professional adviser to the board and to all its administrative officers.
  (*b*) To be the executive head of the department; to design and superintend the construction of all building operations not specifically allocated elsewhere.

(2) The retaining of outside architectural service for certain large units of the building program, namely the four high schools, with individual responsibility in each case.

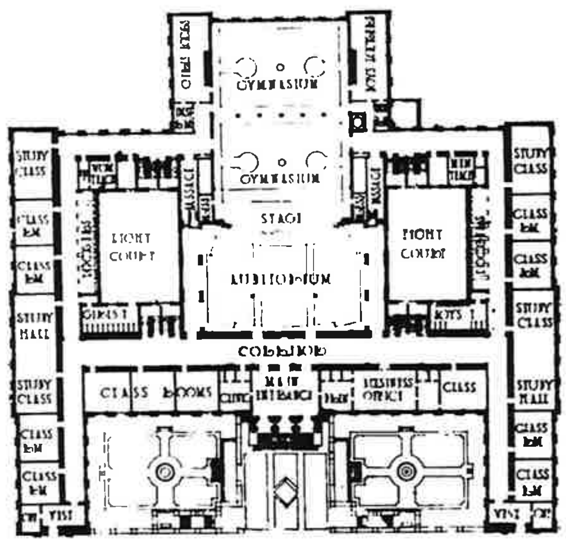
(3) Co-operation of study and mutual criticism on the part of architects retained for the various units.

In making a choice of architects for these four large structures the board depended entirely upon independent information and knowledge of the experience and ability of the firms under consideration and not upon preliminary conferences with a long list of aspirants, a custom so commonly followed by many boards. These four firms have been chosen not only for their known ability as architects, but also for the possible merit of their contributions to the study and discussion of problems which would be common to all four schools. For the Washington Gladden School, in the new civic center, the board has retained Wm. B. Ittner of St. Louis; for the Joseph Sullivant School in the east section of the city, Howell & Thomas of Cleveland; for the Abraham Lincoln School on the south side, Richards, McCarty & Bulford of Columbus, and for the Edward Orton School, on the north side, F. L. Packard, also of Columbus. The contracts entered into with these four individuals or firms include not only the rendering of professional service on one particular building but require that each should co-operate with the other three, and with "such other persons" as may be designated by the board to study and advise on common problems. It is just this requirement which makes the "Columbus plan" unique. The criticism of one's professional efforts by another person not of one's own choice is not ordinarily relished by any practitioner, but the Columbus board's idea that the truth or the truthful solution of any problem will bear just criticism, led it to put into practice a plan which architects themselves would hesitate to suggest.

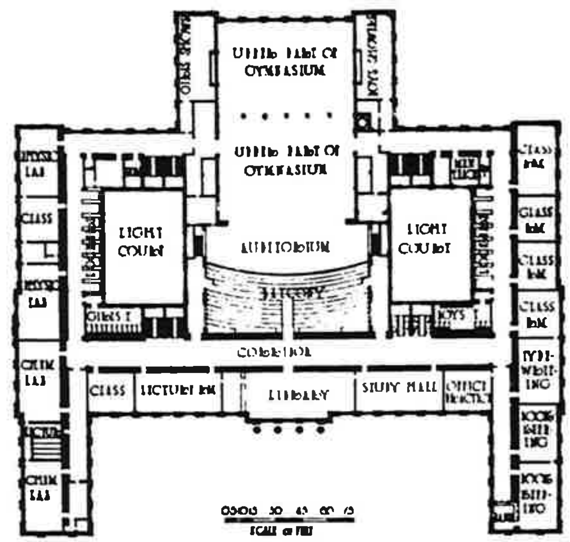
Of Mr. Ittner's ability as a school specialist little need be said. To say that the knowledge gained by his many years of experience is his most valuable contribution to the combined efforts of this group of architects is in no way to belittle his eclectic



GROUND FLOOR PLAN



FIRST FLOOR PLAN

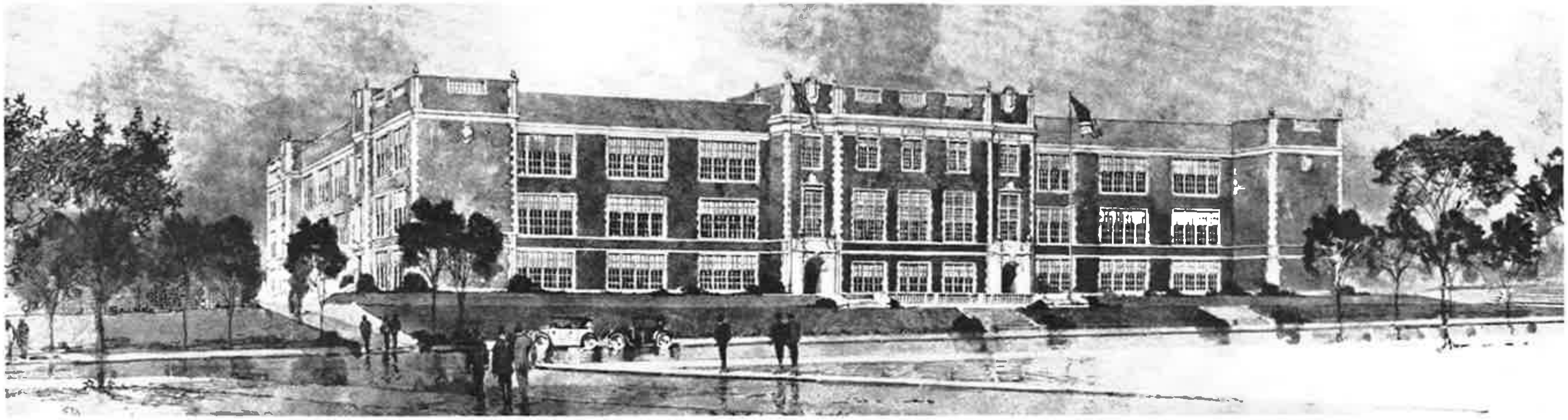


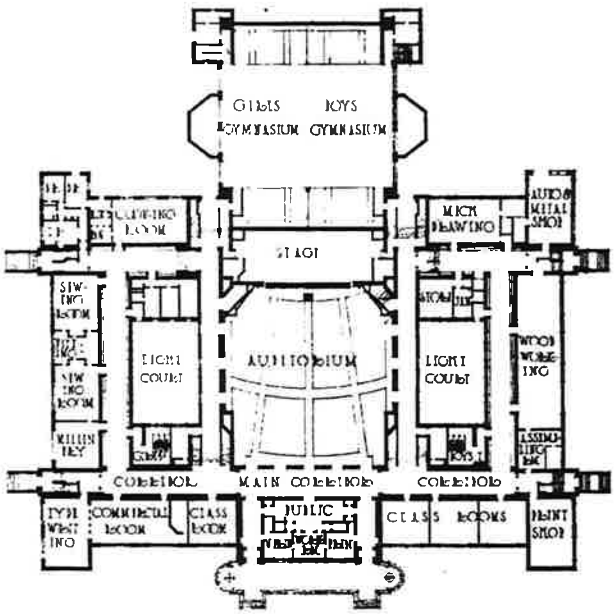
SECOND FLOOR PLAN

Total pupil capacity	2000	Total building cost	$1,058,292	General contract	21.1 c. per cubic foot	Exterior material, Indiana limestone	Heating, steam
Auditorium capacity	1600	Cubic foot cost	27.05 c.	Date of general contract	June 19, 1922	Construction, fireproof	Ventilating, fan blast

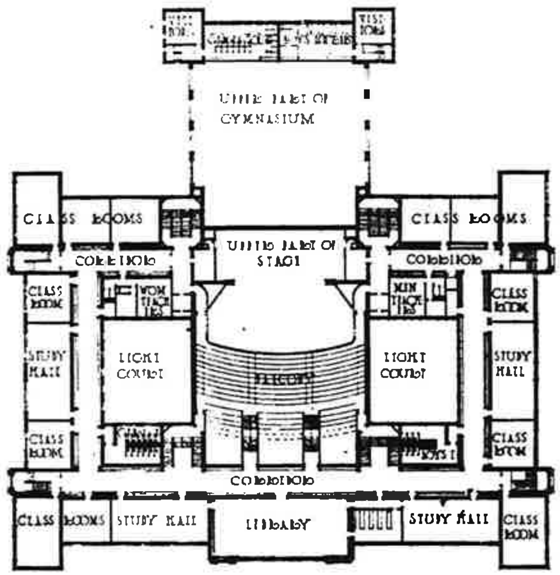
WASHINGTON GLADDEN SENIOR HIGH SCHOOL, COLUMBUS, OHIO

WM. B. ITTNER, ARCHITECT

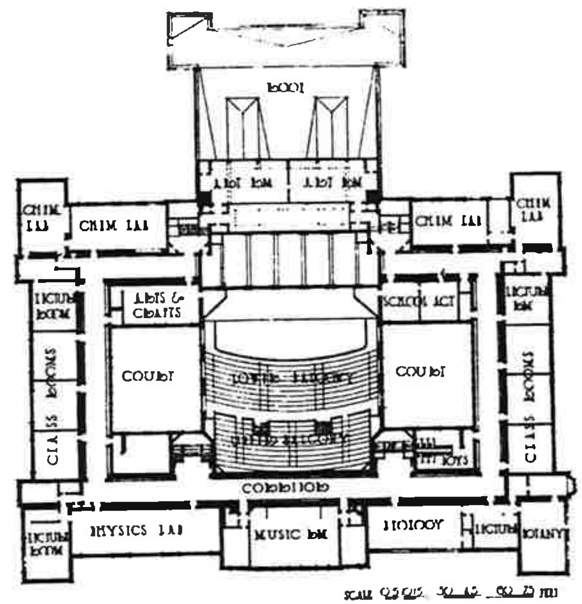




GROUND FLOOR PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN

Total pupil capacity 2000
Auditorium capacity 2000

Total building cost $818,311
Cubic foot cost 26.4 c.

General contract cost 21.6c. per cubic foot
Date of general contract June 19, 1922

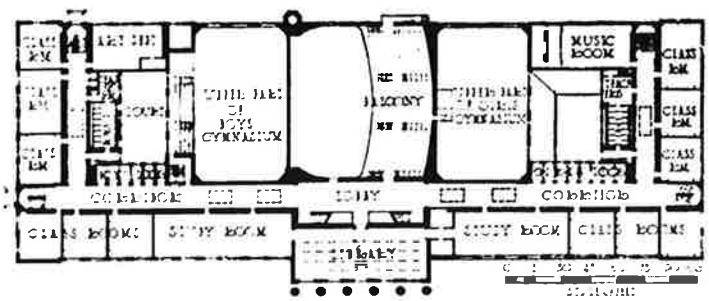
Exterior materials, red brick and Indiana limestone

Heating, steam
Ventilating, split steam, fans

EDWARD ORTON SENIOR HIGH SCHOOL, COLUMBUS, OHIO

FRANK L. PACKARD, ARCHITECT

ability. The simple, artistic ideals always maintained by Howell & Thomas in their work form not a small part of their contribution to the group. Their knowledge of, and sympathy with, local educational problems and building conditions together with their interest in all local civic enterprises on the part of Mr. Packard and the firm of Richards, McCarty & Bulford have given the board the benefit of professional advice of a very broad character. All of which is evidence that the board has sought local interest, expert advice and maximum of architectural ability.



Second Floor Plan

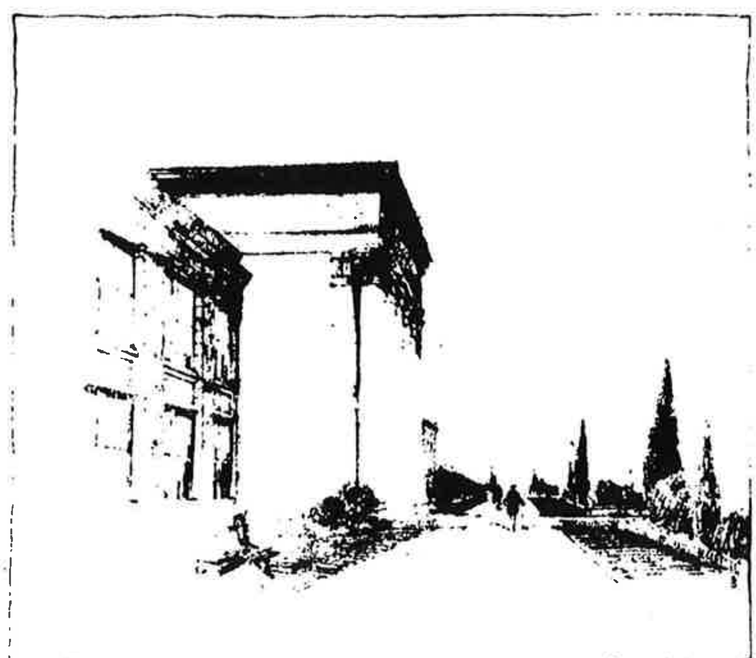
Joseph Sullivant Senior High School, Columbus, Ohio

Howell & Thomas, Architects

Examination of the plans will show that they possess marked similarity in some respects and dissimilarity in others. It is felt that co-operation between the Board of Education, the administrative officers and the architects has resulted in sufficient standardization of plans where that has been deemed necessary for economy and efficiency, but has permitted the expression of architectural personality which is so much to be desired.

Not only has economical and effective planning been sought after in these buildings but the educational value of good architectural expression has not been lost sight of. Rather than compromise their position as leaders in the educational affairs of the community members of the board have insisted that the very exteriors of the buildings themselves should contribute to the education of the public. To this sentiment the architects have responded admirably, and it should not be considered an exaggeration of fact to state that they have again proved that architectural merit depends not so much upon the inordinate expenditure of money as upon simplicity, dignity, good proportion, pleasing color and exactitude of execution.

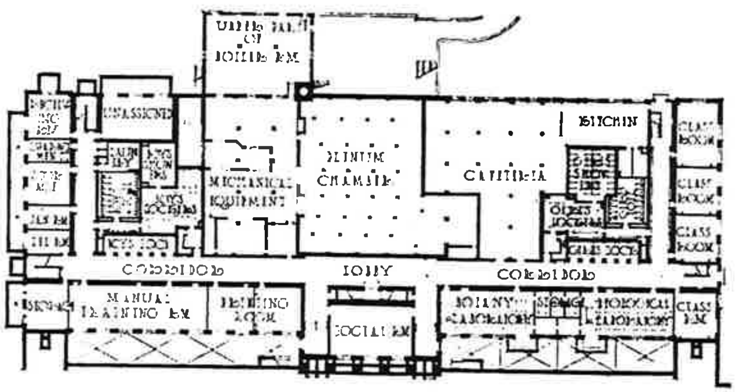
The Washington Gladden School is Mr. Ittner's first effort in the use of classic motifs in schoolhouse exteriors. This style, dictated by the location in the key position of a proposed group of public buildings, has been followed by Mr. Ittner in a manner worthy of his contemporaries who have been using it through years of successful practice. So also is the Joseph Sullivant School, built on a very restricted site along the chief residence thoroughfare of the city, in the classic style. The concentration of architectural interest in the powerful colonnade on the main facade simply accentuates the Greek simplicity and dignity of the whole conception. The Gladden and Sullivant Schools are valuable additions to the group of educational buildings in classic style to which belong the new buildings for the Massachusetts Institute of Technology, and like them are of Indiana limestone.



Pencil Sketch of Terrace and Portico of Joseph Sullivant Senior High School, Columbus, Ohio

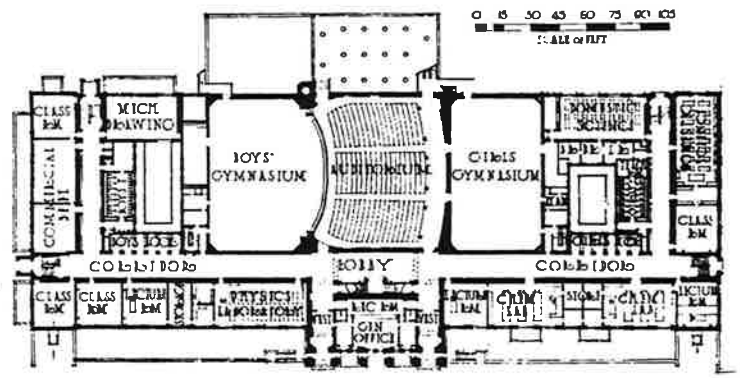
Howell & Thomas, Architects

The brick and stone design of Richards, McCarty & Bulford for the Abraham Lincoln School is classic in that it follows regular modules of pilaster spacing and of fenestration. It does look somewhat to colonial precedent for its inspiration, and we see in its character something not unlike that found, for instance, in the Pennsylvania Hospital in Philadelphia. The Edward Orton School is the only one of the four which has taken advantage in any way of the broad fenestration suggested by Elizabethan precedent, which has been used with varying success in many contemporary educational buildings. The combination of brick wall areas with stone trim and quoinings is suggestive of the English buildings of the late Tudor period.



BASEMENT FLOOR PLAN

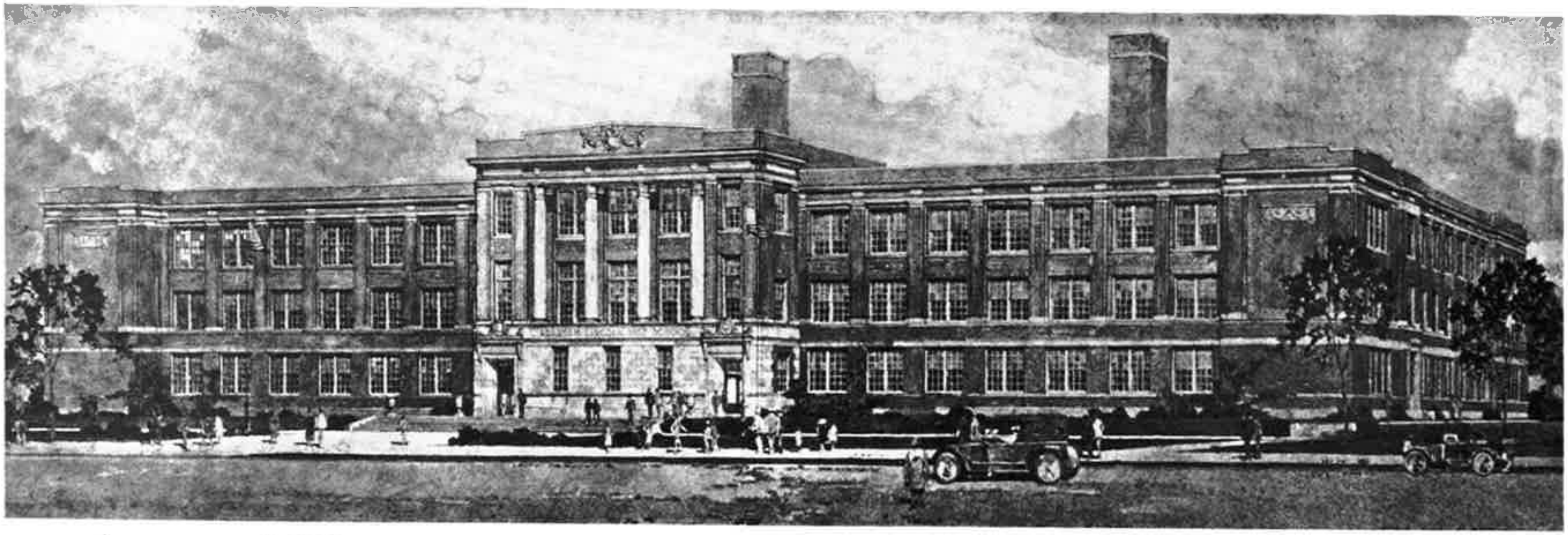
Total pupil capacity 1500
Auditorium capacity 1090
Total bldg. cost $727,037
Cubic foot cost . 30.3c.
General contract cost
per cubic foot . 23.5c.
Date of general contract
February 4, 1922
Exterior material
Indiana limestone
Construction . fireproof
Heating . . . steam
Ventilating
split steam fans

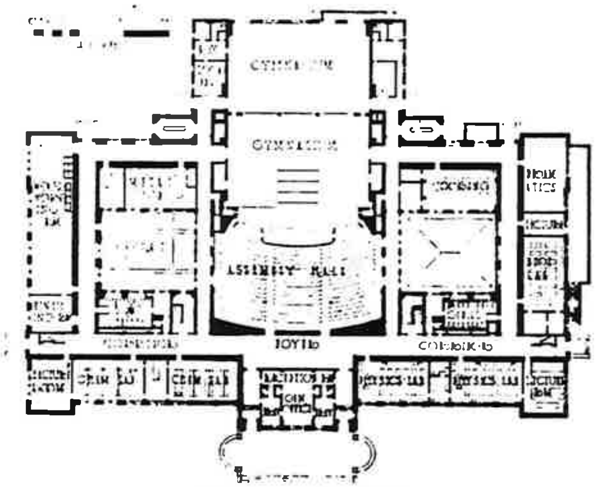


FIRST FLOOR PLAN

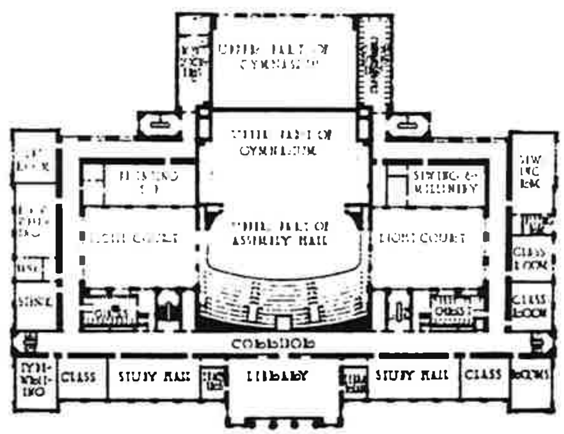
JOSEPH SULLIVANT SENIOR HIGH SCHOOL, COLUMBUS, OHIO

HOWELL & THOMAS, ARCHITECTS

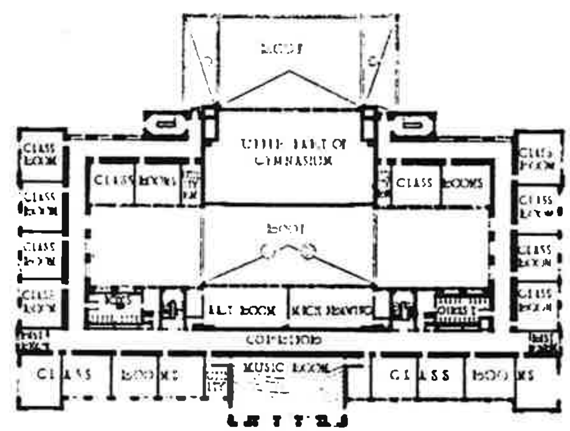




GROUND FLOOR PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN

Total building capacity	2000	Total building cost	$691,259	General contract	20.09c. per cubic foot	Exterior materials, red brick and Indiana limestone	Heating, steam
Auditorium capacity	1325	Cubic foot cost	25.85c.	Date of general contract	June 8, 1922		Ventilating, fan blast

ABRAHAM LINCOLN SENIOR HIGH SCHOOL, COLUMBUS, OHIO

RICHARDS, McCARTY & BULFORD, ARCHITECTS

The Architect's Business Relations with School Boards

By C. STANLEY TAYLOR
Editor, Business & Finance Department

THE important problems occurring in the business relations of the architect and the school board involve points of both law and sound business policy. For practical discussion this relationship may be divided into several phases:

(*a*) Selection and appointment of the architect.
(*b*) Architect's preliminary services to the school board.
(*c*) The legality of the architect's agreement with the board.
(*d*) Agreement between architect and consulting architect.

In regard to the selection of the architect, we are informed that usually the board gives serious consideration to several organizations which by reason of past performance and special knowledge seem particularly well equipped to carry out the work. The element of favoring home talent to the exclusion of experience sometimes appears strongly. Here the decision must be based on sensible judgment by the board. What is expected as architectural service? Is the building involved in the nature of its requirements? Is the value of specialized experience and knowledge given the weight which it deserves?

The logical decision on the part of the school board would seem to be the retaining of an architect experienced in this field. If there are good local architects, however, it may be both impolitic and unfair to bar them entirely from participation in the work because they are lacking in experience in this field. The expedient is often adopted by a school board of commissioning a local architect to carry out the planning of the new school building, but with the understanding that a selected school expert will be employed as a consulting architect. This method has in many instances been proved successful and has certain advantages in combining the knowledge of local building conditions, material sources and sub-contractors with the experience of the school specialist. The local architect is also in a favorable position to supervise the work. Where an architect who has had no previous experience in school work is commissioned to plan a new building of this type he will find it the course of wisdom to engage an experienced associate architect or a consultant. There is no excuse today for the designing of any institutional building which is not efficient of purpose, and specialized knowledge is an absolute requirement for the introduction of this important factor.

The contract between architect and consulting architect should be carefully drawn and the duties of each thoroughly defined. Broadly, the consultant, being generally a school specialist, outlines the design, plan, general details and specifications, based upon consultations with school officials, the requirements of the school administration and the consultant's familiarity with advanced practice in school building, turning over to the architect a complete set of sketch plans and outline specifications which have received the approval of the proper authorities; the development and carrying out of the plans are the part of the architect who is more intimately connected with the work. It should be noted that the consultant is in no wise responsible for the actual working drawings or for building supervision, but he is expected to co-operate should his advice be required during the preparation of drawings and specifications. The matter of remuneration should also be well understood; a consulting architect may receive a fee, generally 1 per cent of the estimated cost of the building, or payment may be in the form of a lump sum, and the dates and amounts of payments should be made part of the contract.

Among the details of any contract between two architects associated in a building operation is usually one which provides that a special joint bank account shall be opened by the associates and that all moneys received for work done shall be deposited to the credit of this account and drawn against only by cheques signed jointly; another provides that books of account shall be kept by both parties to the agreement showing the amount of time spent by each employe on the work and all expenses incurred, each submitting to the other a monthly statement of such expenses and costs; still another detail provides that a special nominal hourly charge be agreed upon for the time of the principals. One provision often made calls for the appointment of an arbitrator to decide any disputed point, and another provides that in case of the death of either party to the contract a final settlement with his estate will be made for all expenses and profits to the time of his death.

Some school boards still insist in employing the old method of selecting an architect, which consists of asking a number of architects to appear at a meeting of the school board and to submit sketches of a school building such as they can build for a certain sum (which amount is always too small). Those who are familiar with the undignified situation of a number of architects' patiently waiting in an anteroom for their turn to consume 15 or 20 minutes of the board's time cannot but feel the humiliation of it all. An impossible proposition confronts the architects, in the first place, as the school usually cannot be built for the money, and the architect who is willing to stretch the truth the farthest by making the most extravagant promises usually gets the job, and then his troubles begin. It is admitted that for the architect to obtain the work he must interview the school board, but there are ways that this can be done and still keep one's self-respect, and increase the respect the school board might have for architects generally.

A very important phase of this relationship is the preliminary service which the architect can render to the school board. Often before an appropriation for a new school building can be made (or an old appropriation increased) it is necessary to influence favorable public sentiment. Again, there may be involved a problem of selling locally a bond issue in order to finance the project. In such instances, long before the money is provided for the new building, the practical assistance of the architect will be found invaluable. He can assist in selecting the site. Sketch plans and cost estimates of the new building must be prepared and presented to the public in an interesting and understandable manner. Public sentiment must be often influenced in favor of the basic idea of increasing local educational facilities. Throughout this publicity campaign the architect can assist materially by providing information as to what has been done in similar communities and by suggesting the logical solution of the local problem. Interesting data of this nature can be supplied to the local newspapers.

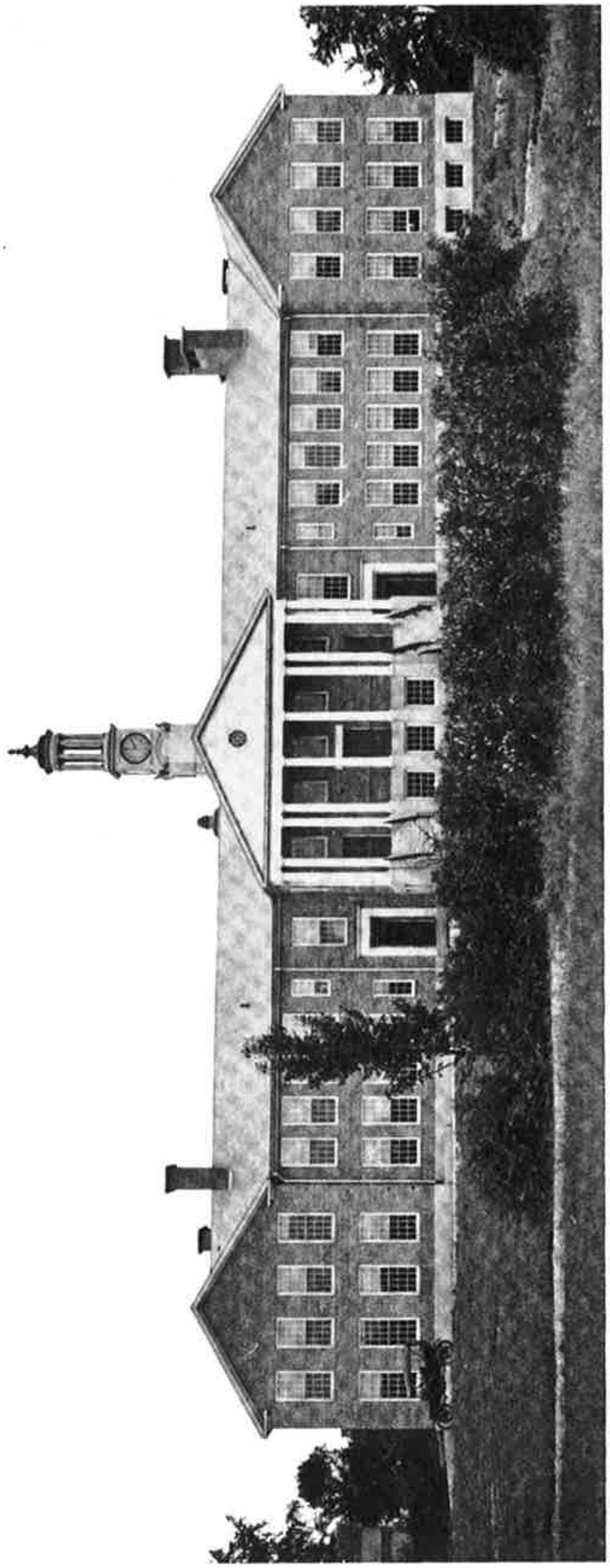
The superintendent of schools can usually compile the general publicity material, and the architect helps by supplying cost data, preliminary plans, and a perspective of the building suitable for reproduction in newspapers or in pamphlets for general distribution, the cost of this work to the architect being included in the amount it was agreed to pay him for preliminary services. The pamphlets or newspaper articles give the costs of similar buildings erected or under construction in nearby towns, together with comparison of tax rates, per capita wealth, bonded indebtedness, etc., in order that the citizens of the district may have an intelligent understanding of what they are being asked to vote upon. The architect in rendering these preliminary services should protect himself as well as the school board by recommending that sufficient money be appropriated to properly erect the building, to take care of roads, paths and landscape work, architects' fees and something for contingencies. This will all amount to a sum greater than the school board anticipated, and here again the ability of the architect is tested in order to convince the board that his figures are correct and that the work cannot be properly done for less money.

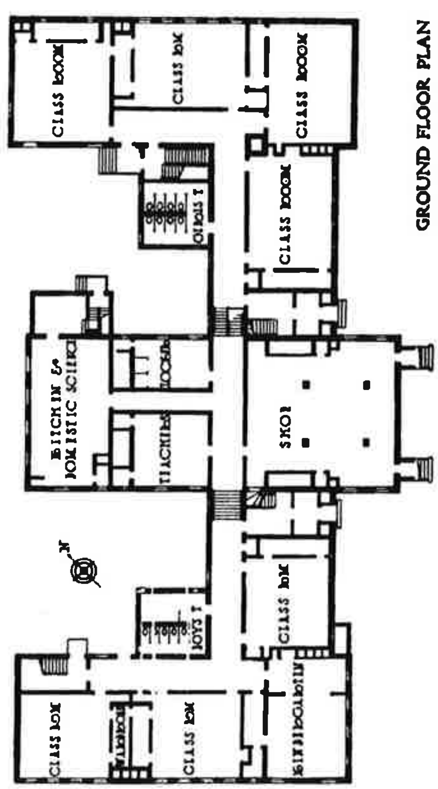
Two legal points which should be definitely covered include the fixing of the exact amount which the architect is to receive for these preliminary services, and the protection of the architect so that he is commissioned to carry out the entire project even though there be some lapse of time between the performing of preliminary work and the final decision to build. Under a general agreement where the architect's fee is on a percentage basis it is, of course, possible to arrange for the payment of 1 per cent of the total estimated cost as the payment for preliminary work and sketch plans. It seems to be more generally satisfactory, however, to arrange for the payment to the architect of a lump sum which may vary from $1,000 to $5,000 for preliminary work. A definite agreement should set forth clearly what work the architect is to do for this sum; it will usually include the furnishing of sketch plans, the cost estimates and general data for publicity purposes. During this stage of the work the architect will not expect much profit but estimates a lump sum to cover the approximate cost to him. In this preliminary work agreement should be included a general agreement on the entire work which will definitely express the fact that the preliminary work is but one stage of the commission for the complete planning requirements. The contract form used by one architect names three years as the time during which his contract as architect holds.

The legal questions involved in the relations between architect and school board are highly important. These relate to the fact of employment, the conditions of employment, and the terms of payment for architectural service. In view of the peculiar legal status of school boards, the possibility of changed personnel, and to avoid all possible friction on the point of authority, no architect should undertake school work without a written agreement or contract.

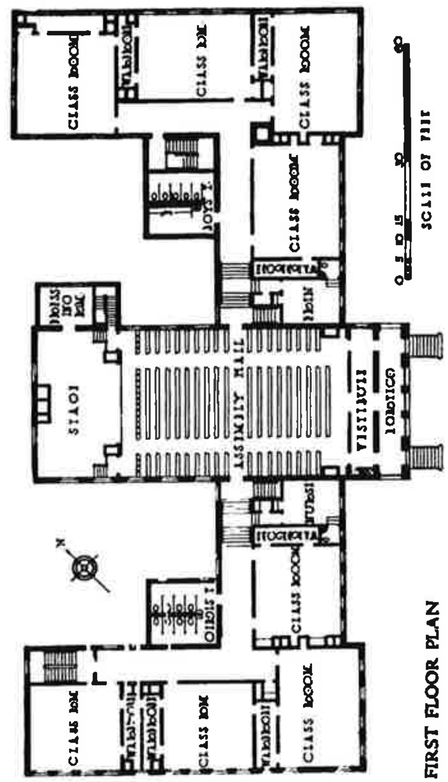
In order to demonstrate a few of the more obvious legal pitfalls involved we will quote the opinions of William Law Bowman, member on legal questions of the Consultation Committee of THE ARCHITECTURAL FORUM. These opinions apply generally to the employment of an architect by municipal corporations and are significant in considering his relations with school boards. The most important points are to be certain that the legal power to contract for such service exists and that duly authorized signatures appear upon a properly drawn contract.

"Under most county and village laws and city charters, no contract is valid or legal unless there has been a prior appropriation for the work. This technical requirement is often so strictly construed as to work the greatest injustice, as is shown by the actual experience of the writer in one of his cases. An architect had been given a signed and sealed contract by the authorized city official to draw plans for a certain building and superintend its construction. The contract had attached thereto the requisite certificate of the head of the department that the estimated cost was a certain amount, chargeable to a certain fund previously appropriated, and also a certificate of the comptroller that there was at hand an unexpended balance sufficient to pay the estimated amount for the work contracted for. The facts were that there had been an original appropriation by the proper board of $18,000 for the work. The architect found upon investigation that in order to have the building conform to other structures of a similar character in the city it would require about $30,000. The appropriating body was asked to appropriate the additional $12,000, but





GROUND FLOOR PLAN



FIRST FLOOR PLAN

BIRD SCHOOL (ELEMENTARY AND JUNIOR HIGH), WALPOLE, MASS.

R. CLIPSTON STURGIS, ARCHITECT

BIRD SCHOOL, WALPOLE, MASS.

Illustrations on Plate 39

THIS school is devoted to all grades of pupils, from the kindergarten through the junior high school. It was completed in 1921 at a cost of $145,000. It accommodates 578 pupils, making a building cost per pupil of $233.

The construction cost was about 28 cents per cubic foot.

The exterior walls are of selected common brick with wood trim. The construction is of second class with fireproof stairs and corridors. Ample exit facilities are provided.

DETAIL OF ENTRANCE FRONT

BIRD SCHOOL (ELEMENTARY AND JUNIOR HIGH), WALPOLE, MASS.

R. CLIPSTON STURGIS, ARCHITECT

took so much time in so doing that the head of the department, believing the work essential and necessary, decided to take the additional moneys required from his general department appropriation Said determination was shown by the contract and approved by the comptroller by his certificate thereto attached. Thereafter the preliminary plans were drawn and approved and the 1 per cent due the architect paid out of the two funds by the comptroller of the city. After the working drawings and specifications had been completed, the work was abandoned, chiefly on account of the death of the official having the work in charge, and the city thereupon refused to pay the balance due the architect for the work actually done and completed by him. An action was duly brought to recover the balance, and upon the trial the case was dismissed upon the ground that there was no specific appropriation of $30,000, the estimated cost of the work. So it was that the architect lost not only the value of his services and work actually performed, but court costs and his own legal expenses. The fact that the actual appropriation of $18,000 was still untouched in the city treasury and sufficient to pay his claim, and the further fact that the acceptance and retention of the work and the payment by the comptroller of part of the contract price would seem to constitute a ratification or at least to create an estoppel against the city, availed nothing. However, this merely verifies the strict rule which is carried out by courts for such governmental bodies, that once the contract is proved void or illegal there can be no recovery upon *quantum meruit* or for the reasonable value of the work done, even though the city, as a matter of fact, had been benefited by it.

This seems to be exceedingly harsh and unfair treatment to put upon an architect. It is inexplicable that any department of a municipality would be guilty of so gross a breach of what would ordinarily be regarded as common business ethics in taking advantage of the trust and confidence which an architect would naturally place in such a body. However, the courts have so held, and it behooves architects to take it into consideration in this class of work.

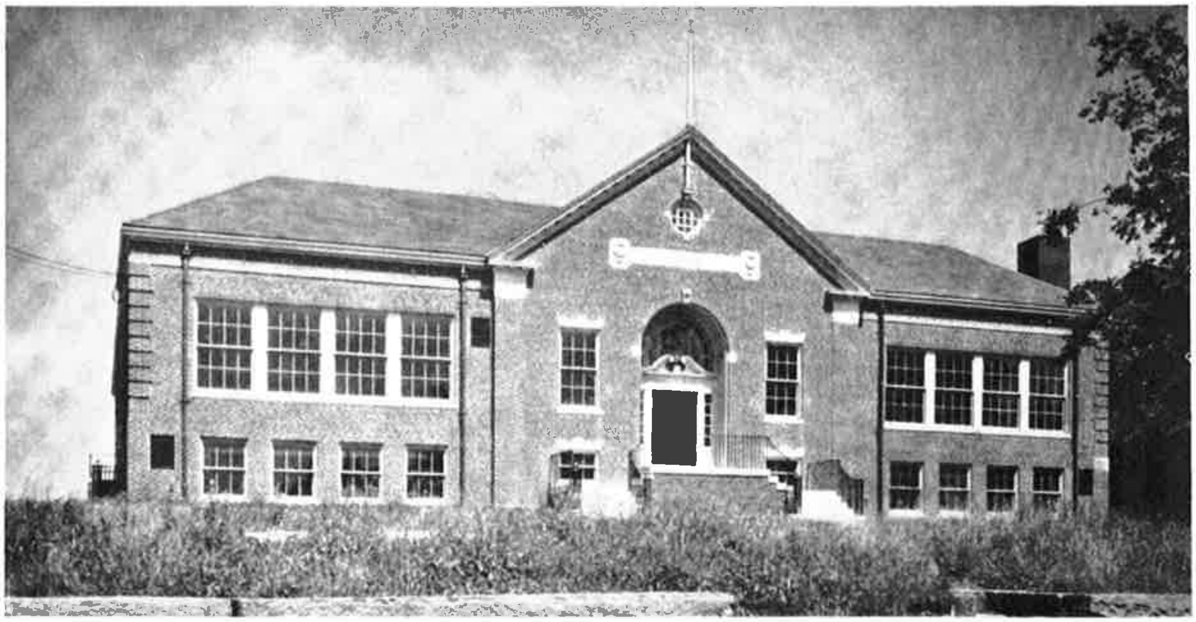
Counties, boroughs, towns and villages have a common practice of appointing committees who deal with architects when their services are required. Frequently these committees are not careful to ascertain and know the powers which they have been given. Thus they, as well as an architect, often innocently enter into a contract for plans and specifications which the committee has no power to make, and the architect has no right to compensation thereunder. For example, a county at one time appointed a committee to investigate and report regarding 'the best manner of raising funds,' and to submit 'recommendations relative to the matter of erecting a court house,' and decreed that the committee file its report in writing, 'together with plans and specifications, with the county clerk on or before ———.' The committee, after examining many different sets of preliminary plans and specifications, finally selected a certain firm of architects to do the work and entered into a duly written contract for seven sets of plans and specifications, detailed drawings, etc. When an action was later brought to recover for the preparation of plans and specifications according to the contract, it was held that the words 'plans and specifications' in the resolution meant *preliminary* plans and specifications, and that therefore the contract by the committee for working plans and specifications was beyond their power, and the architect suing upon such illegal and void contract could not recover. In this particular instance there was also an intimation that the architects could not recover for even preliminary plans and specifications, because it was understood and a custom for architects to draw preliminary plans and specifications without compensation in the hope of securing the contract for the complete work.

A requirement not mentioned in the contract is illustrated by the experience of one architect. By correspondence he offered, for a certain lunacy board, 'to examine the site and then to prepare all requisite probationary drawings for the approval of the committee, and all other drawings and details to be submitted to the commissioner of lunacy, and subsequently to draw the whole of the working drawings and specifications for $2,000.' The board accepted the offer through its clerk and the architect started his work. His first set of plans was disapproved; his second set was rejected as too costly and ornamental; his third set was disapproved, and then the board decided to engage another architect. By law, the plans had to be approved not only by the committee but by the court, and when the detailed drawings were completed they had to be approved by the commissioners and finally by the secretary of state. When the architect sued to recover for the reasonable value of the work which he had actually done, it was held that he could not recover, upon the ground that the architect knew the ordeal through which his plans must go before anything could be done upon them, and that he had agreed to receive the gross sum of $2,000 for the perfect and entire work. In this same case the court, dealing with the question as to whether or not the committee were fair judges of approval, wrote: 'If, with full knowledge of the powers and the circumstances under which he was to act the plaintiff (the architect) chose to agree with them that he should not be paid anything for his drawings unless they should be approved by them, I think he ought to be satisfied with their judgment.' "

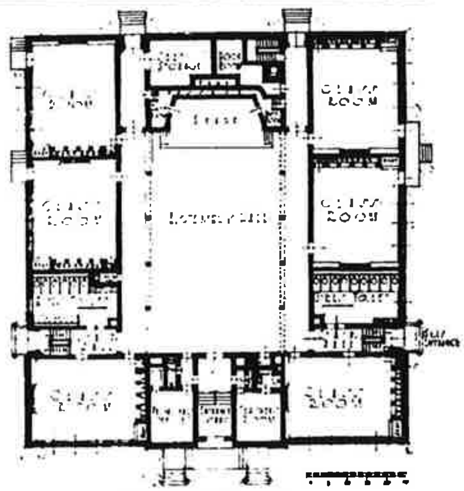
Every school project presents new angles of relationship for the architect. A modest investment in legal advice will remove many of the dangers involved. The balance of the problem is to be solved only by the application of sound business judgment, reasonable diplomacy and that desire to render conscientious service which inspires every architect worthy of the name.

One-Story Elementary School, North Woburn, Mass.

McLAUGHLIN & BURR, ARCHITECTS

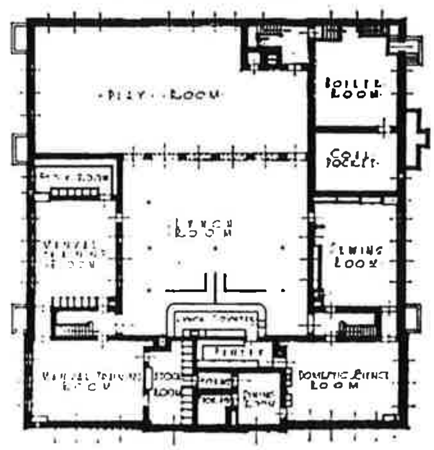


THE Rumford School was erected in 1922 at a cost per pupil of $361 or a cubic foot cost of 32 cents. Selected common brick and cast cement trim are used. Excepting at the front the building is covered by a flat roof containing sawtooth skylights. Fireproof construction is provided for the portion containing the boiler room.

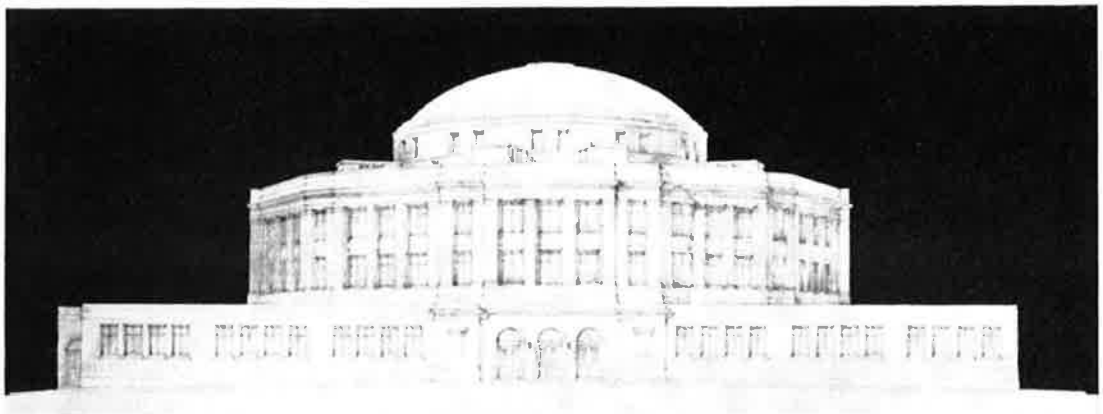


FIRST FLOOR PLAN

DETAIL OF PUPILS' ENTRANCE ON SIDE



BASEMENT FLOOR PLAN



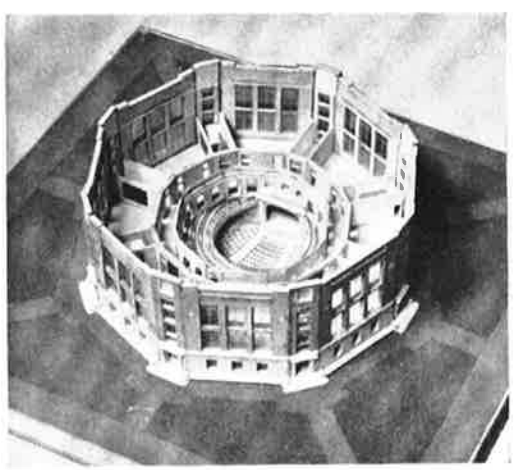
A New Development in School Planning

By JOHN IRWIN BRIGHT, A.I.A.
Architect, Philadelphia

FOR many months we have been studying the fundamentals of school plans. I must use the plural in common justice to the men in my office, who were so largely responsible for the result. We have come to the conclusion that the American school plan is stereotyped to its disadvantage. It has become standardized to rigidity. A large school is a multi-purpose building, and the largest division, the classroom, too often hampers the proper development of the other units. The attempt to evade difficulties by spreading the plan unduly only leads to wastefulness of operation and excessive cost. We have become convinced that the solution of the problem of a city school lies in a compact plan in which the classroom is structurally divorced from the relatively large units, and a polygon surrounded by a one-story plinth containing rectangular rooms is the scheme which seems to give the most promise. It has been tried out under varying conditions of size and terrain, with polygons ranging from hexagons to one 400 feet in diameter, polygons incomplete or in various combinations. The answer was always the same; in comparison with any rectangular plan there was an increase of elasticity and a decrease of cubage of some 25 per cent.

In the specific solution of the problem described here there are 67,240 square feet of instruction space enclosed in a cube of 2,200,000 cubic feet. In other words, there are needed but 32¾ cubic feet of building to develop 1 square foot of instruction space. The pupil capacity is 2,017, demanding 1,090 cubic feet per pupil. The standards of the National Education Association are chiefly concerned with the question of floor areas. It would be interesting to compare a building judged efficient by the N. E. A. standards with this school.

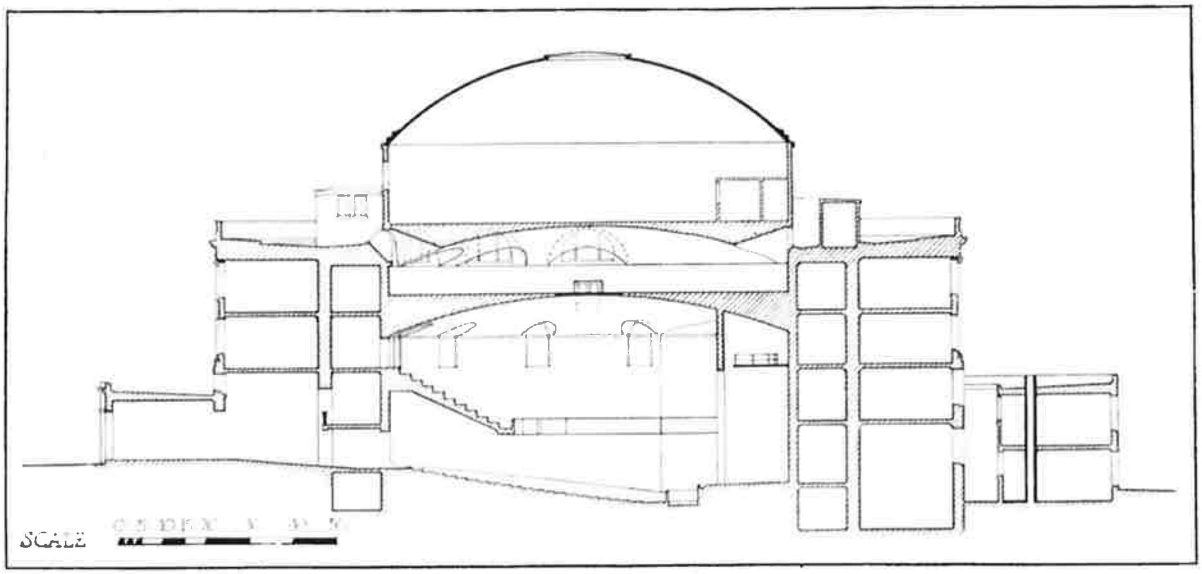
Viewed from the exterior, the appearance of the building has the effect of a circular form surrounded or buttressed by a low, square plinth. As the polygon is well within the lot lines, a nearby high building cannot seriously interfere with its light, and as the plinth has no superstructure and is only one story in height, it can be skylighted where desirable. The polygon, which occupies almost three-quarters of the area of the entire structure, with a maximum diameter of 174 feet, contains tiers of corridors, circular in form, only 330 feet in circumference; under the lowest tier run all the main pipes, conduits and heat ducts. Vertical risers serve the classrooms, the auditorium and gymnasium, and short branch lines distribute to the several rooms in the plinth. The economy of first cost and maintenance in this arrangement will appeal to any mechanical engineer for its simple efficiency.



View of Model, Showing Interior Arrangement

The Plinth

The building occupies a lot about 240 feet square, bounded by streets. The plinth, receding but little from the building line, contains the two main entrance lobbies, the laboratories, the manual training department, the library, the swimming pool and the domestic science rooms. There are also three minor entrances, and there being but two short corridors in the plinth the five entrances make possible the independent use of any unit. This is particularly



Section on North and South Axis

fortunate as the swimming pool, the machine shops and the library serve the community at large as well as the school children. In addition, the pupils of nearby schools will receive instruction in the various ground floor rooms. No criticism is of value unless the limitations of the lot area and the local instruction problems are kept clearly in mind.

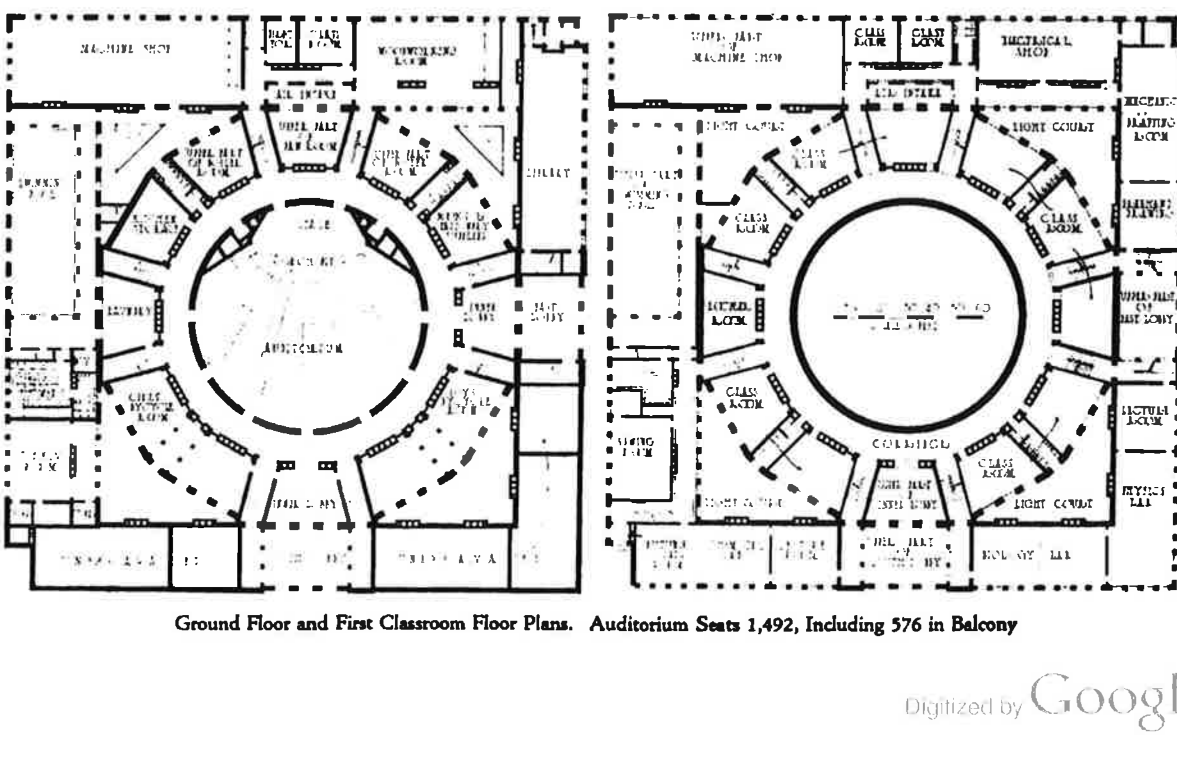
The Polygon

A. The Auditorium. This department is entered at grade through the two lobbies and, taking advantage of the recent progress in the technique of artificial lighting, it was deemed unnecessary to provide direct daylight for this room.

B. The Gallery. The circular plan of the auditorium makes possible a new form of gallery construction. Its principle is two concentric steel rings, connected by tension rods. There are no struts, columns or cantilevers, and the total weight of the metal is less than one-half of that found in the usual construction. The method allows the greatest freedom in the warping of surfaces for sight lines.

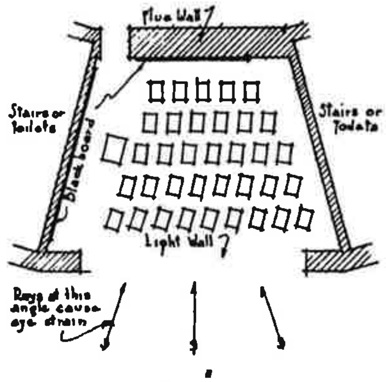
C. The Lunch Room. This room is placed over the auditorium and has adequate outside ventilation and light. It would have been quite possible to place this room on the ground floor, and the penetrations in the dome would then have served to daylight the auditorium. Attention is directed to the 90-foot structural tile dome in this room. Similar construction is used for the ceiling of the auditorium below and for the roof of the gymnasium above. (See section above.)

D. The Gymnasium. The lot being too small to provide for a playground, the area of the polygon (over half an acre) is used for this purpose. The gymnasium has light and air from every point of the



Ground Floor and First Classroom Floor Plans. Auditorium Seats 1,492, Including 576 in Balcony compass, and the running track, eleven laps to the mile, is around the dome and in the open.

E. The Classrooms. The polygon, being in the center of the square, has its light assured, independently of any construction on nearby properties. With the exception of three small rooms in the plinth each of the classrooms is, in plan, a truncated pyramid. There are two outstanding advantages in this form: First, the light wall is considerably longer than that of a rectangular room of equal area, thus giving more light. Second, the desks can be so arranged that the angle formed by the line of vision and the front wall is essentially 90°, and yet glare is absolutely eliminated from the eyes of the pupils. This is a thing long sought for in school architecture. The way it is done is shown in the accompanying diagram. Daylight enters a classroom from many angles, and under the usual plan there are always enough rays falling on the pupils' faces to cause glare. Glare produces eye strain and is especially objectionable to the pupils near the window, but it can be entirely obviated by turning the desk slightly away from the light. We all do this when seated near a window or lamp, so why should it not be done for school children? The desks near the windows are therefore placed so that the light falls over the left shoulders and not in the eyes. The angle diminishes in each succeeding file until, in the depth of the room where the glare is negligible, the sides of the desks are parallel with the outside and inside walls. This arrangement allows every pupil a good view of the blackboard wall without awkward turning of the body or the head. The plan requires that all four walls of the classroom share in carrying the floor loads. They are of brick, making unnecessary any plaster or wood trim. Every classroom adjoins a staircase, and all but four on each floor are contiguous to toilet rooms.



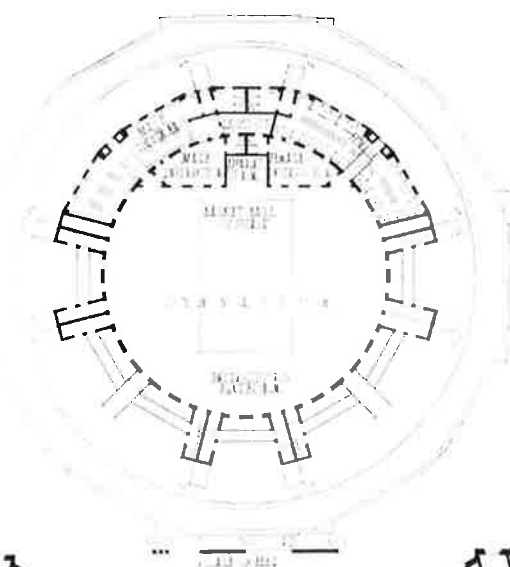
Plan Showing Seating of Classroom

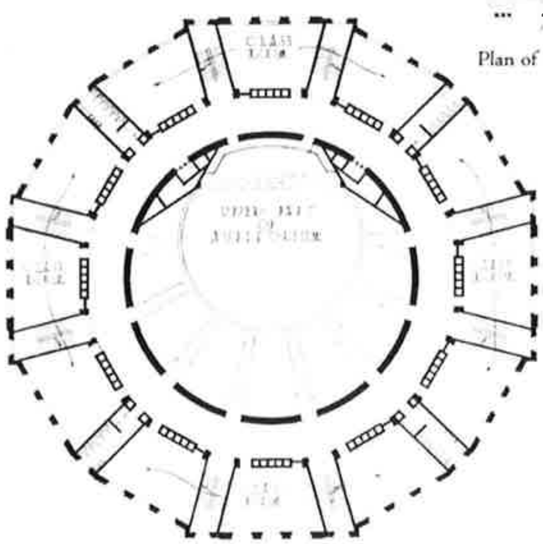
The insistent cry of the public has been for economy of construction. We have answered by economy of plan. Without departing in any important particular from accepted construction standards, this school establishes a new low mark in relation of pupil capacity to building volume.

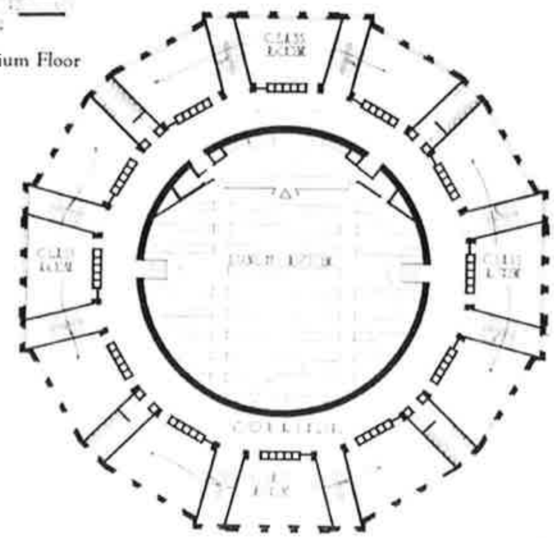
Editor's Note

This school plan marks a radical but logical departure in American architecture. Accepted structural practice is employed throughout but the planning problem has been approached from the viewpoint of developing a high degree of space utility disregarding precedents as to building perimeter.

Here is a suggestion to architects of the possibility of freer interpretation of specific requirements.

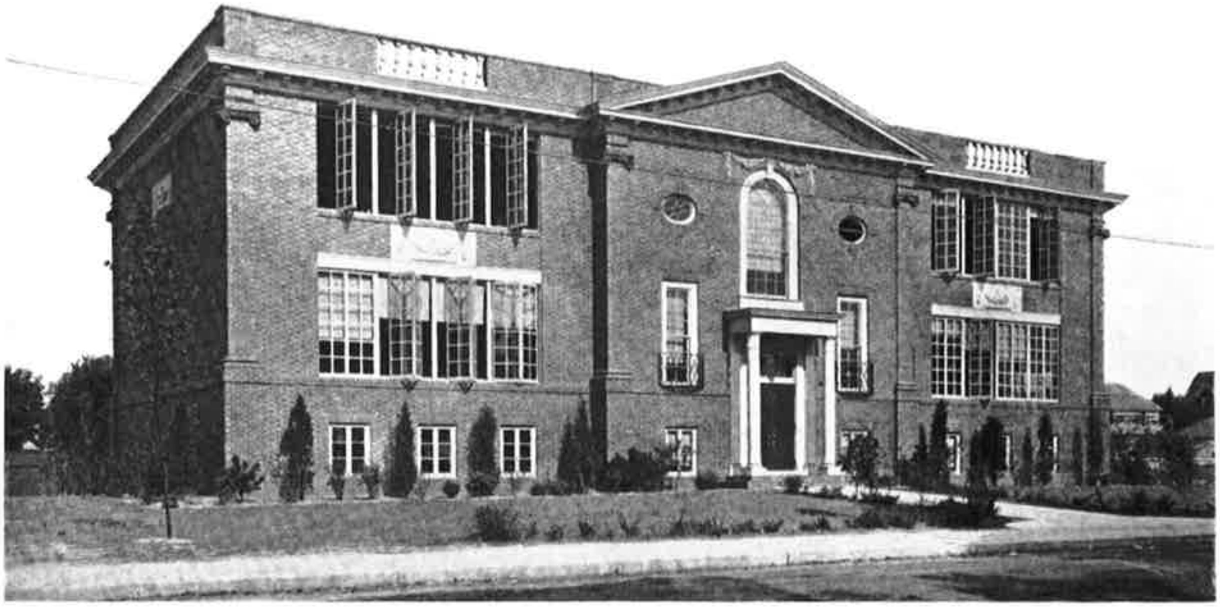

Plan of Gymnasium Floor


Plan of Second Classroom Floor

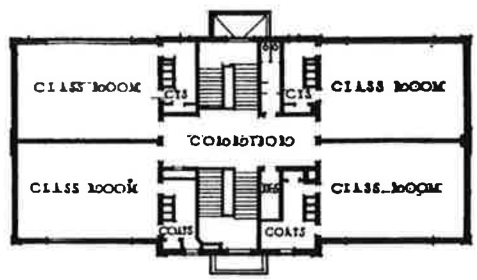

Plan of Third Classroom Floor

Riverside Elementary School, Rockville Centre, N. Y.

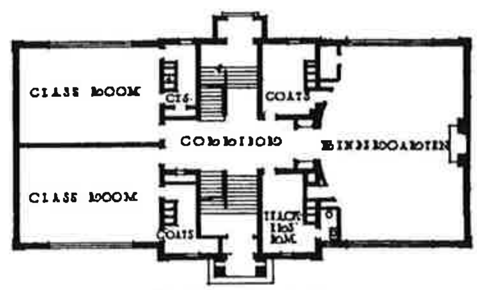
HUSE TEMPLETON BLANCHARD, ARCHITECT



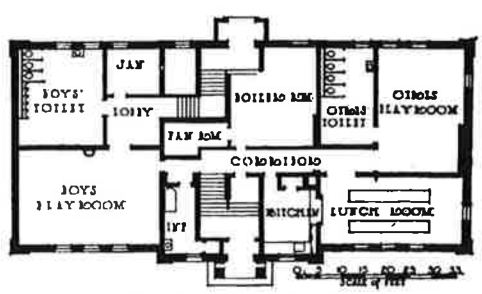
THE use of metal sash in this building, providing unusual window opening facilities, is an interesting feature. Completed late in 1921 at a cost of $100,000 or 45 cents a cubic foot. Capacity of 320 pupils. Exterior walls of purplish shale brick and cast cement trim. Semi-fireproof construction. Heated by split steam system.



SECOND FLOOR PLAN



FIRST FLOOR PLAN

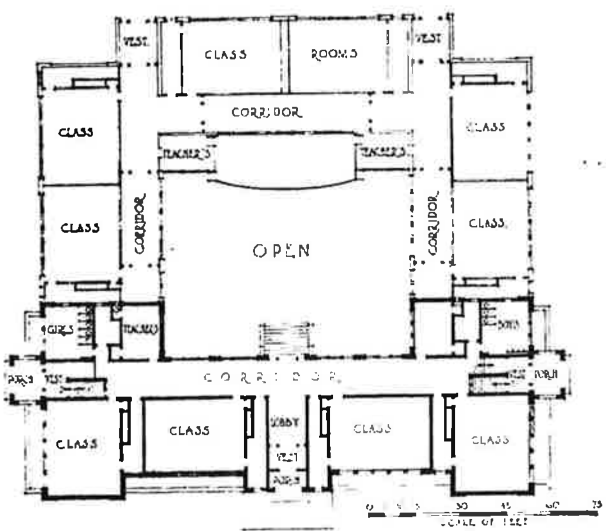


BASEMENT FLOOR PLAN

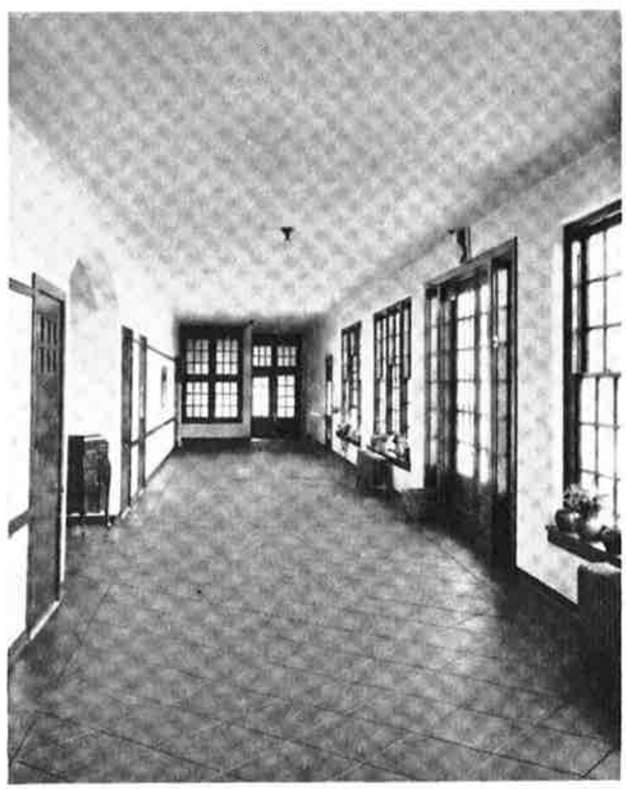
Rosemont School in Township of Radnor, Pa.

BOYD, ABEL & GUGERT, ARCHITECTS

FIRST section, as shown solid in plan, was built in 1914 at a cost of $39,000 (12.3 cents per cubic foot). Rough texture brick exterior on granite base; roof of green slate shingles. This is an interesting example of flexible one-story school design. Future units can be added, using present teachers' rooms as sections of future corridors. Heating by split steam system. Center court can be left open or ultimately fitted as an auditorium.



FLOOR PLAN SHOWING LATER ADDITIONS



VIEW OF CORRIDOR

A Heating and Ventilating System

By JAMES J. MAHAR
Schoolhouse Commissioner, and Heating and Ventilating Engineer, Boston

HEATING and ventilating for schools have many important features for consideration. To describe here all of the various systems adequately would greatly exceed our space, and rather than treat the subject generally we have thought it more helpful to describe in detail a definite application of a system for a junior high school.—The Editor.

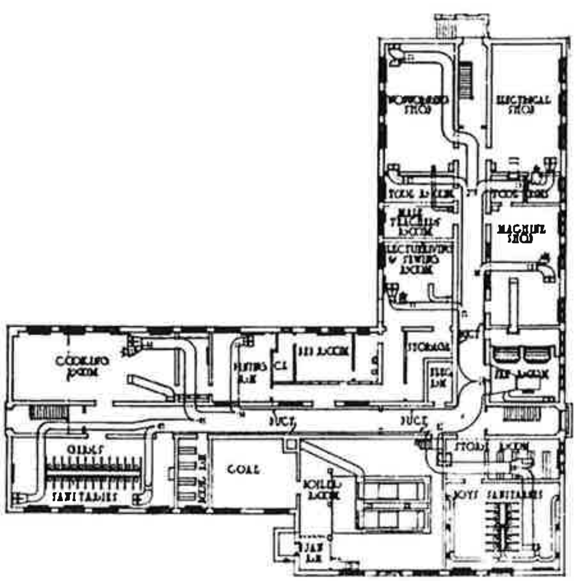
IN the designing of a modern junior high school building, nothing is more important than the early consideration of the type and proper design of its system of heating and ventilation. Too much thought and study can hardly be given to this very important part of the building, which means so much to the health and comfort of the pupils when the building is finally occupied.

The architect frequently proceeds too far with his plans before giving proper consideration to the design of the heating and ventilating system. This results in many cases in a design characterized by compromises to accommodate it to the building plans, with insufficient space for and improper location of the most important parts of the apparatus, and a system, when completed, inefficient in its results and difficult and costly in its operation. It is, therefore, the purpose of this article to point out to those having to do with the design and building of schools a few salient points based on experience, giving dimensions and areas when necessary, which it is hoped will be a guide in the selection and the proper designing of heating and ventilating apparatus for junior high school buildings in particular, and with necessary modifications for other types.

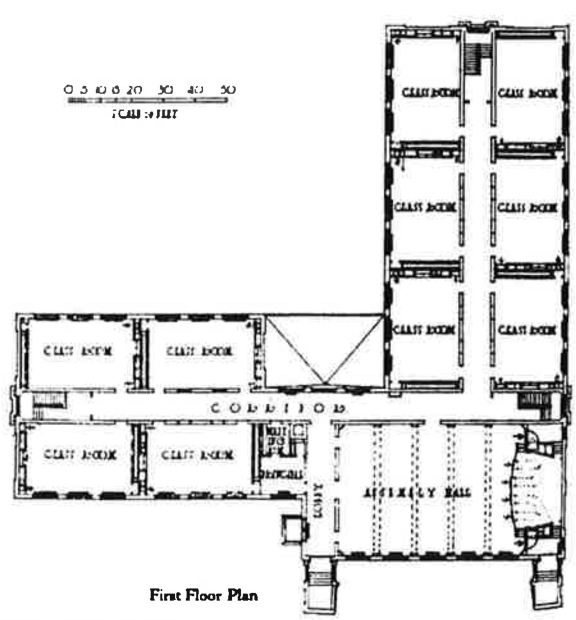
The space in the basement of the elementary school is required only for toilets, playrooms and frequently for manual training and cooking departments, thus leaving ample room for the location of heating and ventilating apparatus. The curriculum of the modern junior high school, however, makes greater demands upon basement space, leaving very little room for the location of the heating and ventilating apparatus. Machine, electrical and wood working shops, and sometimes the domestic science department, are located in the basement, in which event the rooms must be well lighted, comfortably heated and properly ventilated. It is therefore most essential in the consideration of the design of a junior high school building that as soon as the architect is appointed to submit sketches showing the requirements of the proposed building, the engineer be appointed also, to work with the architect in selecting the type of apparatus best fitted for the purpose, and to properly locate on the preliminary sketches the most important parts of the heating and ventilating system.

To illustrate adequately the problem and its solution, a concrete example is taken, viz., the junior high school located in the Roger Wolcott School District, Boston. This building contains 20 classrooms (high school size), an assembly hall and teachers' and master's offices, all located on the first and second floors. The basement contains three shops for machine, electrical and wood working courses, a domestic science unit, a cooking room and toilet rooms for boys and girls.

The type of heating and ventilating system selected for this building was a low pressure vacuum



Basement Floor Plan



First Floor Plan

Junior High School, Roger Wolcott District, Boston
Showing layout of ventilating ducts, outlets in rooms and direct radiators

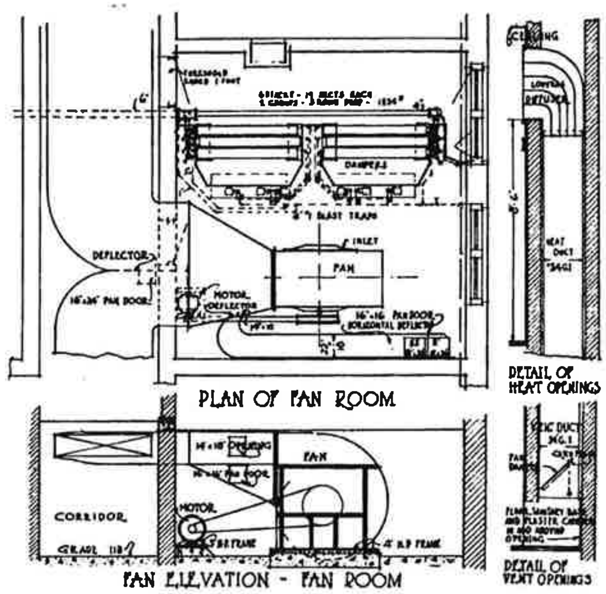
system of heating and a plenum system of ventilation. The reasons for this selection were that indirect stacks supplying air to the various classrooms could not be used without taking away valuable floor space from the basement classrooms, and that, furthermore, a vacuum system of heating permitted the location of radiators near the floor in the basement rooms, reduced the sizes of return piping, and allowed the returns to be installed on ceilings, where necessary to avoid entrance and exit doors. The type of system selected utilized only the minimum amount of basement floor area, as reference to the plans will indicate.

Ventilating System

Fan Room. The fan room is located in the basement. as near the center of the building as possible, and in a part not particularly well supplied with natural light, because, as already said, the well lighted parts of the basement are utilized exclusively for classroom purposes. The fan room is 23 feet wide, 22 feet long and 10 feet high. It contains 1824 square feet of radiators, set in two groups, three rows deep. In connection with these radiators is a multivane fan capable of delivering 35,000 cubic feet of air per minute, and operated by a 10-horsepower electric motor, belt-driven. A fresh air chamber 5 feet, 6 inches wide is provided in the rear of the radiators to allow the passage of fresh air supplied from the outside windows. A door opens from this chamber into the basement corridor, allowing for a recirculation of air in the building and, consequently, quicker heating when the apparatus is started before the morning school session. The primary radiators are encased in galvanized iron and are fitted with a series of mixing dampers which are opened and closed by a graduated action thermostat set in the main air duct, thus providing a constant temperature to the air leaving the fan room.

Air Ducts. Connecting the fan room with the various classrooms and the assembly hall is a system of overhead galvanized iron fresh air ducts, so designed as to furnish to each classroom 30 cubic feet of air per minute per pupil, and to the assembly hall 15 cubic feet per minute per occupant. By means of a galvanized iron deflector, placed in the main air duct, the assembly hall can be entirely shut off from the air delivery system, or operated separately when the remainder of the building is unoccupied. In designing the system of fresh air ducts and determining their respective sizes, a velocity of from 800 to 1,350 feet per minute was used in the horizontal ducts in the basement, a velocity of 7,500 feet per minute in all vertical ducts leading to classrooms and assembly hall, and a velocity of not over 300 feet per minute of the air entering classrooms and assembly hall.

Classroom Inlets. The fresh air inlets to classrooms are located on the walls behind the teachers, in close proximity to the outside walls. The inlets are of the design shown in detail, and are located



Detail Plan and Elevation of Fan Room
Showing arrangement of radiators and start of heating duct. At the right are sections through supply and vent openings in classrooms

8 feet, 6 inches from the floor. (See page 104.)

Classroom Vent Outlets. Vent outlets from the classrooms are located on the same walls as the inlets, but set at floors near the corridor walls. No grilles are used over these outlets, the floors and baseboards being carried around on the inside. This arrangement eliminates a dirt pocket, is easy to clean, and is not so unsightly as the grille or guard. The vent ducts from the classrooms are extended to the attic space and connected to large ventilators on the roof. By actual tests made in many school buildings, this location of heat inlet and vent outlet has been found to give better results in the distribution of the incoming air. The "Boston" or inside type of wardrobe is used in this building and is ventilated at the top through four circular openings connected to a galvanized iron duct which is extended to main ventilators on the roof. Aspirating coils are used to accelerate the movement of the air, insuring the removal of any odors from wet clothing, etc.

Toilet Ventilation. The basement toilet rooms are ventilated through the plumbing fixtures, closets and urinals. A separate system is installed connecting the vents from the various fixtures behind the slate back partitions with a main duct, which is exhausted by a multivane fan, through special ducts to the roof. This method of ventilating toilet rooms through the plumbing fixtures has been found by experience to be a most efficient method and to provide a constant circulation of fresh air in the toilet room.

For the convenience of the architect in providing for the necessary ventilation, a summary of this may be of value, the sizes, of course, varying with the size of the building and the number of pupils to be provided for in each classroom.

Area cold air inlet to fan room =

$$\frac{\text{total air supply cu. ft. per min.}}{1100} = \text{Area in square feet of fresh air inlet.}$$

Size of main horizontal air duct in basement =

$$\frac{\text{total air supply cu. ft. per min.}}{800 \text{ to } 1350} = \text{Cross section area in square feet of duct.}$$

Size of heat duct to classroom

$$\frac{\text{No. of pupils} \times 30}{500} = \text{Area vertical flue in square feet to each classroom.}$$

In the junior high school under consideration these sizes of ducts were used:

Area of fresh air window	=32 sq. ft.
Area of main duct in basement	=24 sq. ft.

Dimensions of each classroom heat duct = 18" x 20".
Dimensions of each classroom vent duct = 18" x 32".
Dimensions of heat inlet to classroom = 20" x 32".
Dimensions of vent outlet to classroom = 18" x 32".

Vacuum Heating System

The heating system of this school consists essentially of two horizontal return tubular boilers, a duplex unit of vacuum pumps, radiation and the usual equipment of valves and vacuum traps. The boilers are standard horizontal return tubular boilers in twin setting, 60 inches in diameter and containing 72 3-inch tubes 18 feet long, with fireboxes equipped for oil burning. Each boiler is designed to handle two-thirds of the load, but if occasion required, one boiler could carry the full load for such time as required to make repairs.

The vacuum pumps are the combined rotary vacuum and low pressure boiler feed pumps, set as a duplex unit. Each pump is capable of handling 16,000 equivalent feet of direct radiation, and excepting in very severe weather, or on turning steam into a cold system on starting, one pump will care for the load, thus leaving one in reserve or for cleaning or repairing. The pumps are furnished with automatic control, which is actuated by both a float switch, which controls the water line in the return tank, and a diaphragm vacuum switch which controls the vacuum carried. The motors can be run together or independently. The motors for the pumps, which are each of 1½ horsepower, are set on the same base as the pumps, and are connected to them through flexible couplings.

Piping

The piping is so arranged that the main building lines are entirely separate from the primary radiation, which is in use only part of the time, and the assembly hall line which is only used occasionally. The supply piping in general is carried at the ceiling and close to the outside walls, making short runouts to risers, thus saving the traps and valves necessary to drip them, and avoiding the necessity of cluttering up the walls with piping. At intervals drip connections are taken from the main, thus insuring dry piping. Each supply and return riser is valved to allow for repairs being made without making necessary the shutting down of the rest of the system, a very important feature, of course, in a school building, where repairs are often required.

The radiation used throughout is the water type fitted for a vacuum system. Wall radiation is used in classrooms, stair landings and basement rooms, and column radiation in master's and teachers' offices, corridors and assembly hall. Each classroom is equipped with sufficient radiation to cover the heat losses through the exposed wall and glass, the air being taken care of in the ventilating system, plus 20 per cent which is allowed for quick heating. This method is very satisfactory, as an automatic thermostatic control is used in conjunction with it, which keeps the temperature of the room at 70°.

Vacuum Traps. These are of the non-adjustable type, with thermostatic discs and screw tops, and can be operated up to a pressure of 10 pounds. The blast traps for the dust radiation are of the same type, but with flanged tops.

Automatic Control. The automatic control system, which is used to control the temperature of all classrooms, workrooms and assembly hall, as well as to control the opening and closing of the main vent dampers in the vent hoods on the roof from a switchboard in the boiler room, is of the standard thermostatic two-pipe compressed air type.

The system consists essentially of two hydraulic air compressors, each of sufficient capacity to handle the air needed, a galvanized iron air storage tank fitted with a relief valve set at 15 pounds, diaphragm valves set on the supply ends of the radiators, on the mixing dampers in the fan room and on the vent dampers on the roof, positive action thermostats located in classrooms, etc., with a graduated action thermostat in main air duct to control the mixing dampers.

The air piping, which is galvanized, is run concealed in all rooms above the basement, and the bases of all risers are fitted with drip pockets with air cocks to remove any condensation which might gather there. A slate panel is located in the boiler room, on which are mounted the pressure gauge and the three-way cocks which operate the vent dampers on the roof.

Oil-Burning Apparatus

A complete system of oil-burning apparatus is installed in the boilers of this building. Oil was selected as a fuel because of its many advantages as compared with coal, which may be summed up briefly:

1. The saving in storage space, oil requiring only about one-half the space that is required for coal.

2. The saving in labor in handling coal and for expensive ash removal.

3. The cleanliness in and about the building, eliminating dust and dirt, thus reducing the annually recurring expense of painting and tinting.

4. The saving in fuel consumption. Economy in the use of fuel oil will undoubtedly be obtained in the heating of this building, because of the nature of the load. In the spring and fall, particularly, it has been found from actual experience in other

buildings that it is only necessary to operate the fires for perhaps an hour or two in the morning and again for a short period in the afternoon. The burning of oil, therefore, in this plant will do away with the costly banking losses in other school buildings.

5. The thermal efficiency of oil is greater than that of coal. From the results of tests made in various plants it has been found possible to equal the results of one ton of good quality coal with 150 gallons of fuel oil, having a calorific value of 18,400 B.t.u. per pound. Taking a season's run this would be arrived at thus:

EVAPORATION (from and at 212°)

Coal (14,000 B.t.u.) 8.5 lbs. water per lb. of coal. (Good average practice.)

Oil (18,400 B.t.u.) 14.2 lbs. water per lb. of oil. (Average results of tests made under operating conditions.)

EFFICIENCY

$$\text{Coal} \; \frac{8.5 \times 970.4 \times 100}{14{,}000} = 59\%$$

$$\text{Oil} \; \frac{14.2 \times 970.4 \times 100}{18{,}400} = 75\%$$

COAL EQUIVALENT per short ton (2,000 lbs.) (Oil 8 lbs. per gal.)

$$\frac{14{,}000 \times 59 \times 2{,}000}{18{,}400 \times 75 \times 8} = 150 \text{ gallons}$$

6. Saving in the cost of fuel. With oil at 4 c. per gallon, it will thus be seen that $6 worth of oil will equal the results of one ton of coal, and in the case of this school, where approximately 300 tons of coal per year would be burned, there will be a saving of $750, even allowing for coal as low as $8.50 per ton.

Description of Apparatus

The oil-burning equipment designed and installed in this building consists of turbine burners to which the oil and air are supplied by means of motor-driven blower and pump sets, which are in duplicate. For each set the motor is directly connected to the blower, but between the blower and motor is a worm reduction gear driving a rotary geared pump which furnishes oil at the desired pressure to the burners, the whole being mounted on a cast iron bed plate. A certain amount of oil is by-passed back to the oil storage tank, depending upon any given fuel requirement of the boiler.

A rectangular steel fuel oil storage tank, 20 feet by 11 feet, 3 inches by 6 feet deep, of 10,000-gallon capacity, is provided with a fill line constructed of 8-inch steel pipe and running from the tank to the sidewalk. A 2-inch galvanized vent pipe is carried from the tank up 12 feet above grade with a screened return bend. Oil is drawn from the tank through a 2-inch suction line, the oil being heated on the way to the pump by means of a 4-inch manifold heater surrounding the suction line and approximately 15 feet long. From the delivery side of the pump the oil goes through a discharge line, and close to the boiler another heater is installed which raises the temperature of the oil at the burners to approximately 170° Fahr. For atomizing the oil and revolving the turbine cup and wheel at the nozzle of the burner proper, a 3-inch air line is run from the blowers to the burners.

Automatic regulation, controlling the supply of oil to the burners is provided, being actuated by the boiler pressure. In the furnaces themselves, the floors, sides and front walls, as well as the fronts of the bridge walls, are lined with the best grade of fire brick. In order to protect the waterproofing under the boiler room floor, this construction is used:

2-inch sand fill.
2 courses of terra cotta.
1 layer of red brick.
Finally, the finished course of fire brick forming the firing floor.

Two burners are installed in each boiler, the center line being about 10 inches above the firing floor.

Air-Washers and Humidifying Apparatus

This building being located in a suburb of Boston on a lot free from city dust, etc., installation of an air-washing apparatus was eliminated. It is the firm belief of the writer, however, that it is better to install such apparatus in school buildings located in the city, where dust from the street, smoke and local impurities in the air are in such an abundance that they may become harmful when introduced in the buildings. Air-washing and humidifying may be accomplished by the same apparatus. The object of humidifying the air is to regulate and control the relative moisture content of the air, while air-washing deals only with the cleansing of the air from dust and other impurities.

There are two general types of air-washers: one is a dry air-washer or filter, the other a wet air-washer or spray. The dry air-washer generally consists of cloth screens of a material which will allow the air entering the building to pass through the screen on its way to the fan. These screens very soon become soiled or torn, and unless renewed or cleaned they offer great resistance to the heating and ventilating system. In addition they remove only the larger particles of dust and allow the finer particles to pass through.

The wet air-washer, as generally used today, does away with the objections just mentioned, and instead uses water entirely to clean the air. The air-washer consists of three parts,—the spray chamber, the eliminating plates and the tank for catching the spray; besides these a reciprocating pump for supplying water and the screen or filter for removing dirt from the water used in the spray chamber are necessary. The washers designed on this type are considered most economical in operation, because the water supply can be used over and over again, only renewed at weekly periods.

Laboratory Installation. Junior high schools today are requiring much of the laboratory equipment generally found in regular high schools, such as chemical and physical laboratories. The method of ventilating which is used in the Boston schools is substantially thus described:

The main room, in which the ordinary experiments are made, is ventilated in the same manner as the classrooms, and as already described; that is, that the air is supplied from a central fan system and the outgoing air is carried to the roof in a separate duct. The ventilation of the fan hoods, where strong chemical fumes are present, should receive special treatment in ventilation. This can be accomplished by exhaust fans with direct connected motors, which are capable of exhausting approximately 600 cubic feet of air per minute, and so arranged that two hoods can be vented by one fan. Two vent openings are installed in each hood, one located at the top and the other at the bottom, with cast iron register faces over the openings. The vent piping from the bottom is carried up in back of the hood and is connected with the upper opening on the top of the hood; the piping from the two hoods is then connected and run to the exhaust fan set on a platform directly above, which exhausts the gases to the roof. All vent piping should be made of an acid-proof material, of which there are several on the market. Glazed terra cotta pipe may be used as a main vertical riser, and the connections to the various hoods can be made of a special process metal which will withstand the attacks of chemical fumes.

Locker Room Ventilation. Where locker rooms are provided in the basement proper, ventilation is most necessary, especially if the locker rooms are to be used in conjunction with a gymnasium.

A very satisfactory method which has been used in the Boston schools is briefly described: The lockers are provided with louver vent openings near the bottom of the doors and also with circular openings in the backs of the lockers near the top. A central space 6 inches in width is provided between the groups of lockers set back to back, and a 4-inch space is provided between the backs of the lockers and the wall, where lockers are set against the wall in single tiers. From this space are taken galvanized iron ducts, connected into a central gathering chamber containing an exhaust fan which discharges the air through a special duct to the roof. This system of ventilation causes the fresh air to enter at the bottom of the lockers, to pass through the clothing, then through the vent ducts to the gathering chamber, and then to the roof. This insures a positive circulation of air from the locker room through the lockers.

Comparative Cost of Heating and Ventilating

In conclusion, it may be of interest to give here a few figures showing the comparative cost of the heating and ventilating system installed in this building:

General contract	$329,383
Heating "	28,934
Electrical "	19,696
Plumbing "	13,243
Total contract price	$391,256

It will be seen that the cost of the heating and ventilating system was only 7.3 per cent of the total contract price, which is a very low percentage.

An analysis of the cost of heating gives:

Wall radiation	4,317 sq. ft.
Column "	994 " "
Indirect "	1,824 " "
Total	7,135 " "

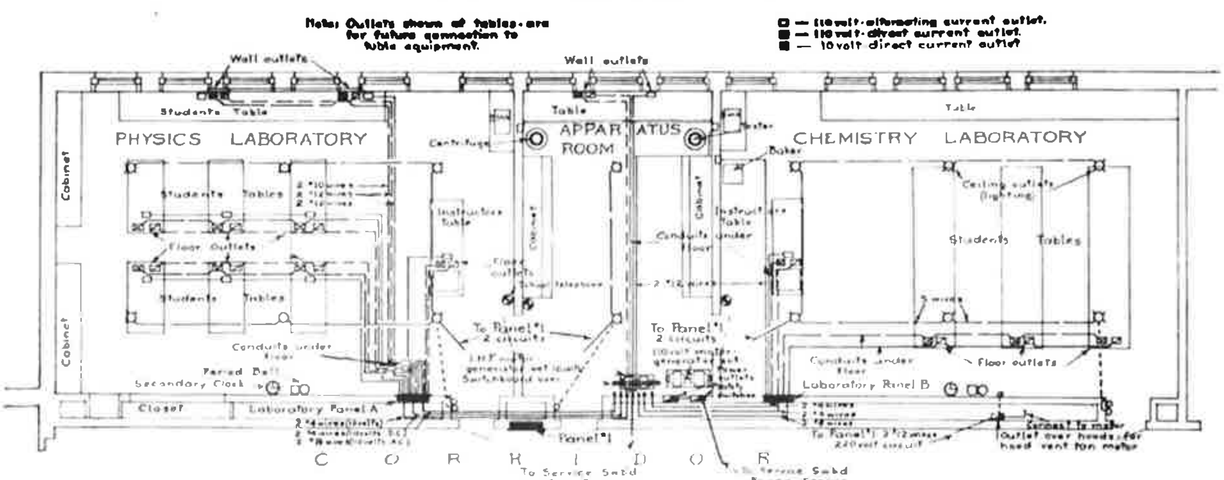
Cost per square foot of radiation, $4.05.

Reducing indirect radiation in terms of direct, we have:

Wall radiation	4,317 sq. ft.
Column "	994 " "
Indirect " 6 × 1,824	10,944 " "
Total	16,255 " "

Or, cost per square foot equivalent to direct radiation, $1.78.

The cubic contents of this building are 655,933 cubic feet, and the cost of the heating and ventilating system installed in the building, based on this cubage, would be 4.41c. per cubic foot.



Details of Electric Wiring and Outlets in Physics and Chemistry Laboratories, with Common Apparatus Room
(See article on opposite page)

Electrical Wiring Layouts for Schools

By NELSON C. ROSS, *Associate Member, A.I.E.E.*

THE wiring layout of the modern school building is more or less complex, depending upon the type of building under consideration and the school courses that are to be given. In schools of the primary type the problem becomes one of lighting only, with at best minor power equipment and the ventilation of the toilet sections, the usual fire alarm equipment and two or three telephones. Clocks are as a rule not used in primary school buildings, other than one or two clocks located in the office and corridor.

In grammar schools the problem again becomes one of lighting, with power-driven fans for the ventilation of the toilet sections, and in the larger grammar schools for the classrooms and for the gymnasiums and assembly halls. Separate fresh air and vent fans may be used for the different sections or the duct system may be so arranged that one fan equipment may be used (by the use of proper deflecting dampers) either for the classrooms or for the assembly hall and gymnasium at will. Provision should be made for the installation of fire alarm and signal equipment in all school buildings, regardless of type, and also for local telephones between the principals' offices and the classrooms of the larger grammar schools. An electric clock system may also be added, but it need not be as complete as the systems that are required throughout high school buildings where more advanced courses are given.

Primary and Grammar Schools. These buildings are not as a rule intended for general use at night; nevertheless the lighting equipment should be complete, as it is becoming the custom to make use of the school buildings as community centers, for night courses and for entertainments, particularly such parts as gymnasium and assembly hall sections, and therefore the lighting of the classrooms, the control of circuits and the types of lighting fixtures, etc., throughout should be proportioned as if the building were to be used for night work.

The general methods of wiring throughout the building, the number of lighting units used for the classrooms, the methods of running distributing feeders and service lines, as well as the methods of installation of low tension equipment will be generally the same for any type of school building, differing only in the volume and completeness of the work. School buildings may be of first, second or even of third class construction. If of first class construction, it is obvious that the wires of all circuits must be run in conduits. If of second class construction, it is advisable that all wires of the lighting and power circuits be run in conduits or with B. X. armored wires, even though local rules permit the installation of other methods of wiring. If, however, it becomes necessary to keep the cost of construction down, it may be permissible to install the wires of the clock, bell, telephone and fire alarm systems in the construction without the use of conduit or covering; if this is done the wires are taped together and clipped to the timbers and studding, a porcelain tube being used at each point where the wires pass through the plaster to connect to an instrument. With wires installed in this way, however, standard rubber-covered wires should be used and care should be taken to keep all wires away from steam and water pipes.

High Schools. The wiring layout for the modern high school building will include:

(1) Service mains, with transformer equipment.

(2) Riser and feeder distribution, with switch and panelboards.

(3) Lighting circuits throughout classrooms, corridors and offices.

(4) Lighting circuits through assembly hall, gymnasium, lunch rooms, etc.

(5) Lighting circuits throughout shops, industrial sections and laboratories.

(6) Power circuits for ventilating fans, elevator, vacuum sweeping equipment, etc.

(7) Power circuits to motor-driven boiler room equipment.

(8) Power circuits throughout shops and industrial sections, laboratories, etc.

(9) Provision for electrical cooking throughout domestic science laboratories.

(10) Empty conduit raceways for wires of outside telephone service.

(11) Local telephone equipment throughout building.

(12) Electric clock and program bell system.

(13) Local fire alarm system.

(14) Provision for city fire alarm connection.

(15) Door bells, where required.

(16) Provision for radio equipment, with amplifier in assembly hall.

(17) Lighting fixtures.

(18) Special wiring circuits to machine room equipment, throughout industrial sections and mechanical laboratories.

(19) Special wiring throughout chemistry and physical laboratories, with equipment for tables as required.

(20) Special wiring throughout lecture rooms, if necessary.

Preliminary Information. Certain information must be at hand before the wiring layout can be completed; this includes some knowledge as to the extent of the courses to be given, so that the wiring of the classrooms, laboratories, manual training rooms, etc., may be made adequate to operate the equipment that will be used. Information must also be had as to the characteristics of the service to be supplied the building, both for electric power, lighting, telephone and fire alarm service. It is obvious that if the building is large enough to warrant the installation of engines and generators, the characteristics of the electrical service will be determined by the generators installed. With the service taken from the street mains, however, we must have accurate information regarding service supplied by the service company.

If the building is to be located in a section furnishing direct current, the service will be delivered over a three-wire, 110–220 volt system for lighting, and at either 110 or 220 volts for power. If the street mains are underground, they will continue from the nearest manhole pit underground to the building; if the street mains are on poles, the service lines may swing from the nearest pole to cross arms on the building, thence through conduits to the service switchboard, or else a pole may be set on the street at a convenient point and the service lines taken from this pole, underground, to the building. If alternating current service is to be furnished, the service company will as a rule provide separate transformers to supply the building; these transformers may be located on poles on the street or they may be installed in a special transformer vault within the building. It is always advisable, where possible, to provide a vault and have the transformers in the building, as transformers located on the street are at best unsightly, and in the event of transformer fuses opening during winter storms, they are more quickly and easily replaced with the transformers in the building; this also applies if the transformers are located in underground pits in the street, as in the event of heavy ice storms it is difficult to remove the covers and enter the pits for the replacement of fuses, particularly if these fuses should open at night, during hours of night school, or during the use of the assembly hall or gymnasium.

It is imperative that information be had from the service company as to the voltage phase and frequency of the service it will supply, as this information determines the types of motors to be used, the type of panelboards and switchboards, as well as the weight of copper that will have to be provided for the main and sub-feeders. As a rule, alternating current lighting service will be furnished over a two-wire system at 110 volts, or over a three-wire system at 110–220 volts, while power will be furnished over single-phase lines at 110 or 220 volts, or over three-phase lines at 110–220, 440–550 volts. Again from some of the older plants power may be furnished at 440 volts on either the single-, two- or three-phase systems. The two-phase service, for motors at any voltage, and 440 volts for power service will be met with rarely, as the standard power service will be three-phase, at a pressure of either 220 volts or 550 volts.

It is well to note also that while the power service in general used through a town may be delivered over a three-phase system, we must make sure that the power service available at the site of the building is to be delivered at three-phase, as three-phase motors should be provided for the equipment, or provision must be made by the service company to extend the three-phase lines to the site. It is advisable where possible to insist on a three-phase power, as the use of large single-phase motors on lighting circuits is not satisfactory, due to the high current taken by these motors which causes poor regulation of the voltage at the lamps.

It may be said that before it is determined to use single-phase motors of any size in a building it is well to ascertain the maximum horsepower in single-phase motors that the service company will permit on their lines, as many companies will not permit single-phase motors of more than two or three horsepower to operate from the lighting circuits. Again, where three-phase circuits cannot be provided, much larger motors may be used with special permission from the company. Where, however, the general power service is 550 volts, three-phase current, it is always advisable to use single-phase motors for kitchen equipment and for tools requiring fractional horsepower, these motors to be connected to the lighting circuits.

Ascertain from the telephone company the point at which their service will be available at the building and their requirements as to the sizes of conduit from their lines to the basement of the building; as a rule a 2-inch conduit is required, although in certain instances larger conduits are insisted on. This conduit will terminate in a service cabinet at the point of entrance, sub-conduits running from the cabinet to the telephone outlets, terminal strips being installed in the cabinet and all branch connections made therein. In the event of gas piping for emergency lighting being carried as a sub-contract to the electrical contract, ascertain the point where the gas service will enter the building and the gas company's requirements as to metering and control. In case of the city fire alarm's being connected with the building, ascertain the city's requirements as to the fire alarm service and the point at which the wires will enter the building. In the event of the lighting, power and telephone services' being carried into the building and terminating in the same general service room, it is important that the underground service lines of the telephone and fire alarm systems be kept not less than 3 feet from the wires of the lighting and power services.

Wiring Details for Classrooms. The lighting of classrooms for best results will require from four to six ceiling outlets for use with direct lighting fixtures. A standard classroom approximating 22 by 28 in floor dimensions will require a single-circuit and from 600 to 800 watts; many types of lighting units are offered for this service, both in the direct, semi-indirect and full indirect type, with fixtures of the pendant type, and with ceiling collars closely spaced to give distribution. Authorities differ as to the volume of illumination required for best results, as well as the spacing of the lighting outlets. The writer's experience, however, has been that four units, practically spaced on the quarters of the room with the use of either 150- or 200-watt, Type C lamps, will give adequate illumination and all necessary diffusion for average classroom work. In addition to ceiling units there should be either a floor outlet for use with a portable lamp or a pendant fixture over the teacher's desk. As a rule there should be two switches installed, each switch controlling one-half the illumination of the room; the teacher's lamp may be switched separately or may be controlled independently of the ceiling outlets from the socket at the fixture. While possibly slightly better diffusion may be had with a greater number of outlets closely spaced, the matter of proportion and the appearance of the fixtures in a room are of equal importance with the volume and diffusion of the light, and the use of simple pendant fixtures with the proper type of enclosed unit is less expensive to install and maintain than a large number of units that are close to the ceiling, and they are, in the writer's opinion, much more pleasing to the eye. In study rooms and in classrooms where bookkeeping, typewriting and sewing are taught, six units are preferable to the use of four, in which case the four units would be fed from a separate circuit which may also be utilized to feed the two additional outlets in an adjoining room.

While certain authorities advocate as high as an average of 8 candle-feet for the lighting of classrooms, the writer's experience has been that an average of 4 candle-feet is ample if proper lighting units are used, since beyond a certain point too much light is harmful, and in many cases when relamping fixtures in classrooms the larger lamps have been removed and units of 150-watt or even 100-watt lamps installed, with satisfactory results.

The hanging height of the unit above the floor will depend upon the type of unit or reflector used; as a rule, however, the filament should be approximately 10 feet above the floor, with the lamp properly focused in the reflector. All things considered, a plain bowl type of enclosed unit of the proper glass will give satisfactory results, as these units are not expensive, are pleasing to the eye and are easily kept clean, whereas units of the indirect or semi-indirect type require greater care in cleaning and are more likely to be broken than units of the bowl.

In addition to the lighting service each classroom should be furnished with a clock, local telephone and period bell. In classrooms where bookkeeping or domestic science work is taught and where the instructors are required to keep in touch with outside sources, an outside telephone may be also required, this either connected on a special trunk line or through the switchboard in the general office. The clock and the period bell may be located side by side at a point just above the blackboard moulding, the wires of both clock and bell terminating at the same outlet; the clock and bell should be mounted if possible on an inside wall, and at a point where the clock may be seen both by the teacher and the pupils. It is generally preferred that the clock and bell be located above the entering door from the corridor and at a point near the teacher's desk. The local telephone should be of the wall type and may be mounted either on the blackboard at the rear of the teacher's desk or at a point near the door. Floor outlets, where used, should be located near the teacher's desk so that a cord may be readily led from the outlet for the use of a portable desk lamp; the floor boxes should be waterproof and should be fitted with a cord guard for the protection of the lamp cord. If it is preferred to make use of a ceiling fixture at the desk in place of a floor outlet, the fixture used should be of a type permitting the lamp to be on a level with the eye.

Laboratories. The lighting of the laboratories will be essentially the same as the lighting provided for the classrooms, excepting that a greater illumination may be required; clock, bell and telephone will be the same as required for the classrooms.

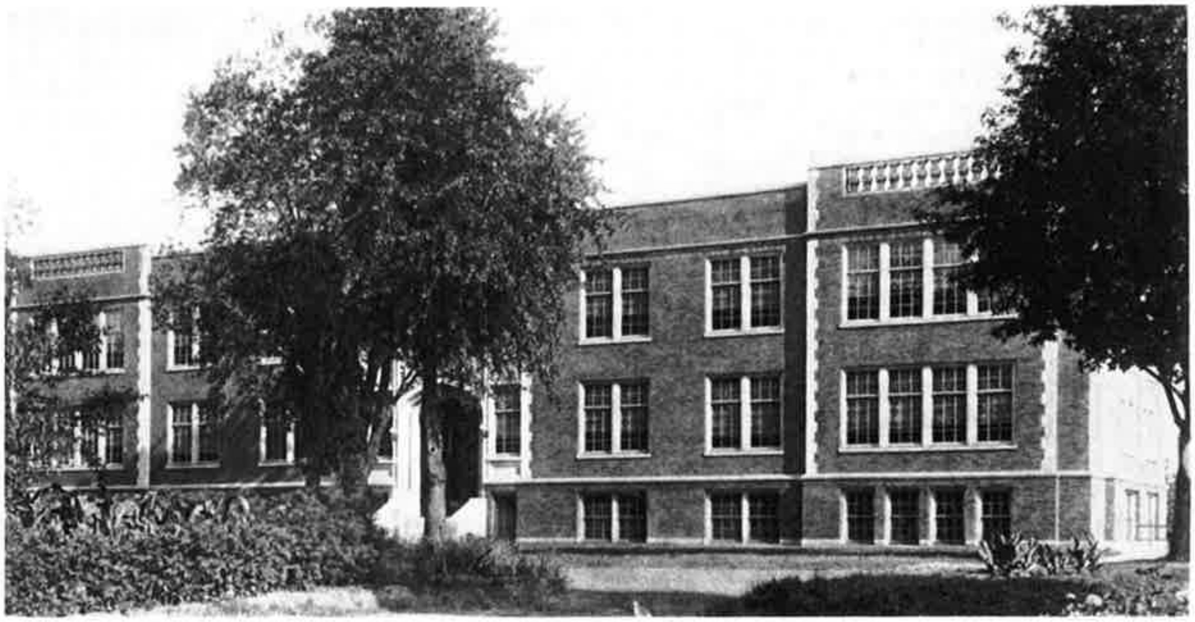
Where sewing is taught there should be a number of receptacles provided, preferably of the wall type (spaced possibly 4 feet apart) so that sewing machines may be operated from these receptacles. As sewing machine motors require but little power, from six to ten outlets may be operated from a single circuit, the circuit feeding from the nearest panelboard. From one to three outlets should be provided in the sewing rooms for use with electric irons, these spaced conveniently for the installation of ironing tables or stands; where iron outlets are used, each should be operated on a single circuit from the nearest panelboard, and each outlet should be made up of one of the standard heater combinations consisting of a flush switch, receptacle and pilot lamp, all mounted on one flush plate. The outlets should be installed approximately 48 inches above the floor.

In domestic science or cooking rooms the lighting and low tension equipment will be the same as required for the classrooms. While these laboratories will be equipped with the usual gas equipment for cooking, both at the instructors' and students' tables, it is also advisable that provision be made to provide for instruction in cooking by electricity. In certain schools all cooking laboratories are equipped for both gas and electric cooking; where this is not desired it is essential that at least one room be fitted for electric cooking, or with both electricity and gas. Electric cooking will (depending upon the size of the stoves that are to be used) require a high current load, and as a result the copper supplying the service to the rooms must be large, so that the feeder circuit should be carried back to and fed from the service switchboard.

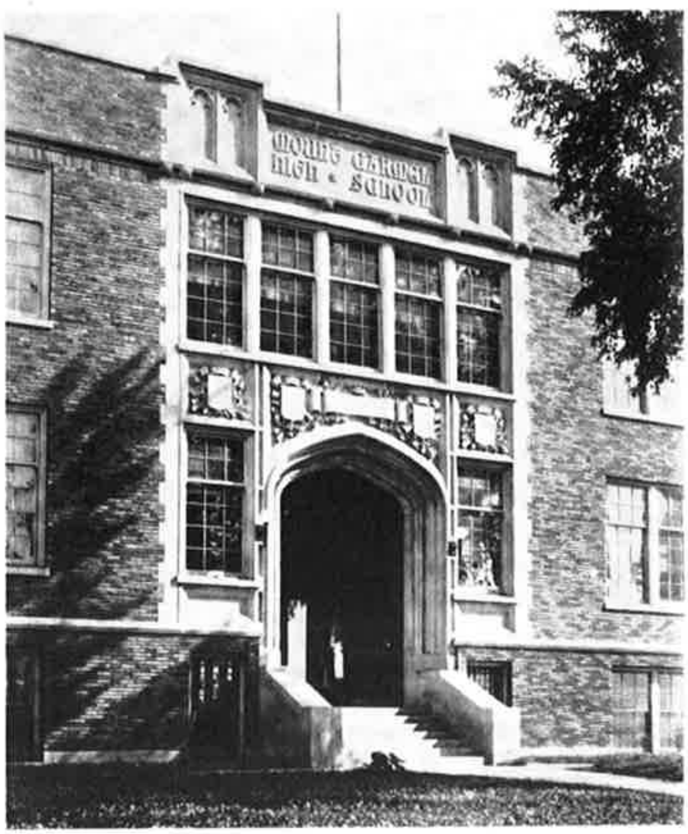
In electric cooking we have the large electric ovens, ranges and other equipment for use in hotels and restaurants, the smaller household ranges for family use, and the isolated hot plates, toasters, waffle irons, percolators, grills, etc., which are in

High School at Mount Carmel, Illinois

HEWITT & EMERSON, ARCHITECTS



BUILT in 1916 of brick and frame construction at a cost of 15 cents per cubic foot. The principal feature of the plan is the placing of the study hall floor at halfway level between first and second floors, providing a story and a half height for the combined gymnasium and auditorium.



general use on the family dining table or buffet; in an average laboratory the equipment will consist of possibly one large range, one or more household ranges, and a number of the smaller units of different types. Depending upon the table layout, the equipment may consist of one household range to each of the students' tables, thus providing for from four to six pupils, with a larger range at the instructor's table, or with a single large range at the instructor's table, and individual grills or hot plates at the students' tables. The usual practice tends to the use of individual plates or grills, with one large range and oven to the laboratory, the plates being combined with the use of gas stoves at the students' tables. This method is inexpensive to install and has proved satisfactory in practice, as all types of portable equipment may be used by the students and the manner of cooking on the larger ranges is taught from the range at the instructor's table.

It is advisable to provide a special panelboard in the laboratory for the control of the cooking circuits, this located at some point convenient to the instructor's table. The cabinet should be fitted with a lock so that the equipment cannot be operated or tampered with when the laboratory is not in use. The household ranges are wired for use on three-wire circuits and will require from 7,000 to 10,000 watts with all utensils in use; the feeder copper therefore to the range should be either three No. 8 or preferably three No. 6 wires. All fuses for the individual circuits of the range are contained in a panel in the body of the range, the feeder wires terminating in the lugs provided on this panelboard. All controlling switches for the operation of the individual heating units are mounted on the front of the range. The conduit from the master panelboard should run in the floor construction to the range, turning up and connecting with the range cutouts.

The individual plates or grills for the students' tables are wired for use on a two-wire circuit at 110 volts and will require from 300 to 1,000 watts each, depending on the size of the unit; not more than two of these units should be operated from a single circuit from the panelboard, and where the larger are to be used there should be a single circuit carried to each unit. It is good practice to provide two 1-ampere double receptacle outlets on each table (where four pupils are to work) and to carry two circuits, one from each double receptacle back to the panelboard, the two circuits to be installed in one conduit in the floor construction from the panelboard to the table. A heater combination can be used with a pilot lamp at each outlet or, with master control at the panelboard, this may be omitted.

Where, however, a large number of students are to work, and tables and high capacity equipment are contemplated, it is advisable to locate a cutout board in a cabinet in each of the tables and to run separate circuits, each separately fused, from the cutout board to each table outlet, each outlet to consist of a single 10-ampere receptacle. The several cutout panels are then grouped and connected to a single feeder, and this is mastered from a switch under lock at the location of the instructor. With a large number of units this method is less expensive than the installation of single circuits from the instructor's panelboard to each receptacle on the tables. The use of receptacles on the tables is to be preferred to the use of fixed units, as with this method any type of portable equipment may be operated from any receptacle, and the equipment may be removed and stored when not in use. Nothing smaller than No. 14 wire should be used for cooking work, and when the distances from the cutout to the units are greater than 80 feet, No. 12 wire should be used. It is advisable also to provide a receptacle or an outlet at some point in the laboratory for the operation of one of the self-contained refrigerator units, this circuit to be of No. 14 wire and to be mastered from the panelboard at the location of the instructor.

The physics laboratory will require, in addition to the lighting and clock equipment, etc., some provision, depending on the scope of the courses to be taught, for both high and low tension electric current at the instructor's and students' tables. The 110-volt service to the tables may be taken from the panelboards in the nearest corridor; it is to be preferred, however, that a separate panelboard be provided for each laboratory and all circuits for the tables, etc., controlled, under lock from this panelboard, the board to be located adjacent to the instructor's table.

The laboratory panelboards may be fitted with precision instruments, etc., or may be made up of only the switches controlling the different table circuits. In the writer's experience, a simple switch panel in each laboratory is all that is required, as when instruments are to be used and current experiments are to be made, instruments of the portable type may be used directly on the tables.

The instructor's table should be fitted with receptacles for 110-volt direct current, 110-volt alternating current, and for 10-volt direct current, a separate circuit carried from each receptacle to the panelboard. There should be three receptacles of the polarized type on the students' tables (for each student at the given voltages); these receptacles may be located on a raised shelf, as with double tables, or on the front of the table permitting easy connection for portable equipment; from four to six of these outlets may be connected on one circuit.

The conduit feeding the receptacles should be run in the floor construction, passing up out of the floor at the location of the table and looping from outlet to outlet. A satisfactory form of construction for this work consists of the use of the so-called "bulb tee," this set in the floor with a tapped bushing set flush with the floor (a brass plug being inserted in the bushing as soon as installed); when the table is in position the plug is removed and a short length of conduit installed passing from the bushing to the table. This construction is waterproof, and in the event of a table being moved no unsightly conduits are left in the floor, as the short conduit can be then removed and the brass plug again screwed into the bushing. As a rule the tables are provided with the school furniture, and these tables are fitted complete with receptacles and other equipment, the wiring contract providing only for the wires and conduits to each table.

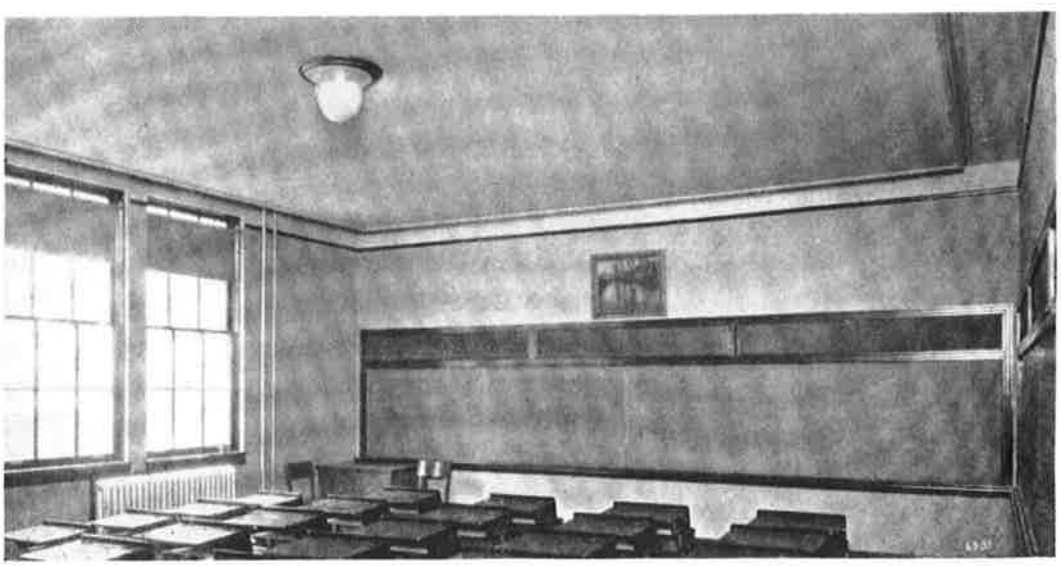
The 110-volt direct current and the 10-volt direct current are usually provided by means of two motor generator sets, each consisting of an alternating-current motor connected to and driving a direct-current generator, the 110-volt generator being also used to provide direct current for the operation of arc stereopticon lanterns in the lecture rooms; this set is usually of 5-kw. capacity at 110 volts, and the smaller set from 1- to 2-kw. capacity at 10 volts. The sets may be located in the laboratory or in the apparatus room. The larger set may also be used if desired for the production of direct current for operation of the moving picture machines in the assembly hall booth, if this is contemplated. This set should be of from 7½- to 10-kw. capacity, depending on the size of the picture machines.

A switchboard should be provided for the control of the two machines, this board to be fitted with a meter and voltmeter for both voltages, the field rheostats, the generator switches and the circuit switches to the different panel boards in the laboratories; also with switch for control of the lantern circuit to the lecture rooms and for the circuit controlling the direct current circuit to the moving picture booth. The motor switches controlling the two motors should not be on the switchboard, but should be connected on the wall at a point adjacent to the motors; these switches should be of the safety type and should be fitted with lock so that when the switches are open and locked the switchboard is dead and cannot be tampered with.

The lecture room should have its own panelboard, with circuits leading therefrom to outlets on the lecture table. The stereopticon lantern outlet should be set at the rear of the seats and should be of not less than 30-ampere capacity. It is well to provide four lighting outlets in the lecture room, two to be controlled by the usual switch at the entering door, the two remaining outlets to be controlled by a three-way switch at the instructor's table, with a second three-way switch at the location of the lantern.

Each base plug on the 110-volt circuit is a potential connection for the vacuum cleaners of the portable type. These machines are of great value in keeping the premises clean and have one advantage over the stationary type in that a long cord is more easily handled than a long hose, but for the heavy cleaning, ordinarily required in schools, the stationary type is generally necessary as being more powerful. With this portable type no special switching is required, the connection to the live plug being all the control necessary. With the stationary vacuum producer special arrangements must be made. Outlets must be distributed throughout the building so that all portions may be reached with a 50-foot length of hose. At or near each outlet should be a switch to operate the motor. This is best done by means of a remote control or solenoid which operates the starting device for the motor.

It is essential to determine the capacity of the machine to be used and to provide on the main switchboard the necessary cutouts, etc. The smallest or one-sweeper installation requires about 500 watts; the multi-sweeper type may require up to 5 horsepower. When the load to be carried is greater than a 5-horsepower motor can take care of, it is advisable to install more units rather than to increase the size and use only one producer. This means greater flexibility and economy in piping as well as power consumption.



Classroom in Theodore Roosevelt Junior High School, Wichita, Kas.
Showing special ceiling acoustic panel as described on opposite page
Lorentz Schmidt & Co., Architects

Acoustical Treatment of Classrooms

By LORENTZ SCHMIDT, A.I.A.
Lorentz Schmidt & Co., Architects, Wichita, Kas.

OUR public school system is keeping pace with the trend of American life toward speed, efficiency and high tension. Children enter the schoolroom younger and are hurried along much faster than even a few years ago; the tension is high from the first morning in the kindergarten. This condition cannot do otherwise than create a nervousness among the pupils, and every classroom noise, no matter how slight, has an unpleasant effect on the pupil. We are adding to this discomfort by constructing our classrooms of materials that intensify and prolong every sound. Outdoor conditions are strived for in purifying the air before it enters the room, and restful, harmonious colors are used in finishing the walls and ceiling. Why, then, is it not also desirable to obtain as nearly as possible the quieting and comfortable feeling of the open field? It will not be the purpose of this article to discuss the technical phases of the subject, but rather to deal with the conditions that obtain in the average classroom and the methods by which these conditions can be greatly improved by a simple and inexpensive treatment.

In the days before fireproof construction was used, when the interior walls were mostly of soft sand brick or wood, finished with wood lath and soft lime plaster, the period of reverberation was much lower than in the modern classroom where the materials are concrete, hard shale brick, cement plaster and metal lath. The room is usually as bare as possible and devoid of any sound-absorbing furnishings. The modern system of ventilation even requires that the windows be kept closed, thereby eliminating the possibility of the open window's becoming a means of sound absorption. Every change has led to developing the present classroom conditions; on the one hand the construction of the building has prolonged the period of reverberation, and on the other the increased efficiency of our school system has placed the pupils under a tension and nervous strain that was not general in former years.

In a fireproof building the period of reverberation in an average sized classroom is approximately 5.63 seconds when empty and 2 seconds when occupied by 30 pupils. In a room with a 12-foot ceiling height a sound will travel back and forth from the ceiling to the floor 183 times before it has spent its energy. A sound wave starting from any place and from any angle in the room will rebound on an average of 102 times during the period of its duration. This means that when the interior is thoroughly saturated with sound waves the audibility of the noise will be about 11 times greater (louder) than the original sound. There is usually at least one talking all of the time; there is shuffling of restless feet and handling of books, all of which creates a condition that causes an uncomfortable feeling, irritability and nervous strain that have an unwholesome effect upon the work of the classroom.

Before attempting to experiment and decide on materials and methods for improving the condition of a classroom it was necessary to place a reverberant which would balance with unity in relation to a point where the sound wave accumulation would be inaudible, or when with the interior entirely saturated with sounds the incidental or original sound waves only would be registered by the hearing senses. It was found that in the average classroom a reverberant of .7, with 30 pupils present, would eliminate 98.1 per cent of the audible sound wave accumulation, thus producing the effect desired.

The ceiling is left unplastered excepting for an 18-inch border, and in the unplastered area (about 80 per cent of the total ceiling space) are placed the sound-absorbing materials. The varying mechanical methods of securing the material are usually left to the judgment of the acoustical contractor, insofar as the efficiency of the material is not interfered with. Below the sound-absorbing material, leaving at least a space of 1 inch, is stretched a light weight canvas. This canvas is secured at the plaster line with a moulding, and because of the additional space required for the treatment and the canvas this moulding is usually about 2½ inches in depth, the result being that this panel on the ceiling improves the appearance of the room.

The thickness of the acoustical material depends upon the coefficient of absorption, and it has also been found that it improves the condition of the room to vary the thickness of the material at intervals of about 4 feet across the room. In rooms thus treated all noticeable reverberation is eliminated, and the results are far exceeding the expectations of those interested in the experiment. There is a quieting and restful atmosphere in the room that reduces the nervous exhaustion which is the cause of the teacher's growing less patient, and the pupils' becoming irritable and restless. There is an atmosphere about the room that is restful. There is no strain to hear what is being said, and the effect upon both teacher and pupil is very satisfactory.

Architects today are following closely the subject of quieting treatments in commercial establishments, as it has been conclusively proved that a quiet interior, without noise accumulation, means an increase in one's mental efficiency, and in many instances to a remarkable degree. The conditions which cause inefficiency and irritability in a commercial office will produce the same results in a classroom, and are remedied by an application of the same corrective methods that have been applied to the classroom.

Sanitation in School Buildings

By **HERBERT L. PATTERSON,** *Civil Engineer*
Boston Schoolhouse Department

SANITATION in a modern school building is far from being the simple affair it was years ago. The public school is the institution which makes the future citizens of this country; therefore, good sanitation in the school is a subject which needs continued study, as it vitally affects the health of the child.

Site. The first requisite in the intelligent planning of sanitation is usually an accurate survey of the building site. This will show the present elevation of the ground, the present and established grades of the adjoining streets, and the locations, sizes and grades of the sewer, surface water, water and gas pipes, electric conduits, manholes and Ys for connections to sewer. Where buildings are to be demolished on the site, due regard is to be given to the disconnection and removal of all old service pipes and to the sealing of openings in street mains; the old sewer connections must be carefully stopped to prevent gases' coming back into the new building.

Grades. The finished grades of the various floors of the proposed building had best be established so that from the lowest plumbing fixture there will be a pitch of ¼ inch to the foot to its connection with the sewer. A reduction of the pitch can be made to ⅛ inch to the foot, but it would be better not to resort to this expedient unless it is absolutely necessary; it is far better to raise the grade of the building. Connection should be made with a sewer if it is within a reasonable distance. Neither a septic tank nor a cesspool is to be installed excepting as a last resort.

Cesspools. If the subsoil is of gravel to suitable depth and surface water stands well below the grade, a cesspool is to be preferred to a septic tank. A cesspool might be 5 feet in diameter and 15 feet or more in depth, built of field stone, laid dry. It may be lined with brick laid dry.

Septic Tanks. Where neither sewer nor cesspool can be used, a septic tank could be installed. A tank based on 70 gallons per day per person and a capacity of 1 cubic foot for every 20 gallons is usually sufficient. The depth of the liquid and the width of the tank may be made roughly equal, and the length about twice the width. The liquid should not be less than 5 feet deep. A conductor system should never be connected with a septic tank, but such connection might be made to a dry well.

All material entering into school plumbing installation should be of high grade. It is important that cast iron pipe (extra heavy) be used for all drains and branches from the farthest fixture through the manhole to the sewer. The conductor and surface water pipe should be cast iron to a point 10 feet outside the manhole on the sewer side. From this point vitrified tile pipe may be laid to the sewer. The house drainage and conductor system are best kept entirely apart, with separate connections to sewer or surface water sewer. There should be running traps in manholes, the same sizes as sewer connections.

All wastes and vents of 2 inches or over should be of iron; of 1½ inches and under they should be of galvanized iron. The ends of all drains or waste lines should be vented into stacks which are carried through the roof to a height of 2 feet, or at least 2 inches higher than any parapet wall. All pipes not exposed should be run in chases or trenched with removable covers so they may be easily accessible for repairs.

Traps. There should be provided under each outlet from urinals a running trap with two handholes; on the house side an iron stopper may be calked in; on the sewer end calk in a T-branch with a brass cleanout which should be flush with floor slab; vent from the T-branch to a large vent that carries over the roof. Traps of laboratory sinks should be extra large in size so that the acid will be diluted immediately after leaving the fixtures and before entering the drain.

Water Supply. An adequate water supply must be provided for the building. Ascertain the water pressure at the main, also whether the pressure is subject to fluctuations. Having the water pressure in view, the service and distribution system should be designed accordingly.

An elementary school, generally speaking, requires a larger service line than a high school, as the elementary school, with the releasing of several hundred pupils at a morning or afternoon recess, will produce a high water consumption. The water supply should be brought to some readily accessible location, and the main reduced in size as the branches are taken off. Each fixture or tank should be provided with a separate stop valve, so that each can be separately controlled without affecting any other fixture or tank. The supply system, both hot and cold, should be provided with drip cocks so the whole system will empty by gravity when the water is shut off.

Water Distribution. From the main water supply it is generally sufficient to run branches, one each to boys' toilet, girls' toilet, boiler room, heating plant, sill cocks and general building water supply, the last supplying fountain, sinks, emergency rooms, teachers' room, office, laboratories, domestic science rooms, etc. The hot water may also be included. Supply pipes to fixtures should be proportioned so as to supply them adequately, and the distribution system should have the same care in design as would be exercised in laying out any other kind of piping installation.

Hot Water Circulation. A hot water tank should be installed, and from it a main with branches to sinks, offices, teachers' room, etc., where hot water is desired. Return circulation should be provided from the highest fixture and the size increased as each riser is connected.

Fire Protection. Such protection in general is limited to standpipes and fire hose. The advisability of installing an automatic sprinkler system, excepting in stair halls, basement and storage rooms, is open to question. With proper supervision of plant the hazard from internal fire is small, especially since the majority of cities require fireproof construction. Statistics show that practically all school fires start in or about the heating plants. All storage rooms for wood, coal and supplies should be fireproof. Standpipes and fire hose should be installed so that any portion of the building can be reached by a length of hose of not exceeding 75 feet.

Pipe Covering. All hot water pipes require covering, usually asbestos or magnesia. To prevent condensation the cold water pipes should be covered so that the air may be kept from the cold iron surface. Alternate layers of wool felt and saturated asbestos paper, covered with a canvas jacket, have been found satisfactory.

Location of Toilets. The toilet rooms of an elementary school should be located in the basement, as the modern school has its basement entirely out of ground on at least three sides so as to receive a maximum amount of sunlight and air. In the high schools the toilet facilities are better located on each floor.

The cut shown on page 100 is a basement plan of an intermediate school building. As will be seen, the toilets are well lighted from the outside by a number of windows, allowing a free circulation of light and air. It will be noticed that the island location of closets allows free circulation around them. The number of closets is based on the number of classrooms, there being 1¼ closets for girls to each classroom, and ⅝ closet per classroom for boys. The urinals (33 inches of linear urinal per classroom) in the boys' toilets are placed against the walls, adjacent to the windows. The walls of the toilets are faced with salt-glazed brick or other non-porous, inexpensive surfacing material, to a height of 7 feet. Above this the brick is painted. The floors here are of asphalt, drained in the boys' toilet to the urinals and in the girls' toilet to floor drains. Much study has been given to the proportioning of closets and urinal spaces, and the number given here have been found to be sufficient.

Fixtures. Plumbing fixtures should be selected with care and due regard to their particular uses within the school. It might be well to say that range closets and urinals have no place in any building making any pretense to sanitation. Water closets should be of the siphonic action, wash down type, with vertical jets inside the bowls, having integral seats with raised integral local vents and tanks of 8-gallon capacity to flush by chain pulls. Pupils' seats are set generally from 13½ to 16½ inches high.

The integral seat has its faults and its good points, the one offsetting the other in favor of its use. The chief fault found with its use is the objection to its coldness when used by the pupils in cold weather, especially if the basement is not properly heated. The good points are numerous,—first, its cleanliness; second, the easy detection of filth by the pupil; third, the avoiding of constantly recurring expense in the repair of the seats. Urinals are generally of slate, without partitions excepting at the ends. Tanks are of a sufficient size in depth, length and width to give ¾ gallon of water to each linear foot of urinal at each flushing. Automatic flushing mechanisms are installed to flush urinals every five minutes.

Toilets and Lavatories. There should be emergency toilets and lavatories on each floor above the basement, also in women teachers' room, master's office, men teachers' room and nurse's room.

Sinks. Sinks are better located in corridors outside of toilet rooms, and the slate sink is preferred; the length is based on the number of classrooms—10 inches per classroom for small buildings, and 6 inches per classroom for large buildings. It might be well to say that the slate sinks are suitable only where cold water is used, and soapstone should be installed where hot water is used for domestic purposes, since the expansion caused by the heat from the hot water will crack and break the slate.

Drinking Fountains. Locate drinking fountains in sinks in all corridors. One fountain to each classroom is sufficient; the overflow from fountain is taken care of by waste pipe from sink.

Shower Baths. Shower baths should be provided in the proportion of one shower to each 40 pupils. Each compartment should be approximately 3 feet square and have a 5-inch swivel shower head. This is controlled by a mixing chamber which maintains the water at an even temperature at all times.

Swimming Pool. The water for the swimming pool should be maintained at an even temperature, which is accomplished by the water's passing over steam coils. During the day the water should be continuously passing from the pool, purified by reheating, and passing through an air curtain, after which it is again reheated and returned to the pool.

Inspection. Constant inspection should be maintained to prevent improper installation of plumbing and fixtures. It is money well spent to employ a competent man to see that the plans are followed and specifications lived up to.