BUILDING NEWS

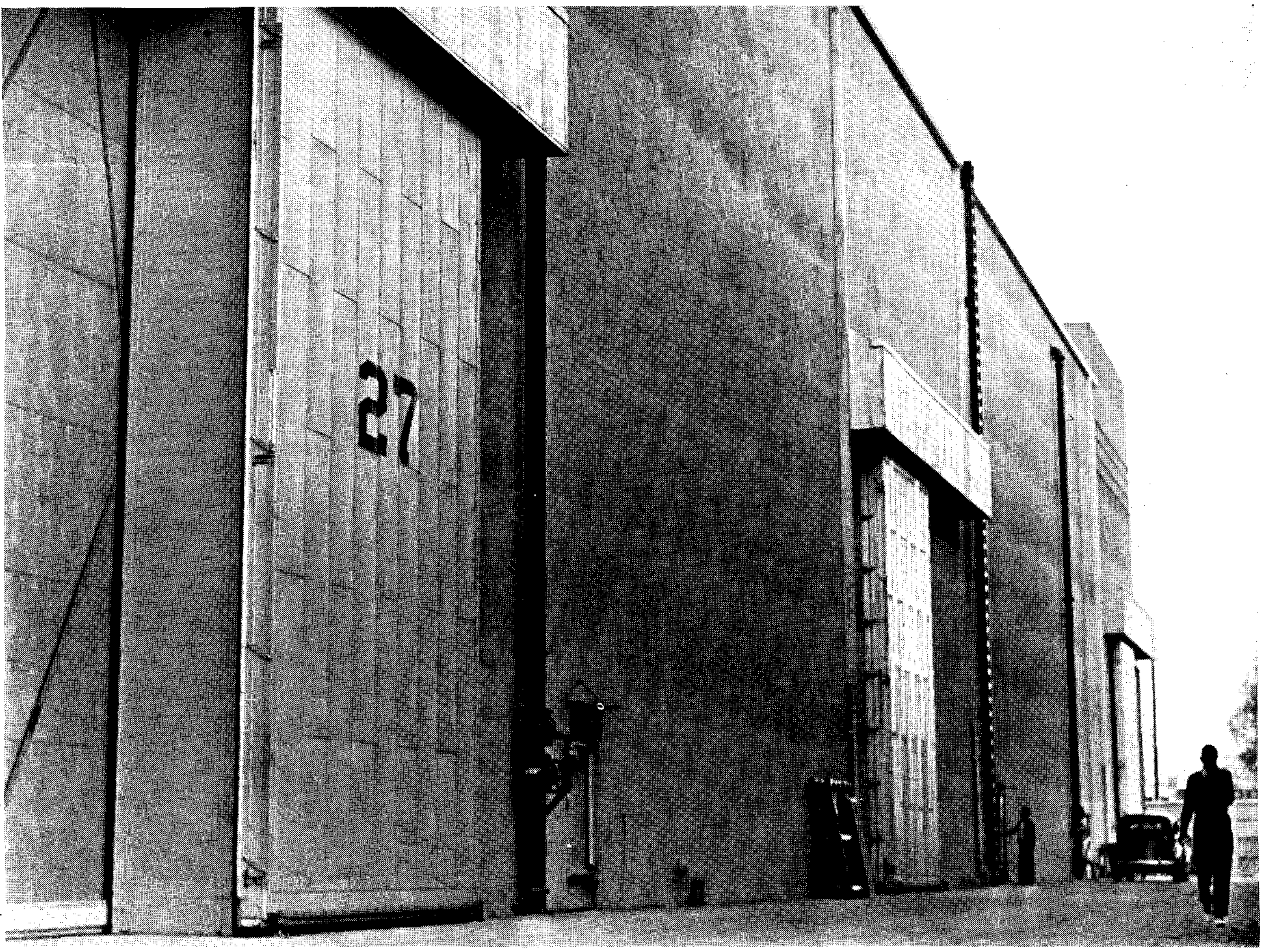
Steel framework designed as reinforcing... see pp. 44-46.

ARCHITECTURAL RECORD

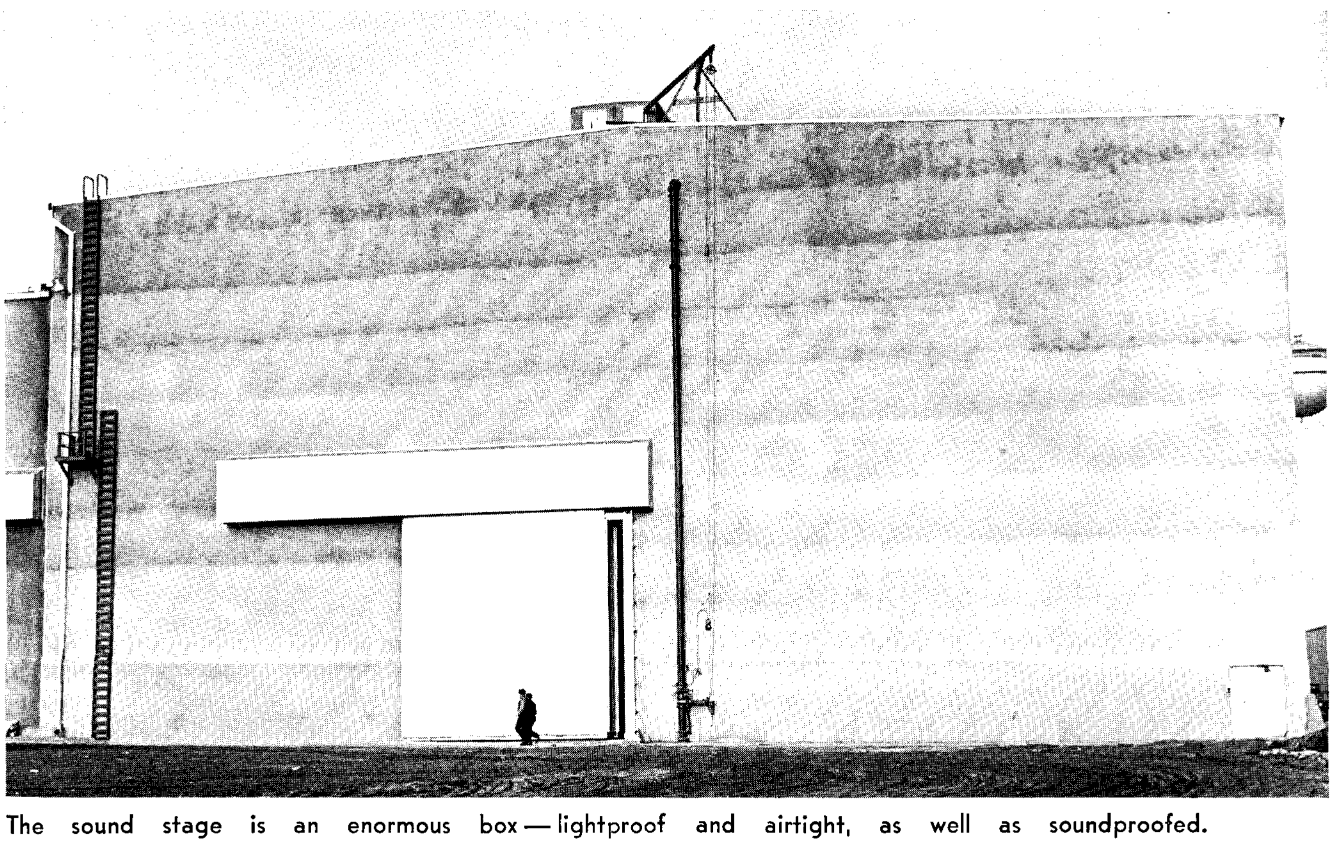
COMBINED WITH

AMERICAN ARCHITECT AND ARCHITECTURE

All photos courtesy M-G-M Studio



View of the new M-G-M sound stages. The doors are electrically operated and held closed by remote control at the camera during filming operations; panic bolts and latches permit opening from within at any time.



The sound stage is an enormous box — lightproof and airtight, as well as soundproofed.

MOVIE SOUND STAGES EXCLUDE NOISES AND REDUCE RESONANCE

CYRIL P. HUBERT, Engineer

FIVE SOUNDPROOFED STAGES, to be used in the making of motion pictures with sound, have recently been built for Loew's, Inc., M-G-M Pictures, at Culver City, California. In the design of these sound stages, there were, acoustically, two requirements to be met: exclusion of noises from without, and reduction of resonance or echo within. Further, to prevent transmission of ground noises, the sound-stage floor had to be separated from the wall structure. And to reduce sound-carrying vibrations in the structure, the continuity of ceilings, walls, and floors was broken.

Exclusion of extraneous noises can be accomplished by either of two types of sound insulation: by heavy mass-type construction, in which insulation value is proportional to the logarithm of wall thickness; and by compound walls built up of alternating dense and semi-porous materials (interposed with air spaces) whose varying conductivity "fatigues" the sound waves. The first of these methods was used in the earliest sound stages. In the new M-G-M stages, the second method, less expensive for large wall areas, has been employed. Reduction of resonance within is accomplished by absorption: materials used in ceiling and interior walls must be not only highly absorptive, but *uniformly* so, throughout the important range of frequencies employed in speech and music.

Before deciding on the design of the new stages, a series of tests was made to determine relative sound-insulating and sound-absorptive values of various building materials. These tests were conducted under the supervision of Professor Vern O. Knudsen of the University of California at Los Angeles.

The test chamber, 10 x 10 x 8 ft., was a room inside a room, with no connection between the two except through the ground; an air space 2 ft. wide was left between inner and outer structures. Measurements of the insulation provided by wall materials were made by comparing the loudness of a test tone produced outside and its loudness measured inside the room. The difference in vibrational energy between the original test tone and the attenuated tone recorded inside is termed "energy reduction"; the decibel, or "energy reduction factor", is ten times the common logarithm of that difference. Test tones of different frequencies were used—128, 512, and 2,048 double vibrations (d.v.) per second.

Comparative Sound-Insulation Values of Materials*

Energy reduction factors in decibels	128 d.v.	512 d.v.	2,048 d.v.
1/2-in. mineral wool (paper each side)	15.8	21.0	21.8
1/2-in. mineral wool (covered with heavy tarred waterproofied paper)	16.1	21.0	23.2
1/2-in. plasterboard	24.3	31.3	28.1
1/2-in. industrial soft insulation board	15.0	21.0	26.0

*Products of different manufacturers vary with the density.

Results of Sound-Absorptive Tests on Mineral Wools

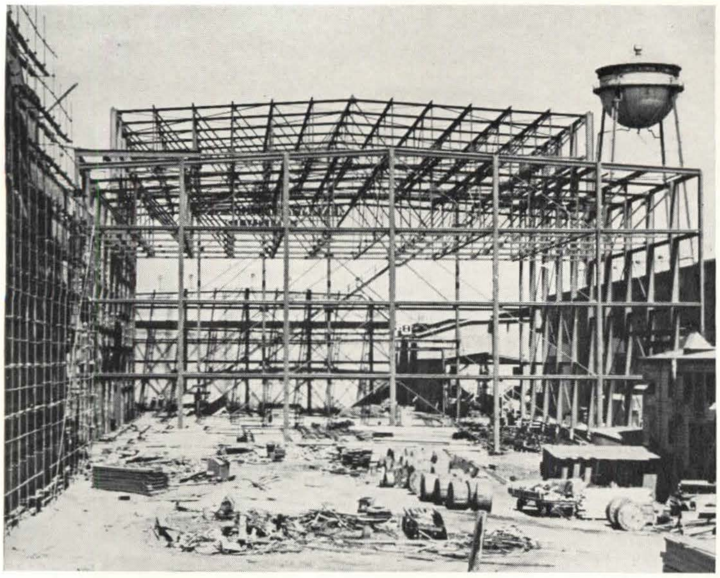
Coefficients of sound absorption in decibels	128 d.v.	512 d.v.	2,048 d.v.
1 -in. mineral wool blankets	37	65	85
1 1/2-in. mineral wool blankets	39	67	85
2 -in. mineral wool blankets	46	70	86
4 -in. mineral wool loosely packed between 2 x 4-in. studs 16 in. c. to c.	48	58	70

Virgil Apger photo.

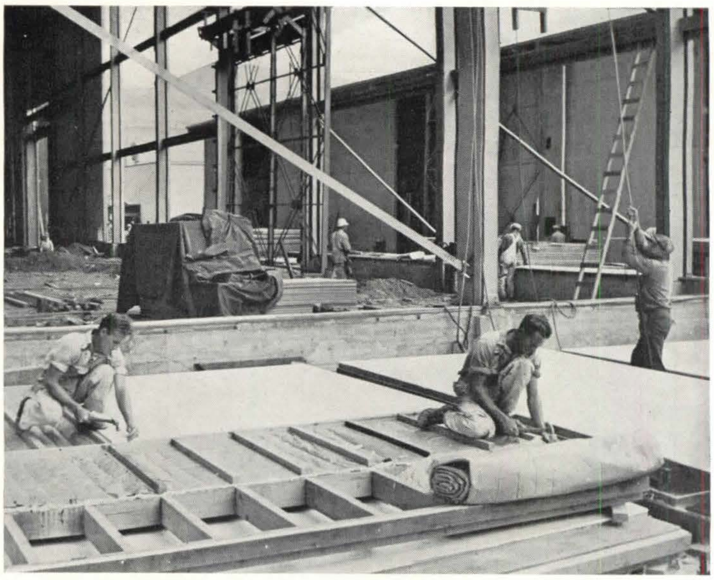
An old-type sound stage; the walls of the structure are solid concrete and insulation is proportional to wall thickness.

Pedestrian door of one of the new sound stages. No single door can provide insulation value equal to that of stage walls: a pair of doors, with a 5-ft. air space between them, is provided.

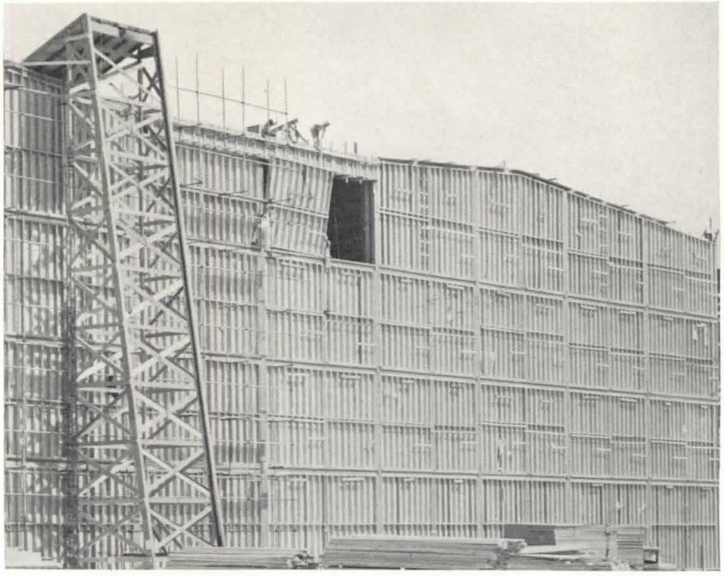
Photos courtesy M-G-M Studios



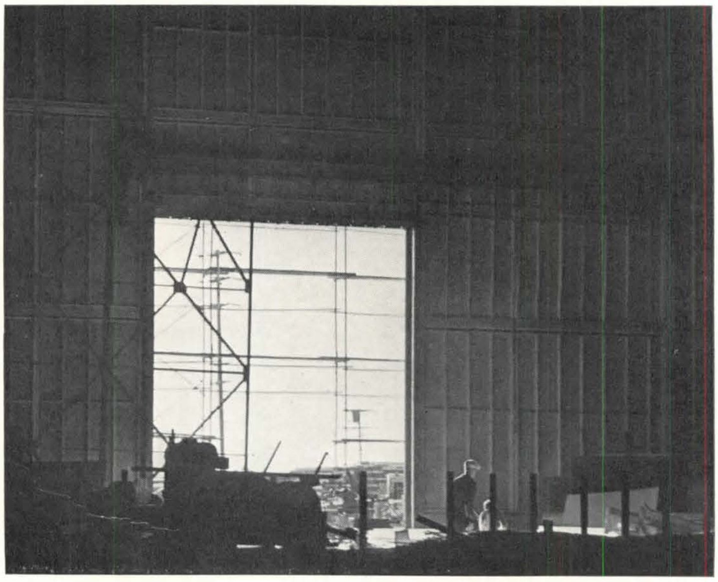
1. Framework is designed for earthquake and wind resistance.



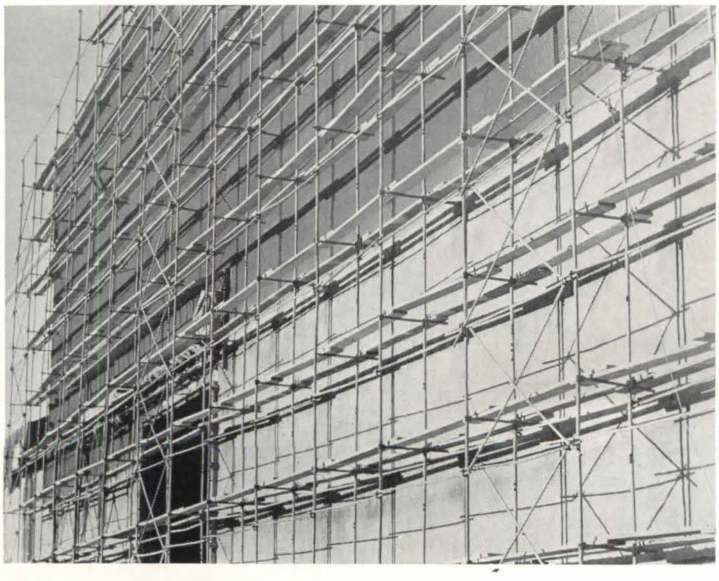
2. Wall panels are prefabricated on the ground. . . . . .



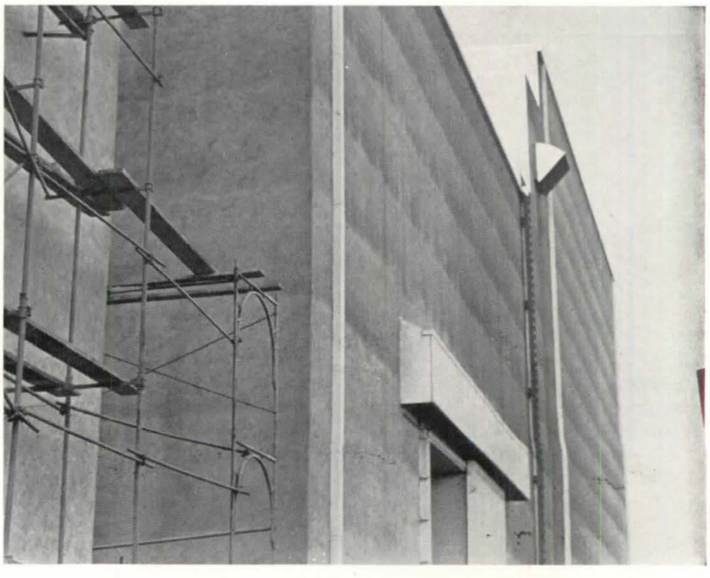
3. Panels are raised to position and nailed in place. . . . .



4. Interiors are faced with mineral wool for sound absorption.

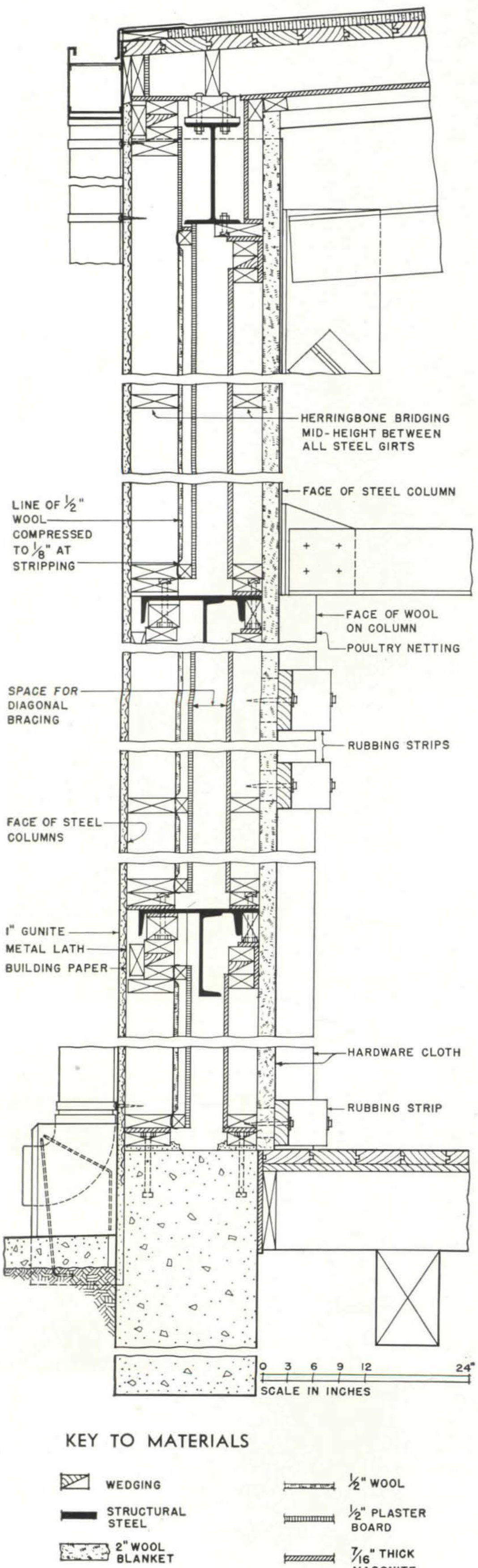


5. From the outside scaffolding, Gunite plaster is applied. . .



6. The scaffolding is then removed from the wall surface.

M-G-M SOUND STAGES



Typical wall section

THE STRUCTURAL STEEL framework of these sound stages conforms to local regulations for earthquake resistance. The compound walls are prefabricated in panels, which are attached to the steel skeleton. These laminated wall panels are made up on the ground while steel construction is in progress, and then raised to position; Celotex stripping is used to insulate panels and wood bolting strips from the steel; clearance openings are sealed off with timber and fiberboard seals. The panels vary in construction, according to the degree of insulation needed.

Exterior wall panels are made in two parts—one part attached outside the diagonal bracing of the steel framework, the other inside. For the outside section of exterior wall panels, a framework of 2 x 6-in. studs is assembled on the ground; a mineral-wool blanket is nailed across it. The exposed side of the stripping is then covered with plasterboard. The inside section of exterior wall panels consists of a framework of 2 x 4-in. studs over which ½-in. soft insulation board is nailed. After the two sections are installed on either side of the steel bracing, metal lath with waterproof-paper backing is fastened to the exterior surface and Gunite plasted applied. (Plaster applied under pressure proves superior for sound-insulation to plaster applied by hand.)

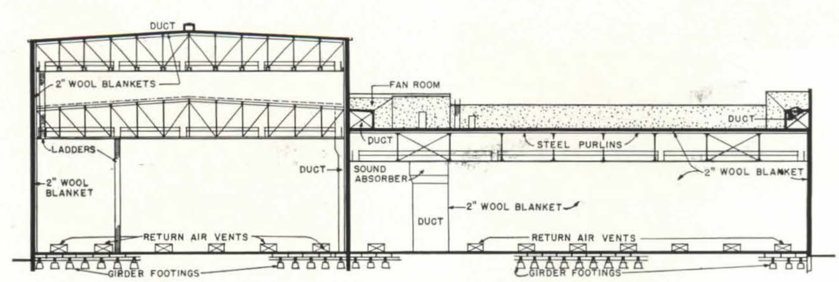
The essential consideration in surfacing wall interiors is not insulation, but absorption. For this reason, interior wall surfaces are faced with 2-in. acoustical mineral-wool quilts, with flameproof muslin face and building-paper back applied to the inner studding. As abrasive protection to the wool, galvanized hardware cloth is applied to a height of 16 ft. above floor level; the rest of the surface is covered with standard chicken wire. Wood wall-guards or rubbing strips are placed around all inner surfaces at heights of 16 and 24 ft. (Mineral-wool blankets are preferred to wool packs because settling of the latter over a period of time reduces their absorptive value.)

Doors are electrically operated and held closed by remote control at the camera during filming of scenes; they cannot be opened from without during "shooting" operations, although panic bolts and latches permit opening from within at any time. The remote control at the camera also short-circuits all telephone bells inside the structure during filming. In determining insulation of a soundproofed door, the limiting factor is tightness of fit or seal against the jamb. No single door can provide insulation value equal to that of stage walls: hence, a pair of doors with intervening air space is necessary; in installations of pedestrian doors a 5-ft. vestibule is provided between inner and outer doors.

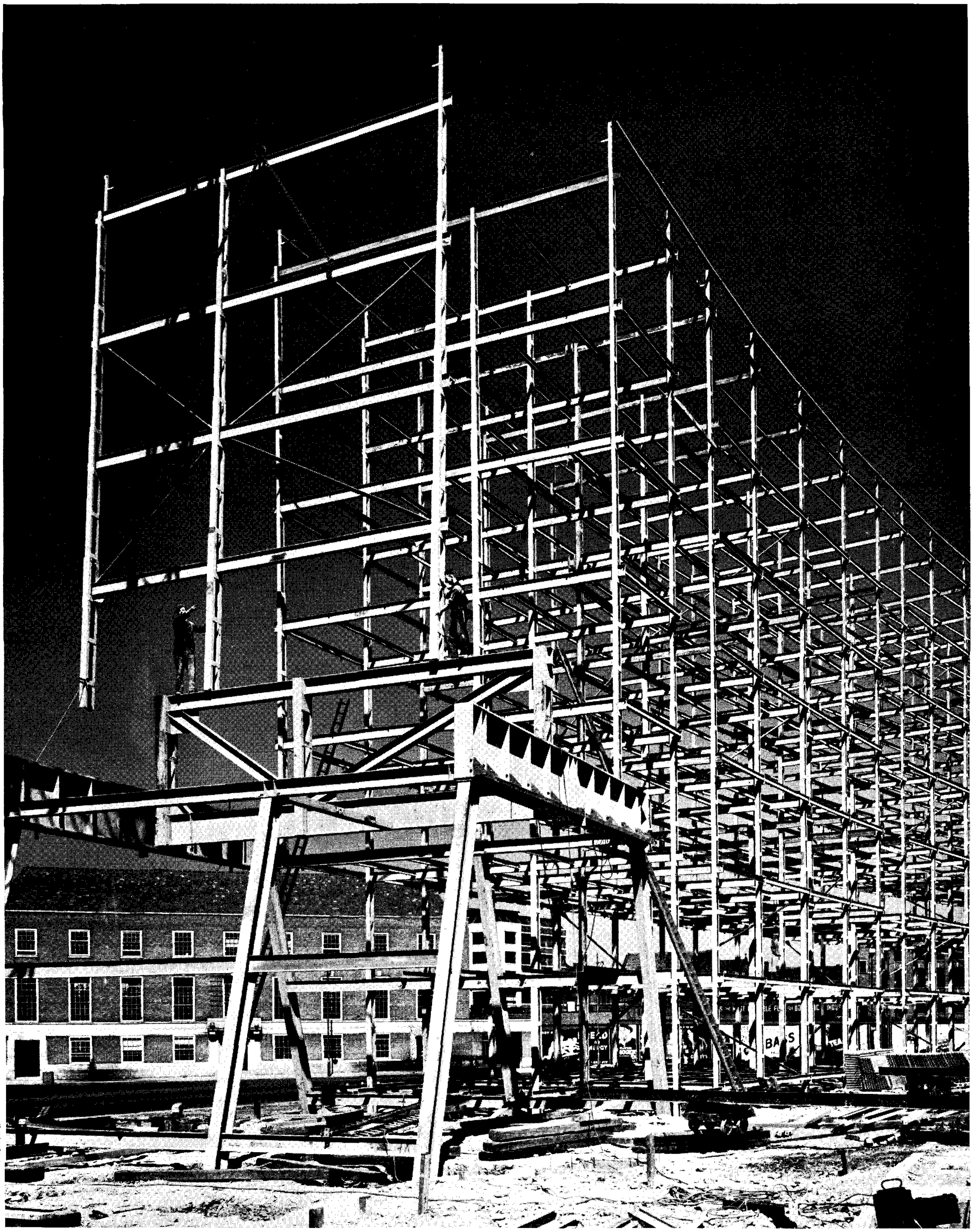
The air-conditioning equipment must function during "shooting" operations; otherwise the heat builds up, making the sound stage uncomfortable.* It is essential, then, that noises generated by the air-conditioning system be, as nearly as possible, eliminated.

Such noises are transmitted in two ways: (1) by the air current; (2) through the structure and ducts. Air-borne noises are smothered by the sound-absorbing materials of walls and ceiling. Fans and motors are placed on vibration-isolation platforms; sounds which otherwise would be transmitted through the structure are thus absorbed. Sound is prevented from traveling along metal walls of ducts by canvas connections in the fan discharge.

* Sound-stage lighting varies in intensity from 50 to 150 watts per sq. ft.; this compares with 1 to 4 watts per sq. ft. for normal office lighting, and 10 watts per sq. ft. for brilliant store lighting. Moreover, insulation that excludes extraneous sound also prevents outflow of heat.



Cross section

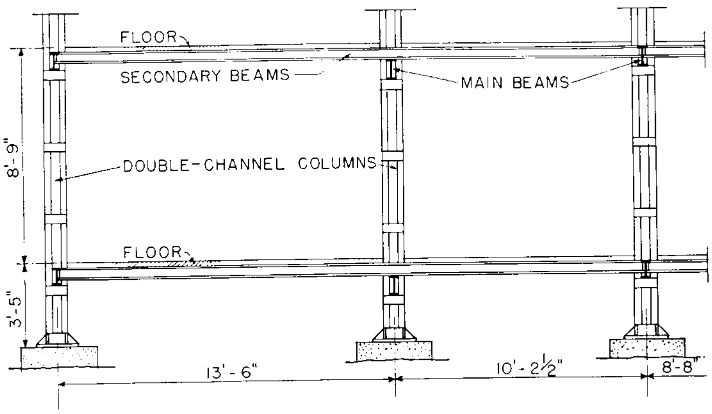


Chas. A. H. Pickard

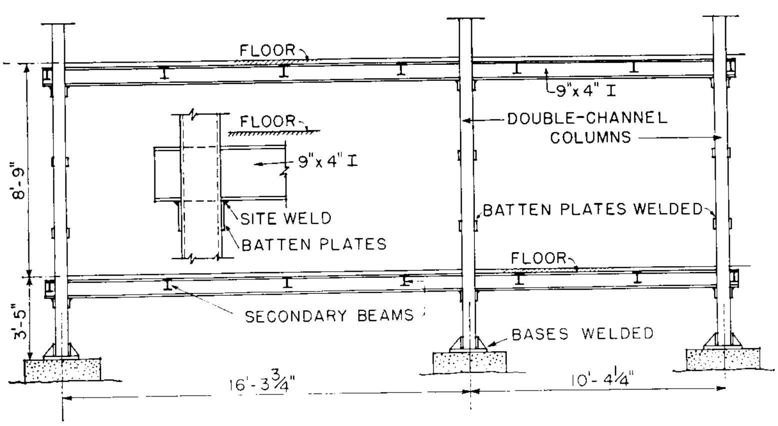
Quarry Hill Flats, under construction at Leeds, England. One of the steel frames being hoisted to position.

NEW STRUCTURAL SYSTEM REDUCES SITE-FABRICATION TO A MINIMUM

EUGENE MOPIN, Engineer



Cross section



Longitudinal section

THE MOPIN SYSTEM, a construction consisting of a light steel framework enclosed by reinforced vibrated concrete units, has been used in the new Flats at Quarry Hill, Leeds, in England. In this structural system, the steel serves actually as reinforcing. Site-fabrication has been restricted to a minimum. The steel skeleton consists of a series of bays, each spanning three columns, the columns connected by continuous beams. Frames are welded together on the ground and lifted to position one complete frame at a time. Joists are bolted in place to avoid "up-in-the-air" welding and to speed erection.

Floors, stairs, and outside walls are built up of vibrated concrete units. The use of the vibratory process produces a concrete which is relatively stronger and more homogeneous than concrete produced in the more usual way.

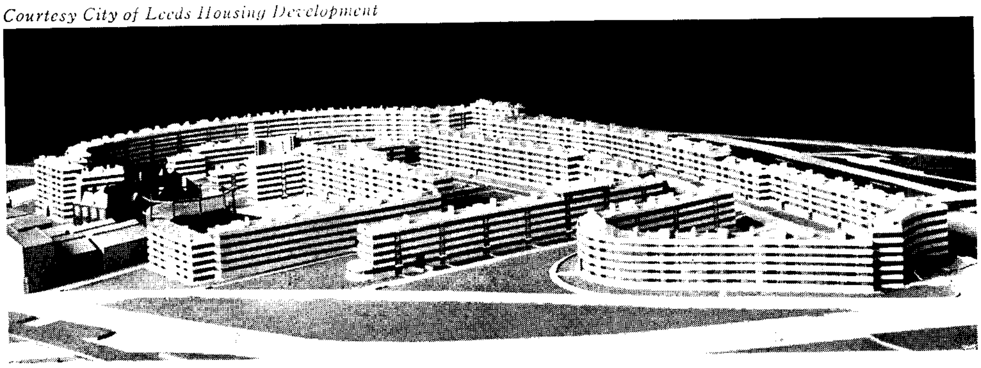
On the outside walls, the concrete units are supported on vertical posts notched to receive them; the posts in turn are supported on joists which are connected to the main beams outside the columns.

Floor slabs are 1¼ in. thick with ribs on the bottom side, from which projecting reinforcing rods are turned over the steel joists. These floors rest on haunching pieces which in turn rest on the bottom flanges of the steel joists. When the floor and wall slabs have been placed, concrete is poured into the cavities between the steel framework and the slabs.

In the Mopin system, the column sections are calculated by determining the load carried by the column without any concrete infill. This load is then increased by 40%, the concrete taking 28.5% of the load. The concrete infilling is vibrated in place by a small vibrator clamped to boards on each side of the double-channel columns.

The advantages (based on British and French standards) claimed for the Mopin system are these: a 25% saving in time; and a 50% reduction in weight as compared with other reinforced-concrete systems.

Courtesy City of Leeds Housing Development



Model of Leeds Housing Development

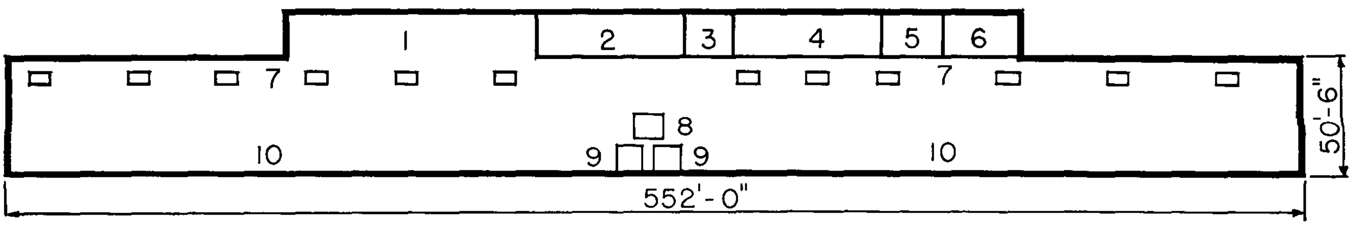
Courtesy City of Leeds Housing Dept.

Concrete units ready to be raised to position; the units are supported on vertical posts notched to receive them.

FOR THE FABRICATION of the vibrated concrete units a small temporary factory was built on the site. These are manufactured in the following manner: a welded reinforcing grid is placed in the mold and blocked up slightly from the bottom. The mold is filled with a semi-wet concrete mix, which is then vibrated. The vibration gives a concrete of higher density and greater strength than that of ordinary concrete. After this, the unit is lifted and turned out of the mold onto the floor. If ordinary Portland cement is used, the unit is ready for placement in about three days; drying can be speeded, however, by the use of quicksetting cement.

Since a mold can be used over and over again, its cost is relatively small; lightness and functional fitness alone determine the shapes chosen. Provision is made to allow reinforcement bars to project out of the castings, to be used for connecting adjacent panels to each other or to the steel frame. Both wooden and metal molds are used. The faces of molds are sprayed with oil before use.

The outer walls are composed of horizontal units about 1 ft. 6 in. high by 2 in. thick and varying in length from 2 to 6 ft. These units are placed in alternate light- and dark-colored bands: in the fabrication, limestone spar or brown gravel is vibrated into the mass of concrete, the first producing a light-colored unit, the second a dark-colored unit. Color has been used largely because of the sooted atmosphere of industrial Leeds.

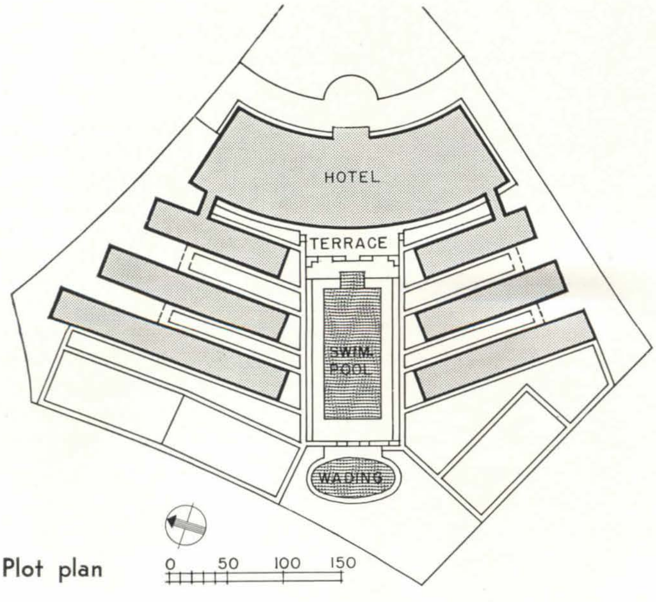


Diagrammatic layout of factory for fabrication of concrete units: **1.** Fabrication of reinforcing, **2.** Mold repairs, etc., **3.** Dynamo, **4.** Office, **5.** Samples, **6.** Mess hall, **7.** Vibrating tables, **8.** Concrete mixers, **9.** Sand and gravel, **10.** Drying space.

John Maltby

HOTEL AND DORMITORIES BUILT ON HILL OVERLOOKING SEA

R. W. H. JONES, Architect



Plot plan

THE SALTDEAN HOTEL near Brighton, England, is located on a hill and slopes down to the sea. There is a 50 ft. fall from front to back of the site and a 20 ft. slope across it. The hotel, facing south and west, is on the high side with a series of dormitory blocks below it; these blocks are screened from the wind by their position in the hollow.

The block arrangement makes it possible to provide a relatively large proportion of bedrooms facing the ocean. Further, in this way, sections of the hotel can be conveniently closed as the season declines. In each wing are located bedrooms and baths for one sex. The flat dormitory roofs serve as tea terraces, several directly accessible from the central cafe. The terraces command a view of the sea.

R. Picard

This is the designer's conception of the central domed hall, in which it is intended to demonstrate, by spectacle, the vitality and the power of science. From an upper gallery, the visitor commands the great arena. Below and about him are physical symbols of the scientific disciplines: a logarithmic spiral, planets in movement, electrostatics equipment, a rainbow, illuminated distillation apparatus, a geneological spiral of the biological realm, etc.—each exhibited in semi-darkness or intense light, whichever seems most appropriate. From this vantage point above the arena, the position of the disciplines and their relation to each other may be comprehended; the details of the separate exhibits will then be understood as part of the larger scientific context.

MUSEUM OF SCIENCE DESIGNED FOR FLEXIBILITY AND EXTENSIBILITY

PAUL NELSON, NITZSCHKE, F. P. JOURDAIN, Architects

THIS PROPOSED BUILDING, a "museum" of science, is one consequence of the success of the scientific exhibit at the 1937 Paris Exposition. Paul Nelson, native Chicagoan and long-time resident of Paris, together with two Frenchmen, Nitzschké and F. P. Jourdain, were commissioned to make studies for a permanent exposition building. The project was ready for presentation to President Le Brun and to Edouard Herriot after the vacations last year; but before the vacations were over, the Appeasement of Munich intervened. . . . The project is now in abeyance.

Unlike an archaeological or historical museum, a "museum" of science is not a static "collection" of symbols inherited from the dead. Science is ever in process of change: facts are constantly displaced and new theoretical patterns conceived; new branches of science rise, others decay or become absorbed. A building, in which science is symbolically exhibited, must be readily adaptable to these changes: in design it must be *flexible and extensible*. For new discoveries may imply redistribution of areas. Various exhibits may have special requirements: high ceilings for optics and low ceilings for x-rays and spectrochemistry; a room 25 meters high (and at least as wide) for electrostatics.

To satisfy these requirements, the designers have proposed a structure without interior supports; a rigid exterior envelope with ceilings of interior rooms suspended; demountable, mobile partitions and ceilings. The roof is to be glazed; the ceiling of each room will be either of opaque or of transparent material, according to the special needs of each exhibit.

The building is to be air-conditioned; close atmospheric control is essential to prevent damage to experiments and to precision instruments. Vitiated air is to be exhausted into the space between structural envelope and interior rooms, thus preventing humidity condensation on ceilings.

The sciences have been grouped in three divisions, each in its logical relation to the others: 1, mathematics, astronomy; 2, physics, chemistry; 3, biology, medicine. These "disciplines" have been organized, independently of each other, about a central hall.

The visitor enters a vestibule in which are located ticket or registration areas, coatroom, catalog counters, etc. In order that these details may not distract attention from the exhibits to come, the visitor is passed through a great funnel-shaped concourse, where are a series of preliminary exhibits intended to prepare him for the exposition to come. Next is the central hall, a parabolic vault, penetrated by an oblique shaft from which are hung the cables which support the radial roof beams; these beams are hinged where they abut the dome. In this hall it is intended to present dramatic spectacles that will illustrate the power and vitality of science. Then to a suspended gallery above the spectacle for a "tour of orientation"; the visitor can then grasp the scheme of the exposition, for he will see the position and interrelationship of the disciplines. From here the visitor descends to the lower level, from which three doors give access to the separate exhibits.

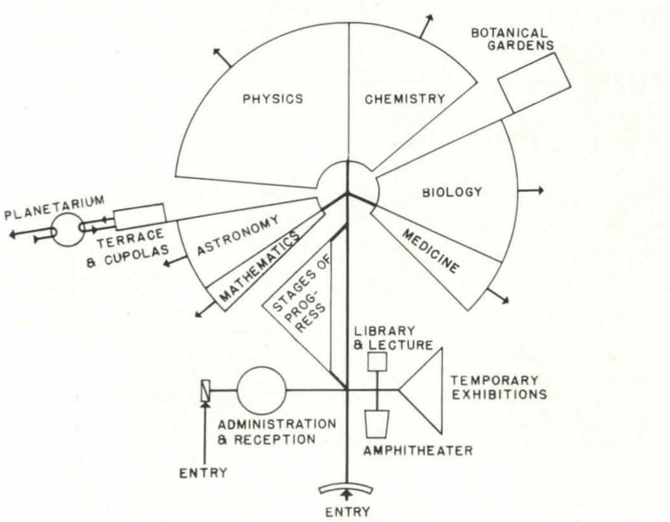
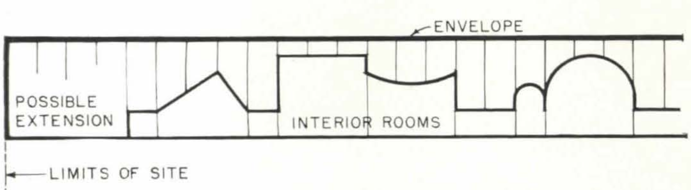
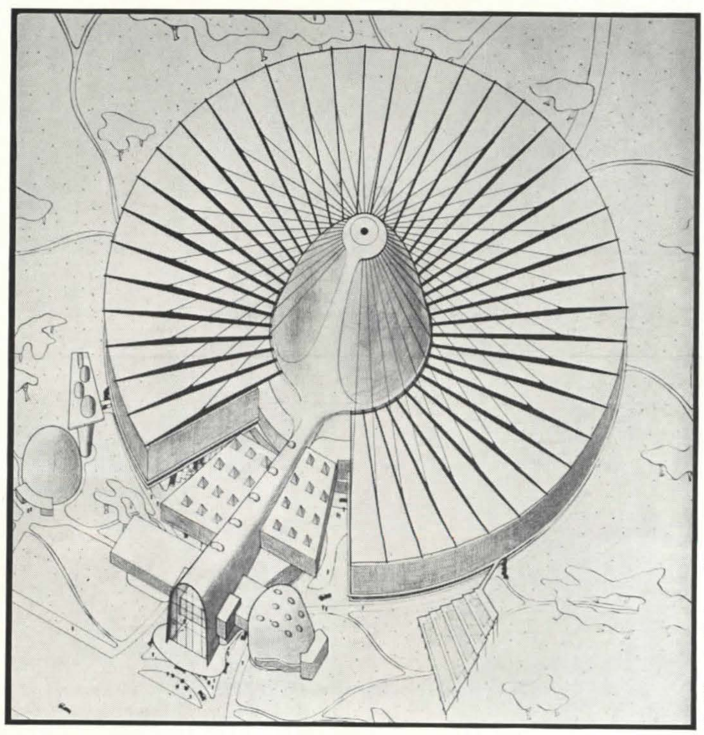


Diagram showing functional relationships of areas

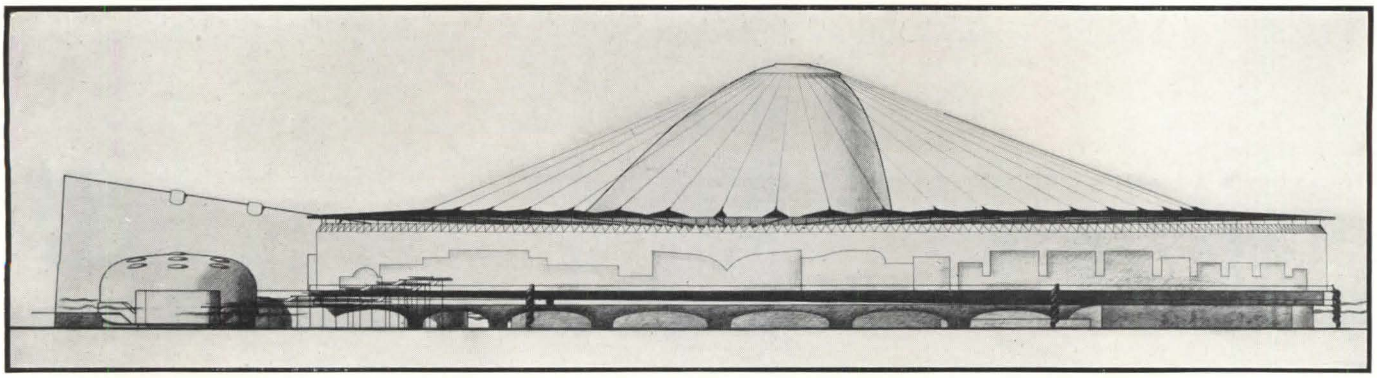


Envelope

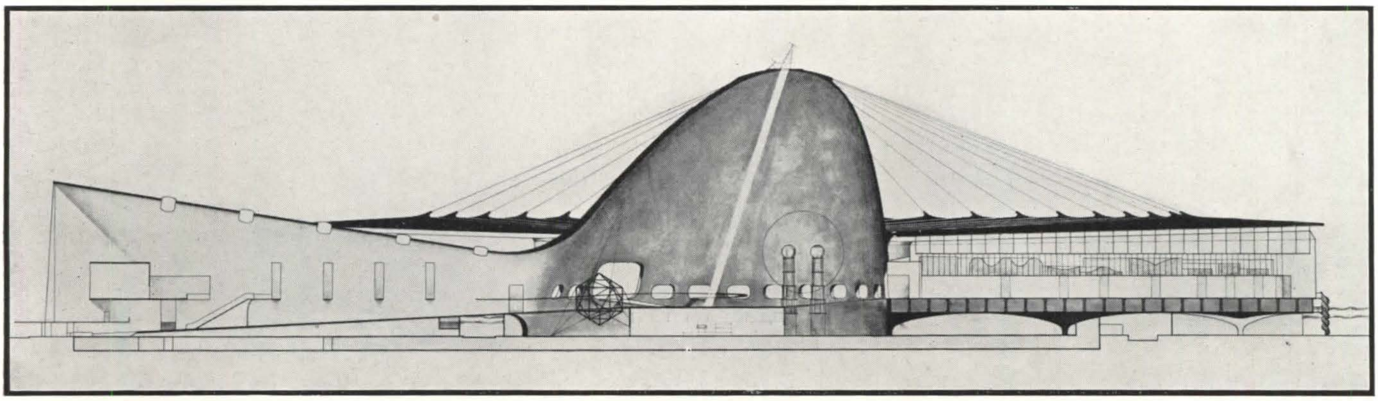


R. Picard, photographer

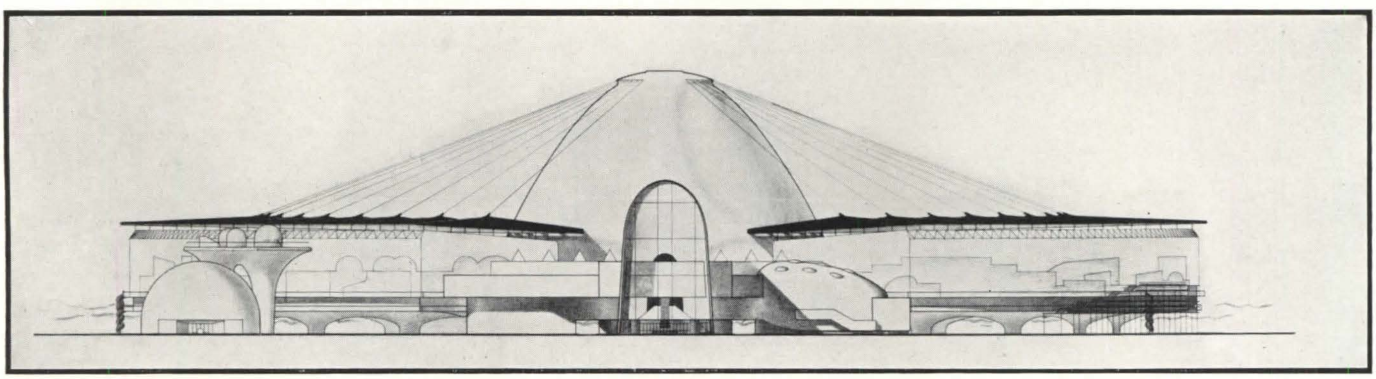
Perspective view from entrance side



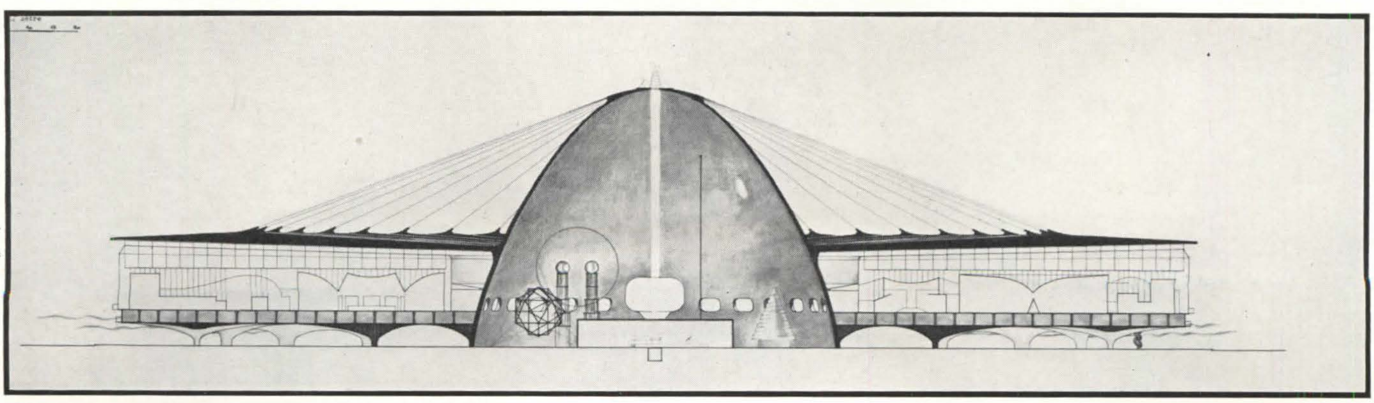
Side elevation



Longitudinal section

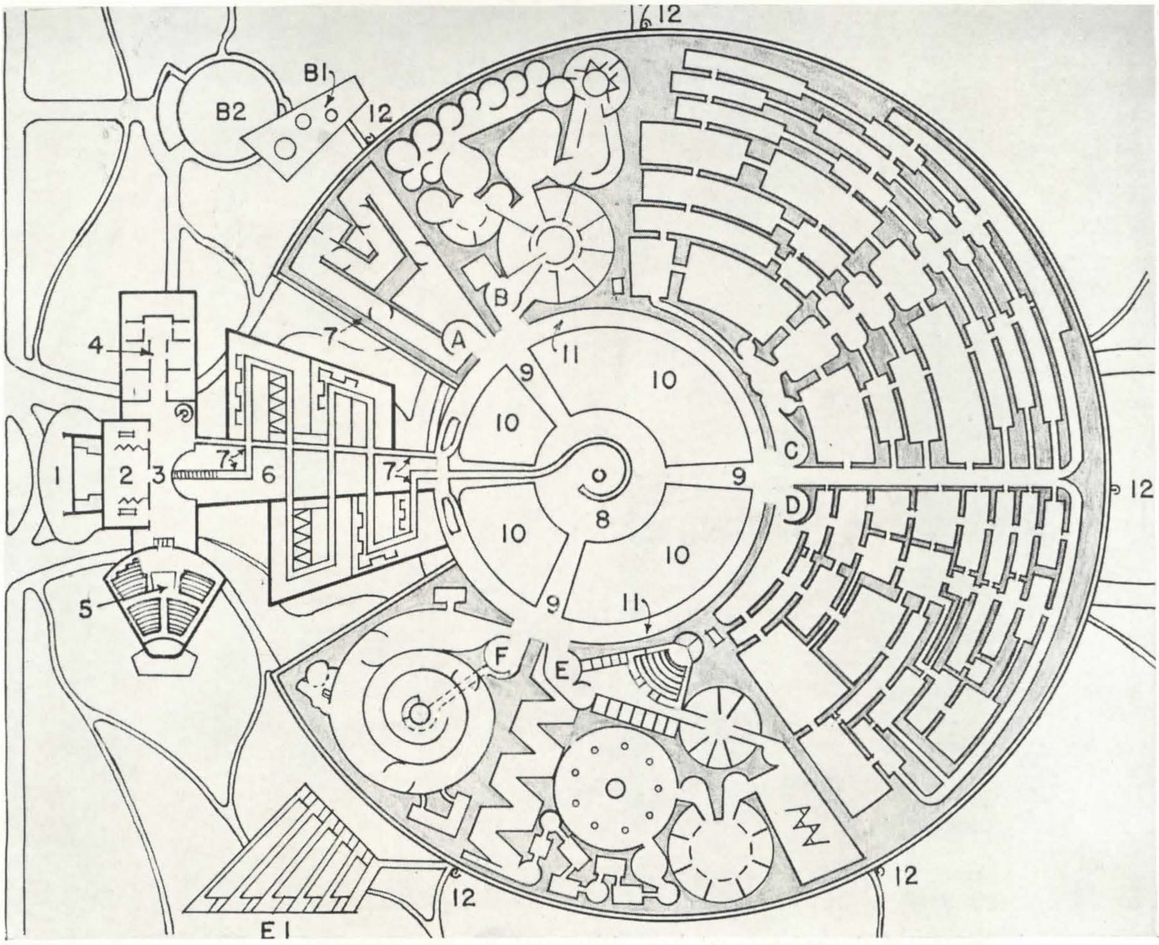


Front elevation



Cross section

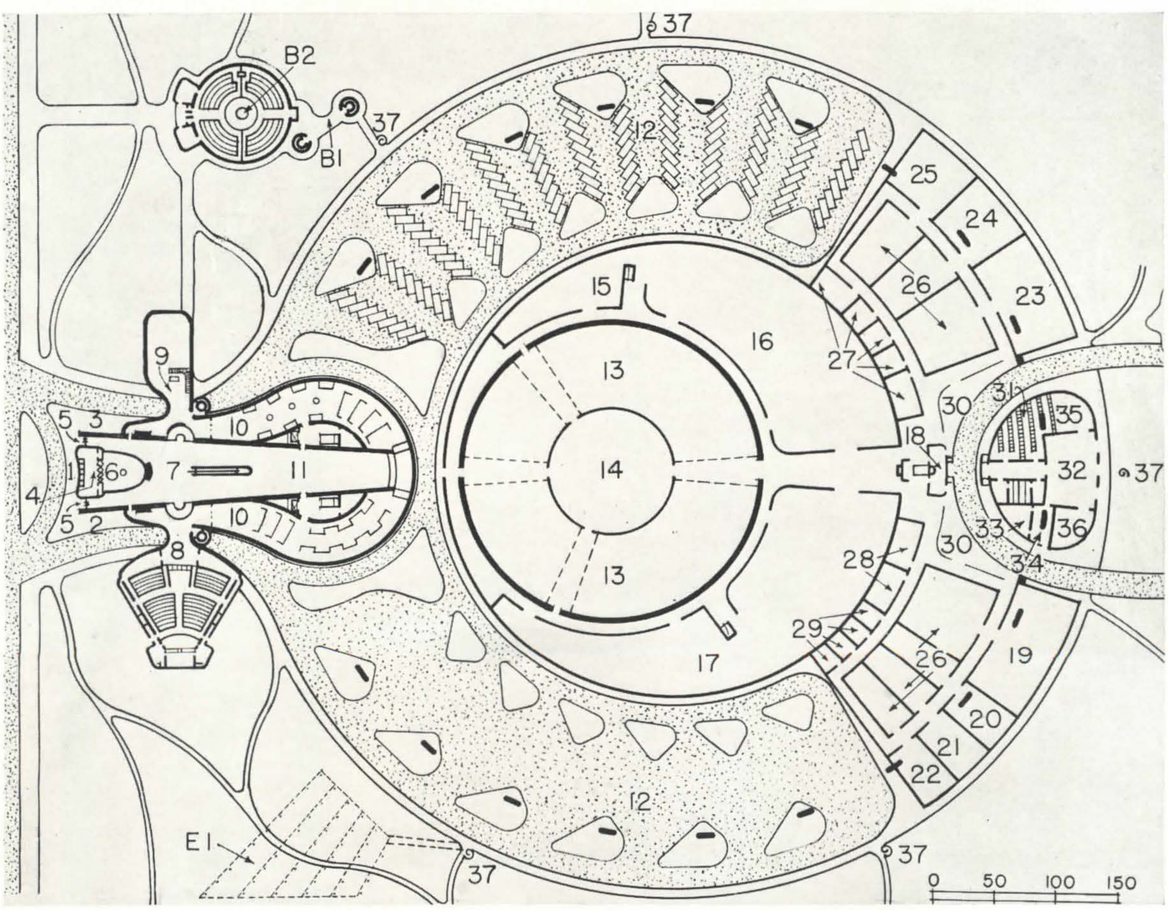
Renderings photographed by R. Picard



Upper level

1. Canopy
2. Reception hall
3. Platform
4. Administration
5. Amphitheater
6. Lower entrance hall
7. Stages of progress
8. Central platform
9. Bridges leading to disciplines
10. Arena for demonstrations
11. Balcony
12. Emergency exits

A. Mathematics
B. Astronomy
B1. Cupolas
B2. Planetarium
C. Physics
D. Chemistry
E. Biology
E1. Botanical garden
F. Medicine



Lower level

1. Main entrance
2. Entrance platform
3. Exit platform
4. Tickets
5. Exits
6. Catalogs
7. Escalators
8. Amphitheater
9. Library and lectures
10. Temporary expositions
11. Hall to disciplines
12. Parking
13. Arena
14. Control center
15. Cold water, gas, compressed air
16. Heating and ventilating
17. Electrical center
18. Guard
19. Mechanical atelier
20. Astronomy atelier
21. Mathematics atelier
22. Medicine atelier
23. Physics atelier
24. Chemistry atelier
25. Biology atelier
26. Extra workrooms
27. Utilities
28. Photo laboratories
29. Transformer rooms
30. Loading platforms
31. Employees' lockers
32. Restaurant
33. Kitchen
34. Office
35. Smoking room
36. Lecture room
37. Emergency exits

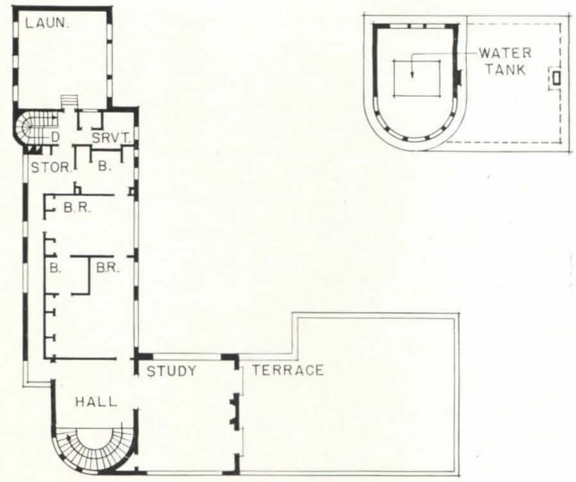

Photos by Gomez

View from the street. Auto entrance at left with direct access to living and dining rooms and stairway to upper floors.

View from rear of garden. Note the terraces, which are accessible from living quarters at all levels.

BUENOS AIRES: TWO-FAMILY HOUSE WITH TERRACES AT ALL LEVELS

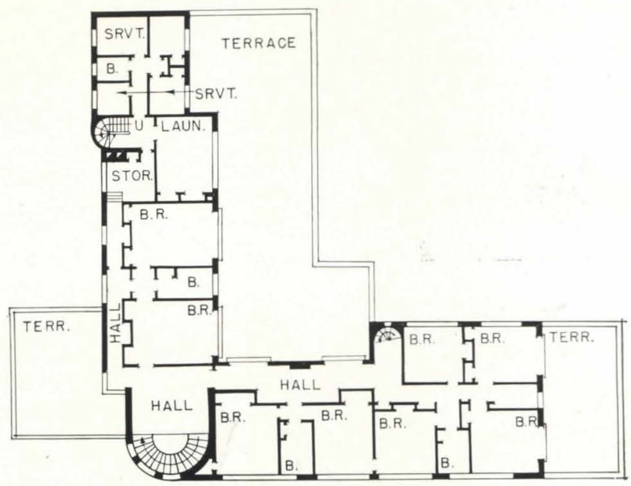
O'FARRELL and VILLEGAS
Architects



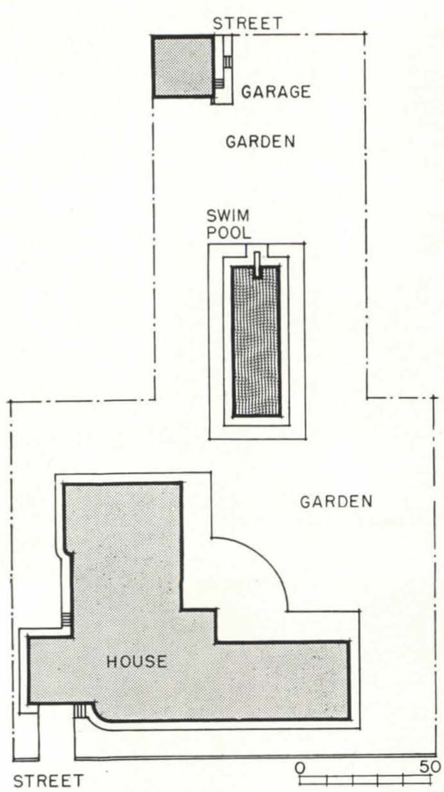
Third floor (water tank above)

THIS HOUSE in Buenos Aires has been designed for two families. One family occupies the two lower floors. On the first floor, there is a study, bedroom, dressing room, and bath for the master; and a bedroom, dressing room and bath for his wife. On the second floor are eight bedrooms and four baths for the children. The apartment of the second family occupies the top floor and consists of a living room, two bedrooms, and two baths. In addition to general service accommodations, there are eight bedrooms and three baths, distributed on all floors of the same wing. In the rear is located a garage on whose upper floor are three bedrooms and bath for chauffeur and gardener.

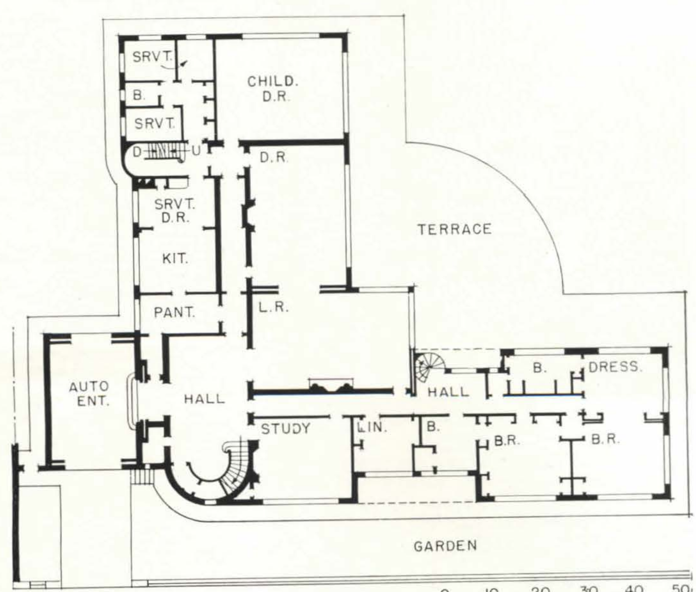
The L-shape of the building permitted a covered entrance for automobiles, with direct access to a hall opening directly on living and dining rooms. Living quarters of both families overlook the large garden and pool, and are directly accessible to wide terraces at every level. The service section, located at one end of the L, has views toward another secondary garden.



Second floor



Plot plan



First floor

Photos by Gomez

Above: Children's dining room, looking toward garden. Left: Stairway at ground floor; doors at left open from covered driveway.

Library-living room on the top floor: the woodwork is oak; two doors open on the roof terrace.

Dining room, looking toward garden: walls and ceilings are painted beige; Flemish tapestry on far wall.

PORTLAND, OREGON: SMALL HOUSE FOR PRIVACY AND VIEW

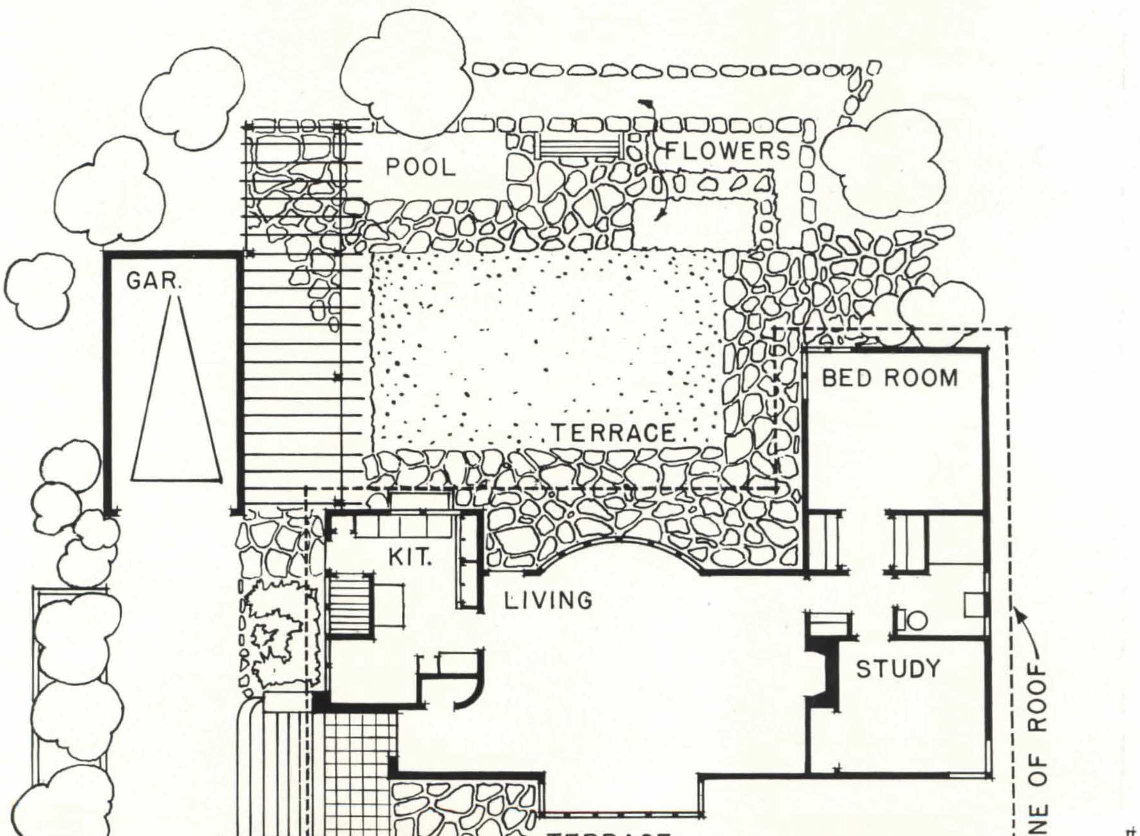
Boychuk

A. E. DOYLE and ASSOCIATE, Architects

DESIGN of this residence for Mr. and Mrs. Pietro Belluschi in Portland, Oregon, was largely determined by three factors—a hillside location commanding a fine view of the valley below, the owners' requirement that the garden be an integral part of the house, and that the interior show the maximum spaciousness possible in a small, low-cost house. The owners further required that the exterior design be "clean and simple but not modernistic—above all that it be in harmony with the hills and big firs of Oregon." The first requirements were met by a U-shaped plan, placed well forward on the lot; soil excavated from the garden in back was used for the terrace along the front. The house is wood frame construction, with an exterior surfacing of split tile veneer around the entrance and spruce siding elsewhere. Cedar shingles are used on the roof, which is framed to permit the wide overhangs so necessary for the climate with heavy rainfall. Heating is by forced air, gas-fired; gas is also used for cooking, refrigeration, and hot water. Specially designed wood casements are used throughout.


Bear Photo Service

View from street



Plot and floor plan

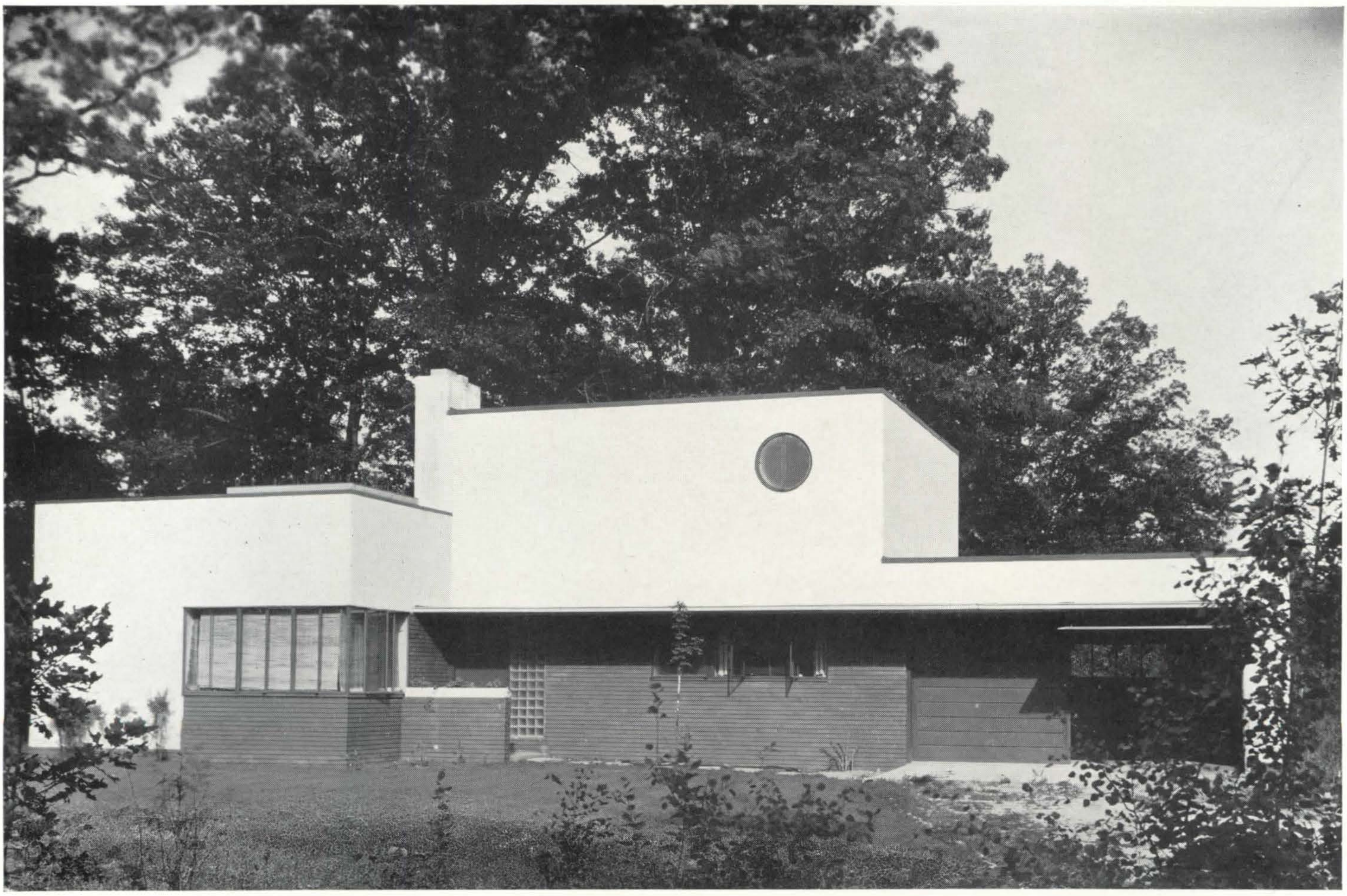
Photos by Boychuk

1. 

2. 

Living areas in small houses seldom have the dignity and spaciousness shown here—achieved largely by segregation of carefully designed furnishings according to function. The "footstool" extension of the low sofa doubles seating capacity, provides for flexibility.

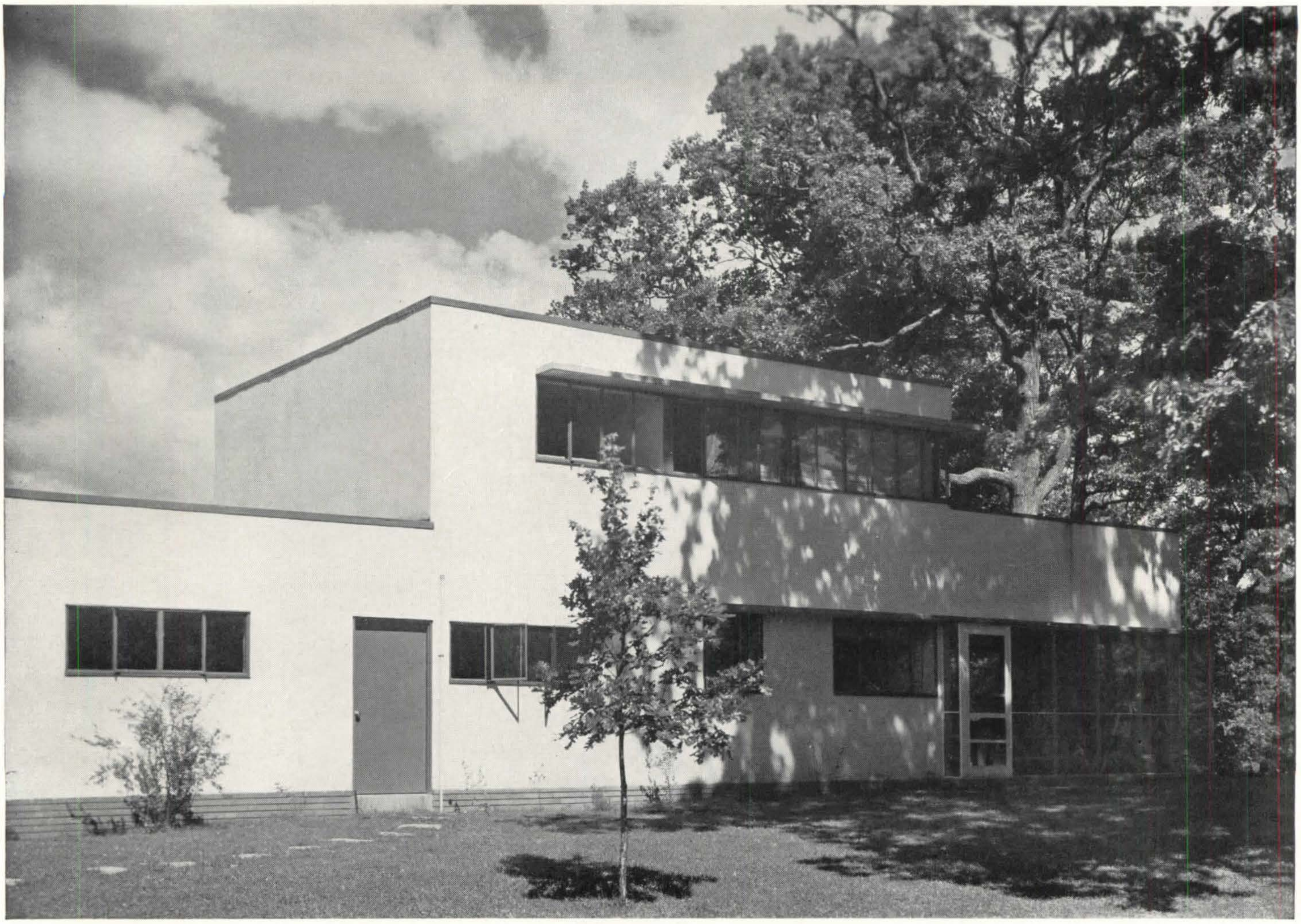
DETROIT, MICH.: FIREPROOF SPACE ACHIEVED AT LOW COST



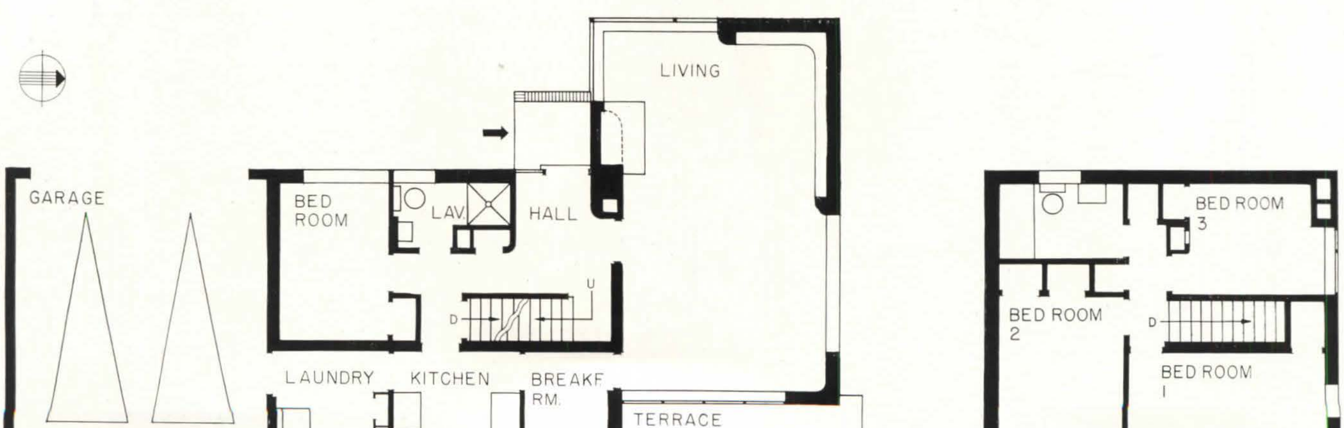
LYNDON and SMITH, Architects

JONATHAN TAYLOR, Associate

LOCATED on a generous plot of ground in the Franklin Hills community 15 miles northwest of Detroit, is this new residence for Mr. and Mrs. Walter Kasten. Aside from its general design, it is notable for being at once largely fire-proof and fairly large (four bedrooms, 2 car garage, laundry) for a total cost of only $12,000. Although the street front (above) is formalized and uncompromising, its general form springs from the functional articulation of internal units (see plans, next page). All bearing walls are of cinder block; floors and roofs are framed with precast concrete joist supporting concrete slabs. Surfacing of exterior walls is in white stucco and red brick. Roofs are built-up composition, with copper flashing. All exterior painted surfaces are red. A panel of glass block lights the entrance hall.

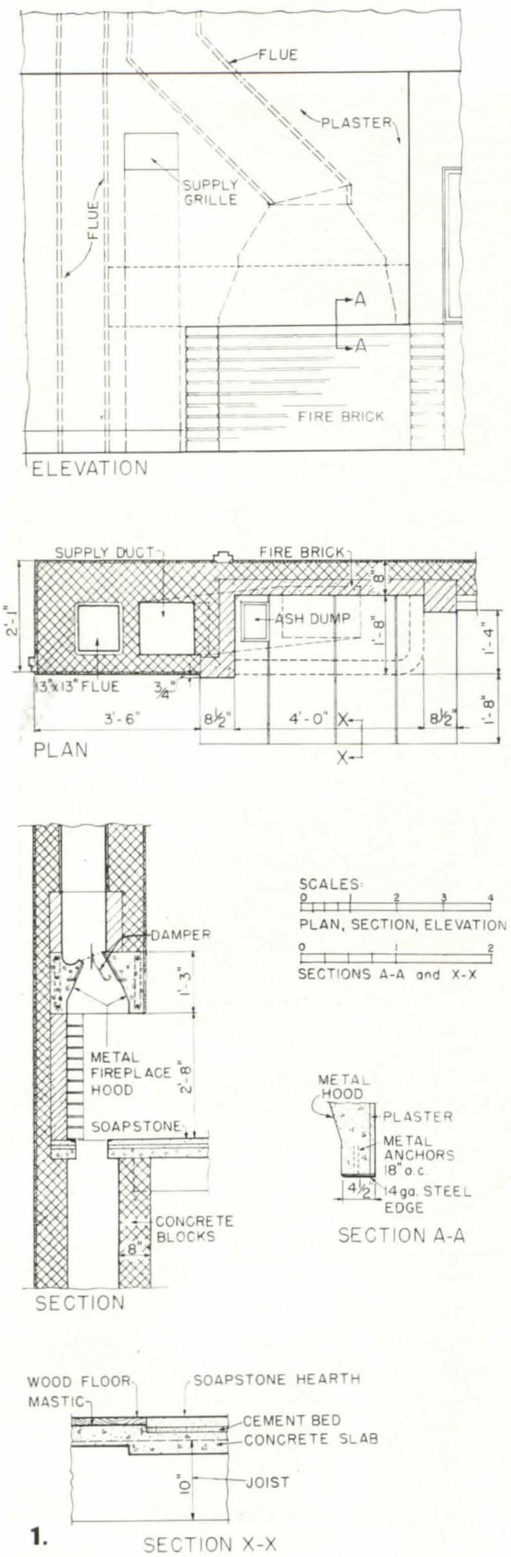


View from garden



First floor

Second floor



1.

2.

Here again living and dining areas have been combined into one room (3). The design and construction of the fireplace (1 and 2) are both simple and efficient—not always the case in such variations from normal fireplace construction.

3.

GREAT NECK, L. I.; SMALL HOUSE BOASTS COMPACT PLANNING

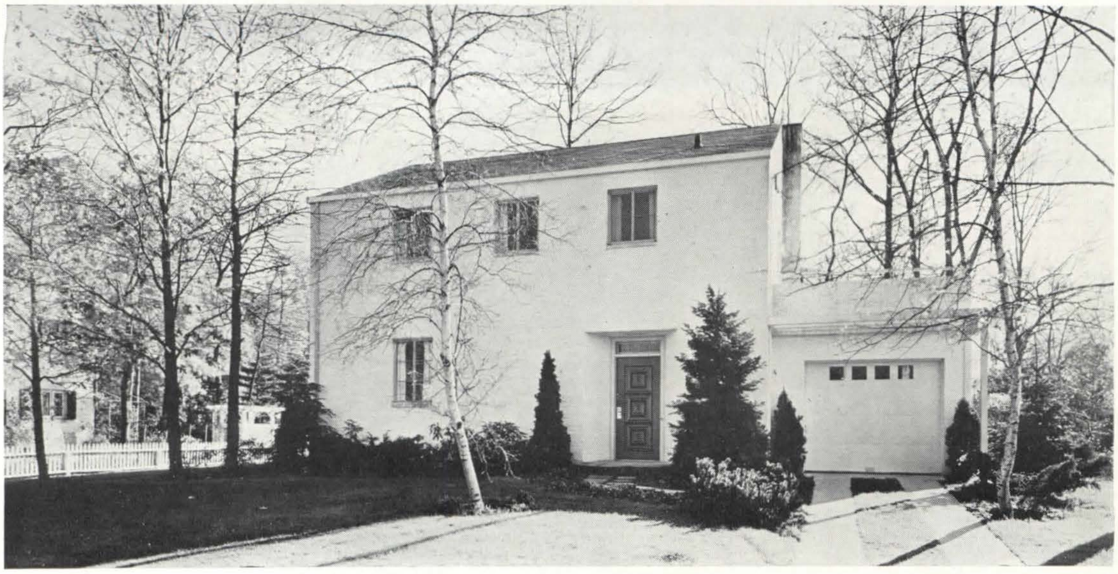
Photos by Ben Schnall

View from garden

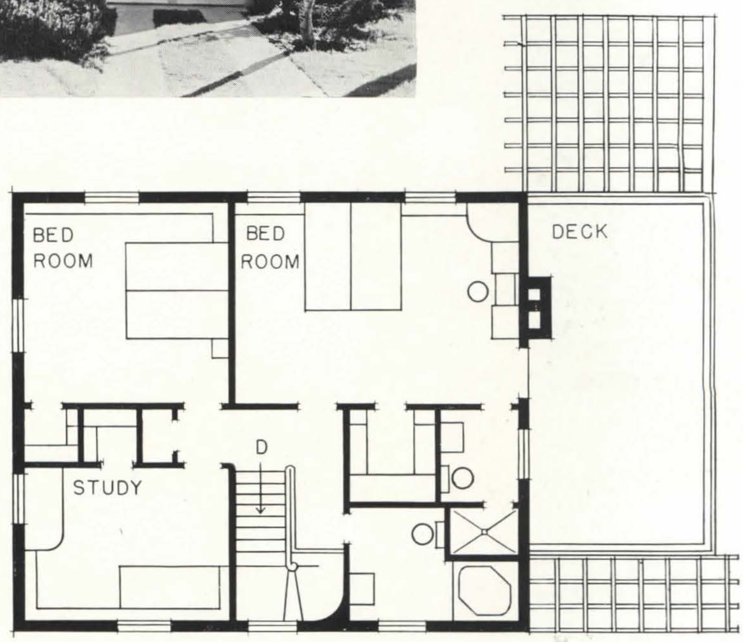
Service entrance

DANIEL SCHWARTZMAN, Designer

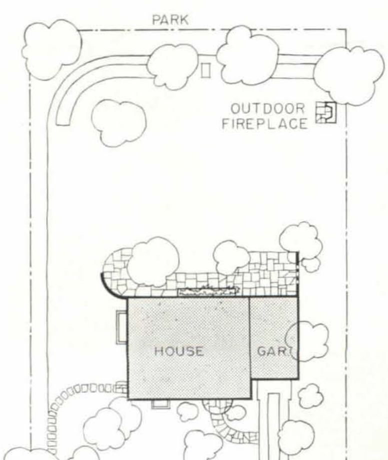
HAPPY COINCIDENCE of a plot whose street frontage was to the north enabled the designer to organize all the major living areas of this small house at Great Neck, Long Island, so that they have both southern and garden exposure. This advantage was still further exploited by the terrace, with wing walls enclosing it. Inside and out, the house is distinguished by a simplicity and freedom from detail which adds considerably to its scale. In plan, the concentration of all service areas along the north (street) front makes for efficient operation as well as material reducing the installation costs of the sanitary system. In most of the rooms there is a considerable use of built-in equipment, inexpensive but space-saving.



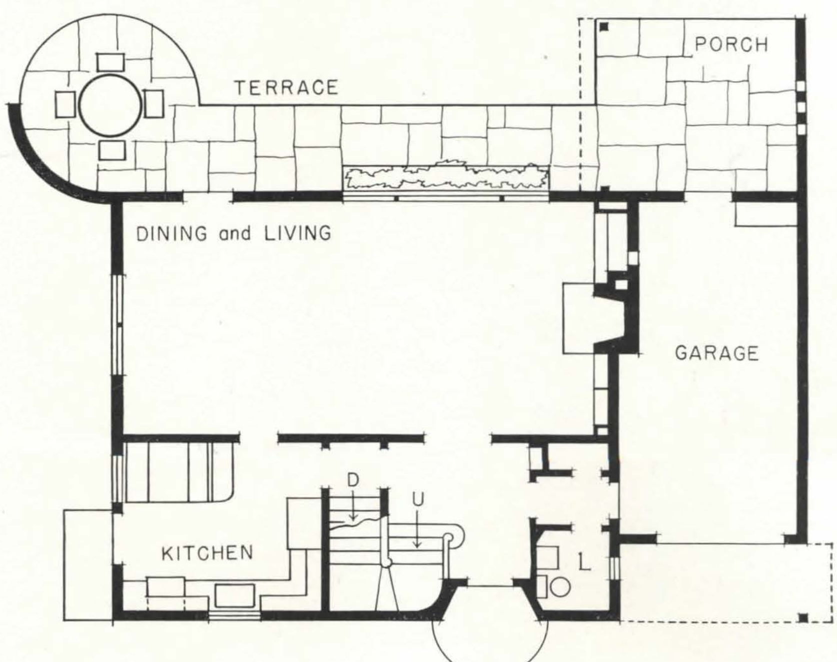
The street front of the house is simple, chief emphasis being on the entrance door. Here, because of the plan of stair and lavatory, a deep splayed reveal without sacrifice of interior space was possible.



Second floor



Plot plan



First floor

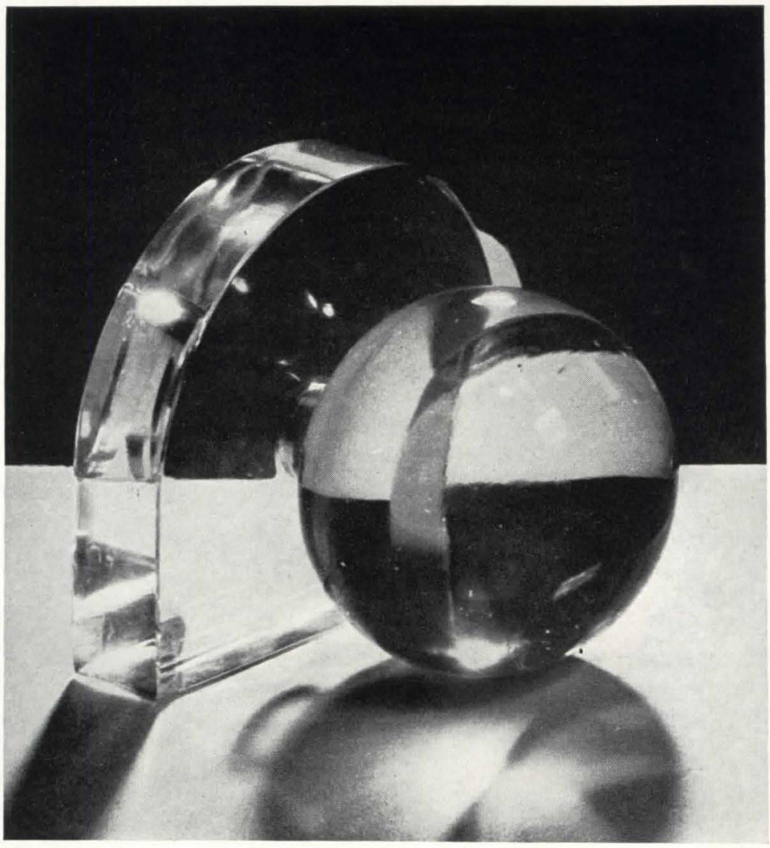
Photos by Ben Schall

1.

2.

Spaciousness is again achieved by good organization of wall space and openings, by careful arrangement of furnishings and equipment. Note relation of fireplace group, piano, and dining.

DESIGN TRENDS



Courtesy Steuben Glass, Inc.

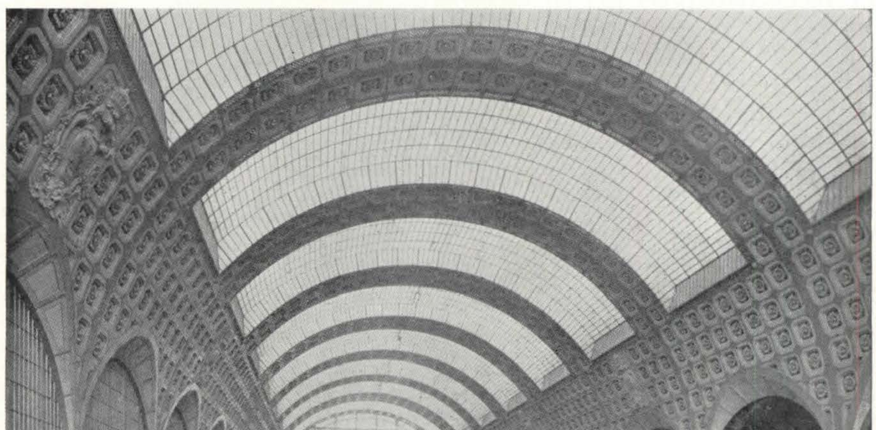
GLASS...Structural Material of Tomorrow

ARCHITECTURAL RECORD
COMBINED WITH
AMERICAN ARCHITECT AND ARCHITECTURE

GLASS . . .

Fig. 1. Interior of Polivka's dome for the Czech Pavilion, Paris, 1937. With a 50-ft. diameter and an over all thickness of only 3 1/5 in., this dome was built in place on special forms. **Figs. 9 and 10 show similar construction.**

The 39 years between Laloux's vault and Polivka's dome have shown that there is a point beyond which glass must either become simply a surfacing material supported by the skeleton (as in greenhouses) or an integral part of the structural system itself (as in Polivka's dome, Figs. 7, 8 and 16).



From "Glass" by Raymond McGrath and A. C. Frost

Fig. 2. Architect M. V. Laloux's Orleans Station in Paris, begun in 1898.

RUCTURAL MATERIAL OF TOMORROW

By Dr. JAROSLAV POLIVKA

Each building material has its own inherent and special potentialities; and each has its limitations. Recognizing this, industry is constantly at work in an effort to isolate the potentialities of each and to employ them (singly or in combination) in new, specialized forms for specialized performance. Dr. Polivka's paper is in line with this trend. He points to a hitherto neglected potentiality of glass; isolates and defines it; and outlines several methods whereby it may be brilliantly exploited. Subsequent issues will bring similar studies of other building materials.

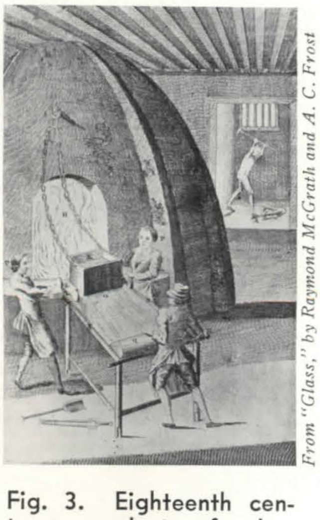
FOR CENTURIES glass has held a peculiarly fortunate position among building materials. No material has seen a longer, more steadily expanding and more multiform employment in building design. Yet the very fact that its use has always been intimately connected with problems of light control has served to somewhat obscure its potentialities in another field—that of load bearing. It is of course true that America has seen an extensive development of glass bricks, tiles, and prisms in the last decade. But it is likewise true that such units are usually combined with steel and concrete into building elements whose final strength is *much lower than that of any of its constituent materials!* While such strengths are quite adequate for certain applications—partitions, curtain walls, etc.—it is apparent that they seriously limit the really wide use of glass as a structural material.

But such uses of glass scarcely begin to exploit its inherent potentialities. Modern building design requires that the use of glass shall not be limited to mere illumination. On the contrary, new problems have arisen which include economic heat insulation, prevention of noise and glare, satisfactory selection and diffusion of light for greater human efficiency, regulation of the various characteristics of light itself. But as these problems are solved, and the relative quantity of glass in a given structure increases, new problems arise—*structural limitations.* In Laloux's station (Fig. 2) such limitations are already apparent, and these must in turn be solved before the glass areas can be further increased.

The author has recently collaborated in the design of several European buildings where the wide use of glass necessitated an unusually detailed study of its properties and physical characteristics.* These buildings have this in common—large translucent roof and wall areas in which glass is no longer merely a *surfacing material* but an *integral part of the structural assembly, carrying its full share of compressive and tensile loads.* In other words, three excellent materials—glass, steel, and concrete—have been synthesized into a new material which exploits the desirable properties of each.

Such applications as those above required, however, the most intensive research. Not only was it necessary to investigate the mechanical properties of glass and concrete; it was also necessary to design new glass lenses—since size and shape have a decisive effect on strength (Table 3)—as well as new concrete formulas and controlled methods of mixing them. Moreover, very precise control of temperature, light, and sound was important in all these structures. It was necessary to design both the individual glass lenses and the entire roof assemblies for correction of the relatively low insulation values of glass as regards both heat and sound. All of these factors have been satisfactorily met, and the experience seems to justify certain generalizations about the use of glass.

*The elliptical dome of the Sport Theater in Berlin by March; the Czechoslovak Pavilion at the Paris World's Fair in 1937 by J. Krejcar; the Technical Museum in Prague by Babuška; Museum of Arts in Prague by Gočár; the great Hall of the Corn Exchange in Rotterdam by J. F. Staal.



From "Glass," by Raymond McGrath and A. C. Frost

Fig. 3. Eighteenth century woodcut of glass manufacture.

GLASS... Structural Material of Tomorrow

TABLE 1

No.	Material	R	R′
1.	Toughened glass	68,000	14,000
2.	Ordinary moulded glass	34,000	8,400
3.	Steel	6,800	6,800
4.	Wood	5,000	6,000
5.	Vibrated concrete	4,000	400
6.	Ordinary concrete	1,800	180
7.	Brick masonry	140	30

*The figures may vary according to the shape, size and particular composition of a given material, but they illustrate very well the magnitude of efficiency.

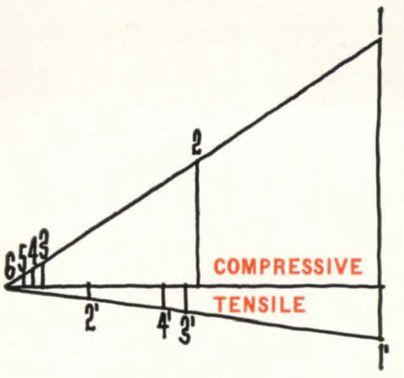


Fig. 4. Tabular and graphic indication of compressive and tensile ratios of efficiency of seven materials. Note that toughened glass (1 and 1′) leads both ratios, while ordinary glass (2) ranks second in R, is only surpassed by steel and wood (3′ and 4′) in R′.

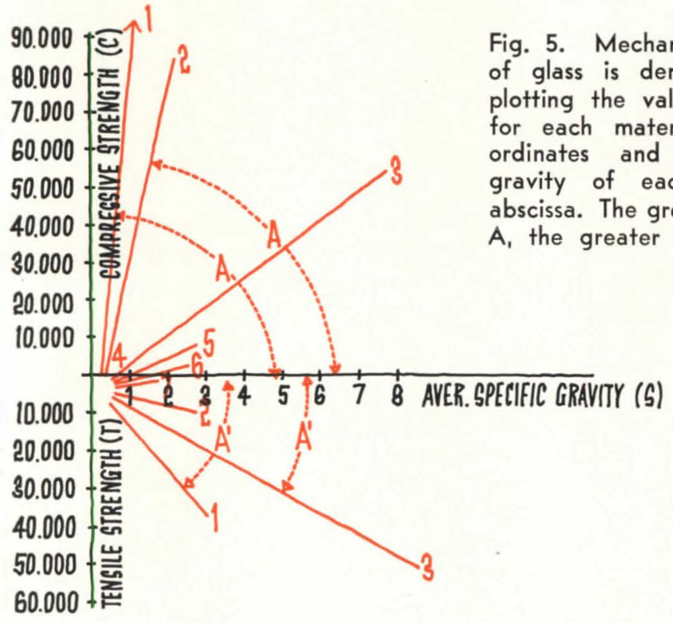


Fig. 5. Mechanical efficiency of glass is demonstrated by plotting the values R and R′ for each material along the ordinates and the specific gravity of each along the abscissa. The greater the angle A, the greater the efficiency.

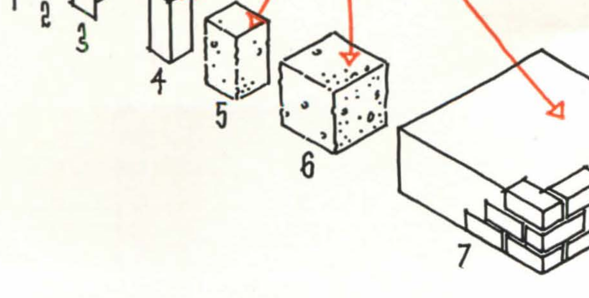


Fig. 6. Economic efficiency of glass is demonstrated by relative size and cost of units required to withstand compressive load of 100 tons (above and Table 2).

1. **Glass is the most efficient structural material in relation to its weight.** The dead weight of a given material is of much greater importance in modern building design than is commonly recognized. The ratio of its ultimate compressive strength to its specific weight can very easily serve as one criterion of efficiency for a given structural material; its ratio of efficiency relative to tensile strength establishes another criterion (Fig. 5).

The combined ratios of compressive and tensile strength relative to weight give a significant index value to *mechanical efficiency*. Generally these average ratios of efficiency are expressed thus:

for compressive strength $R = C/S$
for tensile strength $R^1 = T/S$
where

C = compressive strength
T = tensile strength
S = specific weight of material

Computed on this basis, index values for 7 important structural materials are shown in Fig. 4 and Table 1. As these figures show, the compressive strength of structural glass is extraordinarily high—the ultimate compressive strength of small glass units reaches 65,000—85,000 *lbs./sq. in.*; its ultimate tensile strength is approximately one tenth of that.** Thus glass is theoretically one of the best materials for structural purposes.

2. **Glass is the most economical of incombustible structural materials.** This is demonstrated in a quite general manner by assuming 7 structural units bearing the compressive load of 100 tons—e.g., 7 columns, square in section, 1 ft. high, and of the necessary area for each material. The volume of the material multiplied by its unit price will then indicate the economic efficiency of any material. (Fig. 6 and Table 2.)

TABLE 2

No.	Material	Size	Height	Cost
1.	Toughened glass	2 x 2 in.	1 ft.	$0.80
2.	Moulded glass	3 x 3 in.	1 ft.	.95
3.	Steel (I-beam)	16 x 7 in.	1 ft.	1.35
4.	Wood	6 x 6 in.	1 ft.	.26
5.	Vibrated concrete, incl. forms	10 x 10 in.	1 ft.	1.40
6.	Ordinary concrete	18 x 18 in.	1 ft.	1.60
7.	Brick masonry	50 x 50 in.	1 ft.	9.50

*The figures may vary according to the shape, size, and particular composition of a given material, but they illustrate very well the magnitude of efficiency.
**In very small threads the tensile strength may reach an indicated value of one and one-half million pounds per sq. in. (James Bailey, "An Attempt to Correlate Some Tensile Strength Measurements on Glass," The Glass Industry, 1939, p. 21.)

Photos from Glass, by Raymond McGrath and A. C. Frost

Fig. 7. Using a glass block similar to American ones, architect Roux-Spitz has developed a prefabricated wall unit of greatly increased efficiency in this library at Versailles, France. Here load-bearing properties of glass are in full use.

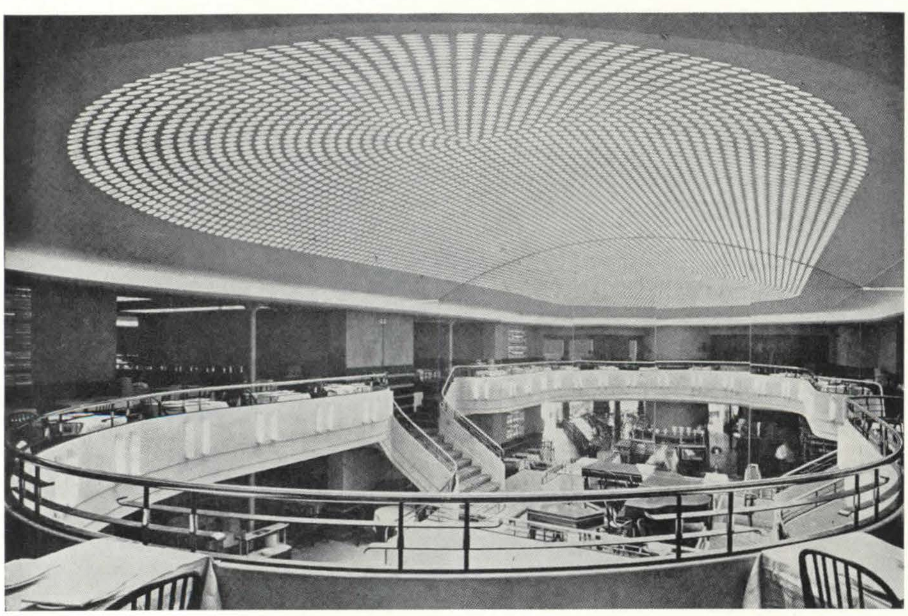


Fig. 8. In this cafe in Paris, architect Roux-Spitz has achieved a thin and shallow translucent dome by means of a system, poured in place and similar to Fig. I.

3. The high strengths of glass can be utilized for bearing structures. The comparative figures of both preceding tables show very clearly that, theoretically at least, glass is a structural material of primary importance. But its utilization in such a manner is an entirely different question. Aside from the inherent chemical and mechanical limitations of any given material, the complexity of modern building eliminates the possibility of monomaterial construction. It is no longer possible to speak of an *ideal all-round* building material. Thus, as regards the structural use of glass, the question is: (1) what forms should it take? (2) with what materials should it be combined? (3) exactly how?

For the preceding calculations we have used the average values of strength on small theoretic samples. Actually, size and shape of the glass unit will be decisive. We find very different values of compressive strength for different forms of the same material:

TABLE 3

Glass prism 2 x 2 x 2 in....	80,000 lbs. per sq. in.
Glass prism 2 x 2 x 10 in...	20,000 " " " "
Hollow glass bricks 8 x 8 x 2 in.	4,700 " " " "
Other hollow glass brick..	1,200 " " " "

The most important aspect of the integration of glass into the structural system is undoubtedly in the search for convenient and economical glass units. In Europe, *blocks* (Fig. 7), *lenses* (Figs. 1, 8, 10) and *prisms* (Fig. 16) are in most common use.

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Steel and concrete, separately or in combination, have hitherto seen the widest use with glass; and they still appear best suited. The exact fashion of their combination, however, is subject to wide variation and gives widely varying results (Figs. 6, 7).

The usual installation of glass panels consists of a plurality of solid or hollow glass building units arranged in superimposed relation, whose joints are filled with mortar. The cement mix usually recommended is one part of Portland cement, one part of lime, and four to six parts of sand—approximately mortars No. 3 and No. 2, U. S. Bureau of Standards (1926). The average compressive strength of these mixes of mortar is:

Mortar No. 2......800 lbs. per sq. in.
Mortar No. 3.....1200 lbs. per sq. in.

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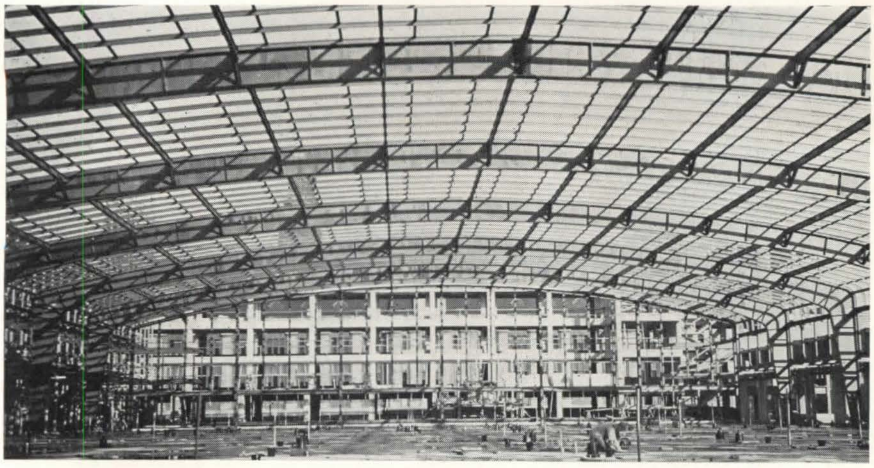

Fig. 9. The "trading floor" of Rotterdam's Corn Exchange, now under construction, will boast the world's largest glass-concrete roof—50,000 sq. ft. and only three inches thick. Here engineer Polivka and architect J. F. Staal had to meet the most rigid requirements in terms of light, sound, and atmospheric control. Precision was guaranteed by prefabricated panels (below) on light steel purlins carried in turn by rigid frames (above).

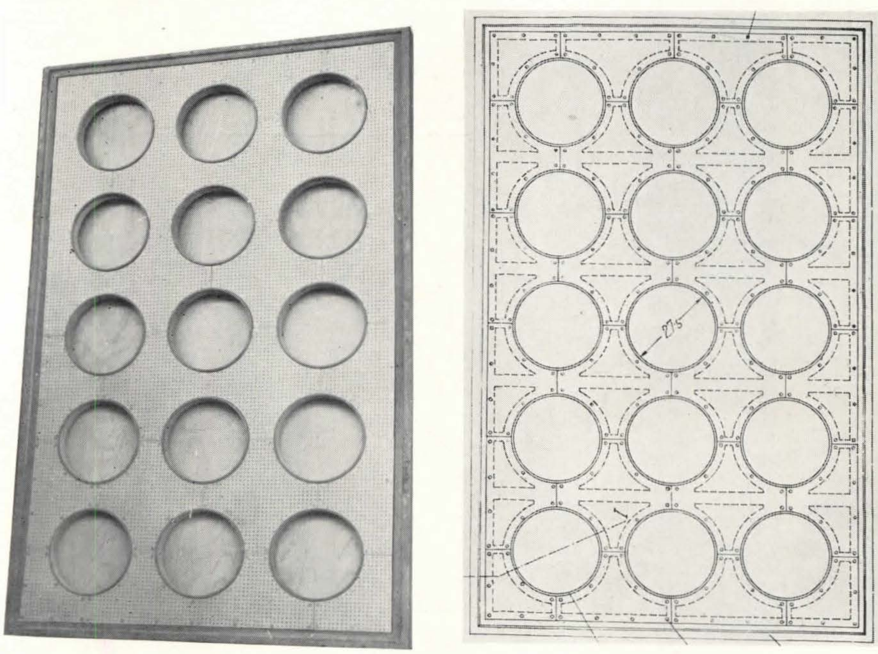

Fig. 10. Plan and photo, typical prefabricated unit ready for installation.

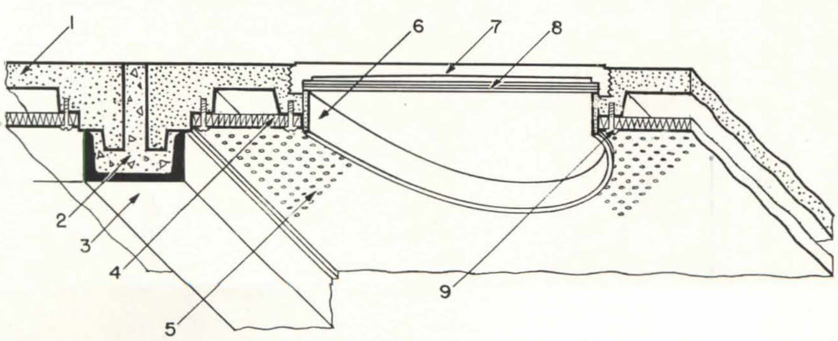

Fig. 11. 1. Precast vibrated concrete. 2. Poured joint. 3. Special steel purlin. 4. Mineral wool backing. 5. Perforated metal sheathed fibre board. 6. Precast asbestos cement frame. 7. Concave pressed glass lens. 8. Double sheet glass with glass silk interlayer. 9. Screws for fixing insulation.

With an average tensile strength of about 80 and 120 lbs. per sq. in., respectively, the average ratios of efficiency R and R′ are:

	R	R′
Mortar No. 2.......	470	47
Mortar No. 3.......	700	70

Such a typical installation, according to one national manufacturer, yields an ultimate compressive strength of only 400 lbs. per sq. in.

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But the characteristics of concrete are likewise subject to wide variation. In the Corn Exchange in Rotterdam (Figs. 10, 11) a special-formula, specially-vibrated concrete (Shockbeton) in precast units achieves an ultimate compressive strength of 11,000 lbs. per sq. in. Concretes of the same general type are in wide use throughout Europe and are, indeed, essential to extensive "glass-crete" construction.

Of course, for the combination of two or more materials into one structural unit, it is essential that they have approximately the same coefficients of linear expansion.* It is often said that large areas of glass and reinforced concrete are impracticable because of different coefficients of expansion and that most cracks and other injuries spring from this fact. This is not quite correct. For example, in a glass-concrete structure—consisting of 12 in. square glass units in reinforced concrete network—the coefficients of expansion are 0.0000086 (glass) and 0.000012 (concrete) for a temperature change of 54° F. Such a small differential weakens the combination only slightly—100 lbs. per sq. in. out of a maximum load bearing capacity of 71,000 lbs. per sq. in. in compression. Whereas the coefficient for a given kind of glass remains almost constant, that of concrete depends largely on its aggregates and mixing. It is quite possible to design a reinforced concrete whose coefficient of expansion is very close to that of glass.

To improve a given structural material it is always necessary to combine it with other materials of higher efficiencies. This has been achieved in the case of reinforced concrete by addition of steel; likewise in brick masonry, where mortar of higher compressive strength than the crushing

*Since most building elements in which glass would be employed—vaults, domes, walls, panels—may be assumed to be of minimum thickness, the third dimension can be ignored.

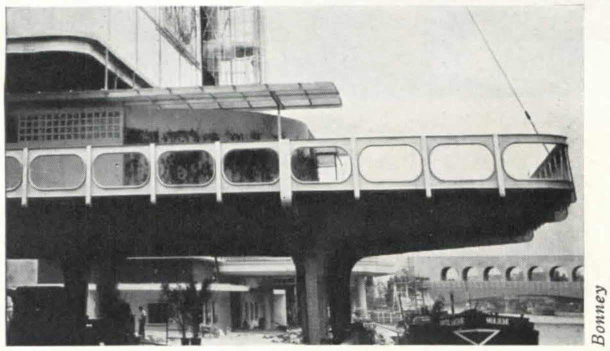


Fig. 12. Direct combination of steel and glass. Czech Pavilion, Paris Exposition, 1937.

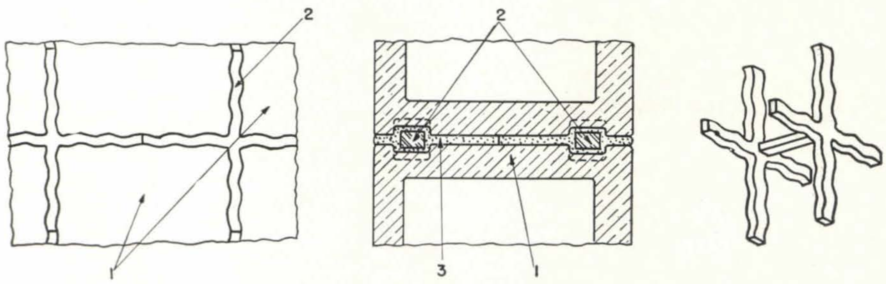
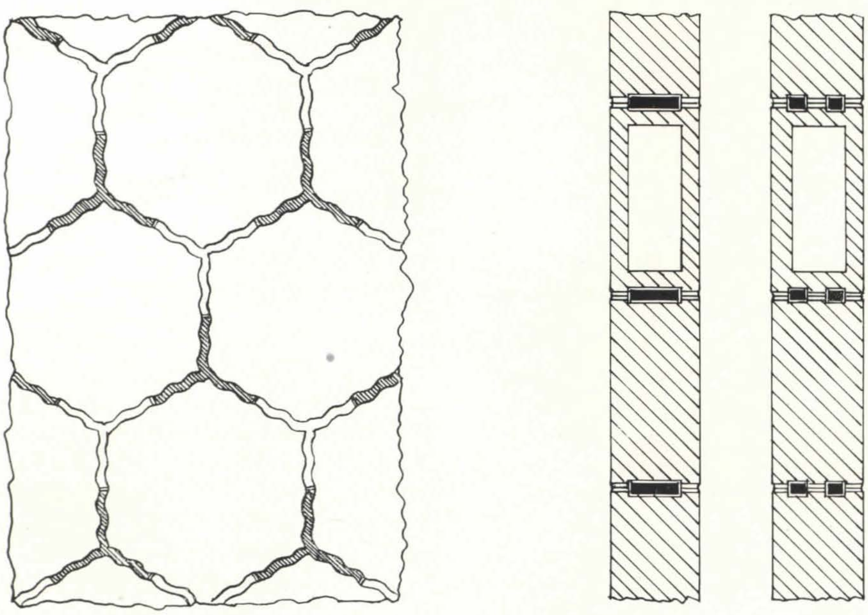


Fig. 13, above, and Fig. 14, below. Two of many variations of Polivka's design principle (patent applied for) employing special glass and steel units in direct combination. Suitable for panel, vault, or dome construction. 1. Special glass unit. 2. Special steel unit. 3. Mastic filler.



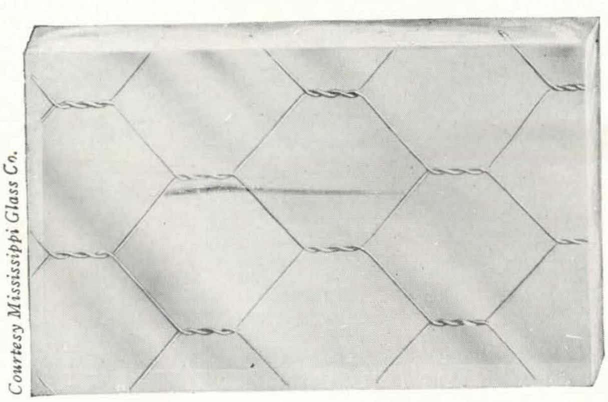


Fig. 15. Wire glass—commonest example of reinforced glass units.

strength of individual common bricks gives greater strength. But in glass brick walls and panels it is usually the other way round. Glass units of exceedingly high strength (Table 3) are laid up in mortar joint beds of relatively low strength. Steel reinforcement only increases the tensile strength of the joint or of the rib, the compressive strength remaining almost the same. This condition can be overcome by redesign of the structural unit to permit prefabrication, using a reinforced concrete of exceedingly high strengths. (Figs. 10, 11.)

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But the employment of any such material as binder—whether mortar alone or in combination with steel reinforcing—has another aspect: by its use, light transmission is greatly reduced. This might often prove a serious disadvantage where maximum transmission of light is desired. Tests have shown that in a panel using ordinary mortar joints of 1/4 in. for binding glass units of 7 3/4 x 4 3/4 x 1 7/8 in., about 5% of light transmission is lost; and where 2 in. reinforced concrete joints are used, 22% light transmission is lost.

By the entire elimination of cement or concrete joints, and by anchoring adjacent glass units together with specially designed elements of steel (or other suitable material), the loss of light could be reduced to only 2 1/2%. Such comparatively thin joining elements would be inserted between adjoining glass units—specially designed to receive them—and anchor the latter in a permanent and effective manner. Such elements (Figs. 13, 14) would take up and distribute the forces arising in the complete glass structure. In this way the direct combination of two very efficient structural materials —glass and steel—is simply and economically achieved. Very strong and stable construction would result.

Another possibility is the direct reinforcement of glass with steel as achieved in wire-glass (Fig. 15). But the effect is quite different and not so efficient structurally; indeed, the bending strength of wire-glass is lower than that of plain glass.

TABLE 4

	Bending strength
Window-glass	9,100 lbs. per sq. in.
Plate glass	8,400 " " " "
Pressed glass	8,000 " " " "
Wire-glass	6,200 " " " "

*For detailed discussion of physical properties of glass, see "Glass," by K. Lonberg-Holm, pp. 327-356, October 1930, ARCH. RECORD.

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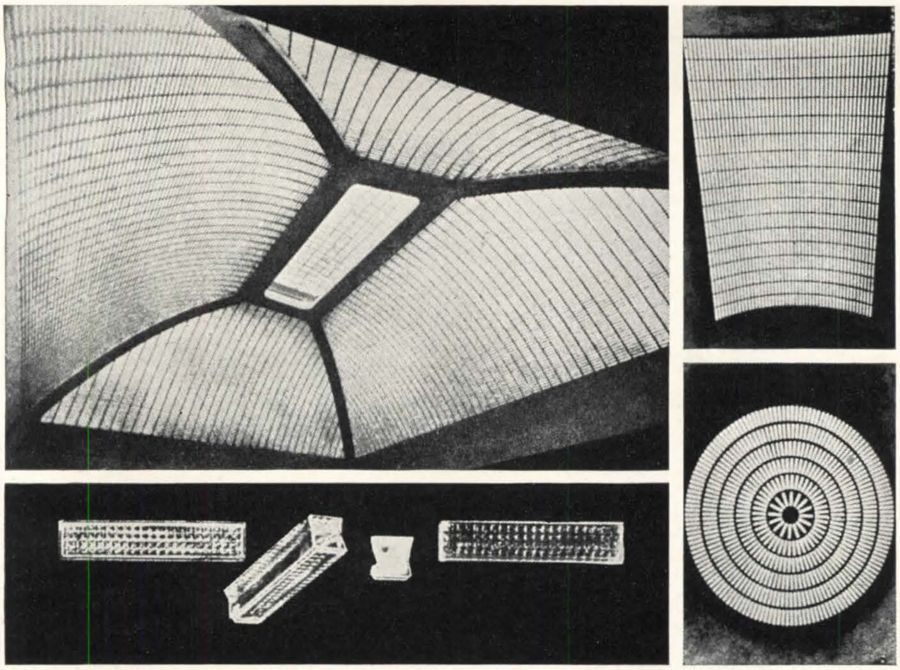


Fig. 16. Although exploiting the high strengths of glass and transmitting a maximum of daylight, domes built of glass prisms have definite limitations where insulation against heat, sound, and precise control of light are concerned.

Information on the characteristics of glass with regard to transmission of light, heat, and sound is too generally available to warrant more than a summary of those factors which bear on the use of glass as a structural material.*

4. Glass can meet any specified requirements in the control of light. The intensity of the light transmitted by structural glass units varies with the thickness of the unit (simple or double-hollow), with quality and color of the glass, and with the face pattern selected. The average percentage of incident light transmitted by the completed glass wall or glass slab naturally depends upon the total light transmitting area.

Light requirements naturally vary from building to building; consequently, a wide variety of individual glass units, as well as various means of incorporating them into the structural assembly, is inevitable. However, European practice has indicated that *control* of the chief factors in illumination—diffusion, refraction, and reflection—is most often efficiently achieved by the use of double walled units with an intermediate membrane of glass silk (Fig. 11). Flexibility is assured since, by different thicknesses and densities in the glass silk, intensity and distribution of light can be accurately controlled. The silk membrane reduces light intensity from 25 to 50%; but improved distribution usually makes up for the loss.

5. Variation as to composition and form of glass units will yield wide range of atmospheric control. Inch for inch, glass is practically as good an insulator against heat as ordinary brickwork.** The hitch lies in the fact that glass is seldom more than ½ in. thick while brickwork is seldom less than 8 in. Here again a double walled unit with an interlayer of glass silk is highly efficient—thermal resistance increasing with the dead air space between walls. Such glass units also greatly reduce "sweating" or condensation on inside surfaces, though its complete elimination necessarily depends on the relative humidity of the inside air.

TABLE 5

	B.Th.U.*
Clear glass 1/12 in.	1.16
Clear glass 1/4 in.	1.10
Clear glass 3/8 in.	1.07
Double clear glass 1/12 in. with 6 in. air space	0.58
Glass panel of hollow bricks	0.56
Double clear glass 1/12 in. with air space of 1 5/8 in.	0.54
"Thermolux"-glass with 1/8 in. interlayer of glass threads	0.74
Double window one sheet clear glass, one plate TX-glass	0.45
Double TX-glass with air space of 6 in.	0.38

* °F

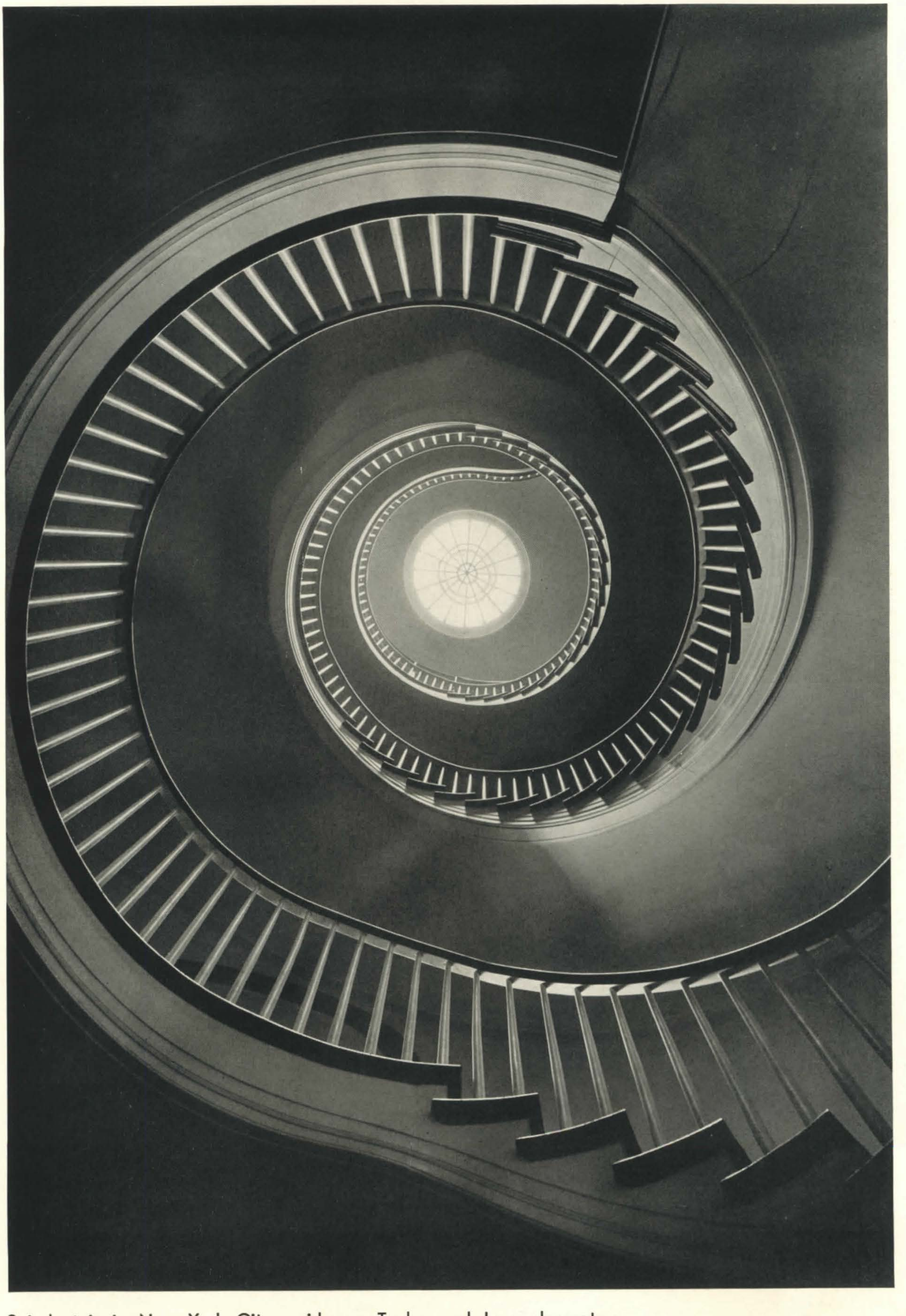
6. Variation as to form and profile will increase sound absorption of glass units as much as 10 times. Glass generally is a very poor absorbent of sound due to its hardness and smooth finish. This factor varies considerably with the size, profile, and rigidity of the unit. Most of the sound striking a glass surface is reflected, while a small portion of the energy, entering the glass, vibrates it and sets up a new source of sound. Increasing the thickness of the glass does not help much—a sheet ½ in. absorbs 33 decibels while a sheet 10 times as thick only absorbs 7 decibels more. The most efficient glass unit from the standpoint of higher sound absorption is again a double walled unit with an air space up to 2 in. (Beyond that width, the value increases less rapidly and finally begins to decrease). An interlayer of glass silk increases its absorptive efficiency about 50% more. A detailed study of specific conditions with appropriate corrections of shape, profile, and size, will yield still further efficiencies. Such a design principle as the above enabled the writer to evolve a glass unit (Fig. 11) whose coefficient of sound absorption was increased from an average of 0.01-0.03 per sq. ft. for various pitch of vibrations to 0.36, as compared with 0.06 for rough finishes gypsum plaster, 0.50 for heavy draped fabrics.

*Most comprehensive book on subject is "Glass" by McGrath and Frost, Architectural Press, London. See also Polivka: "Beton Translucide", Les Etudes des Composes Siliceux, Brussells.

**Thermal conductivity of clear glass ranges from 4.8 to 7.4 B.T.U. per hr. per 1 in. thickness per degree temperature difference; that of brickwork from 4.8 to 5.7 B.T.U.

STAIRWAYS

Gottscho



Spiral stair in New York City residence, Taylor and Low, decorators

STAIRWAYS . . . circular

Gottscho

1

ON THIS PAGE: 1 is a stair in a New York City residence designed by Mott B. Schmidt, architect. 2 is the famous mahogany spiral stair in the century-old Halliday-Cary house at Auburn, Ala., which uses no central post and is entirely self-supporting. 3 is a residence at Grays Lake, Ill., Ralph Huszagh, architect.

ON OPPOSITE PAGE: 4 is in a residence in Winnetka, Ill., Denison B. Hull, architect. 5 is in a Cleveland, Ohio, residence, John S. Kelly, architect. 6 is in a residence at Red Bank, N. J., for which Howard and Frenaye were arcihtects. 7 is in a residence at Highland Park, Ill., William N. Alderman, architect.

Courtesy R. L. Adams, Jr.

2

Hedrich-Blessing

3

4

Hedrich-Blessing

5

Ernest Graham

6

Gottscho

7

Hedrich-Blessing

STAIRWAYS . . . circular

Hedrich-Blessing

8

8 is a concrete and aluminum stair in a residence at Wilmette, Ill., George Fred Keck, architect. 9 is in a residence at Glencoe, Ill., Ralph Huszagh, architect. 10 is in a Brookville, Long Island, residence, Bradley Delehanty, architect; Arundel Clark, Ltd., decorators.

Hedrich-Blessing

9

Gottscho

10

. . . and broken run


Gottscho

11

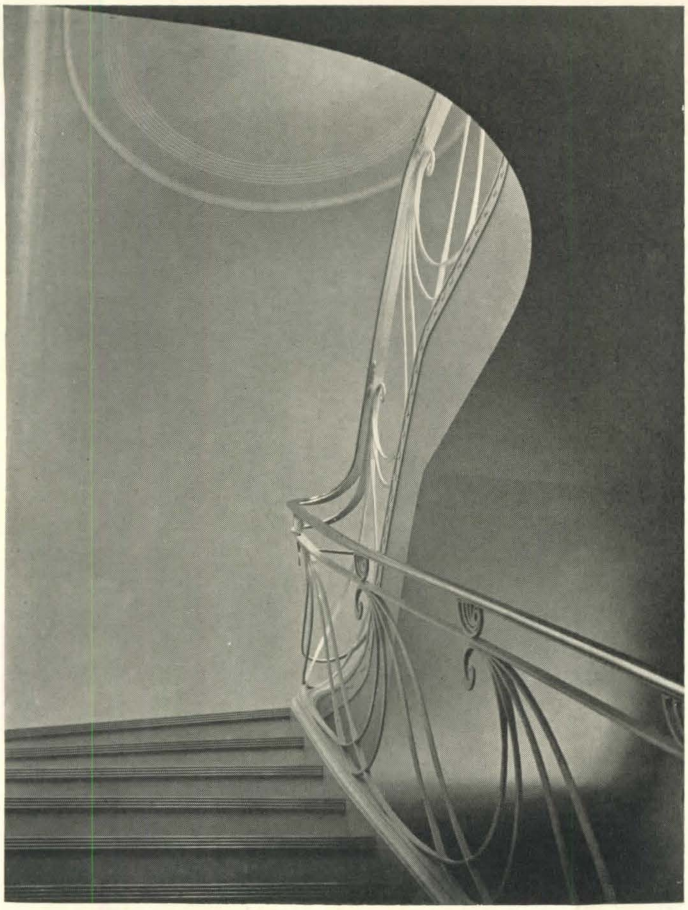
11 is a stair in a residence at Riverdale-on-Hudson, N. Y., Dwight James Baum, architect. 12 is in a Princeton, N. J., residence, H. T. Lindeberg, architect.


Gottscho

12

STAIRWAYS . . . broken run

Gottscho



13

13 is in a residence at Sands Point, Long Island, Treanor and Fatio, architects; Paul McAlister, decorator. 14 is in a residence at Miami Beach., Fla., Robert Law Weed, architect. 15 is in a residence at Wilmette, Ill., Olsen and Urbain, architects; Gertrude Stanton, decorator.

Gottscho

14

Hedrich-Blessing

15

. . . and straight run

Gottscho

16

16 is in a Norfolk, Conn., residence, Taylor and Levi, architects. 17 is in a residence in Chevy Chase Park, Washington, D. C., Dan Kirkhoff, architect. 18 is in a residence at White Plains, N. Y., De Young, Moscowitz and Rosenberg, architects.

Lincoln

7

Lincoln

18

STAIRWAYS . . . straight run

Carl F. Waite

19

Hedrich-Blessing

20

19 is in a residence at Lakewood, Ohio, Copper and Conrad, architects. 20 is in a Winnetka, Ill., residence, White and Weber, architects.

Current Trends of Building Costs

Compiled by Clyde Shute, Manager, Statistical and Research Division, F. W. Dodge Corporation, from data collected by E. H. Boeckh & Associates, Inc.

CURVES INDICATE trend of the combined material and labor costs in the field of residential frame construction. The base line, 100, represents the U. S. average for 1926-1929 for residential frame construction.

Tabular information gives cost index numbers for the nine common classes of construction. The base, 100, in each of the nine classes represents the U. S. average for 1926-1929 for each particular group. The tables show the index numbers for the month for both this year and last.

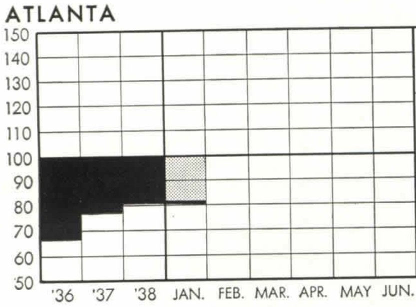
Cost comparisons, as percentage differences for any particular class of construction, are possible between localities or periods within the same city by a simple process of dividing the difference between the two index numbers by one of them. For example: if index for city A is 110 and index for city B is 95 (both indexes for A and B must be for the same class of construction), then costs in A are approximately 16% higher than in B $\left(\frac{110-95}{95} = 0.158.\right)$ Conversely it may be said that costs in B are approximately 14% lower than in A $\left(\frac{110-95}{110} = 0.136.\right)$

Similar cost comparisons, however, cannot be made between different classes of construction since the index numbers for each class of construction relate to a different U. S. average for 1926-1929.

CONSTRUCTION COST INDEX

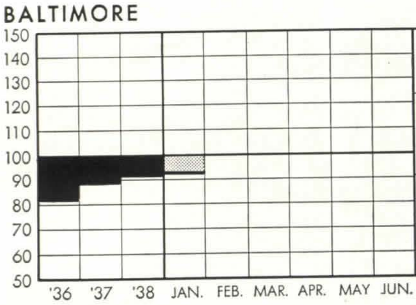
U. S. average, including materials and labor, for 1926 - 1929 equals 100.

ATLANTA



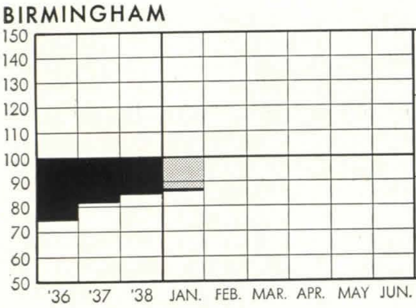
	Jan. '38	Jan. '39
Residences		
Frame	76.4	81.6
Brick	82.5	85.0
Apartments		
Br. & Wood	80.7	85.3
Br. & Conc.	93.7	95.3
Br. & Steel	92.9	95.4
Comm. & Fact.		
Frame	73.9	79.5
Br. & Wood	83.5	87.8
Br. & Conc.	96.4	97.4
Br. & Steel	94.0	96.0

BALTIMORE



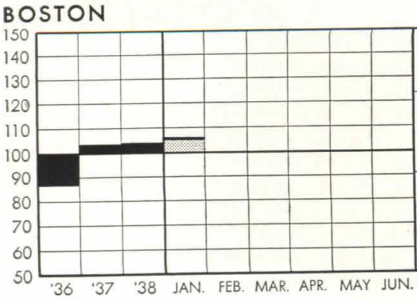
	Jan. '38	Jan. '39
Residences		
Frame	91.6	92.6
Brick	94.5	95.2
Apartments		
Br. & Wood	93.9	94.5
Br. & Conc.	97.9	97.7
Br. & Steel	97.9	97.9
Comm. & Fact.		
Frame	91.3	92.8
Br. & Wood	95.4	95.6
Br. & Conc.	98.4	98.0
Br. & Steel	100.1	98.9

BIRMINGHAM



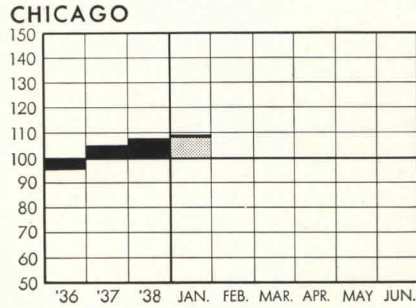
	Jan. '38	Jan. '39
Residences		
Frame	81.7	86.6
Brick	86.5	89.8
Apartments		
Br. & Wood	86.1	90.4
Br. & Conc.	92.4	95.3
Br. & Steel	91.6	95.3
Comm. & Fact.		
Frame	79.1	83.9
Br. & Wood	92.1	94.7
Br. & Conc.	94.5	96.3
Br. & Steel	92.8	95.3

BOSTON



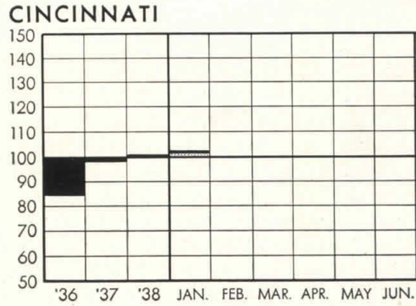
	Jan. '38	Jan. '39
Residences		
Frame	102.1	105.2
Brick	107.8	109.6
Apartments		
Br. & Wood	106.1	109.6
Br. & Conc.	113.2	116.9
Br. & Steel	110.7	114.7
Comm. & Fact.		
Frame	101.9	104.5
Br. & Wood	107.7	111.1
Br. & Conc.	114.9	118.5
Br. & Steel	116.7	119.5

CHICAGO



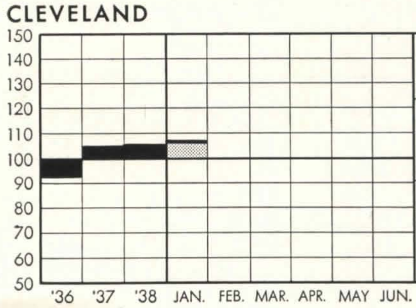
	Jan. '38	Jan. '39
Residences		
Frame	104.0	109.2
Brick	108.6	111.5
Apartments		
Br. & Wood	106.9	110.1
Br. & Conc.	121.6	123.1
Br. & Steel	116.6	118.3
Comm. & Fact.		
Frame	107.7	112.3
Br. & Wood	105.8	108.6
Br. & Conc.	125.4	127.0
Br. & Steel	122.0	122.1

CINCINNATI



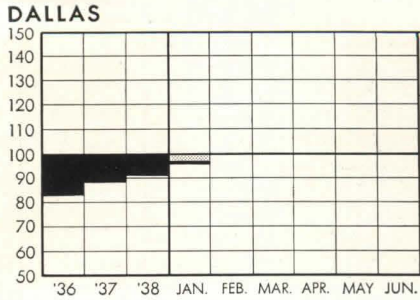
	Jan. '38	Jan. '39
Residences		
Frame	101.1	101.7
Brick	107.7	104.7
Apartments		
Br. & Wood	105.5	104.7
Br. & Conc.	112.1	112.4
Br. & Steel	109.5	109.3
Comm. & Fact.		
Frame	101.0	101.9
Br. & Wood	107.7	105.9
Br. & Conc.	115.8	113.9
Br. & Steel	114.0	113.2

CLEVELAND



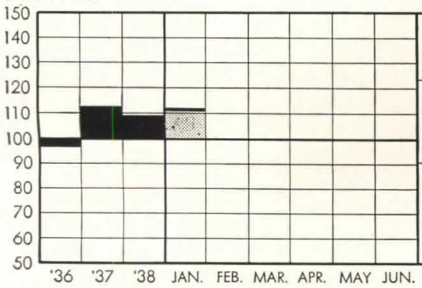
	Jan. '38	Jan. '39
Residences		
Frame	105.6	106.5
Brick	111.9	109.5
Apartments		
Br. & Wood	109.2	109.6
Br. & Conc.	115.0	114.4
Br. & Steel	111.5	112.6
Comm. & Fact.		
Frame	107.1	108.3
Br. & Wood	110.2	109.1
Br. & Conc.	118.8	116.1
Br. & Steel	118.0	117.5

DALLAS



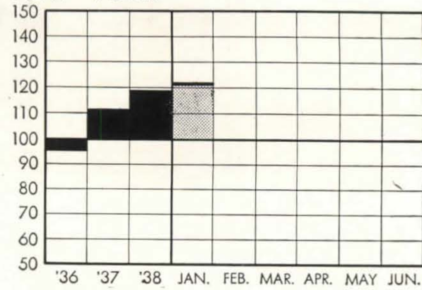
	Jan. '38	Jan. '39
Residences		
Frame	88.8	96.3
Brick	90.9	96.5
Apartments		
Br. & Wood	90.3	97.1
Br. & Conc.	90.9	99.7
Br. & Steel	92.8	100.6
Comm. & Fact.		
Frame	86.0	96.4
Br. & Wood	92.2	96.5
Br. & Conc.	90.4	99.0
Br. & Steel	93.6	102.4

DENVER



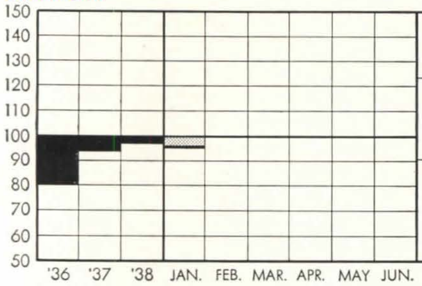
	Jan. '38	Jan. '39
Residences		
Frame	108.5	111.5
Brick	108.7	110.0
Apartments		
Br. & Wood	108.0	110.1
Br. & Conc.	114.3	115.4
Br. & Steel	112.8	113.9
Comm. & Fact.		
Frame	110.7	113.7
Br. & Wood	106.9	108.1
Br. & Conc.	116.0	116.4
Br. & Steel	116.9	116.2

NEW YORK



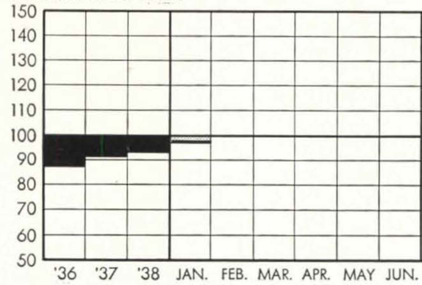
	Jan. '38	Jan. '39
Residences		
Frame	113.3	121.3
Brick	117.1	122.5
Apartments		
Br. & Wood	114.9	121.8
Br. & Conc.	126.3	130.0
Br. & Steel	121.9	125.5
Comm. & Fact.		
Frame	115.1	124.6
Br. & Wood	113.6	119.0
Br. & Conc.	127.9	132.6
Br. & Steel	126.4	129.4

DETROIT



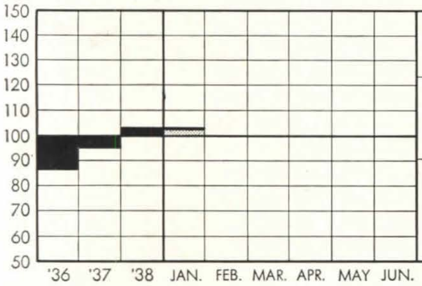
	Jan. '38	Jan. '39
Residences		
Frame	97.8	96.0
Brick	103.1	100.8
Apartments		
Br. & Wood	102.4	101.0
Br. & Conc.	109.0	109.0
Br. & Steel	107.3	107.4
Comm. & Fact.		
Frame	97.9	95.4
Br. & Wood	102.7	103.0
Br. & Conc.	110.9	111.0
Br. & Steel	113.0	111.9

PHILADELPHIA



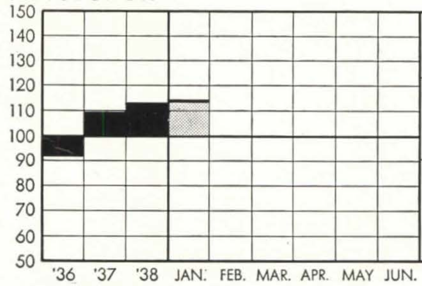
	Jan. '38	Jan. '39
Residences		
Frame	86.8	97.9
Brick	91.6	101.8
Apartments		
Br. & Wood	91.7	101.8
Br. & Conc.	97.4	105.4
Br. & Steel	96.9	103.0
Comm. & Fact.		
Frame	83.3	97.6
Br. & Wood	95.7	103.9
Br. & Conc.	100.2	106.3
Br. & Steel	100.2	104.2

KANSAS CITY



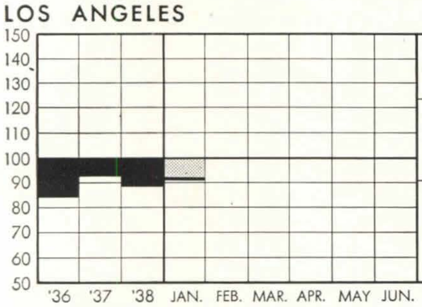
	Jan. '38	Jan. '39
Residences		
Frame	97.0	102.7
Brick	103.5	108.7
Apartments		
Br. & Wood	102.2	108.6
Br. & Conc.	111.1	118.2
Br. & Steel	108.9	115.1
Comm. & Fact.		
Frame	95.8	102.2
Br. & Wood	105.3	112.2
Br. & Conc.	113.7	121.5
Br. & Steel	114.3	119.5

PITTSBURGH



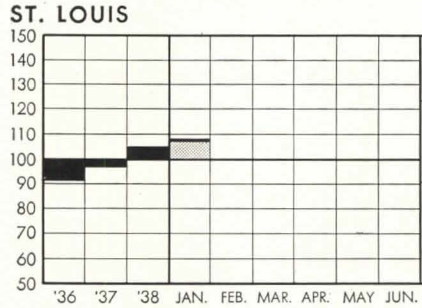
	Jan. '38	Jan. '39
Residences		
Frame	113.4	113.4
Brick	118.4	117.0
Apartments		
Br. & Wood	117.0	115.3
Br. & Conc.	118.4	117.4
Br. & Steel	114.8	114.1
Comm. & Fact.		
Frame	112.6	113.6
Br. & Wood	119.5	116.2
Br. & Conc.	120.3	119.1
Br. & Steel	117.9	117.2

LOS ANGELES



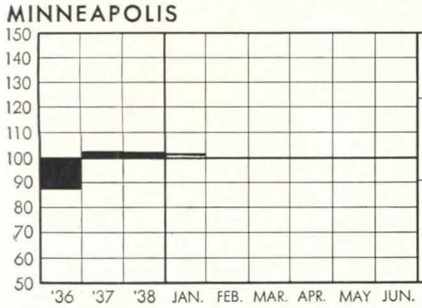
	Jan. '38	Jan. '39
Residences		
Frame	94.9	90.9
Brick	96.2	96.7
Apartments		
Br. & Wood	95.7	96.9
Br. & Conc.	99.3	103.5
Br. & Steel	101.8	104.7
Comm. & Fact.		
Frame	96.1	95.4
Br. & Wood	93.4	96.3
Br. & Conc.	99.0	104.5
Br. & Steel	104.6	106.0

ST. LOUIS



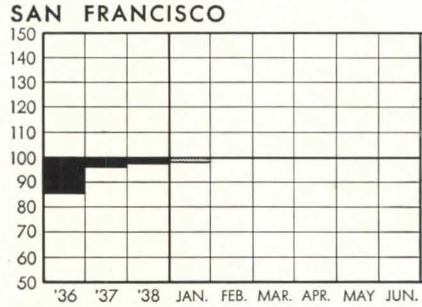
	Jan. '38	Jan. '39
Residences		
Frame	98.6	107.7
Brick	105.3	110.7
Apartments		
Br. & Wood	103.4	110.6
Br. & Conc.	116.2	119.1
Br. & Steel	114.3	117.0
Comm. & Fact.		
Frame	96.6	108.2
Br. & Wood	115.9	110.7
Br. & Conc.	120.4	120.1
Br. & Steel	119.5	120.4

MINNEAPOLIS



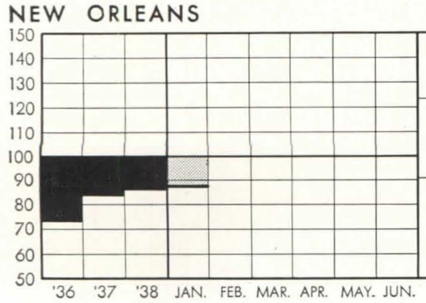
	Jan. '38	Jan. '39
Residences		
Frame	104.5	100.5
Brick	108.0	104.0
Apartments		
Br. & Wood	106.5	103.2
Br. & Conc.	114.3	113.5
Br. & Steel	112.3	110.4
Comm. & Fact.		
Frame	105.9	101.0
Br. & Wood	105.1	102.9
Br. & Conc.	118.0	117.1
Br. & Steel	116.5	114.3

SAN FRANCISCO



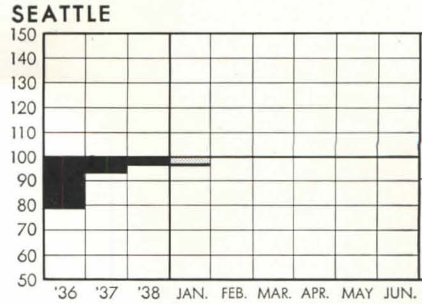
	Jan. '38	Jan. '39
Residences		
Frame	97.7	98.7
Brick	104.9	106.6
Apartments		
Br. & Wood	101.9	103.5
Br. & Conc.	114.6	117.6
Br. & Steel	111.8	114.7
Comm. & Fact.		
Frame	96.1	97.1
Br. & Wood	105.5	107.1
Br. & Conc.	118.7	122.3
Br. & Steel	115.1	117.7

NEW ORLEANS



	Jan. '38	Jan. '39
Residences		
Frame	81.6	87.2
Brick	83.5	88.3
Apartments		
Br. & Wood	83.7	89.4
Br. & Conc.	89.2	93.1
Br. & Steel	92.9	96.5
Comm. & Fact.		
Frame	80.5	85.9
Br. & Wood	84.8	90.0
Br. & Conc.	87.3	92.1
Br. & Steel	94.1	95.8

SEATTLE



	Jan. '38	Jan. '39
Residences		
Frame	94.4	96.3
Brick	102.6	104.1
Apartments		
Br. & Wood	101.2	103.8
Br. & Conc.	118.0	120.1
Br. & Steel	113.3	115.9
Comm. & Fact.		
Frame	91.7	93.9
Br. & Wood	104.9	108.3
Br. & Conc.	124.6	126.4
Br. & Steel	119.7	121.5

Review of New Books

ROMANTICISM AND THE GOTHIC REVIVAL. By Agnes Addison. Richard R. Smith, New York, N. Y., 1938. 152 pages. 6 x 9 in. Price, $2.50.

IN THIS brief but concise review the author traces the rise and decline of the Gothic Revival movement in architecture in France, England, Germany, and the United States.

The author notes that this Romantic Movement was particularly widespread in England where country houses designed in the popular conception of the Gothic style rose on every hand, and "restoration" of Gothic churches became a national pastime.

The book's pages are enlivened by quotations from contemporaneous publications by the large group of architects, writers, and painters who advocated the Romantic revival. Miss Addison says that these writings have been the basic source material not only for architectural studies during the Romantic period but also for present day research in that field. Although the book includes an excellent biblography, it will in itself serve as a valuable guide in selecting secondary works on the Romantic period.

NEW ORLEANS AND ITS ENVIRONS. By Italo William Ricciuti. William Helburn, Inc., New York, N. Y., 1938. With 135 plates of photographs and scale drawings. (Photos by Rudolf Hertzberg). 8¾ x 12¾ in. Price, $10.

A SHORT general description concerning the history of New Orleans and its environs in architecture serves as a preview to this illustrated record on house facades and details from the beginnings of this settlement until the late 1800's. What architectural material has been covered in the review can readily serve as a reference work for architects and draftsmen.

Only subjects of real architectural merit have been included, those of historical, romantic, or literary connections being omitted while concentration was almost entirely on structures of non-public nature.

In order to have easy reference to specific material which might be desired, photographs of building exteriors are separated from various details such as ironwork, doors, fireplaces, etc. The measured drawings are at the end of the book. Details are in chronological sequence as nearly as is possible so that the development and evolution of architecture in New Orleans may be traced. Exterior views of buildings fall into three main groups—The Vieux Carre, The Garden District, and the Plantations. The architectural arrangement is a very obvious development from page to page showing the evidence which established precedence of one building over another.

The Louisiana Division of the Historic American Building Survey aided the author of the book by making available measured drawings taken from valuable material they had gathered, and presented through the courtesy of Mr. Richard Koch, director of the project. Mr. Nathaniel C. Curtis' book, *New Orleans, Its Old Houses, Shops, and Public Buildings* lent valuable ideas, as well as Mr. Stanley C. Arthur's recent book on New Orleans dealing with the "French Quarter."

The two opening pages contain a map of the districts discussed as well as street and building locations in the old city of New Orleans which may be used as a reference in determining the location of the various architectural subjects discussed and illustrated in the book.

PLANTATIONS OF THE CAROLINA LOW COUNTRY. By Samuel Gaillard Stoney; edited by Albert Simons and Samuel Lapham, Jr. Introduction by John Mead Howells. Carolina Art Association, Charleston, S. C., 1938. Text and photographs. 244 pages. 10 x 13 in. Price, $7.

FORTY-FIVE South Carolina plantations and ten parish churches are described and illustrated in this handsome volume just published by the Carolina Art Association. There are 148 pages of plates, including photographs of exteriors, interior details, and gardens, together with plans and detail drawings. Historical and descriptive data on each building are given in the text. A very useful map showing the locations of all the plantations with reference to the city of Charleston forms the flyleaf of the book. Format, typography, and presswork all contribute to a handsome presentation of exceedingly valuable architectural and historical material.

The text consists of an introduction by John Mead Howells, an essay on The Country and the People, by Samuel Gaillard Stoney, and a brief statement on Architectural Trends introducing the descriptions of the individual buildings. Through these, the development of the plantation system and the cultural influences of the eighteenth century are related to the characteristic architecture of the plantation country. The development through the colonial and provincial periods into the republican era are traced, and this chronological order is followed in the arrangement of descriptions and illustrations.

This book is the result of some eleven years of work on the part of the author, the editors, members of the Historical Society, and present plantation owners, aided and encouraged by financial assistance given by Mr. and Mrs. William Emerson of Boston and later by the American Council of Learned Societies. The photographs are by Ben Judah Lubschez and Frances Benjamin Johnston.

HISTORY OF SPANISH ARCHITECTURE. By Bernard Bevan. Charles Scribner's Sons, New York City. 164 illustrations, 70 plans and drawings, 2 maps. 172 pages. 6¼ x 9¼ in. Price, $7.50.

AS THE first general survey of Spanish architecture since the 1840's, this book is noteworthy. But its value lies also in the excellent collection of photographs of infrequently visited architectural monuments, many of which, by reason of their remote locations, escaped unharmed the assaults of Medieval warfare. That such escape may no longer be possible adds materially to the value and timeliness of the volume. Organized on the basis of chronological sequence of influences, Mr. Bevan's book is a comprehensive, readable record of the extraordinary diversity of Spain's architecture.

(*Continued on page* 128)

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MINNEAPOLIS-HONEYWELL *Gradutrol System*

BUILDING TYPES

Courtesy Dept. of Education, Baltimore, Md.

ELEMENTARY SCHOOL BUILDINGS

FORTHCOMING ISSUES: 1939—March, Housing Developments; April, Retail Stores; May, Houses; June, Factories; July, Houses; August, High Schools. PRECEDING ISSUES: 1939-1938—January, Restaurants; December, Office Buildings; November, Houses ($25,000 and Up); October, Houses ($15,000 to $25,000); September, Apartments; August, Hospitals.

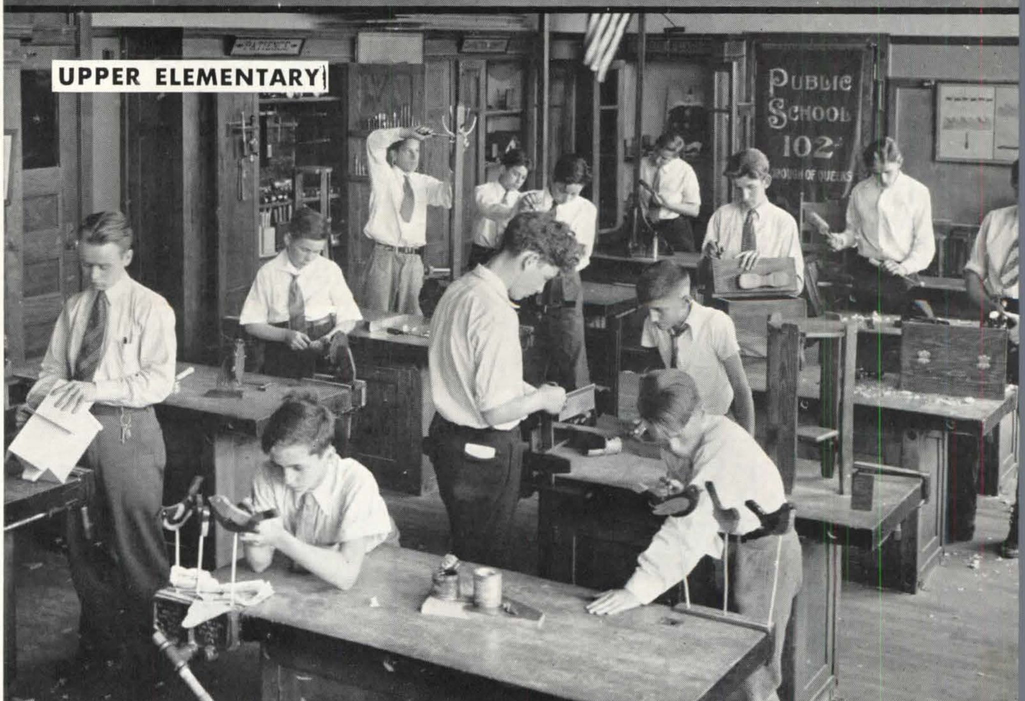
ARCHITECTURAL RECORD

COMBINED WITH

AMERICAN ARCHITECT AND ARCHITECTURE

W. A. Shum

Courtesy San Francisco Bd. of Educ.



Courtesy New York City Bd. of Educ.

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Many of the illustrations in this study were obtained through the courtesy of the editors of "90,000 Children in School", a report of the Buffalo, N. Y., Board of Education; "All the Children", a report of the New York City Board of Education, and similar reports from the Boards of Education of the following cities: Springfield, Mo.; San Francisco, Cal.; Los Angeles, Cal.; New Orleans, La.; Detroit, Mich.

ELEMENTARY PUBLIC SCHOOL DESIGN

CURRENT TRENDS OF EDUCATIONAL PROGRAMS—by N. L. Engelhardt, Jr., Research Assistant, Department of Educational Research, Teachers' College, Columbia University

PUBLIC EDUCATION in the United States is broadening its scope of activities. The demand for greater educational opportunities for the young and old as well as the changing emphasis in the teaching of youth is creating problems in administration, curriculum, and building design which are without precedent. Fundamental changes in home life and the recognition of the desirability of early childhood education have stimulated demands for nursery schools. The need for retraining to free adults from obsolete occupations, the cultural and social needs of adults, and the importance of understanding civic responsibilities have brought about the growth of adult educational programs under many agencies of the states and federal government.

Within both elementary and high schools the formal education program is changing rapidly from the rigid and standardized academic curriculum of earlier decades to one that is rich, varied, and dynamic to meet the needs of our newer and more complex society. These changes in the scope of education and the content of the curriculum will, in all probability, continue to grow, although the impact of new ideas and new conceptions of the role of the school in our society may lend still different weight to the several activities within the broad area of education.

The housing of these new activities becomes a complex problem. The changes in education are taking place so rapidly that many of our buildings constructed only a few years ago are obsolete today. The program for which a building is designed tomorrow may not even remotely resemble the activities that will be housed in the building twenty, or even ten years hence. Therefore, a major objective in school plant planning stated by many educators is flexibility of structure. They say provision should be made for the shifting of interior partitions, changing sizes and shapes of rooms, expanding the building, or reducing its size as poulation decreases. No longer can spaces be thought of in terms of units of a desk and chair. They must be conceived in terms of activities.

Consideration may well be given to the possibility of constructing buildings inexpensively to facilitate abandonment of educationally obsolete structures without loss of capital outlay. Monumental school buildings have no place in modern education programs, nor are they practical economically in this age of decreasing elementary school population. The extension of school building needs and the demands for a maximum of flexibility in design have led in some instances to the construction of small, one-story units as opposed to the large three- or four-story structure.

Factors influencing curriculum

Several factors may be indicated that are at present vitally conditioning the school curriculum. The influence of the school of thought that is so succinctly expressed by John Dewey's phrase "learning is doing" cannot be underestimated. There is a wealth of significant implications in those few words. Extensive research in the field of child psychology has indicated the tremendous influence of a favorable environment on the young child. Furthermore, indications are that the greater part of a child's personality is relatively fixed by the age of six.

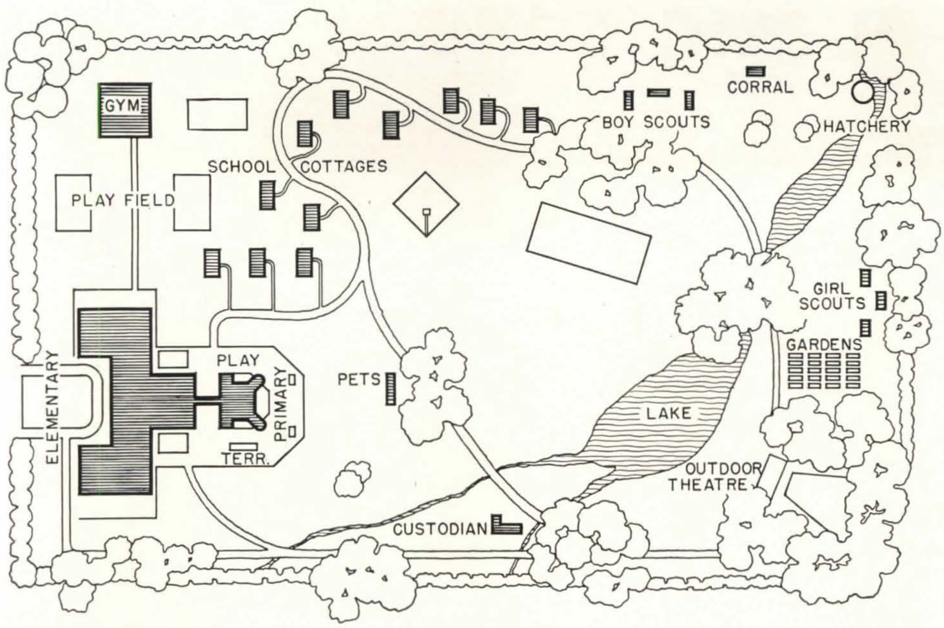
Such conclusions from scientific research, not available in previous decades, place new responsibilities on the school and society. The development of nursery schools and the bridging of the gap between schools and community life become of increasing significance and importance. Education is no longer merely thought of by educators as preparation for adult life. It is actually the participation in community life at varying stages of maturity. Babies, children, youths, adults, and parents turn to the schools for aid and guidance throughout life. They come to school together to learn to live together in a complex civilization. The school is the common meeting place rather than a place for segregation.

The implications for building design are far-reaching. Instead of designing for one age or type of individual, the designer must create in terms of all ages and must make provisions for children and their parents within one educational center.

Contemporary trends in curriculum emphasize the physical, mental, and emotional development of the child. This emphasis has required a shift from the recitation type of program to an activity curriculum. The shift has already been made in many schools throughout the country and will undoubtedly be universally accepted within a very few years. Activities are being organized about broad study units such as food, shelter, clothing, transportation, and man's relationship to his environment. Subjects such as English, arithmetic, spelling, geography, and the like are integrated with these broad units in such a manner that the application of subject matter is at once apparent to the child.

This new program requires spaces for art, drama, music, dance, and literature. Provision must be made for exploratory work in the fields of industrial and home arts. Recreation and health programs require larger play spaces, clinics, and health rooms. Club activities—previously treated as extra-curricular—such as school newspapers, science clubs, and the like, function today as an integral part of the curriculum and require housing within the school plant.

These changes have already been made in many communities. Still more cities are in the process of accepting them. In designing new buildings the expectation should be that the changes will come about long before the building has become too old for service.



A suggested future type of elementary school compound, developed by Columbia University. Within the primary unit are contained both nursery and kindergarten-primary areas. Gymnasium, boy and girl scouts' buildings, and open-air theater suggest possible coordination of the compound with various community interests.

Obsolescence may be prevented to a large extent by so doing.

Organization of the elementary school

A decade ago the elementary school was organized by grades 1 to 6 with a kindergarten. Promotion from one grade to another was based on the achievement of certain skills commonly associated with each grade. In recent years, however, the whole question of marking, promotion, and differentiation by grades has undergone searching analysis by the educational profession. The result of this study has been to recommend differentiation in the elementary school on the basis of age rather than upon achievement of skills commonly required. This means that in all probability children will move through the elementary school with others of their own age and will not be held back merely because they have not yet attained the skills of their fellow pupils.

This condition has led to the reconception of the elementary school in terms of age groups. These groups are today thought of as first, the nursery school for children 2 to 5 years of age, second, the kindergarten-primary unit for children 6 to 8 years of age, and third, the upper elementary unit for children 9 to 12 or 13 years of age. Up to the present time it has been recommended that these units be housed in one building or group of buildings with central administration.

Nursery schools

Nursery schools are finding their way into the public school system on the basis of the effects of a favorable environment upon children. Children who have had nursery school training were found, upon entering kindergarten, to have improved motor control, accelerated mental growth, independence of personality, and improved health when compared with children who did not have such previous education. Nursery schools are of considerable value to the working mother as well as to those mothers whose modern life demands time for activities outside the home. These schools give to children living in slum areas some respite from the misery which generally surrounds them at home. Finally, nursery schools are being used as training ground for parents in the care and education of their children.

The program of the nursery school is largely that of supervised play. Children learn to play together, control their bodies, dress themselves, and extend their contacts far beyond the point which home life alone permits. The length of the program varies. Slightly more than one fourth of the nursery schools have half day programs three hours in length. The remainder range from three to twelve hours in length with the average at approximately five to eight hours. The tendency in the public nursery schools is toward the maintenance of a longer school day.

The kindergarten-primary unit

The tendency is toward no noticeable break between kindergarten and primary grades. Kindergarten-primary building units have been established in many elementary schools with three large play-work rooms closely associated. The program for children aged 6 to 8 consists largely of play, construction, music, and the like. The formal classroom with rows of desks and chairs has completely disappeared in the buildings of late design.

The upper elementary unit

Children from 9 to 12 years of age take on more searching inquiries and broader investigations of human knowledge. The curriculum becomes wide and flexible during these years permitting children to reach out and participate in many phases of activity. Music and art must be provided for in every room. Opportunities for using hands in woodwork, dramatics, home arts, clay modeling, and the like are important. There is also a breaking away from the home room to more general activities such as gymnasiums, assembly rooms, club and newspaper rooms. Out-of-door spaces must be larger and provision made for group activities.

Thus, the elementary school divides rather simply into three major sections. The nursery unit and the kindergarten-primary unit, are to a large extent independent of the general facilities required in the upper elementary unit. Each of the first two units is largely self contained with its own play work room and out-of-doors space. The latter unit is provided with more extensive facilities which can be used in common by all upper age groups.

Bibliography

Forest, Isle, *The School for the Child from Two to Eight,* New York, Ginn and Co., 1935, 286 pages.

Hildreth, Gertrude, *Learning the Three R's, a Modern Interpretation,* Minneapolis, Educational Publishers, Inc., 1936, 824 pages.

Johnson, Harriet, *School Begins at Two,* New York, New Republic, Inc., 1936, 224 pages.

McGaughy, J. R., *An Evaluation of the Elementary School,* Indianapolis, The Bobbs-Merrill Co., 1937, 421 pages.

Progressive Education Association, *Creative Expression, The Development of Children in Art, Music, Literature and Dramatics.* Edited by Gertrude Hartmann and Ann Shumaker. New York, John Day Co., 1932.

Wrightstone, J. Wayne, *Appraisal of Newer Elementary School Practices,* New York, Bureau of Publications, Teachers College, Columbia University, 1938, 221 pages.

NURSERY SCHOOLS

Courtesy New York City Bd. of Educ.

The well-equipped Nursery School for pre-elementary training of children 2 to 5 years old is currently regarded by educators as an increasingly necessary unit of the modern elementary school. Fifteen is considered an optimum size for class groups; and it is desirable that Nursery Schools be self-contained units located to serve a neighborhood from three-eighths to one-half a mile in radius.

GENERAL PLANNING

Gottscho

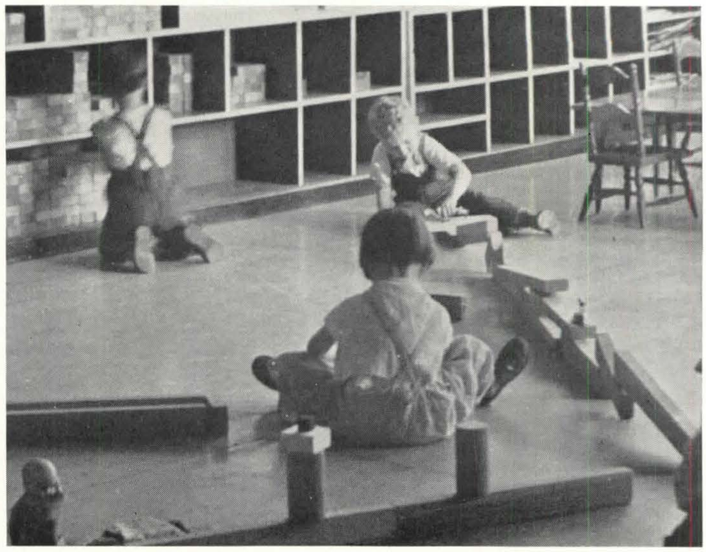
Story-telling

MacDowell

Exercising

MacDowell

Playing



Helen M. Post

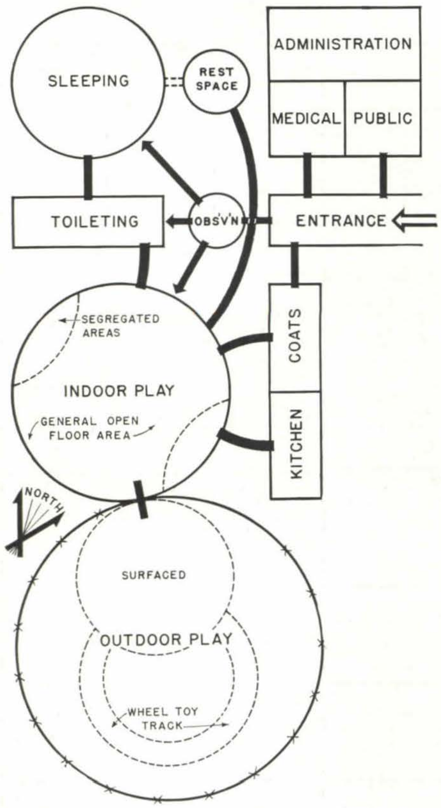
Building

Helen M. Post

Eating

W. A. Shum

Sleeping



Relationship and approximate orientation of nursery school spaces

NURSERY SCHOOL SPACE REQUIREMENTS

SPACE	AREA per CHILD (sq. ft.)			TOTAL AREA (sq. ft. unless otherwise noted)		
	Min.	Avg.	Max.	Min.	Avg.	Max.
Play						
Indoor	40	50	52	850	945	1,200
Outdoor—surfaced	..	..	..	850	4,490	...
—grass, shrubs, etc.	..	..	..	...	2,825	...
—total	85	145	..	7,283	...	...
Sleeping	15	27	..	...	495	...
Rest Space	3.6	9	10	254	315	333
Cloakroom						
Clothing only	..	..	..	...	200	200
Clothing plus play space	..	..	..	400	500	500
Storage						
Play equipment closet	..	..	..	97	122	122
Playroom, cupboards	..	..	..	300 cu.ft.	324 c.f.	500 c.f.
Teacher	..	..	..	48	48	48
Outdoor	..	..	..	18	100	120
Baby carriage	..	12 per carriage		...	...	...
Toilet and lavatory	4	5.4	..	80	108	108
Medical	..	..	..	108	180	250*
Kitchen	..	..	..	...	100	100
Staff						
Superintendent	..	..	..	...	150	150
Common	..	..	..	200	200	300

*Minimum if used as combined medical-teacher-parent space

Information contained in this and subsequent Time-Saver Standards was developed from data compiled by N. L. Engelhardt, Jr., and assistants, based upon recommendations of educators and designers in all portions of the country. Additional recommendations from the following have been included: Dr. L. T. Hopkins (Professor of Education, Teachers College, Columbia University), Dr. Arnold Gesell (Director, Clinic of Child Development, Yale University), Grace Langdon (Specialist, Family Life Education, Works Progress Administration), Bertha M. Luckey (Chief Examiner, Psychological Clinic, Cleveland Public Schools), Burton P. Fowler (Tower Hill School), Mrs. MacGuffey (Columbia University Nursery School).

Recommendations of various educators and designers are not always identical. Data in diagrams and tables represent averages; noteworthy variations are discussed in the text.

Economical minimum class size was stated to be 10 pupils; desirable average enrollment, 20 pupils, from among whom a regular actual attendance of 15 can be expected.

Toilet rooms and lavatories

Much work in the nursery school is designed to enable the child to take care of himself. It is therefore essential that toilet facilities be provided for each nursery playroom and *immediately* adjacent to it. This space should be provided with sunlight and should be mechanically ventilated. When more than ten children are to be housed in the nursery unit, two toilets are needed, perhaps separated by a low partition but accessible through a common entry off the playroom. Juvenile seats are required. One washbasin should be provided for every 4 children. These are likewise juvenile size, and are provided with thermostatically controlled hot water to prevent scalding. A mixing valve and single faucet with automatic slowly closing valve is desirable. Each child needs an individual rack for his towel, soap, and toothbrush.

In slum areas showers and tubs are required for older children and sink baths for two-year-olds. A dressing room is necessary in such instances.

Cloakroom

Again this is a space of great educational importance. It may be an alcove off the main playroom or a separate room. In either case it should be naturally lighted and sufficiently large to permit all the children to dress at the same time. An alcove is probably most economical of space since it permits children to overflow into the playroom, thus avoiding congestion. A room of 200 sq. ft. is adequate for approximately 15 children. An alcove can be somewhat less in area, size depending on freedom of movement to the playroom.

Individual open lockers, each with a low shelf for rubbers and a hook for hat and coat; and benches, 8 to 10 in. high, are desirable. Benches may be in the coat alcove or adjacent to it.

Alcoves or space within playrooms, relatively long and narrow, are generally preferred. Complete physical separation from playrooms is not usually deisrable.

Sleeping space

Sleeping space is necessary only in nursery schools which carry their programs into the afternoon. This space should be separated from the playroom to allow for individual differences in sleep requirements. In mild climates sleeping porches are satisfactory; however, for most situations, heated rooms are necessary. An area of 300 sq. ft. is ample for 15 children. Where there is more than one playroom group, a common sleeping room is practical.

Opinion is divided between desirability of natural ventilation through open windows or a completely interior room with mechanical air conditioning and complete soundproofing. Probably the final decision depends upon economy.

Storage space for sheets and blankets is required; linen closets or closed shelves built in walls are equally suitable. Each child uses two sheets and one blanket. Toilet and lavatory should be readily accessible from the sleeping space.

Space requirements vary with cot arrangements, of which one type consists of placing cots in groups of 2, 3, or 4 so that congenial children may be together. Aisles between cots are from 1 ft. 6 in. to 2 ft. 6 in. wide; circulation aisles around groups of cots require 3 to 4 ft. In some cases one or two cots may be placed behind screens, in alcoves, or behind dwarf partitions. These are for restless children, or those who require most sleep.

Rest space

Ideally, perhaps, no "isolation" space is needed, since nursery school objectives are social, intended to teach children not only independence but also how to conduct themselves in groups. However, segregated cot space noted under "Sleeping" is then necessary. So is a resting or retiring area to which children can go of their own volition when tired of group play. This may be a balcony from 3 to 6 ft. high (see "Playrooms", page 95), an alcove, or a separate room. Exposure and interior treatment should be attractive and stimulating.

Supervision, either from playroom or from administrative areas, is necessary. Medical isolation space may be needed in some cases.

Storage for baby carriages

Mothers ordinarily bring 2 and 3 year olds to school in baby carriages. It is therefore essential to provide a shelter where carriages may be left during the day. In mild climates mere protection from the elements is all that is required. However, in colder climates, carriages should be left in a warm storage room adjacent to the entrance.

Medical space

Many schools recognize the desirability of careful daily medical attention of young children. In such conditions provision should be made for a room near the entrance to which each child and parent report each morning. Equipment for this room consists of scales, medicine cabinet, and cot, and seats for children and adults. Since the space serves as a meeting place for parents and teachers, it should be somewhat informal in treatment.

Kitchen

For nursery schools extending beyond the noon hour a kitchen should be provided. A room of 100 sq. ft. equipped with mechanical refrigerator and stove is desirable. A serving wagon is required to move the food into the playroom. Provision for storing china and linens is needed. The kitchen should be easily accessible for food delivery. Simple fresh food generally will be delivered daily so that large storage spaces are not essential, but ample shelving should be provided. Garbage may be handled electrically or by means of a tightly covered and locked metal container removed from the children's play areas.

Administration space

Nursery school offices, other than the one listed under "Medical Space," may well be a part of the office suite of the elementary school. Likewise teachers' rest and work rooms may be combined with those called for in other school units.

EQUIPMENT

SPACE and TYPE	QUANTITY: Minimum Desirable	Average	Maximum
Toilets, lavatories			
Waterclosets	2	4	6
Sinks		1	1
Washbasins	3	4	7
Mirrors	1	1	Several
Tubs (bath-sink)	1 (slum areas)	1	2
Showers		1 (slum areas)	1
Platforms or tables		1 (smallest children only)	2 (1 on casters)
Racks for toothbrush, comb, towel, etc.	20	20	20
Storage	For towels, soap, first aid, etc.		
Cloakroom			
Lockers	20	20	20
Platforms or benches	1	2	2 lin. ft. per pupil
Drying space	Ventilated racks or cupboards for wet clothes		
Sleeping			
Cots	20	20	20
Lockers, bedside	1 per cot if children undress		
Lockers or storage cupboard	For sheets (2 per cot); blankets (1 per cot); for 20 cots if needed		

SPACE and TYPE	QUANTITY: Minimum Desirable	Average	Maximum
Rest space			
Cots	2	2	2
Screens	2	2	2
Tables		1	1
Chairs	2	2	2
Books, Toys	Obtained from indoor playspace		
Storage, teachers			
Shelves, cupboards	For mats, dusters, overalls, bibs, napkins, dishes, silverware, brooms, mops; possibly 1 cupboard with sloping top for recording notes		
Closet	May be substituted for cupboards, etc.; 48 sq. ft. area		
Medical	1 cot; 1 medicine chest; 1 desk; 1 file; seats for parent and child; 1 weighing machine*; 1 sink*		
Kitchen	Storage: groceries, china, cutlery, cleaning materials, utensils, refrigerator; sink, range		
Administration	1 coat room; 1 lavatory; 1 large desk; 2 plain chairs; 1 revolving chair; 1 filing cabinet		
Observation	One-way ports; 3 or 4 adults' chairs or bench		

*In bathroom if it adjoins medical room

Bibliography

Bradbury, Dorothy E., "Case for Nursery Schools," *Childhood Education,* June, 1936, pp. 406-408.

Davis, Mary Dabney, "Nursery Schools, Their Development and Current Practices in the United States," *U. S. Office of Education, Bulletin* 1932, No. 9.

Davis, Mary Dabney, "Young Children in European Countries," *U. S. Office of Education Bulletin,* 1936, No. 2, 108 pages.

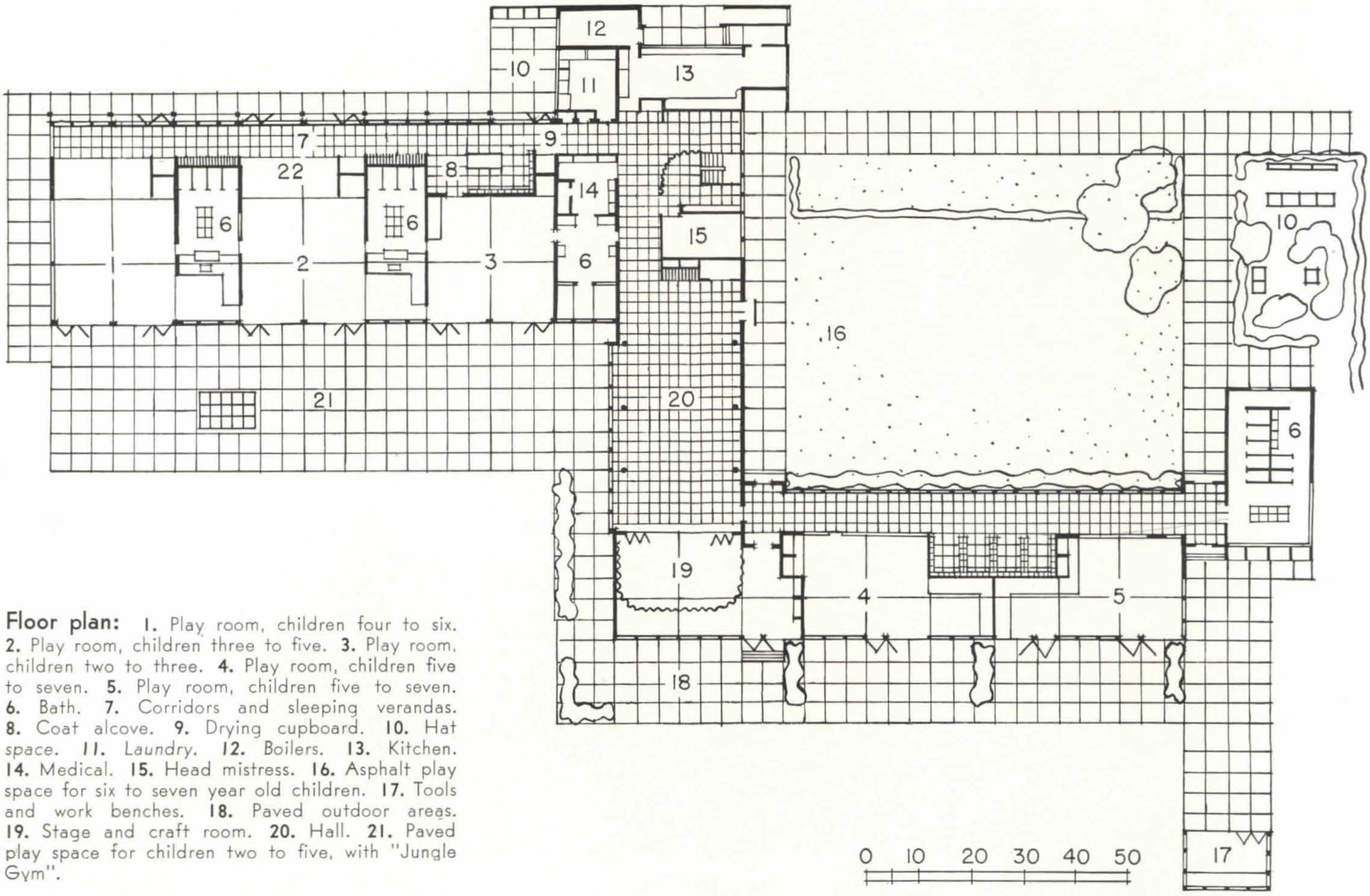
Gray, Grete and Staples, Ruth, "Housing the Nursery School," *Childhood Education,* 1928, Vol. 15, pp. 33-36.

Haskell, Douglas, "Modern Nursery School," *Architectural Record,* March, 1938, pp. 84-100.

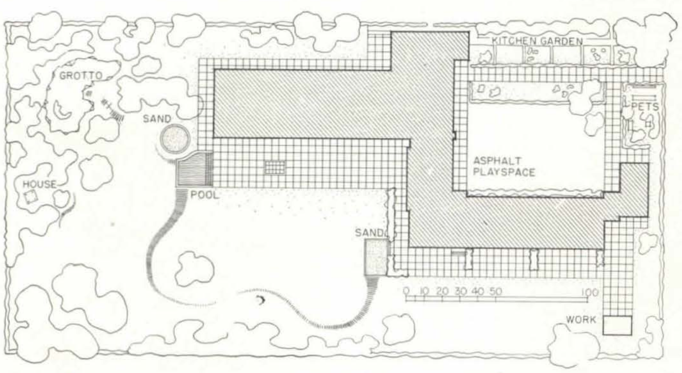
Stoddard, George D., "The Planning and Equipping of Nursery Schools," *American School and University,* 1935, pp. 218-221.

Updegraff, Ruth and Dawe, Fales, Storm, and Oliver, *Practice in Pre-School Education,* New York, McGraw-Hill, 1938, 408 pages.

Wright, H. Myles, and Gardner-Medwin, R., *The Design of Nursery and Elementary Schools,* London, Architectural Press, Ltd., 1938, 120 pages. May be obtained through the Architectural Press, New York.



Floor plan: **1.** Play room, children four to six. **2.** Play room, children three to five. **3.** Play room, children two to three. **4.** Play room, children five to seven. **5.** Play room, children five to seven. **6.** Bath. **7.** Corridors and sleeping verandas. **8.** Coat alcove. **9.** Drying cupboard. **10.** Hat space. **11.** Laundry. **12.** Boilers. **13.** Kitchen. **14.** Medical. **15.** Head mistress. **16.** Asphalt play space for six to seven year old children. **17.** Tools and work benches. **18.** Paved outdoor areas. **19.** Stage and craft room. **20.** Hall. **21.** Paved play space for children two to five, with "Jungle Gym".



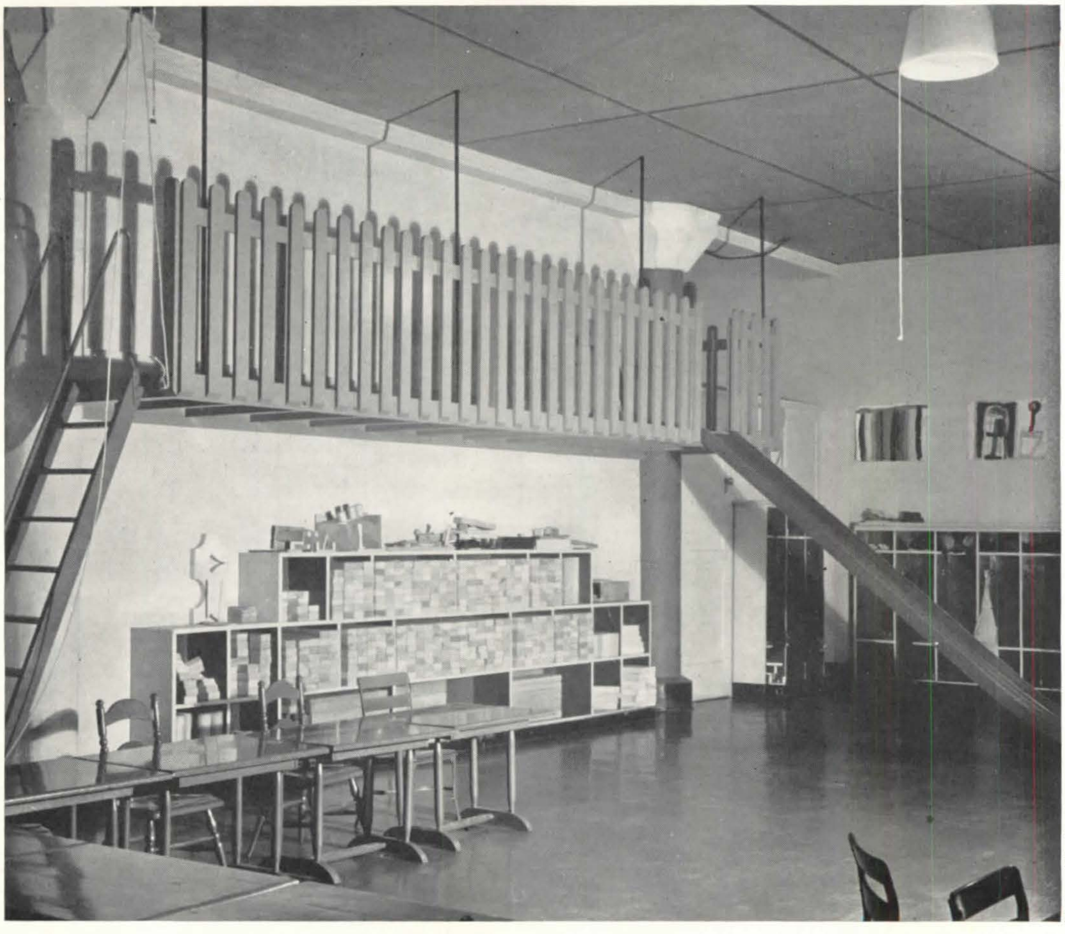
Plot plan

Drawings courtesy "Design of Nursery and Elementary Schools", by H. Myles Wright and R. Gardner Medwin; The Architectural Press, London

A nursery infant school designed by H. Myles Wright and R. Gardner Medwin, English architects, authors of the "Design of Nursery and Elementary Schools". This plan, designed primarily for use in Great Britain, is in many respects satisfactory for American purposes, but is intended to illustrate British recommendations as follows:

1. Surroundings spacious, yet sufficiently intimate;
2. Building plan in units adapted to simple frame and panel fabrication (4 ft. modules are used);
3. Easily supervised entrance;
4. Nursery play rooms, coat lobbies, and lavatories planned as self-contained units;
5. Rooms for more advanced children are segregated;
6. General hall used for: assembly, circulation between age groups, open air community play in wet weather, elementary dramatics, dining space for four to seven year olds, welfare meetings for parents;
7. Corridors convertible into sleeping verandas;
8. Play rooms open to outdoor areas;
9. Circulation minimized;
10. Kitchen centrally placed;
11. Main window walls face southeast;
12. The observation gallery in this case was designed as a second floor area with windows overlooking the hall and outdoor play spaces.

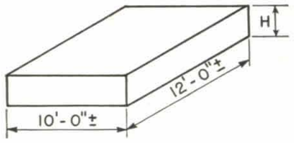
PLAYROOMS



Helen M. Post

MacDowell

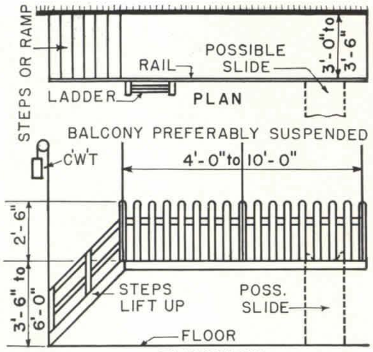
At top, interior of playroom at Harriet Johnson Nursery School, New York: The ceiling-hung balcony affords a retiring place for children who prefer occasional solitary play. The steps are counterbalanced and may be lifted to provide additional floor space, or to prevent use of the balcony when the teacher desires. At left, *interior* of Columbia University Nursery School: The building is an adapted greenhouse which not only provides sufficient headroom, but permits the interior to be flooded with sunlight. Most of the equipment is in this case portable. At the extreme left may be seen the sandbox which is approximately 4 ft. wide and extends the full length of one side of the room.



PLAY PLATFORMS

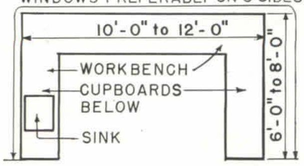
H= LOW. 1'-0" to 1'-6"
MEDIUM 2'-0" to 3'-0"
HIGH 3'-0" to 4'-0"

EACH SUPPLIED WITH STAIR AND RAMP OR LADDER

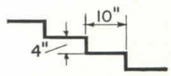


SUGGESTED BALCONY

WINDOWS PREFERABLY ON 3 SIDES

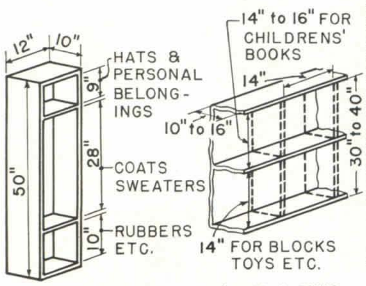


WORK ALCOVE



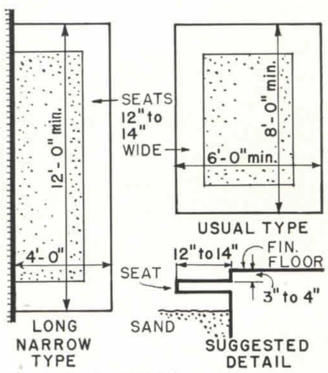
STEPS FOR CHILDREN 2 to 5 YRS.

SCALE: 1/8" = 1'-0"
EXCEPT AS NOTED



CLOTHING SHELVES & BINS

STORAGE SCALE 1/4"=1'-0"



SAND BOXES

ACTIVITY EQUIPMENT

TYPE	QUANTITY: Minimum Desirable	Average	Maximum
Platforms	1, medium height	2, one low one med'm	3, one low one med'm one large
Floor blocks Hollow blocks	50, varied sizes	100	100
Sandbox	1	1	1
Slides	1	1 or more built-in or movable	Same as average
Blackboards	1	1	2
Swings	1	1	2 or 3
Pool (water)		1	1
Chairs	20	25 varying sizes 1 teacher's	25 plus stools, work benches, teacher's
Tables	7 (4 large, 3 small for children)	9 children's (5 large, 4 small) 1 teacher's	Same as average
Easels	2	2	3
Musical instruments	Swing bells; tom-toms; xylophones; piano; material for children to make own musical toys; musical forks; dulcitone		
Work shop	1	1	1
Miscellaneous	Dolls and housekeeping equipment; puzzles; books; posterboard; string; paper — plain, corrugated and colored; cartons; milk bottle caps.		
Storage (Toy shelves and bins) Books	300 cu. ft. 15 lin. ft.	324 cu. ft. 25 lin. ft.	500 cu. ft. 40 lin. ft.

This is the center of children's activities during the day. In it they play and eat. Supervision is of great importance; for safety, playrooms should not be irregular in shape and playgrounds should be so placed that activities both indoors and out can be seen by one teacher. A maximum of glass area with south exposure is desirable. Tri-lateral lighting, with the long side of the room opening immediately on the playground to the south, is an acceptable standard. Greenhouse design has also been used for nursery units.

Interior furnishings of the playroom should be developed around the activities of the children. Juvenile tables and chairs should be provided for each child. Workbenches and clay modeling table are desirable; so is space for a piano and phonograph. A large supply space immediately adjacent to the playroom is necessary for the teacher. A teacher's table and chair should be provided.

Floor construction of the playrooms is particularly important as most activities are carried on there. It should be dry, damp-proof, and warm at all times. One satisfactory type is laid on sleepers imbedded in concrete with proper waterproofing, over an excavated section or basement. Finish, of a resilient and non-abrasive nature, may be of such materials as cork, linoleum, or asphalt tile. Wainscoting should be easily cleanable up to a height of about 4 ft.; finish is preferably similar to that of floors. Above this, plaster may be used. Acoustic treatment of ceilings is desirable in view of the noisy activities carried on in the room. Color treatment may be cheerful and varied. Walls above wainscots offer space for murals depicting scenes and characters from nursery rhymes. A drinking fountain and wash sink of juvenile height are essential in the playroom proper. To avoid accidents these should be recessed in walls.

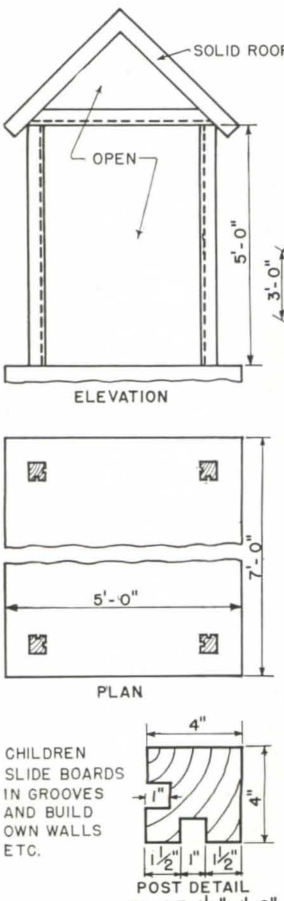
Minimum area recommendations vary from 20 to 60 sq. ft. per child. Height recommendations range from 9 or 11 to 18 ft. The latter figure is preferred if a jungle gym or other large, tall apparatus is used indoors. Of the total floor area, approximately one-third is occupied by semi-permanent apparatus; one-twelfth to one-tenth is needed for children's block set-ups, etc., which may remain in position for several days at a time. For this purpose and for small group activities, portions of the general floor area may be somewhat segregated, either by use of alcoves, or by organization of natural circulation routes, sunlight areas, cupboards, apparatus, etc.

PLAYGROUNDS

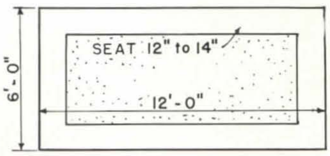
Courtesy New York City Bd. of Educ.

Courtesy New York City Bd. of Educ.

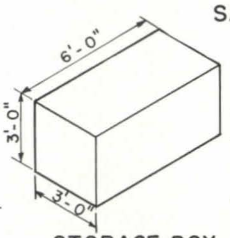
Courtesy Los Angeles Bd. of Educ.



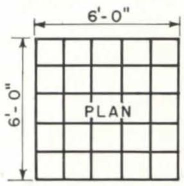
SCALE 1/4"= 1'- 0"
PLAY HOUSE



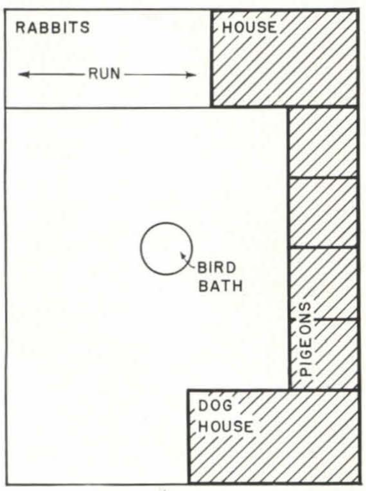
SAND BOX



STORAGE BOX



JUNGLE GYM.



PLAN
PET SPACE (300 SQ.FT)

ACTIVITY EQUIPMENT

TYPE	QUANTITY		
	Minimum Desirable	Average	Maximum
"Jungle Gym"	1	1	1
"Tower Gym"		1	1 large 1 small
Slides	1	2	2
Swings	1	2	3
Boxes (play)		5	5
Boards	2 boards (modeling) 2 large (climbing) 10 small (building)	3 boards (modeling) 3 large 12 small	
Ladders, bars, vert. and horiz.	1	2	several
Blocks	50 (varied sizes)	100	100
Sand box	1	1 or more, 1 large	
Wheel toys	2 tricycles 2 wagons 1 wheelbarrow 2 trucks	2 tricycles 3 wagons 2 wheelbarrows 4 trucks	
Balls	4	6	6
Kegs	2	4	4
Sawhorses	6	12	12
See saws	1	2	3
Shovels	4	6	6
Gardens	1	1 or more; veg. plots	
Pool		1	1 or more
Workshop	1	1	1
Playhouse	1	1	1
Wheeltoy track	1	1	1
Tool shed	1	1	1
Pet space	1	1	1
Climbing rope		2	3
"Grotto"	1	1	1
Storage box	1	1	1

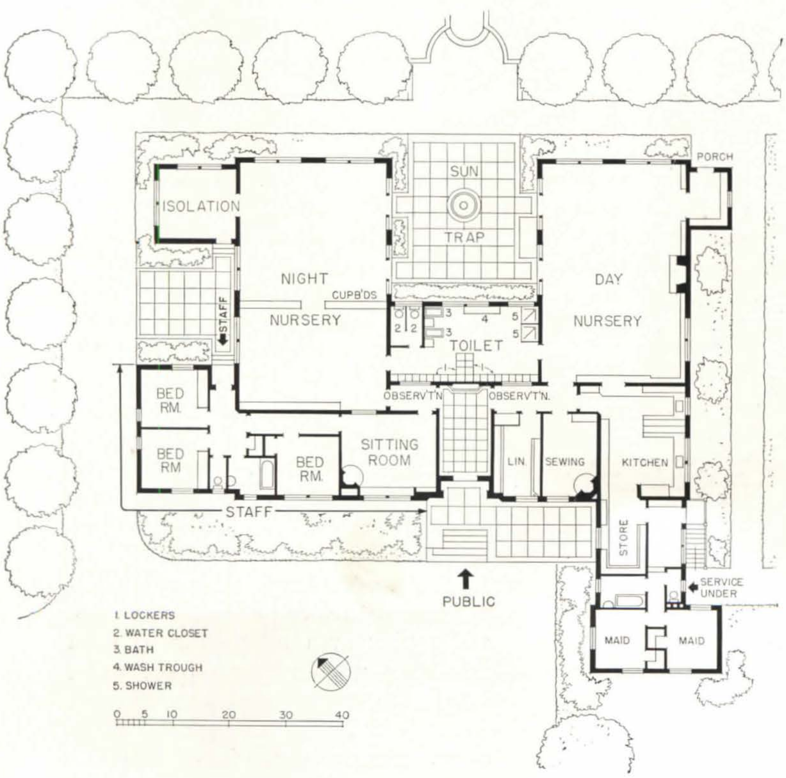
Each playroom group should have immediate access to a segregated outdoor play area, of which the larger part should be surfaced with non-abrasive, quick-drying material. Shade trees and lawn areas are desirable in corners or at one side. Equipment includes a sand bed, play house, jungle-gym, swings, ladders, and slides. The playhouse need only be a roof supported by four posts which have been grooved to permit children to fill in the walls with their own building blocks. A large storage box is needed for housing play tools, blocks, toys, etc. This box is preferably waterproof and placed in a readily accessible location.

If the nursery school operates during summer months, a wading pool is very desirable. An overhead shower and garden hose will prove a source of much enjoyment.

The play area should be completely surrounded by a high fence with the only entrance and exit through the playroom, so that children cannot stray out of their own area. The entire area should be within sight of a teacher standing at any point.

Minimum area recommendations range from three to four times indoor play area, with a lower limit of 4,000 sq. ft. *Surfaced portions* are universally desirable, but recommendations as to extent range from an area at least equal to indoor play area, to the entire outdoor space excepting that required for trees, shrubs and gardens. A *hard-surfaced track* for toys is essential. It may become advisable to combine general surfaced areas and tracks. Such a play area might consist of a single strip not less than 6 ft. wide, around the playground's perimeter. "Grottos", or secluded, somewhat mysterious, spaces, are often desirable.

Photos by W. A. Slum



HOLIDAY HOME FOR CHILDREN

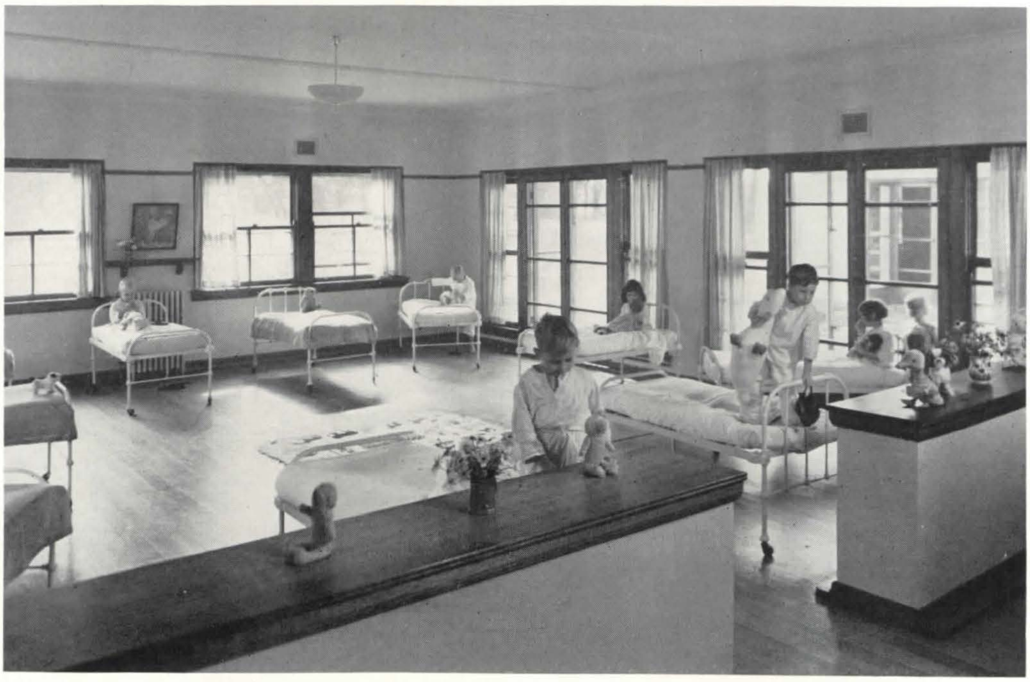
Forest Hill, Victoria, Australia

MARCUS W. MARTIN, A.R.I.B.A., F.R.A.I.A., Architect

Below, sun trap

1.

2.



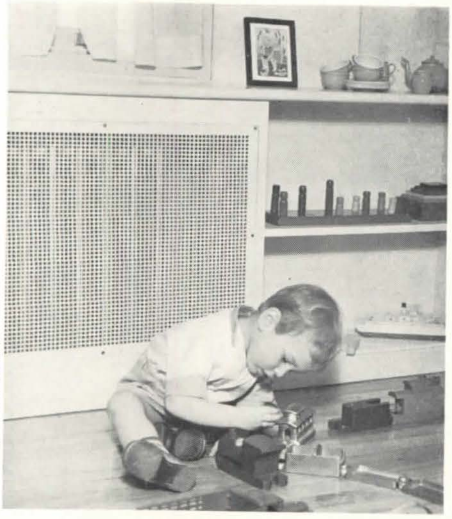
3.

The school was established by the Free Kindergarten Union of Victoria for children from industrial areas in Melbourne; and was designed for 20 children, 3 staff members, and 2 domestics. Photographs on this page are:

(1) Day nursery, which is also used as dining space. Walls are grayish-pink, curtains multi-colored, furniture stained cherry, and wainscoting variegated cherry-colored rubber.

(2) Night nursery is divided by low cupboards which minimize the apparent room size. Walls are primrose color, floors honey color, curtains multi-colored. Isolation space (see plans) is for medical purposes and is under observation of a staff member who sleeps in the night nursery.

(3) Bathroom containing baths set on pedestals for staff's convenience. A dressing cubicle is provided for each child.



Photos by Troy Studio

Illustrating the necessity for protecting children from exposed radiators or other heat sources; Nursery School, Department of Home Economics, Cornell University

Venetian blinds are used to dim natural light; artificial lighting fixtures are semi-direct; sleeping room, Cornell Nursery School

Heating and ventilation

Most children's nursery school activities are carried out on floors. Activity is also constant. These factors lead to three conclusions: (1) Heat should be directed toward floor level; (2) floor drafts should be eliminated; (3) temperatures may be lower than those commonly used in upper elementary grades. Radiators or other exposed heating elements should be equipped with guards to prevent children from burning themselves. These requirements may be complicated by the presence of large glass areas, either fixed or openable.

Temperatures found to be comfortable and healthful, range between 67 and 73F. Toilets, lavatories, rest spaces (not sleeping areas), may be kept to higher limits; sleeping areas are usually kept to lower limits. Recording and control devices (thermometers, humidistats, etc.) are best located at child height, averaging 3 ft. to 3 ft. 6 in. from the floor.

Air supply: Official regulations of thirty states require a minimum of 30 cu. ft. per minute per child. Reports from recent independent research, including studies by the Architectural Commission of the New York City Board of Education; by Dr. John R. McClure, a pioneer in school ventilation research; by the American Society of Heating and Ventilating Engineers; and others, tend to show that from 10 to 15 cu. ft. per minute per child is satisfactory.

Four principal types of heating-ventilating systems are commonly available: *Unit heater and ventilator systems,* with or without direct radiation; *direct radiators plus window-gravity ventilators; direct radiators plus central fan ventilators;* and *central fan heating and ventilation.* A fifth type, *radiant panel heating,* is available but is not yet commonly used. In this type heating elements are incorporated in wall, floor or ceiling structure, or finish.

Selection of heating method may be based upon factors previously outlined and upon such local factors as cost, climate, type of construction, and regulations of local authorities. Additional considerations not previously stressed include use of folding or sliding exterior wall sections and the desirability of including some form of natural ventilation.

Lighting

Natural lighting in nursery schools should be as great in quantity as is consistent with planning problems. Modern educational research indicates, as a desirable minimum, that at least 25% of the wall area (one wall) be glass; 50% (two walls) is preferable; and 75% (three walls) is recommended by many authorities. Greenhouse design, with the major portion of walls and ceilings glass, is satisfactory in temperate localities.

Glare should be eliminated in so far as is possible. This indicates that highly reflective outdoor play area surfacing is undesirable, particularly adjacent to window walls. In localities where sunlight is uniformly intense, exterior awnings, venetian blinds or similar means of control, are desirable. Modern design features include low window sills (from 1 ft. 10 in. to 2 ft. 6 in. from floor); narrow mullions; heads preferably flush with ceiling. Since children do not face continually in one direction no opaque wall space is necessary to control glare on blackboards or bulletin boards. This implies that windows can extend from wall to wall within the playroom.

Artificial lighting is important in playrooms only as it is required to supplement natural light during daylight hours. Lighting problems are similar to those encountered in residences rather than those of institutions or commercial buildings. Glareless fixtures are desirable. Low intensities are necessary in sleeping areas, higher intensities in playrooms, rest spaces, toilets, lavatories, and cloakrooms. Switches in these latter areas may be set 3 ft. from the floor to permit children to use them.

KINDERGARTEN-PRIMARY

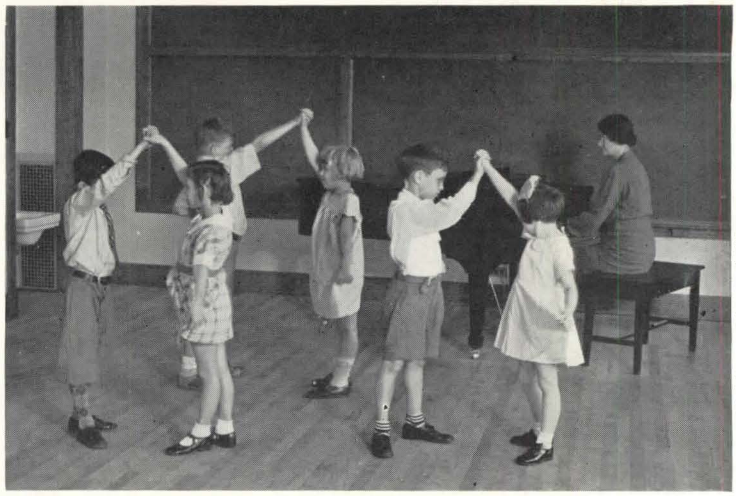
Courtesy New York City Bd. of Educ.

As an increasingly important division of the modern elementary school, the Kindergarten-Primary unit is designed for children 6 to 8 years old. It combines elements of both nursery and upper elementary units in an activity program which requires indoor and outdoor facilities for supervised play and instruction. Optimum class size is considered to be 20 to 25 pupils.

GENERAL PLANNING

Courtesy Detroit Bd. of Educ.

Listening



Courtesy Baltimore Dept. of Educ.

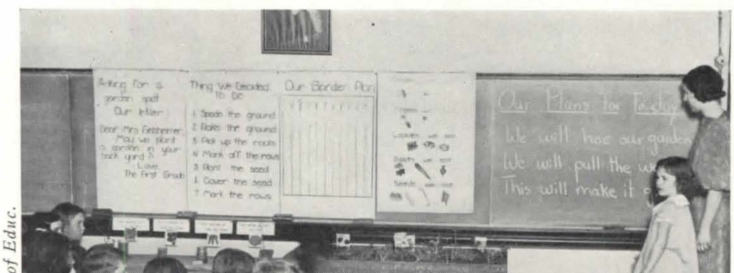
Dancing

Courtesy Los Angeles Bd. of Educ.

Handicrafting

Courtesy Springfield, Mo., Bd. of Educ.

Eating



Courtesy Springfield, Mo., Bd. of Educ.

Learning . . .

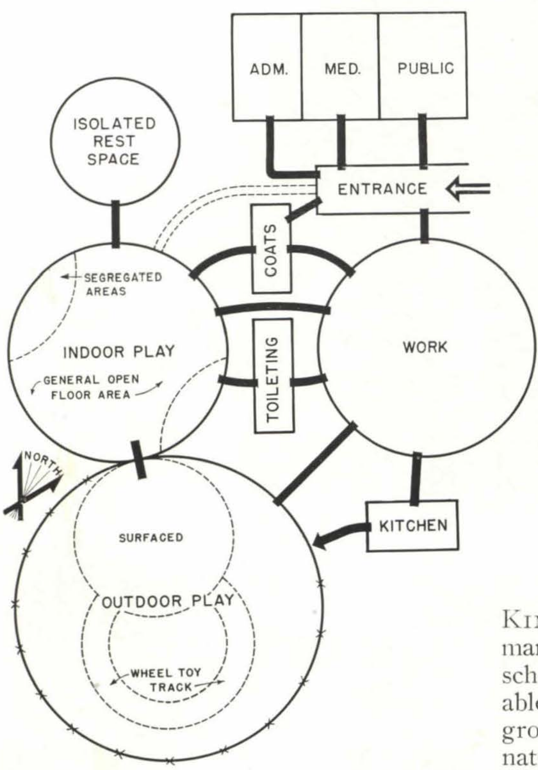
Courtesy Springfield, Mo., Bd. of Educ.

. . . by Doing

SPACE REQUIREMENTS

SPACE	AREA PER CHILD (sq. ft.)			TOTAL AREA (sq. ft.)		
	Min.	Avg.	Max.	Min.	Avg.	Max.
Play						
Indoor (incl. work area)	25	60	60	625	1500	1500
Outdoor—surfaced......	250	300	300	5000	6000	6000
—lawn, shrubs, etc....	..	..	..	300	360	360
—pet space..........	..	..	..	..	300	..
—gardens...........	..	18	..	..	450	..
Work						
Indoor (include in playroom space allowance)	10	16	16	250	400	400
Rest and Isolation.........	8	12	12	200	300	300
Cloakroom						
Clothing only...........	..	8	10	..	150	250
Toilet and Lavatory						
Boys'.................	..	..	..	..	80	80
Girls'.................	..	..	..	..	80	80
Medical................	..	..	..	108	180	250*
Kitchen.................	..	..	..	100	100	100
Staff						
Offices	..	..	..	..	150	150
Common...............	..	..	..	200	300	300
Storage						
Playroom						
—Children's..........	..	1.5 cu. ft.	..	..	..	..
—Supplies...........	..	..	..	..	48	..
Work space...........	..	1.5 cu. ft.	..	..	..	..
Cloakroom............	Open lockers as for nursery schools					
Outdoor..............	As for nursery schools					

*Minimum if used as combined Medical-teacher-parent space.



Relationship and approximate orientation of kindergarten-primary spaces: observation and sleeping areas may be eliminated; coatrooms and toilets are smaller than in nursery schools; and it is desirable to locate the kitchen so that both indoor and outdoor meals can be served conveniently.

KINDERGARTEN-PRIMARY UNITS are in many respects extensions of nursery schools. Facilities for programs suitable to older children are added; outgrown facilities are reduced or eliminated. There remain many factors common to both school types; such similarities and differences are noted in the subsequent text.

Location

The fact that acceptable location standards for both kindergarten - primary schools and nursery schools are identical (both should be within three-eighths to one-half mile of homes to be served) makes possible their combination in single buildings.

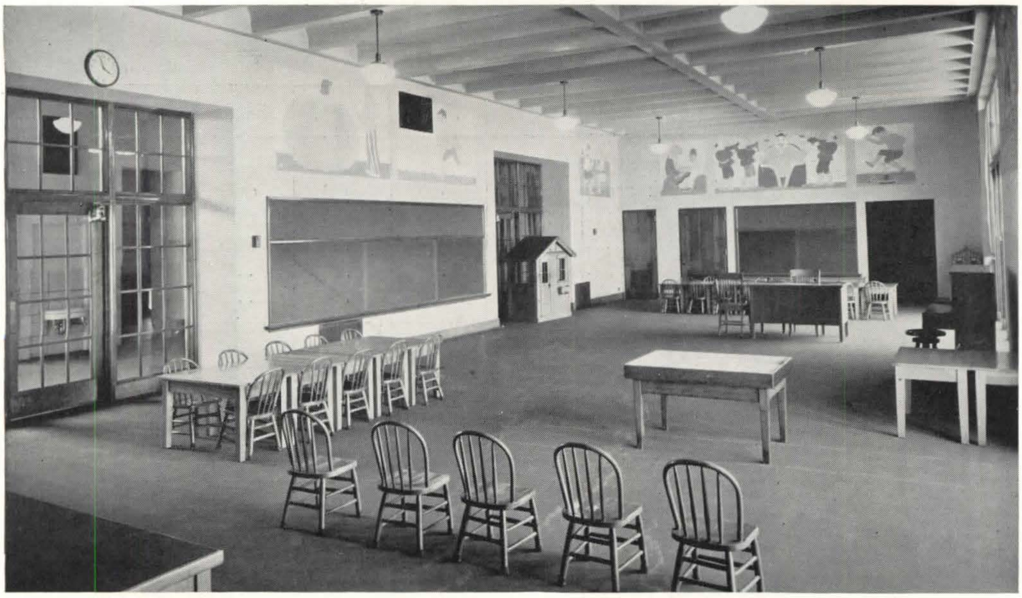
Relationship to elementary building

Like the nursery school this unit will often be housed in the elementary building for administrative purposes. Similarly again, the unit, however, will be self contained so far as the children are concerned and there will be no pupil traffic with other units of the school.

Types of activities

Children in this age group engage in strenuous physical activity such as running, climbing, jumping, skating, and dancing. Boys like to play ball, girls to jump rope and play with dolls and houses. These activities require more outdoor space than in the nursery school and certainly no less indoor play space.

PLANNING (cont'd.)



Equipment in the Herzog School kindergarten, St. Louis, Mo., George W. Sanger, Architect

Photos by Alex. Piaget

Center and lower photographs, kindergarten room, Wright School, St. Louis County, Mo., Robert E. Denney, Architect

EQUIPMENT			
SPACE AND TYPE	QUANTITY		
	Minimum Desirable	Average	Usual Maximum
Toilets, lavatories			
Waterclosets	2 (boys') 2 (girls')	2 (boys') 2 (girls')	3 (boys') 3 (girls')
Washbasins	3 (boys') 3 (girls')	3 (boys') 3 (girls')	4 (boys') 4 (girls')
Mirrors	1 (boys') 1 (girls')	3 (boys') 3 (girls')	4 (boys') 4 (girls')
Paper towel rack	1 (boys') 1 (girls')	2 (boys') 2 (girls')	2 (boys') 2 (girls')
Showers, baths	Necessary in slum areas only		
Cloakroom			
Lockers	25	25	25
Drying space	Ventilated racks or cupboards for wet clothes		
Rest space			
Cots	2	4	6
Chairs	2	3	4
Tables	1	1	1
Bookshelves	6 lin. ft.	8 lin. ft.	10 lin. ft.
Teachers' storage			
Shelves, cupboards	For mats, dusters, brooms, mops; napkins, dishes, silverware; teaching supplies		
Closet	May be substituted for cupboards, etc.; minimum area, 48 sq. ft.		
Medical	1 cot; 1 medicine chest; 1 desk; 1 file; seats for parent and child; 1 weighing machine*; 1 sink*		
Kitchen	Storage: groceries, china, cutlery, cleaning materials, utensils, refrigerator; sink; range		
Administration	1 coat room; 1 lavatory; 1 large desk; 2 plain chairs; 1 revolving chair; 1 filing cabinet		

*In bathroom if it adjoins medical room

Sleeping room

Children 6 to 8 need little extra provision for sleeping during the day. A special rest room should be provided in the unit for children of low physical vigor and for convalescents. Comfortable chairs and cots for resting or quiet reading constitute its equipment.

Toilet facilities

Two toilet rooms should be provided, one for each sex, adjacent to each playroom. Since they are not as educationally significant as in nursery schools less space is needed. Fixtures should be of juvenile size. A washbasin and paper towels are necessary in each toilet room. In addition at least two washbasins are required in the main playrooms. A drinking fountain in each room of the unit is desirable.

Cloakroom

The cloakroom at this age is merely a service agency. Open lockers are similar to those in the nursery school, one for each child. The space allotted for this purpose may be an alcove off the main room, or a separate room. In either case mechanical ventilation is desirable to aid in drying clothes during wet weather.

Administrative and service spaces

Medical observation, kitchen, and storage spaces are similar to those required in the nursery school. However, the medical space and kitchen may be used in common by not more than four groups.

Bibliography

Forest, Isle, *The School for the Child from Two to Eight,* New York, Ginn & Co., 1935.

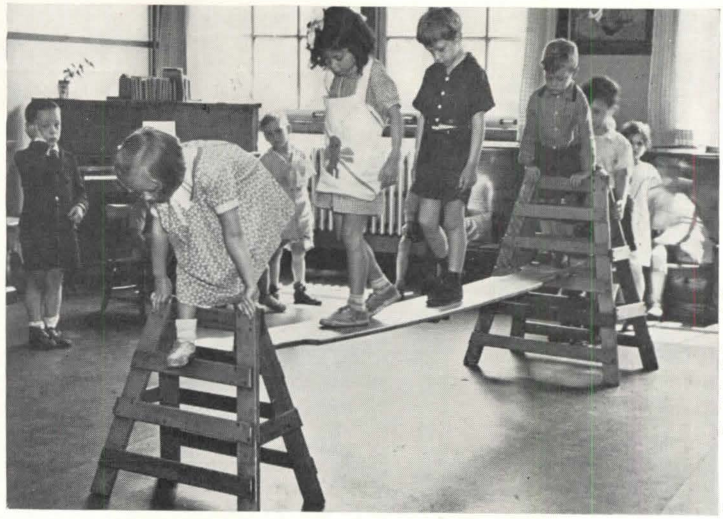
Foster, Josephine C. and Headley, Neith E., *Education in the Kindergarten,* New York, American Book Co., 1936, 368 pages.

Garrison, C. G., Sheehy, E. D., and Dalgliesh, A., *The Horace Mann Kindergarten for Five Year Old Children,* New York, Bureau of Publications, Teachers College, Columbia University, 1937, 146 pages.

Strayer, G. D. and Engelhardt, N. L., *Standards for Elementary Schools,* New York, Bureau of Publications, Teachers College, Columbia University, 1933, 181 pages.

PLAYROOMS and Workrooms

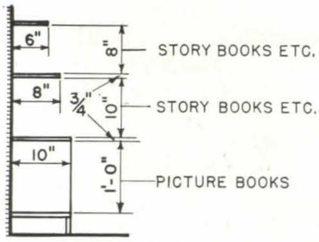
Courtesy New York City Bd. of Educ.



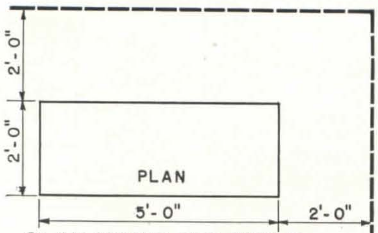
Courtesy San Francisco Bd. of Educ.

Courtesy San Francisco Bd. of Educ.

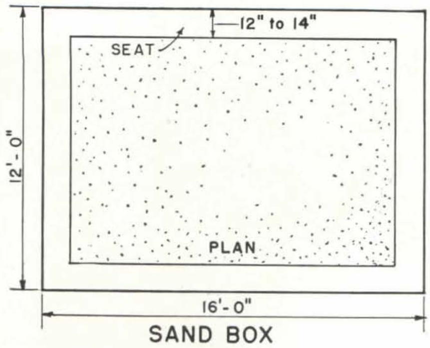
Kindergarten-primary playrooms must be adaptable to group instruction—as story-telling and play exercises, at top of the page—to resting and to eating. These latter activities are not relatively as important in the kindergartens as in nursery schools. The center picture was taken during a rest period in a California kindergarten; the lower one shows a playroom with tables set for luncheon.



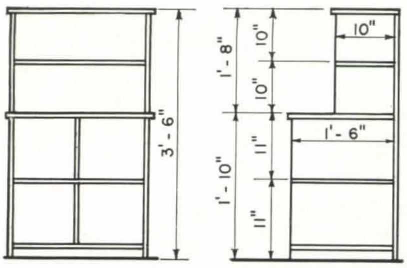
BOOK SHELVES



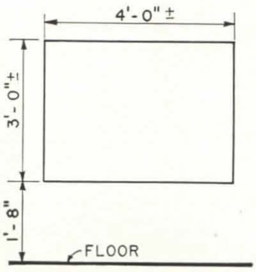
CLAY MODELING TABLE



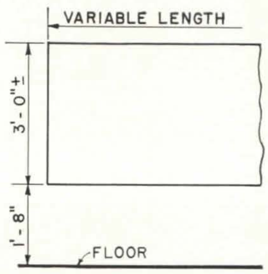
SAND BOX



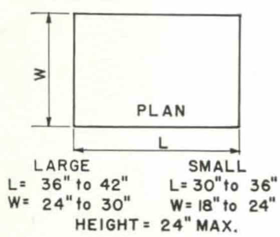
BINS AND CUPBOARDS



BLACKBOARD SECTIONS



TACK OR BULLETIN BOARDS



TABLES

ACTIVITY EQUIPMENT

TYPE	QUANTITY		
	Minimum Desirable	Average	Usual Maximum
Chairs	25	30; 1 teacher's	30; 2-3 teachers'
Tables (children's)	8 (4 large, 4 small)	10 (5 large, 5 small)	10 (5 large, 5 small)
Tables (clay modeling)	1	1	2
Tables (teacher's)	..	1	1
Washbasins	1	2	2
Drinking fountains	1	1	1
Easels	2	3	4
Bulletin boards	As much as available wall space permits		
Blackboards	2 small sections	3 small sections	4 small sections
Swings	1	1 or 2	2 or 3
Slides	1	1 or 2	2 or 3
Sandbox	1	1	1
Pool (for toys)	..	1	1
Aquarium	1	1	2
Herbarium	1	1	2
Workbenches	1	Several	Several
Musical Instruments	Piano and other instruments and materials as for nursery schools		
Storage			
Pupils' shelves, bins	375 cu. ft.	450 cu. ft.	550 cu. ft.
Bookshelves	25 lin. ft.	40 lin. ft.	50 lin. ft.

The design of the playroom must permit segregation of activities. This can be accomplished by bay windows, alcoves, or separate rooms. Such spaces can be devoted to quiet work and separated from the noisy work room, or can serve as shop sections for the most deafening activities.

Movable chairs and tables are necessary to the activity program carried on. With development of individual interests and work along different lines according to ability, need arises for a cupboard for each child. In it he can store whatever type of object he is working on at the time. Cupboards must be low and so placed as to avoid congestion. Bulletin board space is necessary; a wainscoting of cork or other suitable material is satisfactory. Small sections of blackboard are useful.

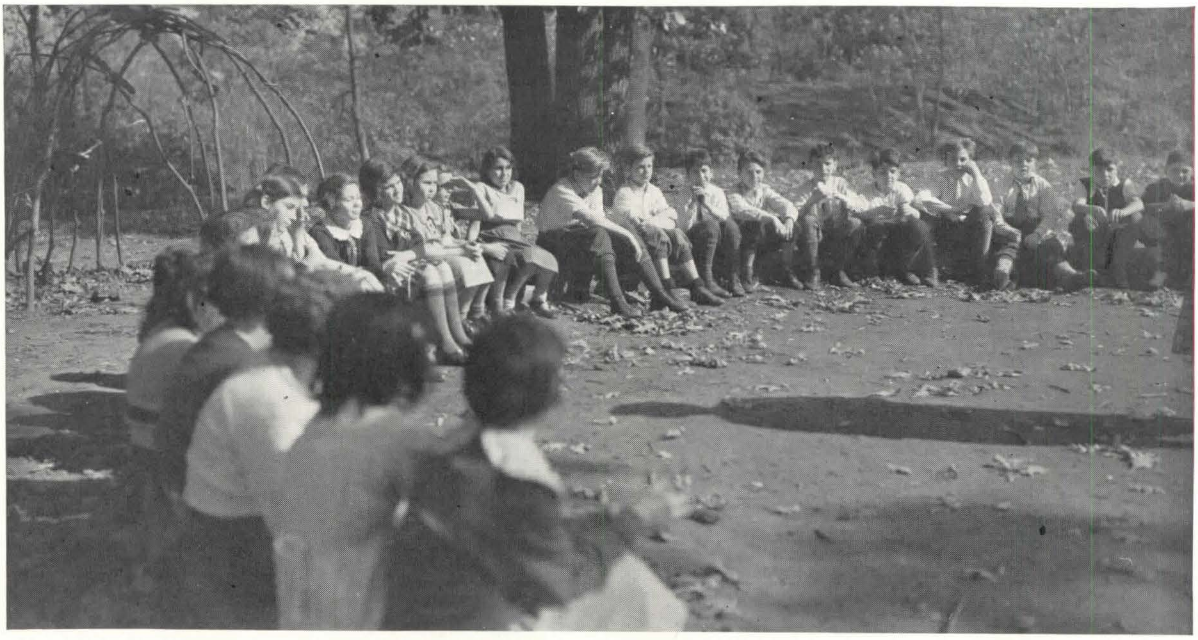
Large equipment includes swings and slides, particularly in the kindergarten; and a large sand box, aquarium, and space for floating toys. A pool, built into the floor, with a protecting curb, will be useful and attractive.

Extensive work with wood requires several workbenches equipped with small standardized tools. For some types of art work, easels are valuable; art work on a smaller scale is carried out in clay and crayon. A clay modeling table serves to prevent tracking clay all over the floor. Low tables are needed for rough sewing.

PLAYGROUNDS

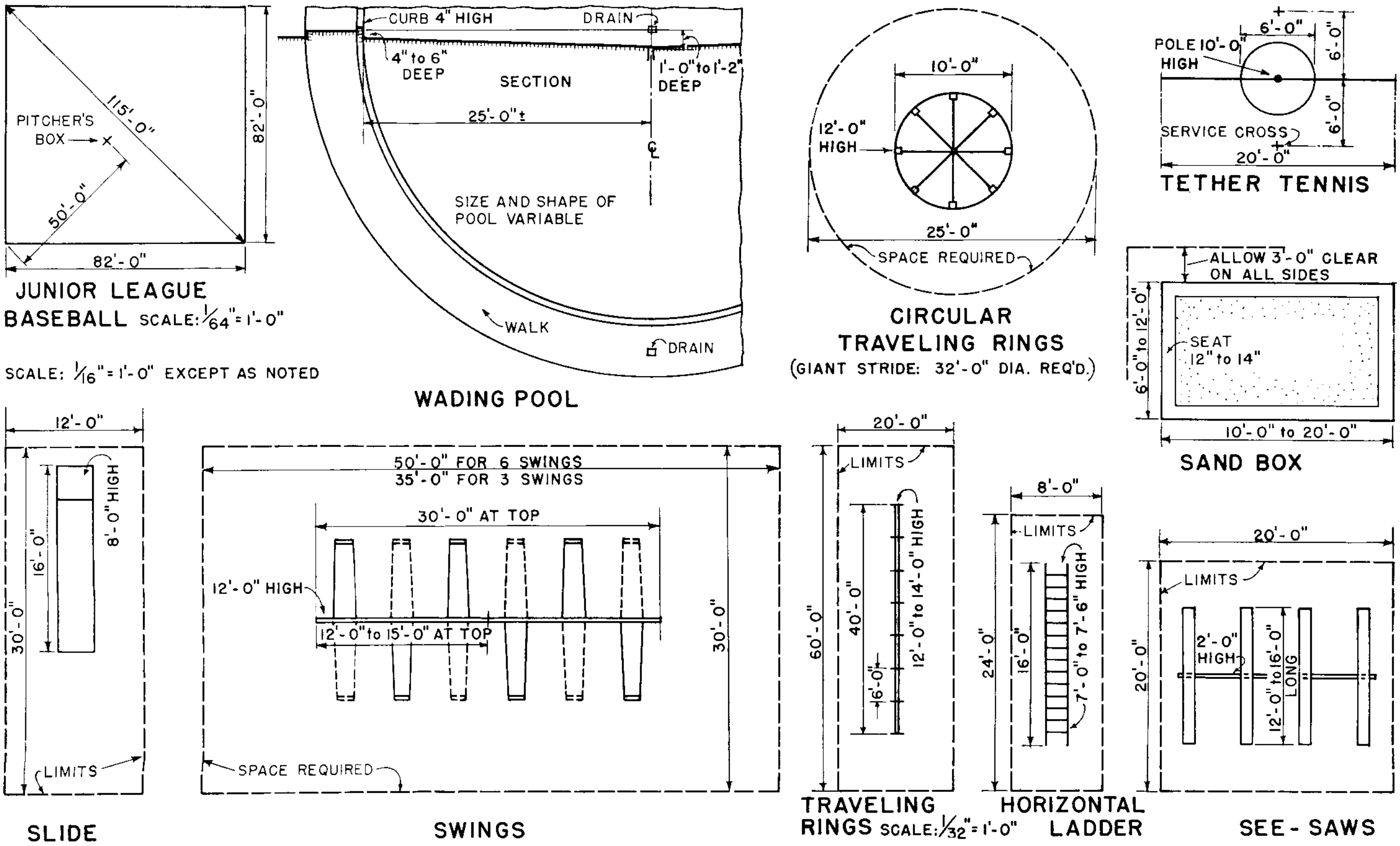
Courtesy Springfield, Mo., B'd. of Educ.

Modern processes of education can be advanced out-of-doors as well as in classrooms. Surfaced play areas are desirable for the type of group activities illustrated at the left and for organized games, as suggested in the bottom picture. An area of natural terrain is desirable for individual gardening, and nature study, and for group instruction and recreational activities.



Courtesy New York City B'd. of Educ.

Courtesy Los Angeles B'd. of Educ.

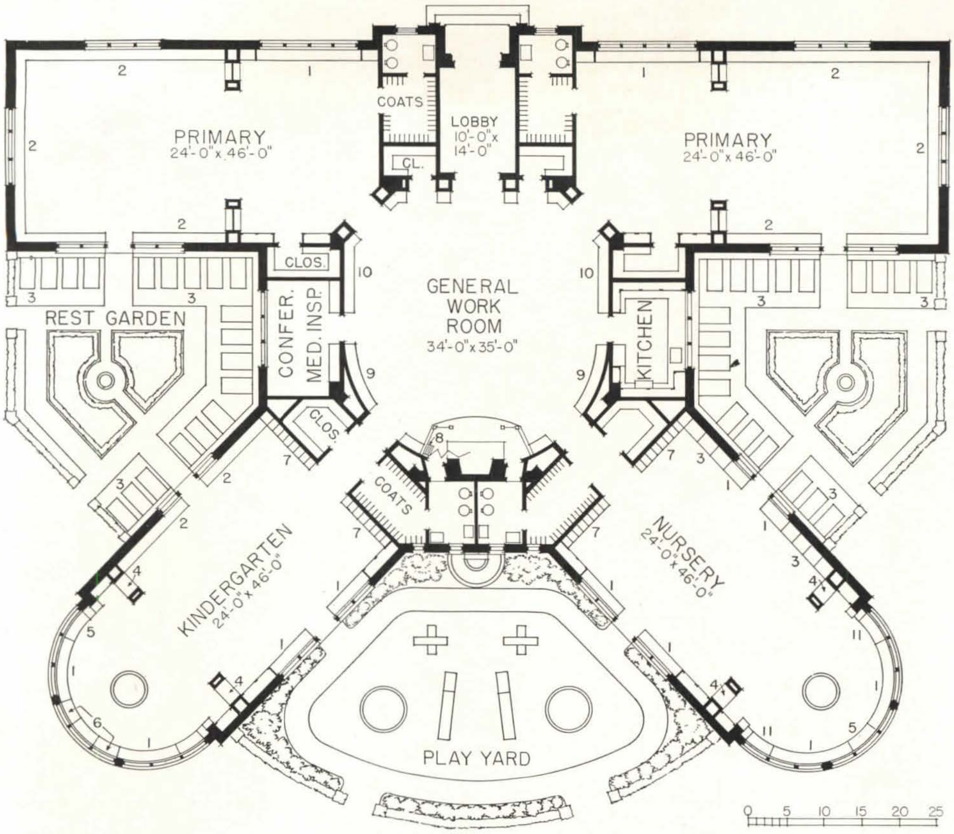


ACTIVITY EQUIPMENT			
TYPE	QUANTITY		
	Minimum Desirable	Average	Usual Maximum
"Jungle Gym" (large)	1	2	2
"Tower Gym" (large)	1	1	2
Slides (large)	2	2	3
Swings (large)	2	3	3
Climbing ropes	2	3	3
Ladders, bars (vert. and horiz.)	1	2	Several
Seesaws	2	2	3
Sawhorses	8	12	12
Boxes (play)	3 or 4	5 or 6	5 or 6
Sandbox	1	1 or more	1 or more
Pet space	200 sq. ft.	300 sq. ft.	300 sq. ft.
Gardens	450 sq. ft.	450 sq. ft.	450 sq. ft.
Playhouse	48 sq. ft.	48 sq. ft.	48 sq. ft.
Wheeltoy track	1	1	1
"Grotto"	..	1	1
Tool shed	1	1	1
Boards	Several for modeling; 2 or 3 large, for climbing; 12 or 15 small for building		
Wheel toys	From 2 to 4 each of the following: tricycles, wagons, wheelbarrows, trucks		
Miscellaneous	6 to 8 balls; kegs; carpentering tools and materials; garden tools, seeds, fertilizer, etc.		

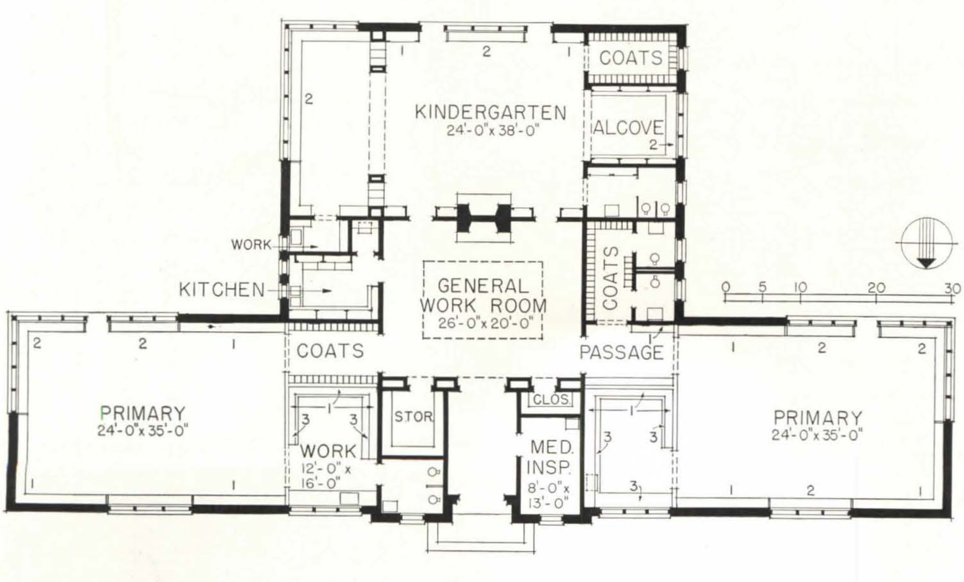
Play space should be contiguous to playrooms. Sliding or folding doors opening onto a surfaced play area are highly desirable. Surfacing should be resilient and of a non-abrasive material which sheds water easily.

Play apparatus should include large jungle gyms, large slides, swings, sand box, a playhouse, and a storage box similar to the one called for in nursery units.

Provision should be made in one corner of the play area for housing pets. A section should be set aside for individual gardens. Each garden plot should be separated from its neighbor by a small path. Shade trees are highly desirable.



COMBINED NURSERY SCHOOL AND KINDERGARTEN - PRIMARY UNIT



SELF-CONTAINED KINDERGARTEN-PRIMARY SCHOOL

These two plans for one-story kindergarten-primary schools embody suggestions relative to spaces and equipment which reflect current advances in educational practice. Though shown here as separate buildings, each is susceptible to development as a division of a complete elementary school plant.

Particularly noteworthy elements of the designs are:

1. An "open" type of layout that assures a maximum of sunlight and natural ventilation in all major spaces.
2. Central work room, lighted by a monitor.
3. Segregation of age-groups in areas, self-contained as concerns work space, sanitary and storage facilities, and instruction equipment.

Plans were developed by Douglas Ellington, architect, and Dr. N. L. Engelhardt, educational consultant, for a proposed rural rehabilitation community project. Legend, upper *plan: (1) seats,* (2) seats with cupboards below, (3) cots, (4) pet spaces, (5) aquarium, (6) herbarium, (7) cubicles, (8) movable screens, (9) cupboards, (10) benches, (11) window gardens. Lower plan: (1) cases, cubicles, (2) seats, (3) work benches.

UPPER ELEMENTARY

Courtesy New York City Bd. of Educ.

This unit corresponds to the upper grades in the traditional elementary school organization and represents an effort to meet broader needs created by expanding horizons of the child's experience. It provides an opportunity for children of 9 to 12 or 13 to move from manual experiences to those gained through investigation of environment and new fields of activity. "Activity" programs are, again, considered best. Optimum class size is set at 35 pupils per room; with a desirable maximum of 40 per room.

GENERAL PLANNING

Courtesy Detroit Bd. of Educ.

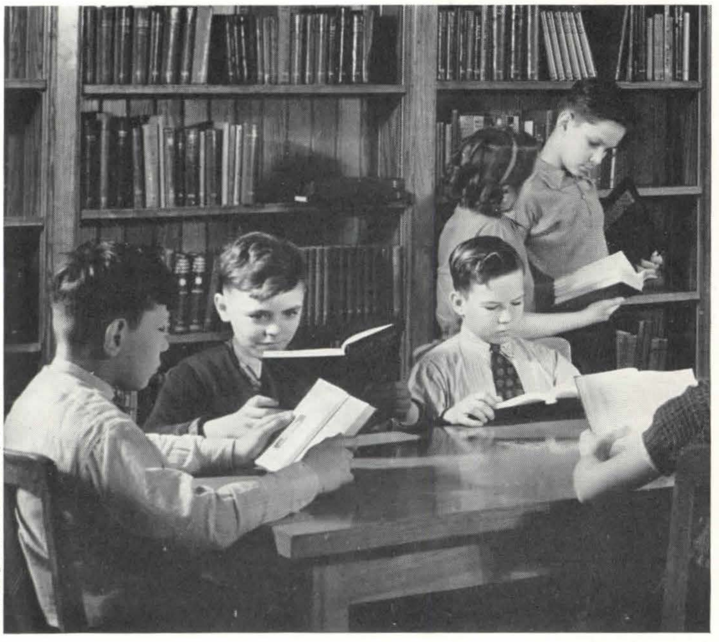
Buying and Selling

Courtesy San Francisco Bd. of Educ.

Sewing

Courtesy Buffalo Bd. of Educ.

Discussing


Courtesy Detroit Bd. of Educ.

Reading

Courtesy Los Angeles Bd. of Educ.

Pet-care

ACTIVITIES

Children of this age group take especial interest in team games, trips, and excursions. Boys are interested in experimentation. Work with radio sets and electric bells, construction with wood or metals, investigation in the simpler aspects of general science are all important activities. Girls prefer work in the home arts, in cooking and sewing. They enjoy constructing and furnishing playhouses and are particularly interested in dramatization and folk dancing.

Skating, swimming, and similar outdoor sports are popular with both boys and girls. Children of these ages start to play musical instruments and collecting has a strong, general appeal.

Interest in art is at a critical stage; and the majority of children 9 to 12 years old profit if emphasis on technical aspects of artistic craftsmanship which require specific talent, gives way to appreciation of beauty in clothing, housing, gardening, city planning, and art as a means of enriching life.

Voluntary reading is at its peak. Clubs and group activities become increasingly important.

SPACES

Toilet facilities

Educators are increasingly favoring the installation of toilet facilities in connection with workrooms at the elementary level. However, usual current practice is to install central toilet rooms for each sex on each floor within 100 ft. of each room. If facilities are provided in connection with workrooms each one may be available to two or more adjoining rooms.

Coat storage

It has been common practice to store coats in classroom wardrobes or in built-in coat alcoves at the rear of the room. As a result of experiment, many educators now hold, however, that individual corridor lockers are probably the most efficient means of caring for clothes. This practice, current in high schools, is a new departure in upper elementary school plants only to the extent of its application.

Shop

It is generally recommended that a large part of the industrial and home arts work be carried on in the workrooms. Often, however, it is desirable to provide a central laboratory or shop in which the more advanced equipment can be used under competent guidance as a supplement to workroom facilities.

The shop is an experimental center in which construction of simple wood and metal objects is carried on. It can also be used for science, radio work, home crafts, electrical work, and simple printing. A large amount of open floor space is required with the equipment spaced around the walls. A bilaterally lighted room, about 30 x 50 ft., equipped with movable partitions, is desirable.

This room should be located to provide a separate entrance for adult night activities. Heating arrangements should be correspondingly flexible. Facilities include toilets for both sexes, hot and cold running water, lavatories, shop sinks, extensive electrical outlets at floor level, gas burners.

Library

Although each classroom requires its individual library, the elementary school plant particularly requires a centralized space for books. The library will serve the need of growing children for a place in which to browse and whet their interests in various fields of literature. It may be used as a place for consultation on class problems, as well as a source for books for use in workrooms. The central library may also house collections of adult books; and if this is the case, a separate entrance should be provided for adults.

Space requirements include well-lighted reading areas at 25 sq. ft. per person, open stacks of books easily accessible to children, a control desk centrally located, and a workroom about 10 x 16 ft. in area for the librarian. A comfortable, inviting atmosphere is desirable in the library. This may be developed in part by providing such things as a fireplace, reading nooks, and large bay windows for group work.

Gymnasium or play shelter

The elementary school gymnasium is principally for use as a sheltered play area in inclement weather. Construction of this space may be similar to that of a small field house. Elaborate finishes and decoration are not necessary. Simple materials—such as painted concrete or cinder block—are more generally desirable.

To provide space for team or group games, the play shelter should cover a large unobstructed floor space 40 x 60 ft. minimum. Great height is unnecessary; probably the optimum ceiling height is about 16 ft. Ceilings are preferably acoustically treated.

Shower and locker provisions for both sexes are essential, as is storage space for mats and other equipment.

The gymnasium may often be used by the community in general; and means of adapting it to adult recreation needs should include a separate entrance and provisions for heating and lighting the room apart from the rest of the building.

Assembly room

Dramatics are an increasingly important part of activities; and the assembly room, therefore, becomes a major unit of a modern elementary school building. Because the room is also an important factor in the trend toward increased use of visual aid, space must be included for motion picture projection apparatus, screens, and sound equipment. Ceilings usually require acoustical treatment; and means for darkening the room—shades, curtains, etc.—are necessary.

The assembly room in the elementary school need only seat from 200 to 300 people, allowing 6½ sq. ft. per person. Seats should be fixed. A fly gallery is not necessary. Space for hanging draperies and curtains is desirable. It can be provided as a pocket, stage width, and about 6 ft. above the proscenium. Required auxiliary spaces include a workshop for construction of scenery, two group dressing rooms, and storage closets for costumes, property, and scenery.

It is increasingly desirable that the auditorium be planned to serve the purposes of adult education and to provide a place for neighborhood meetings. Therefore, it is generally best to include separate entrances to both auditorium and scenery workshops, and to equip the rooms with independent lighting and heating circuits.

Music room

The need for a room specially designed to encourage appreciation of music and the use of musical instruments, and for group rehearsals, is increasingly general. It should be approximately 24 x 40 ft., treated for sound insulation, and equipped for storing phonograph records, sheet music, books, music stands, and instruments.

It is desirable that the room be located near the auditorium stage to serve as a retiring room for the school orchestra.

Student activity room

Extra curricular activities such as a school newspaper, various clubs, student councils, or other school management bodies, safety patrols, etc., may be housed together in an activities room about 24 x 40 ft.

Essentials of such a room include a clear work space, a section partitioned off for group meetings, and plenty of storage space.

Cafeteria or lunch room

The size and type of lunch room facilities will vary according to the needs of the school, but a minimum of 9 sq. ft. per pupil using the lunch room should be provided. Similarly kitchen facilities are subject to wide variation and are also dependent to a large degree on the type of educational program. In small schools a kitchen space 20 x 30 ft. will generally be ample. In larger buildings an allowance of 1½ sq. ft. per dining seat is satisfactory.

Lunch rooms are best located to provide maximum sunlight and natural ventilation, preferably with at least mechanical exhaust.

Administration

Facilities required for administration also vary widely with the size and type of school. In general, however, the following average sizes are considered satisfactory:

Principal's office: 250 sq. ft., with connecting toilet.

General office and waiting room: 24 x 30 to 40 ft.

Medical office: 20 x 25 ft., with adjacent rest room 16 x 24 ft.

Guidance director's office: 12 x 16 ft.

Psychologist's office: 12 x 16 ft., with one or more testing booths 6 x 6 ft.

Teachers' rest room: 20 x 24 ft., with connecting toilet.

Bibliography

Bonser, F. G., and Mossman, L. C., *The Industrial Arts for the Elementary School*, New York, MacMillan Co., 1925, 490 pages.

Croxton, W. C., *Science in the Elementary School, Including an Activity Program*, New York, McGraw-Hill, 1937, 454 pages.

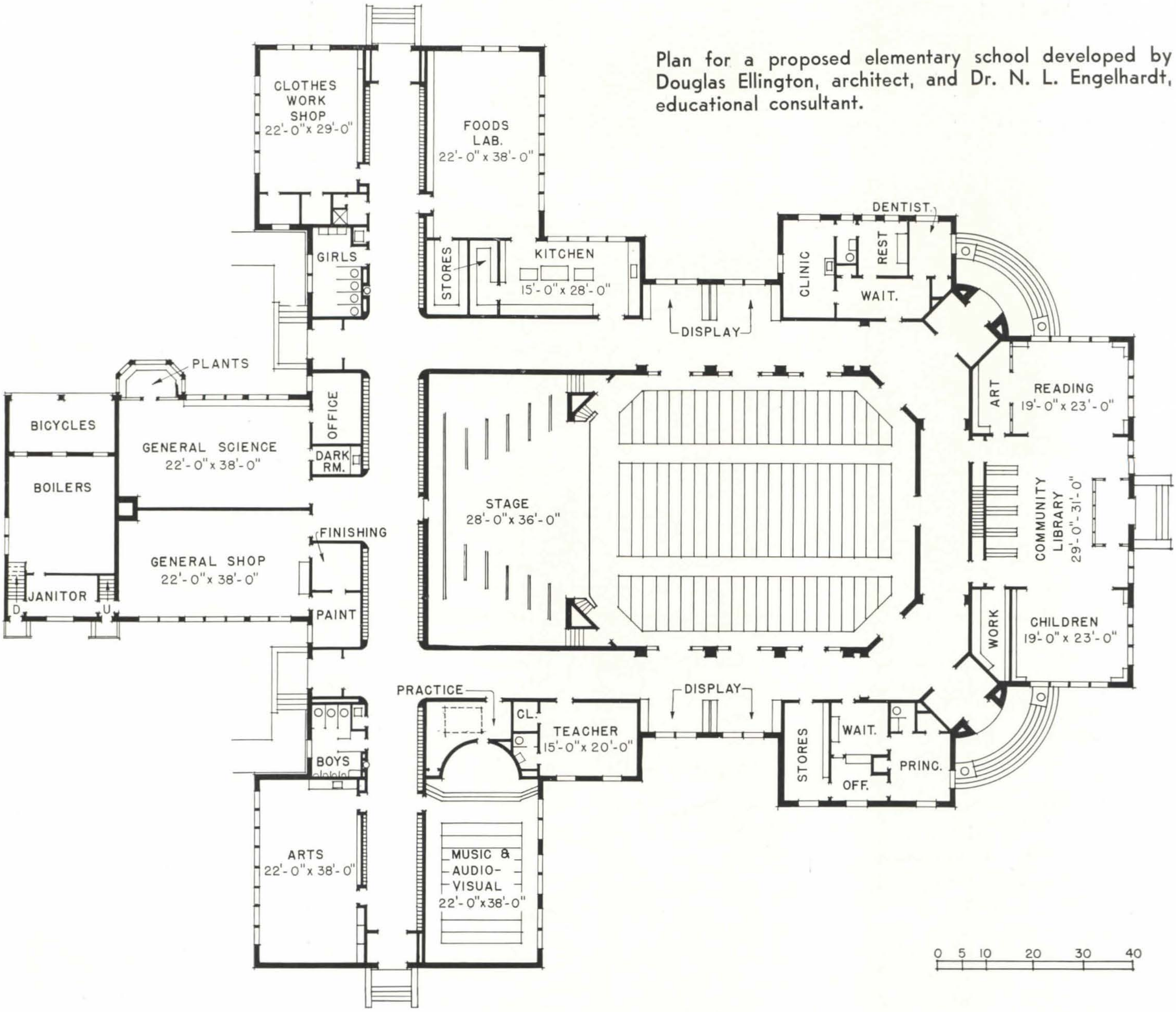
Hockett, John A., and Jacobsen, E. W., *Modern Practices in the Elementary School*, New York, Ginn and Co., 1938, 346 pages.

Lane, Robert H., *The Progressive Elementary School*, Boston and New York, Houghton-Mifflin and Co., 1938, 197 pages.

Long, Frank, *Desirable Physical Facilities for an Activity Program*, New York, Bureau of Publications, Teachers' College, Columbia University, 1933, 116 pages.

Otto, Henry J., and Hamrin, Shirley, *Co-curricular Activities in Elementary Schools*, New York, D. Appleton-Century Co., 1937, 441 pages.

Strayer, George D., and Engelhardt, N. L., *Standards for Elementary School Buildings*, New York, Bureau of Publications, Teachers' College, Columbia University, 1933, 181 pages.



Plan for a proposed elementary school developed by Douglas Ellington, architect, and Dr. N. L. Engelhardt, educational consultant.

Designed as the upper elementary unit of a rural or suburban community school system, this plan illustrates, graphically, the trend of present educational practices and suggests a method of providing facilities adequate to the needs of a currently recommended activity curriculum. It is projected as a one-story building for the use of the entire community. In one sense, therefore, it is less an elementary school than it is a neighborhood center to serve the rapidly expanding requirements of adult educational and community activities which, more and more, are being closely linked with child training.

Noteworthy as a means toward these ends is the central location of both library and auditorium, both of which are equipped for adult as well as children's use. Equally noteworthy is the substitution of "workrooms" for "classrooms", each designed to provide a desirable environment and adequate equipment for specialized activity. From the standpoint of an elementary curriculum, this permits "learning by doing", a method of educating that seeks to integrate a child's growing experience with the progressive events of the world in which he lives.

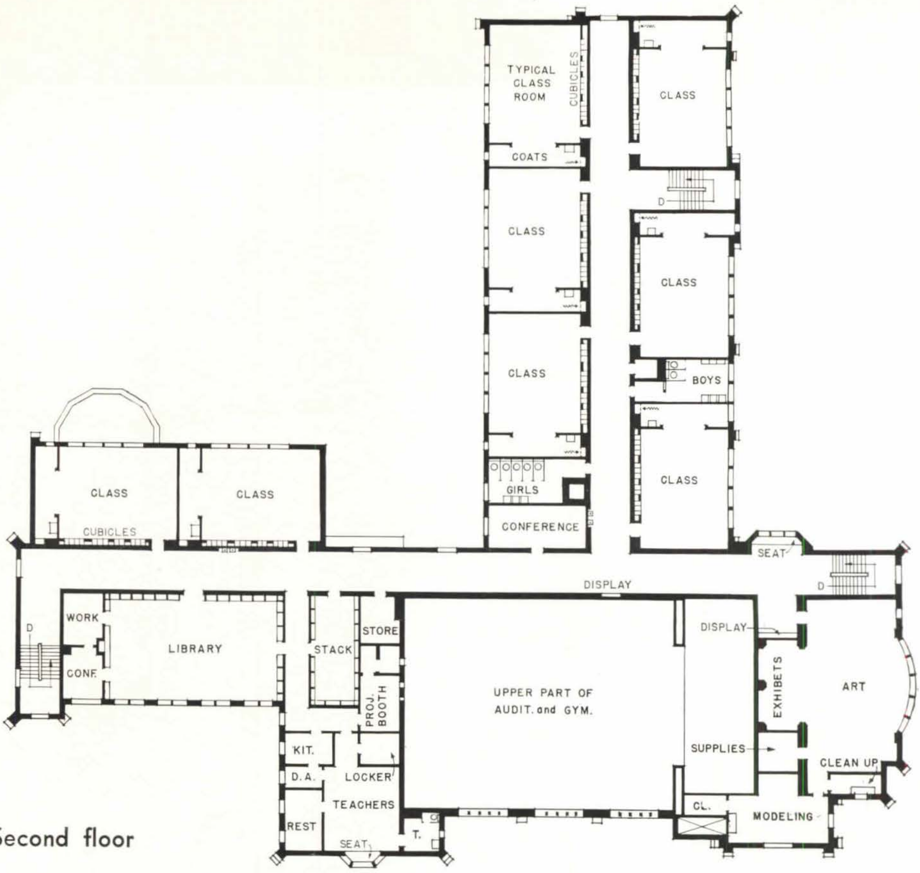
Outdoor areas for both work and play are a necessary complement to a design of this type. An elementary school of this size would require a plot of at least five acres.

UPPER ELEMENTARY

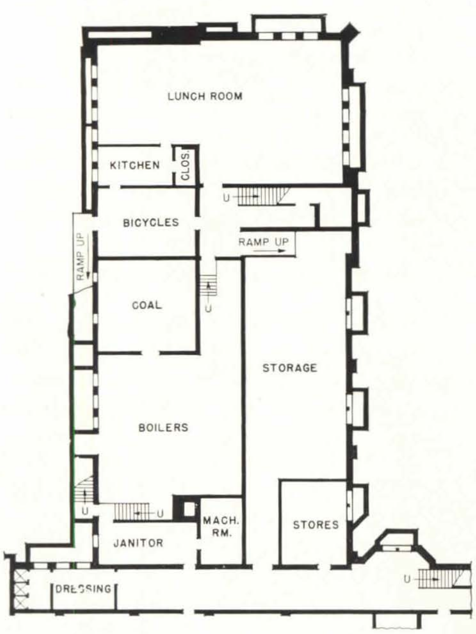
Plans developed and approved for

HIGHLANDS GRADE SCHOOL
White Plains, New York

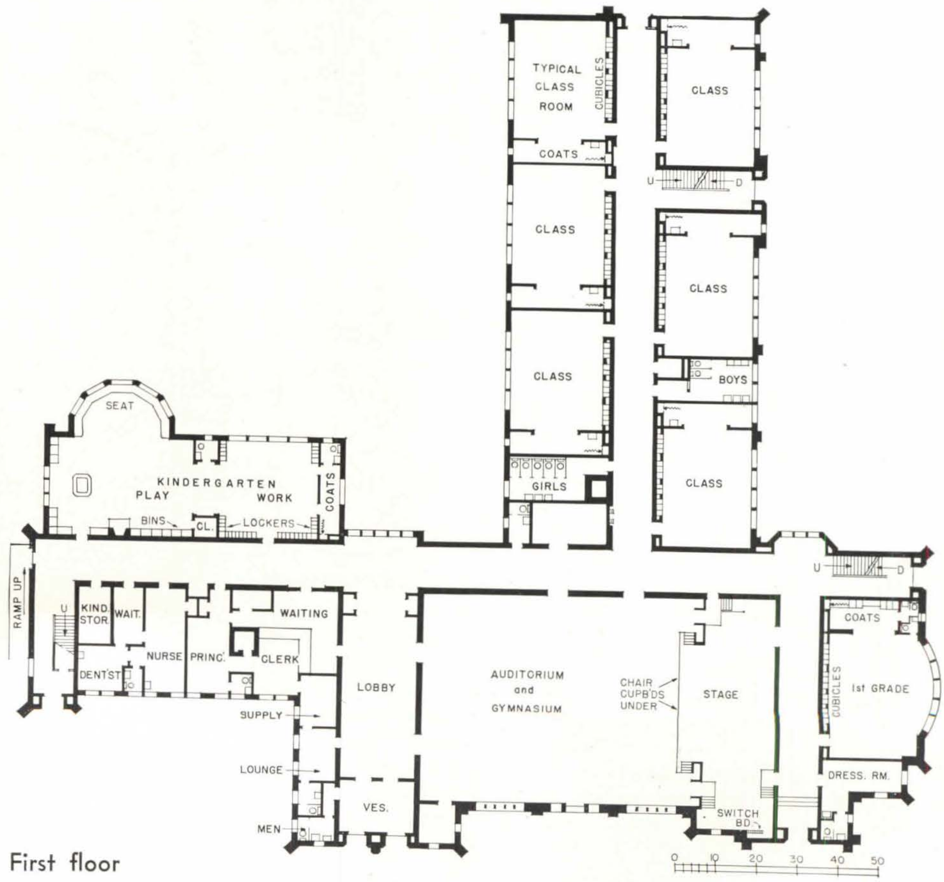
TOOKER and MARSH, Architects



Second floor



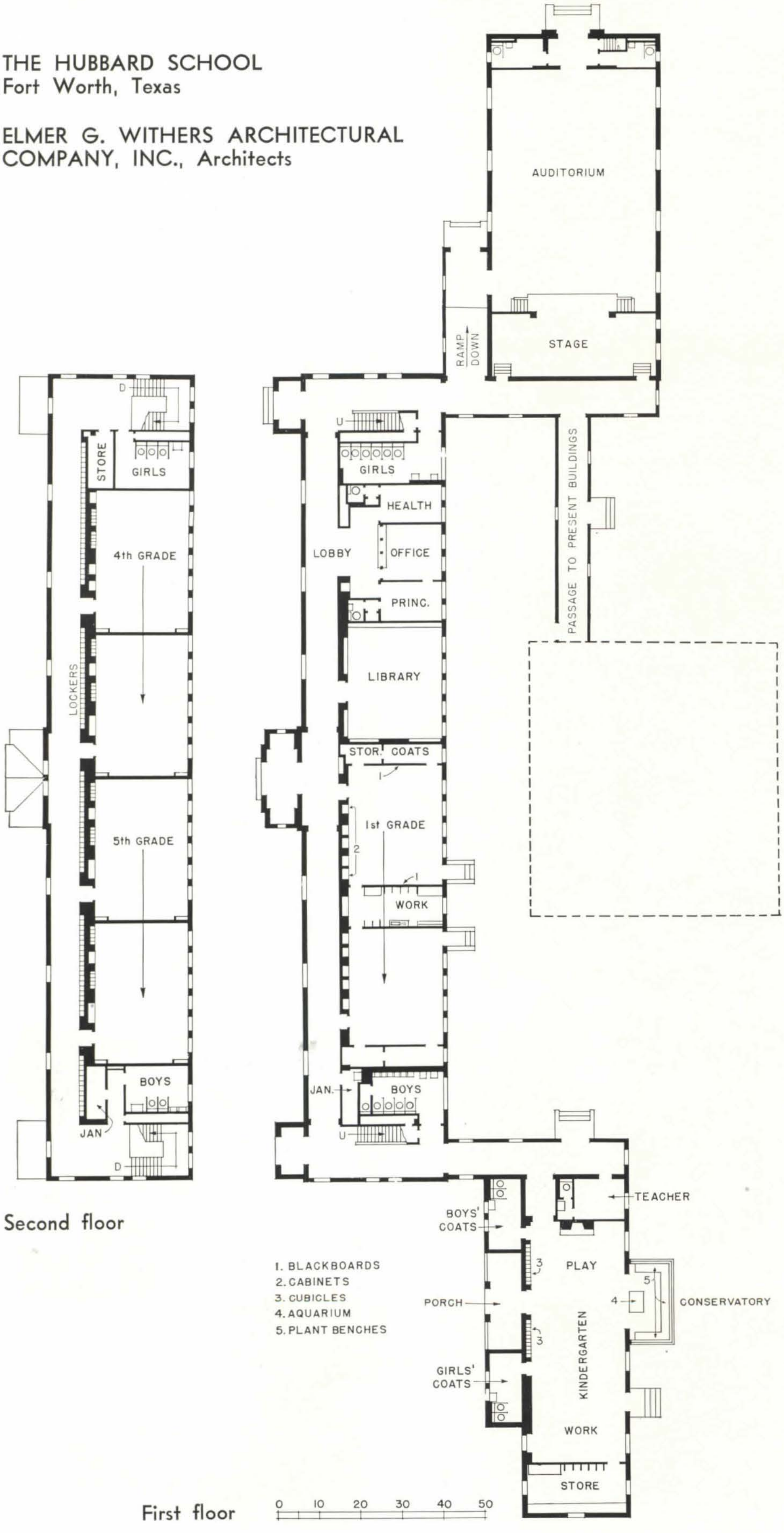
Part of basement



First floor

THE HUBBARD SCHOOL
Fort Worth, Texas

ELMER G. WITHERS ARCHITECTURAL COMPANY, INC., Architects



Second floor

First floor

On this and the facing page are plans of two recently designed schools that embody many principles of advanced educational thought outlined in this reference study. Though in widely separated parts of the country, each reflects a common attempt to integrate the school plant and the various community educational requirements of adults and children.

Characteristics that are especially noteworthy include:

1. Segregation of kindergarten units from other instructional areas. This separation has also been developed in the treatment of adjacent outdoor areas.

2. Direct access to auditorium from outside. Equipment facilities permit adult-group use of this space.

3. Separation of age groups. Older children occupy rooms on the second floor.

4. Classrooms that are susceptible to use according to an activity program as opposed to the traditional recitation system of instruction.

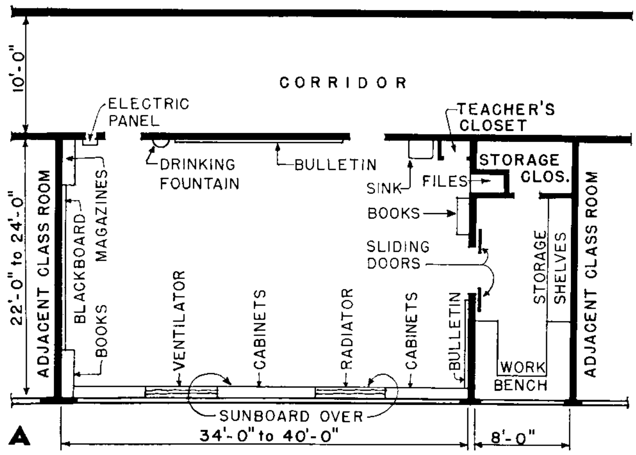
5. Provision of rooms for specialized activities — as art room and library — and, in the Highlands School particularly, a health clinic easily accessible to the public.

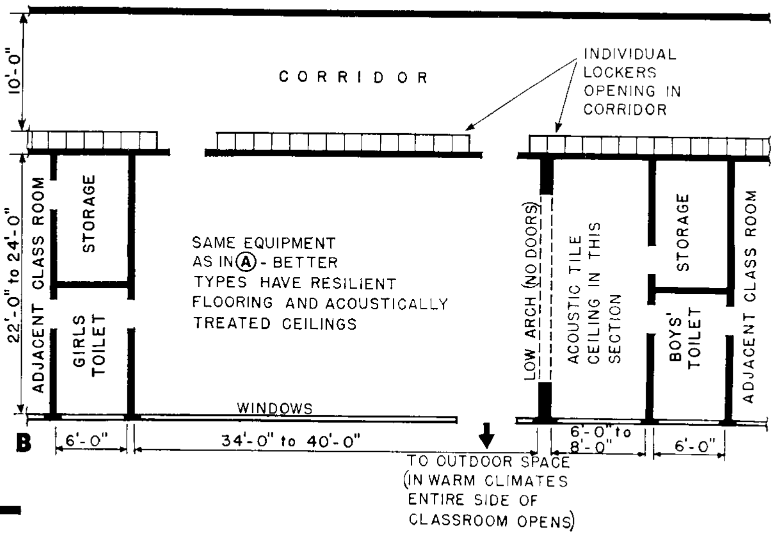
Dr. N. L. Engelhardt was educational consultant for both school buildings.

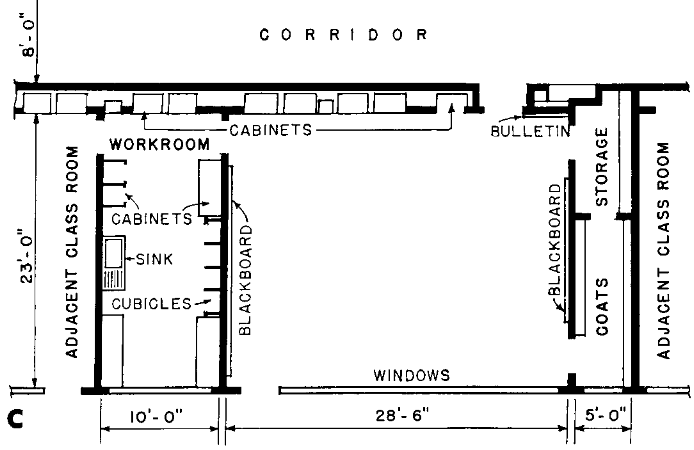
WORKROOMS (Classrooms)

All four photographs illustrate activities which modern upper elementary school rooms must accommodate if the school is to function satisfactorily. Above and left: types of instruction and pupil activity to which the more common classroom for general instruction may be adapted; below, handicraft and scientific studies for which specialized workrooms are suitable.

Photos courtesy Los Angeles Bd. of Educ.







Three types of workroom-classroom planning: Types A and B were developed as the result of research conducted at Teachers' College, Columbia University; Type C was adapted from plans by the Elmer G. Withers Architectural Co., Inc., for the Hubbard School at Fort Worth, Texas. Equipment required for all three is essentially the same. Differences consist principally of changed locations of plan elements, and of the degree to which work alcoves and toilets are made available to more than one class unit.

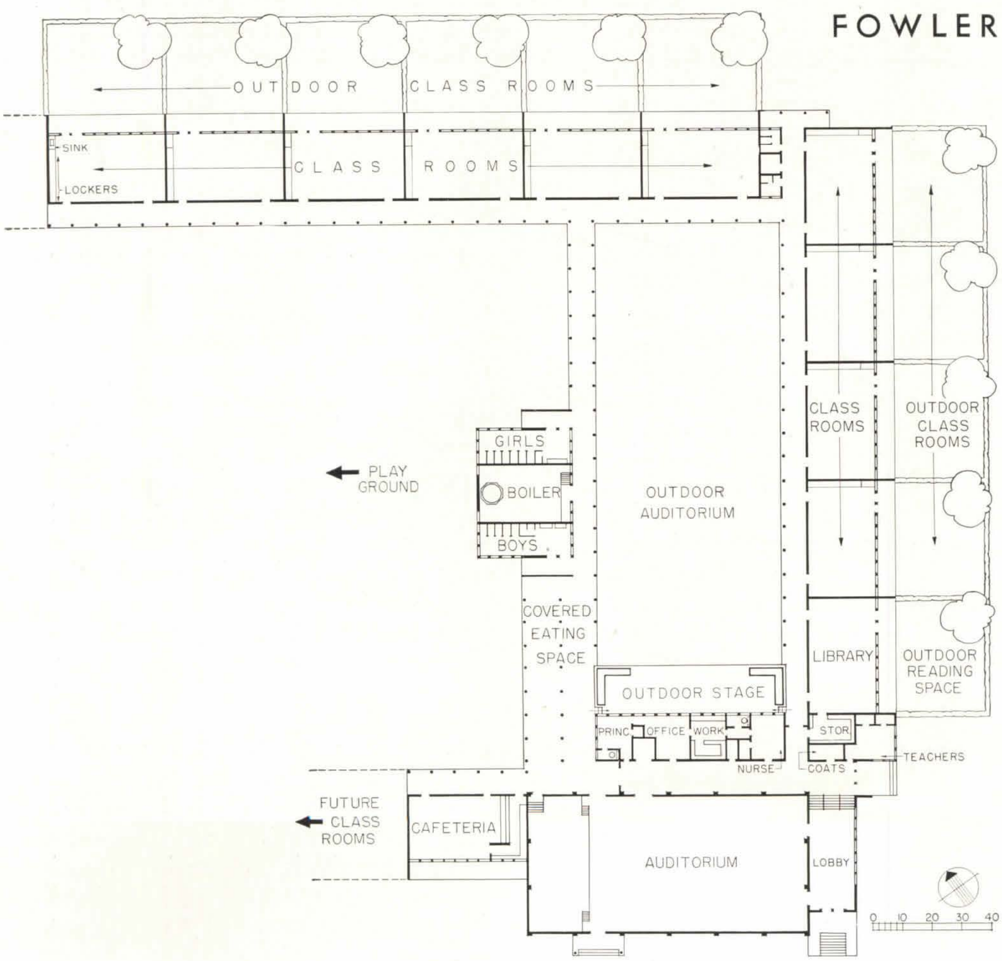
The usual term "classroom" is gradually giving place to "workroom" as a name reflecting more accurately the activities it houses. Major changes in equipment and size of elementary school classrooms have been made in recent years as a result of research and changing curricula. The most advanced planning has pointed toward increasing storage space and bulletin boards, reducing blackboards areas and substituting movable tables and chairs for desk-chairs and fixed seats; and room areas are increasing. In the past decade elementary rooms 22 x 28 ft. were considered desirable. In 1933 Dr. Frank Long's research in this area brought out the need for rooms at least 35 ft. in length. Strayer and Engelhardt recently have recommended classrooms 32 to 34 or 35 ft. in length, and the recent trend is toward rooms 36 to 40 ft. in length for classes of 35 to 40 pupils. Most authorities agree that 35 pupils per room is desirable, but realize that frequently economy necessitates 40 per room. With decreasing elementary school enrollments it is generally safe to plan buildings in terms of slightly more than 35 pupils per room relying on the natural decrease to bring utilization to a more reasonable limit in a few years.

An alcove or work space, partitioned off in the rear of the room, is customarily recommended for noisy activities. This space may be 6 to 8 ft. wide running full width of the main room. There may be a work space for each room or one space may be used in common by two adjacent rooms. Equipment in this space usually consists of one or two work benches, a tool rack, and as many varied storage facilities as can be secured. An acoustic ceiling is highly desirable.

Equipment in the main room usually includes 12 to 16 linear ft. of blackboard, 3 ft. high, set 26 in. above the floor on the front wall. Corridor and rear walls are used for bulletin boards, which should extend from about 26 in. above the floor to a line 7 ft. above the floor. Above and below bulletin and blackboards it is well to provide a map and tack strip which allows use of picture hangers. Space below these boards can be utilized for necessary storage cabinets and map cases, preferably built into the walls. At either side of the front blackboard it is desirable to have bookcases and magazine racks, and above the blackboard, a loud speaker.

The inside wall should contain drinking fountain and sink toward the rear of the room; and, toward the front, clock, telephone, thermostat, radio switch, and light switch, the latter four items grouped on one electrical panel board. In absence of heating or ventilating equipment, space under the windows may be well used as storage cubicles for pupil use. Picture molding is desirable near or against the ceiling on all three inside walls. Each room requires two entrances, one in the front and one in the rear. A teacher's storage locker and files, preferably built-in and of legal size, should be provided on the rear wall.

Photos by Esther Born



FOWLER ELEMENTARY SCHOOL

Fowler, California

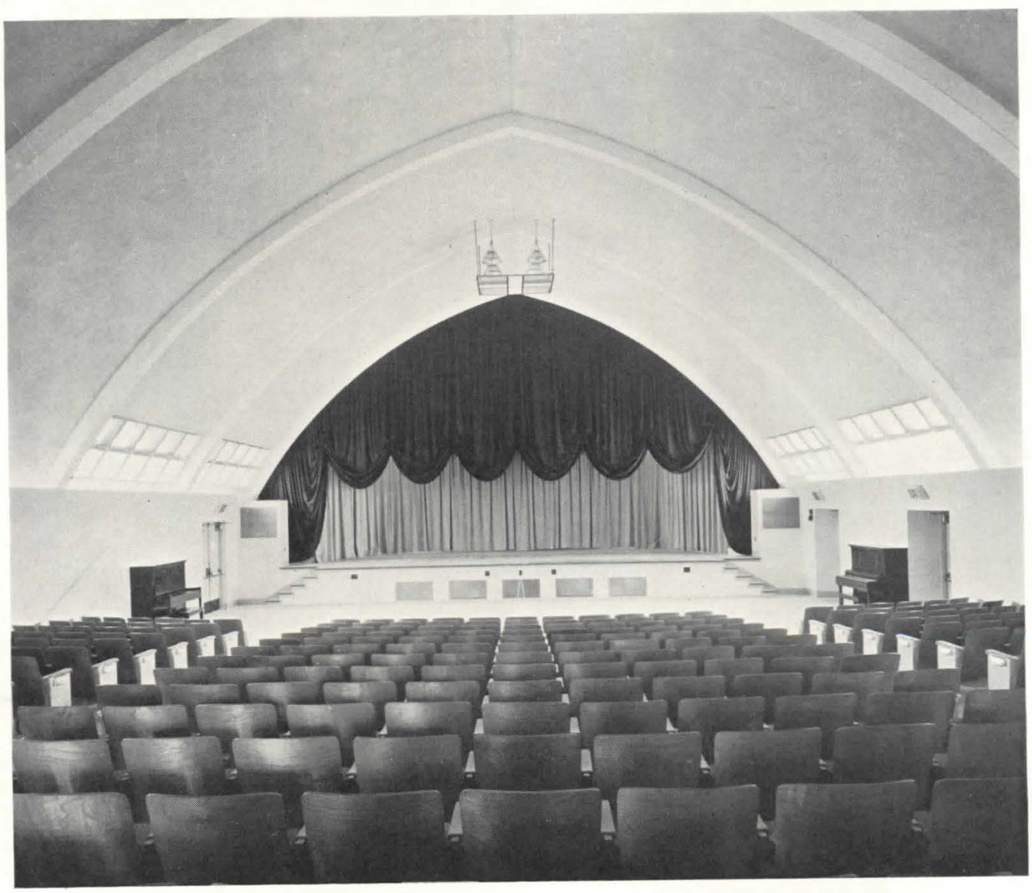
FRANKLIN and KUMP,
Architects

Construction, except for the auditorium unit, is frame, laid out on 4 ft. modules. All cross partitions are non-bearing. This type of structure permits changing locations of intermediate classroom partitions without altering the frame. Future expansion is provided for at the ends of the cafeteria and northwest classroom wings. A single service unit is located conveniently to the playground as well as to the school building. The auditorium is available for use without entering any other portion of the building.

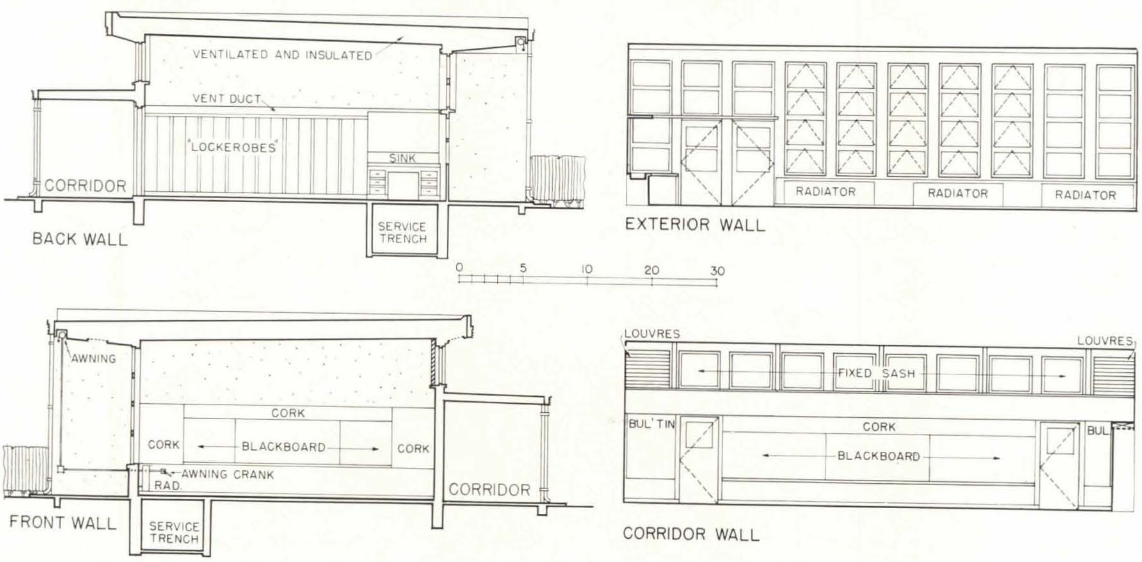
Roofs are of 26-gauge copper bearing galvanized iron, sprayed with aluminum paint, and insulated with rock wool and ventilated air spaces.

Each classroom has its own outdoor area which will be enclosed with high hedges when planting is completed. The outdoor auditorium has a complete lighting and public address system, and it is used by the school and by the public.

The indoor auditorium is shown at the right. Floor and wall structure consists of inverted rigid concrete frames, 16 ft. on centers. These resist the thrust of the laminated wood three-hinged arches which form the roof. Insulation, acoustical treatment, and roof surfacing are similar to construction used in classroom areas. Structural systems are designed to cope with seismic disturbances.

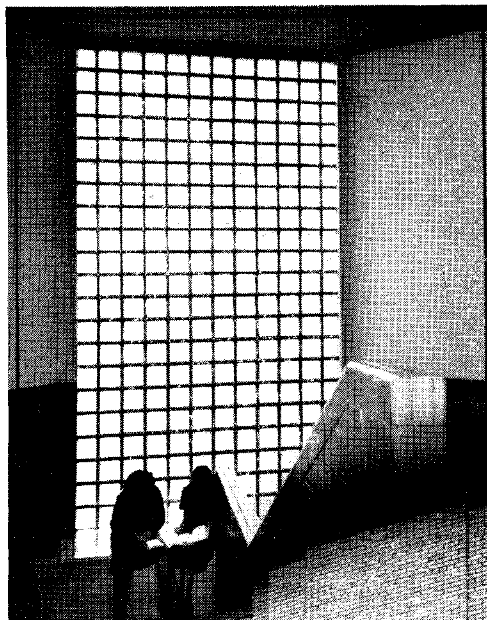


Esther Born



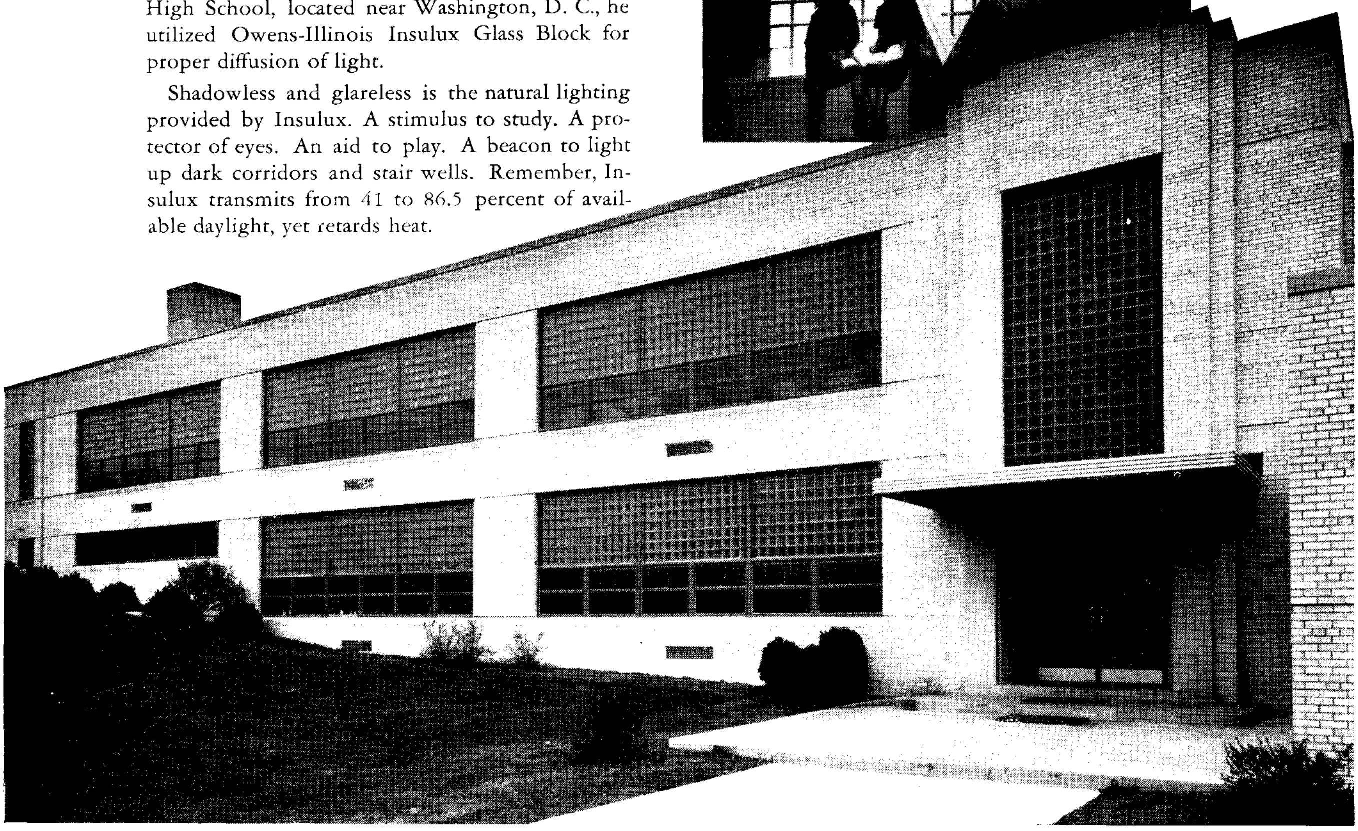
Natural lighting is bi-lateral. The intense sunlight which prevails during most of the school year is the reason for the canopies which overhang windows. Large window areas are shaded by vertical, adjustable drop shades, aluminum in color on the exterior and green on the interior. These can be adjusted from indoors in order to keep the direct rays of the sun off the glass. Wing walls prevent diagonal light rays from entering classrooms. Clerestory windows over the corridors are used for lighting only and are equipped with aluminum slat shades which direct a maximum of light onto the ceiling and thence to desk level. Cross-ventilation is provided by the louvered sections of the clerestory at each end of each classroom.

NO SHADES TO DRAW NOR SHADOWS TO BLUR . . . .



Study Architect Burkett's answer to that most baffling problem of school design . . . proper lighting. In all 15 rooms of the new Kensington Junior High School, located near Washington, D. C., he utilized Owens-Illinois Insulux Glass Block for proper diffusion of light.

Shadowless and glareless is the natural lighting provided by Insulux. A stimulus to study. A protector of eyes. An aid to play. A beacon to light up dark corridors and stair wells. Remember, Insulux transmits from 41 to 86.5 percent of available daylight, yet retards heat.

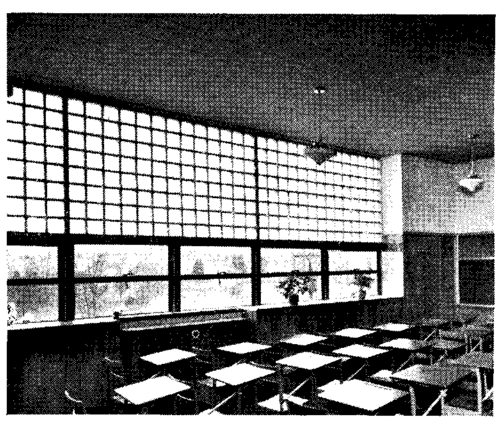


Modern in concept, but sound in design, this school lives in harmony with surrounding Colonial homes, typical of Washington's Rock Creek district.

When designing educational buildings, consider Insulux. It is the glass block proved by more than 50,000 actual installations and under continuous rigid testing at Purdue University. Owens-Illinois Glass Company, Insulux Products Division, Toledo, O.

. . .

All Views, Kensington (Maryland) Junior High School. Architect, Rhees E. Burkett, Washington, D. C.



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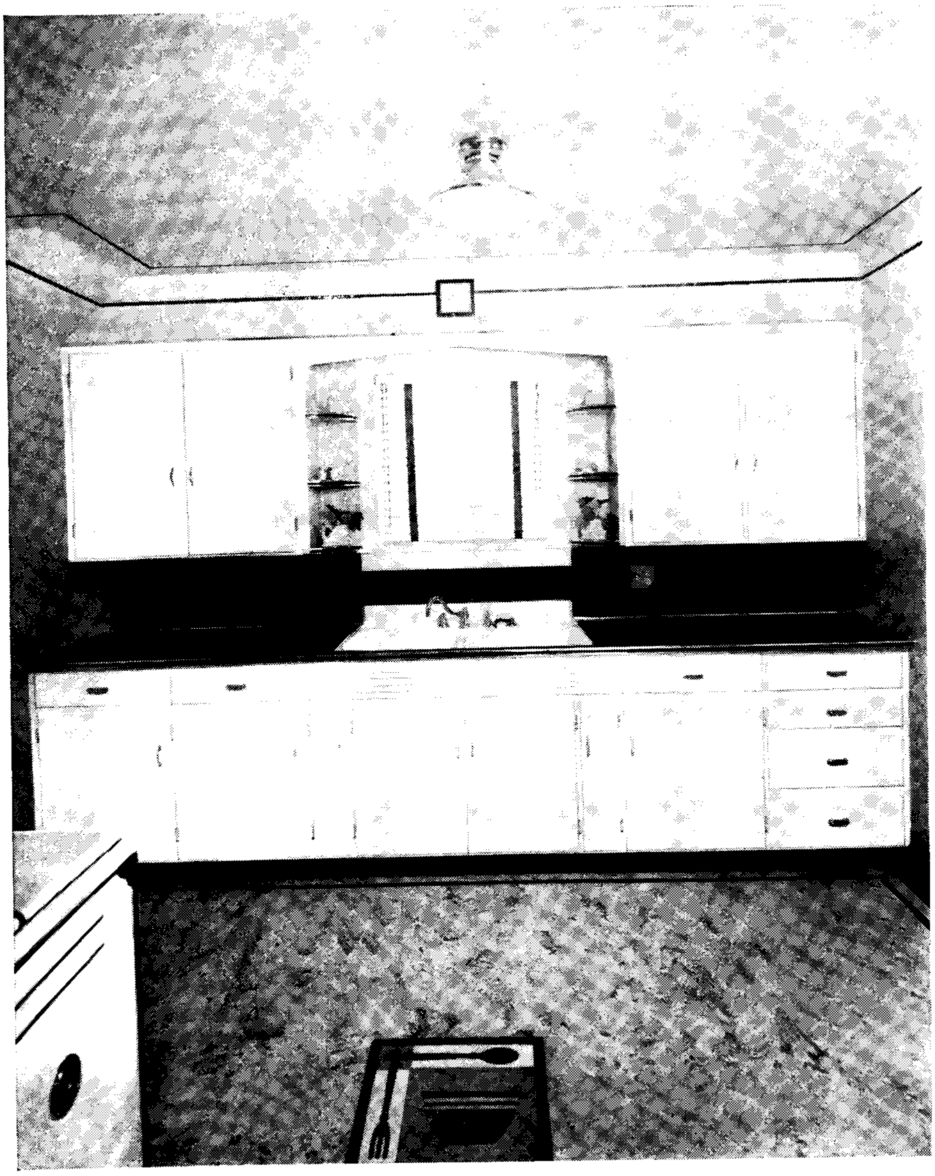

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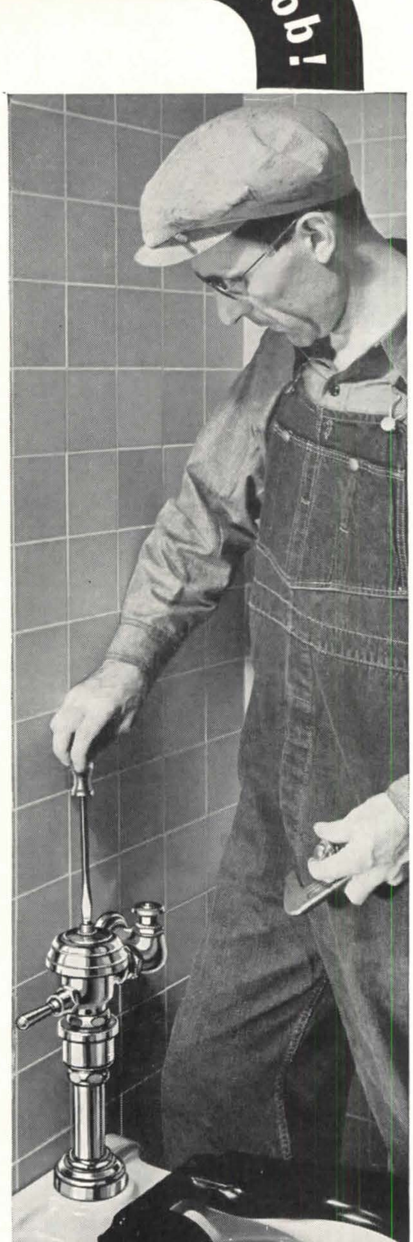

IF you have used Watrous Flush Valves on your school jobs you may have noticed that the plumbing contractor usually has a man adjust the valves as just about the last detail of the plumbing installation.

Why are plumbing contractors so careful to do this?

The answer is—they know that different toilet fixtures have different water requirements—that installation conditions vary. And they know that the Watrous Water Saver Adjustment makes it possible to regulate any Watrous Valve quickly and easily so that a minimum amount of water will be used by each fixture.

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But this is only one reason why Watrous Flush Valves save. The patented, self-cleansing by pass—which eliminates the need for constant inspection and maintenance—is another.

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See Catalog No. 58, Section 27 of Sweets Catalog file for 14 pages of specification and installation details on Watrous Flush Valves.

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Wyandotte High School, Kansas City, Mo.
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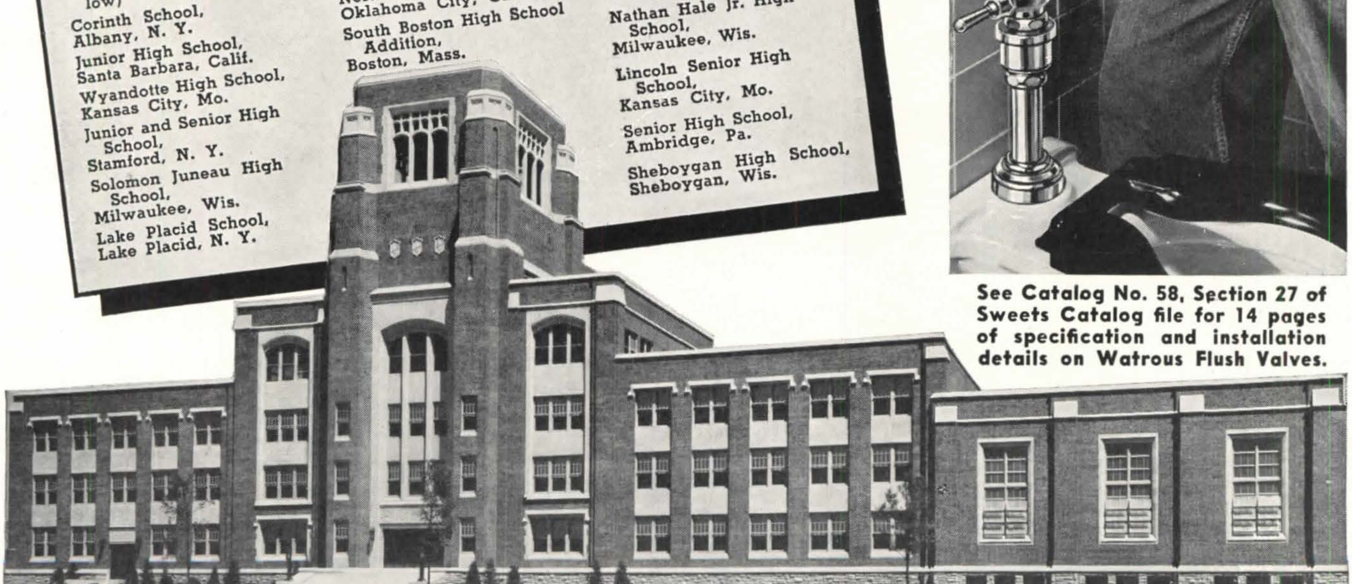
Solomon Juneau High School, Milwaukee, Wis.
Lake Placid School, Lake Placid, N. Y.
Mary E. Curley School, Boston, Mass.
Senior High School, Providence, R. I.
Northeast High School, Oklahoma City, Okla.
South Boston High School Addition, Boston, Mass.
George Mason School, Richmond, Va.
Vernon School, Birmingham, Ala.
Chelsea Heights School, St. Paul, Minn.
Nathan Hale Jr. High School, Milwaukee, Wis.
Lincoln Senior High School, Kansas City, Mo.
Senior High School, Ambridge, Pa.
Sheboygan High School, Sheboygan, Wis.



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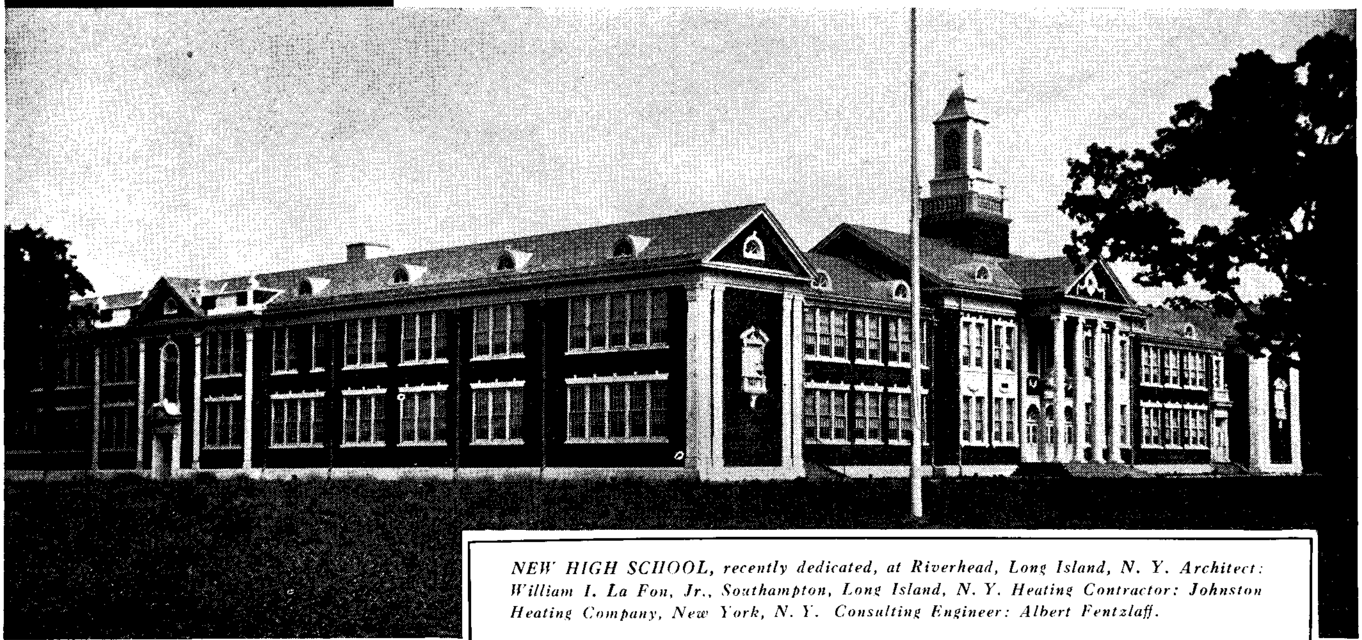
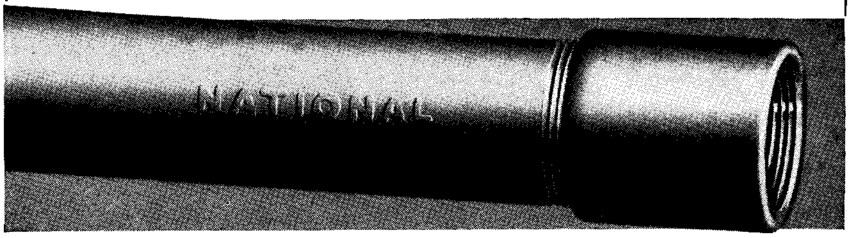


NEW HIGH SCHOOL, recently dedicated, at Riverhead, Long Island, N. Y. Architect: William I. La Fon, Jr., Southampton, Long Island, N. Y. Heating Contractor: Johnston Heating Company, New York, N. Y. Consulting Engineer: Albert Fentzlaff.



RIVERHEAD'S 8000 residents turned out en masse at the recent opening of its new high school. To a man, they are proud of their new school. Proud of its distinctive Georgian Colonial architecture . . . of the many modern innovations in physical equipment . . . of the comfortable size which will provide for normal increase in student body.

But most of all, Riverhead is proud that its new school has been built to last for many years. Only the finest available materials went into the construction.

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Riverhead High is typical of hundreds of private and public buildings completed, in construction, or planned. Principal objective of the planners and builders is to give these buildings reasonable expectancy of long trouble-free life. Contractors have found that the best way to meet this specification is to use NATIONAL Pipe.

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UNITED STATES STEEL

Review of New Books

(*Continued from page* 83)

RENAISSANCE ARCHITECTURE OF ENGLAND: Its Social and Historical Development. By A. Thornton Bishop. With an introduction by Harvey Wiley Corbett. John Wiley & Sons, Inc., New York, N. Y., 1938. With 48 pencil drawings by the author. 107 pages. 9¼ x 12 in. Price, $6.

THIS book studies the architecture of England during the Renaissance from the social and economic aspects. The three parts into which the book is divided are obvious: Early Renaissance, Palladian, and Georgian periods. Chapter headings include: The Italian Idea Transplanted; Inigo Jones Develops the Italian Idea; The Development of English Renaissance Interiors; and The Decay of the Renaissance.

THE NEW HOME OWNER'S HANDBOOK. By C. B. Smith. Drawings by R. M. Bennett. Modern Age Books, Inc., New York, N. Y., 1938. Price, 75c.

THIS BOOK attempts to give the home owner the information that will help him to buy materials, equipment, and services for his house and prepare him for those emergencies when he must make temporary or permanent repairs. Some of the chapter headings are: Insulation and Its Values; Heating the Home; Air Conditioning; Electricity; Landscaping; Rural Water Supply and Sanitation.

AMERICAN PLANNING AND CIVIC ANNUAL. Edited by Harlean James. American Planning and Civic Association, 901 Union Trust Building, Washington, D. C., 1938. 344 pages. 6¼ x 9¼ in. Price, $3.

SUMMARIZED here is the record of recent civic advance as shown in the proceedings of the conference of National Parks held at Washington, D. C., the National Conference on State Parks, held at Norris, Tenn., and the National Conference on Planning held at Minneapolis, Minn. The book is in three sections: National Parks, State Parks, and Planning.

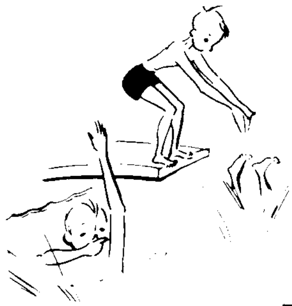
HISTORIC AMERICAN BUILDINGS SURVEY. Compiled and edited by John P. O'Neill. United States Government Printing Office, Washington, D. C., 1938. Catalog of Measured Drawings and Photographs. 264 pages. 5¾ x 9 in. Price, 50c.

MATERIAL listed in this catalog is available for consultation in the library of Congress, Washington, D. C. The catalog records the work of the survey (measured drawings, photographs, and data on ownership and date of construction) on 2,200 structures in 41 states, the District of Columbia, and Puerto Rico. It contains a number of photographs and reproductions of measured drawings.

NATIONAL CONFERENCE ON PLANNING, 1938. American Society of Planning Officials, 1313 East Sixtieth St., Chicago, Ill., 1938. 201 pages. 6¼ x 9¼ in. Price, $2.

THIS summary of the proceedings of the conference held in June, 1938, at Minneapolis, Minn., represents the combined findings of The American City Planning Institute, The American Planning and Civic Association, and The American Society of Planning Officials. Directed by Walter H. Blucher, Executive officer of ASPO, the conference discussed the salient problems and solutions of city, state, regional, and national planning. Among the subjects here reported

(*Continued on page* 130)



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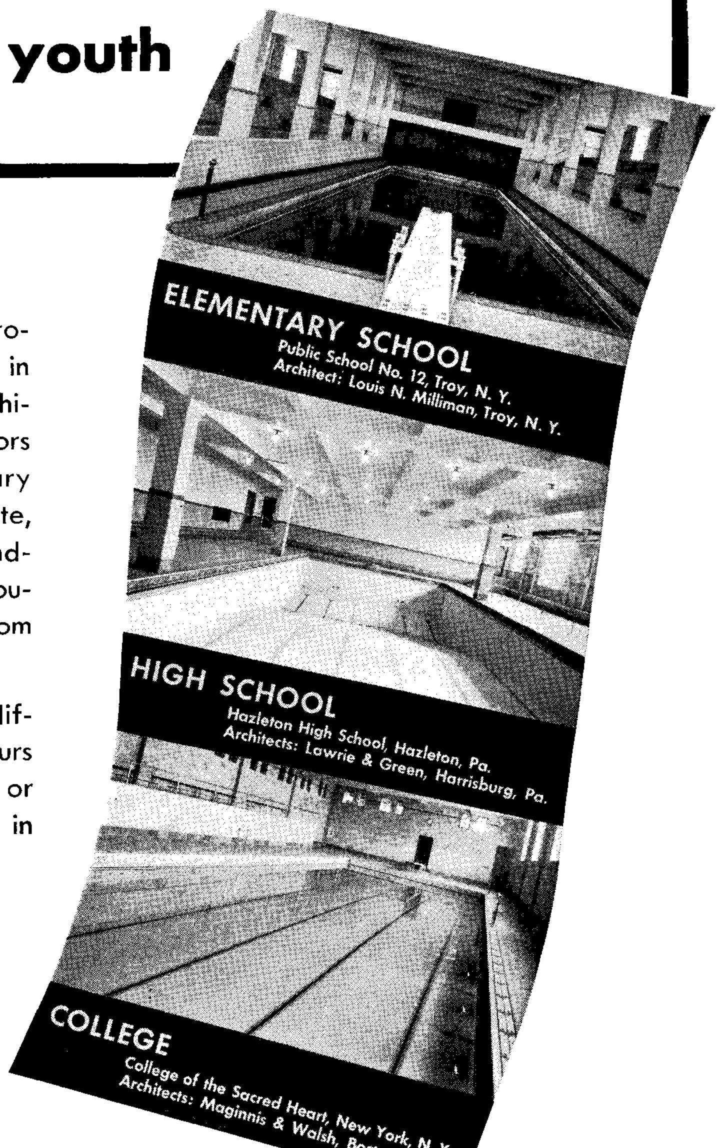

ELEMENTARY SCHOOL
Public School No. 12, Troy, N. Y.
Architect: Louis N. Milliman, Troy, N. Y.

HIGH SCHOOL
Hazleton High School, Hazleton, Pa.
Architects: Lawrie & Green, Harrisburg, Pa.

COLLEGE
College of the Sacred Heart, New York, N. Y.
Architects: Maginnis & Walsh, Boston, Mass.

(Photographs courtesy of Swimming Pool Construction Corp.)

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NEWARK, NEW JERSEY — **BRANCHES IN PRINCIPAL CITIES**

Review of New Books

(*Continued from page* 128)

are: Trends in Planning Law, Legislation, and Litigation; Education for Planning in the United States; Migration and Economic Opportunity; and Rural and Agricultural Zoning.

THE AMERICAN ART MANUAL. Published by The American Federation of Arts, Washington, D. C., 1938. Volume 34, 711 pages, cloth. Price, $7.

THE FIRST edition since February 1937, Volume 34 will now be available earlier in the art season and will be issued every other year—instead of annually—alternating with its sister volume, Who's Who in American Art, which is biennial.

Improvements have been made in its contents with the addition of running heads throughout, a new modern readable type, double columns for straight text, and an improved index.

Included in this book which brings up to date all regular directories are:

1. Eighteen Months in Art (A summary of trends, events, and happenings in art from Jan. 1937 through June 1938).
2. The American Federation of Arts (Activities, officers, trustees, staff, and annual report for two years are given, together with a list of Chapters).
3. National and Regional Organizations, Local Museums, Art Associations, and American Organizations Abroad (Information on names of officers and staff members, activities, accessions — for museum purposes and exhibitions held — is covered in this grouping).
4. Art Museums and Galleries in Latin America and Canada (New directory answers many questions concerning these countries in the field of art).
5. Directory of Art Schools (All art schools, colleges, and universities with art departments are listed).
6. Fellowships and Scholarships in Art (This section describes fellowships and scholarships from 105 sources and how to qualify for them.
7. The Art Press (Magazines, bulletins, and newspapers carrying art notes together with name of editor, publisher, date of issue, and price of these printings are noted).
8. Paintings and Prints Sold at Auctions—Two Seasons (A list of paintings sold at auction for $50 and up are included in this report).
9. Complete Index with Cross Reference.

This new Annual graphically highlights the expanding interest in art organizations and the growing public interest in art.

SUNDIALS: HOW TO KNOW, USE, AND MAKE THEM. By R. Newton Mayall and Margaret L. Mayall. Hale, Cushman & Flint, Boston, Mass., 1938. Illustrated with drawings and photos. 197 pages. 6 x $8\frac{1}{4}$ in. Price, $2.

A PRACTICAL handbook for persons especially interested in the history, types, and development and fashioning of sundials. Ample photos, drawings, and formulas for computing hour lines and designs for all styles of dials clarify the technical phases of this sundial duty. The volume

(*Continued on page* 132)

Review of New Books

(*Continued from page* 130)

contains valuable suggestions and data for sundial enthusiasts by astronomical authorities.

STANDARDS FOR COLLEGE BUILDINGS. By E. S. Evenden, G. D. Strayer, and N. L. Engelhardt. Bureau of Publications, Teachers College, Columbia University, New York, N. Y., 1938. 216 pages. 6 x 9 in. Price, $2.25.

WRITTEN PRIMARILY for college administration officials, this book of standards also serves as an excellent outline for the architectural designer. Since the book was prepared for use in connection with the Evenden-Strayer-Engelhardt score card for College Buildings (included in the volume), the text follows the topical order of the card and clarifies the various points on which evaluation is based. These standards represent the composite judgment of nearly 300 persons in educational, administrational, and architectural fields who are familiar with college buildings and the purposes for which they are intended. In compiling the material, the authors visited many colleges and universities in the United States, Canada, and Europe, and they have included in this volume the better features of these buildings.

The book contains chapters on Site (location, size, form, etc.); Buildings (campus plan, gross and internal structure, interior finish, and decoration); Service Systems (heating, ventilation, fire protection, etc.); Instruction Rooms (number, availability, size and shape, natural light, equipment, teachers' offices, etc.); and General Units (administration, library, auditorium and chapel, health, recreation and athletics, dormitories, and social rooms). In addition, there is a set of supplementary standards for the physical plants of normal schools and teachers' colleges.

SOME EUROPEAN ARCHITECTURAL LIBRARIES: THEIR METHODS, EQUIPMENT AND ADMINISTRATION. By Talbot Hamlin. Columbia University Press, New York, N.Y., 1939. 101 pages. Illustrated. $6\frac{1}{4}$ x $9\frac{1}{4}$ in. Price, $3.

THE architectural library, Mr. Hamlin believes, must play an increasing role in today's world of art. Because it can become, as he says, "a power for progress or for reaction", and because it can "use the architecture of the past to illumine the perplexities of the present", this book will interest both the architect and the architectural librarian. This volume represents a correlation of the material gathered on a tour of Europe's most important libraries. The decades of experience of European libraries, as against the years of experience of their American prototypes, seemed to offer a logical source of valuable information. As librarian of Columbia University's Avery Library, Mr. Hamlin speaks with authority on the problems, both general and specific, which beset the specialized library. He has studied here the various systems of organization and administration and the methods of cataloguing, classifying, and arranging both books and drawings; the last chapter discusses the function and place in culture of the large architectural library.

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Manufacturers' Publications

Doors and windows

Hope's Casements Projected, Hopkins and Austral Windows; Publication No. 66. Hope's Windows, Inc., Jamestown, N. Y.

Wood Accepts the Challenge. National Door Manufacturers Assn., 332 S. Michigan Ave., Chicago, Ill.

Electrical equipment

Allen-Bradley Solenoid Starters. Allen-Bradley Co., Milwaukee, Wis.

Inspected Electrical Equipment, Supplement to May 1938 *List, Nov.,* 1938. Underwriters' Laboratories, Inc., 161 Sixth Ave., New York, N. Y.

Manually-Operated Indicators for Thermocouple Temperatures, Catalog No. 33*A*(5), 1939. Leeds & Northrup Co., 4907 Stenton Ave., Philadelphia, Pa.

This Shadow Controls Your Business. (*Brown Instrument General Line Folder*) The Brown Instrument Co., A Division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

Equipment

Aeroil No. 99 *New Giant Flame Super Thawing Torch.* Aeroil Burner Co., Inc., West New York, N. J.

A. M. Byers General Catalog for Wrought Iron, Tubular and Flat Rolled Products, and Steel Tubular Products. (A wire bound general catalog, 8½x 11 in.). A. M. Byers Co., Pittsburgh, Pa.

Corrosion-Proof Laboratory Equipment, (Laboratory Sinks and Acid-proof Piping), Bulletin No. 503. The U. S. Stoneware Co., Akron, Ohio.

*Flexoseals for Enclosed-Type Ammonia and Freon-*12 *Compressors, Bulletin No.* 139-*A*. Frick Co., Waynesboro, Pa.

Kawneer Sealair Double-hung Windows, Series 220 *and* 120. The Kawneer Co., Niles, Mich.

Kewanee Steel Boilers, Catalog No. 80. Kewanee Boiler Corp., Kewanee, Ill.

Royalchrome Distinctive Furniture. Royal Metal Mfg. Co., 1138-40 S. Michigan Ave., Chicago, Ill.

"Snow White" and the Seven Reasons; The Modern Cabinet Gas Clothes Dryer. The Williamson Heater Co., Cincinnati, Ohio.

The New Ozalid White Print Machine (Model A, D, and E). Ozalid Corp., 354 Fourth Ave., New York, N. Y.

Van Huffel Continuous Rolled Metal Shapes and Tubing, Catalog "E." Van Huffel Tube Corp., Warren, Ohio.

*Wenner Thermocouple Potentiometer for Highly Precise Measurements of Low Voltages, Catalog E-*33*A* (1). Leeds & Northrup Co., 4907 Stenton Ave., Philadelphia, Pa.

Worthington Deep Well Turbine Pumps for Economical Water Supply. Worthington Pump and Machinery Corp., Harrison, N. J.

Heating and air conditioning

Air Conditioning and Refrigeration in New England and Manhattan. The Automatic Refrigerating Co., Hartford, Conn.

Lee Gas Fired Unit Heater, Suspended Type. Dravo Corp., Machinery Div., Pittsburgh, Pa.

The New Kohler Type G Coal Burning Boiler. Kohler Co., Kohler, Wis.

The Pittsburgh Automatic and Automatic Gas Steam Radiator. Automatic Gas Steam Radiator Co., Pittsburgh, Pa.

Webster Nesbitt Giant Unit Heaters. John J. Nesbitt, Inc., Holmesburg, Philadelphia, Pa.

(*Continued on page* 136)

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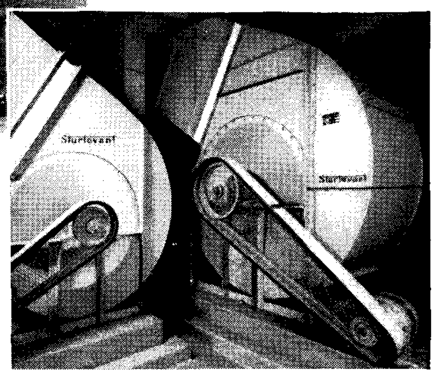
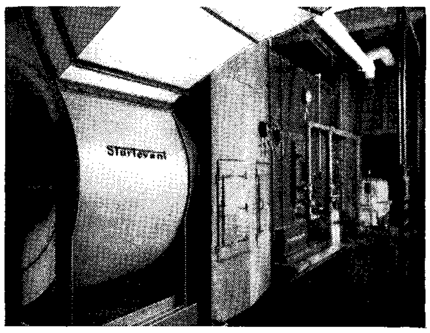


Photos show two of the Sturtevant Silentvane Fans and one of the Sturtevant Air Washers installed in Southern New England Telephone Building, New Haven.



Fans, Blowers, Air Washers, Air Conditioning, Heating, Vacuum Cleaning, Drying, Mechanical Draft Equipment

Manufacturers' Publications

(*Continued from page* 134)

Winter Air Conditioning: Forced Air Heating. National Warm Air Heating and Air Conditioning Assn., 11 W. 42nd Street, New York, N. Y.

Insulation

Formica Wall Covering Basing (Cabinet, Counter, and Table Tops). The Formica Insulation Co., Cincinnati, Ohio.

Lighting

Fluorescent Lamp Fixtures, Bulletin G. Day-brite Lighting, Inc., St. Louis, Mo.

Higgin Light Tight Shades (Shades designed to provide the ultimate in light proofing equipment for hospitals, auditoriums, lecture and classrooms, photographic studios, and for practically any type of room with almost any size opening). Higgin Products, Inc., Newport, Ky.

Lamps by Lightolier. The Lightolier Co., Jersey City, N. J.

The Control of Light with Alzak Reflectors, Bulletin No. 30. Major Equipment Co., Chicago, Ill.

The Ultimate in Lighting, Catalog No. 34. Edwin F. Guth Co., St. Louis, Mo.

Vaportight Industrial Lighting Fixtures. Bulletin No. 1125. The Pyle-National Co., 1338-58 N. Kostner Ave., Chicago, Ill.

Materials and material proofing

About This New Three Coat Enamel Process That Will Boom Business for You Now. John W. Masury & Son, 50 Jay Street, Brooklyn, N. Y.

Auer Register Book No. 39. Auer Register Co., Cleveland, Ohio.

Classical Columns for Modern Buildings, Catalog No. 50-H. The Union Metal Mfg. Co., Canton, Ohio.

Clev-O-Cement for Making Permanent Patches on Broken Cement Floors. The Midland Paint & Varnish Co., Cleveland, Ohio.

How to Repair Concrete to a Feather Edge with Cellulose-Processed Ruggedwear Resurfacer. Flexrock Co., Philadelphia, Pa.

New Color Stripe Mouldings. Pyramid Metals Co., 455 N. Oakley Blvd., Chicago, Ill.

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