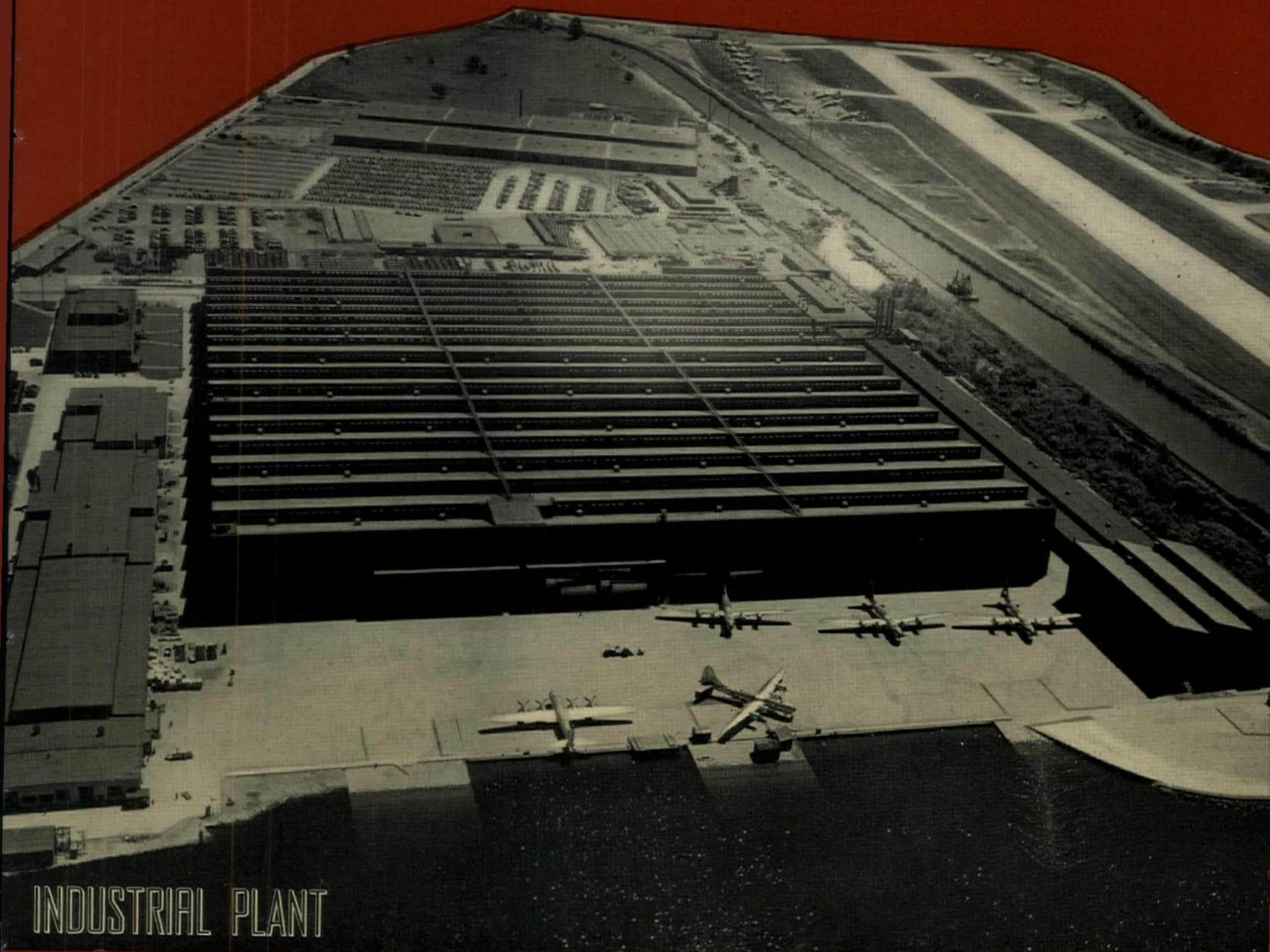
PROGRESSIVE ARCHITECTURE

PENCIL POINTS



BRASILIAN CHURCH

KITCHEN DEVELOPMENT

CONCRETE SPECIFICATIONS

DECEMBER 1946

PROGRESSIVE ARCHITECTURE

PENCIL POINTS

THE PLANNING OF A MAGAZINE

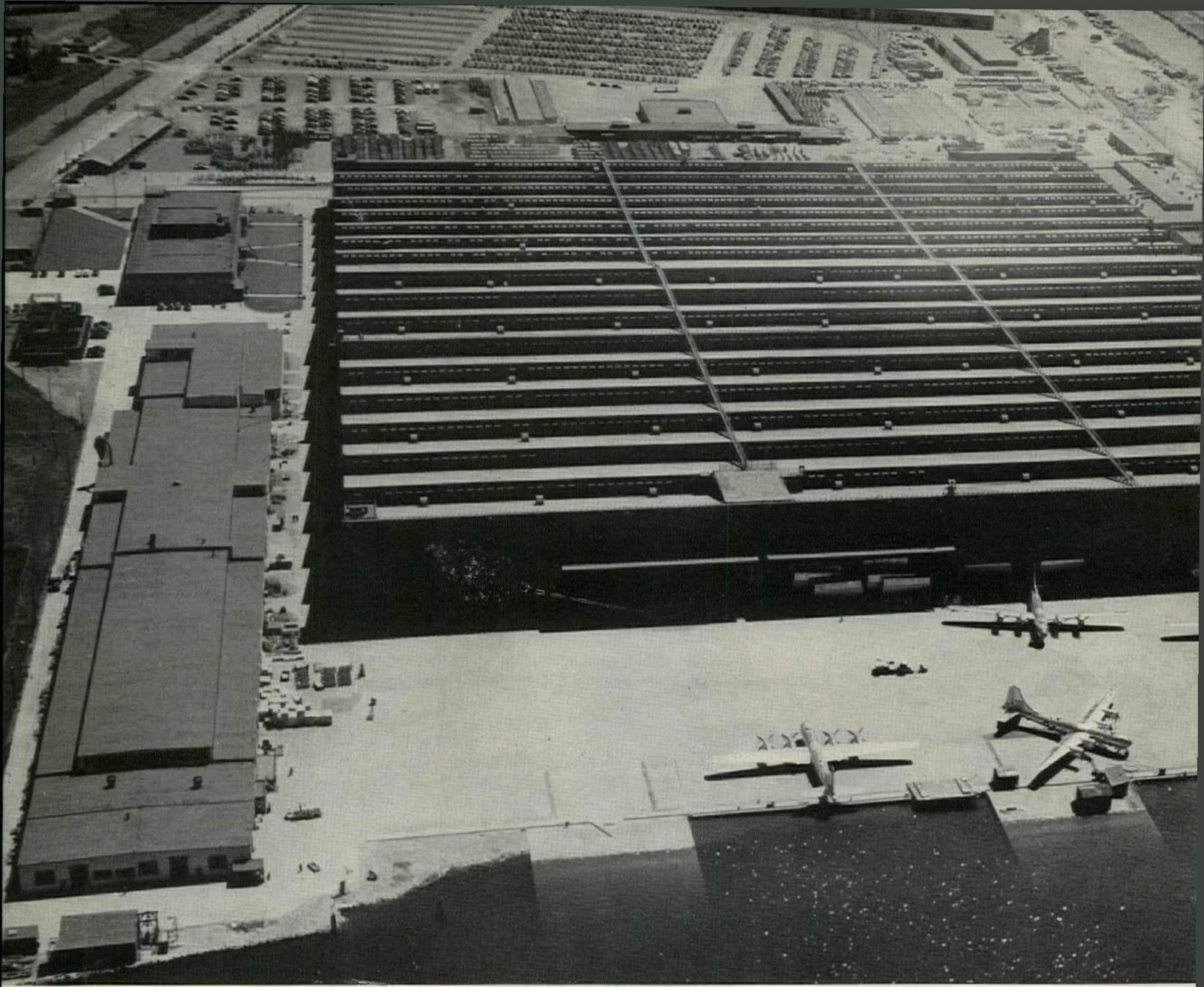
PROGRESSIVE ARCHITECTURE's policy of thorough analysis of the architecture its editors select for publication inevitably means that a limited amount of material can be used each month. Just as an architect reviews a number of excellent materials and selects the ones that best suit a particular design purpose, so we are forced each month to make selections—and, regrettably, rejections—that best suit our publication plans. Let us speak frankly of our procedure in this respect.

Some of the work that appears in PROGRESSIVE ARCHITECTURE is gathered by our editors, some of it is sent to us by photographers; much of it comes unsolicited from you designers. When you have designed something that you think should be published, we are very pleased if you let us see it—a set of prints and a snapshot are usually sufficient. We let you know within a few weeks whether we can publish your building design or planning project or manuscript. Many factors besides excellence of design are involved in our decisions—we try to have a representation of many building types and all regions, for instance. Occasionally a newly arrived item is of such importance that it displaces something previously scheduled. Normally it will be scheduled some months ahead; in due course you will be asked for all the necessary data, and soon your architecture will be described and documented for the benefit of designers everywhere.

There remains the question of good work that space limitations prevent us from scheduling definitely within a reasonable period. There are several alternatives. We could continue holding this material with a dog-in-the-manger attitude (we are too concerned with the interests of the architects involved to do this); we might occasionally plan a relief-valve issue, calling it Design Progress Report or some such name, and use a great number of projects briefly (we don't believe this is professional journalism); or we can, frankly but reluctantly, explain the situation to the designer so that he can seek publication elsewhere if he wants to (this is our policy).

We have had many expressions of support since we began this series of statements on architectural publishing. One of the most effective ways of demonstrating approval of a magazine is to continue submitting to it your best work. We have no complaint on this score; the purpose of this exposition is to let you know that we intend to give you as a contributor prompt attention, an honest answer, and, let us hope, full professional publication.

The Editors



INTEGRATED DESIGN on a vast scale growing directly out of the functional requirements.

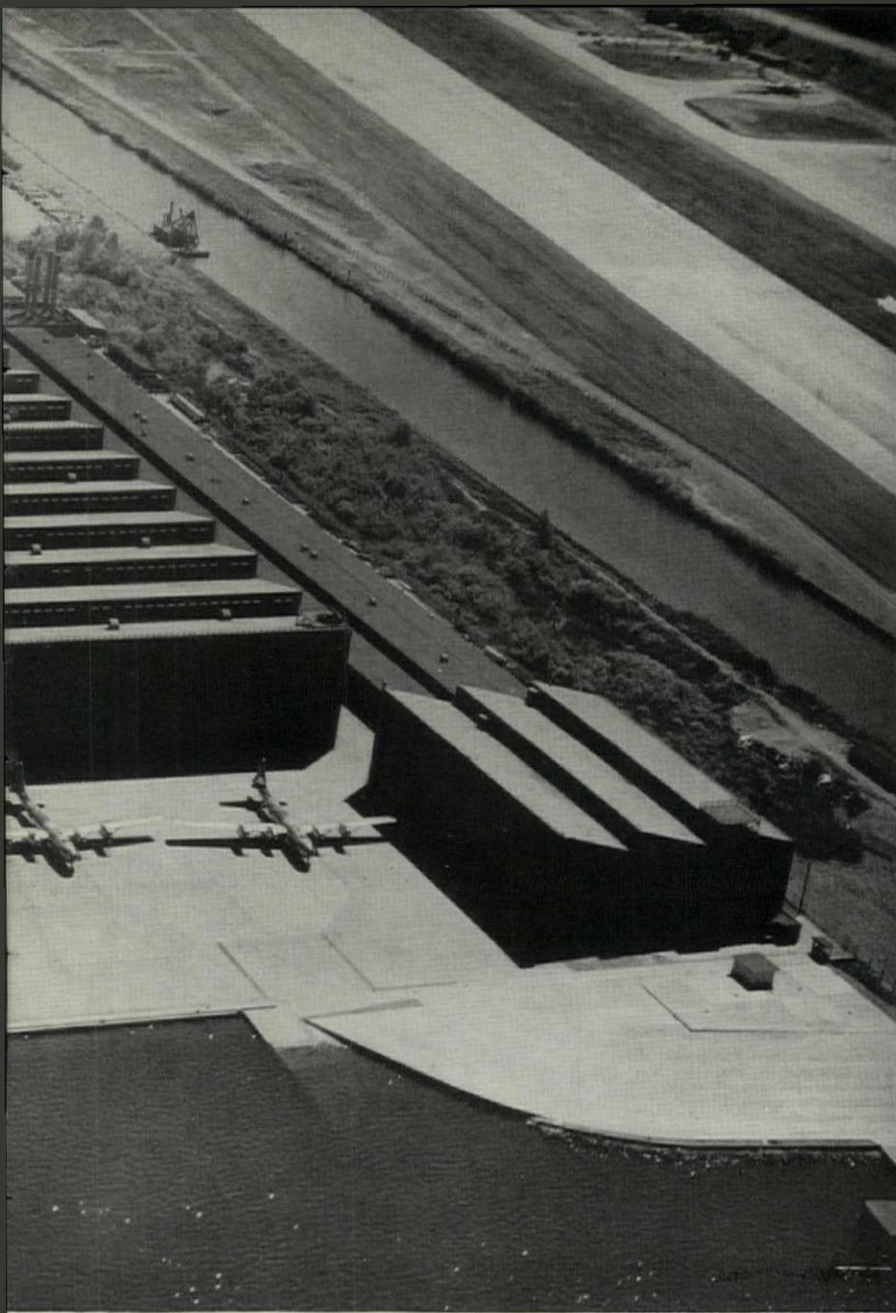
INDUSTRIAL PLANT

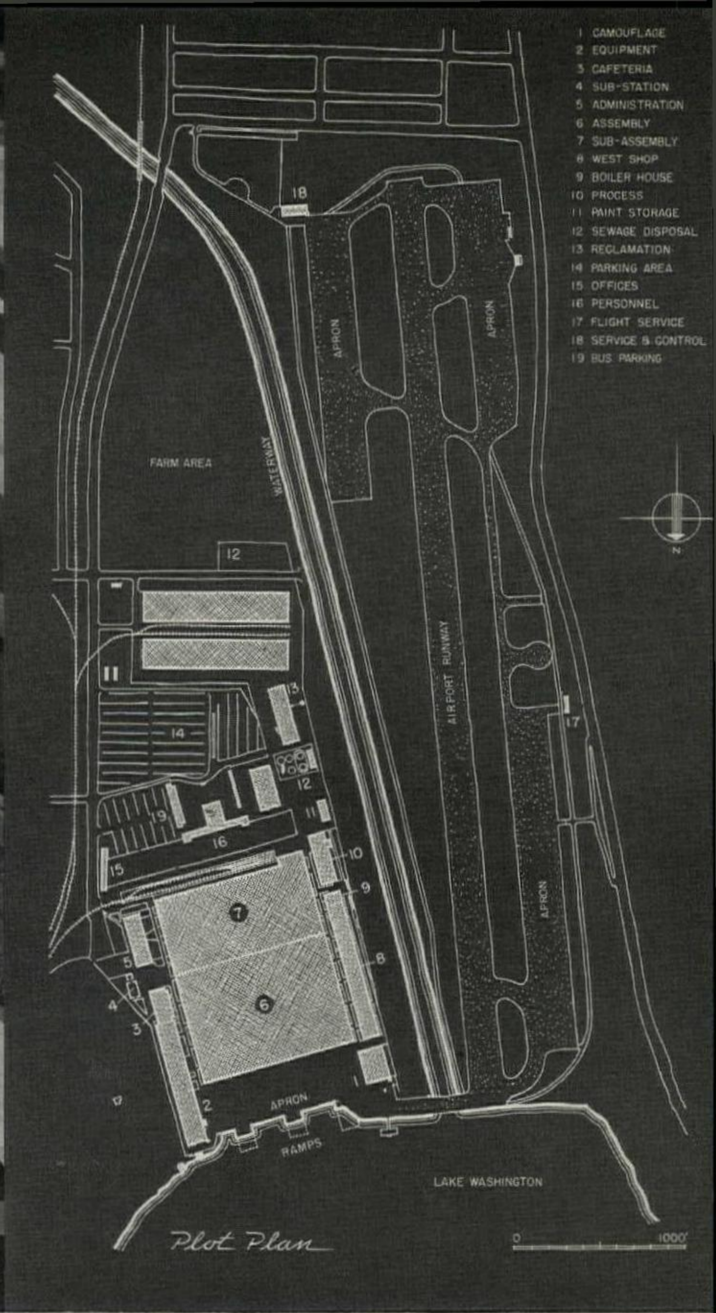
FLEXIBILITY that can cope with changing needs is an important and increasing trend in progressive architectural design. During the war this consideration was put to the most urgent test, and nowhere was its success more crucial than in the production of prime war materiel. The Boeing-Renton plant is, perhaps, the supreme example: an almost ideal site . . . a precise ordering of the several units on the site for speedy flow-line production on a vast scale . . . preplanned flexibility that allowed swift conversion to meet shifts in wartime exigencies . . . rationalized construction and quality systems of control that produced near-optimum conditions for working.

BOEING AIRCRAFT COMPANY,

When converted to B-29 production, this factory at Renton constituted the final assembly unit. Subassemblies were brought to the plant and fed into simply organized flow-production lines, at the end of which finished bombers rolled out of the three great doors on the north for camouflage treatment and test on the adjacent airfield.

The site proved advantageous in almost every respect. The prime requirements were sufficient space, nearness to spur tracks and freight-truck facilities, and (since the plant was originally schemed for production of seaplanes) a location adjacent to fresh water that was navigable—for ship movement, if necessary. As shown in the plot plan,





All photographs are by Boeing Aircraft Company except those that are specially credited.

RENTON, WASHINGTON

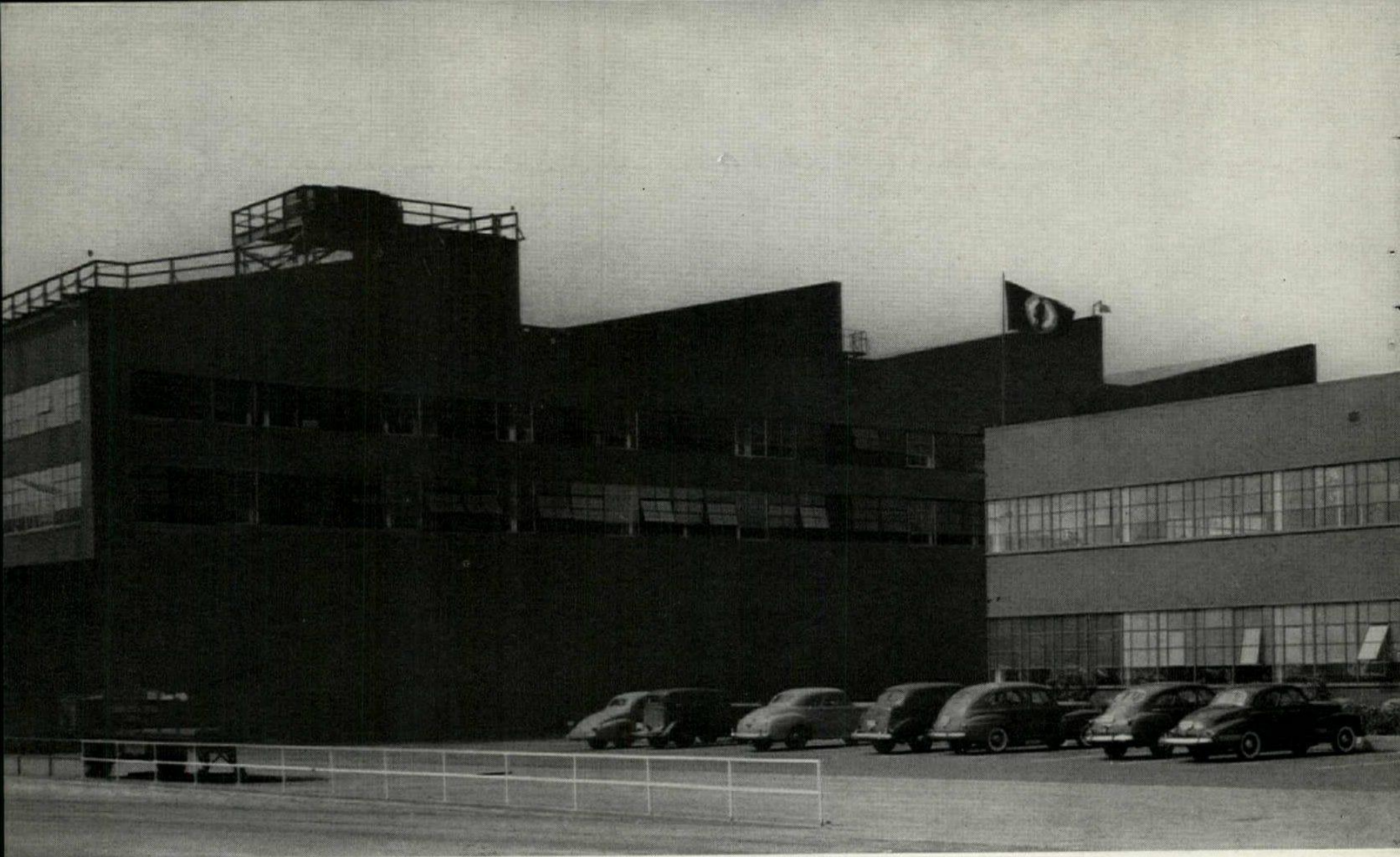
THE AUSTIN COMPANY, Engineers and Builders

all these requirements were present in the site on the shore of Lake Washington. Not the least of its advantages was the fact that Government locks at the far end of the lake kept rise and fall of the lake water to a minimum.

Organization of the several units on the site was based quite simply on functional requirements. The huge main assembly building, planned for complete multiple assembly, was placed directly adjoining the lake frontage. Conversion to B-29 production brought the addition of an access way from the lakeside apron across the adjacent waterway to the airfield on the far side. Secondary buildings—administration, personnel, and various warehouses and shops—were located at the sides and far end of the main assembly building.

To provide maximum control and protection, the administration building is placed near the one public street that borders the property. Parking for employees' cars and busses occurs in the same general area, adjoining the personnel building.

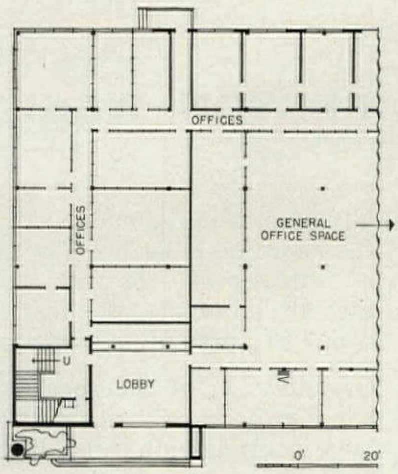
The latter houses all of the plant-personnel facilities including a bank and post office. The storage and equipment building and the separate cafeteria—a development that came after this country's entry into the war—are located in space that was originally assigned to storage warehouses.



MAIN ASSEMBLY BUILDING

BOEING AIRCRAFT COMPANY, RENTON, WASHINGTON

All photos on this spread by P. A. Dearborn



Floor Plan

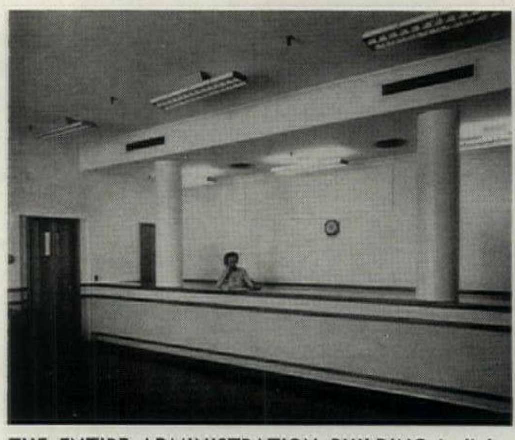
ADMINISTRATION BUILDING

THE AUSTIN COMPANY, Engineers and Builders

ADMINISTRATION BUILDING

Housing the head offices and general business offices of the plant—chiefly engineering and accounting—the administration building is placed between the entrance gates and the main assembly building.

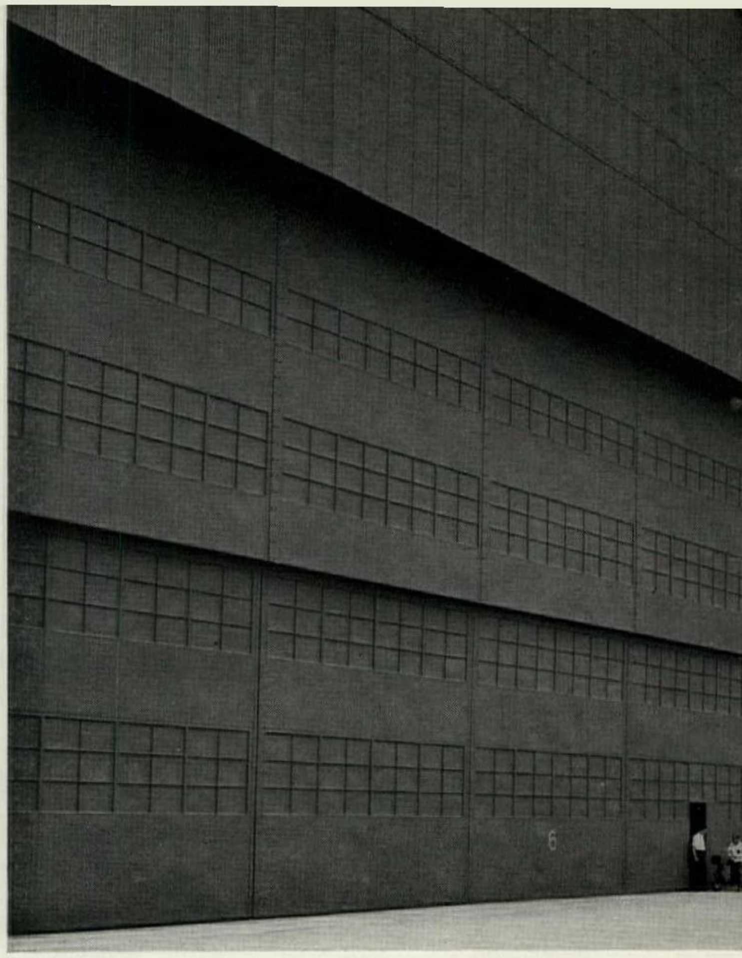
The partial plan across page indicates the general layout—private and specialized offices around the perimeter, general work space in the center. Since this building and the personnel building were considered as semi-permanent, and wood was plentiful at the time, these buildings are of wood frame with exterior walls of waterproof plywood. The 100-by-300-foot building is laid out in 20-foot bays both ways and is constructed on a concrete slab laid on dirt fill; standard steel sash with muntins omitted is used for the continuous fenestration. Roofing is composition over a layer of rigid insulation laid on roof boarding above open joists.



THE ENTIRE ADMINISTRATION BUILDING is lighted by fluorescent units, providing 50 foot-candles in work areas.

BOEING AIRCRAFT COMPANY

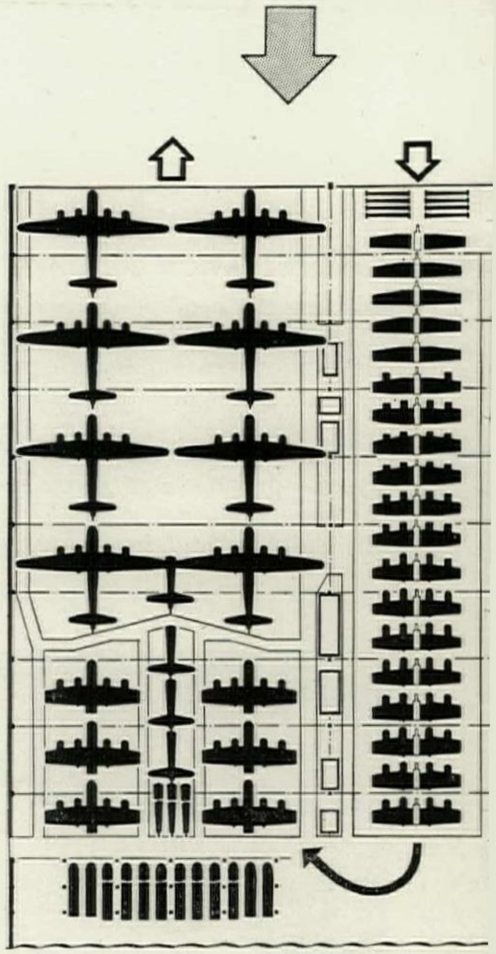
RENTON, WASH.



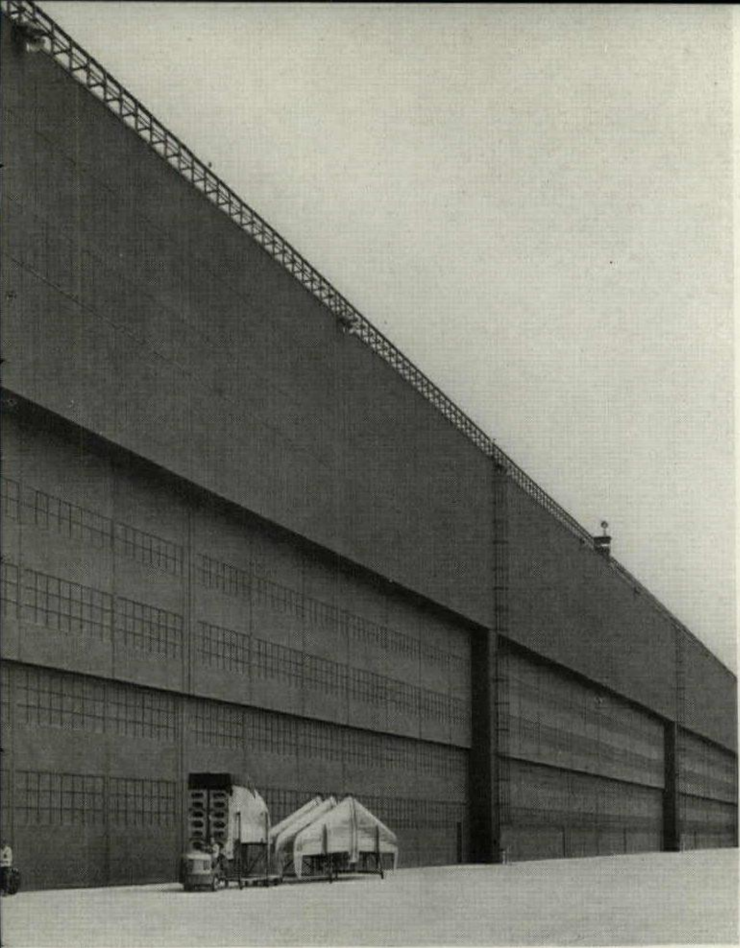
MAIN ASSEMBLY BUILDING

The final assembly area of this vast, 1,100-by-900-foot main building is 650 by 900 feet in area, divided into three 300-foot clear span bays. The southern 450 feet of the building's floor area has a balcony level used for sub-assembly. The ground-floor portion of this southern area is divided into eighteen 25-foot bays north and south and eighteen 50-foot bays east and west; the sub-assembly balcony is divided into nine 50-foot bays north and south and six 150-foot bays east and west. Across the road to the west are shops, from which parts can be brought into the main assembly building at several different points.

P. A. Dearborn

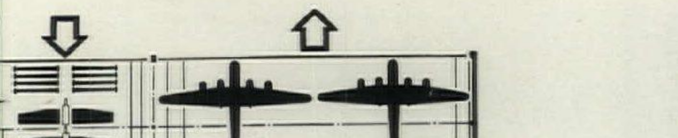


INBOARD WING STRUCTURES are received at the north end of the building and progress down the center of the bay, being progressively fitted out as they travel. They are then transferred, complete with power plants and all installations,

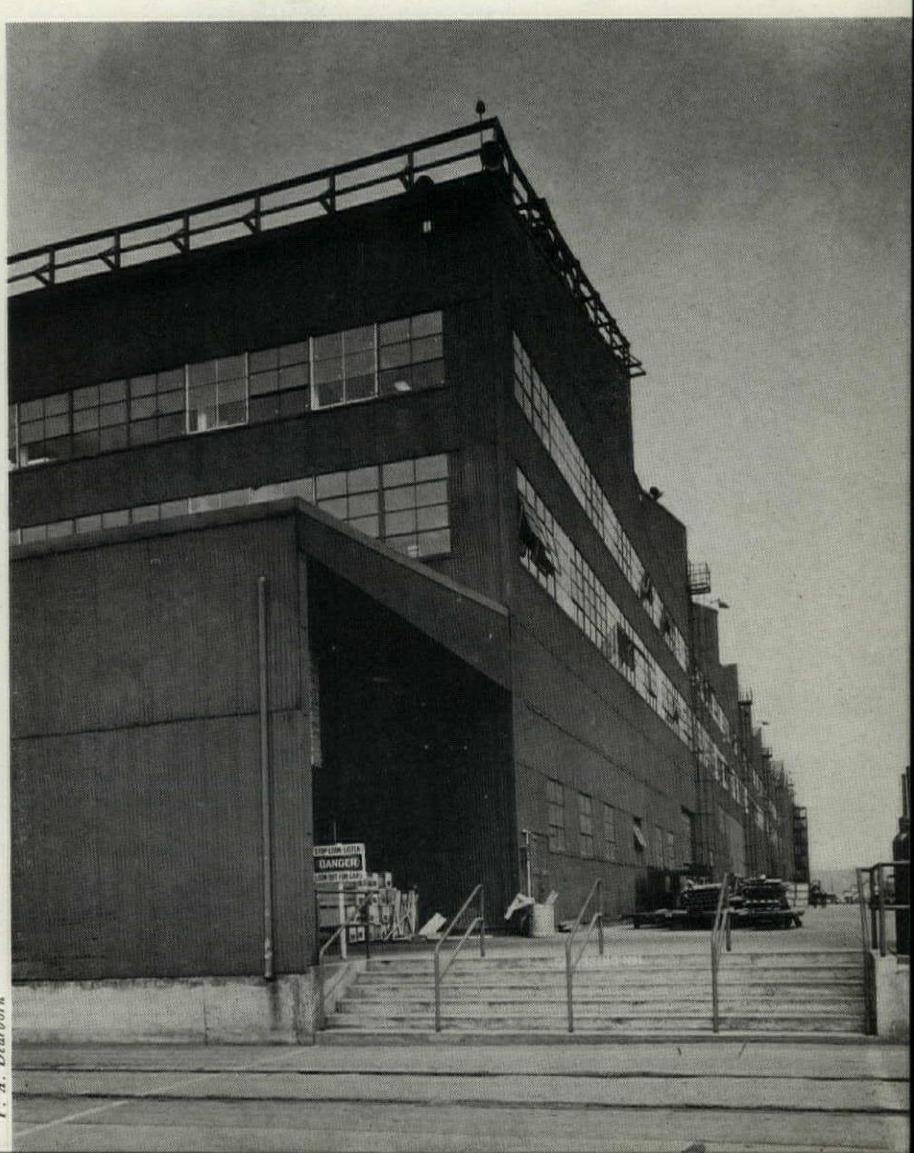


STRUCTURE

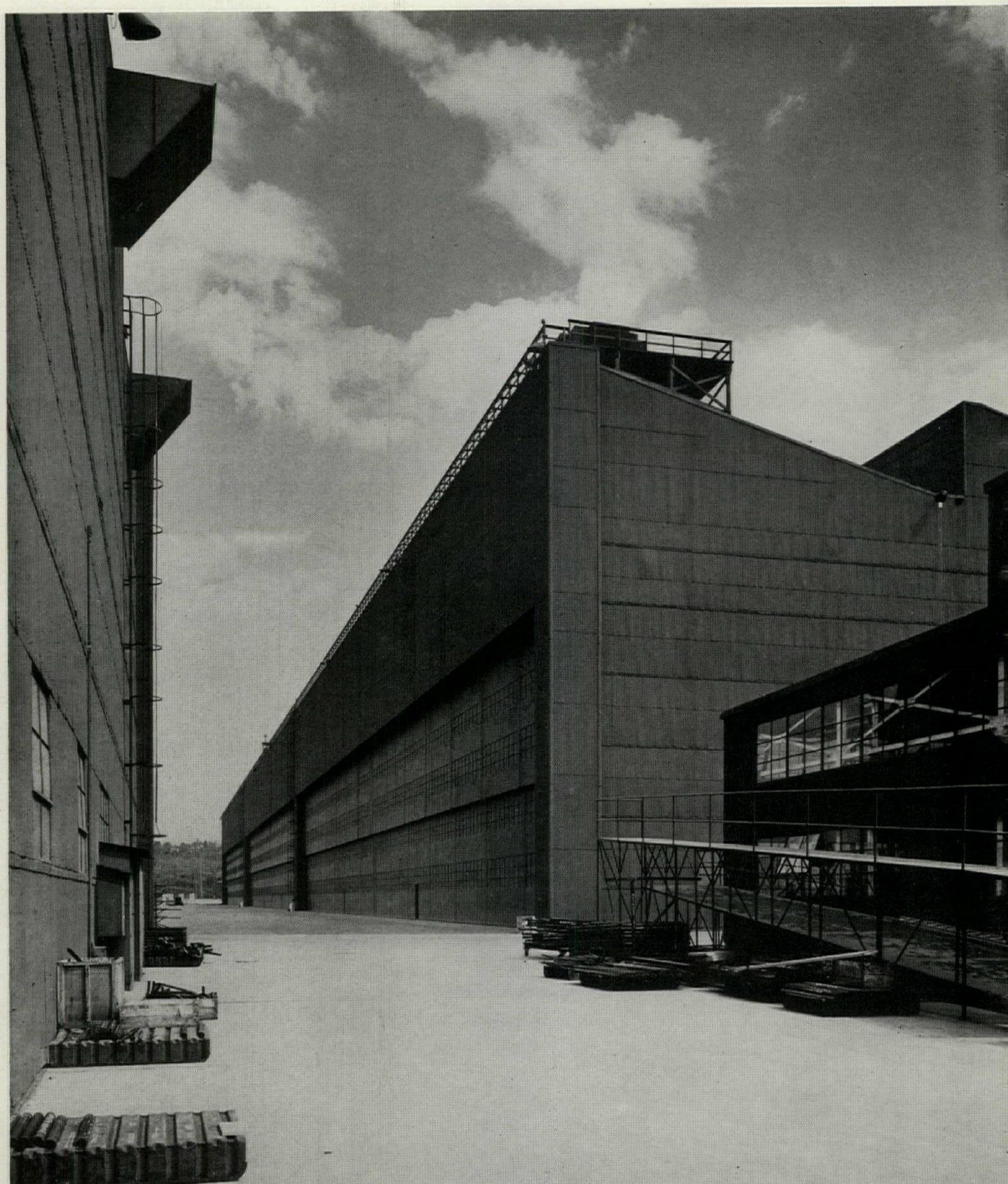
The main assembly building, framed in steel, is sheathed outside with asbestos-protected metal siding and roofed with composition waterproofing installed over insulation and steel roof decking. The wall-surface material was chosen for its light, fast construction, its high salvage value, and because much of it could be precut at the factory. The huge hangar doors on the opening end are of steel, canopy type, opening vertically for half their height before pivoting action starts; when fully opened, the canopy overhang equals one-third of the height. A section showing the pattern of the trusses in the final assembly area appears on the following spread.



to the adjacent B-29 assembly bays, and attached to fuselage sections which move up from behind. The B-29 tail assembly line joins the process between the three rear stations of each pair of B-29 production lines.

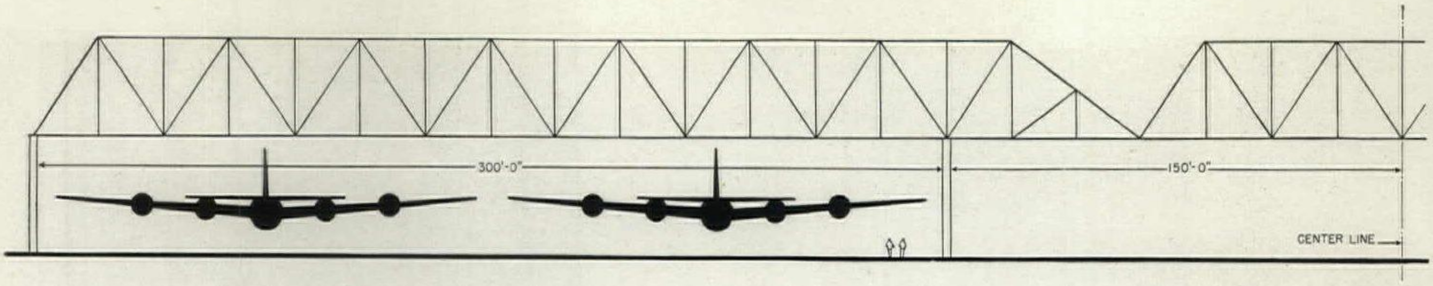


P. A. Dearborn



P. A. Dearborn

CAMOUFLAGE BUILDING at left, SHOPS at right, and the north end of the MAIN ASSEMBLY BUILDING in center.



BOEING AIRCRAFT COMPANY

RENTON, WASH.

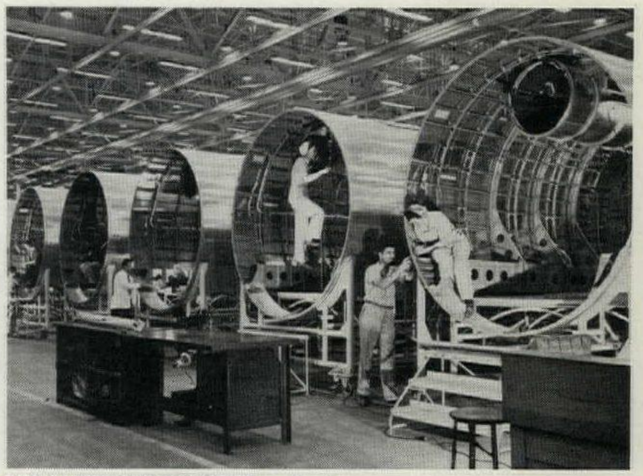
THE AUSTIN COMPANY

Engineers and Builders

To form the three 300-foot clear spans in the final assembly area of the main building, trusses 35 feet in depth are used, with the outer truss members cantilevered 65 feet beyond the supporting columns. The central suspended truss section, 170 feet long, is pin connected to the ends of the cantilevers. Columns from front to back are spaced 65 feet apart. Height to the underside of bottom chords is 45 feet, and there is a complete monorail crossover system to provide maximum flexibility in product movement forward.

HEATING AND VENTILATING

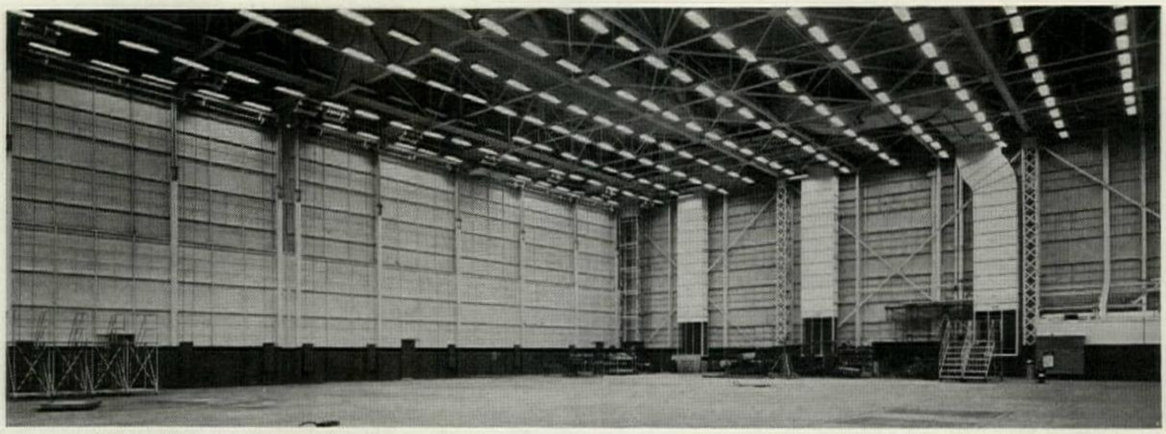
The heating installation for the entire plant, located in a separate building, consists of four 450-horsepower high-pressure steam units. Calculations were based on a minimum outside temperature of plus 10° F. with maximum inside temperatures varying from 55° to 70° F., depending on the kind of space being heated. Direct radiation was used in the administration building, personnel building, and balcony offices. In the main assembly area building, rotary distributing type unit heaters were used, each heater capable of supplying 1,250,000 Btu per hour on an air-handling basis of 19,500 cubic feet per minute. Each heater is designed for 100 percent recirculation and is controlled by pneumatic thermostats with diaphragm control valves. For later blackout conditions, direct air intakes were designed with recirculating control dampers for any desired position from no recirculation to full recirculation. In the sub-assembly balcony area central heaters of the vertical projection type supplemented rotary discharge type units. In the primary area below the balcony, four-way fixed discharge unit heaters were installed. Supplementing these basic systems, highly specialized systems were designed for special-use areas.



BOMB-BAY SECTIONS being fitted . . . .

for attachment to wing members . . . .

and so on to **COMPLETED B-29's.**



IN THE CAMOUFLAGE BUILDING, vaporproof, high-intensity mercury fixtures produce 25 foot-candles of illumination.

BOEING AIRCRAFT COMPANY, RENTON, WASH.

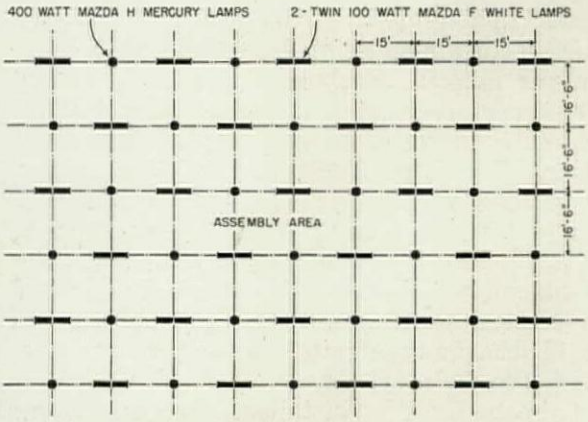
THE AUSTIN COMPANY, Engineers and Builders

OFFICE SPACE in the administration building, lighted by fluorescent units providing 50 foot-candles at desk height.

PLANT LAYOUT ROOM with unit fluorescent fixtures; note the blackout panels, inside the windows along the far wall.

LIGHTING

Lighting in the main assembly area was designed to produce 30 foot-candles in service at working height. These outlets, installed at approximately 45-foot height, consist of an alternating, diagonal pattern of high-intensity mercury vapor lamps and pairs of twin-lamp fluorescent units as shown in the diagram below and the photograph across the page. The combination was used for color correction necessary to the blue predominance of the mercury units and consequent distention of color. A further advantage of the use of the longer light source of the fluorescent tube was better diffusion of light at the high mounting levels with less reflection glare from the bright metal used in airplane construction.



DIFFUSED, color-corrected lighting with an intensity of 30 foot-candles is provided in the main assembly area.

THE FINISHED DESIGN is simply a frank organization of plan and structural elements, materials, and equipment.

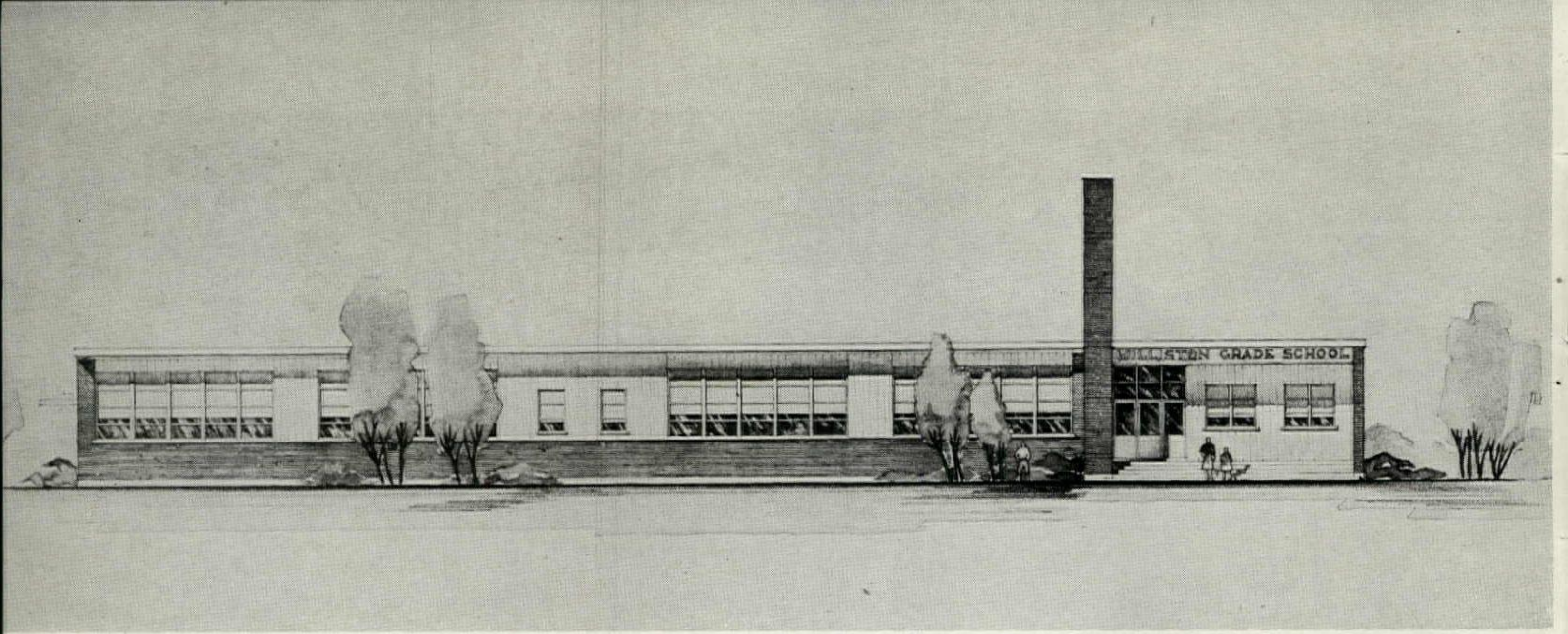


Photo of rendering by Walter E. Lewis

TO CREATE A CHEERFUL ATMOSPHERE, the architects suggest supplementing natural wood and red brick with "positive" colors on some classroom walls.

SCHOOL

PROPOSED CENTRAL GRADE SCHOOL, WILLISTON, VERMONT

FREEMAN-FRENCH-FREEMAN, Architects

IT IS EXCEPTIONAL to find straightforward, contemporary design applied to the problem of the small rural grade school. Herewith is an exceptional exception. In its disarming simplicity, one might almost overlook the fact that it not only incorporates many of the most advanced elements of schoolhouse planning but makes interesting contributions of its own.

PURPOSE

To replace the overcrowded, 60-year-old village school and four typical one-room (8 to 25 students) district schools, thus giving the individual student a better opportunity for proper education at the same time cutting down over-all expense of the local school system. It is also contemplated that the building would be used by local adult groups.

SITE

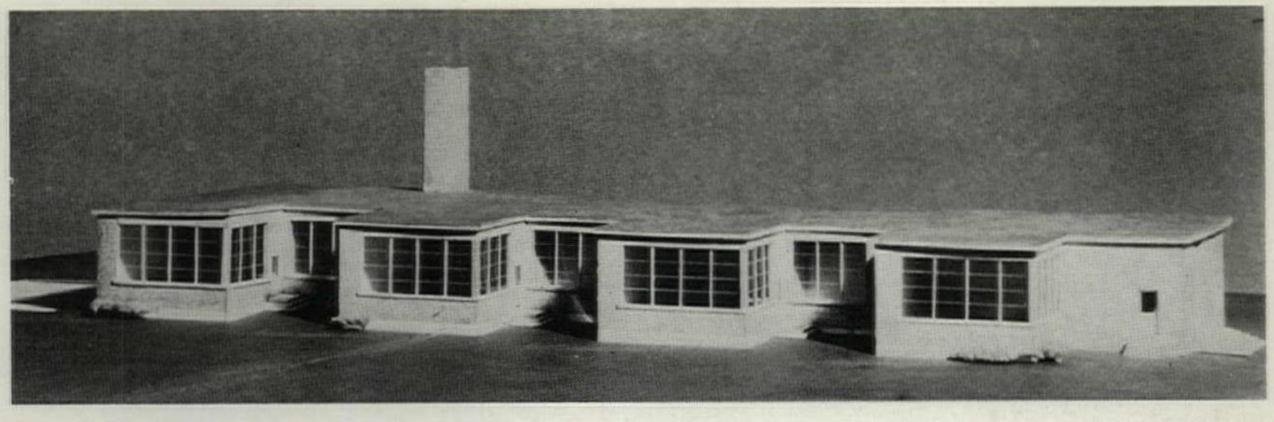
The site of the present village school plus adjacent property—a fairly level, L-shaped parcel 320 feet deep and 400 feet on its longest side, centrally located on the one main road through town.

SCHOOL DIRECTORS' REQUIREMENTS

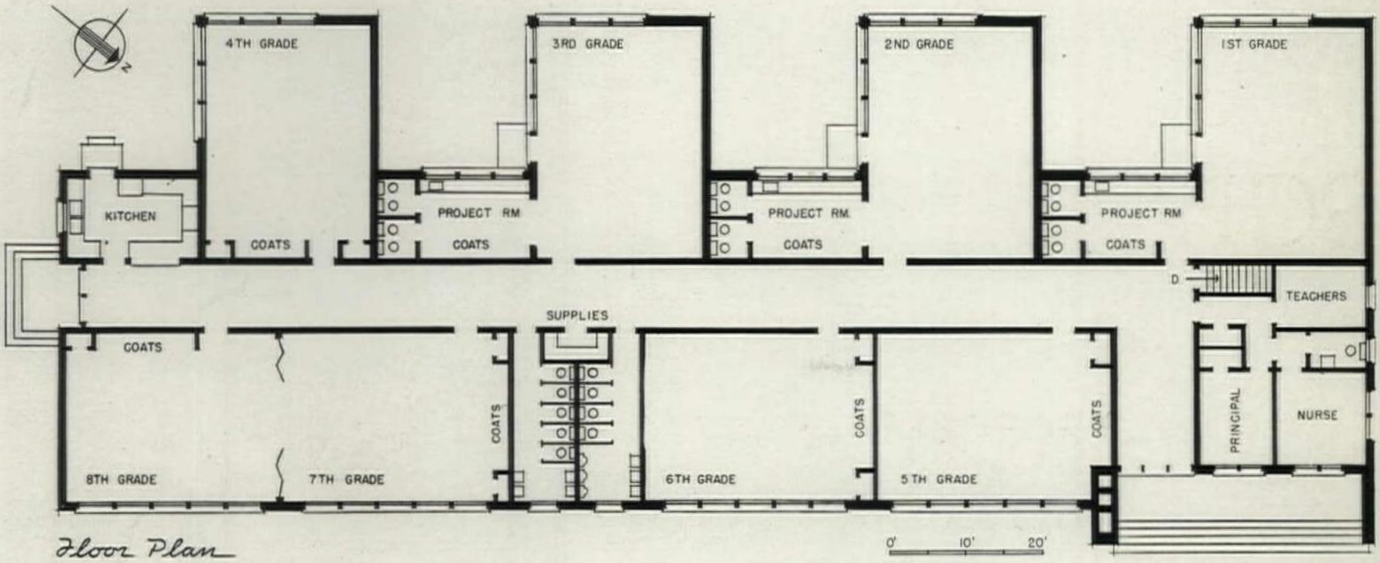
Separation and privacy for Grades 1, 2, and 3, with separate play areas and toilet facilities; a hot-lunch kitchen; standard classroom space for the other grades; offices and nurse's room.

SOLUTION

The four lower-grade classrooms are arranged in



THE PLAN SCHEME for the four lower grades provides good light and maximum flexibility in individual room arrangement.



right-angle relationship to the corridor, automatically forming separate play yards and well lighted entrance, coat locker, and project space. Separate toilets are provided for the three lower classes. Adjoining the fourth-grade room is the school kitchen. Other classrooms are standard, but with folding partition between seventh- and eighth-grade room to form a general assembly room.

The nurse's room is large enough to provide for isolation of an ill child, in case it is impossible (as it often would be) to reach the child's parents during the day.

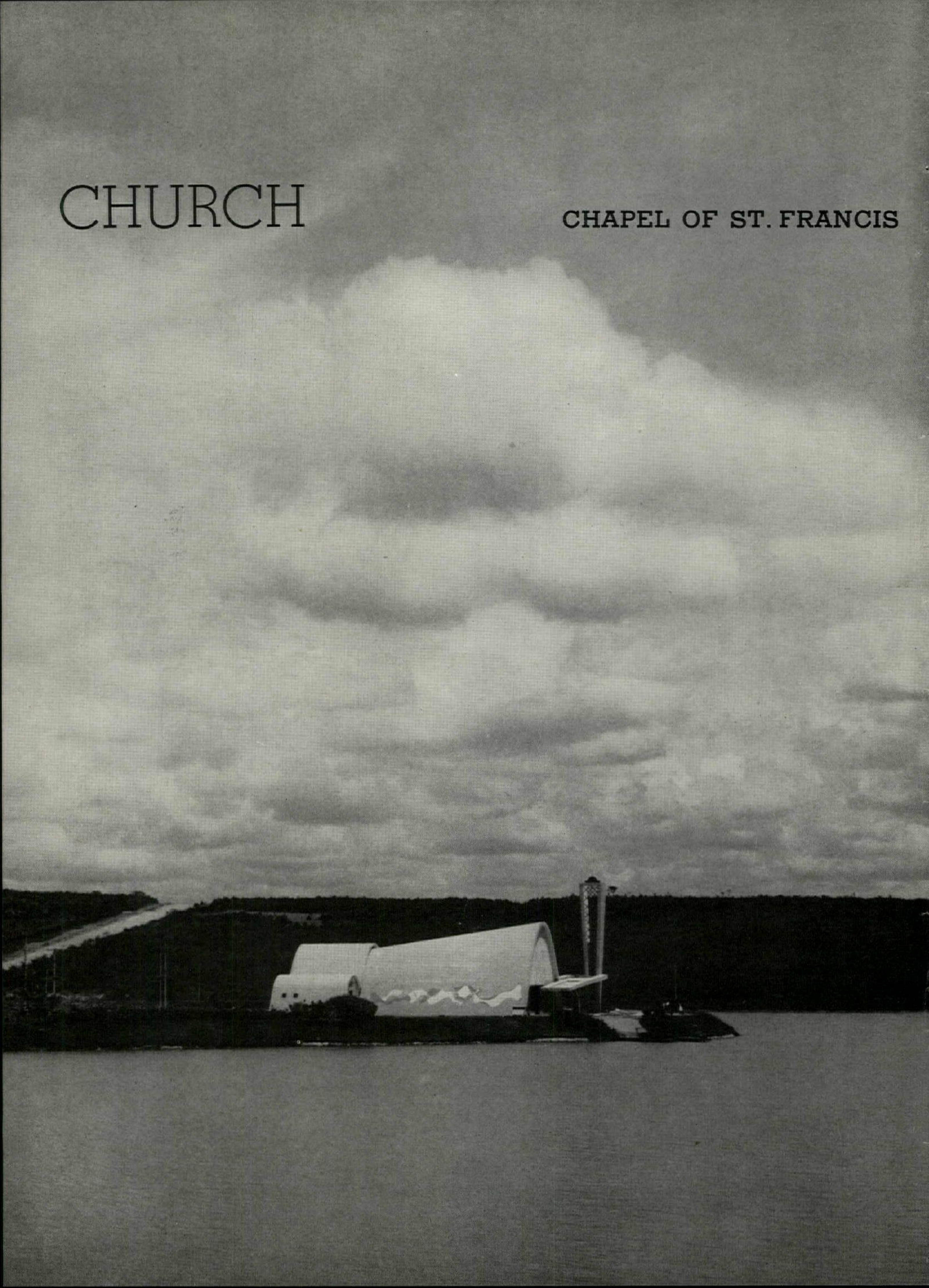
A basement under the north corner (beneath the small offices and entrance corridor) contains the furnace for an oil-fired, low-pressure steam system; unit ventilators would be used in each classroom.

PROPOSED CONSTRUCTION

For economy's sake, it is suggested that as many local materials as possible be used: foundations of reinforced concrete grade beams on concrete piers; exterior walls to window sills, locally produced brick, exposed on the interior; Vermont slate for sills, window stools, etc. Construction between windows: wood with vertical sheathing, and battens for the exterior face. Corridor partitions: masonry, exposed on both corridor and classroom sides. Partitions between classrooms: wood frame, sheathed with native clear pine; ceilings: soft fiber board tile, to assist in acoustic control. The ceiling of the corridor would be furred down to provide space for ventilating ducts, exhaust fans, etc. Floors: hardwood for classrooms, colorful mastic tile for the corridor.

CHURCH

CHAPEL OF ST. FRANCIS



We are indebted to DR. LOUIS PARNES for his interest and kindness in bringing the material used for this presentation back with him from a recent trip to South America.

PAMPULHA, BRASIL

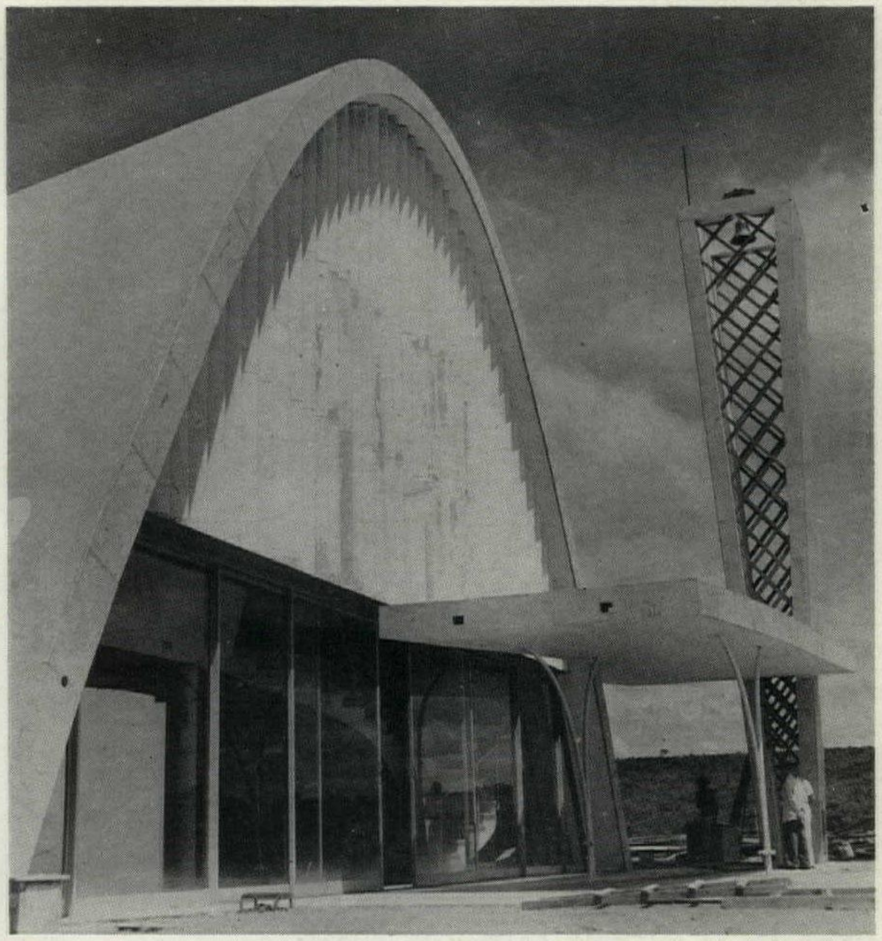
OSCAR NIEMEYER, Architect

THIS REMARKABLE CHAPEL joins the other distinguished buildings by Oscar Niemeyer—the yacht club, casino, and restaurant—in the new resort town of Pampulha, near the industrial city of Belo Horizonte. It is exciting to come across a church designed for today that attempts to be as sincere and vital and appropriate for our time as the early Gothic church was for its day.

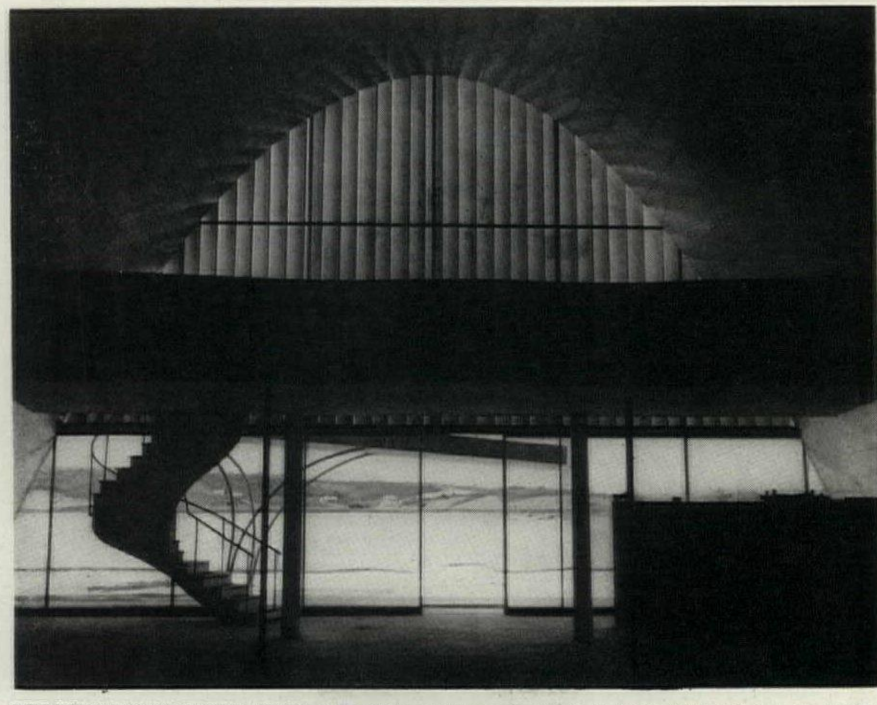
Symbolism is one of the most important functional requirements of church design—the psychological need, so to speak, that supplements and gives meaning to the more routine matters of adequate space allotment and arrangement.

For years, this symbolic emphasis in church design has been variously rationalized within the framework of architectural stylism. It took courage and confidence on the part of the well known architect, Oscar Niemeyer, to re-explore the basis of this need and develop a design based on imaginative use of the structural potentials of today's building techniques.

Remember that this is the chapel of St. Francis—a humble man whose life and devotion were directed toward the gentlest and simplest of living things, little children, fishes, birds, and so on. Hence the forms and surface treatment of the series of articulated, reinforced concrete dome sections are almost primitive in their direct treatment. The assembly of parabolic curves—a logical expression of concrete—practically suggests an outcropping of rock, a natural extension of the earth, albeit spaced and spanned in such a way as to provide for all the elements of the traditional church—nave and cruciform plan, altar and bell tower.

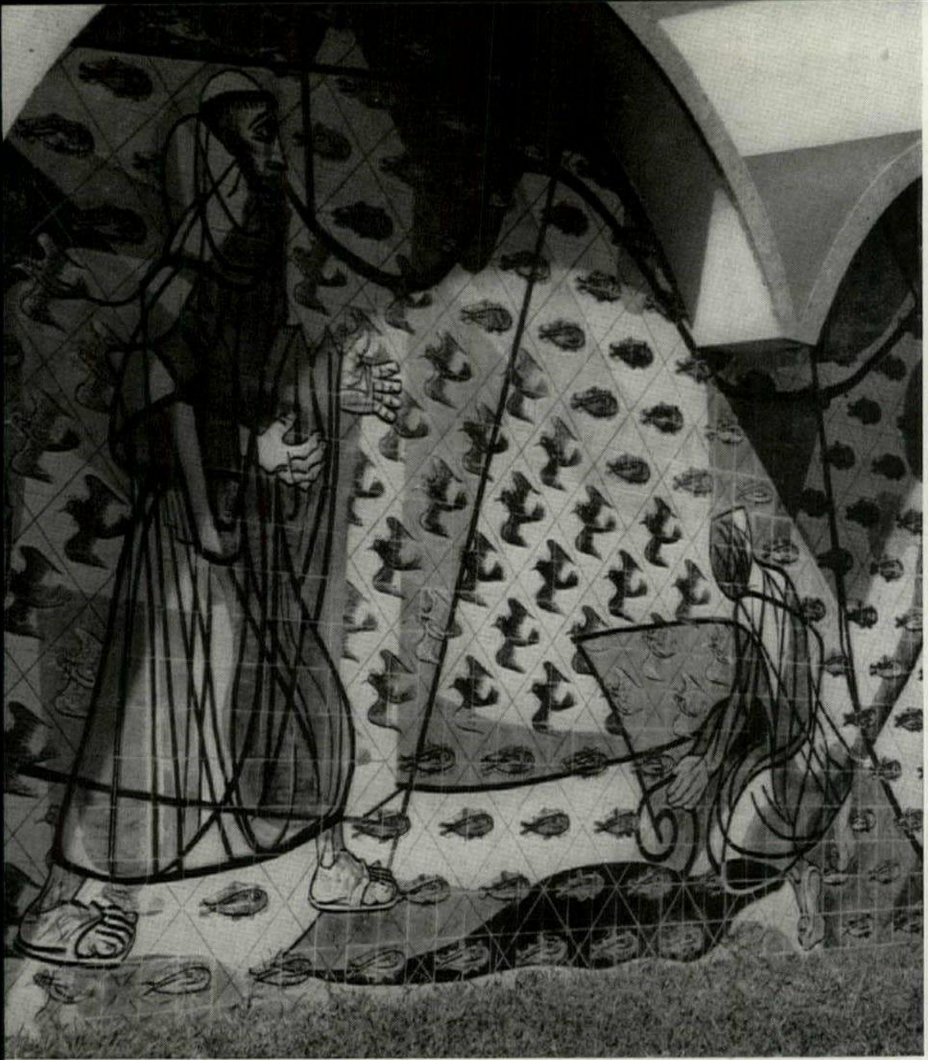


EDGES OF THE ENTRANCE CANOPY, supported by tubular steel members, are surfaced with pink granite.

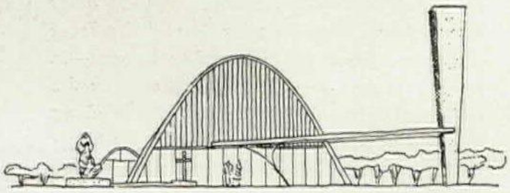


Photos by Marcel Gautherot

THE HUGE WINDOWED AREA above the entrance doors is protected by a brise de soleil made up of fixed panels of asbestos cement.



DETAIL of the Portinari ceramic-tile mural.

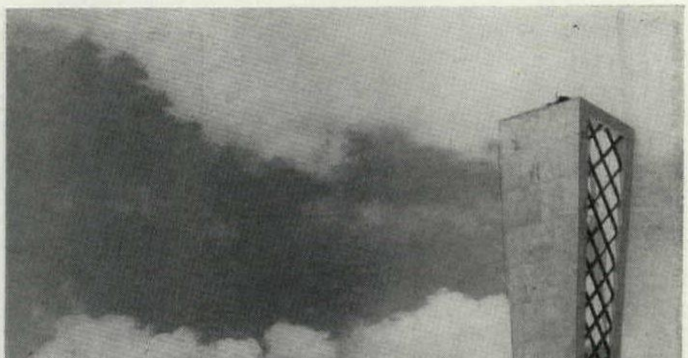


CHAPEL OF ST. FRANCIS, PAMPULHA, BRASIL

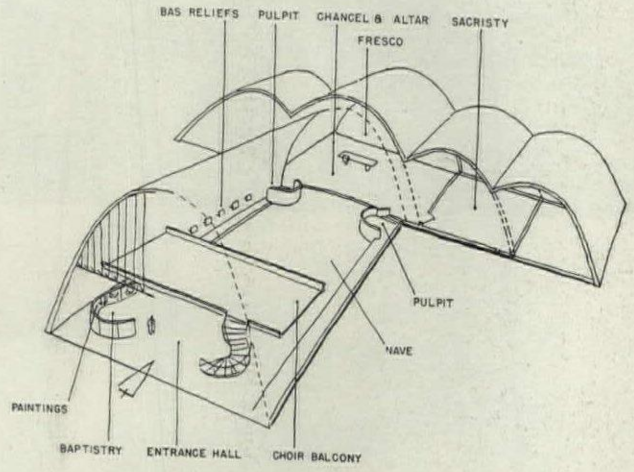
OSCAR NIEMEYER, Architect

The effect of naturalness and earth-closeness is further symbolized by the design of the great ceramic-tile mural by Portinari that makes up the rear face of the structure. Close at hand, the lively and colorful assortment of little wild animals surrounding the modest Saint have a sprightliness that one suspects children would enjoy—more, incidentally, than could be said for those church edifices usually referred to as "imposing." At not too great a distance, the huge mural becomes obscure and practically fades into the landscape, so skillfully is it devised in line and pattern, a technique not unrelated to that of the camouflage artist.

In the black and white photographs, unfortunately, the pale blue color of the mosaic tile that surfaces the vaulting toward the sky fails to show; though in actuality, as one observer tells us, it closely approximates sky color on a bright day and results in the same evanescent quality conceived in the earth-related wall mural.



DESIGN OF THE BELL TOWER—arms opening outward; limitless faith—surely as admissable a concept as the spire terminating in a point.



THE ALTAR FRESCO is the work of Portinari and his school.

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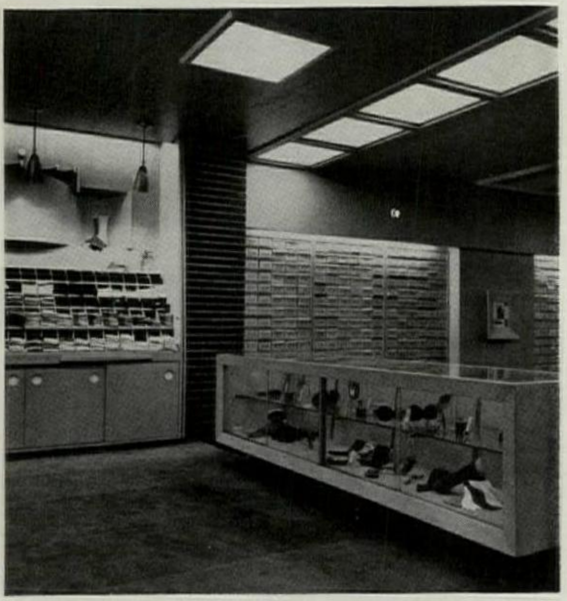

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4

Photos by Gottscho-Schleisner

RETAIL STORE

JOHN WARD MEN'S SHOE STORE

NEW YORK CITY

PLANNED AS A COORDINATED UNIT with as little visual separation as possible between shop front and interior, this retail store represents a happy blending of basic requirements of successful merchandising with uncluttered design.

Organization of the store interior is extremely simple—a single, central sales area, with reserve stock used as wall decoration on the left, and within alcoves on the right and in a room to the rear.

The sidewalk face of the store is treated as a frame around the brilliantly lighted recessed entrance and store proper. Surfaces are brick (on the left) and gray stone on the element at right, in which is set a small, square, bronze-framed display window.

PHOTOGRAPHS AT LEFT: 1. The white oak chairs are upholstered in deep red-brown leather. Ceiling light panels contain concealed fluorescent lamps. 2. Two steps in foreground lead from entrance platform down to main sales level. Reserve stock is stored in library-type racks in alcoves at right. 3. Entrance area: hosiery bar (at left) and cantilevered showcase marking the division between this entrance area and the shoe-sales level. 4. Rear view of the cantilevered showcase, with shoe mirror at bottom.

(Details on following page)

Gottscho-Schleisner

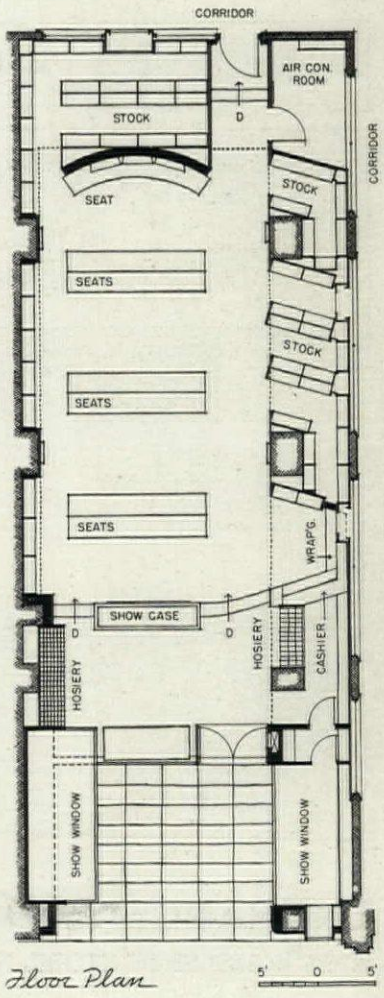
ENTRANCE AND SHOW WINDOWS

JOHN WARD SHOE STORE, NEW YORK, N. Y.

JULIAN VON DER LANCKEN, Architect

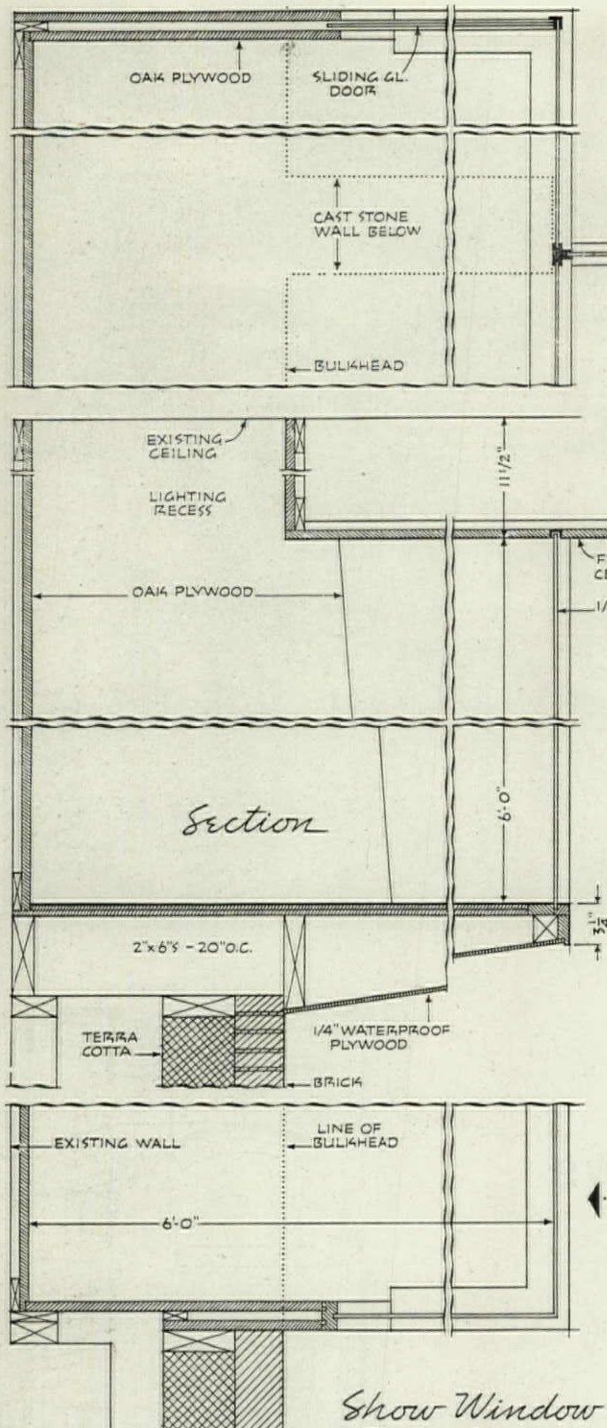
RAYMOND LOEWY ASSOCIATES

So ingeniously is the relation of interior to exterior of this store worked out that the three small white oak display cases on the brick-red rear wall are almost as important to the passer-by on the sidewalk as the exterior showcases. This is the aim of most store designers. Here it is accomplished by continuing from the arcade through the all-glass wall as many elements as possible: the gray ceiling with its square, recessed fluorescent fixtures; the show-window head height; tones and colors matched and repeated inside and out (from gray stone to gray-painted wood, with touches of brick color; carpet is gray-green). In such a scheme design of every interior detail becomes doubly significant. Taking advantage of a small difference in floor levels, the designers have used steps as well as fixtures to delimit the hosiery department and add spaciousness to the shoe sales area. The furniture and show cases (detailed on following pages) are upholstered in red-brown leather.

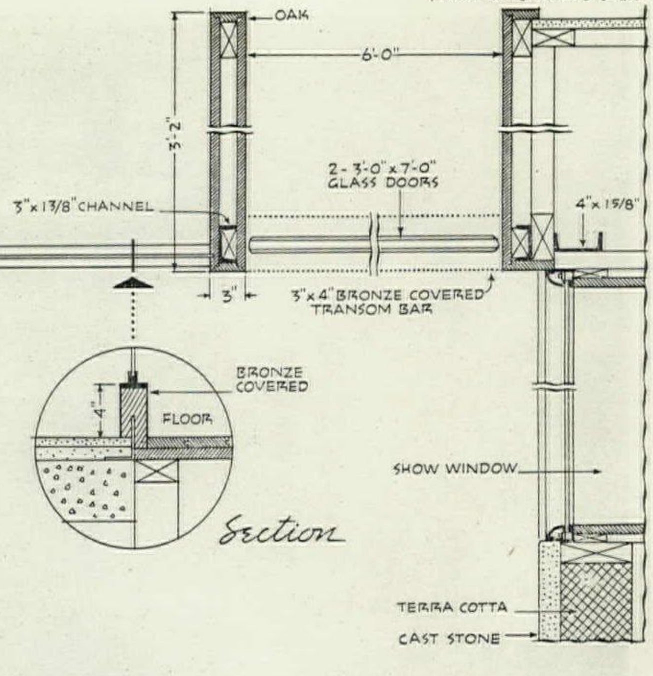


Floor Plan

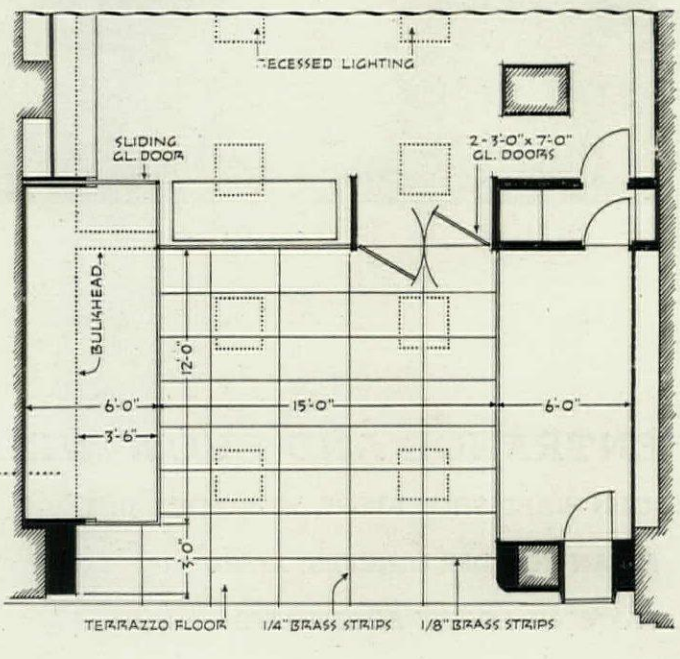
(Photo on preceding page)

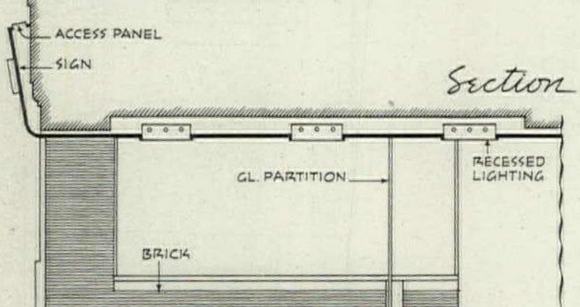


Show Window Detail 3/4" SCALE

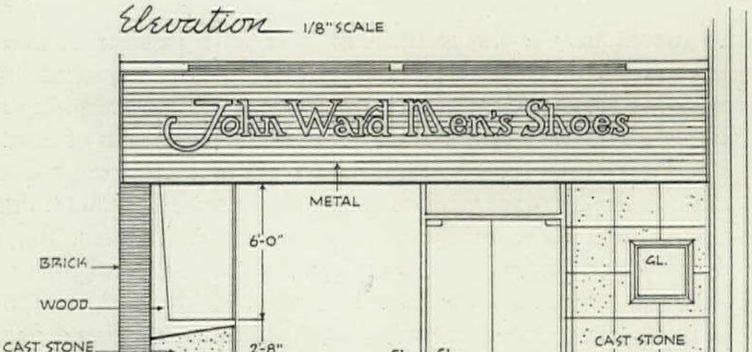


Plan 1/8" SCALE





Elevation 1/8" SCALE



ENTRANCE AND SHOW WINDOWS

JOHN WARD SHOE STORE, NEW YORK, N. Y.

JULIAN VON DER LANCKEN, Architect

RAYMOND LOEWY ASSOCIATES

(Details on following page)

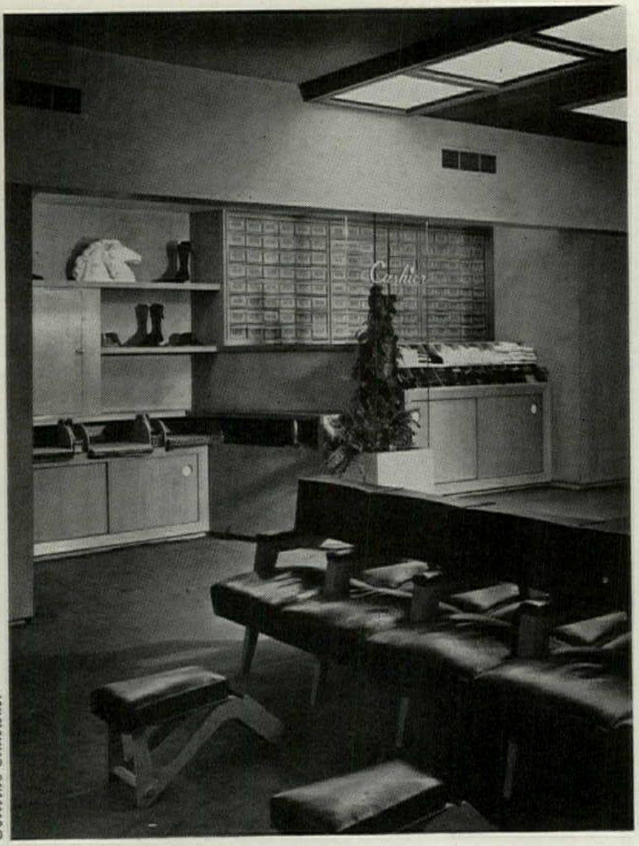
Gottscho-Schleisner

SEATS AND SHOW CASES

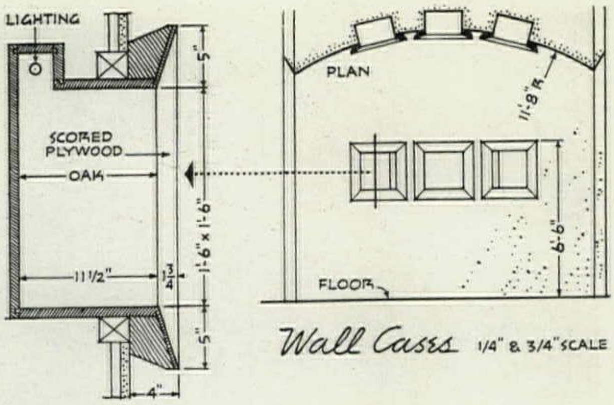
JOHN WARD SHOE STORE, NEW YORK, N. Y.

JULIAN VON DER LANCKEN, Architect
RAYMOND LOEWY ASSOCIATES

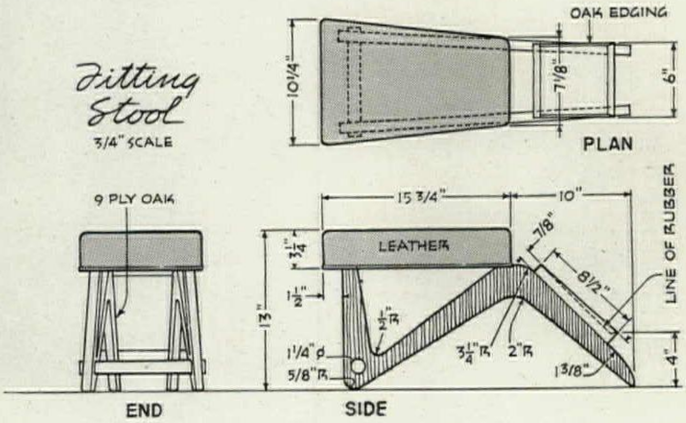
(Photo on preceding page)



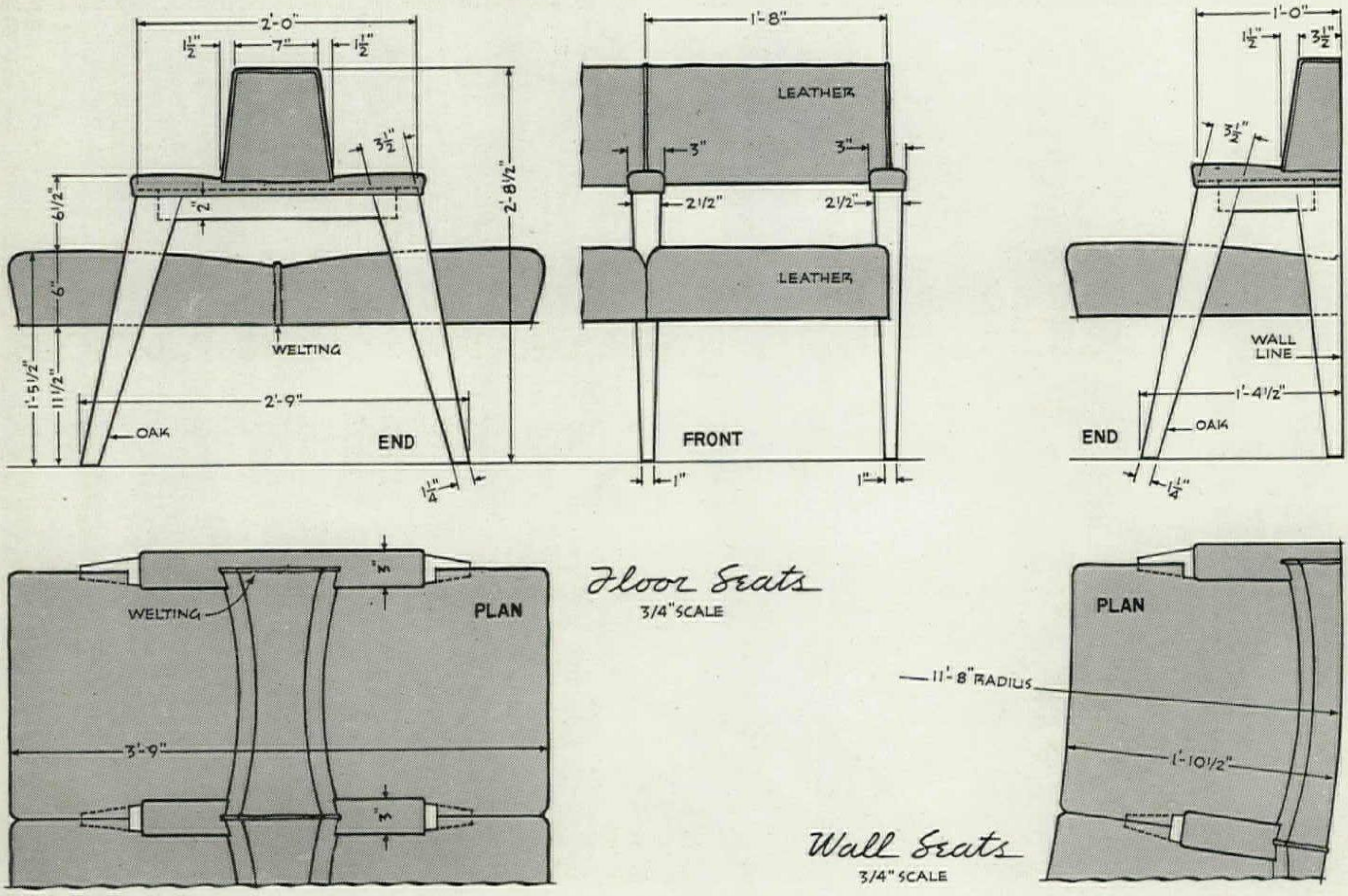
Gottscho-Schleisner



Wall Cases 1/4" & 3/4" SCALE



Fitting Stool 3/4" SCALE



Floor Seats 3/4" SCALE

Wall Seats 3/4" SCALE

SEATS AND SHOW CASES

JOHN WARD SHOE STORE, NEW YORK, N. Y.

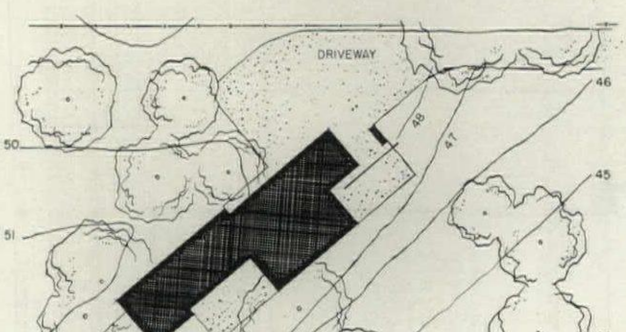
JULIAN VON DER LANCKEN, Architect

RAYMOND LOEWY ASSOCIATES

Photos by Hedrich-Blessing Studio

HOUSE NEAR BARRINGTON, ILLINOIS

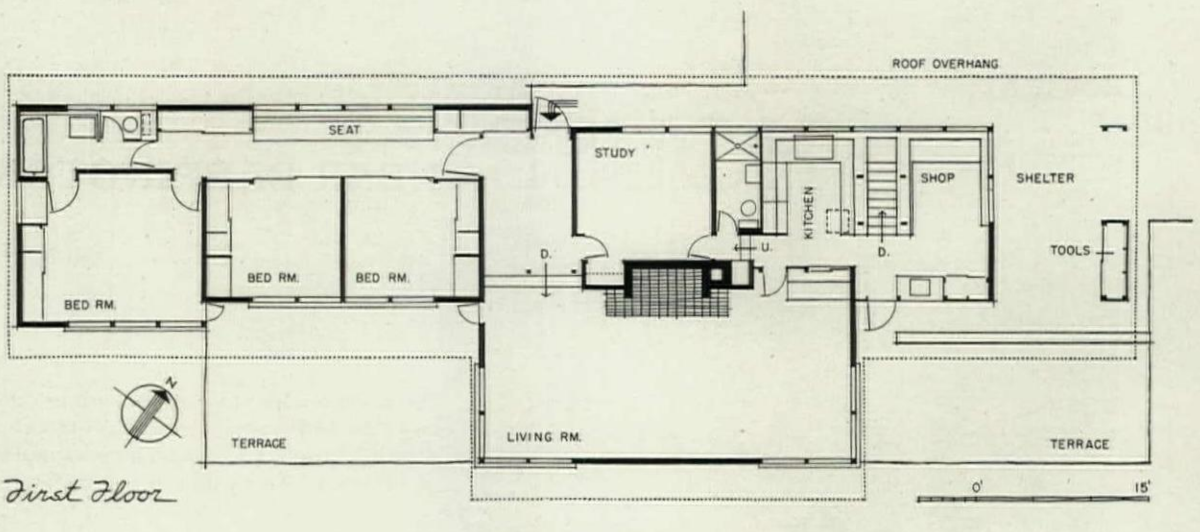
SCHWEIKHER AND ELTING, Architects



The family consists of the parents and two children nearing high school age. The head of the house works in Chicago, 45 miles distant, but wished to live in the country, grow vegetables, keep a cow, chickens, and a horse. This is, then, a contemporary version of the farmhouse.

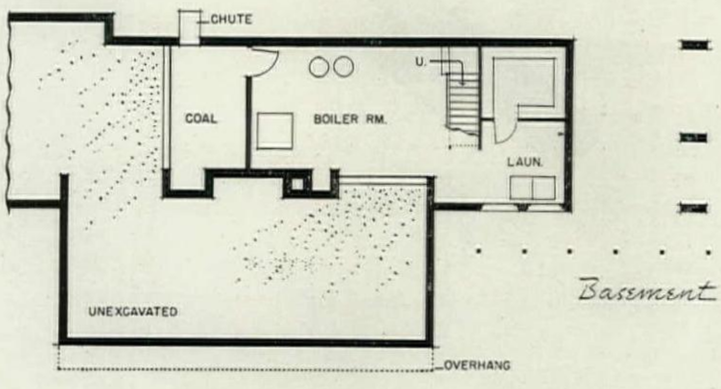
The site was chosen for its reasonable convenience to the school and shopping facilities of the town and to the railroad to Chicago. The Northwest Highway to the city parallels the property. The house, placed on the highest point of land, farthest from the highway, is planned so that its long axis is parallel to the northwest prevailing winds. The design scheme is developed so that the big southern window areas receive maximum low-angle winter sunlight and minimum afternoon summer sun.

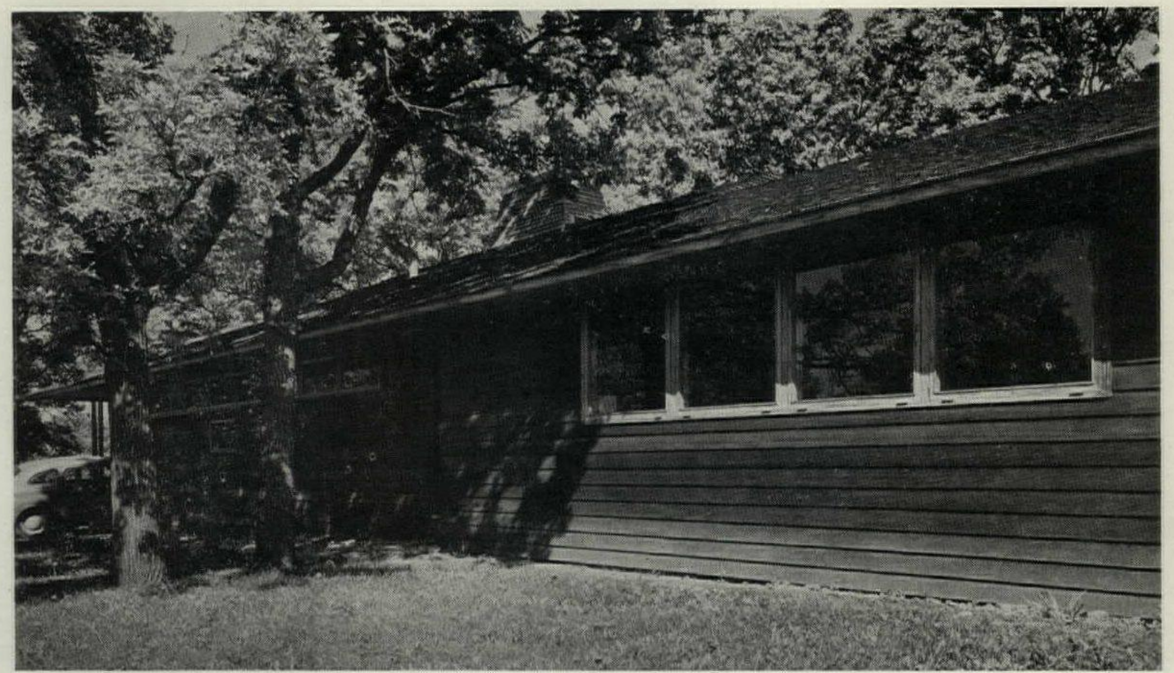
THE BEDROOM WING and southern corner of the living room; plywood ventilator panels, redwood siding, cedar shingles on roof and sloped gable ends.



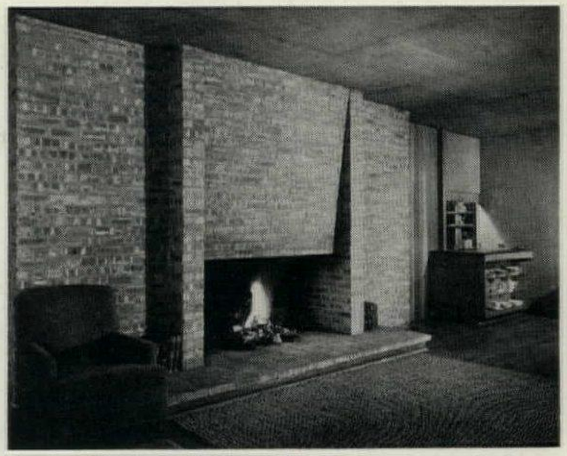
PLANS

The entrance is on the north; the study is schemed so that it also makes a private guest room. Workshop next to the kitchen is for minor carpentry and home-maintenance activities. Central placement of the kitchen makes it readily accessible from the workshop, boiler room, and laundry downstairs, and to the car shelter and southeast garden. The big living room is also used for recreation, dining, musical sessions (everybody plays some instrument). All doors either pivot on wood dowels let into the floors and ceiling or are sliding, providing great use flexibility and a greater sense of space.





A COVERED PASSAGE joins the car shelter with the front door; windows at right light the bedroom hallway.



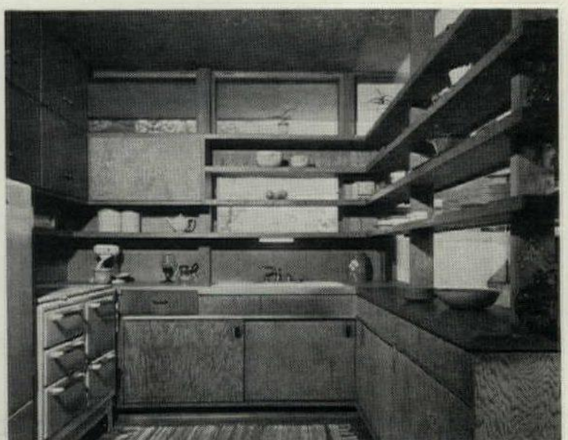
THE LIVING-ROOM FIREPLACE. The room has oak flooring and fir plywood on walls and ceiling.

HOUSE AT BARRINGTON, ILLINOIS

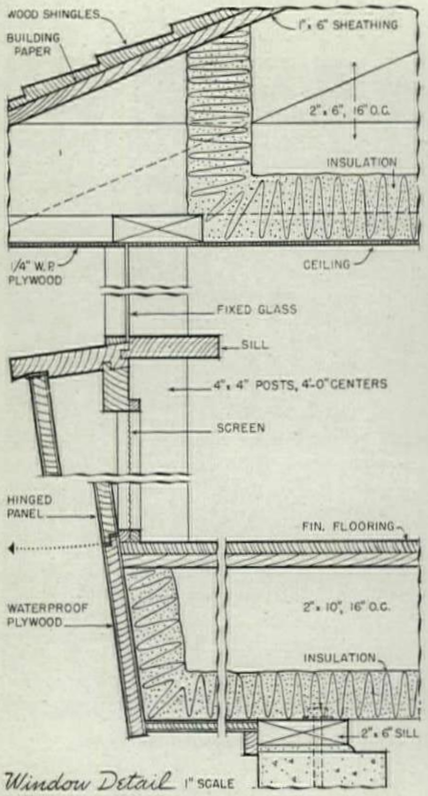
SCHWEIKHER AND ELTING, Architects

The simplified structural system consists of concrete footings, fir studs, joists, and posts, with the framing posts spaced 4 feet on centers. The 4-foot module lends itself at once to application of the standard-size ¼-inch fir plywood that is used throughout for interior finishes. Plywood is also used for all sliding doors; swinging doors were made up on the job out of fir planking. Exterior siding is redwood; the roofing is cedar shingles. Trim has been wholly eliminated, and the structural members are exposed wherever it is logical to do so. Screened ventilators (see details, next page) occur beneath all fixed window areas.

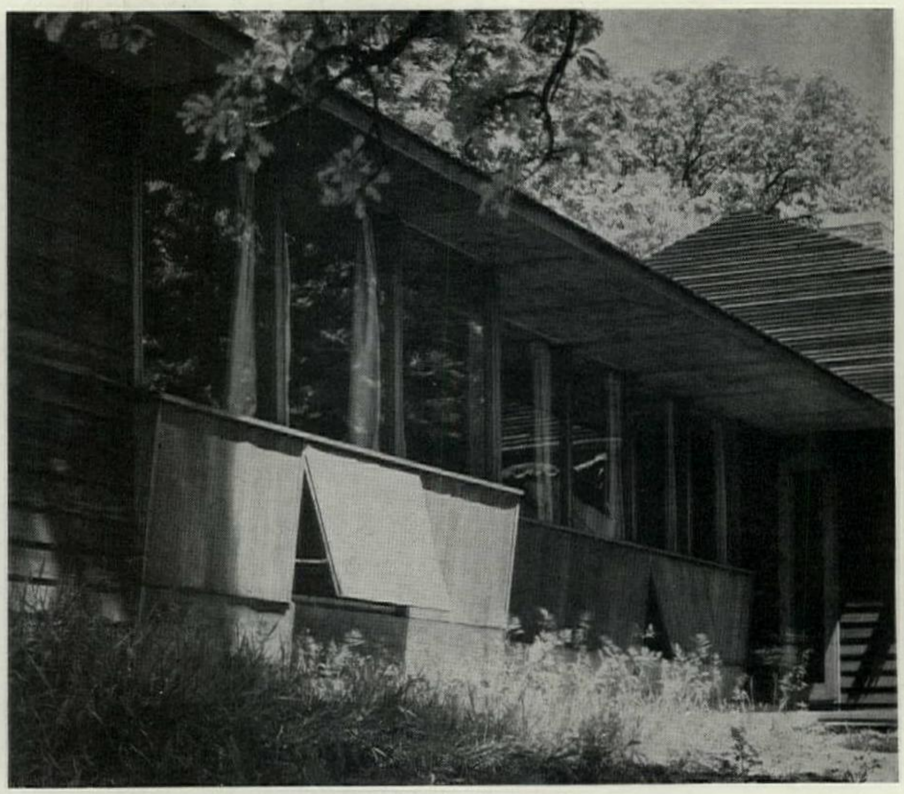
The house is heated by coal-fired, direct, hot-water radiation, with column radiators placed at ventilators to offset winter infiltration of air at these points. For lighting, flush ceiling fixtures are used where general illumination is required, floor and table lamps taking care of special-area lighting.



THE ALL-WOOD KITCHEN, with ventilator windows at ceiling height.



Window Detail 1" SCALE

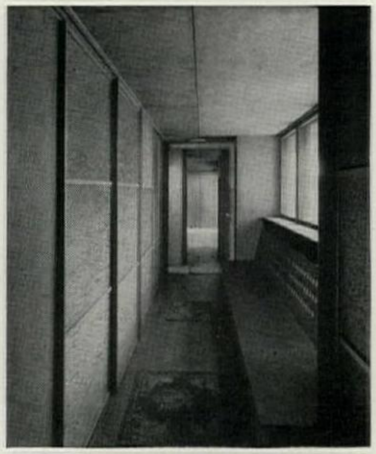


THE VENTILATOR PANELS under the fixed windows are operated by lever devices inside the house.

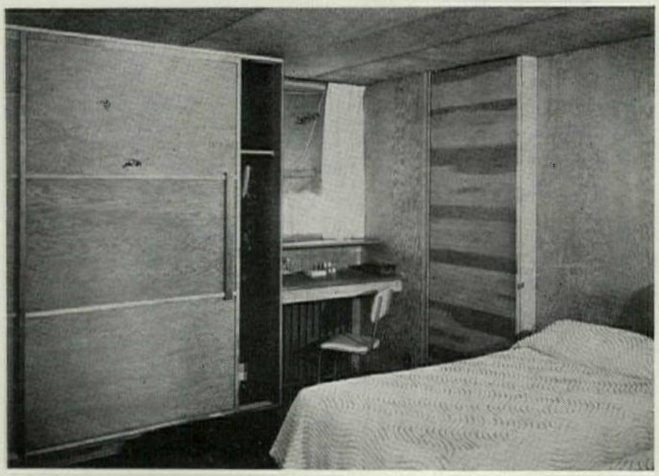
HOUSE AT BARRINGTON, ILLINOIS

SCHWEIKHER AND ELTING, Architects

The detail of the fixed window combined with the ventilator shows how completely this house is a blend of structural and control elements. Photographs at right illustrate the flexibility obtained by use of sliding doors in the children's bedrooms.



BEDROOM WALLS slide back to open up space for other uses. . . . . Closed, the walls give the rooms complete privacy.



CORNER OF OWNER'S BEDROOM; sliding closet doors, pivoted door to bathroom.

Photos by P. A. Dearborn

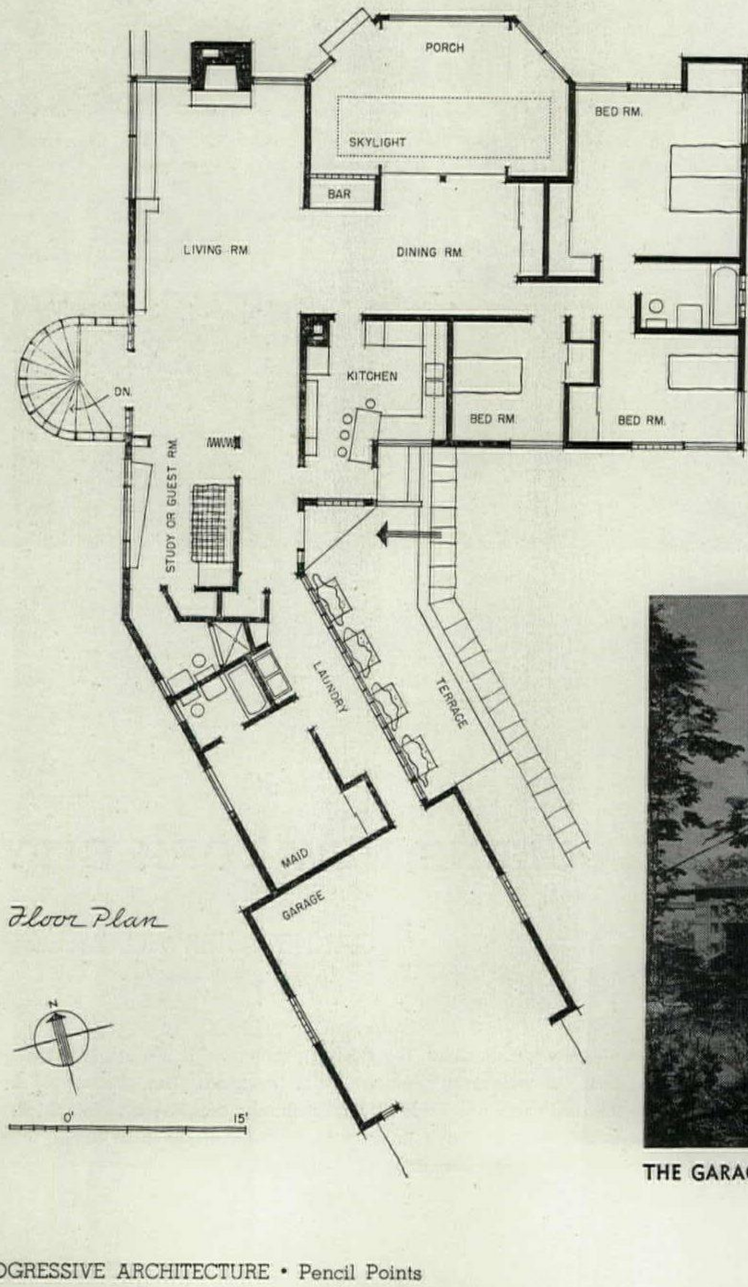
HOUSE AT WHITESTONE, QUEENS, NEW YORK CITY

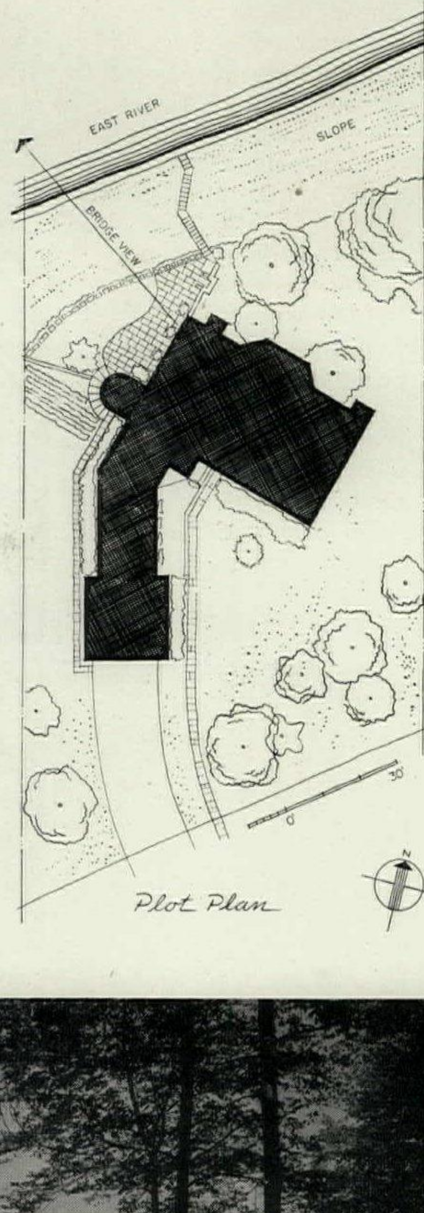
GANNETT HERWIG, Architect

WE ASKED THE ARCHITECT to say a few words about the design problem. "It is hard to think of this house as a problem," he replied. "It was pure pleasure from the start. The site would be wonderful anywhere, but to have this right in New York City is probably unique—a level, thickly wooded lot 100 by 400 feet in area and 40 feet above its own waterfront on the East River, with the beautiful Whitestone Bridge in full view only a quarter of a mile away."

THE GLAZED, CIRCULAR STAIRWAY joins the living floor with the terrace and playroom at the lower level.

HOUSE AT WHITESTONE,





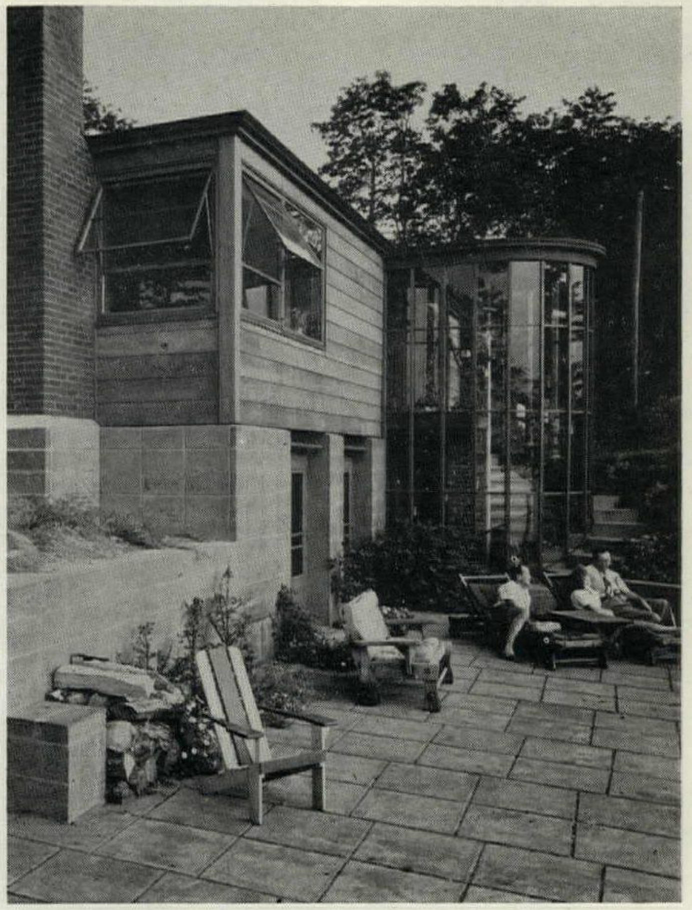
THE GARAGE is coordinated in design and plan with the main house.

QUEENS, NEW YORK CITY

GANNETT HERWIG, Architect

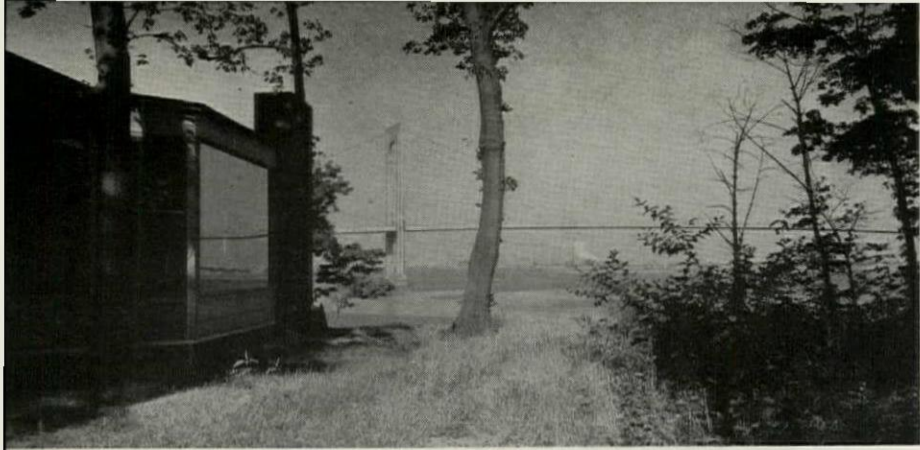
The house is bent in plan to conform to the contour, to preserve trees, and to bring the garage into convenient proximity to the access road. It is the home of a family whose chief delight is in people and entertaining. Hence, the generous, flexible-use study-living-dining-porch area facing the view. The bedroom wing occupies the eastern wing; the long, well lighted laundry also serves as undercover access from the garage.

It is interesting to know that the owners purchased the Redwood House in the "Town of Tomorrow" at the New York World's Fair (Landefeld and Hatch, Architects). While this house is in no sense a restoration, many elements, such as living room paneling, roof-frame members, steel sash, and glass block were re-used.

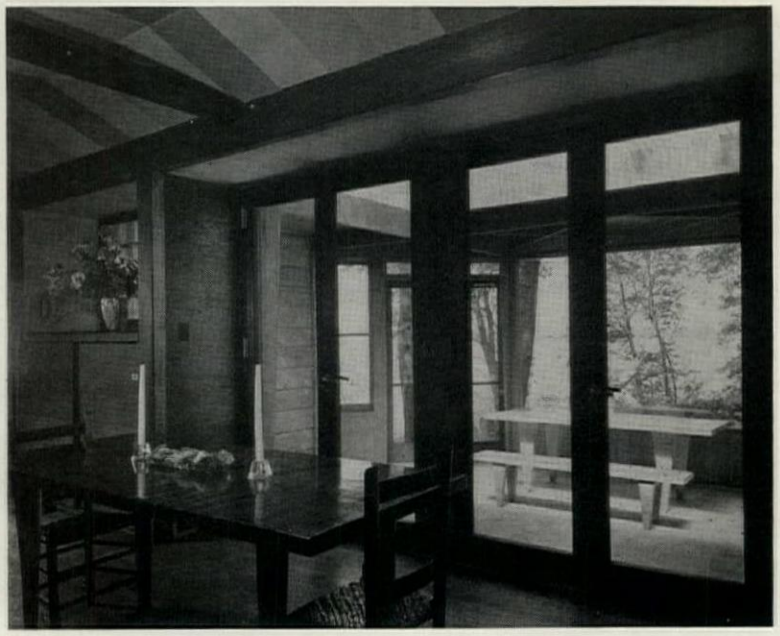


THE LOWER TERRACE AND PLAYROOM were gifts of the site, both enjoying the best view—along with the upstairs living room.

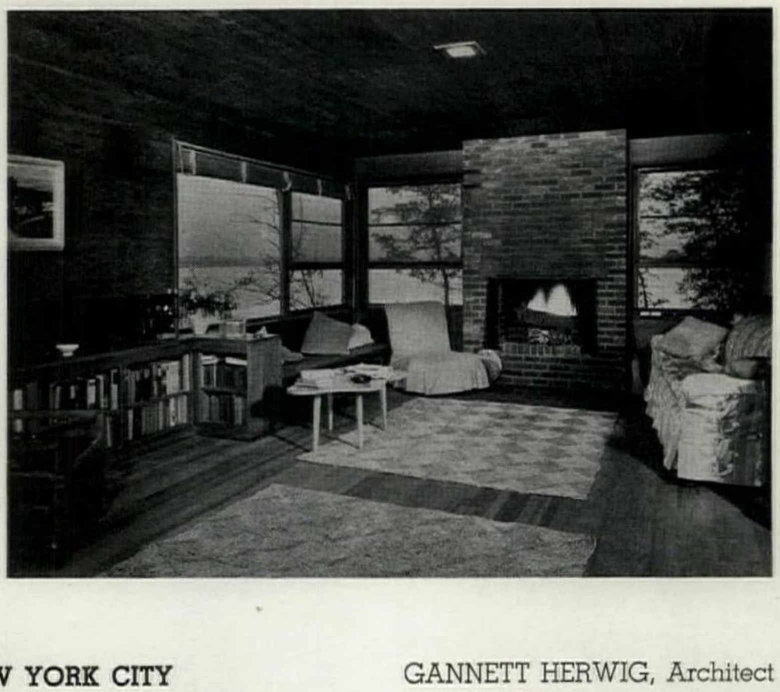
THE SOUTHEASTERN ENTRANCE CORNER preserves the remarkable view for a delightful surprise on entering.



THE DINING-PORCH BAY, clear glazed on three sides and with a corrugated glass panel in the roof, provides a special view vantage point.



Within, THE DINING ROOM may be closed off or joined with well lighted porch.



THE INFORMAL LIVING AREA is finished with redwood plywood, re-used to the last inch from the World's Fair Redwood House.

HOUSE AT WHITESTONE, QUEENS, NEW YORK CITY

GANNETT HERWIG, Architect

An unusual provision in the frame structure is a double 2" x 10" plate, spliced for continuity, around the entire perimeter, allowing flexibility of fenestration. House lighting combines recessed incandescent fixtures with indirect fluorescent units, plus table lamps. The heating system is oil-fired, direct forced warm air, from a basement unit.

MECHANIZATION OF THE HEARTH

1

2

EVOLUTION OF THE MODERN KITCHEN

By SIGFRIED GIEDION

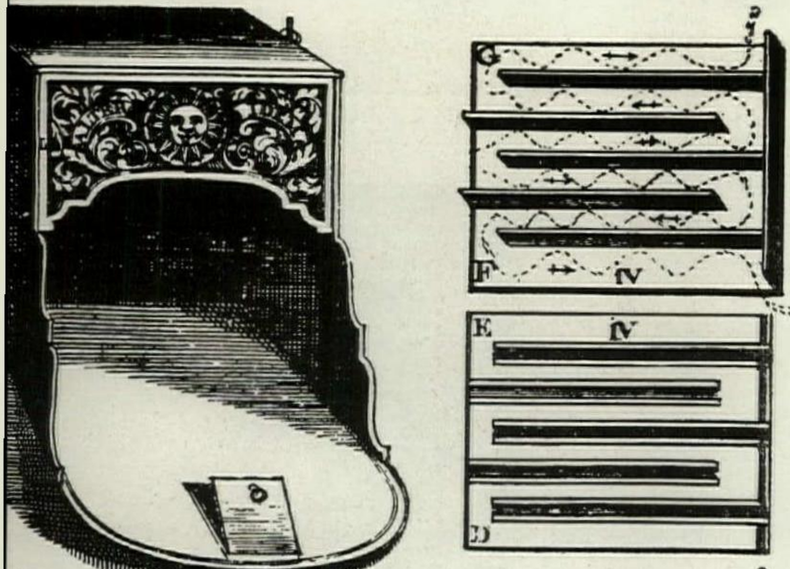
The following is a portion of Dr. Giedion's forthcoming book on the changes which the machine age has wrought in human environment, to be published by Oxford University Press in 1947. Dr. Giedion, architectural historian and member of the International Congress for Modern Architecture (C.I.A.M.), has completed several years' research into the complex devices and systems which the average person today takes for granted. PROGRESSIVE ARCHITECTURE's editors have selected from the book's many subjects Dr. Giedion's history of the kitchen range, which has profoundly affected family life not only of itself but also in its influence on kitchen planning and on refrigerators, cupboards, sinks, and related equipment.

Fig. 1: Cast-iron plate of a Pennsylvania Dutch stove, 1748, built by German and Swiss settlers. This was the origin of the cast-iron stove, basic heat source in the U.S.A. in the 19th century. Inscription reads: W. B. (William Bransen); K. T. F. (Koven Tree —i.e., Coventry—Furnace); and a bit of scripture: Gotes Brynlein hat Waser die Fyle (God's Well had Water in Plenty). *Fig. 2:* Gas or electric range incorporated in the Earle Unit Kitchen, announced in 1946 by the Reynolds Metals Company.

THE CAST-IRON RANGE: Concentration of the Heat Source

The history of the kitchen as we know it today is largely bound up with the growing concentration of its heat sources. The open flame of the hearth, coal within the cast-iron range, gas, and finally electricity, have followed one another as the heating agents. Their eras were of unequal length. For ages the open flame reigned supreme. During the half century between 1830 and 1880 the cast-iron range became prevalent. Between 1880 and 1930 the gas range won acceptance. Then, in ever rising tempo, began the era of the electric range. We are speaking here of things in flux, not of rigid dates. The different forms compete side by side, and before a heating agent triumphs it must usually pass through a prolonged incubation period.

Until late in the seventeenth century the open fire, the flame in the hearth, was often the sole heating agent in the cold season. The chimney of colonial times, whose stone blocks formed the heavy backbone of the house, is some measure of the tradition's vigor. In the large Gothic households, at the Burgundian court, or in the lordly castles, several fireplaces might be united in a kitchen building, as at Dijon or the royal palace of Cintra in Portugal. Their flues, meeting in a conical vault, formed the dominant of the architectural complex.



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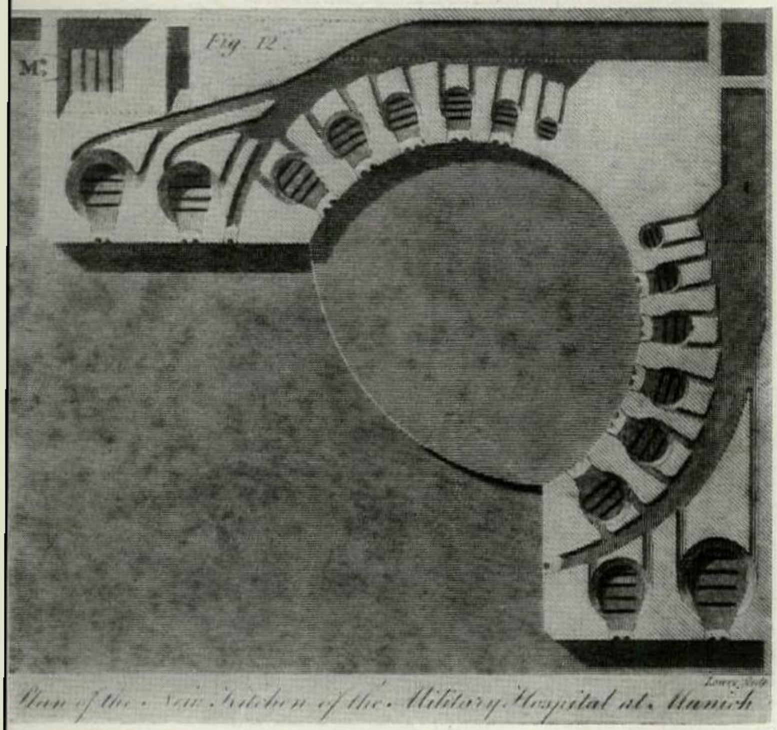

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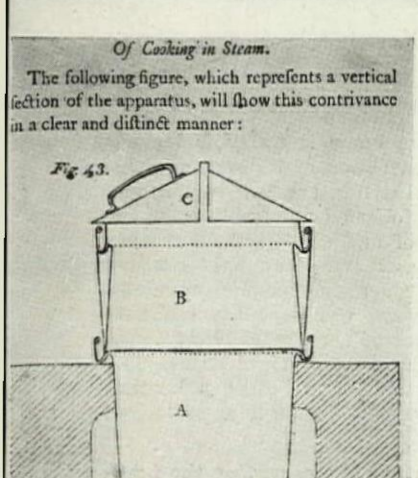

Of Cooking in Steam.

The following figure, which repreſents a vertical ſection of the apparatus, will ſhow this contrivance in a clear and diſtinct manner:

Fig. 43.

C

B

A

A, is the boiler, which is ſeen ſet in brick-work.
B, is the ſteam-diſh; and
C, is the cover of the boiler, which is here made to ſerve as a cover for the ſteam-diſh.
The ſides of the ſteam-diſh (which is made of tin) are double, for the purpoſe of confining the heat more effectually.

Fig. 3: Franklin stove, ca. 1740. Concentration of the heat source (leading to the improved cast-iron range) begins with raising the stove's efficiency by passing combustion gases through flues. Franklin points out the precedent of French experiments: "Air rarefied by heat is specifically lighter than it was . . . and will rise . . ." *Fig. 4:* Count Rumford, oval range for military hospital, Munich, late 18th century. Rumford's semicircular or elliptical arrangement made it possible for the cook to watch all his pots from one position in the center. *Fig. 5:* Count Rumford, sunken saucepan for cooking by steam, forerunner of the modern steam table and of the cooking well available in some stoves today.

Only in the fifteenth century, with the awakening of a burgher consciousness, did the kitchen become a separate room of the house. But even into the seventeenth century it often served as the burgher dining room, 'often as the bedroom too,' and occasionally as a social chamber.[1] It was a neatly kept place and its rows of coppers became the display pieces that so often glow in the Dutch little-masters of the seventeenth century. A drawing ascribed to Jerome Bosch bears witness to the feasting and merrymaking enjoyed in the fifteenth century burgher house around the tall kitchen fireplace.

In the seventeenth century the kitchen ceased to be one of the main dwelling rooms. It became solely 'a service utility.'[2] In the nineteenth century, with its speculative building and ceaselessly growing city populations, the kitchen lost its charm.

THE CAST-IRON RANGE

The fireplace prevails through the centuries. The cast-iron range, heated by wood or coal, dominates in the nineteenth; the steam boiler and the iron range are as characteristic of the nineteenth century as hydraulic power and electricity are of ours. No country has produced iron stoves and ranges in such profuse variety as America. English observers note this, from Charles Dickens' comment on 'red-hot monsters' in the forties to Oscar Wilde's complaint some four decades later against heat-radiating decorations often seen in the center of the room. The cast-iron stove and range were identified with America much as the automobile was later. From America the most diverse models reached the Continent and England, but the tiled range with its even store of heat was still favored in the European kitchen, despite the fact that specialists were required to build it tile by tile. Catherine Beecher, if not on the esthetic grounds of the English observers, voiced practical objections to the cast-iron range which in the sixties was already supreme. "We cannot but regret that our old steady brick ovens have been almost completely superseded by those ranges which are infinite in their capacities and forbid all general rules."[3]

The range is based on the concentrating of the heat source within a reduced space, and all the skills of a scientific century were needed to channel the heat effectively and overcome the range's drawbacks. Thermal efficiency lay beyond the craftsman's scope; it was a matter for the physicist. The steam boiler and the cast-iron range have a common prerequisite: the efficient utilization of heat by the correct channeling of combustion gases. Understandably then, the men who guided the development of the range were rarely stove makers by training.

Benjamin Franklin built no kitchen range, but had designed before mid-eighteenth century a stove to be placed in the fireplace, for utilization of the unexhausted combustion gases. In France especially, as Franklin himself admits,[4] attempts had already been made to improve the thermal efficiency of fireplaces. Franklin's 'Pennsylvania Fireplace' of 1742,[5] although it met with no favor in its own day, has remained the most famous of such efforts. Franklin also found suggestions in the 'Dutch Stove' which was widespread in Pennsylvania (he also calls it 'Holland Stove'). It was made of cast-iron plates. Using the same material, he formed an air box with cast-iron walls in which 'the smoke ascends and descends and heats the plates.' By this and other improvements he more fully used the escaping heat, and allowed it to radiate more equally through the room.[6]

Benjamin Thomson, Count Rumford (1753-1814), raised in colonial America, was a British officer, Bavarian statesman and general-in-chief, and, which is to the point here, one of the great late-eighteenth-century physicists. Rumford designed an indirectly heated oven for the kitchen of a workhouse in Munich, where the heat and smoke passed through a ramification of flues around the sunk-in saucepans. Discoverer of latent heat, inventor of the soups which still bear his name, author of an essay, *Of the Excellent Qualities of Coffee and the Art of Making it in the Highest Perfection,*[7] (giving recipes, several designs of percolators still used today, and voicing the idea that coffee should become the beverage of the masses) Rumford, with his scientific experience, was indeed the man to perfect the range.

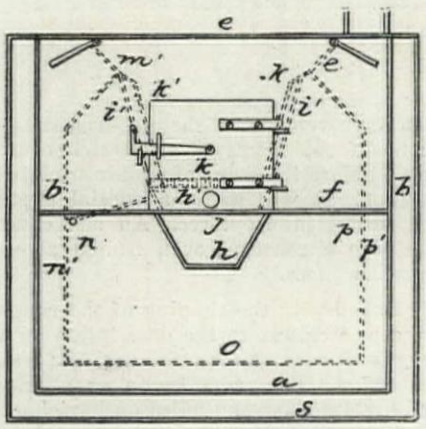
6

7

The social experiment of cooking for a thousand people daily in his Munich workhouse offered an excellent opportunity. Rumford also built large ranges for Bavarian aristocrats, for military academies, and for hospitals in Italy. All were shaped along similar lines: the cook did not walk around his pots but watched them from the center. For the range was hollowed in the same semicircular or oval shape as the small *maisons de plaisance* in the Park of Nymphenburg, where Rumford was a frequent guest. In form, these ranges were infused with the eighteenth century spirit, and bore no resemblance to the towering monsters created by the nineteenth century. They are described and precisely shown in one of Rumford's most perspicacious essays, the tenth. These 300 pages, *On the Construction of Kitchen Fireplaces and Kitchen Utensils, Together with Remarks and Observations Relating to the Various Processes of Cooking and Proposals for Improving that most Useful Art,*[8] are a store of experience and suggestions based on exhaustive theory and a gift for technical solutions. It is almost the outline of what was to follow in the development of cooking equipment.

How was the kitchen outfitted in Rumford's time? There were then no kitchen appliances in the present-day sense. All were yet to be invented. "The kitchen fireplace of a family in easy circumstances in this country," he wrote on his return to England, "consists almost uniformly of a long grate for burning coal placed in a wide and open chimney."[9] In its stead he proposed the range he had evolved in Munich, but went a step further. The heat source, he repeatedly stressed, should be contained within the smallest possible compass. He showed the "usefulness of small iron ovens and the best methods of constructing them,"[10] and, before 1880, had designed "small ovens for poor families."[11] Most interesting perhaps, in this connection, is a 'very simple and useful portable kitchen furnace' with Rumford's sunken stewpan, around which the combustion gases may pass. The conically tapered fire chamber is suspended like a bird's nest. This confining of the heat, as well as its suspension allowing ready access of air, laid down the pattern for the rational range of a later time.

He painstakingly argued to the public the advantages of the roasting oven in even radiation and greater juiciness of the meat, and proposed roasting ovens made of "a hollow cylinder of sheet iron, closed at one end and set in brick work, so that the flame of a small fire may play directly beneath."[12] He paid special attention to the design of the cooking vessels to be placed on a compact heat source. And here we can see the iron adapter rings later used to make the range fit various sizes of pans. The utilization of steam for cooking, and the economizing of heat by stacked pans, were outlined in strikingly adequate constructions. The sides of the steam dish were double 'for the purpose of confining the heat more effectually.' There was even an elegant proposal for a self-contained kitchenette shut off by doors, which he recessed, cupboard-like, into the wall. Rumford called it a 'concealed kitchen.'[13] Rumford often moved along paths that were not later traveled. But, he pointed out, his suggestions, although based on wide practice, were experimental. He was delving into an unknown sphere, and as a creative scientist he often anticipated things later to be laboriously wrested from the trial and error of everyday experience.



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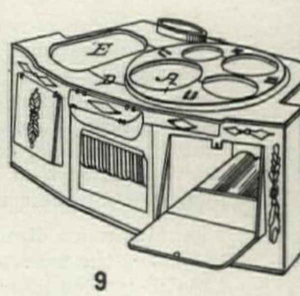

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Fig. 6: "Mock-up" of a proposed electric range with sunken pans, 1943, Libbey-Owens-Ford Glass Co. Built-in cooking vessels, waffle iron, food mixer. When not in use, counter panels were to be lowered over working units to convert the kitchen into playroom or study. Is this a sign that the kitchen may again become a dining and social chamber? Might it, at least, contain an easy chair for the housewife, play space for children? *Fig. 7:* Cast-iron cooking stove, American, 1858. From the Pennsylvania stove and improvements by Franklin, Rumford, and Stewart, the cast-iron range was developed. *Fig. 8:* Philo Penfield Stewart, summer and winter cooking stove, U. S. patent, 1838. Firebox "formed narrower below than at the top" as in Rumford's stoves. Stewart claims manifold technical improvements: removable jackets to control room temperature; even radiation; heat control; partial extinction and re-ignition; fuel economy; adaptability to various fuels; easy ash removal; hot water supply. *Fig. 9:* Range with rotary top, U. S. patent, 1845. Any of several utensils could be held over the fire by rotating the top plate, reducing inconvenience and danger of shifting pots. By changing dampers heat could be directed to stationary boiler, to rotating plate, or both.

10

The successive American improvements of the cast-iron range were largely elaborations of the Pennsylvania Dutch oven. Over three decades passed before the stove of cast-iron plates entered upon its expansion. It was given a special grate such as had long been useful in fireplaces. An ash chest was added, and on one side a roasting oven heated above and below by the combustion gases.[14]

The third name directly linked with the shaping of the range is that of the man who comes closest to the description of a stovemaker; he later engaged in stove manufacture. He was Philo Penfield Stewart (1798-1868), who began as a missionary and teacher, riding two thousand miles on horseback to preach before an Indian tribe. He was instrumental in the founding of Oberlin college and possessed the inventive gift, as widespread in the America of his day as the gift of painting in the Renaissance. Philo Stewart hoped to combine study in his college 'with such economy that the students may defray all their expenses.' The school opened in 1833, and the next year Stewart took out a patent for a cast-iron stove which he named Oberlin, after his institution. When he registered a last patent a few years before his death the mechanism had been thoroughly thought out and proved in use. A glance at the sketch reveals the features he had intended from the first: utmost concentration of the heat source (which burned the fuel then usual, wood); free suspension of the fire chamber like a bird's nest, as in Rumford's range; the surrounding of this chamber by air; perforation of the chamber walls which, as in Rumford's model, taper towards the bottom.[15] We may take it that a man of Stewart's type must have been acquainted with Rumford's writings, which enjoyed an extraordinarily wide public. He nevertheless went his own way, for he had to apply his theoretical knowledge of heat to the practical course of development of the stove in America since 1800.

When he patented his first stove in 1834, Stewart, thinking that royalties might yield some income, made over the patent rights to his college—a clear indication that this was the pre-business period. But Stewart soon left Oberlin and moved to Troy, where in thirty years he manufactured some 90,000 stoves.

Philo Stewart's Oberlin Stove, it is generally recognized, formed the starting point for the technicalized range. Then begins the time of specialists and technical improvements. By around 1840 the cast-iron cooking stove was a vigorously plastic type, having a base and superstructure. It drew the same interest in its time as efficiency kitchen units a century later. As in other fields, the most active period of invention was from the middle fifties down to the seventies. We shall not need to follow the coal range in its later career.

THE TIME OF THE GAS RANGE: 1880-1930

The advent of coal gas made possible a further concentration of the heat source: although the open flame is still used, it is now confined within the narrow bounds of a burner ring. Just as England led the seventeenth century in the utilization of coal for industrial or household purposes, so it led in the manufacture and use of coal gas during the nineteenth.

Compared with its rapid attainment of popularity for illumination purposes, gas established itself surprisingly slowly and belatedly as a heating agent.[16] True, several starts were made in the first decades, but it was only toward mid-nineteenth century that interest began to awaken among the English public. Demonstration kitchens were put on view, and a wide variety of gas-cooked dishes proved how well this tenuous fuel could serve the household. Well in the direction of the future standard was the gas range with a plain cast-iron top and spiral burners, constructed by a Glasgow restaurant owner and shown at the Great Exhibition of 1851.[17] But even then the general public failed to patronize the range, which was mainly purchased for hotel kitchens. "The history of the use of gas for heating and for cooking" during the three decades from 1850 to 1880 "was one of exceedingly slow development."[17] In 1879 an English firm exhibited "over three hundred appliances in which gas was to be used for other purposes than lighting"[17]—for ranges, ovens, flatirons, and other laundry appliances. This is supposed to have given considerable impetus to the new fuel.

Around 1880 the time slowly set in during which the public lost its distrust of the gas range. But one must not suppose that people at large were quickly or easily won away from wood and coal to the imponderable fuel. In 1889[18] a Chicago catalogue stressed: "For eight years we have been manufacturing the Jewel. We were among the first to appreciate that gas was to be the fuel of the future. Is the use of gas for cooking purposes an extraordinary luxury? No, it is an economical necessity. The popular prejudice is gradually giving way."[19]

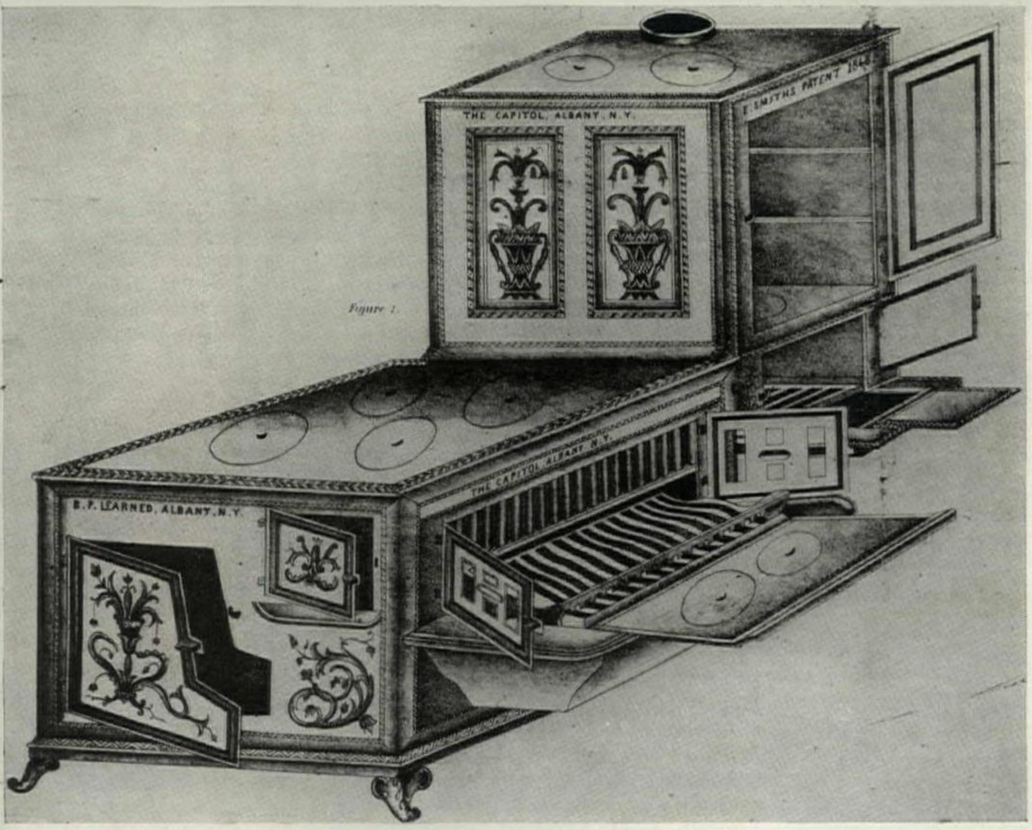
As late as 1910 'combined coal and gas cooking ranges' are listed,[20] and even around 1915 the catalogues appeal in verse with the ever returning refrain "Save the Wife her Time and Care: Cook with Gas."[21] Nevertheless in 1910 half the volume of gas used for illumination was already being consumed for burning purposes.

Deviously, the pure forms of the gas range emerge around 1930. At that time gas cooking already had to reckon with a new rival, the electric range. There seemed to be no breaking loose from its prototype, the coal range; in the larger models the baking oven and broiler were still being placed above the cooking top, a practice which in the smaller ones led to somewhat giraffish proportions.

All that at first glance distinguishes them from the coal range is the table-like frame on which they stand, whose curved and highly ornamented cast-iron legs seem to have emigrated from some Regency salon. These models had their day from the nineties into the second decade of our century. Their design, viewed in conjunction with their time, and considered together with their exuberant ornamentation of silvery metal, betrays the inner insecurity and helplessness of that prosperous era.

But these diversions are secondary. Of greater consequence was the fact that, bogged in the pattern of the coal range, the gas range was segregated within an insulating zone, which delayed its merging into the kitchen work process. Side by side with this, however, ran another form more in keeping with the nature of the gas cooker. Here the flat range top cut by circular burners prevailed as in the model seen at the Great Exhibition of 1851. The broiler and oven occupy the space beneath, while to either side perforated stacking surfaces extend the range top.

The white areas of porcelain enamel, which were later to cover the range and change radically the aspect of the kitchen, were already used in 1910, although confined at that period to the range top and splashback.[22]



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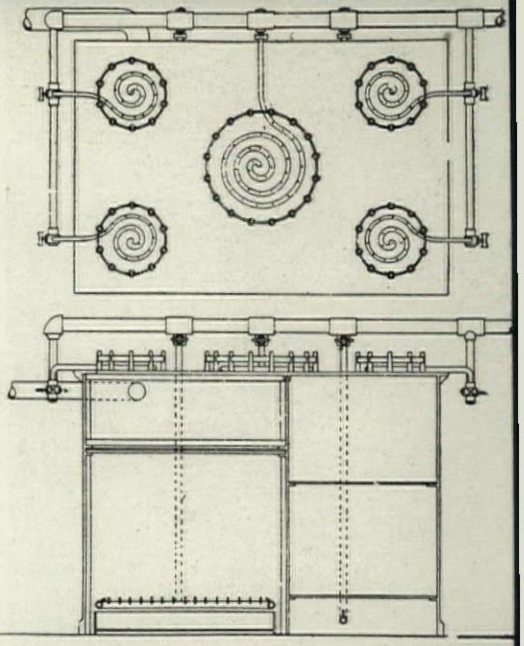

12 Graham's Gas Range, Glasgow, 1851.

Fig. 10: Gas range, American, 1941. The "table top" range, with white enamel work surfaces, developed during the early 1930's. Confined heat source permits compartments for towels, plates, cutlery, etc. *Fig. 11:* American cast-iron range, 1848. Combinability and movability are stressed; illustrations usually show all doors open. A forerunner was the fireplace with built-in boiler and cast-iron oven of the early 19th century; a later "improvement" was the imitation of brick or stone in cast-iron plates. *Fig. 12:* Gas range, Glasgow, 1851. Designed by a restaurant owner, this had many features of the "table top" range, but the gas range had to be tediously derived from the cast-iron stove when gas cooking became accepted toward 1900. *Fig. 13:* Gas range, American, 1889. "The popular prejudice is gradually giving way," reported its manufacturer. *Fig. 14:* "Table top" gas range, 1933. Thoroughly assimilated, the gas range has been brought into line with base cabinets and other units of the mechanized kitchen. The few later refinements include more complete insulation, slight changes in organization, methods of hinging doors, etc.

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From the flat topped English type with its stacking surfaces, where oven and often a broiler occupy the base, the Americans after 1930 developed their 'table top range.' Now the black top has become a working surface of white enamel, cut only by the burner openings to the left. Under the name of 'compact table top range,'[23] although they have no true working or stacking surface, the earlier models appear around 1931. The catalogues advise that the new range 'makes smaller kitchens possible, makes kitchen planning easier.' The influence of household planning is taking effect.

That the gas industry should have supplied the leadership at this time is not strange. It had long practice in setting up demonstration kitchens equipped with household aids. Beginning in the early thirties trailer demonstration kitchens traveled the land; the gas industry was first in the commercial field thoroughly to investigate scientific management in the kitchen.

The automatization of the range so carefully perfected in America during the time of full mechanization began with the gas cooker. In 1915 appeared the oven regulator, a thermostat adapted to this purpose, the first notable invention since mid-century.[24] This begins the mechanical regulating of time and temperature, later to become an American specialty, particularly in the electric range.

The table top range fits the height of other working surfaces and, the makers stress,[25] is proportioned so as to merge with base cabinets continuous along the wall. Soon the abbreviated legs altogether disappear. The table top range, with its drawers for accessories, has found its standard form. It is

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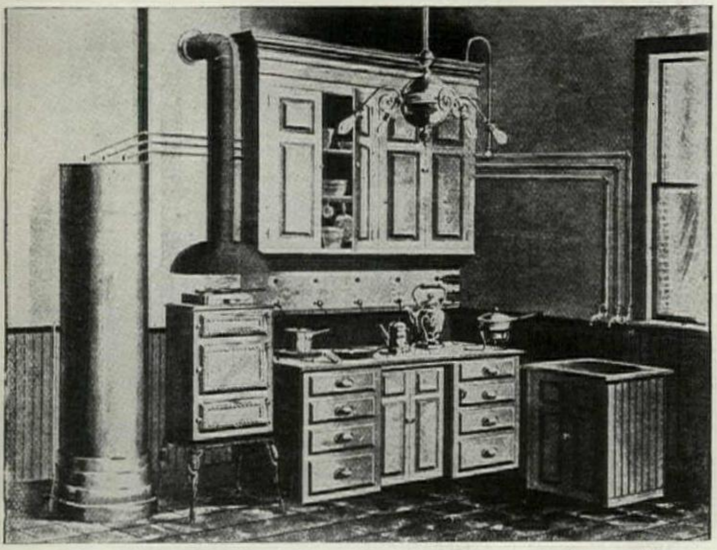
Fig. 15: Imaginary electric kitchen, 1887. Saucepans, heated by battery current, rest on insulators; walls of the pan are conductors. Foods cooked are said to have "an electrical flavor." *Fig. 16:* Electric kitchen, Columbian Exhibition, Chicago, 1893. Distinct units for each purpose, a principle revived in the 1940's. *Fig. 17:* General Electric range, 1905. The electrical heat source is still treated with experimental caution. Movable jacks afford varying temperatures. *Fig. 18:* The electric range becomes popularized—mail-order catalog, 1930. *Fig. 19:* "Hotpoint," 1946, electric range, part of the "all-electric kitchen" designed for the veterans' housing market, is easily combined with counters and other equipment. *Fig. 20:* The range, gas- or electric-heated, disappears into a complex assembly comprising all mechanized equipment needed in a small house (Ingersoll "Mechanical Core," 1946). The assembly dictates location not only of kitchen but also laundry and bath. (Ed. Note: Range manufacturers have yet to discover that many housewives would prefer oven and broiler design which would not necessitate bending far over, or squatting Indian-fashion on the floor.)



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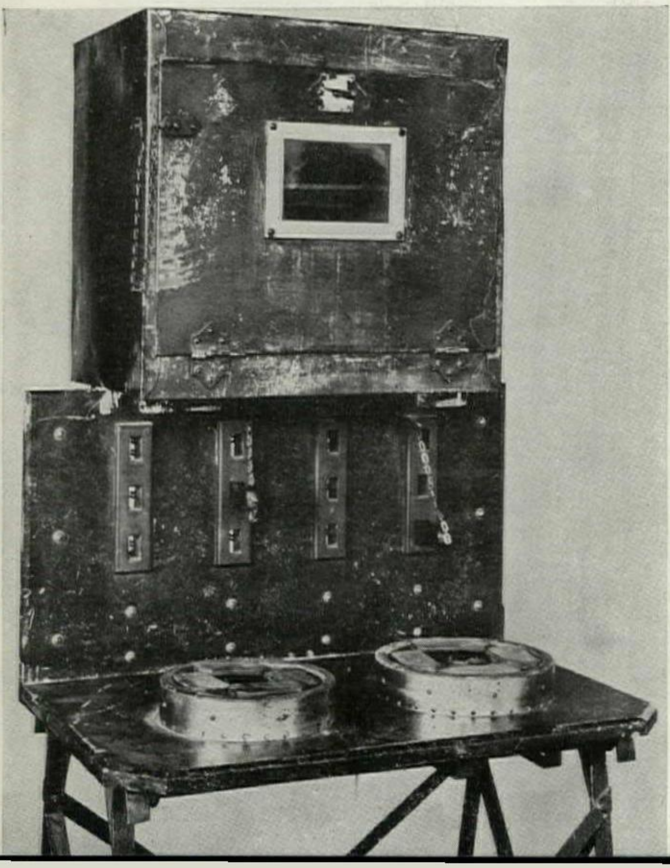

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furniture among furniture. The concentration of the heat source has been carried to its logical conclusion.

THE ELECTRICAL HEAT SOURCE

Electrification shrinks the heat source to a mere spiral of wire, a thin resistance which the current causes to glow and radiate heat. From the first the main task was to bring this radiation in close contact with the object to be heated. The problem was technically solved in several ways, no change of principle being involved. Now heat is instantaneously produced without so much as the striking of a match.

The creation of heat without a visible source went counter to the age-old association of heat with flame. Yet the use of gas fuel has opened the public mind to new, unfamiliar methods. The gas range had taken eight decades to introduce; the electric range no more than half that span. Now, around 1930, household mechanization, previously a cause of hesitation and distrust, became the strongest of sales inducements. Obstacles there were. But they lay rather in the nature of things. The electrical network was sporadic, current too expensive, the apparatus too highly priced and too delicate for the household.

For a long time a tinge of the wondrous seemed to pervade all things electric. There was in truth something to marvel at when the seventy-year-old Michael Faraday toured the English lighthouses in 1862 and first beheld the practical application of his light, or 'magnetic spark' as he called it, which had arisen in his hands three decades earlier.

When, late in the eighties, one toyed with the idea of using electric current for culinary purposes, its portrayal was more suggestive of witchcraft than of a useful invention. One of the popular scientific booklets[26] then so numerous reports a Canadian invention 'answering to this fantastic desideratum,' cooking by electricity. The description is the more fantastic in that the inventor claims to have baked cakes with his apparatus, and these are supposed to have an indefinable 'electrical flavour.'

Yet electrical cooking caught on quickly enough. Practical experiments were first made in England around 1890. An electrical fair held at the Crystal Palace, London, in 1891,[27] is said to have brought the new cooking agent before the public.

The Chicago World's Fair of 1893 outdid in one respect the Eiffel Tower and Halle des Machines of its immediate Parisian forerunner: it provided a display of electrical illumination such as had never before been witnessed. A number of industrialists had spiritedly begun electrical experimentation in various directions. Included in the exhibition was a "Model Electric Kitchen" having a small electrified range, electric broiler, and electric kettles.

Just as demonstration kitchens had been set up to bolster confidence in the gas range of 1850, the same strategy was used four decades later to popularize electrical cooking. The Algonquin Club in Boston is recorded as having set up a demonstration restaurant for twenty persons, where a full dinner was cooked, (from the bread to fish, sirloin roast, and

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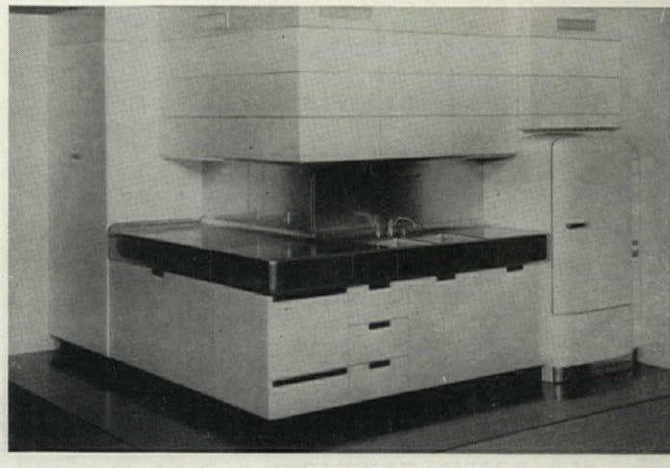
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coffee) the cost of fuel amounting to barely over a cent per person.[28] But this dinner seems to have proved no more persuasive than the electrically cooked banquet held in 1895 in honor of the Lord Mayor of London. There followed an incubation period (1890-1910). The electrified ranges which then made their appearance had the same giraffish aspect as the contemporary gas stoves. "Between 1909 and 1919," a contemporary handbook states, "electric range manufacturers had developed the most perfect cooking device in the world."[29]

Various producers of electricity were now delivering current for cooking at a low price, and the power network was spreading. The electric range was recognized as a large consumer of current, and modern sales organizations grew up in America to apply the necessary stimulus. They were later imitated in most electricity-producing countries.

Yet for 1919 this optimism was perhaps too rosy. Indeed, five years later, a long series of articles on electric kitchens for private houses tells us that disappointments were not unknown. "Some people who tried electric cooking gave it up again on account of the excessive repair bills and the inconvenience connected with the burning out of elements. This shows that there must be many defects still connected with electric cooking appliances and room for considerable improvement."[30]

About the development of electric types there is little more to be said than for gas ranges. They were patterned after the gas range of the type already mentioned, a console raised on legs with oven and broiler above the cooking top. Until after 1930, when the electric range's popularity began, the gas range held the lead, and was apparently first to attain the "table top" form, standard today. From then on, as the larger electrical firms take to selling entire kitchen units and undertake their own investigation of the work process, the electrical range comes to the fore. This is in the mid-thirties. Now it has a gleaming white enamel casing and the oven cannot be distinguished from the utensil drawers. It has merged with the kitchen. And even more clearly than where there is a visible flame, one can see how the kitchen of today developed from the serving pantry, the room with continuous working surfaces where, in large middle-class households, domestics used to add finishing touches.

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1. Havard, *Dictionnaire de l'Ameublement et de la Decoration depuis le XIIIe siecle jusqu'a Nous*, Vol. 1, col. 1132.
2. Ibid., col. 1133.
3. Catherine E. Beecher and Harriet Beecher Stowe, *The American Woman's Home*, New York 1869, p. 175.
4. Nicolas Gaucher.
5. In his biography of Franklin, Van Doren gives the date as 1740.
6. It is rewarding to read Franklin's own description and the six methods he lists for artificial heating in his time; and pleasant to observe how he mentions to the disadvantage of the Dutch Stove that "There is no sight of the fire which is in itself a pleasant thing." And of the 'German Stove' where the heat is piped in from another room he remarks, "People have not even so much sight of the fire as in the Holland Stove." Cf. Jared Sparks, *The Works of Benjamin Franklin*, London 1882, Vol. 5, pp. 38, 43, 44.
7. Sir Benjamin Thomson, Count Rumford, *The Complete Works*, Boston 1870-75, Vol. 4.
8. Ibid., Vol. 3. Cf. another essay in the same volume, "Of the Management of Fire and the Economy of Fuel."
9. Ibid., Vol. 3, p. 227.
10. Ibid.
11. Ibid., Vol. 3, p. 321.
12. Ibid., Vol. 3, p. 257.
13. Ibid., Vol. 3, pp. 460-67.
14. For particulars of this development, see William J. Keep, "Early American Cooking Stove," *Old Time New England*, October 1931, Vol. 22, which includes a list of the American patents down to 1836.
15. Philo Stewart's patents: 19 June, 1834; 12 September, 1838; 18 January, 1859, (No. 22681); 28 April, 1863 (No. 39022).
16. F. N. Morton, "The Evolution of the Gas Stove," *Public Service*, Chicago, July 1908, Vol. 15. According to Morton the first English patent on gas appliances for heating purposes was taken out at the beginning of the nineteenth century by F. A. Windsor; other patents and proposals, in 1825, 1830, and 1832 (illustrations of these in Morton).
17. Morton, op. cit.
18. Prior to this time (from around 1880 on) America, with its abundant petroleum had specialized in the gasoline stove which was later perfected and is still in use (kerosene stove) throughout the country.
19. Catalogue of George M. Clark & Co., 179 N. Michigan Ave., Chicago, Ill., *Jewel Gas Stove Catalogue;* copy in the Edison Institute, Dearborn, Mich.
20. Catalogue of the Fuller and Warren Company, Troy, N. Y.; copy in the New York Public Library.
21. Catalogue of the Standard Lighting Company, Division of the American Stove Company, Cleveland, Ohio, *New Process Gas Ranges;* copy in the New York Public Library.
22. Catalogue of the Reliable Stove Company, Division of the American Stove Company, Cleveland, Ohio, *Reliable Gas Stoves and Ranges*, 1914; copy in the New York Public Library. Cf p. 10: "Some years ago we introduced the beautiful . . . porcelain enameled idea which has proven a decided success . . . We are now operating one of the most complete enameling plants."
23. Catalogue of the Standard Gas Equipment Corporation, 18 E. 41st St., New York, N. Y., *Gas Ranges for Apartments, Residences, and Housing Developments*, p. 9; copy in the New York Public Library.
24. "The first major development was the Lorrain oven regulator by an engineer of the American Stove Company." Cf. *American Gas Journal*, New York, May 1934, Vol. 140, p. 110.
25. Standard Gas Equipment Corporation, op. cit.: "Table top height, 36", fits in well with cabinet work."
26. Max de Nansouty, *L'Annee Industrielle*, Paris 1887, p. 14.
27. Society for Electric Development, Inc., N. Y. *The Electric Range Handbook*, New York 1919, p. 48.
28. *Electricity at the Columbian Exposition*, Chicago 1893, p. 402.
29. Society for Electric Development, op. cit.
30. H. Bohle, "The Electrical Kitchen for Private Houses," *Electricity*, New York, July-August 1924, Vol. 38.

STANDARD SPECIFICATIONS FOR CONCRETE CONSTRUCTION—I

By JAMES D. BEACHAM, A.I.A.

Editor's Note: Progressive Architecture presents herewith a document which should prove invaluable to practicing architects and engineers. With the author's approval, these concrete specifications have been thoroughly checked by Fred N. Severud, Consulting Engineer. In the few cases where author and consultant did not agree, Mr. Severud's suggestions appear as footnotes; all such points are minor. These are not wholly "streamlined" specifications; they may be incorporated in a project specification by reference and modification. The first part is published this month; the second portion, which includes a sample project specification, will be published shortly.

GENERAL PROVISIONS

PART S-I.

S1-01. STANDARD SPECIFICATION.—Intent and purpose: to amplify for the Contractor the details of the materials and methods elected for the concrete construction required to complete the work called for in the accompanying project specification and drawings.

A) Scope: This Standard Specification covers various items of concrete and related work some of which may not be included in the requirements of the contract. Items inapplicable to the contract requirements (those not indicated in the requirements set forth by the project specification or drawings or according to a reasonable interpretation thereof) shall be ignored. The Contractor shall provide strong, durable concrete construction and finish throughout the work.

B) Meaning: The mention herein of materials, articles, operations, and/or methods applicable to the contract work requires that the Contractor provide each item mentioned or indicated and perform each operation prescribed, subject only to qualifications noted and conditions stated in the project specification or drawings, or otherwise specifically authorized by the Architect or Engineer; and provide therefor all necessary labor, equipment and incidentals.

S1-02. STANDARDS FOR MATERIALS and methods for judging their quality and suitability follow.

A) Reference specifications for materials:* 1) Specifications of The American Society for Testing Materials (ASTM Des.); 2) Federal Specifications (Fed. Spec.); 3) American Standards Association (ASA Spec.); 4) other reference or standard specifications mentioned in the project specification or drawings.

1) *Editions in effect at the date of proposals. Copies of applicable reference specifications mentioned obtained by the Contractor, from the respective organizations.

S3-03. INSPECTION.—All materials subject to inspection and approval prior to their delivery at job site, by the Architect or Engineer; all such inspection desired by the Owner at his expense.

1) Materials proportioned, mixed and placed only in presence of the Architect or Engineer; ample notice given by Contractor prior to starting such work.

S1-04. TESTS.—All materials and products subject to Owner's tests at source of manufacture or production, or places other than the site; all such tests desired by the Owner at his expense.

1) Notice to be given: Owner to Contractor, as to materials to be included; ample notice prior to shipping or delivery schedule given by Contractor to Owner.

A) Required tests by Contractor: all desired by Owner as proof of conformance of materials and/or products not tested at production source with specifications; all such tests made at Contractor's expense under appropriate arrangements initiated by him, by professional agency or agencies approved in advance by the Owner.

MATERIALS

PART S-2.

S2-01. CEMENT.—General: A well-known, approved brand used; type or types indicated, conforming by approved laboratory tests and certification to the standards of quality required.

A) Portland cement: Standard (normal) type ASTM Des. C 150-44 or Fed. Spec. SS-C-191, used throughout work unless otherwise required by the project specification or drawings.

B) Other cements: When and as called for by project specification or drawings, such types as "high early-strength Portland"; "moderate-heat-of hardening"; "sulphate-resisting"; "low-heat of hydration"; "hydraulic", and "natural" cement used; each conforming to the current standard requirements of the reference specifications. (S1—02).

S2-02. ADMIXTURES.—Used only when and as called for by project specification or drawings, or when specifically authorized.

A) Hydrated lime: In accord with ASTM Des. C 6-31 or Fed. Spec. SS-L-351.

B) Silicious type: A finely divided inorganic material approved by the Architect or Engineer.

C) Calcium Chloride: In accord with ASTM Des. D 98-34.

S2-03. WATER.—Clean, free from oil, acids, and injurious amounts of vegetable matter, alkalies or other salts; of drinkable quality.

S2-04. AGGREGATES.—General: All aggregates in general accord with applicable requirements of ASTM Des. C 33-44; materials as described herein, following, unless otherwise provided by the project specification or drawings.

S2-05. FINE AGGREGATE:—Material: Clean, strong, natural sand, or (subject to approval and authorization as to use) other inert material suitable for the work to be done, having characteristics similar to natural sand; free from frosted or frozen materials; all meeting the following specific requirements.

A) Grading: Coarse-to-fine; sizes indicated in project specification or drawings; in absence of specific indication, the following grading used* (by weight on standard sieves).

Total passing	for massive concrete	for building concrete
No. 4 Sieve	95—100%	100%
" 16 "	45— 80	....
" 30 "	....	45—75
" 50 "	10—30	12—30
" 100 "	2—10	2—10

*Table not applicable for use with materials other than natural sand.

S2-06. COARSE AGGREGATE.—Material: Strong, clean, crushed granite or limestone, or gravel; or subject to approval as to use, other inert materials having similar characteristics; free

TABLE I—Aggregate **Required grading**

	(3")	(2")	(1½")	(1")	(¾")	(½")	(⅜")	(NO. 4)
¾"				100	90-100		30-55	0-10
1 "			100	90-100		25-60		0-10
1½"		100	95-100		35-70		10-30	0-5
2 "		95-100		35-70		10-30		0-5
3 "	95-100		50-80		20-60	10-20		0-5

TABLE II—Aggregate **Maximum size of aggregate for:**

Minimum dimension of section (in.)	Reinforced walls, beams and columns	Unre-inforced walls	Heavily reinforced slabs	Lightly reinforced or unrein-forced slabs
2½ to 5	¾"	¾"	¾"	1"
6 to 11	1½"	1½"	1½"	2"
12 to 29	2"	3"	2"	3"

from adherent coatings, and injurious amount of friable or fragile pieces, flats, organic matter or other deleterious substances; all meeting the following specific requirements.

A) **Blast-furnace slag:** (used only when and as called for in project specification, or when specifically authorized) broken air-cooled material having angular fragments reasonably uniform in density and quality; reasonably free from thin, elongated, or glassy pieces, dirt and other objectionable matter; weighing not less than 70 lbs. per cu. ft.

B) **Grading:** Material conforming to following requirements (% by weight on standard sieves).

1) **Max. size aggregate as specified.**

See Table I

2) Maximum size of coarse aggregate not larger than 1/5 of narrowest dimension of a concrete member or slab, nor larger than ¾ the clear space between reinforcing bars; in no case larger than 3". In absence of specific indication in project specification or drawings, sizes used determined from applicable requirements of Table II.

See Table II

S2-07. SAMPLES of proposed or approved materials required as follows:

	Fine aggregate	Coarse aggregate
1) Representative material for each 150 tons of aggregate	25 Lbs.	50 Lbs.

S2-08. METAL REINFORCEMENT.—All materials and accessories free from rust scale, grease, clay, and other coatings and foreign substances which may impair their bond with concrete.

A) **Bars:** of structural grade (unless other grade or grades called for in project specification or drawings), new billet steel; deformed (except ¼" bars, which may be plain, round), in accord with ASTM Des. A 15-39 or Fed. Spec. QQ-B-71.

B) **Steel wire:** of cold-drawn steel quality for use in securing reinforcement in place; in accord with ASTM Des. A 82-34.

C) **Fabricated types:** 1) bar or rod mats having all intersections secured by welding or by approved mechanical ties; material in accord with designated requirements for reinforcing bars including ASTM Des. A 184-37.

2) Woven or electrically welded wire fabric: 6" x 6" mesh of 0.192" nominal diameter wire weighing approximately 42 lbs. per 100 sq. ft., conforming to ASTM Des. A 185-37.

3) Paper-backed wire fabric reinforcement (for thin slabs over steel joists or light steel framing): 3" x 4" mesh fabric of #12 ga. galvanized wire conforming to A.S.T.M. specification A 185, attached to a strong water-resistant backing; equal to Pittsburgh Steel Co's "Steeltex Floor Lath".

D)* **Bar supports, chairs, spacers, spotters, etc:** suitable types as approved; adequate to avoid displacement of reinforcement during construction.

S2-09. JOINT FILLER.—Preformed, non-extruding resilient type, in accord with ASTM Des. D 544-41; full width and depth of concrete section; ½" thickness bituminous joint material used unless otherwise provided in project specification or drawings.

A) **Bituminous joint material:** of asphaltic or tar composition provided with stiffener strips; bitumen-impregnated uniformly with suitable filler; remaining undeformed by ordinary handling in hot weather, and not becoming hard or brittle in cold weather.

B) **Cork material:** of clean, granulated cork particles relatively free from hard particles and dust, bonded thoroughly by suitable resin or rubber compound; remaining undeformed and unbroken by twisting, bending and ordinary handling, or by standard tests required by the Architect or Engineer; type 1 used (unless other type or types specified).

S2-10. STORAGE.—All materials stored in approved facilities provided by Contractor, in manner affording convenient access for identification and inspection, at all times.

A) **Cement, lime, admixtures, etc.:** stored in suitable weatherproof, properly-ventilated buildings with dry floors.

B) **Aggregates:** stored on areas covered with

** S2-08: (D). In concrete ceilings or soffits required to be painted, avoid bar chairs that dent formwork, and also avoid concrete briquettes for bar support.*

NOTES ON USE OF STANDARD SPECIFICATIONS

FOR CONCRETE CONSTRUCTION

SUGGESTED APPLICATION.—The Architect or Engineer will prepare his Standard Specification, in manner similar to the accompanying data, adequate and comprehensive to the extent required for his general practice, and including appendices pages thereto for use in uncommon operations. A copy of the Standard Specification and applicable Standard Appendices will be furnished with each set of bidding data issued. **(See accompanying "Specimen Project Specification" for illustrated application).**

NECESSARY SUPPLEMENTARY DATA.—Includes specific information in the project specification and/or drawings giving reference data and necessary modifications of applicable provisions of the Standard Specification and its appendices, as follows:

a) As to **standard specification:** Make reference thereto stating, in effect, that all applicable provisions found therein shall be considered as part of the conditions covering the construction work to be performed. (S1-01)

b) As to **aggregates:** If use of fine material other than natural sand will be required or permitted, designate materials and give grading requirements. (S2-05)
If use of slag or other manufactured coarse material will be required or permitted, designate material. (S2-06)

c) **As to reinforcement:** Show sizes, details and locations on plans. If other than "structural" grade bars are wanted, specify other desired grades. (S2-08)
Specify or indicate type, size and weight of fabric-type reinforcing wanted, if any, should characteristics of material called for in S2-08C be unsuitable for project requirements.

d) As to **joint filler:** Designate type of joint filler required, if any, other than bituminous type; and thickness wanted if ½" thickness is unsuitable. (S2-09)

e) As to **proportioning of concrete mixtures:** Specify proportioning method elected and give data therefor as follows: For Method "A", class(es) of concrete for use, generally, or for various parts of the work. See Table "A" in Part 3.
For Method "B", (S3-01A), -03), include design data, presented in the following table.

Table B.

Class	Minimum allowable compressive strength at 28 days; p.s.in.	Maximum allowable net water content per sack of cement; gals.	Consistency range in slump; inches	Maximum size of coarse aggregate; inches
(1)	(2)	(3)	(4)	(5)

For Method "C", specify proportions of cement, aggregates and water required. (S3-01C). See Table "A" for recommended values.

f) As to **special types of cement:** If any special cements are required, specify type, and locations and instructions for use. (S2-01B)

g) As to **admixtures:** If any are required, specify type and conditions for use. (S2-02 and S3-08)

h) As to **volumetric measuring:** If this method will be permitted in lieu of weight measuring, without limitation, so specify. (S3-05A)

i) As to **ready-mixed concrete:** If this will be acceptable, so specify. (S3-06C)

j) As to **mechanical vibration:** Specify extent of work, or locations, where vibration of concrete will be required, if any. (S7-04)

k) As to **lined forms:** If lined forms are required, so indicate. (S4-02)

l) As to **concrete placed under water:** Indicate extent and design characteristics of any concrete to be so placed. (Appendix 4)

m) As to **high early-strength concrete:** Specify locations or extent to which this material will be used, if any. (S3-07)

n) As to **special concretes:** If any such concretes as "Lightweight", "Fireproofing", "Rubble", or "Cyclopean" are required, designate type(s) and indicate locations for use. See "appendices" pages.

o) As to **seal-coat curing:** Specify use of this method, if such is required, giving locations or class of work affected. (S6-02B)

p) As to **heat-curing:** Specify this method for parts of interior work to be constructed, if any, in extreme cold weather. (Appendix 5)

q) As to **special surface finishes:** Specify or indicate type(s) desired, if any. (S9-04 and Appendix 6)

r) As to **types of floor finish:** Specify type(s) wanted other than Type "A", if any. Specify and/or indicate thickness if more than minimum called for is required. (S10-01 and S10-03, -04, -05, and -06). Specify preference, if any, for "monolithic" or "separate" topping in connection with use of Type "A" finish.

s) As to **metal division strips:** Indicate type, size and locations of such strips required, if any. (S10-08B)

t) As to **cement base:** Indicate extent and design of cement base wanted, if any. (S10-09)

OPTIONAL DATA.—Should the Architect or Engineer wish to indicate in the specification his preference for certain makes of materials or articles, it is suggested that he include a statement to the effect that where names of manufacturers and trade-names appear, such mention is intended to be descriptive, but not restrictive; that the information is given to indicate to the Contractor the type and quality that will be acceptable.

tightly-laid wood planks, or other approved hard, smooth and clean surface; in manner precluding foreign material; aggregates of different classes stored in separate piles, in horizontal layers not more than 4' in depth.

C) **Reinforcement:** Material, including accessories, stored in manner preventing objectionable changes in original surface characteristics; in separate piles or racks; above grade.

S2-11. *POROUS FILL UNDER SLABS ON GROUND.—Gravel or crushed stone graded between ⅜" and 1½" in size, or a combination of gravel, or stone, and coarse sand.

PROPORTIONING AND MIXING OF CONCRETE

PART S-3.

S3-01. PROPORTIONING—done according to the method designated in the project specification or drawings, using one or more of the methods following as described herein. In absence of specific designation, Method "A" used.

A) **Method A:** a proportion determined by the Architect or Engineer following trial and adjustment of tentative mixes on the job; based primarily on the class of concrete designated and the proportions therefor indicated in Table "A", using the materials specified in Part S-2.

B) **Method B:** a proportion determined by the Contractor, providing concrete of the minimum strengths (compressive and/or flexural) designated and having characteristics as indicated in the project specification or drawings.

C) **Method C:** the fixed proportion given in the project specification or drawings, used throughout the work unless otherwise directed or authorized by the Architect or Engineer.

S3-02. SPECIFIC REQUIREMENTS FOR METHOD A.—Estimates based on cement factor and quantity of fine aggregate within range of the class of concrete specified as indicated in columns (7) and (3) respectively, of Table "A"; in case of radical departure therefrom, as directed, equitable adjustment made in contract price.

A) **Quantity of fine aggregate:** variable within limits indicated in column (5) of Table "A", as necessary to obtain proper workability and a smooth, dense, homogeneous, plastic mixture, free from segregation; such variations as approved or directed.

B) **Quantity of mixing water:** Maximum indicated includes free water on the aggregates; moisture absorbed in the aggregates not to be included.

C) **Slump of mixture:** as directed or approved; lowest slump compatible with proper placing used. In absence of specific designation or directions, applicable values of table in Par. S3-04 govern.

D) **Verification of strengths:** Concrete strengths verified during the progress of work at intervals directed by the Architect or Engineer, by testing cylinders of samples taken at the mixer.

1) Upon establishment by preliminary tests of the ratio of 7-day and 28-day strengths, 7-day strengths taken as satisfactory indication of 28-day strengths.

2) Increase or decrease in quantity of cement required by Table "A", may be ordered by the Architect or Engineer as necessary to produce concrete of the indicated strength or desired workability, subject to equitable adjustment in contract price in accordance with terms of the contract.

E) **Trial batches:** Without exceeding water-cement ratio and slump designated, full-size trial batches made by Contractor to establish correct proportions to give proper workability; proportions of fine and coarse aggregate adjusted within limits of column (5) of Table "A" until the workability of the mixture meets with the approval of the Architect or Engineer.

S3-03. SPECIFIC REQUIREMENTS FOR METHOD B.—Intent: Secure for every part of the work concrete of homogeneous structure which, when hardened, will have the required strength and resistance to weathering when made in accordance with the limiting requirements indicated in the project specification or drawings; including the following:

1) Class of concrete; 2) Minimum allowable strengths (compressive and/or flexural as required) at 28 days; 3) Maximum allowable, net water content per sack of cement; 4) Consistency range in slump; 5) Maximum size of coarse aggregate. All values based on use of normal Portland cement, and aggregates and water meeting the requirements given in Part S-2 of this specification. (Maximum allowable, net water content is the total water in the mixture at time of mixing, not including water absorbed by the aggregates.

A) **Determination of strengths:** accomplished as in case of Method "A" proportioning; [S3-02 (D).]

B) **Determination of proportions:** by means of certified laboratory tests of concrete made with the materials approved for use on the work.

1) Samples of materials proposed for use by the Contractor submitted to Architect or Engineer, for approval, at least 35 days prior to beginning of concrete work.

2)* Statement of proportions proposed by Contractor for concrete mixture submitted prior to beginning of concrete work, accompanied by a detailed report from an approved testing laboratory showing, for at least 3 different water contents, the 7-day and 28-day concrete strengths obtained when using the materials proposed for the work; such determinations based on not less than 5 concrete test specimens for each age and each water content.

3) Architect's or Engineer's right: to make all desired check-tests of concrete, using materials proposed or in use, and to order such changes as may be necessary to meet requirements of the contract.

4) Ratio between the 7-day and 28-day strengths established by preliminary tests used to determine the 7-day strengths necessary to satisfy the 28-day strength requirements indicated; ratio modified as work progresses as may be indicated by the results of field tests.

C) **Workability:** Concrete mixture such as to be workable readily into corners and angles of forms and around reinforcement, without permitting the materials to segregate or free water to collect on surface; proportions of cement and aggregate adjusted as may be necessary to produce a mixture easily placable at all times.

D) **Mechanical vibration:** When used (where specified or authorized) for compacting concrete, limiting consistencies modified only on the approval of the Architect or Engineer; required consistency for workability, as specified, satisfied.

E) **Changes by Architect or Engineer:** may be made during progress of work should it be found impracticable to obtain concrete of required workability and strength with materials being furnished by the Contractor; in such cases, changes in proportions or materials, or both, made as may be necessary to secure desired properties, subject to the limiting requirements indicated; all such changes made at Contractor's expense and no extra compensation allowed by reason thereof.

F) **Changes by Contractor:** Materials originally approved may be changed by Contractor, during progress of work, because of objectionable changes in initial characteristics of materials or for other justifiable reasons; provided conclusive evidence satisfactory to the Architect or Engineer is submitted showing that new materials or conditions proposed will produce concrete meeting the requirements indicated, and will not bring about objectionable changes in the color or appearance of the exposed surfaces.

G) **Changes in requirements:** by Architect or Engineer, in order at any time during progress of work, regardless of limitations indicated; changes in materials or proportions, or both, considered necessary to meet the requirements of the structure; in such cases, Contractor compensated in accordance with terms of contract for additional cost of materials and for additional handling and placing costs, if any, entailed by changed conditions.

S3-04. SLUMP REQUIREMENTS.—Applicable values of following table used unless otherwise directed, or in absence of specific designation in project specification or drawings.

1) Type of Construction	Slump Max.	Slump Min.
Heavy mass construction	3"	1"
Pavements	3"	2"
Plain footings and substructure walls	4"	1"
Reinforced foundation walls and footings, and thin plain walls	5"	2"
Slabs, beams, and reinforced walls and building columns	6"	3"

With use of high-frequency vibrators, slump values reduced about one-third.

S3-05. MEASUREMENT OF MATERIALS. — Cement and aggregates for concrete requirements involving a total of more than 50 cu. yds., measured by direct weight upon suitable weighing devices approved by the Architect or Engineer, or subject to specific authorization, other suitable and approved methods; accuracy of weighing devices such that successive quantities can be measured to within 1% of desired amounts. Each size aggregate and bulk cement weighed separately:

1) Mixing water measured by weight or volume, by device susceptible of control accurate to plus or minus ½ of 1% of the capacity of the storage tank.

A) **Volumetric measuring:** (used only under conditions specified in Par. S3-05, or when specifically authorized) comprises the transposition of weight proportions indicated to equivalent volumetric proportions, as checked and approved by the Architect or Engineer; suitable allowances made for variations in the moisture condition of the aggregates, including the bulking effect in fine aggregate.

S3-06. MIXING.—All concrete machine-mixed, at site or at Contractor's central plant, unless otherwise specified or authorized.

A) **Equipment:** modern mixer or mixers capable of producing homogeneous mixtures of uni-

TABLE A

Based on 3" Slump. See Note Below Table.

Class of concrete and max. size of aggregate (in.)	Maximum water per sack cement (gal.)	Gravel % Sand (For F.M. range from 2.20 to 3.2)	Stone % Sand (For F.M. range from 2.2 to 3.2)	Gravel Minimum amount of cement (sacks)	Stone Minimum amount of cement (sacks)
A— ¾	8	41-47	46-52	4.6	5.0
A—1	8	38-44	43-49	4.5	4.9
A—1½	8	34-40	39-45	4.3	4.6
A—2	8	32-38	37-43	4.0	4.4
B— ¾	7½	41-47	46-52	4.9	5.3
B—1	7½	38-44	43-49	4.8	5.2
B—1½	7½	34-40	39-45	4.5	4.9
B—2	7½	32-38	37-43	4.3	4.7
C— ¾	7	41-47	46-52	5.3	5.7
C—1	7	38-44	43-49	5.1	5.6
C—1½	7	34-40	39-45	4.9	5.3
C—2	7	32-38	37-43	4.6	5.0
D— ¾	6½	41-47	46-52	5.7	6.2
D—1	6½	38-44	43-49	5.5	6.0
D—1½	6½	34-40	39-45	5.2	5.7
D—2	6½	32-38	37-43	4.9	5.4
E— ¾	6	41-47	46-52	6.2	6.7
E—1	6	38-44	43-49	6.0	6.5
E—1½	6	34-40	39-45	5.7	6.2
E—2	6	32-38	37-43	5.3	5.8

Increase water content 3 per cent for each 1 in. increase in slump. Add cement to maintain water cement ratio.

** S2-11: Many designers specify that porous fill be covered with building paper to prevent loss of wet concrete. This practice requires additional care in placing concrete to prevent puncturing the paper.*

S3-03: (B. 2) Many architects and engineers require the mix selected to show laboratory test results 15% higher than the design strength, to allow for field irregularities.

form color, and of discharging the mixtures without segregation; equipment at mixing plant so constructed that all materials, including water, entering mixer drum can be accurately proportioned and will be under control; devices for weighing aggregate and cement specially designed for that purpose; all equipment subject to approval of the Architect or Engineer.

B) **Machine mixing:** Volume of mixed material, per batch, according to manufacturer's rated capacity, not exceeded; mixing continued for not less than 1 minute (or longer as directed), and with drum rotating at peripheral speed of not less than 190' per minute throughout the mixing period, when all the materials are in the mixer; the entire batch discharged before mixer is recharged; retempering of concrete or mortar not allowed.

1) Initial mixing at plant not required when concrete is to be transported to job site in approved revolving-drum type truck mixers.

C) **Ready-mixed concrete:** (used only when called for or allowed by project specification or drawings, or when authorized); in accord with ASTM Des. C 94-43T.; plant properly equipped in all respects for accurate proportioning and proper mixing and delivery of the concrete, including accurate water measurement and control; plant of sufficient capacity and having sufficient transportation equipment to deliver concrete at the desired rate; all conditions subject to the approval of the Architect or Engineer.

D) **Delivery to job-site:** Concrete transported in clean, watertight receptacles equipped with an agitator device which, following initial mixing of concrete at the plant, will operate until the load is discharged; or in revolving-drum type truck mixers in which the concrete materials, in the proportions required, are placed and the drum revolved until the mixture is discharged, at a speed of not less than 4 r.p.m., or for not less than 4 minutes after all materials are in the mixer.

1) Interval between batches for a pour not to exceed 30 minutes; elapsed time between discharge from mixer and placing concrete not to exceed 1 hour.

E) **Hand mixing:** method used only when specifically authorized.

1) **Equipment and procedure:** watertight platform; mixing done in manner insuring a uniform distribution of materials throughout the mass; mixing continued until a homogeneous mixture of the required consistency is obtained.

S3-07. HIGH EARLY-STRENGTH CONCRETE. — High early-strength type Portland cement used only when and where called for in the project specification or drawings, or when specifically authorized; requirements for such concrete, generally, the same as specified for normal Portland cement concrete, except that estimated 28-day strengths indicated for normal cement taken as estimated 7-day strengths when high early-strength Portland cement is used.

S3-08. ADMIXTURES.—Hydrated lime or silicious admixtures used only when and as called for in the project specification or drawings or when specifically authorized by the Architect or Engineer. Use of calcium chloride in concrete avoided where exposed surfaces will be painted.

S3-09. TESTS OF CONCRETE.—During progress of work, tests made of specimen pieces of concrete to determine whether the concrete as produced complies with the standards of quality specified. Under proportioning methods "A" and "C", desired tests made by a laboratory employed by Owner (Contractor's cooperation required to extent of allowing access to work for selection of samples and storing and protecting samples and specimens, in a manner preventing injury or loss through his operations). Under proportioning method "B", tests made by laboratory acceptable to Owner, at Contractor's expense.

A) **Test pieces:** Sample of concrete taken at the mixer, or from transportation vehicle during discharge; 3 cylinders or beams made for each class of concrete used in any one day's operation; specimens molded immediately in accord with the requirements of ASTM Des. C 31-42, placed in a protected spot, and kept 24 hours under moist curing conditions at approximately 70 deg. F.; then transported to testing laboratory.

B) **Laboratory testing:** Specimens kept under standard moist curing conditions at approximately 70 deg. F., until tested; tests made at 7 days and 28 days in accordance with designated methods following; upon establishment of relationship between 7-day and 28-day strengths, 7-day test results used as an indication of probable 28-day strengths.

1) Method for compression tests, ASTM Des. C 39-42. Method for flexure tests, ASTM Des. C 78-39.

FORMWORK

PART S-4.

S4-01. FORMS.—General: Suitable and adequate forms provided conforming to the shape, lines, grades and dimensions of the concrete called for in the project drawings; exposed surfaces produced having smooth appearance practically free from offsets, fins, honeycomb, and other objectionable defects. For forms for architectural concrete see S4-02.

1) Responsibility for adequacy and safety of forms rests with the Contractor, but design of all such work subject to approval of the Architect or Engineer.

2) All work done in accordance with specific requirements following.

A) **Materials:** wood, metal or other approved material used for contact surfaces; free from objectionable surface defects that may affect the finished concrete; material optional with Contractor unless specific requirements are indicated in project specifications or drawings.

1) Lumber forms: No. 2 common or better, reasonably-dry yellow pine or other approved species used for form lumber; for exposed work, contact boards dressed and tongue-and-grooved.

2) Plywood forms: of approved grade and quality; made for use as concrete forms.

3) Metal forms: Surfaces free from irregularities, dents and sags; pans used for floor construction not less than 16 ga. metal; forms for concrete joist construction in accord with ASA Spec. A 48-1932.

4) Sectional or patented forms: used only if specified or authorized, under conditions approved by the Architect or Engineer.

B) **Form ties:** Bolts and rods, of adjustable type to permit tightening forms; so arranged that upon removal of forms no metal is within 1" of any exposed concrete surface; no wire ties used where concrete surfaces will be exposed to weathering.

C) **Design and construction:** Forms mortar-tight; well-braced, tied and supported so as to maintain the desired position and shape during and after pouring concrete; trussed supports provided where adequate foundations for shores cannot be secured; forms for heavy beams and similar members constructed with suitable camber as directed; all forms designed for removal without injury to the concrete.

1) Knot holes and broken places in wood contact forms covered with metal patches; adequate temporary openings provided where necessary for cleaning and inspection of forms; where indicated, suitable mouldings placed in forms to shape the edges or surfaces of concrete members.

2) In water-front structures, forms made water-tight below high-water level.

D) **Oiling:** Contact forms for exposed concrete surfaces coated with non-staining mineral oil applied immediately before reinforcement is placed.

S4-02. FORMS FOR ARCHITECTURAL CONCRETE.—General: Requirements of **S4-01** apply, except as modified herein or otherwise directed; type of contact forms as required by project specification or drawings; of plywood; lined or unlined as designated.

A) **Materials:** All subject to inspection on site and approval as to use, by the Architect or Engineer; lumber forms (No. 2 common or better grade), dry, dressed-and-matched, tongue-and-groove boards.

1) Plywood forms: of 5-ply Douglas fir structural plywood of "concrete form" grade; of adequate thickness, and largest standard-size sheets available, each piece grade-marked.

2) Form linings: of strong, non-warping, fiberboard having a smooth, hard surface on the contact side; not less than 3/16" thick; processed to resist moisture; or ¼" thick Douglas fir plywood in largest practicable-size sheets to obtain the minimum number of joints.

B) **Design and construction:** Studs and wales provided having face widths of not less than 3" at joints of ⅝" plywood form boxing; studs spaced 12" o.c.; wales not more than 24" o.c.

1) Full-size plywood sheets used except where smaller pieces will cover an entire area; panel forms used only where a single panel will cover an entire area from one reveal to another; straight edges and tight, close-fitting joints provided; all abutting sheets nailed to the same stud or wale immediately supporting such units.

2)* In lined forms, joints in lining and form boxing not to occur at the same point: abutting edges of adjacent lining sheets nailed to the same board, and applied and secured so as to prevent buckling; linings installed with 1/16" joints between adjacent sheets; pieces accurately fitted and joints filled with mixture of equal parts of beef tallow and Portland cement, or with other approved material.

S4-03. SETTING MISCELLANEOUS ITEMS.—Required anchors, bolts, inserts, supports, hangers, pipe sleeves, conduits, drains, etc. (furnished under another section of the specifications and set under this section), occurring in connection with concrete work, placed and secured in position before concrete mixture is deposited.

HANDLING AND PLACING REINFORCEMENT

PART S-5.

S5-01. GENERAL.—Reinforcing formed and installed as indicated or required; bolts, ties, chairs, spacers, supports, and other devices necessary to properly install reinforcing, furnished and placed.

A) **All reinforcement and accessories** free at time of pouring from injurious amounts of rust scale and other coatings, and from foreign substances tending to impair the bond with concrete.

B) **Shop drawings** furnished by Contractor, showing pertinent details of required reinforcement including location, size and length of each bar and unit, bar list and bending diagrams; adequate copies furnished as directed.

S5-02.* FORMING.—Fabrication: Bars bent cold; formed to dimensions indicated or approved; bar bends (stirrup and tie bars) made around pins having a diameter of at least twice the thickness of such bars; 1" and smaller bars, 6 times; larger bars, 8 times.

A) **Straightening or rebending:** not allowed to extent that will injure reinforcing materials; no heat used unless specifically authorized; use of bars with kinks or bends not shown on approved plans, avoided.

S5-03. PLACING.—General: Reinforcing materials accurately positioned and strongly secured against displacement, using annealed-iron wire ties or suitable clips at intersections; supported by metal or concrete chairs, metal spacers or hangers (all of approved type and size) in a manner keeping all metal away from exposed concrete surfaces.

A) **Spacing:** as shown by approved drawings; where not shown, minimum clear space between parallel bars twice the diameter of round bars (2½ times the side dimension of square bars); but in no case less than 1½ times the designated maximum size of coarse aggregate used in the concrete, nor less than 1" in beams and girders or less than 1½ in columns.

B) **Moisture protection:** Reinforcing adjacent to surfaces installed so as to provide adequate coverage; as shown by approved drawings; where not shown, requirements following apply.

1) Concrete not exposed to weather: Bars parallel to exterior surface of any member bedded at least one diameter, for round bars (or the diagonal dimension in the case of square bars), but in no case less than ¾" clear from an exterior surface.

2) Coverage at bottom: at least 3" provided for concrete placed directly on ground or on earth fill.

3) Concrete exposed to weather: reinforcement protected by not less than 2" of concrete for bars larger than ⅝"; 1½" for ⅝" and smaller bars; at least 1" protection provided at underside of slabs raised above ground.

C) **Splicing reinforcement:** Necessary and authorized bar splices, not shown on approved drawings, made as directed or approved by the Architect or Engineer; all bars lapped sufficiently to develop the strength of the bar by bond, and securely wired, splices in adjacent bars staggered; adjacent sheets of wire mesh lapped at least 6" and securely wired together.

D) **Future bonding:** For future construction in-

** S4-02: (B. 2) Concrete ceilings or soffits required to be painted shall be constructed to produce reasonably smooth and dense surfaces, free from bulges and depressions, except for tolerance listed below, and free from fins projecting more than 1/32" or offsets in surfaces more than 1/32". A tolerance of ¼" from the level in 10'-0" will be accepted.*

S5-02: Unless specifically shown on drawings, contractor to submit for approval arrangement of bars at column splices.

dicated, exposed reinforcement shown on approved drawings provided with adequate protection from corrosion, by wrappings of burlap saturated with bituminous material.

JOINTS

PART S-6.

S6-01. CONSTRUCTION JOINTS.—General: Work planned by Contractor so as to use practicable minimum of such joints; type number and location in each member, unit or section of structures subject to approval, prior to placing concrete, by Architect or Engineer.

A) Location: where shown on approved drawings or as directed or authorized; generally, approved type construction joints uniformly placed at locations described following.

1) In floors on ground or fill: On column lines or similar divisions; at centers of slabs between such points.

2) In framed floors and roofs: At middle of spans in slabs, beams and girders, except where intersecting members occur at such points; in all such cases, joint offset a distance approximately equal to twice the width of the intersecting member and provided with approved supplementary reinforcing.

3) In columns: At underside of floor or roof members, and at floor levels.

4) In walls: Horizontal construction joints avoided in walls below grade and in one-story walls above grade; otherwise, joints located at well-defined horizontal lines such as window sills, heads, belt courses, etc.

B) Design: Joints in all horizontal members made vertically; tongue-and-groove joints provided at center of depth in beams and girders, and in slabs if required; specified reinforcement continued through joints.

C) Forming: Hardened concrete roughened, cleaned and grouted with Portland cement mortar before being connected with new material.

1) Beams, girders, brackets, haunches, column caps, etc., considered as part of, and built continuous with, floors, walls and roofs, and placement monolithically therewith required following elapse of not less than 2 hours after depositing concrete in vertical supporting members.

S6-02. EXPANSION AND CONTRACTION JOINTS. —General: Adequate isolation joints or separations provided in the several parts of the construction as necessary to allow them to expand and contract within anticipated variations in temperature or moisture conditions; such joints made watertight where transmission of water may be imminent; use of shear dowels, filler material, caulking, water stops, etc., included to extent indicated or specifically required.

A) Location and design: Joints provided in slabs on ground or fill at all walls and similar vertical members, and around columns and foundations; at points and of type and design indicated in project specification or drawings or directed or authorized.

S6-03. SHEAR REINFORCEMENT.—Adequate provisions made to resist shear action across adjacent sections, to extent indicated or directed, at all joints.

1) Approved construction joints in reinforced concrete provided with additional steel reinforcement as approved or directed by the Architect or Engineer; no additional compensation allowed the Contractor for such work.

2) For concrete without reinforcement, adequate shearing strength at construction joints provided by forming a tongue-and-groove joint or by means of dowel bars, as the Architect or Engineer may direct.

CONVEYING AND PLACING CONCRETE

PART S-7.

S7-01. GENERAL.—Conveying, transporting and placing done as rapidly as practicable, manually or by approved mechanical means preventing the segregation or loss of ingredients; unnecessary rehandling avoided.

A) Placing: Each unit and section placed and formed as a monolithic structure the component parts of which are securely bonded together; free from an excessive amount of pits, honeycomb, and visible lines of juncture at construction joints; corners sharp; surfaces smooth and of uniform color throughout. Mechanical type placing equipment of adequate capacity for project work, suitable, as approved.

1) Concrete placed or discharged into forms before its initial set; in any event, not more than 30 minutes after its mixing. No retempered concrete mixture used.

2) All equipment used for conveying and placing thoroughly cleaned before each run, discharging water used for purpose outside the formwork.

S7-02. PREPARATION.—Before placing concrete, all dirt, debris and water removed from forms, trenches and excavations; position and securing of reinforcement checked; approval of Architect or Engineer given as to forms, areas, reinforcement, etc., prior to placing concrete.

S7-03. PLACING METHODS.—A) General: Concrete mixture deposited continuously in approximately horizontal layers, in a manner to prevent displacing reinforcement and the accumulation of concrete on the forms or the reinforcement above the level of the fresh concrete, and the formation of seams and planes of weakness within the sections. Construction joints used only when and where approved by the Architect or Engineer.

1) Concrete puddled with suitable tools, working around reinforcement and embedded fixtures; over-working which may result in segregation avoided.

2) In columns and other members of small dimensions, including all such location where congestion of reinforcement makes placing difficult, mortar containing only the proportion of cement and fine aggregate used in the concrete, placed in the bottom of the form, sufficiently to cover the surface; followed immediately with a deposit of the approved concrete mixture; the whole worked into place by puddling where practicable or by hammering on the forms opposite the freshly deposited concrete, or by mechanical vibration when such method is specified or authorized.

B) Vertical sections: filled with compacted concrete to top of 1" wood strips placed 1" above the lowest beam soffit and/or above the top of wall forms; fresh concrete struck off at top of strips; strips removed and concrete struck off cleanly after concrete has set.

C) Dropping concrete: Maximum allowable vertical drop 5", but concrete dropped through reinforcement (as in columns and walls) from any heights or under conditions causing segregation, avoided.

D) Chuting: Equipment used of such size and design as to insure continuous flow in the chutes; chutes metal or metal-lined, with all sections having a uniform, minimum slope of 1 (vertical) to 2 (horizontal): the spout maintained as near the surface of the deposit as practicable; in intermittent operations, material from chute discharged into approved type hoppers.

E) Pneumatic placing: Machine located as close as practicable to place of deposit; discharge end of line positioned not more than 10' from point of deposit; discharge lines horizontal in position or inclined upward from the machine.

F) Pumping: Equipment and operation of pump such as to produce a continuous stream of concrete free from air pockets; upon completion of pumping, concrete remaining in line, intended for further use, ejected in manner avoiding contamination of the concrete and separation of the ingredients.

S7-04. VIBRATION. — General: Compacting by mechanical vibration done when and to extent called for by project specification or drawings, as an aid to placing under difficult conditions.

1) For exposed surfaces, vibration supplemented by forking or spading along the surfaces adjacent to the forms.

2) Vibration discontinued when concrete appears to be thoroughly compacted and ceases to decrease in volume.

3) Vibration of forms and reinforcement allowable only when specifically authorized; disturbing of partially hardened concrete, and application of vibrating element to reinforcement extending into hardened or partially hardened concrete, avoided.

A) Equipment: High-frequency mechanical, internal vibrators of approved type, designed to operate with the vibratory element submerged in concrete, with a frequency of not less than 3.000 blows per minute.

1) Sufficient number of vibrators used to properly consolidate the concrete within 20 minutes following its deposit in forms; maximum output duty allowable for each vibrator, 20 cu. yds. per hour.

B) Adjustment of mix: Where necessary when compacting by vibration, concrete mix adjusted to use the practicable minimum percentage of fine aggregate and water; in every case, concrete mixture kept sufficiently plastic and workable to permit effective placing and compacting.

S7-05. PLACING IN COLD WEATHER.—General: No concrete deposited when atmospheric temperature is below 40 deg. F., or when the concrete will likely be subjected to freezing temperatures within 24 hours after placement.

1) Lumps of frozen material and ice removed from concrete materials before they are placed in mixer.

2) No salts or other chemicals, or foreign materials, used in concrete for purpose of preventing freezing.

A) Temperature of concrete: Not less than 50 deg. F., nor more than 120 deg. F. Heating of materials done only when and as authorized by the Architect or Engineer.

B) Acceleration: When called for by the project specification or drawings, or when specifically authorized, maximum of 2 lbs. of calcium chloride per sack of cement used as an accelerator; applied in the mixer in the form of a solution consisting of 4 lbs. of calcium chloride to 1 gal. water (this water included in the water-cement ratio of the concrete mixture); use of calcium chloride avoided in concrete ceilings and soffits required to be painted.

C) Protection against freezing: Concrete given adequate protection on all exposed sides, by straw, tarpaulins, or other practical means; use of manure or other unsuitable insulating material in contact with concrete, avoided.

S7-06. BONDING. — Methods and operations: Forms re-tightened before new concrete is deposited on or against hardened concrete.

1) Contact surfaces of hardened concrete roughened in manner thoroughly removing laitance and loosened particles of aggregate or concrete, and saturated with water.

2) Prepared surfaces parged with neat cement mortar; new concrete placed before mortar has attained its initial set.

CURING

PART S-8.

S8-01. GENERAL REQUIREMENTS.—Intent: All concrete given adequate protection from injurious action by sun, rain, flowing water, frost, freezing, mechanical injury, and premature drying out; concrete cured through protection against loss of moisture carried in the mixture, to extent developing the full anticipated strength and durability of the material.

A) Low atmospheric conditions: During cold weather adequate provisions made, when necessary, to maintain 50 deg. F. (min.) on surfaces of uncured, normal-cement concrete, for period of not less than 5 days after placement (for 48 hours in case of high early-strength concrete); temperature within enclosures, 100 deg. F. (max.).

S8-02. CURING.—General: Concrete surfaces effectively sealed during curing period by approved methods preventing the early evaporation of water used in the concrete mixture.

1) Whenever practicable, contact formwork left in place during curing operations.

A) Water-curing: used throughout unless other methods are designated or authorized; only fresh, clean water used; all surfaces kept thoroughly wetted.

1) Horizontal surfaces cured by ponding, or by application of 1" (min.) layer of sand or sawdust; other surfaces covered with cloth mats, or kept wet by continuous sprinkling or spraying.

The second and final portion of these concrete specifications will be published shortly.

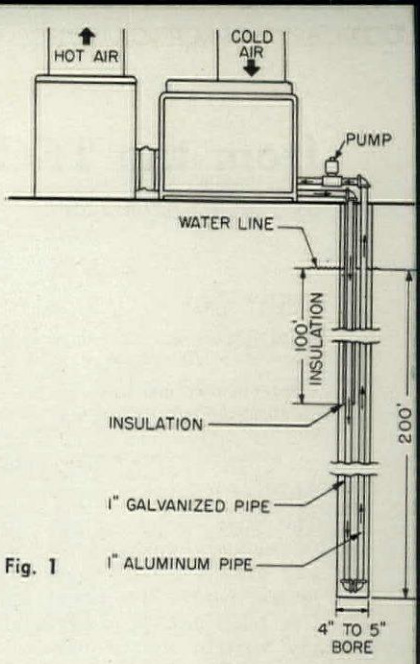


Fig. 1

REVERSE-CYCLE HEATING:

The "HEAT PUMP"

Reverse-cycle heating has a history of nearly a century. In essence it is mechanical refrigeration reversed; hence the name. Lord Kelvin is credited with suggesting, almost a hundred years ago, that the same mechanism which extracts heat from the fluid employed in a mechanical refrigerator for cooling purposes, wasting the heat, might extract and use the heat for warming purposes. Devices for this purpose have also been called *heat pumps* because they "pump" heat from a lower temperature level to a higher.

Recently there have been newspaper reports of experimental installations of heat pumps about to be made by the Chattanooga Electric Power Board. These are by no means the first; the American Gas and Electric Company system has eight pumps installed, the first of them in operation since 1934, and estimates that there are some 200 installations in the U.S.A. A West Coast manufacturer has a fairly extensive 1947 production program for heat pumps. The Muncie Gear Works, of Muncie, Indiana, has a unit ready for mass production; Muncie units, reportedly, will be used at Chattanooga.

REQUIREMENTS

The two principal requirements are a heating medium of even, moderately warm temperature, and electrical current. Water, air, or earth may be the heat source; heat extracted from it is applied to an air stream which may be circulated through the building as in any warmed-air or air-conditioning system. En route the air may be cleaned, humidified, or dehumidified as desired. In some cases heat is transferred directly from air to air, in others an intermediary (water) circulation system absorbs heat from the source and transfers it to the air stream. If the water can be reheated economically it can be used repeatedly and can circulate within a closed piping system. Otherwise it must be disposed of, and fresh water drawn into the system; this might impose on urban water supplies a tremendous overload. If wells are used, there may be danger of permanently lowering the water table. But the system will undoubtedly find a market in urban areas, and consequently closed water circulation is desirable.

As to electrical consumption, tests conducted during the heating season of 1945, in which a one-story house, 30 by 28½ ft. in area, was kept at a constant day-and-night temperature of 78F, required a total of 8,070 Kwhr of current. Consumption will undoubtedly vary with the usual factors, such as local weather conditions, insulation, weatherstripping, glass type, area, etc.

ADVANTAGES

The chief advantage of reverse-cycle systems lies in their simplicity, ease of operation, and cleanliness. They can be made to furnish both winter heating and summer cooling at slight additional first cost (for controls and equipment to re-reverse the system) and at the added operating cost of the 2000 Kwhr (for the case cited) required for summer operation. The desired indoor temperature can be maintained regardless of seasonal variation, unusually cold or warm days, etc. The equipment requires no attention. As demands are made upon it, cooled or warmed air is automatically provided. The units themselves can be quite small, and there is little reason for them to require more maintenance than the average mechanical refrigerator. The process of combustion usually required in a heating system is entirely eliminated.

A TYPICAL SYSTEM

The system illustrated, known as "Marvair," is manufactured by the Muncie Gear Works, Inc., Muncie, Indiana. In general, the Marvair consists of three circulation systems: 1, a water circuit used to absorb heat from below the surface of the earth; 2, a refrigeration circuit used to transfer this heat from the water circuit to the air stream; 3, an air stream which transports the heat to the spaces to be warmed.

The water system is a closed circuit (Fig. 1). The pump circulates water which travels through the Marvair unit, where its heat is removed, then through 1" piping which extends 200 ft. below ground-water level, where it regains heat, then back again through the unit. Aluminum is used for the return pipe because heat can be absorbed through it easily. The pipe entering the well is 1" galvanized, inserted into 1½" galvanized pipe with the space between sealed off to act as thermal insulating dead air. Experience with test installations indicates that piping extending 200 ft. below the water table provides satisfactory results in most conditions. U. S. Geological Survey data on temperature of water from wells 30 to 60 ft. deep show that water temperatures in the populous northern industrial belt of the U.S.A. range from 62 to 47F.

The refrigeration system consists of the four elements shown in Fig. 2. The compressor pulls gas contained in the circuit from the water radiator, raises its pressure and temperature, and passes it on through the air radiator. Here its heat is transferred to the air stream, and in giving up heat, the gas condenses back into a liquid which travels through an expansion valve into the water radiator, where it vaporizes and picks up heat from the water circuit. When cooling is required, automatic controls reverse the refrigeration system.

The air system utilizes conventional ducts, fan, filters, and dehumidification. A single control unit, once set at the desired temperature, will maintain temperatures within prescribed limits regardless of outdoor conditions.

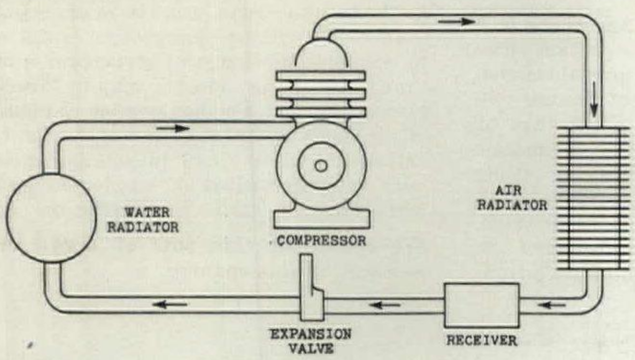
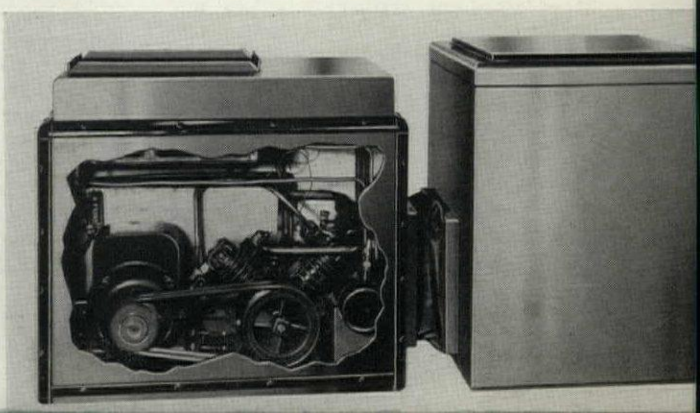


Fig. 2

The "Marvair" heat pump is only waist-high.



from the TECHNICAL PRESS

By JOHN RANNELLS

BOOKS

Fluorescent Lighting. *A.D.S. Atkinson. Chemical Publishing Co., Inc., 26 Court St., Brooklyn, N. Y. 144 pp. 5½" x 8½", illus., diagrams, index. 1946. $3.50*

The first comprehensive treatise on fluorescent lighting which has come to our attention, this book was written primarily for electrical engineers in Great Britain. It is so clearly and simply written that architects and other "laymen" can get a clear picture from it of the theories and facts. The slight differences in terminology and current (50 cycle AC, for example, instead of 60 cycle) should not bother the reader.

PAMPHLETS, REPORTS

Airline Airport Design Recommendations. *Part I: Airport Requirements, Airport Location, Classification of Airports, Aprons, Runway Clearances, Runway Configurations, January 1946. Part IV: Airport Lighting, May 1946. Air Transport Association of America, 1107 16th St., N.W., Washington, D. C. 45 pp.; 33 pp.; 8½" x 11", diagrams, tables. Free*

A "must" for all those concerned in planning and development of airport facilities, this series presents the "considered opinions and mature judgment" of the entire air transport industry. The sort of broad thinking displayed here (backed by solid factual material) should always form the basis of any planning effort. These "design recommendations" might even serve as a standard of planning procedure in other fields, to be cited by architects as an example of the way to tackle a problem.

Part I, especially the first two sections, is a brief but comprehensive treatise on planning, with due regard to changing conditions which the master plan of each development will have to accommodate. Typical runway patterns are given in detail (drawings, data, discussion) and comparative data for all types are given in tabular form.

Part IV gives airport lighting designs which will fill the operational requirements of the various types of airports in accordance with standards established by joint civil aeronautics and military authority. Double-page drawings give typical lighting installations, wiring diagrams, and obstruction lighting requirements. Descriptions of the various equipment are given; also a "bibliography" of available specifications, drawings, and equipment sources.

Parts to follow in this series will cover: obstructions, approaches, and zoning; paving and drainage; buildings, etc.

Dear Mr. Architect. An Open Letter From the School Librarian. *American Association of School Librarians, Baton Rouge, La. Pamphlet, 13 pp., diagrams. 1946. 15 cents*

This pamphlet describes the needs of various types of school libraries from the librarian's point of view. To the architect planning any particular school it would be as useful as though he had had several conferences with a particularly intelligent librarian who would run that school's library. Covers space allowances, light, sound, furnishings and equipment, planning.

Home Construction, Second Report. *(No. 23 in a series of postwar building studies of the British Ministry of Works.) Prepared by a committee "representative of the architectural and engineering professions and of other elements of the building industry."*

The Architectural Use of Building Materials. *(No. 18 in the series.) Prepared by a committee convened by the Royal Institute of British Architects. His Majesty's Stationery Office, London, England, 1946. 68 pp.; 91 pp.; paper bound, illus.; appendices with No. 23; index with No. 18. One shilling and sixpence; two shillings and sixpence. Available on order from the British Information Services, 30 Rockefeller Plaza, New York, N. Y., at 50 cents and 75 cents.*

House Construction, the first of this series (reviewed in *Pencil Points,* July 1945) covered "materials and methods of construction suitable for the building of houses and flats, having regard to efficiency, economy and speed of erection" and made recommendations for postwar practice. The *Second Report* evaluates experimental houses constructed by eight builders in terms of the standards set up in the first report. Appendices cover: (a) protection of steel against corrosion, information from the British Standards Institutions; (b) condensation within roofs and walls of composite construction; (c) revised standards of fire resistance, resulting from the recommendations of the Fire Offices Committee for the draft Code of Practice on Fire Resistance.

Each house is described and there is a full-page isometric construction diagram for each. All are prefabricated, more than half with steel frame, two with concrete uprights. Floors are of steel joists, precast concrete beams, or timber. Exterior wall covering (they call it "cladding" over there) is steel, concrete slabs, asbestos cement, or brick. No comparisons are made between the various types, but results of investigation of each house are given under these headings: Strength and Stability, Resistance to Moisture Penetration, Thermal Insulation, Sound Insulation, Fire Hazard, Vermin Infestation, Maintenance and Durability. Where the investigation showed performance below the desired standard, the manufacturers have corrected their designs.

The Architectural Use of Building Materials (No. 18) is little more than a listing of materials and their uses with many nostalgic references to ancient methods and frequent deploring of modern trends. This report has a strangely antiquarian air among its straight-thinking companions.

FROM OTHER PUBLICATIONS

The Organization of Building Science Research. *Paper read at a meeting of the R.I.B.A. Architectural Science Board by Prof. J. D. Bernal, Chairman of the Scientific Advisory Committee.* Journal of the Royal Institute of British Architects, *No. 66, Portland Place, London W.C.1, England. Apr. 1946. 3 pp.*

The British are fortunate in getting their research organized on the broad lines described in this paper. The old concept of building research as examination of performance of materials has been replaced by a much wider concept: "Research now includes general sociological and economic studies aimed at formulating in the first place the needs for building in such a way that the right technical problems are presented and then further research and development for solving those problems with full regard to the human and economic aspects of the building industry." This seems too vast a program to produce early results but the urgent problems, particularly in housing, are to be tackled at once so that the "limited number of research workers can achieve those results which can most rapidly be turned to practical advantage."

The work was divided broadly into (1) requirements; (2) materials; (3) structures; (4) construction or building industry. In no case is tradition taken for granted, but everything is being tested out before fixing new requirements and putting new materials and methods into broad use. It is expected that codes will be changed to conform to current knowledge of structures and that the building industry may be largely reorganized. Studies are being made of productivity of labor and of mechanization in building, all in collaboration with representatives of employers and workers.

We could use this sort of organized research in this country.