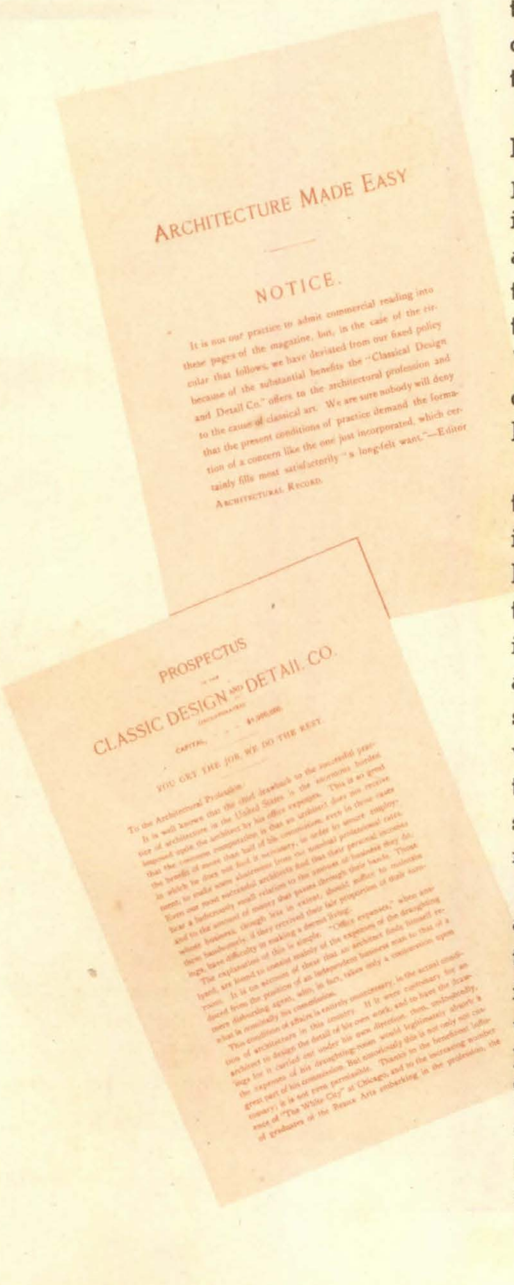
AMERICAN ARCHITECTURE: 1891-1941

PART I

The half-century elapsed since the first issue of ARCHITECTURAL RECORD appeared has been perhaps the most portentous in human history. Certainly, encompassed within this span, lie America's most important years. The beginning of this period saw the disappearance of one frontier — the buffalo retreating before the iron horse, the prairie sod before the gang plow. The end of this period sees the expanding conquest of another set of frontiers — those of science and technology. Between these two termini lies a revolution in habits of thought and action, with the routine of every field of human endeavor greatly, if not entirely, altered.

These two frontiers inevitably had their architectural parallels. The architects of 1891 were, in many respects, more confident than those of today. The classic revival had just burst upon the scene, offering a rationalized system of ornament which one RECORD correspondent "had no hesitation in calling one of the greatest labor-saving inventions of the age . . . Having laid out his building and designated the style, the architect can now take a trip to Europe and leave the detail to the boys."

This optimism went so far in 1897 as to produce the Classic Design and Detail Co., Inc., (Capital $1,000,000.00). In a prospectus called "You Get The Job, We Do The Rest," this organization pointed out that it was "not only no longer necessary for an architect to design anything . . . but in the detail of architectural work there is no longer any room for designers." Hence, the C. D. & D. Co. was setting up a central plan factory where, "from a small scale pencil sketch of plan and elevation, we work out a complete set of drawings and . . . reproductions of entire buildings (can be) reduced, enlarged or modified as desired."


ARCHITECTURE MADE EASY

NOTICE.

It is not our practice to admit commercial reading into these pages of the magazine, but, in the case of the circular that follows, we have deviated from our fixed policy because of the substantial benefits the "Classical Design and Detail Co." offers to the architectural profession and to the cause of classical art. We are sure nobody will deny that the present conditions of practice demand the formation of a concern like the one just incorporated, which certainly fills most satisfactorily "a long-felt want."—Editor ARCHITECTURAL RECORD.

PROSPECTUS

CLASSIC DESIGN AND DETAIL CO.

YOU GET THE JOB, WE DO THE REST

Such easy optimism was not peculiar to the architecture of the period; it cut across most aspects of American life. But today it appears more fruitful to investigate not so much *what* has happened since that time as *why*. And it should by now be clear that these fifty years can be understood only in terms of the impact of science and technology upon society in general and architecture in particular. How explain the appearance of the skyscraper on the scene except in terms of the cables and motors which made vertical transportation a reality? How understand the broadcasting studio's rapid rise without a corollary understanding of the radio? How design a hospital in ignorance of modern surgery?

To mirror such developments in science and technology and anticipate their architectural effects, has long been the aim of the RECORD. But to summarize the developments of this amazing fifty years is no simple task. So to guarantee a clear perspective we have asked a group of scientists under the chairmanship of Dr. F. G. Fassett, Jr., Editor of the Massachusetts Institute of Technology's *Review*, to survey for us the major contributions of their respective fields to the *means* of building. The second portion of their study — dealing with the effect of science on the *aims* of building — will appear in February.

Drawings are by William E. Haible and B. Leonard Krause, Research Assistants, Bemis Foundation.

CONTRIBUTIONS OF SCIENCE AND TECHNOLOGY TO

A SYMPOSIUM BY

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SCIENTIFIC AND ENGINEERING achievements of the last half century have influenced the architecture of that period through far-reaching *general* effects on all society and through *detailed* effects applying specially to the technics of building and of satisfying human needs within the building. Of the two groups, the first—chiefly those induced by the internal combustion motor and the applications of electronics—is the more significant. But these can best be appreciated after the more immediate field has been surveyed; hence we may profitably plunge at once into consideration of the detail.

It may help our orientation if, retaining our knowledge of what has ensued, we step back into the shoes of a mutton-chopped, spatted, clubman architect who in the year 1890 reposed in his comfortable chair, comfortably won. Our man we may imagine to have reached the age of fifty, and to have made the traditional travels and measured drawings abroad. He may be assumed to have been a man of culture and of education, though not of much technical education; even to have taken the dangerously forward-looking view of defending Louis Sullivan in a gentle way over a gentle madeira at the club; to have been somewhat interested in science.

Let us explore this man's mind and his prospects, to see how either was to be concerned over the remaining thirty years of his life (he died ripely in 1920) with what was happening or what he might expect could happen to building.

WE SHOULD PAINT an untrue picture were we to look at this man purely as architect, pundit of style, and arbiter of equipment. He, too, was a man and lived in his day. He was not of a stupid generation, however complacent it may have been. Surely enough has been written about the decade to set the general environmental picture, and we need adduce no specific historical events, no descriptions of the parlor, to set the stage for a direct attack on what might be in the mind of this man as he observed those historical events and sat in that parlor.

Such a man was not very much interested in scientists and their announced theories, though he doubtless had some interest in inventors. On this January 1, 1891, he would probably not have heard of Hertz or have known that the latter had discovered radio waves three years earlier; nor have known of Elihu Thomson and his proposal in 1889 that the waves be used for communication. Even ten years later when Fessenden telephoned by the use of these waves it is doubtful that our architect heard about it, though he may have been mildly interested in Fessenden's first broadcast on Christmas Eve, 1906. What might have been of more interest was the adventure of Clement Ader who in 1890 made a sustained flight in the air of 50 meters, but this must have seemed very silly to our man and so too the appropriation for five years' research made for Ader by the French Government. Kitty Hawk (1903) was still to come, and the flight on that windswept strand probably never impressed him.

It would scarcely have been of interest to him to know that Dr. Carlos Finlay was practising medicine in Havana even if he had been able to foresee the later relations between Finlay and Walter Reed. The discovery of X-rays by Roentgen in 1895 would not have stirred his placid contemplation of the Romanesque nor would the fact that in that year young Rutherford went to work with Sir J. J. Thomson. The Bateson experiments of 1900 and before which brought the earlier known and just rediscovered Mendelism to prominence would also have seemed of no importance, even if understood. That architecture had a strong social reason for being was scarcely a part of this man's philosophy.

Being of a progressive turn of mind, he would have been more interested in some

BUILDING DESIGN: 1891-1941

of the applications of earlier science which were beginning to prove sometimes useful. Communication seemed to him one of those fields in which too much was being accomplished. Typewriters, for example, were known and some of his friends had tried to use them in offices. Photographic film had been on the market three years: a dictaphone—a sort of phonograph for two—had appeared in 1890: and in the year he was facing there was to be the first commercial color photography. In 1892 the moving picture came on the scene, based on inventions which were pre-Civil War, but it was not until 1905 that his son-in-law took him to a nickelodeon. Disc records appeared in 1894 to cap a remarkable commercial development of some six years. By 1902 our man was accustomed to using the telegraph. In 1920, the very year our architect died, the first commercial radio broadcast went out over station KDKA, Westinghouse, in Pittsburgh. He never saw a sound picture or a radio photograph. Transportation, too, was changing, but at this very moment less dramatically. By 1900, the trackage of railway lines for the United States was virtually all laid and in that year there were just 8,000 automobiles. But by 1930 there were 26,000,000 of these vehicles with the dramatic expansion coming after development of the multiple disc clutch in 1907 and drawing on railroad steel-fabrication techniques for development of chassis. The auto itself, of course, was known in the year this story begins.

HIS PROFESSIONAL ATTITUDE was conditioned not by his attitude towards society, which was one of indifference, but primarily by what was available to him in the way of materials, structural methods, and amenities. By 1890, many of the

THE ARCHITECT "is likely to be far more severely blamed for a misplaced bell-button, or an inconvenient elevator, or for dark offices . . . than for ill-studied and inartistic treatment of the architectural forms . . .

"Modern processes of building, moreover, as exemplified in these monstrous many-windowed stacks of offices still further hamper the free expression of artistic ideas. Iron and steel now form a large part of the framework of every important building, and the development of constructive forms in metal has naturally proceeded along the lines of engineering rather than of high art."

October-December 1891

principal discoveries and inventions had indeed been made, but few of them were ready for use. The manufacture of aluminum by electrolysis was developed in 1886, but the metal was costly and almost never appeared in architecture. In 1890, if the architect bought steel, he almost certainly obtained it (86%) from a Bessemer mill. Forty-five years later, only one-tenth as much was made by the Bessemer process, while the open-hearth mills had increased their run from 12% of all to 90%. Perhaps more significant was the domination of iron. In very old times non-ferrous metals had been those of the greatest importance. But our man lived in an iron age. In the period 1884-1924, pig-iron production bore a ratio of 40:1 to non-ferrous production. Improvements in non-ferrous metallurgy, however, have reduced that proportion since 1924 to 14:1, a significant change. Finally, our architect never saw Monel metal, chrome nickel steel, structural aluminum alloys, plastics, wall-board, rubber anti-oxidants, or cellulose varnishes. Nor could he enjoy the use of the industrial X-ray.

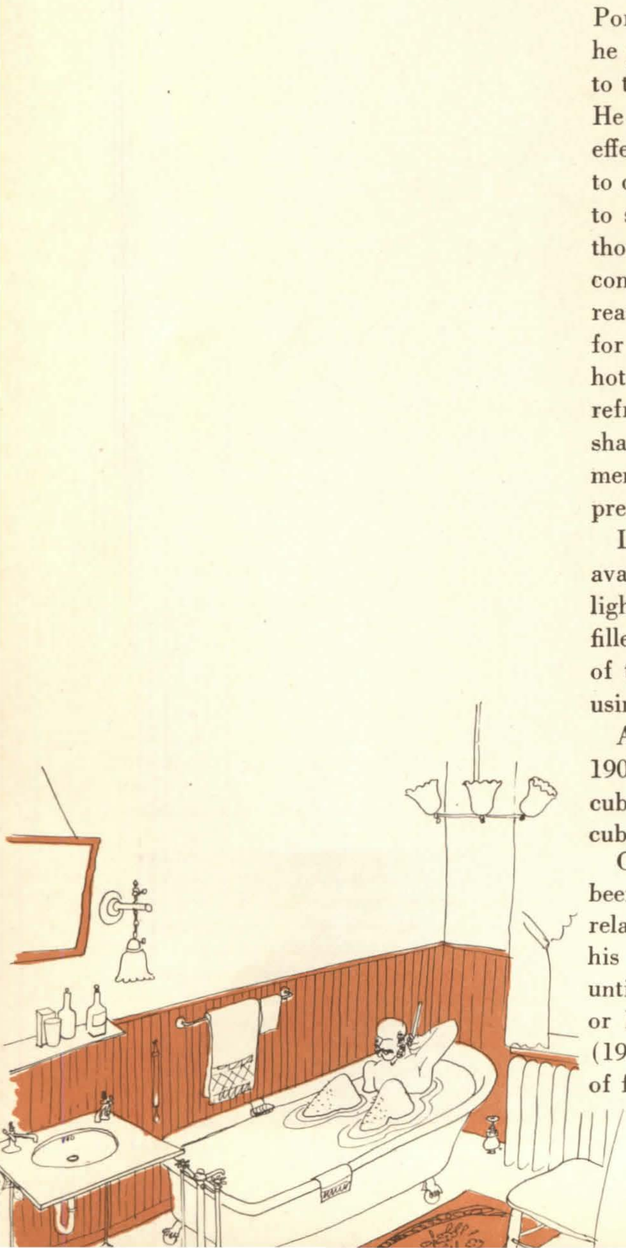
With skeletal construction he was somewhat familiar though he preferred load-bearing walls. Up to 1884, he indeed had been one of those who valiantly jousted against the admission of the skeletal form of building, but Le Baron Jenny's Home Insurance Building (1885) and Bradford Lee Gilbert's Tower Building in New York (1889) had somewhat changed his mind. Though Roebling's ropes were being used elsewhere, they had not yet come to make the elevator the catalyst by which buildings could get really high. By 1901, the limits of framed buildings were quite well determined and Joseph K. Frietag, a prominent engineer, could state, "The Park Row Building is the highest office building ever erected and it is doubtful if it will ever be found desirable or profitable to erect other buildings as high as this one." (Park Row, 390 feet; Empire State, 1250 feet).

For concrete the architect also had scant use. Modern methods of making Portland cement were scarcely supplied before 1892 and to the day of his death he preferred brick masonry, stereotomy, and the principles of heavy mill construction to those of frames of steel and ferro-concrete. Of acoustical science he knew nothing. He knew that some rooms were good for some purposes because of their sound effects, and when control of sound was important (and this was not often) he tried to copy those rooms which had worked well. He rarely, if ever, had consciously had to struggle against unduly high sound levels. He paid little attention to ventilation though he was concerned (unnecessarily, it now appears) with carbon dioxide content. Heating systems were as troublesome as they are now, but for different reasons. In his later years he had some difficulty providing enough electric circuits, for how was he to anticipate what would happen following the development of the hot electric coil (flatiron) in 1892? The electric washing machine (1905), electric refrigerator (1917), and later, the complete electrification of the house down to the shaving apparatus, were not things with which he ever seriously had to cope. Gentlemen for whom he worked did not demand all this in their residences. Their main preoccupation was that the bathtub be large enough.

Lighting did interest him somewhat. Edison's first incandescent lamp had become available in 1879, the essential central generating station in 1882. The acetylene light (1892) was perhaps the most intense source available at this time. The gas-filled electric lamp did not come till 1913, and our man died before the appearance of the inside-frosted lamp (1925), though he did see some printing establishments using the mercury vapor lamp developed in 1904-1906.

As to electric power, how could he foresee how ubiquitous it would become? In 1900, the 5-horsepower motor weighed over 700 pounds and took up nearly 20,000 cubic inches of space; now it weighs under 200 pounds and occupies less than 4,400 cubic inches.

On the sanitary side our architect lived a dangerous life. Though canning had been known since Napoleonic days, it was not until 1903 that the tin can was made relatively safe. His family always dreaded tinned goods. He did not expect that his local water could be anything but hard; chlorination of water did not come in until 1908. If he had a headache he was free from the benefit of aspirin (1899) or barbital derivatives (1903). He would have regarded the irradiation of food (1921-1925) as scandalous had he lived to see it; but he readily tolerated the refining of food then going on, which was later to lead to the necessity for irradiation.



"— THAT THE BATHTUB SHOULD BE LARGE ENOUGH"

IT WOULD BE CONVENIENT if we could trace scientific and engineering developments of the past half century as though each contributing event were a separate stream, wandering, perhaps, but behaving inevitably as a tributary. With the forks given due chronological marking, we should finally arrive at the broad river of building whose date is today. But this analogy simply will not apply.

Rather, the work of science in this period ought to be compared to a wood—a tangle of unusual trees with roots which descend and re-emerge joined to those of other trees; with branches which anastomose; so that not only is it never clear which elements furnish the nutriment and which consume, but it is also never clear which elements are those that first arose from the germinated seed.

Nonetheless a closer view is essential. Though the roots cannot be isolated it is possible to make a sort of plot by digging now here, now there, and to pluck from the digging this or that root which one may follow a little way. Thus if enough holes are dug with reasonable spacing over the forest floor, we may gain some idea of what lies beneath.

But the holes must be dug with some plan, and it hence becomes necessary to map ordinates and abscissae for the digging. Let us choose simple axes: one for the building envelope (materials, structure), one for the biological requirements within it (atmosphere, light, sound, sanitation).

THE ENVELOPE: 1. Materials

MODERN BUILDINGS are distinguished by the combination of great scale with lightness of structure, and this fact reveals yet another of the paradoxes which so freely interlard this story: Steel, the material which above all might have been expected to create the release from the weight of older buildings, was already fully developed for structural purposes. But reinforced concrete, the material which was not so well developed, and which was destined to be the material of the half century—gave at its inception promise of return towards the heavy structures of Rome rather than towards arrangements which would rival the structural delicacy of the Gothic.

Since 1925 the addition of 4% to 5% of alloy ingredients to structural steels has made for stronger steel per unit weight. Though steels of vastly better properties are made for other purposes, and though from time to time some enthusiast urges their use for building, the economics of the manufacture militates against it except in very special situations.

In the development of ordinary steel plates used in regular or more often in prefabricated buildings, the continuous strip mill (J. B. Tytus of American Rolling Mill Company, November, 1926) is noteworthy. Rolling of plate itself was of course very old. Lead sheets were rolled by hand as early as 1615 and sheet iron at least by 1728. But the continuous rolling machine with its tremendous capacity was another matter. Whether this was a product of the demand of the automobile manufacturer, or whether its development led to more use, is another of the hen-and-egg stories. Competition forced the building of more mills than were needed to supply the demand, and the battle of strip has been one which is bound to have effect on the building industry sooner or later. Among other things, it notably increased, for a time anyway, the interest of the steel manufacturer in the possibilities of the prefabricated house.

The introduction of reinforced concrete naturally led to interest in the composition of cement and the chemistry of the gel-reaction. Johnston at Swanscombe, in England, had developed fine grinding, clinkering heat, and other technical and chemical perfections of cement as early as 1845; but the true beginning of concrete structures in America may be set at 1892 when modern developments of making Portland cement

IN APRIL-JUNE 1893 THE ARCHITECTURAL RECORD carried an analysis of the cost of brick bearing walls vs. steel framed walls which showed that steel framing was a very expensive luxury which increased dramatically in cost as the height reached towards the towering elevation of 20 stories.

were introduced. Of even greater interest are the careful study of water ratios (Duff Abrams) and of aggregates as to size, shape, and proportion, including the work of John J. Earley and the interesting and newer developments of vibration and of dewatering by vacuum so that today it is possible actually to design a cement mix to produce expected properties.

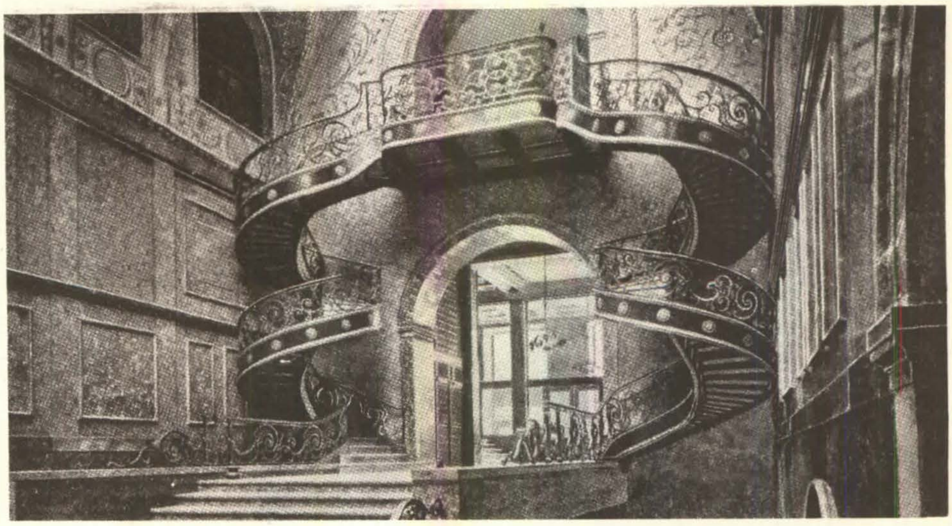
THE PERIOD has witnessed a slow appreciation by the producers of older materials that times have changed. The transition from wall-bearing to framed structures has required the production of light and durable facing materials. Stone producers, realizing this, have sought with some success to cut their product with more delicacy, being aided by metallurgy through the use of steel shot in grinding. Advances in manufacturing processes have resulted in an increasing number of improved clay products, of which brick is still (at least quantitatively) the leader. Wood producers have given much attention to correction of the defects of a material which otherwise has magnificent properties. Understanding and control of insect destruction has greatly advanced. Of distinct interest are the stressed-skin structures of laminated wood; and the plasticizing of wood with urea.

Another of the ancient materials, glass, has been the subject of much activity in the production of special-purpose glasses of many kinds, infrared-absorbing, ultra-violet-transmitting, tempered plate. Other uses of glass, such as the beautiful fibers which adorn equally a damask of silica or an insulating wool bat, have played their role. But perhaps the principal development of glass technology is in the manufacturing process which has made large sheets available at reasonable prices; the effect of the big pane of glass on contemporary architecture is obvious even to him who runs as he reads. The use of glass as an opaque non-deteriorating exterior surface material should have an important future.

Metals have entered building dramatically in other than structural ways. Window sash, frames, laths, of steel or aluminum, are well known. They were practically unheard of in 1890. Great advances have been made in the manufacture of pipes and fittings of copper, brass, bronze, lead, and steel, and by developments in shaping and forming these metals.

Corrosion has also been subjected to exhaustive research. The patent to Ambrose Monell in 1906 for the reduction of ore to an alloy containing 70% nickel and 30% copper; the chrome nickel stainless steel developments of Strauss and Maurer in 1910-1914; the straight chromium stainless steels of Brearly about the same time; the substitution of chrome plating for nickel plating through the work of Liebreich (1921) and Fink (1926); these are the landmarks.

One of the great metals of the period has been aluminum. The Hall and Heroult patents for its extraction from the ore were known before 1890, but aluminum could not come into its own until great sources of electric power were available. The price of sheets and castings of aluminum came down to a reasonable level, therefore, only after 1900. In 1911, a paper by Wilm in Germany on the aging of aluminum alloys



CAST IRON was hailed by an early RECORD as the material par excellence for such elements as the elaborate stairway at right.

suggested their structural use. After this paper, the application of aluminum alloys to many structural parts in and out of building was greatly advanced.

Two other developments of aluminum may be added. Aluminum pigments, processes for the manufacture of which were patented by another Hall and the Hametag organization in Germany, materially changed the technology of paints. The use of aluminum foil was made possible by the development of special rolling mills, yet the introduction of the material for insulation may possibly be attributed to Schmidt (1925) who, from the older reflectivity measurements of Rubens, concluded that it should be extremely efficient.

Other metallic progress includes the development of thin copper sheets through the process of electro-deposition and the development of lead pigment in metallic form to parallel the development of aluminum pigment. It is probable that despite the spectacular nature of these developments in metallurgy as directly applied to building, the greater contributions would be found only by tracing a circuitous path. Reflection might suggest to the reader the indirect impact which may have been felt by building through the development of high-conductivity copper; of contact materials, two million embodiments of which are employed in a central telephone station; of thermostat metals and alloys; and of magnetic alloys and related products.

Finally, one cannot ignore in any treatment of metal technology the growth of welding. So long as welding is employed in building operations primarily only to reduce the noise incident to riveting, it will not serve in its full role. Its real implication is that it brings to steel the advantage of continuity of structure which concrete has always had; and in this advantage the potentials are enormous.

ONE OF THE MOST spectacular developments of the period has occurred in synthetic organic chemistry and especially in the chemistry of the resins generally referred to as plastics. This entire industry may be said to have developed since 1890. Baekeland in 1909 completed processes for making a synthetic resin of phenol and formaldehyde. Since then, hundreds of other resins and plastics have been developed, some thermosetting, some thermoplastic, many with special properties which make them advantageous for certain uses but none with a wider versatility than those of the phenol-formaldehyde type.

The resins appear in small obvious ways in buildings: as insulating materials in electrical equipment, as adhesives in plywood, as laminated counter tops. But their principal use in building is unobtrusive. Gradually they and synthetic esters have been incorporated into paints until today few are blended without the addition of any synthetic resin. In the last fifteen years, resins have been developed as substitutes for the erratic natural resins, even the best of the copals, damars, and shellacs having suffered from this competition. A much wider choice of colors is available in modern paints because in 1890 most pigments were inorganic while today a large number of the coloring materials are derived from synthetic organic dyes.

Wallboards, too, are largely a development of the last twenty years though one special type, plywood, was known to the Egyptians. Our improvement on this old product has been made possible through the development of synthetic-resin binders. No one who has followed the course of domestic architecture of the last ten years can have failed to appreciate how this giant, plywood, has grown. Because the earlier casein-bonded plywoods were by no means popular with the architects on the basis of performance, a combination of efforts at prefabrication, need for economy, and a new technique of manufacture was needed to bring about this growth. The other types of wallboards, synthesized in large part from vegetable fiber bound with gypsum plaster and encased in paper, or of asbestos fiber bound with Portland cement, have been improved in properties.

All told, the architect of today is beset by an embarrassment of riches in materials. He must now have a far more specialized knowledge of the old materials to cope with their new uses; and of the new materials he can hazard no successful guess without a background of fundamental chemistry and physics which has in the past been unnecessary. The problem of selection between the claims of existing materials is no slight one, and not the least of the effects upon the architect which the fifty years have wrought.

"OF BRONZE there are two kinds, the solid cast bronze, and the thin sheet bronze, spun bronze it is called, the first very good and very costly, the second not good for much as they are easily dented by accidental knocks in moving furniture, but much less expensive than the solid. Recently spun bronze has been made, filled up inside with typemetal or something of the sort which I should think might be a good thing.

"There is, too, in the market a gaudy material called *electro-plate.*"

April-June 1894

THE ENVELOPE: 2. Structural Analysis

THE EIFFEL TOWER (1889) had set the pattern for quite high structures. The Crystal Palace (1851) with its million square feet of glass had had something to say about large spans with light members. Structural analysis itself needed little modification in order to make the high building possible.

That this was so was due to a very great activity in the century preceding 1890. Although structural engineering is a very old *practical art*, it is in fact a very new *science*.

Beginning with Galileo's inquiry in 1638 into the strength of cantilever, structural analysis benefited by a series of brilliant theorists—Hooke, Mariotte, Varignon, Bernouilli, Euler, Coulomb. In the period 1776-1820 the importance of tests began to be realized and the names of Girard and Young are landmarks; while only slightly later the work of Navier, Cauchy, Poisson, developed the theory of elasticity. Even the work theories of Chapeyron and Saint-Venant were known; as was the work of Rankine on earth pressures; of Ritter on sections; and of Mohr in graphic analysis; while the studies of Müller-Breslau were well begun. The modern theory of statically indeterminate structures had also a foundation of good groundwork by the beginning of our period.

Thus little was necessary from science to permit the analysis of pin-connected steel frames such as were prevalent in the time and, so far as the theoretical design was the only question, to permit the construction of such buildings to great height. Though fundamental changes have been made in some materials, the structural steel of the day was ready to be carried aloft. Yet other contributions were needed to make the high building a reality. Without the metallurgy of the cable and without other work in physics, the high-speed elevator could not exist and without it the high building was impossible. Nor could there be even an imaginary need for such a building until applications of science to transport and communication permitted great congestions of working populations. Development of rolling mills and the standard steel section contributed largely to making such buildings economically possible.

THE PRINCIPAL development of the period has been, then, in the analysis of indeterminate structures, and, so far as building is concerned, this fundamentally marches parallel with the development of structures of reinforced concrete (though welded steel buildings, a more recent development, must rely on the same reasoning).

In 1906, C. A. P. Turner of Minneapolis devised the flat slab type of floor, and the mushroom floor was a new thing to be compared with the floors of the more familiar wood and steel structures. It was inevitable in this rapid expansion that construction should often be in advance of theory, as was notably true in the case of flat slab construction. Since this introduction, several important methods of analysis have been developed, such as the slope deflection method of George Maney about 1915 and its offshoots; moment distribution by Hardy Cross; mechanical analysis by Beggs; elastic analysis by Westergaard; and most recently the theory of limit design as advanced by Vanden Broek and others.

The advantage of flat slab construction was that it gave the architect a clear ceiling with no obstruction to light and ventilation, though this advantage was not always utilized to the utmost. More recently, Molke and Kalinka have discussed the use of extremely thin shells for domes and other wide spans. The dome at St. Peter's (16th century) weighs 10,000 metric tons for a span of about 40 meters, Breslau weighs 6,340 metric tons for a span of about 65 meters, a modern Zeiss-Dywidag dome might weigh 5,000 metric tons for a span of 100 meters.

With these increasing heights and with increasing spans, the problem of loads other than those imposed directly by gravity (wind loads, for example) became more significant. It was through advanced structural analysis that their effect could be studied; then physics made it possible to study strain distributions in complicated sections through the use of photo-elasticity and to study fatigue due to vibrations. A completely new concept as to foundations came through the work on soil mechanics initiated by Terzaghi. Another important development is that of the theory of similitudes and the application of the theory to model analysis. Though model analysis is used most frequently on structures other than buildings (dams, bridges, ships, aircraft), there is no reason why it cannot be applied wherever the problem is sufficiently difficult; such difficulties would normally arise only when there is a distinct departure from tradition in the framework of the building, when the scale is one which far exceeds tradition, or when the loads expected are most unusual.

FINALLY, the designers of aircraft and other mechanical engineers, whose primary concern is not with structure, have on the whole pushed the boundary of analysis much farther than have the structural engineers. It can be argued that their principles offer scant factors of safety, sufficient for the structures with which they deal but inexcusable in structures to which weight is by no means the chief detriment. Yet it seems reasonable to suppose that in time the influence of this pioneering analysis will be felt in building design. It might, for example, today illumine the question of wind loads.

On the whole, the full vigor of the possibilities in modern structural analysis has not been exerted on buildings which have had architectural supervision. There has been a timidity in the use of advanced structures which perhaps stems partly from the old idea that the competent architect could "feel" the proper design, as indeed he could for a load-bearing masonry wall, and a centered stone arch; and partly from the idea that the engineer is to come in and make a building stand up after the plan and especially the facade have been well worked out. Since the advanced engineering forms dictate to some extent the façade and these along very different lines from the rectangularity which remains to man only in his buildings (and which never appears in nature), such an attitude towards engineering would in itself defeat the adoption of these newer methods.

It is no surprise, then, that outstanding examples of the application of modern engineering analysis are to be found principally in buildings where the engineer has been important; and indeed by and large in greater profusion in Europe where the aesthetic sense of the engineer is held in far greater respect by his fellow-builders, the architects, than is yet true in America.

Evidently some building types gain more from the new engineering than can others. Principal achievements already noted are in amusement places, stadia, theaters, arenas; and, to a less degree, in the market, the museum, the work space. Other types can also benefit from the flexibility which is possible only when these structural methods are used in the utmost.

"SHOULD ENAMELED terra cotta prove to be what is claimed for it, if it stands the test of Chicago's severe winters and changeable climate, there can be no possible doubt but what as a material for exterior construction it will be largely used in such cities as are afflicted with a smoky, sooty atmosphere. The idea of being able to wash your building and have it as fresh and clean as it was the day it was put up, must undoubtedly attract people to the use of this material."

January-March 1895

"—THE STOVE REMAINED THE MOST COMMON DEVICE—"

BIOLOGICAL REQUIREMENTS: 1. The Atmosphere

THOUGH NO ONE would pretend that buildings of 1890 were entirely comfortable in the winter or the summer, it is remarkable how few heating devices of today were unknown then. In 1890, for example, all the types of domestic heating systems were in general use, though the stove remained the most common domestic device and only more expensive homes enjoyed central plants. Controls were in general manual and over- and under-heating were common. Engineering data were largely lacking and design was based almost entirely on experience.

Consider controls, which we are likely to regard as a principal achievement of the past few years. The first low-voltage electric thermostat (bi-metallic) had appeared in 1885; the gradual-acting vapor disc thermostat (forerunner of heating and ventilating controls for large buildings) was invented by William Penn Powers in 1889. Perhaps the single important exception is the mercury tube switch invented in 1920 which made possible the direct control of high voltage equipment such as motors, solenoids, and the like. Since the domestic oil burner, the domestic gas burner, the domestic refrigerator, automatic heating systems, forced ventilating systems, and air-conditioning systems have all been made possible by the simultaneous development of suitable controls, it is evident that a substantial foundation for progress in this direction had already been established.

As in so many other developments, the pioneering work had already been done and a daring architect could experiment with the results much as a man of today might experiment with ultra high frequencies. The accomplishment of the period lay rather in an incredible degree of refinement to make the devices foolproof plus

"***STEAM HEAT*** with radiators in the rooms is little used for dwellings, for country houses hardly at all. It seems to have more objectionable points and fewer advantages than any other system."

April-June 1894

the customary change in production techniques, which made it a matter of course that an architect would use them rather than a seven days' wonder that he should dare to try.

Of the principal methods of heating, all were known. Steam, reaching a peak of popularity some years back, has declined in popularity as a result of more public knowledge of the hygiene of heating. Modulating vapor steam systems were available commercially by 1902. Perhaps the outstanding new result is the development, about 1925, of orifice control of steam supply to radiators, leading to many other controls applied to other heating methods as well. The net result is that the heat may be supplied in proportion to heat loss with the outside temperature as the main control, the inside temperature as a modifying control, and a time control as well. All of this finds its principal application in large buildings where substantial economies may be realized.

A practical demonstration of the use of oil in heating was made at the Chicago Exposition in 1892 and it developed rapidly for industrial heating purposes, though the domestic oil burner was not introduced generally until 1919. Metallurgy played a role in the development as heat-resisting steels were needed for some parts; but the most important factors were the remote scientific efforts which centered around the processes of refining petroleum. The use of gas as a domestic heating fuel may be laid to corresponding or even more purely commercial forces. On the other hand, the introduction of silica gel for air conditioning in 1924 made gas the best fuel for reactivation and the advent of the Platen and Munters system of refrigeration in 1922 also made gas the most economical fuel as a source of heat for this refrigeration.

With the single exception of radiant heating, recent interest in which is a result of physiological rather than heat-engineering research, hot-water systems are much the same today as they were in 1890.

Hot-air heating, well known in 1890, later decreased in popularity until the National Warm Air Heating and Ventilating Furnace Research began under Dr. A. C. Willard and A. P. Kratz (at the University of Illinois). The research, which still continues, put the system on a rational basis. For this reason, plus the fact that hot air is best adapted to residence air conditioning, it has rapidly regained popularity since the public became interested in air conditioning. Important contributions to the technic were the addition of forced circulation and air filters about 1924.

PREVIOUS TO 1911, air conditioning was practised generally only in certain types of industry, particularly in textile manufacture where humidification was essential. Previous to 1906, systems were crude and uncontrolled. Stuart W. Cramer, who in 1906 developed a control based on the wet and dry bulb, first introduced to the textile industry in 1907, paved the way toward modern practice.

In 1911 Willis H. Carrier presented a paper to the American Society of Mechanical Engineers setting forth the basic psychrometric data and principles of air conditioning. By 1920, large installations for public comfort had made their appearance. By 1931, unit equipment for small users had come into existence.

Perhaps more progress has been made in cooling buildings than in heating them. Though the Greeks and the Romans had used natural ice and snow for refrigeration, in our year 1890 a warm winter produced a great ice shortage and stimulated the development of artificial ice which up to that time had been considered unhealthful.

But the first mechanical refrigeration had been produced by Dr. William Cullen in 1755; between that time and 1890, aided particularly by Faraday's discoveries of liquefaction and condensation, many of the important developments had been made.

Small mechanical refrigerating apparatus for cooling butcher boxes and household refrigerators came into use during the first World War, but it was not until 1926 that much progress was made. Over 210,000 units were sold in that year. Since that time, the growth has been phenomenal.

Chief progress in heating has, however, been in the increased understanding of physiological needs rather than in devices for fulfilling these needs.

Up to the introduction of forced-circulation hot-air furnaces, for example, the circulation of air in buildings depended either on separate blower systems which

IMPORTANT DEVELOPMENTS in hot water and steam heating may be summarized as follows:

1. Research to put design of system on a rational basis, led by Dr. E. F. Giesecke of Texas A. and M. Experiment Station about 1930.
2. Use of orifices for balancing systems.
3. Forced circulation for small systems which had been used only on large systems prior to 1890.
4. Use of copper tubing in place of iron pipe about 1932 but not yet general.
5. Panel or radiant heating by means of hot-water coils buried in the plaster ceiling or concrete floors. Used for many years in Europe, this has been accepted only slowly by American engineers so that only a few installations have been made in the United States. The interest is increasing.

WHILE MOST OF THE EQUIPMENT for air conditioning was available in 1911, some of the important developments since that time have been:

1. Basic research data on what constitutes comfort and to some extent health by air conditioning—American Society of Heating and Ventilating Engineers and others, 1920 to date.
2. Development of controls for air-conditioning systems for the most part using known basic elements.
3. Development of Freon as a safe refrigerant about 1931 by Kenetic Chemicals, Inc.
4. Development of non-ferrous fin tube surface for blast heating about 1922 and its later application to cooling installations.
5. Silica gel systems for dehumidification about 1924 and later such substances as calcium chloride and lithium chloride.

OUTSTANDING developments in refrigeration have been:

1. Hermetic sealing first used by Johns-Manville on the Audiffren Singrum commercial unit about 1919, and the first household unit by General Electric Company in 1926.
2. Freon as a safe non-toxic, non-corrosive refrigerant about 1931.
3. Improvements to control humidity conditions in boxes about three years ago.
4. The invention by Von Platen and Munters in 1922 of a small hermetically sealed absorption refrigeration unit making household gas refrigeration commercially possible.
5. First commercial use of CO_2 (dry ice) in 1905 in the medical field; about 1925 it was used commercially for refrigeration of ice cream.

circulated cool air or on gravity. The former resulted in local cool drafts and the latter in local hot drafts. The forced-circulation types with thermostatic controls gave good distribution of reasonably warm air. When they are provided with some type of air filter, even a dry cloth tent, there is reduced circulation of dust. The replacement of coal as a fuel by gas or oil has decreased the available dust in houses. Gravity hot-air furnaces commonly draw air continuously from the outside near the ground level or from the cellar, which is just as bad. The earlier types of central heating resulted in very dry buildings, despite various ineffective attempts to mitigate the condition. Recent warm-air systems, for example, make provision for evaporation of water within the furnace where the temperature is high, but to avoid the fogging of windows the humidity is not raised to a really comfortable level.

In 1923, Yaglou pointed out the relation of temperature, relative humidity, and air movement, giving what is called the effective temperature. Most persons are comfortable only between 30% and 70% relative humidity. Hence, in winter in very dry buildings no degree of heat, even 80° or higher, is really comfortable and in summer no cooling will quite succeed if the water is left in the air and the relative humidity rises nearly to saturation.

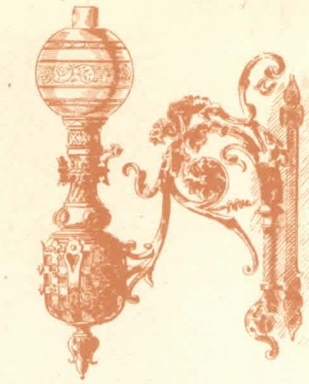
"—LAMP SHADES CUT OUT FOR NON-EXISTENT SMOKE AND DRIP PANS FOR NON-EXISTENT WAX."

BIOLOGICAL REQUIREMENTS: 2. Light

THE SUN on a bright day in the temperate zones produces illumination intensity of 10,000 lumens a square foot. On a cloudy day the intensity may be 1,000. One of the principal developments in the science of artificial illumination has been that which has permitted steadily increasing values of illumination. Unlike the situation in heating, practically nothing which now governs artificial illumination was available, even by inference, in 1890.

We might compare the kerosene lamp of 1870 (0.3 lumens per watt) with the first Edison lamp of 1879 (1.4 lumens per watt, improved by 1890 to 3 lumens per watt), with the fluorescent lamp of today (40 lumens per watt).

The years since 1890 have witnessed a long series of developments in light sources with a steadily increasing amount of light per unit of electric energy for each. The landmarks on this road are perhaps the production of drawn tungsten wire by William D. Coolidge in 1911; the later addition by him and others of thoria and like compounds to control the grain size and thus make possible a non-sagging filament; the development by Irving Langmuir in 1913 of the gas-filled tungsten lamp; and the development of the fluorescent lamp in 1938. Fluorescent lamp development was directed principally to finding suitable phosphors to fluoresce under the ultraviolet radiation. It is notable that since these phosphors made many colors possible, the lamps first caught on in color, and white and daylight lamps were supplied merely to complete the range. However, the demand now is for the daylight and the white lamp. The increased light output of the fluorescent lamp for the same amount of energy is quite comparable with the revolution of 1911 when the tungsten lamp was introduced. Moreover, the new lamp offers for the first time an approximate daylight quality of artificial light; a light also comparable in coldness with that of the much publicized firefly.



Developments in fixtures have scarcely kept pace. To be sure, in 1890 the unadorned gas jet and the unshaded incandescent lamp were the rule. Subsequent periods went to style rather than performance in the design of luminaires and tended clearly to follow tradition set by the candle and the oil lamp. Even today lampshades are carefully cut out for the passage of non-existent smoke and have drip pans to catch non-existent wax.

Since the electric light does not require provision for removal of smoke, can be enclosed in air-tight compartments, and is safely portable because it introduces a negligible fire hazard, the frank realization of these characteristics has resulted in notable installations where the lighting equipment is an integral part of the building structure and the illumination is adequate but unobtrusive.

NO REPORT on the development of building lighting would be complete without mention of the revolutionary change that has taken place in our ideas on lighting requirements. A realization has gradually grown up that sufficient light must be provided so that the given visual task can be performed quickly and easily, and glare and shadows must be minimized. The Illuminating Engineering Society has worked since 1907 in the formulation of rules for the lighting of offices, factories, and schools. Following the I.E.S. recommendation, several states have adopted lighting codes to protect workers from unsatisfactory lighting conditions. The Pennsylvania Code went into effect in 1916. New York, New Jersey, and Wisconsin followed in 1918, and in 1931 thirteen states had specified minimum standards for lighting in factories and other work places.

In 1890, one lumen per square foot (1 "foot-candle") was considered rather good. Today some states require that for fine work at least 8 lumens per square foot be provided, and recommended values are even higher. Many modern drafting rooms, offices, and machine shops provide 40 or 50 lumens per square foot over the entire room, and values of 100 to 1,000 are often used in the local lighting of work requiring the discrimination of the finest detail, while operating rooms may have 1,500 to 4,000 lumens per square foot.

The artificial lighting of 1890 was doomed to inadequacy by the ineffective light sources and by the high cost of electric energy. The natural lighting of buildings, however, was hampered in no such way, yet it is an interesting fact that the daylight illumination of buildings at that time was almost as bad as the artificial illumination. Since about 1910, factory buildings have been much improved by the use of large glass areas and by the generous application of white paint inside. Saw-tooth roofs and other special constructions have further improved the quantity and uniformity of daylight illumination. Special diffusing glasses reduce the annoying heating effect while allowing most of the visible rays to pass unaltered.

A citizen of the modern world finds bad illumination too high a price to pay for some designer's preference as to the appearance of a façade.

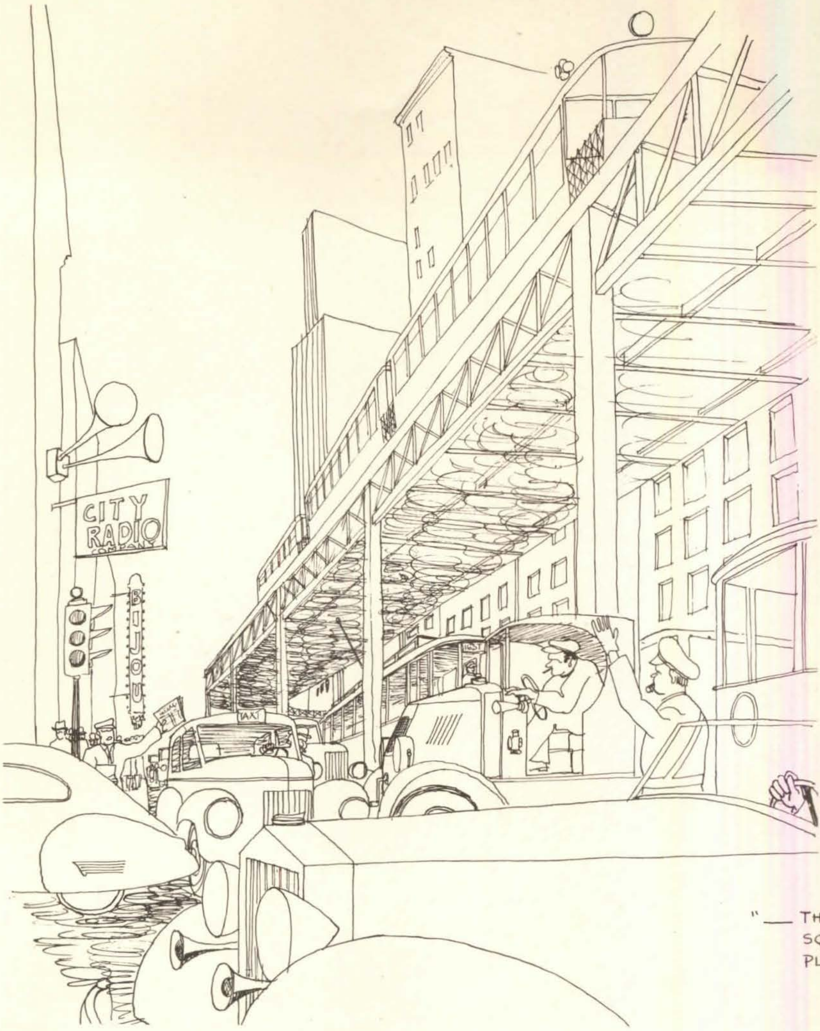
"THE ARRANGEMENT of electric lights in an office building, and of the wiring for them, is generally the last thing in connection with the design to receive attention from the architect, and it is frequently the case that no thought is given to the disposition of the wires until after the contract is let and the construction of the building well under way.

. . . alternating current "is but rarely found in office building practice.

. . . "in the matter of distribution of lights in an office building there is but little to be said. Where the floor area is divided up into small offices, the lights should be placed with due reference to the probable location of desks and other office furniture. In small rooms, except those occupied by doctors and similar professions, ceiling outlets are not as useful as wall brackets. In rooms of considerable floor space . . . the most ideal light is one which is diffused from small clusters of two or three lights each, distributed uniformly on the ceiling. If this is carried to an extreme, however, where the ceilings are low, it will give one the feeling of not being able to get away from the glare of light . . . a very good illumination is often obtained by rings of lights arranged about the columns and carefully worked into the ornamentation.

"In a large open space with not very high ceilings, one sixteen-candle-power lamp to seventy square feet of floor space is fairly good lighting . . . while fifty to sixty square feet per light may be considered an average."

October-December 1896



"— THE KLAXON, THE BRAKE SQUEAK, THE HORN WHICH PLAYS ANNIE LAURIE."

BIOLOGICAL REQUIREMENTS: 3. Sound

MAJOR DEVELOPMENTS in the science of sound fall in the category of general controlling influences later to be discussed. The studies of auditorium acoustics cannot be regarded as a major scientific development. Nonetheless, the transition from the situation where an acoustically correct auditorium was an accident to one where an acoustically incorrect auditorium is inexcusable has occurred in the period under review. Since the word auditorium has a meaning which has often been belied by rooms actually contrived by architects, this is evidently a progression of some importance.

In 1895, Wallace Sabine, an instructor at Harvard University, was asked to see what he could do to improve hearing in the auditorium of the Fogg Art Museum. It might have taken him less time had he tried merely to patch up the room in question; but, because he had a scientific mind, he preferred to attack the problem as a whole and to derive a solution applicable to other auditoriums as well.

This work of Sabine had little application until 1910 or 1915. Since that time, several companies have begun developing acoustic absorbents for improving the properties of existing rooms. This period of development witnessed a good deal of juggling and misinterpretation of results, but it now happily is almost over. In the past ten years great advances have been made in auditorium acoustics, both as to knowledge of the methods of improving design of room shape and as to materials which can be used as sound-absorbers.

Indeed, with proper design, including design of form and of materials to be used, an auditorium may be tailor-made before it is built. It can be designed to be best for a single speaker with the auditorium on the average half full, or to be best for a symphony orchestra with a normally full audience, and so forth. Architects have more realization of this fact than they once did, though many still seem loath to undertake the relatively simple job of learning the fundamentals of acoustics. Le Corbusier made such an analysis for his proposed Hall for the Palace of the League of Nations. More recently, Merkelbach and Karsten, who built the broadcasting station at Hilversum, Holland, one of the most distinguished applications of science to architecture, went farther. After designing a room to be good under one set of conditions, they provided flexible parts which also made it very good under quite different conditions. This sort of thinking evidently represents a far better application of science to architecture than that which says "we can put in a microphone and a loudspeaker" for surely, no matter what the improvements in electronics to date, no speaker who has ever heard his own voice over a public-address system can want to hear it again unless he be a veritable Casper Milquetoast. The strain on the audience is of a similar sort. It is far better to use the results of science cut near the roots than picked as a fruit from the end of a limb.

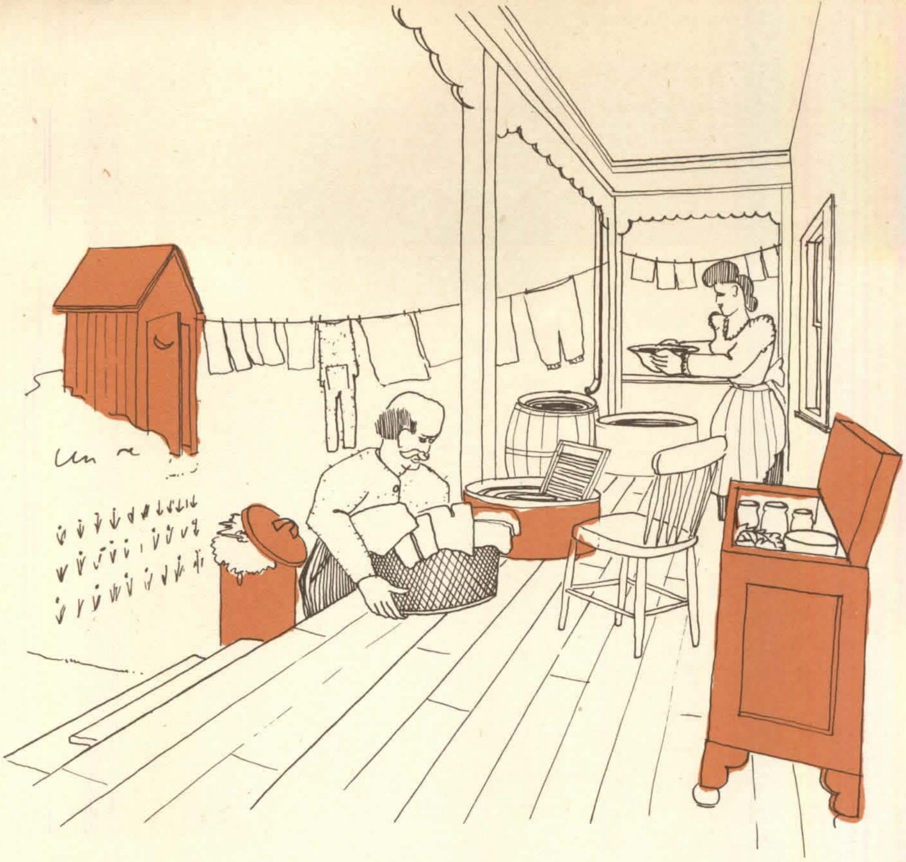
THE VERY SCIENCE which brought the wonders of the new communication brought also the terrors of noise. In 1890, the clack of the horses' hoofs was a timid prototype of the backfire, the klaxon, the brake squeak, the horn which plays Annie Laurie. In 1890, the horse cars came to a rest on a light-gage track with seldom a sound wave to distress the atmosphere, while now the heavy cars, seldom rubber-wheeled, rumble on the tracks and roar around the curves of the elevated, and the ventilating systems of the subway whistle through the gratings. In the office the scratch of the pen in the ledgers has been replaced by the staccato of countless typewriters only by courtesy called noiseless. Human speech itself, it appears, has become louder. And at night in summer in the Bronx the blare of seventeen different radio stations received on 100,000 sets reflects from the brick walls of close-packed dwellings where once the cheerful cricket chirped his chirp.

All this new noise has brought with it some attention to noise scale. The decibel values once established have become of importance in many fields. Among other things they measure noise. Among the decibelian gradations, significantly, there is one called the "threshold of pain." Far below this there are intensity levels which if prolonged can create at least mild insanity, while at even lower levels, well below those frequently met in any modern city, the effect has been demonstrated to be detrimental to efficient work.

For every ill it produces, science customarily finds an antidote. So the science of acoustics has also been marshaled to stop noise. With the new acoustic materials mentioned above it is now possible to quiet office rooms, building lobbies, and dwellings to reduce annoyance and fatiguing noise.

Moreover, in the past five years, materials have been developed and theories advanced for the insulation of rooms from outside noises. As air conditioning becomes more and more prevalent, this insulation can be made more effective. Good insulation depends upon attention to a large number of details in design of the structure and the use of newly developed wall materials and lining materials for use in the ventilation ducts. In this way it is possible to reduce to a minimum the noise coming from the outside and to silence completely the fan noise from air-conditioning units, though the latter is but another example of forcing science to correct one of the difficulties in itself raised by science.

For public purposes, soundproofing has achieved the greatest value in hospitals; and this is but another example of the extent to which major advances in science, as applied to buildings, have been demonstrated most clearly in juxtaposition with advancing medical science. This is not an unnatural thing since it is precisely in a hospital that man needs most the shielding from the difficulties of today's urban life, themselves all a product of science. Its next most logical extension will be to sleeping chambers for the increasing number whose work and whose environment inhibit sleep and yet whose bodies demand it. Another possibility lies, of course, in improving the morale of the civilian populations who cower in deep shelters. If they cannot hear the bombs they may once again induce in themselves the state of complacence which first made the bombs possible.



BIOLOGICAL REQUIREMENTS: 4. Sanitation

"QUITE THE MOST IMPORTANT of the recent improvements in house drainage consists of carrying the main drain pipe all the way to the top of the house and out through the roof. That this is an improvement everybody is agreed and it is easy to see how it is so. It affords an opportunity for the bacteria-laden exhalations from sewer or cesspool to escape by an easy path . . .

"The all porcelain bath, costing a trifle of $300 with carved marble claw feet, at $75 apiece, such as I have put into very costly jobs of plumbing are not quite available for the ordinary house. No more is the aluminium bath, the latest thing out, in trade slang, and costing about as much as the porcelain.

"Sewers are bad enough; our whole system of water carriage of refuse, ending by depositing it in the bed of lake or sea, may be destined to fertilize continents that shall hereafter rise to be *inhabited* by our descendants ten thousand years from now, but it is certainly not adapted to benefit ourselves now in the slightest degree. The whole thing is radically wrong, manifestly and admittedly a mistake, yet so tied to us by custom, by legislation, by easy availability of appliances, that it would be a task inconceivable to rid ourselves of it."

April-June 1894

GREATER AVAILABILITY of domestic bathing facilities has resulted from improved methods of manufacture and consequent decrease in cost during our period. In addition to aesthetic advantages, this advance has had some part in the reduction of pediculosity, and it serves to illustrate an indirect effect of technological advance on architecture. The essential features of sanitation systems—water supply and waste disposal—are largely community affairs and beyond the scope of the individual building; and the actual appliances are ancient and have not undergone essential change in the last half century. Yet expansion of municipal services and refinement and cheapening of appliances have worked on architecture, through facilitating life in communal dwellings. The many-storied apartment house might well be an impossibility if water supply depended on individual storage tanks and unreliable pipes; or if waste disposal were a matter still of short-run sewers. Greater compactness of installations, made possible by engineering design, has contributed economically to the apartment house and the hotel. Much the same, by the way, should be said of cooking and refrigerating appliances. Gas or electric cooking, leading to freedom from coal storage and transport, and from ash disposal, is a requisite of the modern multi-family building. The compact working-space kitchen which this cooking and automatic refrigeration allow is likewise a factor of economy in such structures.

The major improvement in waste disposal during our period has been the chemical closet (1912) which makes indoor facilities possible where sewerage does not exist and cesspools or septic tanks are impractical—an improvement of distinct importance in view of the fact that in spite of expansion of municipal services only 60% of the population of the United States in 1934 lived in dwellings connected to municipal sewerage systems.

Of interest in connection with sanitation, too, is the development of water softening, which in 1890 was carried out only in large-scale municipal plants. Hard waters caused several difficulties in house construction, reducing the effective diameter of pipes and cutting down water flow by the deposit of scale, particularly in hot-water systems where higher temperatures increased deposition. Larger amounts of soap were required in hard waters, in order to extract the hardness factors before sudsing action could be obtained. This combination of soap and the chemicals causing hardness formed a scum that deposited in clothes being laundered, or adhered to plumbing fixtures, necessitating frequent cleaning. Development by Gans in 1905 of artificial zeolites—solid substances through which water can be passed, giving up during passage the metal ions that cause hardness—opened the way to domestic water-softening installations. Resins of the bakelite type were found by Adams and Holms (1935) to be more rapid in action and more stable in use than the zeolites. Other resins are available which remove the acid ions, so that today by a combination of two of these resins as treating agents, it is possible to obtain water equal to or better than most distilled water. Estimates have it that for a family of five the annual saving in soap that can be obtained by such a process will average from about $20 in New England to as much as $130 in north central states such as Illinois and Iowa.

THE IMPACT OF science and technology on architecture during the past half century has been expressed in many and diverse ways, of which those here surveyed appear primary. Their over-all effect has been to simplify performance of the functions of existence but to render more complex the act of living. They have thus increased the delicacy and the difficulty of the architect's work, placing on him greater and greater responsibility for wide knowledge and judicious choice. At the same time they have vastly enhanced his opportunities. Best testimony to the wealth offered him by science and technology, and to the resource and adventurous versatility with which he may have employed that wealth, is everywhere around us.

"WATER CLOSETS should not be flushed by means of valves from the water-supply pipe for domestic use. There should be a separate supply for the water-closet cisterns . . .

"Cisterns capable of holding from three to four gallons of water, placed 8 to 10 feet or more above the closet seat."

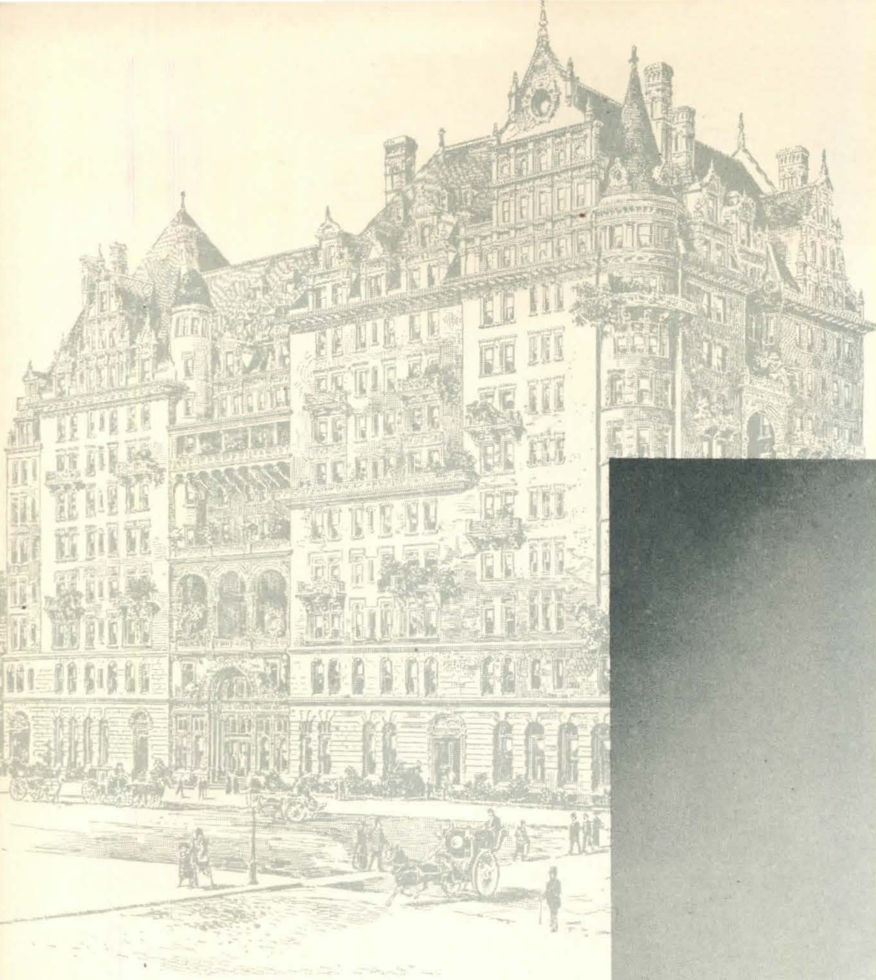
July-September 1891

AMERICAN ARCHITECTURE: 1891-1941

The foregoing survey of the contributions of science and technology to architecture serves as a necessary background to understanding the buildings which appear on subsequent pages. But however basic these forces may be there are other—and no less important — factors which operate to make American architecture today so different from that of fifty years ago. More than the mere availability of a host of new equipments and materials separates the two frontiers. Throughout the rich diversity of contemporary building — regardless of type, style or size — runs a new concept of the purpose of architecture — that buildings are for life today, not monuments tomorrow.

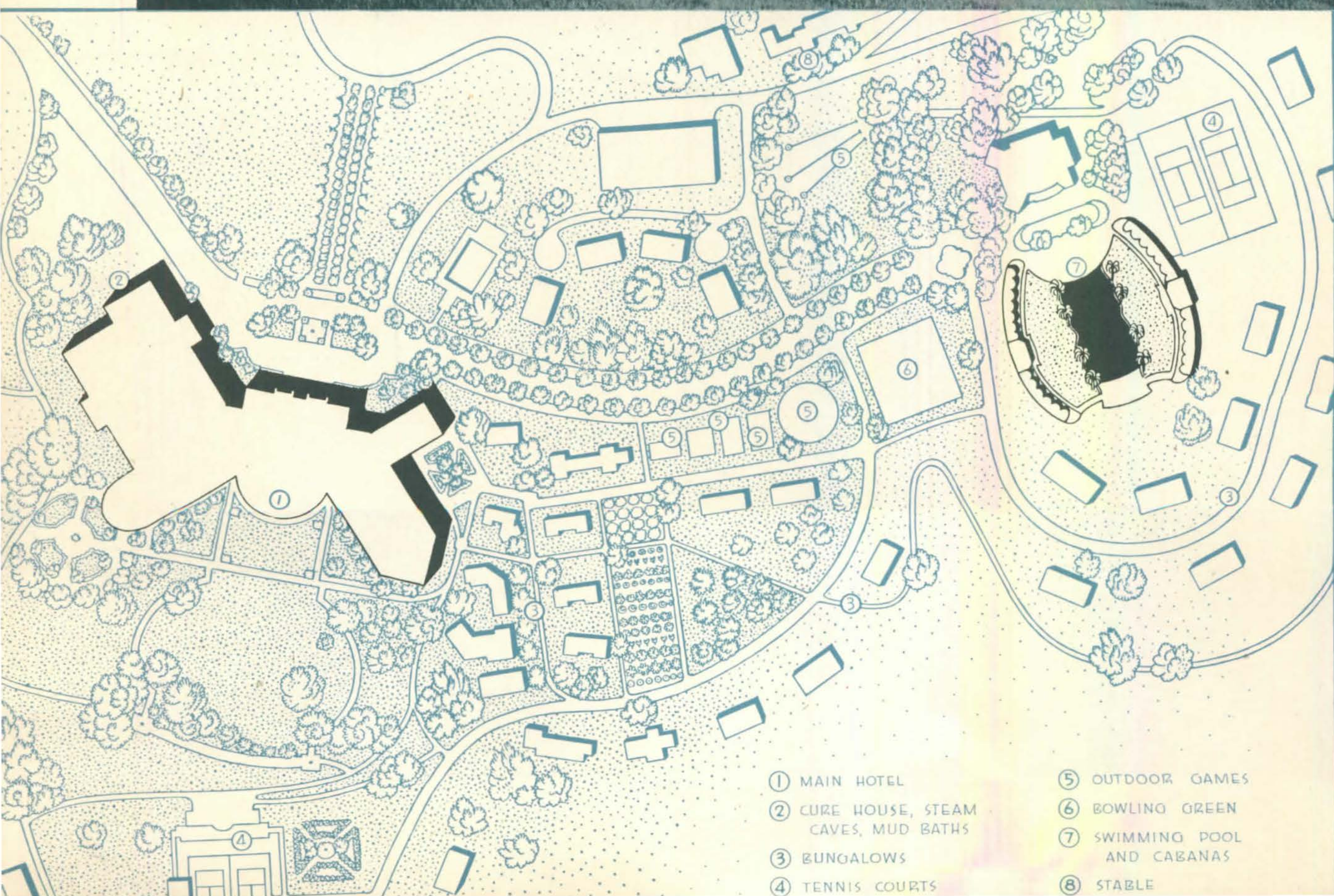
It would be wrong to assume that the buildings herewith presented are selected as representing all of, or even the best in, each type. The effort has been merely to select new, representative and hitherto unpublished projects. But it would be even worse to assume that all American building reaches the levels indicated here. On the contrary, *the biggest job* lies still ahead — that of rebuilding all America.

Credits for all photographs in following pages (58-136) appear on page 164.



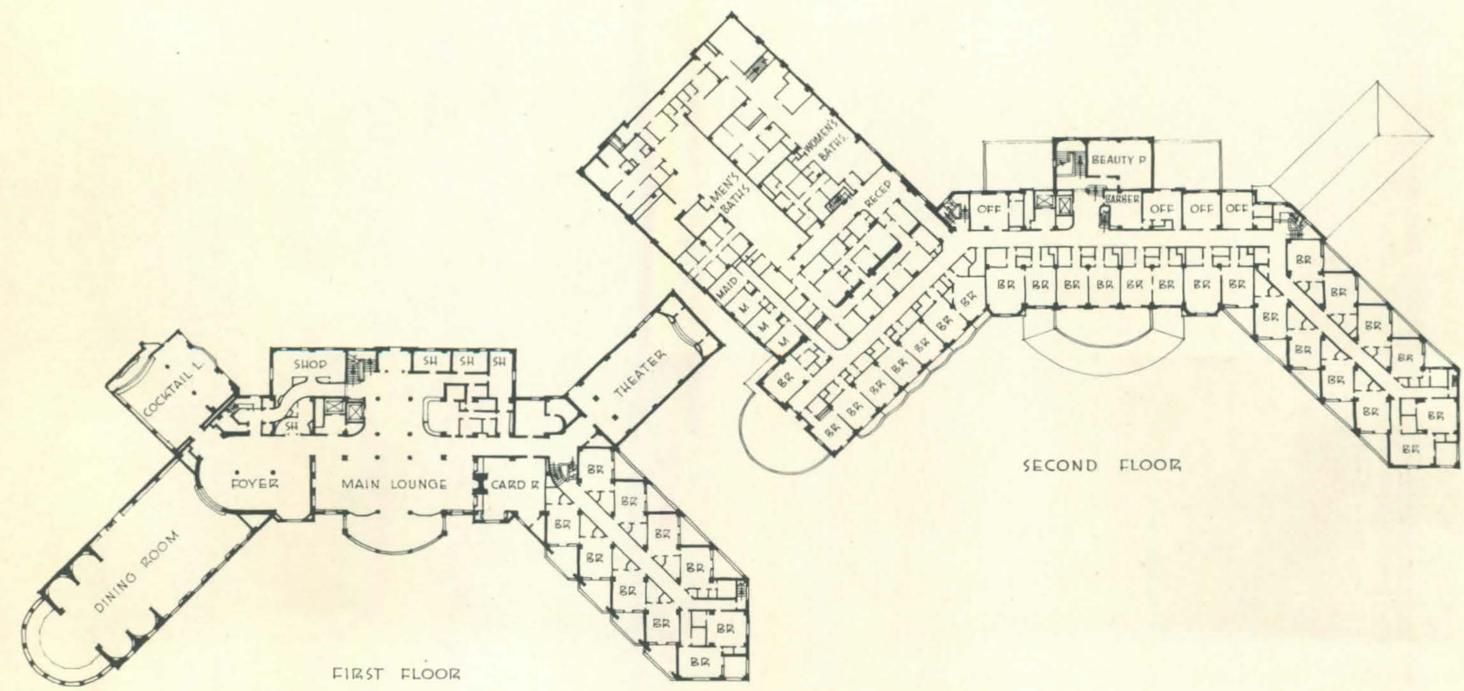
1891-1941 *Typical of the many luxurious metropolitan hotels which had already caught the imagination of American architects, the Waldorf was viewed by an early RECORD as being of "very considerable interest. The central feature . . . is a picturesque and attractive design, in which some Italian detail does not interfere with the general expression of homeliness and quaintness which characterizes the German Renaissance." Of the roof: "To set the gabled front of a three-story North German dwelling bodily above the cornice of a huge nine-story schloss . . . was a bold device quite justified by its results." In the decades which followed, the RECORD was to chronicle many changes of perhaps greater importance in the design of hotels; but the most significant has been their specialization into a dozen or more sub-types. Some representative examples are shown herewith, beginning with Miami's spectacular new skyline (right) where, according to Dr. Homer Hoyt, 41 separate resort hotels are abuilding simultaneously.*

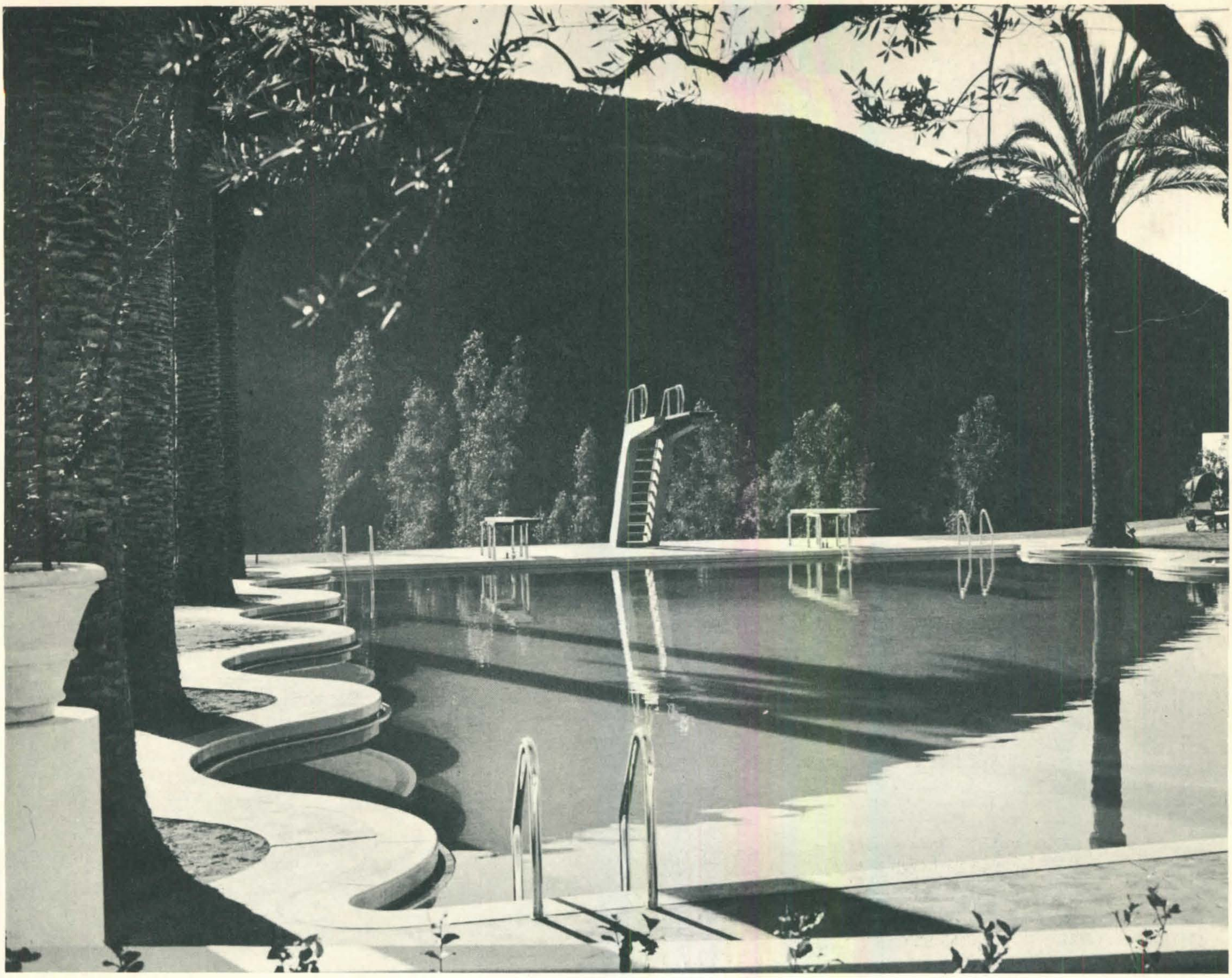
HOTELS


① MAIN HOTEL
② CURE HOUSE, STEAM CAVES, MUD BATHS
③ BUNGALOWS
④ TENNIS COURTS
⑤ OUTDOOR GAMES
⑥ BOWLING GREEN
⑦ SWIMMING POOL AND CABANAS
⑧ STABLE

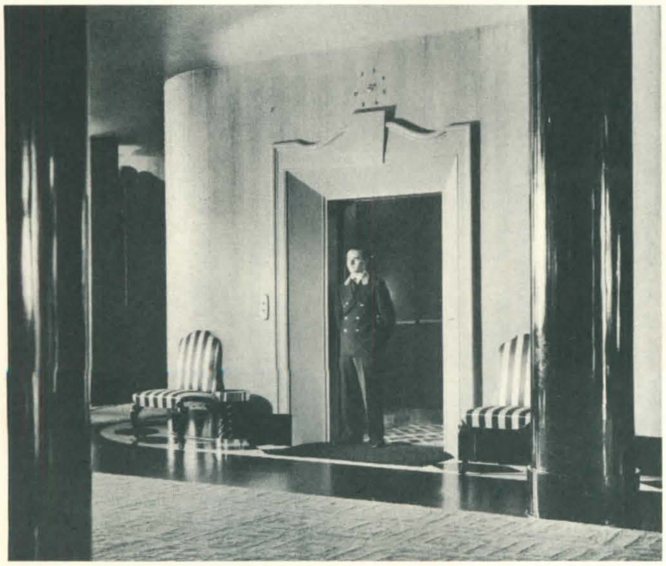
HOTELS

GORDON KAUFMANN AND PAUL WILLIAMS, ASSOCIATED ARCHITECTS: DOROTHY DRAPER, DECORATOR: ARROWHEAD SPRINGS HOTEL, CALIFORNIA. Located in the Sierra Madre Mountains, not far from Los Angeles, this splendid resort hotel and spa, a contemporary version of a specialized hotel type that was well known back in the '90s, consists of 150 rooms, single or en suite, and 10 bungalows of from 3 to 5 rooms each. Mineral springs and curative muds are the basis of an extensive bath and treatment building connected with the hotel proper. Other facilities include a little theater, shops, an 18-hole golf course, tennis courts, swimming pool, and provisions for all manner of outdoor sports. The rooms of one whole wing of the hotel are equipped with triangular outdoor sitting decks that command a view of the mountains.





SWIMMING POOL



ELEVATOR LOBBY

COCKTAIL LOUNGE

TYPICAL BEDROOM

FOYER

DINING ROOM

LIVING ROOM

EXTERIOR, STEVENS HOTEL

LIVING ROOM

HOTELS

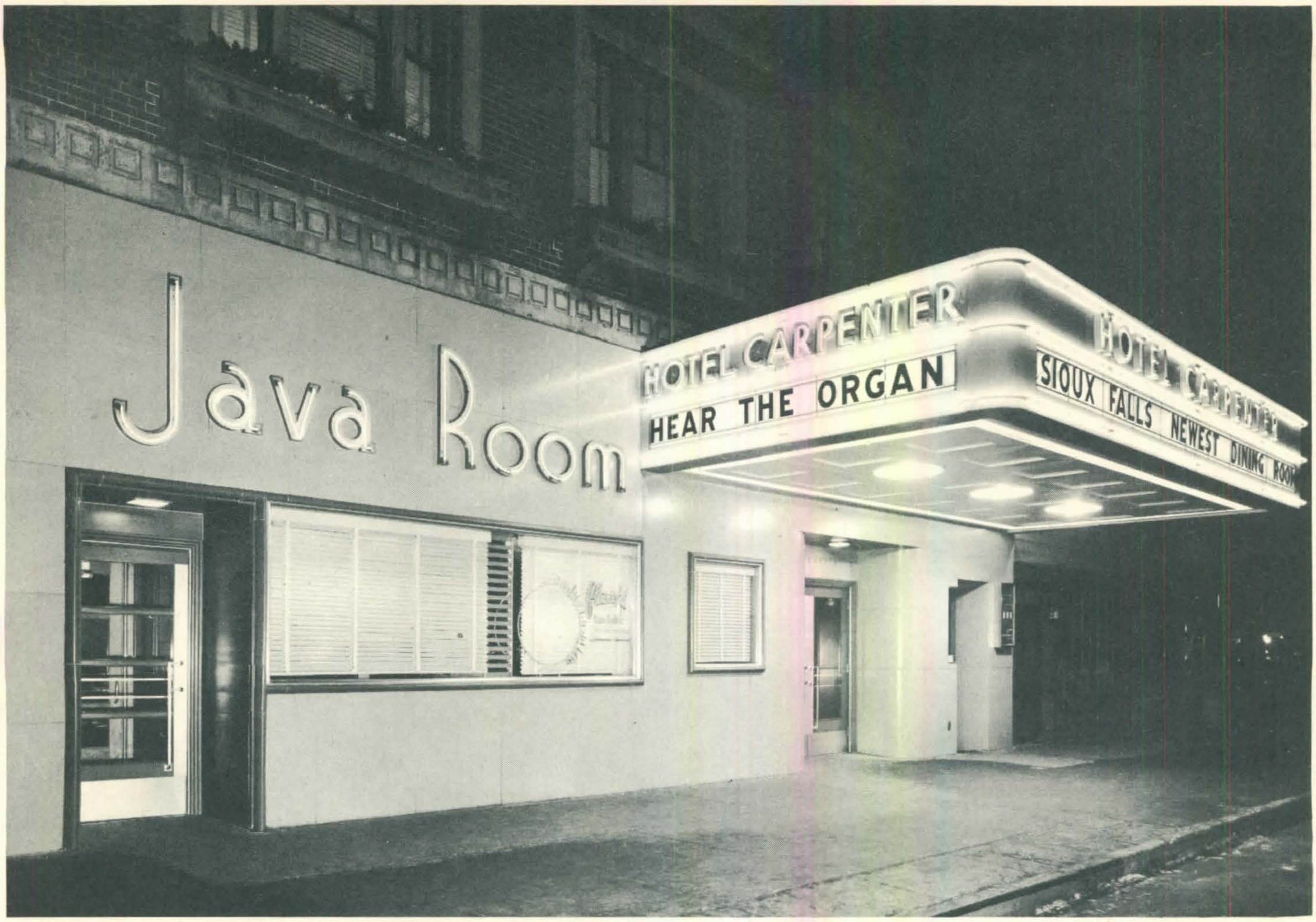
BUILT-IN BOOKCASE AND DESK

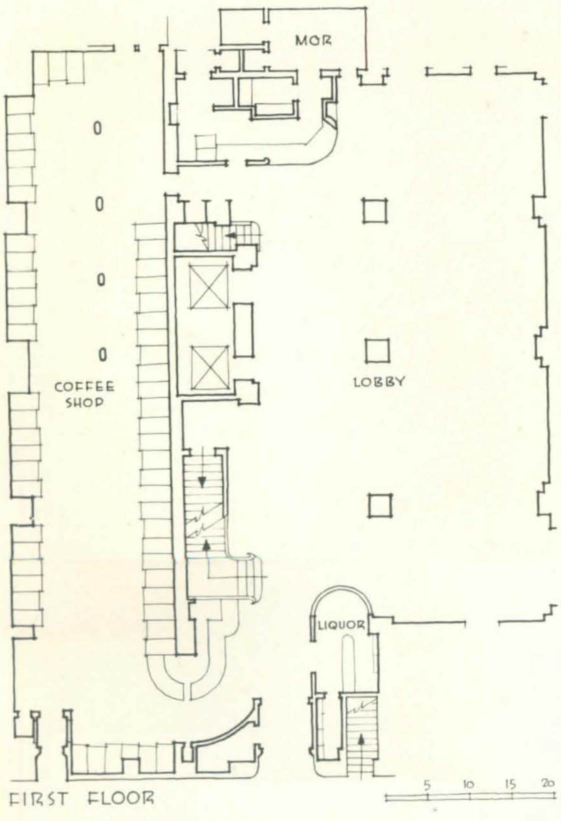
*** SKIDMORE, OWINGS & MERRILL, ARCHITECTS: REMODELED SUITES IN STEVENS HOTEL, CHICAGO.** Part of a long-range program of modernization and conversion of small hotel rooms into suites, based on obtaining useful spaces rather than rooms. Since the rooms overlook Lake Michigan, large sections of the walls were glazed to take full advantage of the view.

**To be treated more extensively in a later issue.*

LIBRARY

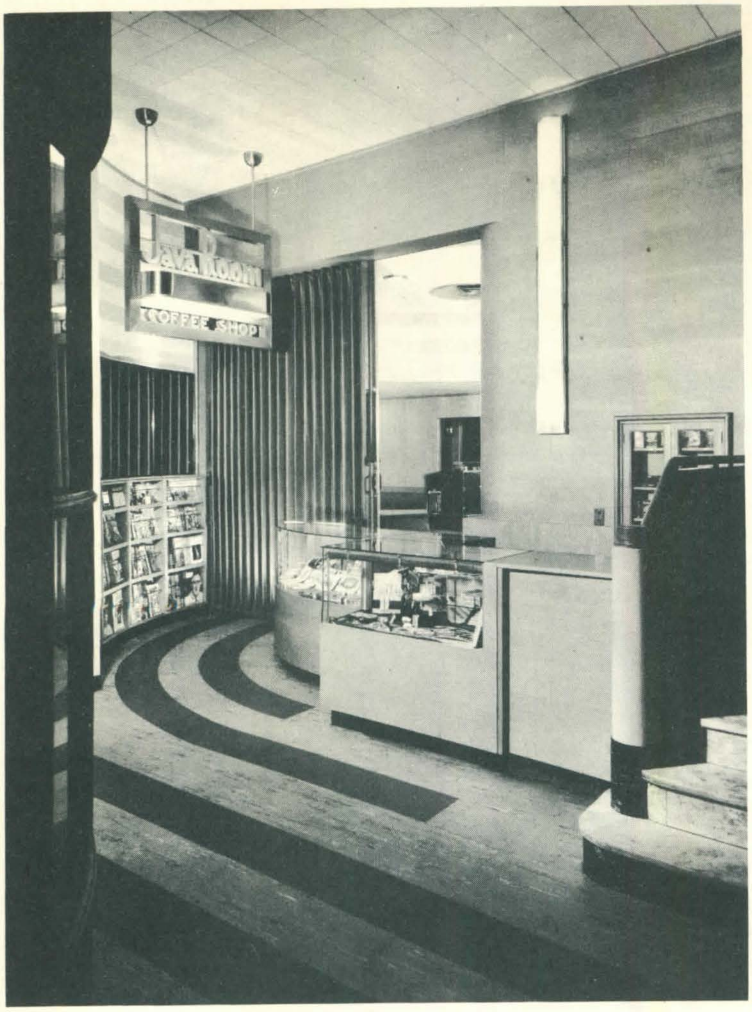
BEDROOM





BEFORE MODERNIZATION

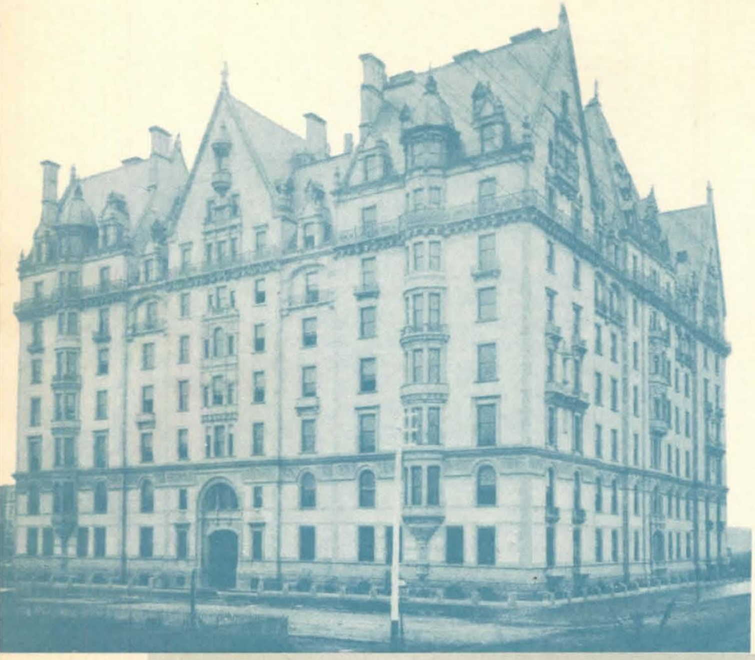
HAROLD SPITZNAGEL, ARCHITECT; ALEXANDER C. RINDSKOPF, COLLABORATOR: CARPENTER HOTEL, SIOUX FALLS, S. D. A modernization job which involved resurfacing the first-floor exterior with porcelain, and remodeling the lobby and adjoining first-floor rooms. In remodeling, the coffee shop was moved up from the rear, where it had proved a losing venture, to the front of the



hotel; it now operates at a profit. Cigar stand and coffee shop require only one cashier, as the counter is continuous; an accordion door shuts off the coffee shop after hours, when only the cigar stand is operated. For economy, the original marble wainscot was retained in the lobby; columns were furred out, and surfaced with plywood.

APARTMENTS

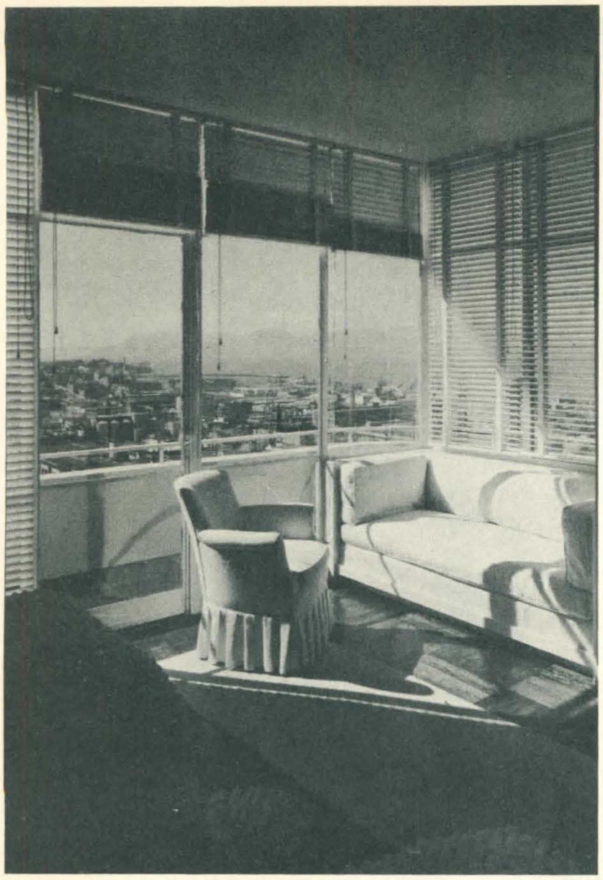
1891-1941 ***"That an eight-story apartment house could become a truly positive addition to the attractiveness of (Central Park)," comments an early RECORD, "was an attainment which the architect could scarcely have ventured to promise himself. Yet in the Dakota this complete success has been attained." A building type that rapidly increased in importance in the new century and received proportionately greater space in the RECORD, the apartment building is today a dwelling structure that is familiar in all cities of the country. As it has grown in numbers, it has also become a highly specialized field of practice. Two of the largest recently completed houses are shown here. On the following pages is a variety of other work in this category that indicates the wide range of design specialization.***



The Dakota Apartment House, New York City; Henry J. Hardenbergh, Architect

ABOVE: Aaron Colish, Architect: 2601 Parkway Apartments, Philadelphia.

ON FACING PAGE: Albert Mayer, Architect; Julian Whittlesey, Associate: Apartments on Central Park, New York City



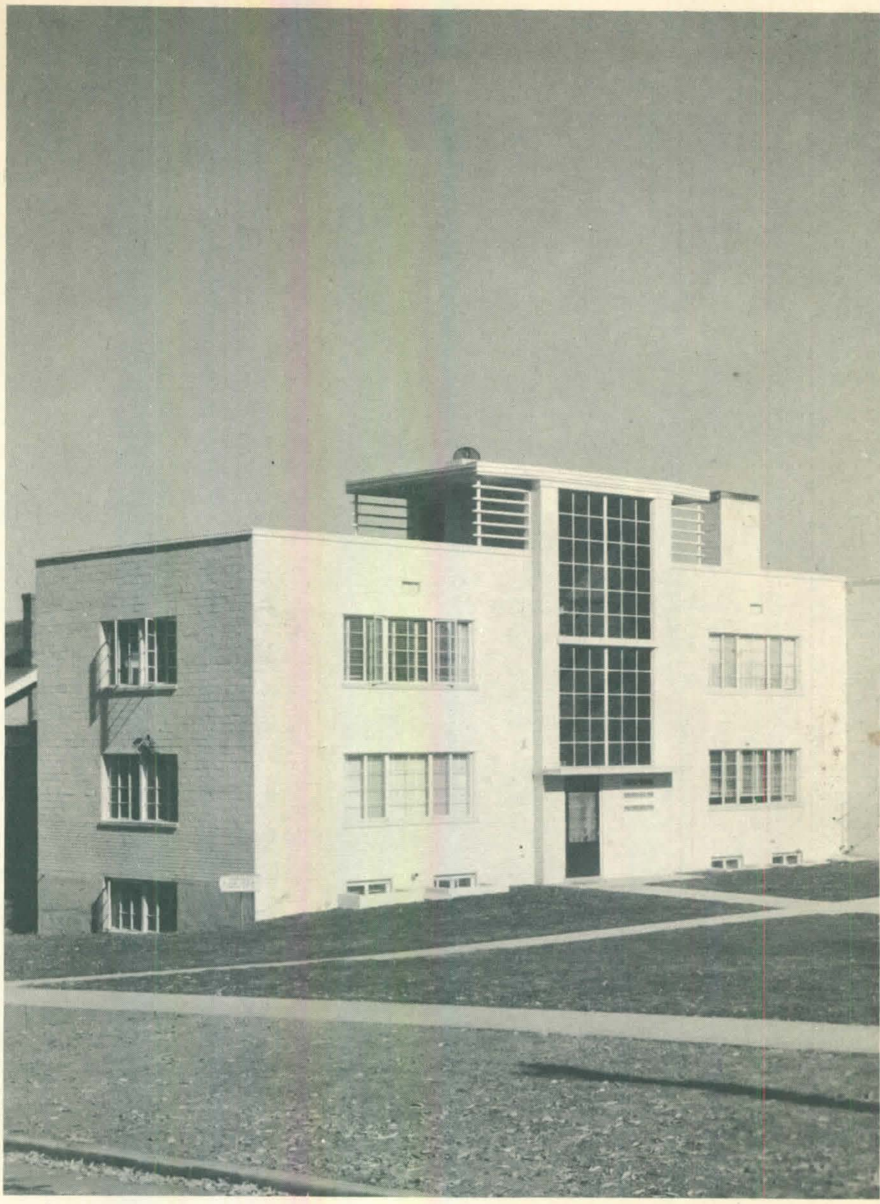
BEDROOM

CIRCULAR STAIR at top floor landing (above) and stairwell from landing (right).

GARDNER A. DAILEY, ARCHITECT: DUPLEX APARTMENT IN SAN FRANCISCO, CALIF. Central feature in this duplex on San Francisco's famed Telegraph Hill is a handsome spiral stairway continuous through three floors. Added space is given the top floor landing by a mirrored wall facing the stair. Large glass areas make the view of the Bay an important decorative feature in all major rooms. Trim and detail, rigidly subordinated; color, kept to large uninterrupted areas.

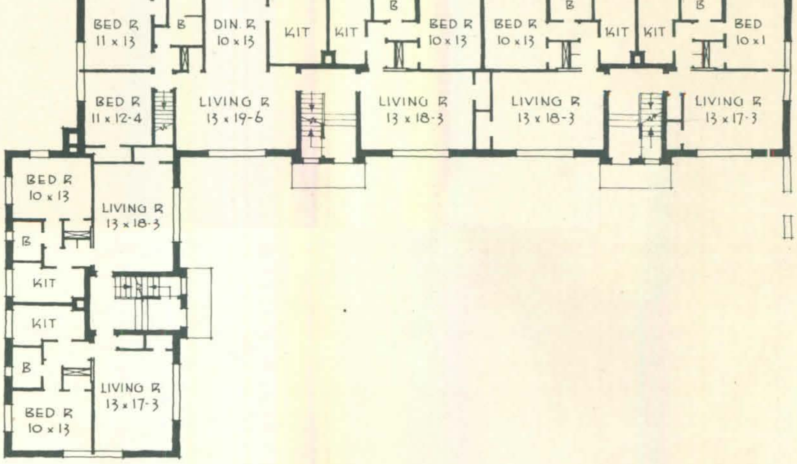
APARTMENTS

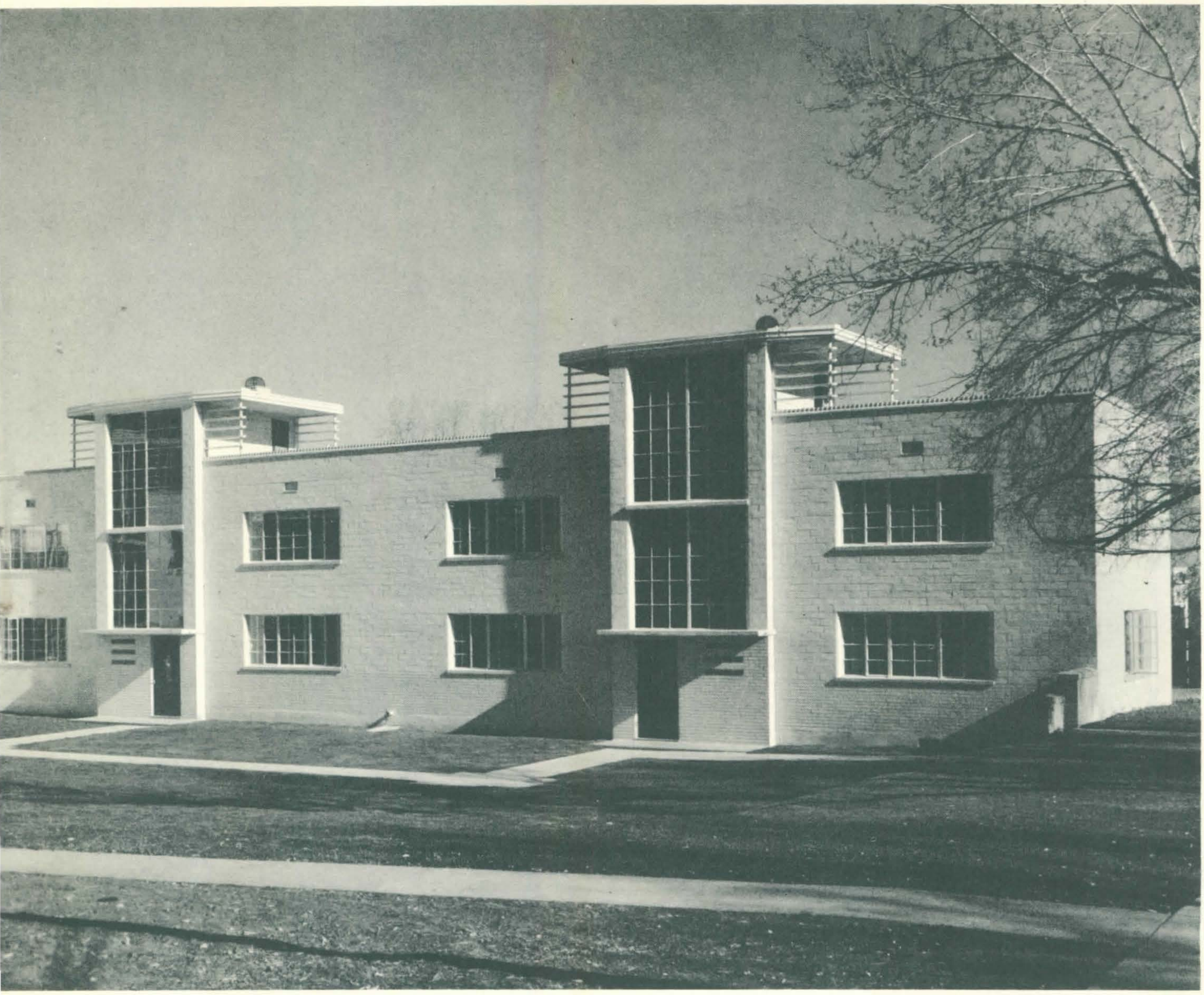
APARTMENTS



HUNTINGTON, JONES & HUNTER, ARCHITECTS: HUNTINGTON APARTMENTS, BOULDER, COLO. Twelve apartments, plus janitor's quarters, garages for five cars, and communal roof deck, basement recreation and laundry rooms are included in this new project. All vertical circulation is efficiently handled by grouping each four units around a central stair running continuously from cellar to roof. Construction is of hollow tile, furred on inside; soundproofing consists of double sets of joists with blanket insulation between for horizontal divisions, while vertical party walls have staggered joists and blanket insulation. Heating and cooling are supplied from a central system but each apartment has an autonomous distribution. Lighting throughout the apartments is fluorescent recessed.

TYPICAL STAIR

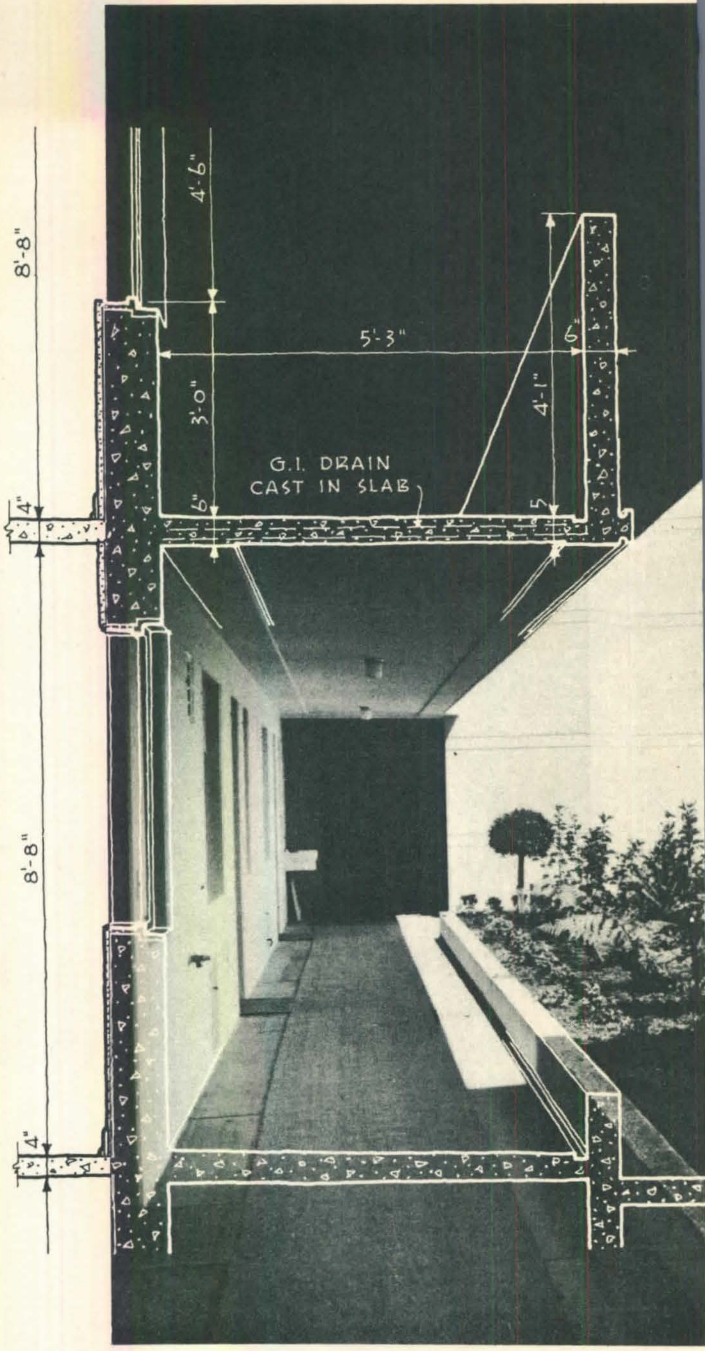


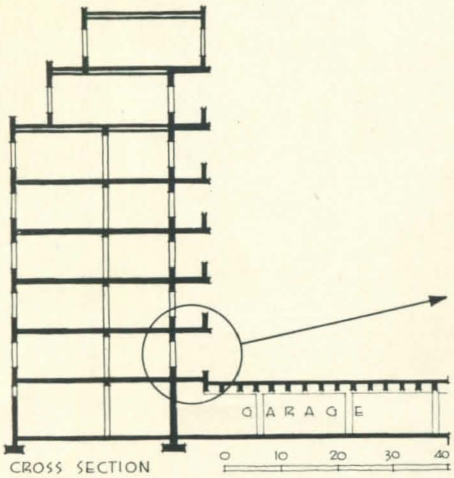


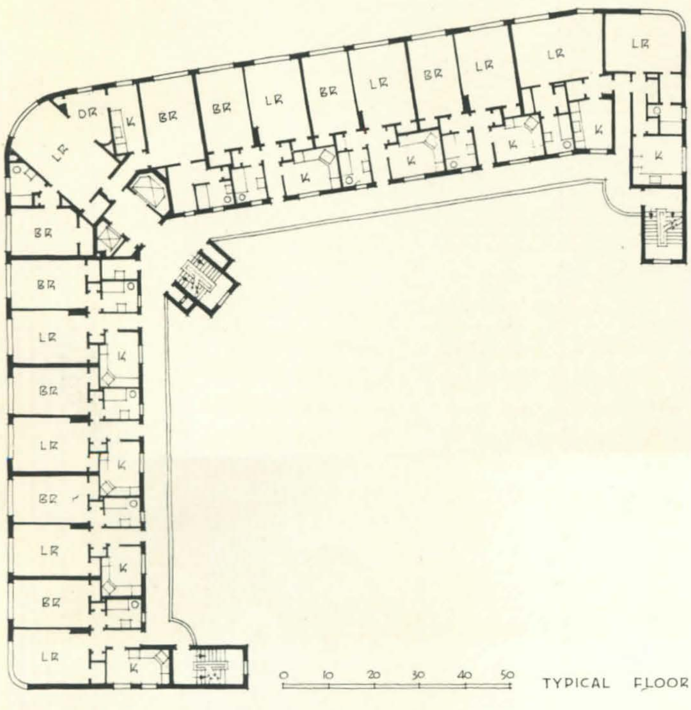
LIVING ROOM

DINING ROOM

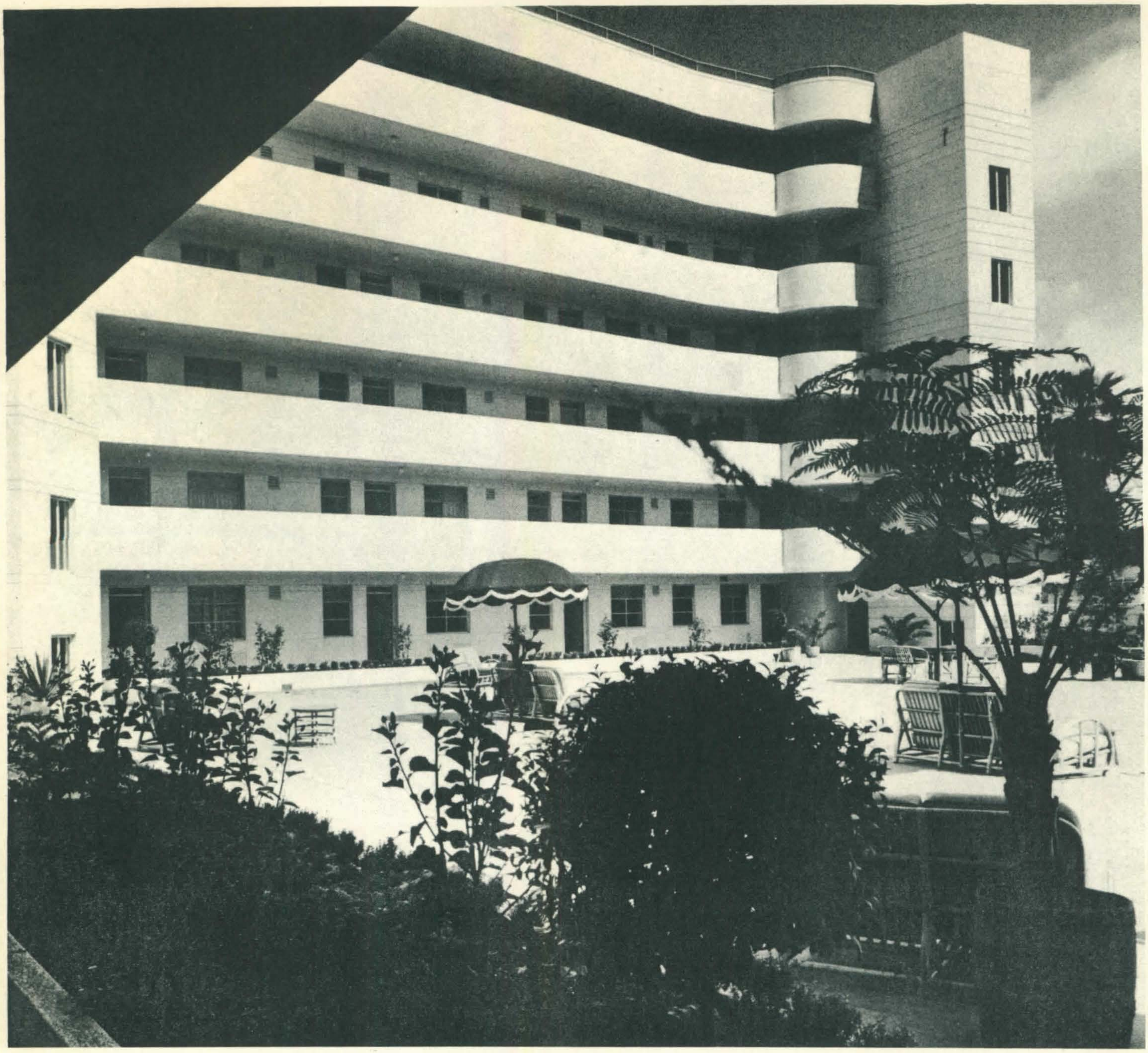
APARTMENTS



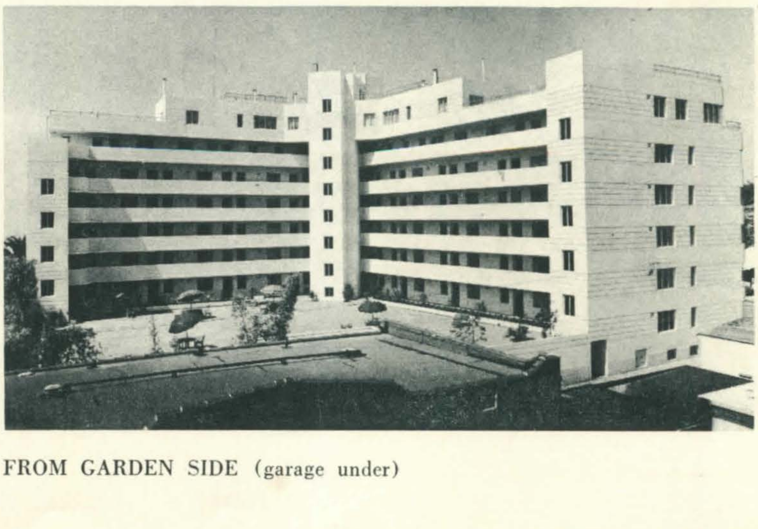




WILLIAM E. FOSTER, ARCHITECT: SHANGRI-LA APARTMENTS, SANTA MONICA, CALIF. Apartment house of 62 dwelling units: 11 two-room units, 49 *three-room* apartments, 2 large penthouses. Exterior galleries take the place of interior hallways; all apartments have cross ventilation; only entrance halls, bathrooms and kitchens face galleries. So that all living rooms could share an ocean view, the side-street wing of the building was set at an angle. Below the garden court is a garage for 62 cars. The structure is of reinforced concrete.



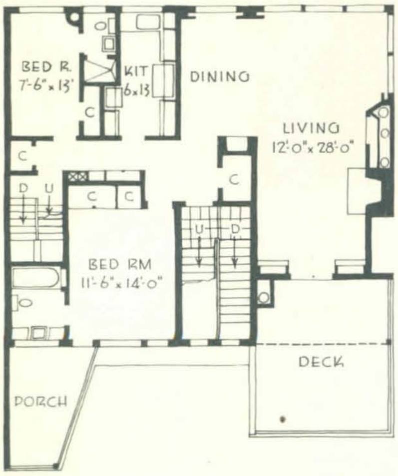
FROM STREET

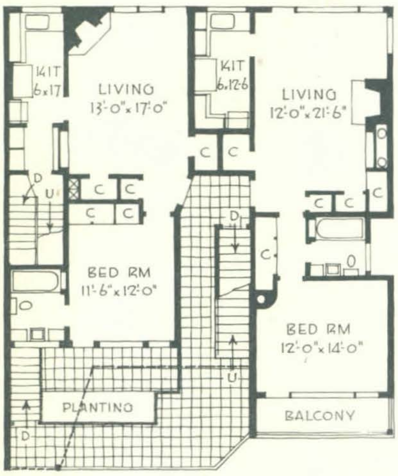


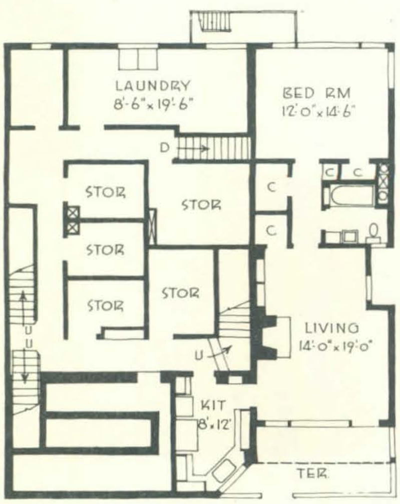
FROM GARDEN SIDE (garage under)


GENERAL VIEW (from garden front)

APARTMENTS

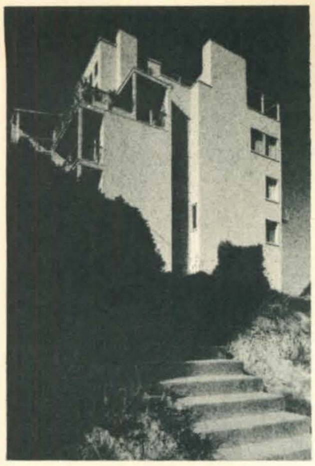




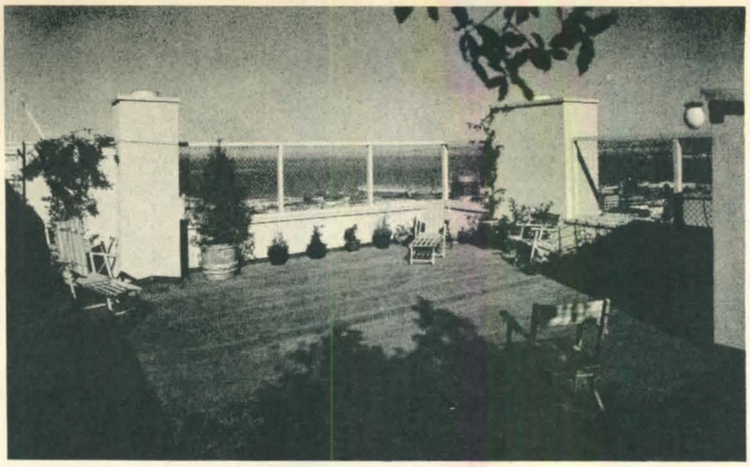


TYPICAL GARDEN TERRACE

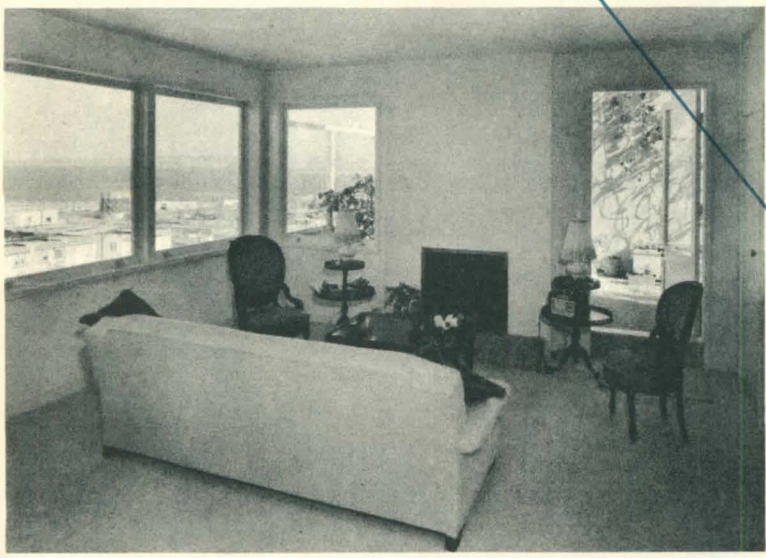
WILLIAM WILSON WURSTER, ARCHITECT: HELEN VAN PELT, LANDSCAPING: SIBBETT APARTMENTS, SAN FRANCISCO, CALIF. Local topography and street pattern lead logically to the stepped-back plan of this small apartment house. Main objects were privacy, garden, and fireplace in each unit. View is to north, with gardens along south and east; brow of hill protects structure from prevailing west winds. Large roof deck at top is for use of all tenants and is thoroughly soundproofed to protect the apartment below.



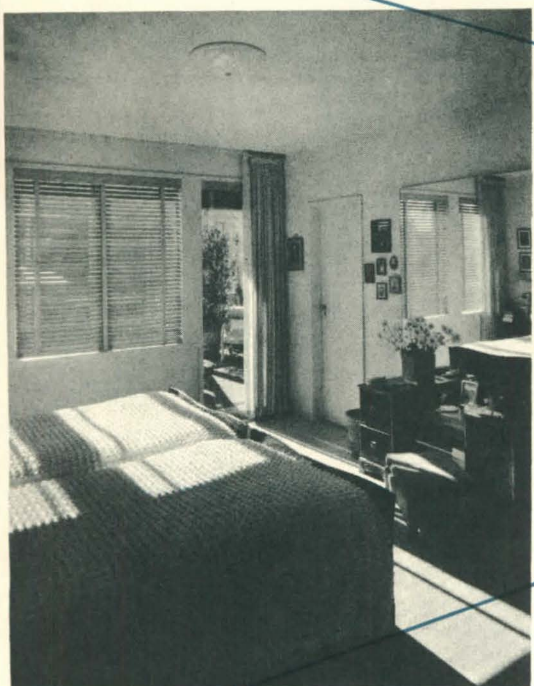
STREET FRONT



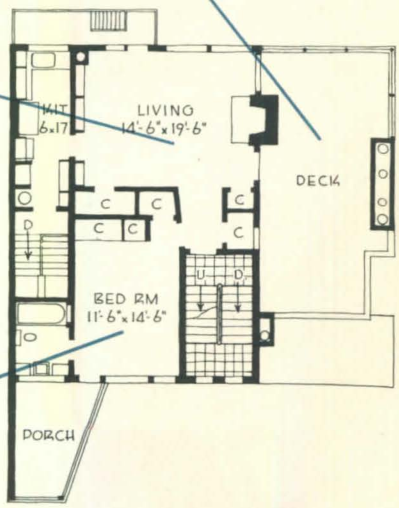
ROOF DECK



LIVING ROOM



BEDROOM



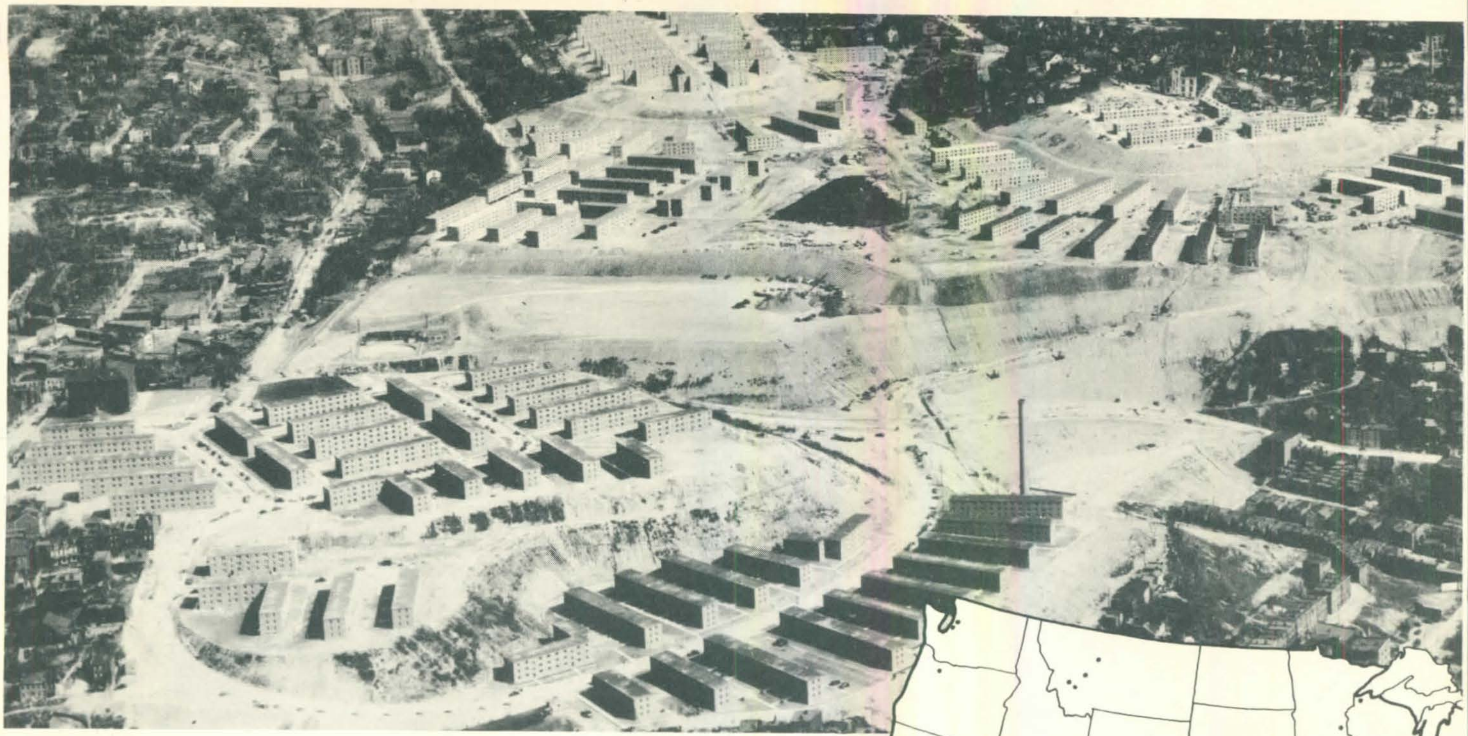
TYPICAL UNIT PLAN, showing organization of main rooms to exploit view. Staggered garden terraces make each unit a "first floor".

"Fairly roomy establishments of 17 or 19 rooms each" (below). At right, Elyton Village, USHA housing project, Birmingham, Ala.; D. O. Whilldin, Architect.

MULTI-FAMILY

HOUSING

1891-1941 ***Multi-family housing projects — of the type, size and rental levels now being built throughout the country by both government and private agencies—are the product of urban congestion such as early RECORDS could not imagine. Only in the last decade has the large-scale housing project come to be recognized as the chief means of clearing the unpublished slums of the '90's.***

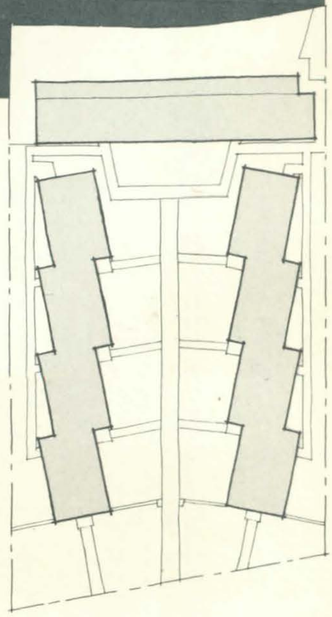


ONE OF USHA'S MOST AMBITIOUS PROJECTS: PITTSBURGH, PA.

EACH DOT MARKS A USHA PROJECT

USHA

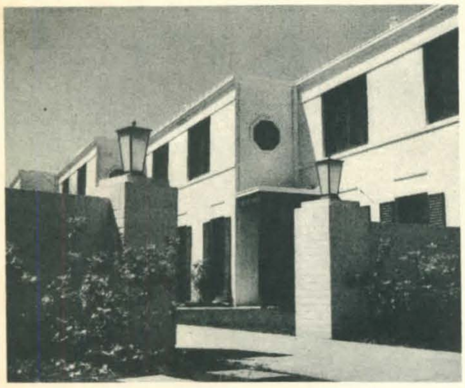
UNKNOWN IN 1891, the publicly owned, low-rent, mass-housing project has become an important and characteristic feature of American life. Perhaps the most important single building type in the building field, the actual construction of housing has had to parallel new techniques in law, financing, land acquisition, design, construction, and management. Growing maturity in these techniques is marked by the number of the projects, by steadily falling unit costs, by satisfied tenants, and by increasing flexibility in plan, construction, and style to meet regional variations in topography, climate, and tradition. To date, the United States Housing Authority and its predecessor have to their credit approximately 190,000 units finished, under construction, or under contract.

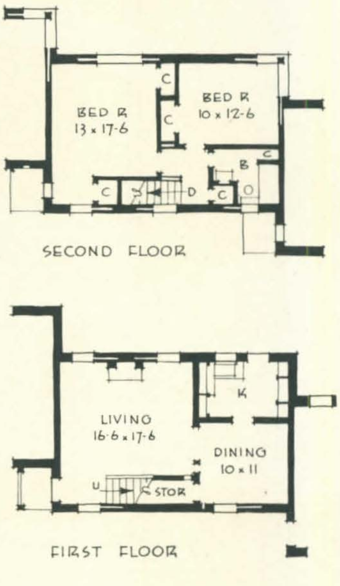


FHA

TALBOTT WILSON & IRWIN MORRIS, ARCHITECTS: CHILTON COURT APARTMENTS, HOUSTON, TEX. These eight row houses of typical plan, located on an interior lot, are staggered to provide each unit with four exposures and isolate as many as possible from a busy street. Because of soil conditions, buildings float on 6-in. concrete slab braced with integral grid of 10-in. beams 6 ft. in each direction. Construction is brick veneer on 6-in. studs. A bank of eight garages protects the rear of the property.

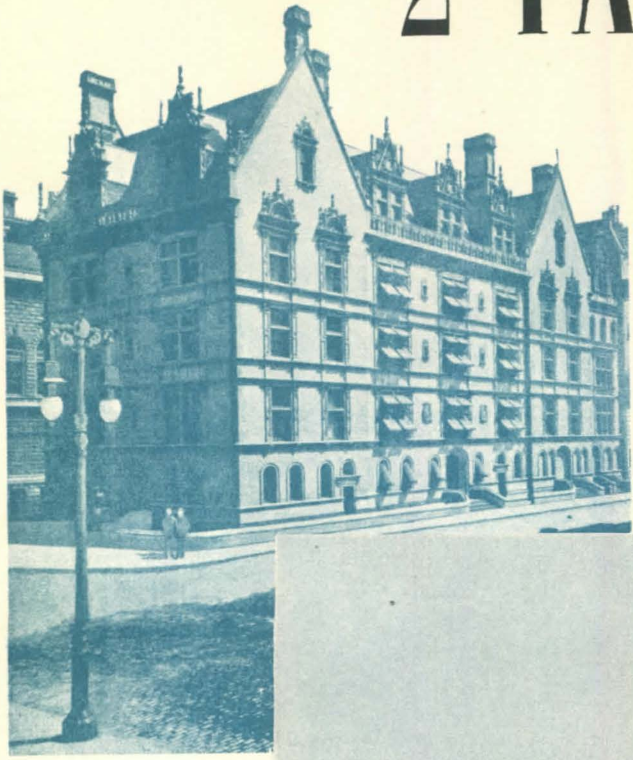
TALBOTT WILSON AND IRWIN MORRIS, ARCHITECTS (continued)





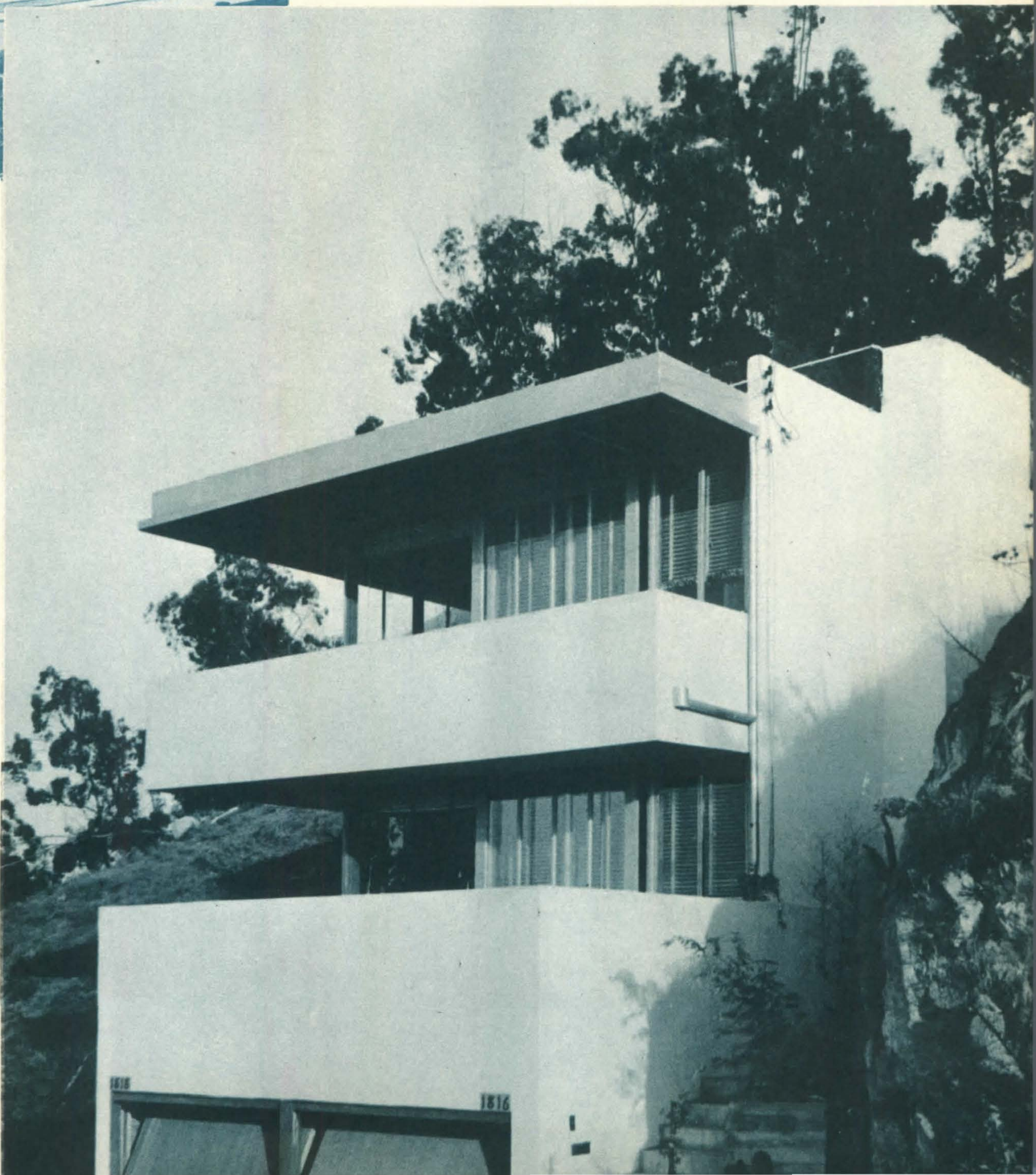
Unit plans are typical, providing living-dining room and kitchen on the first floor; two bedrooms and bath on the second floor.

2-FAMILY HOUSES



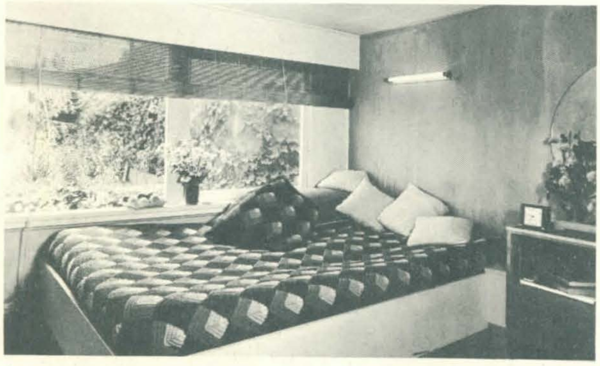
Four residences, New York City;
Clinton & Russell, Architects

1891-1941 ***Although a statistically important type, then as now, no exact counterpart of the modern two-family house was reported by the early RECORD. However, on a similar point, the RECORD in 1897 called attention to "several dwellings made to look like one large and imposing structure. One of the best of these groups . . . is so arranged as to resemble a simple and well-designed college or seminary." Typical modern solutions appear herewith.***



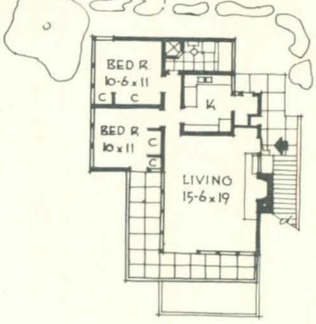
2-FAMILY HOUSES

DOOR TO BALCONY

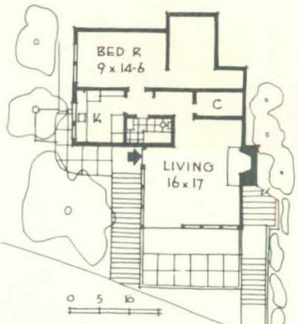


BUILT-IN DESK, BEDROOM

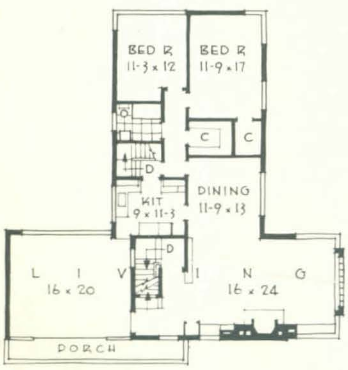
RICHARD J. NEUTRA, ARCHITECT: DUPLEX FOR MR. HARRY KOBLICK, LOS ANGELES, CALIF. Designed for a very steep site with a view; bachelor quarters on lower floor; apartment for a couple above. Both living rooms open out onto terraces. Construction is of unit-type timber chassis with continuous diagonal bracing against lateral shocks. Exterior finish is of cement plaster; all sash are of steel.

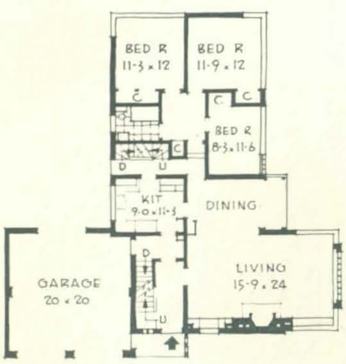


UPPER FLOOR

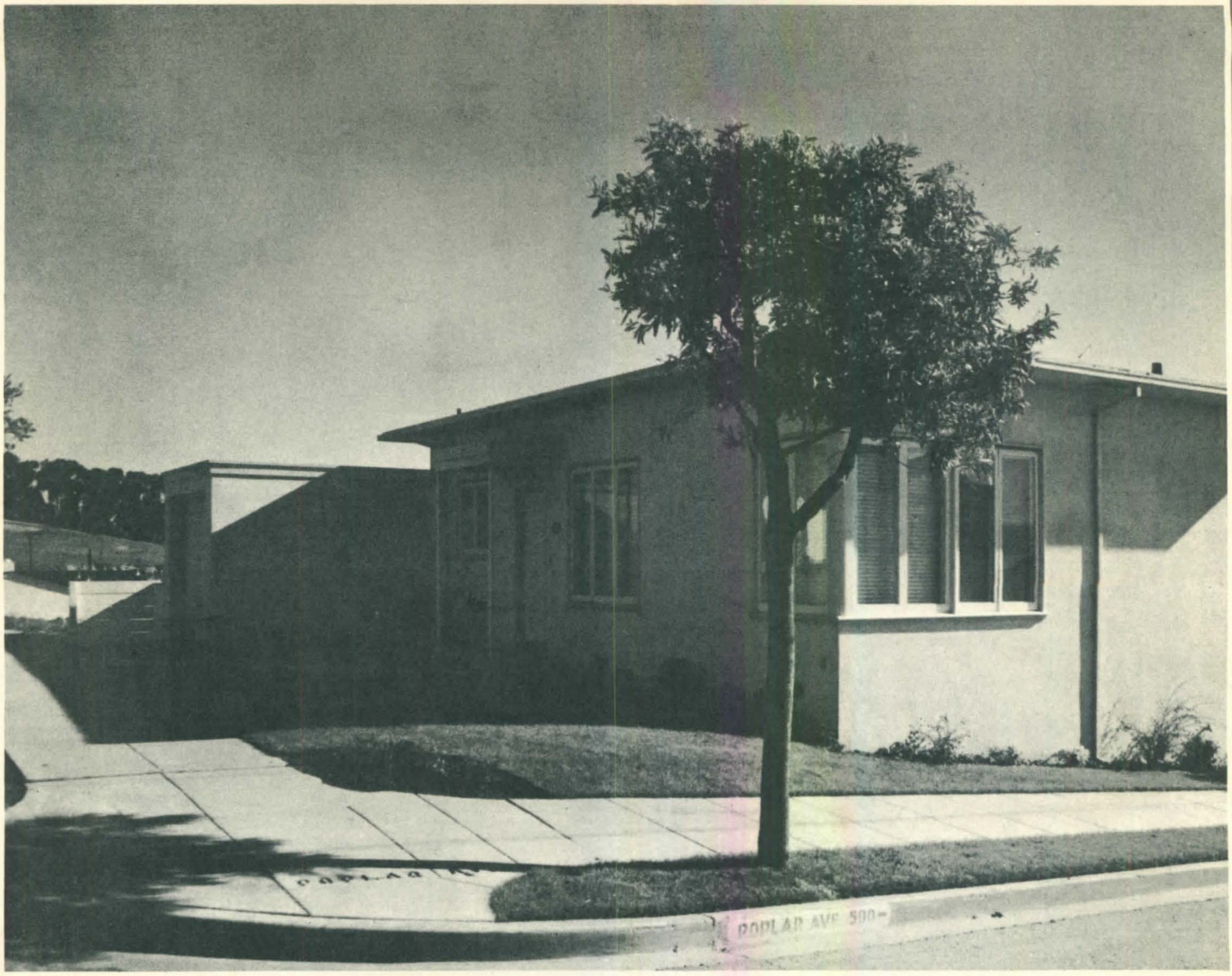


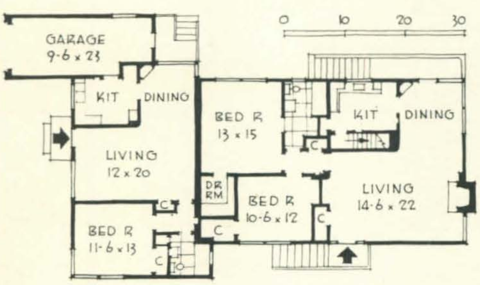
LOWER FLOOR



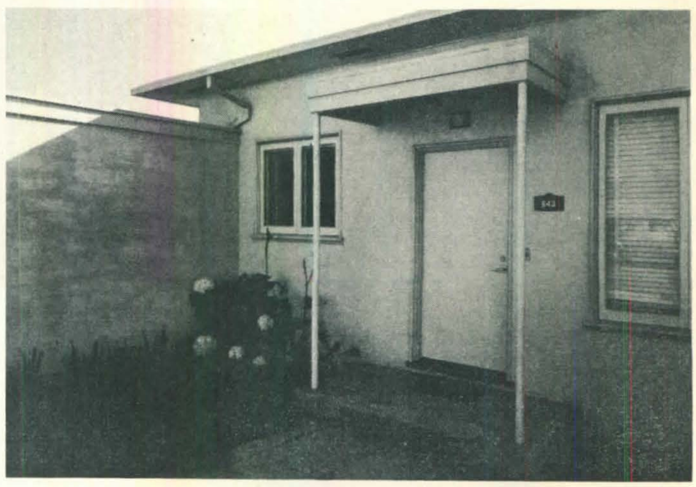


GEORGE B. BRIGHAM, ARCHITECT: TWO-APARTMENT HOUSE FOR MRS. A. E. GREENE, ANN ARBOR, MICH. "Two houses under one roof;" upper apartment occupied by owner; lower, by the architect and his family. A fireproof house built of cinder cement block, painted white. Space over garage is glazed and screened as a year-round living deck. Basement space under bedrooms serves as hobby room.



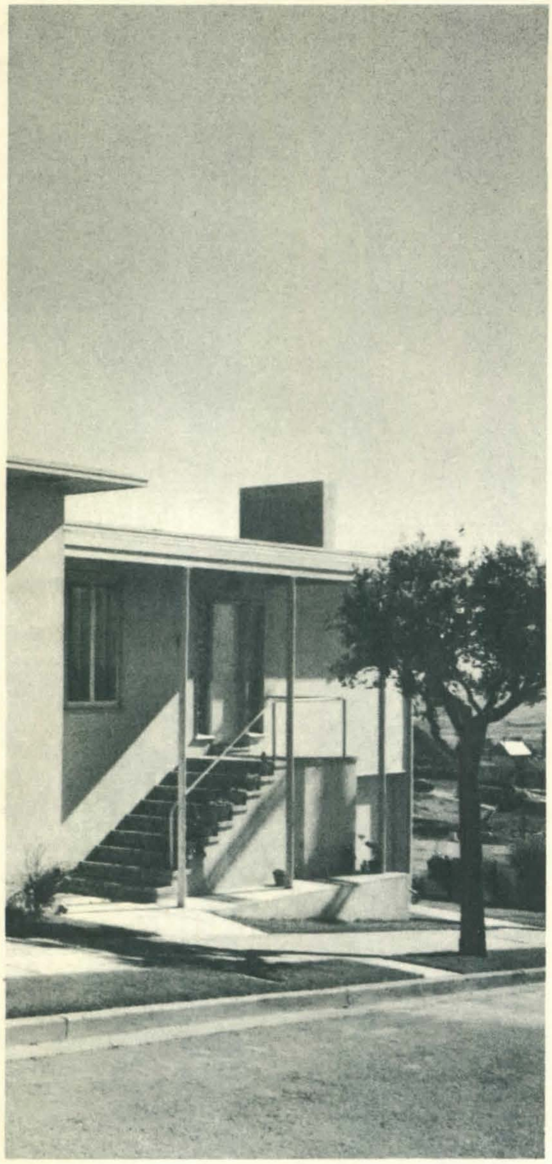


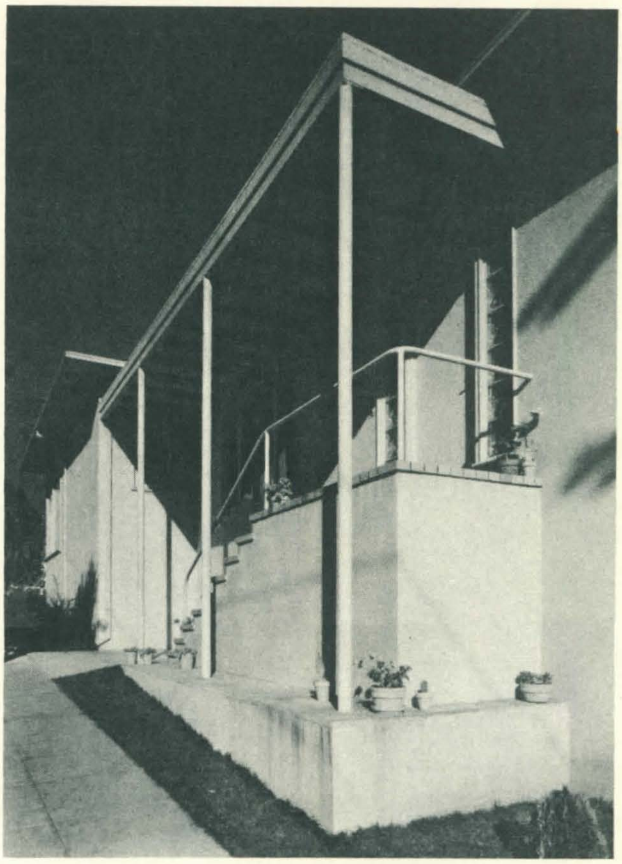
MARIO CORBETT, ARCHITECT: DUPLEX FOR MISS ELIZABETH MAFFEI, SOUTH SAN FRANCISCO, CALIF. Planned for a corner site, the house contains two small dwelling units, one with two bedrooms; the other, with one. Each has complete privacy: a sound-deadening partition separates the two areas; entrance doors and garages face different streets. In each case an impression of spaciousness results from making the dining area an ell of the living room. The building is of frame construction, surfaced in cement plaster; built-up roof.



ENTRANCE TO SMALLER APARTMENT

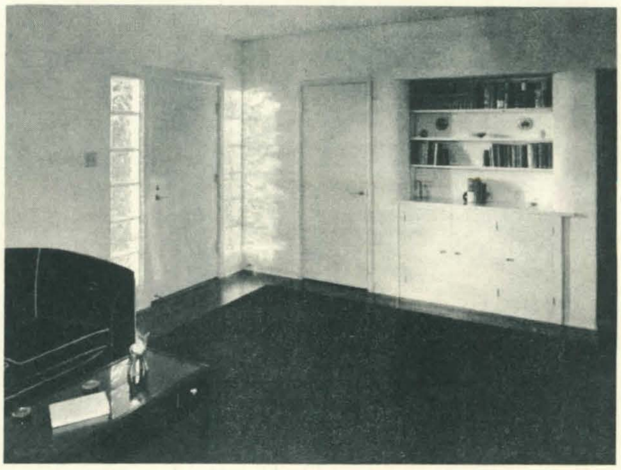
2-FAMILY HOUSES





ENTRANCE TO LARGER APARTMENT

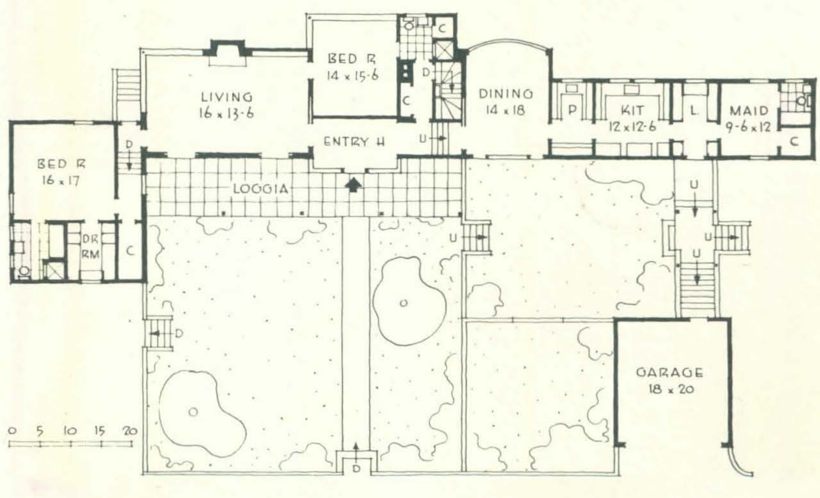
CORNER WINDOW, DINING AREA



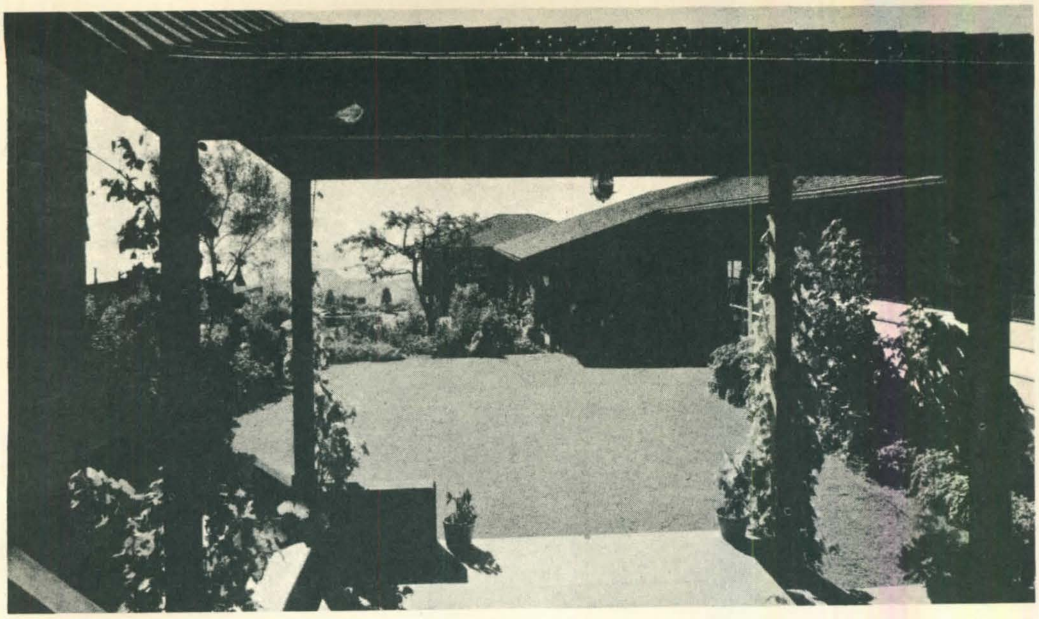
AN ENTRANCE DOOR

HOUSES

1891-1941 ***The RECORD had admitted as early as 1894 that "it is not possible for every building to be beautiful, or even pretty. The best we can do esthetically" was to insist that "each object should, as perfectly as possible, express its nature by its appearance." Though there is still room for discussion of this point, the fact remains that contemporary houses—by their clarity of organization and directness of expression — are heeding this prescient dictum of the early RECORD. James Lord Brown was the architect of the elaborate country house shown at left.***



CLARENCE W. W. MAYHEW, ARCHITECT: RESIDENCE FOR MR. AND MRS. WM. P. MORGAN, MARIN COUNTY, CALIF. Designed for a couple with one servant, this hillside house is organized so as to give all main rooms access to a magnificent view. At the same time, these rooms also have access to a garden protected from the wind. By placing the house fairly close to the road, landscape maintenance is reduced to a minimum — important consideration in a dry climate. Construction is frame, with redwood siding and cedar-shingled roof.

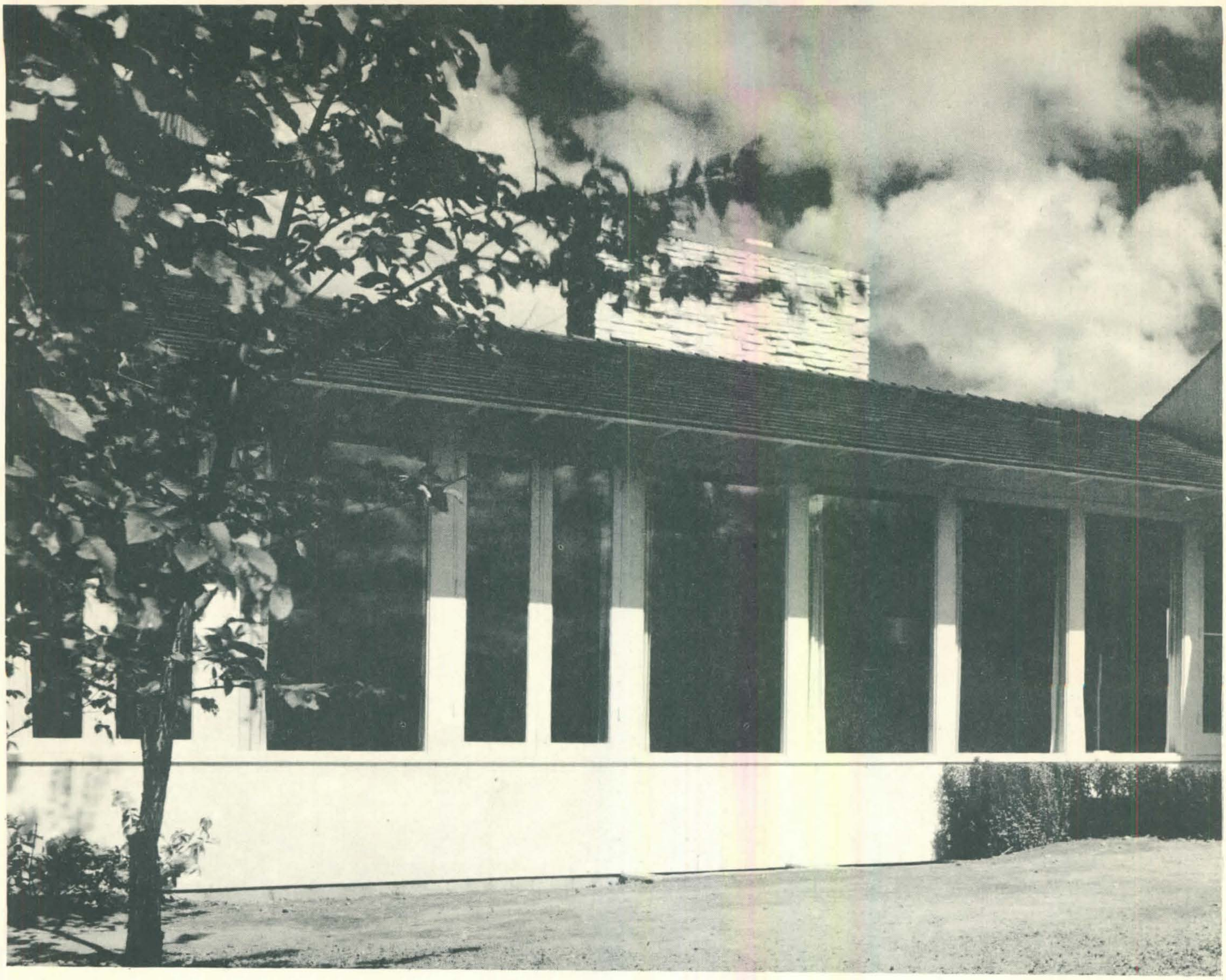


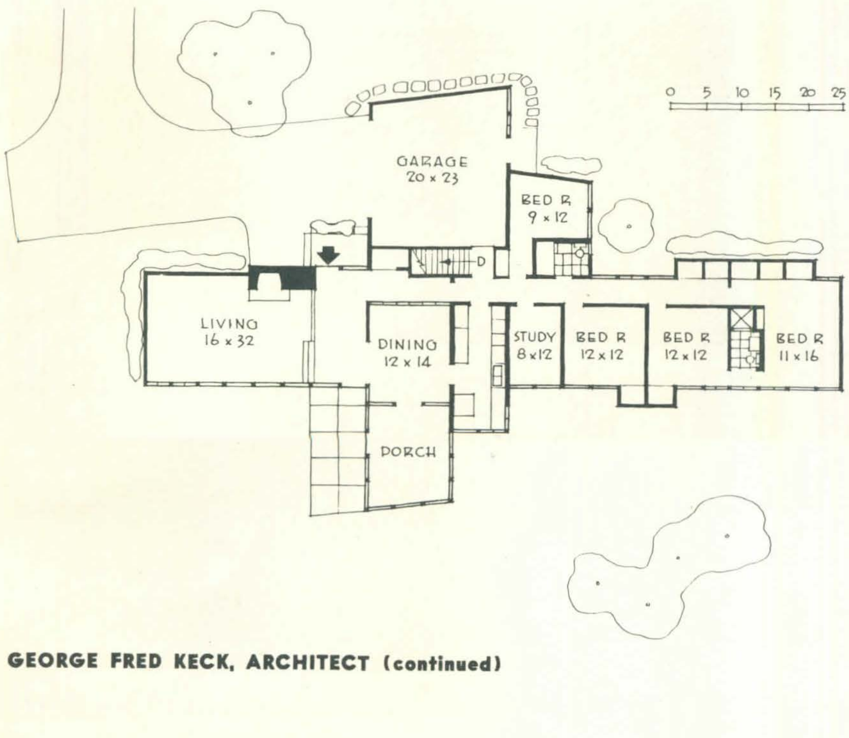
ENCLOSED GARDEN
(from garage passage)

ENTRANCE HALL (right)
LIVING ROOM (below)

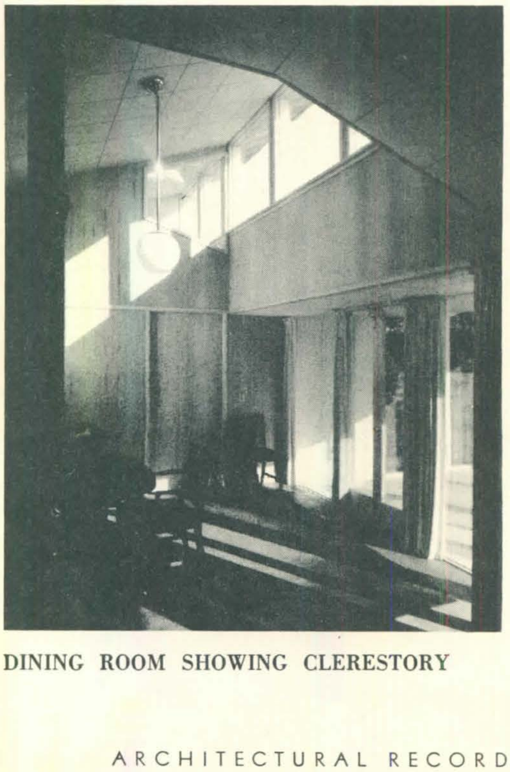
HOUSES

GEORGE FRED KECK, ARCHITECT: A "SOLAR HOUSE" FOR HOWARD M. SLOAN, GLENVIEW, ILLINOIS. Perhaps the first house in the country to make extensive use of the sun as an element in its heating system, this solar house opens up a whole new field of potentials. In the design of the house, the proper orientation for optimum insolation was carefully studied, and the size, placement, and arrangement of fenestration is a direct result. In fact the entire plan layout is determined by this factor; all rooms face south, and their wall areas on this exposure are largely of glass. To gain solar penetration in the dining room, which occurs at the back of a projecting porch, a clerestory window was introduced.

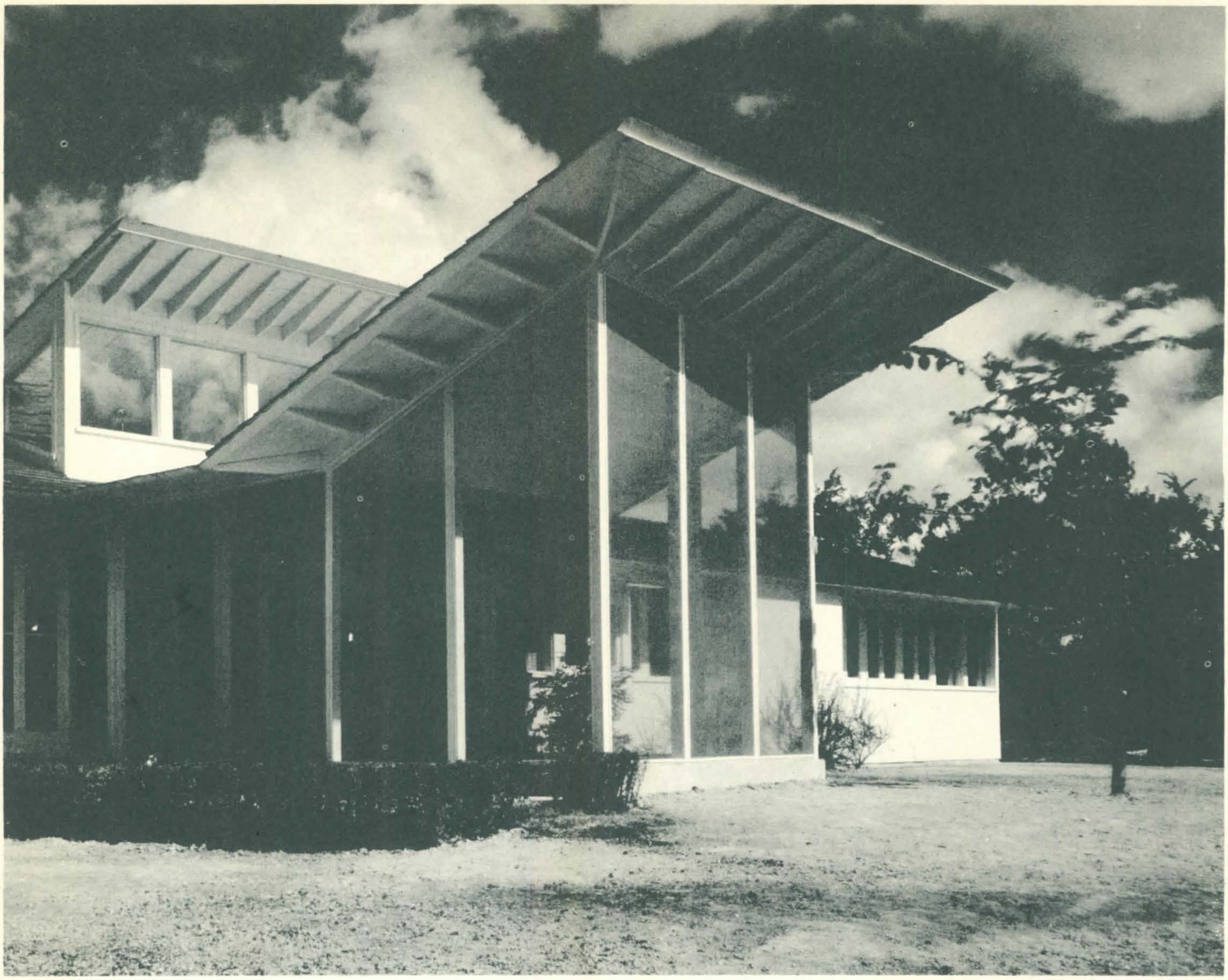


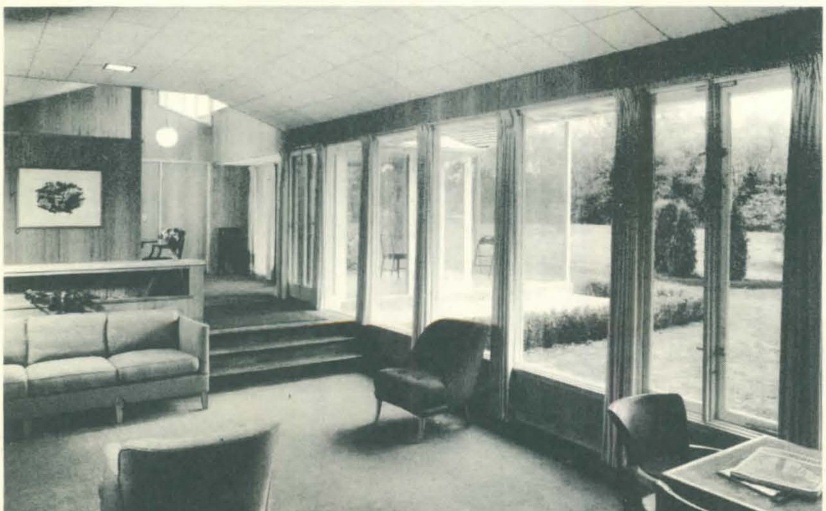


GEORGE FRED KECK, ARCHITECT (continued)



DINING ROOM SHOWING CLERESTORY

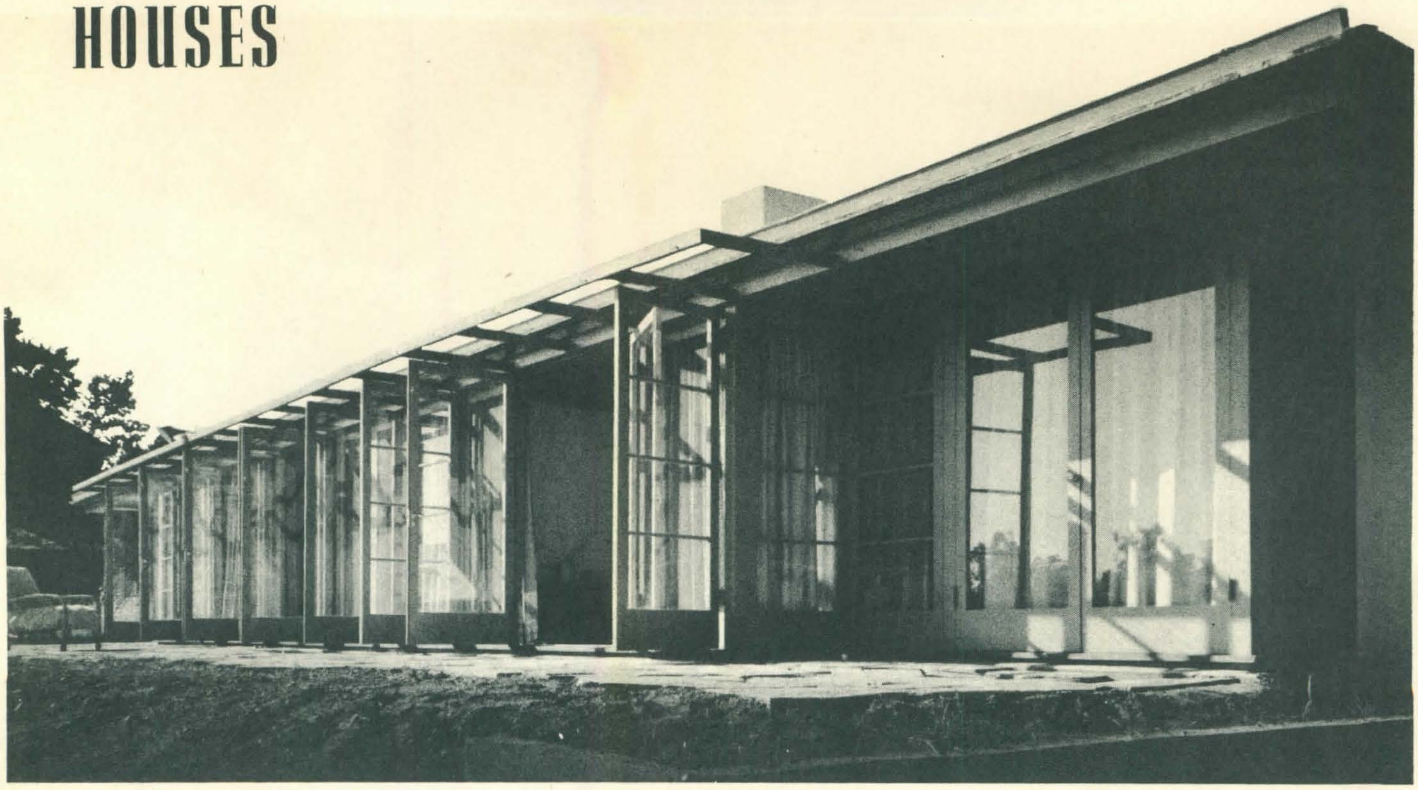




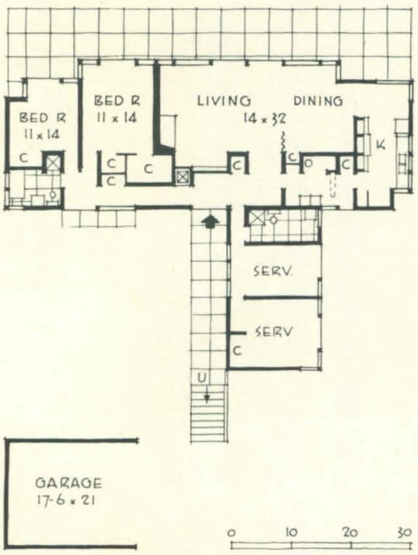
LIVING ROOM. View toward garden

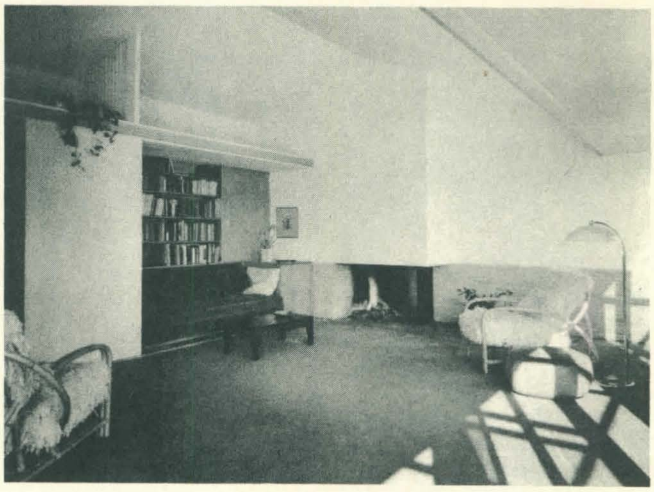
DINING ROOM

HOUSES

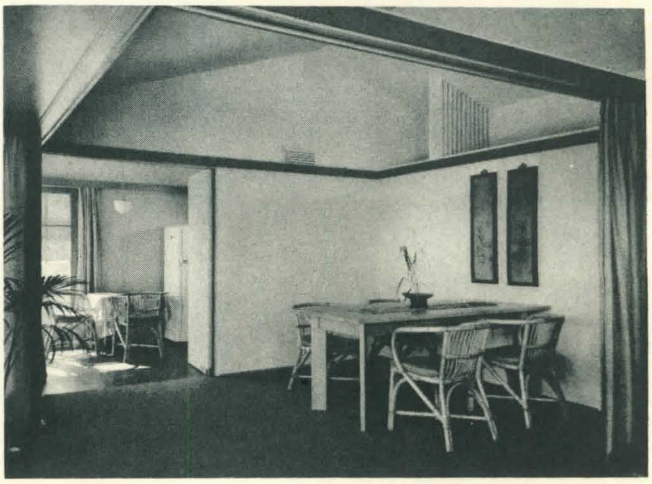


WINDOW WALL OF THE HOUSE, facing the view





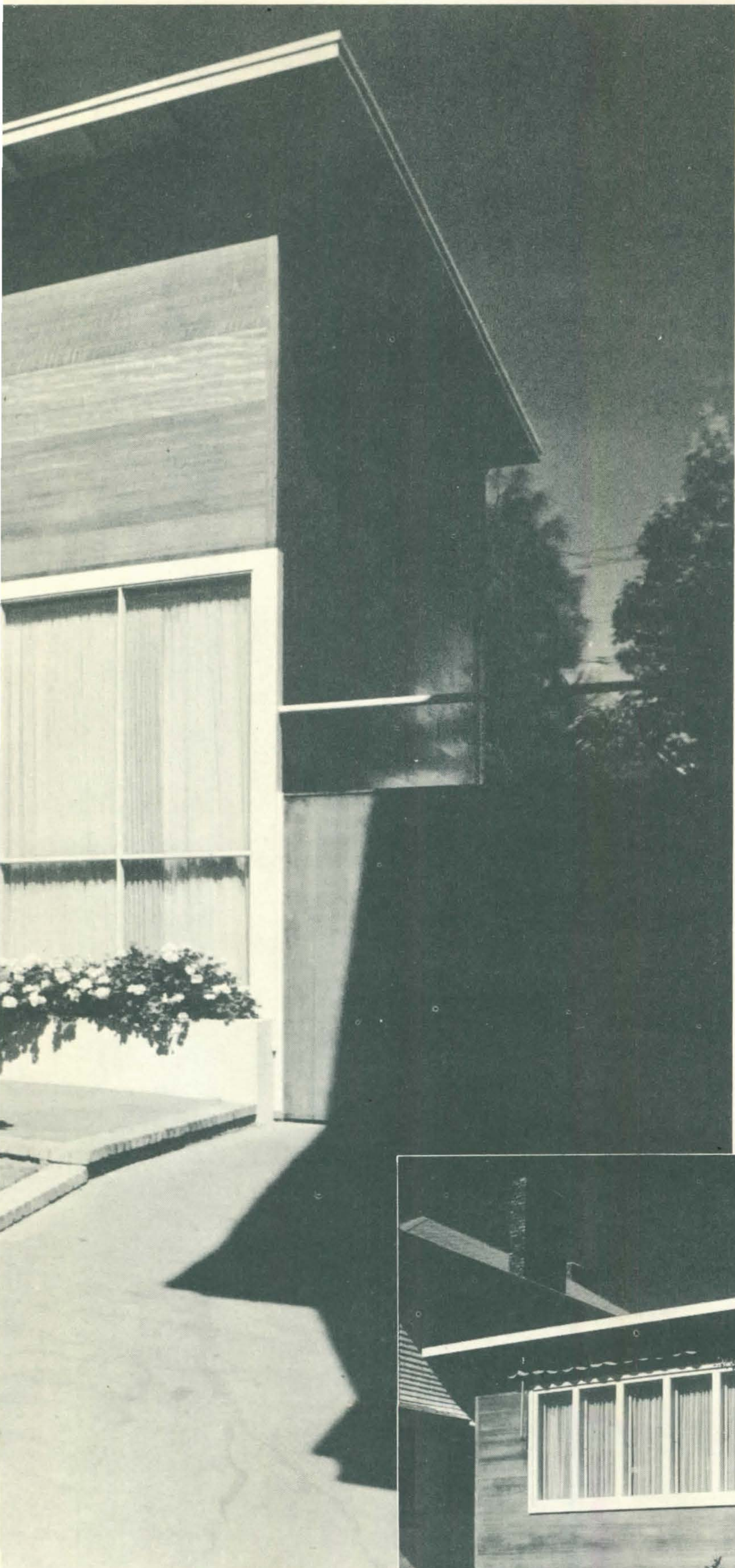
LIVING AREA

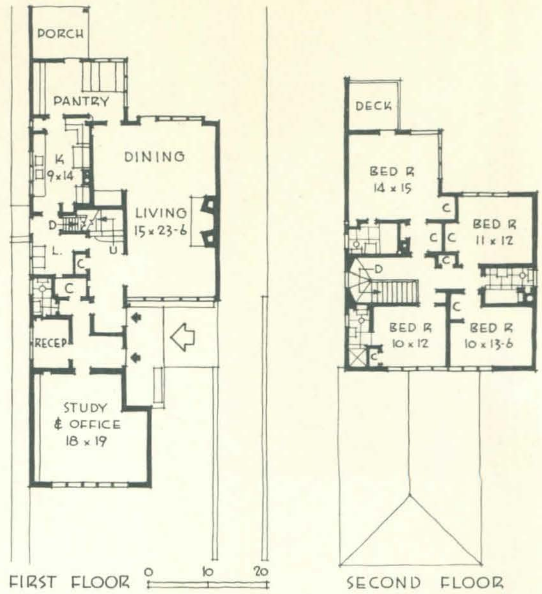


DINING AREA

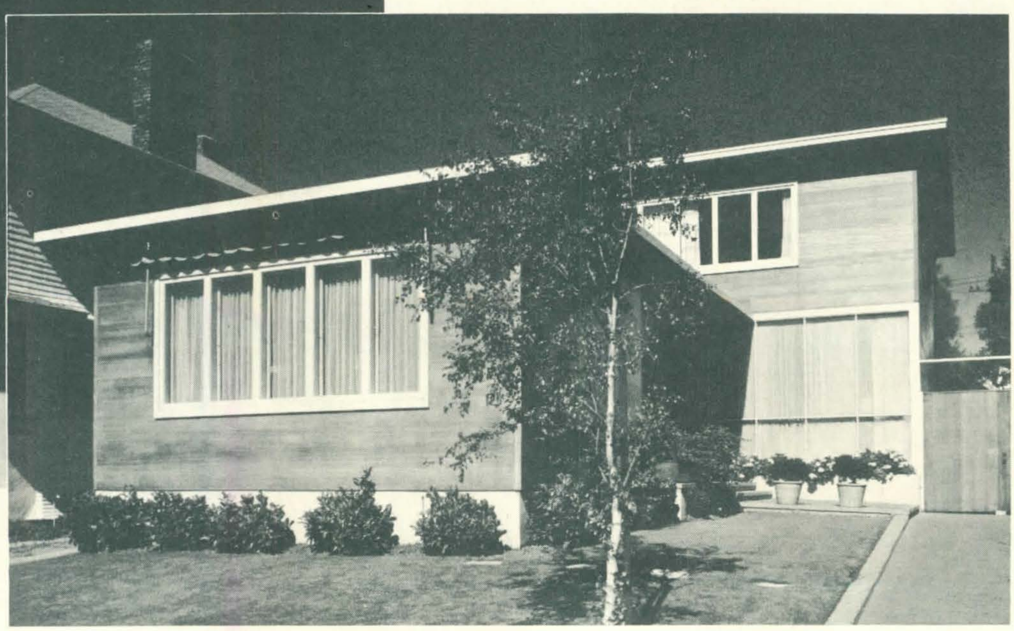
HARWELL HAMILTON HARRIS, DESIGNER: HARRIS HOUSE, LOS ANGELES, CALIF. All main living rooms are so arranged that they overlook a diversified view of mountains in the background and a small lake near at hand. The wall of this side of the house is almost entirely of windows and glazed doors opening onto a terrace. The general living-dining area may be divided by a draw curtain. Garage and service wing, placed on the street side, serve, in effect, as a sound-break for the private living quarters. Location of the garage forms a sheltered garden, bordering the entrance passageway.

HOUSES





GARDNER A. DAILEY, ARCHITECT: COMBINED RESIDENCE AND OFFICE FOR DR. AND MRS. BERNHARD BERLINER, SAN FRANCISCO, CALIF. Built on a typical residential lot, the house is but 31 ft. 4 in. in width. Separate entrances lead to the living quarters and the office-study area. For added privacy and quiet, this consultation office is equipped with double sash, double doors, and double insulation. The house is of frame construction, surfaced with tongue-and-groove redwood. Roof is of composition, with an aluminum-painted mineral surfacing cap sheet. The exterior walls are natural-finished redwood; trim and entrance recess are painted cream-white color.



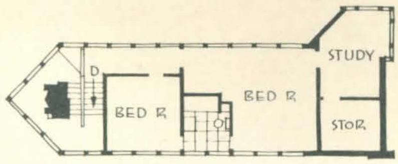
REAR VIEW. (Tree is a casuarina cunninghami.)

LIVING ROOM, toward front of house

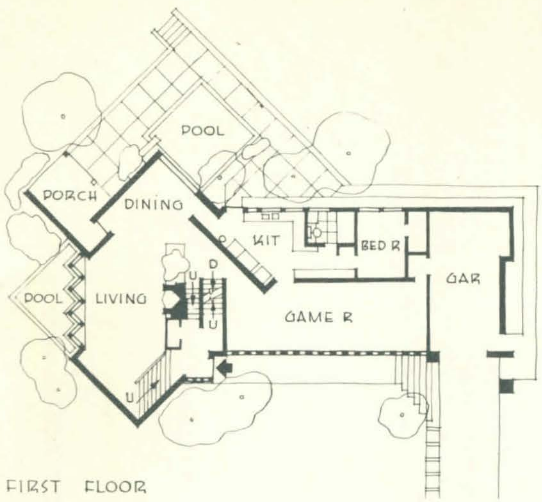
LIVING ROOM, showing dining area and garden window

HOUSES

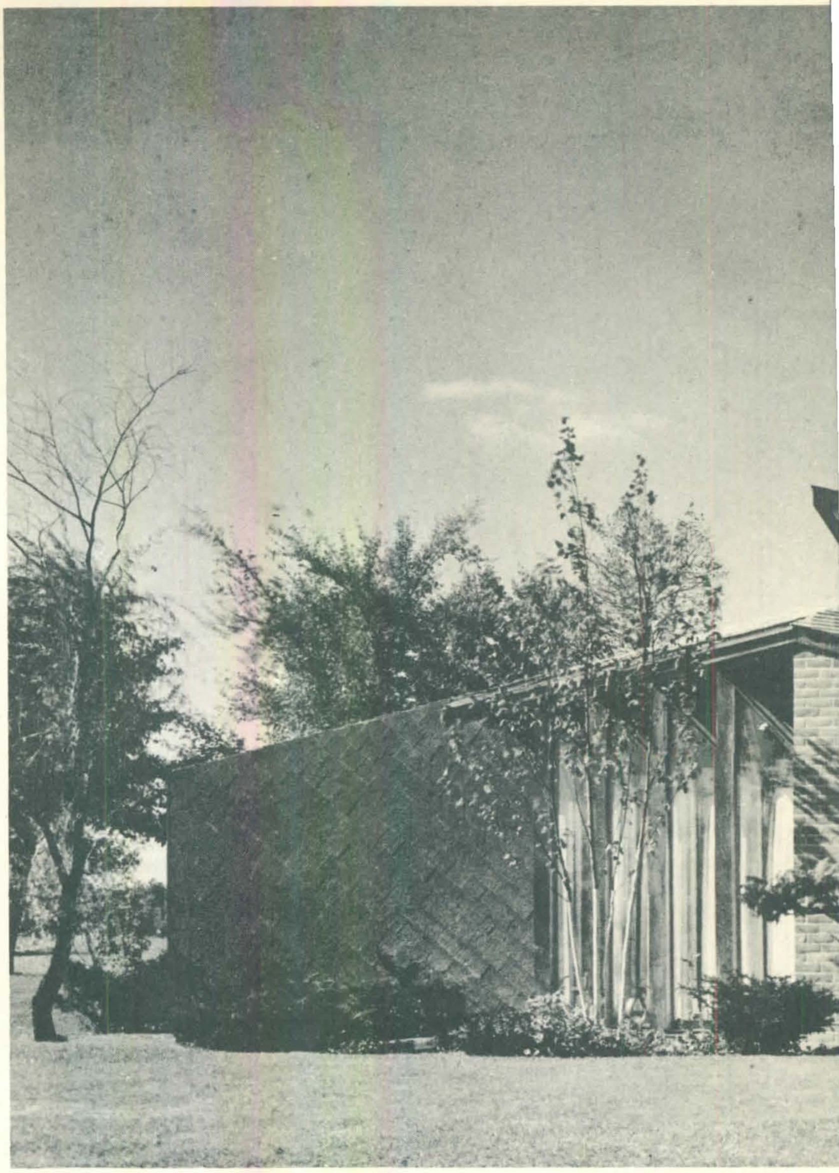
ALDEN B. DOW, ARCHITECT: GEORGE GREENE RESIDENCE, MIDLAND, MICH. The striking photograph above is a detail of the living-room window treatment. A bold handling of unconventional angles and planes, characteristic of much of Mr. Dow's work, both emphasizes and dramatizes special features of the plan and brings interior design and exterior landscaping into close harmony. In this case, the series of windows front directly on a garden pool. Further photographs and the floor plans appear over page.



SECOND FLOOR



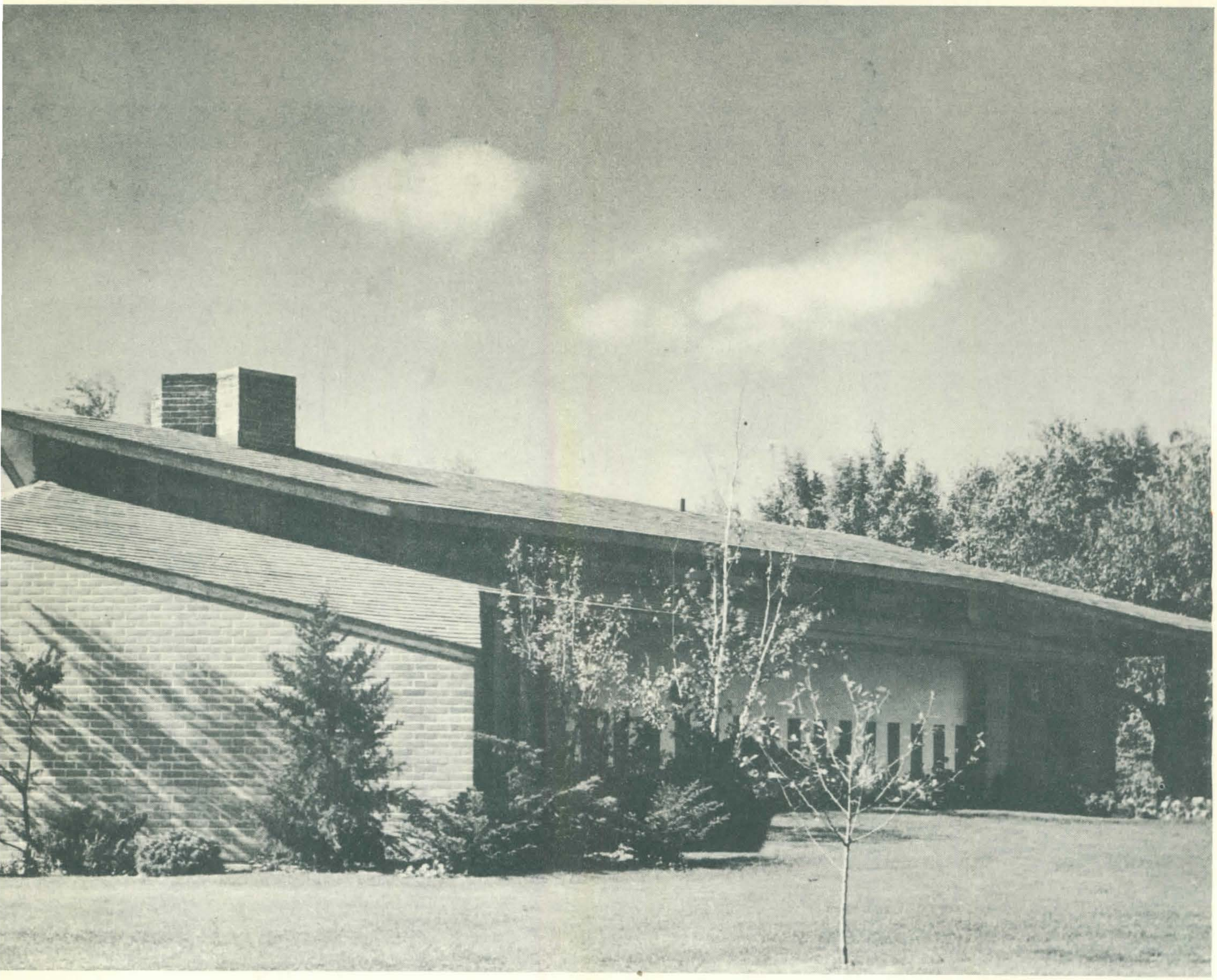
FIRST FLOOR



THE GENEROUS LIVING AREA, arranged around the fireplace and sawtooth bay window, is the focal center of the house. At one end, in a 90° angle formed by outside walls, stairs descend from the entrance hall. In the parallel angle at the far end of the room is the dining area, with its own garden-view window and a door to a dining terrace. A passageway behind the central stairs leads to a large game room for informal entertaining. On the second floor is an unusually commodious master bedroom suite, with a study, completely isolated for utmost privacy.

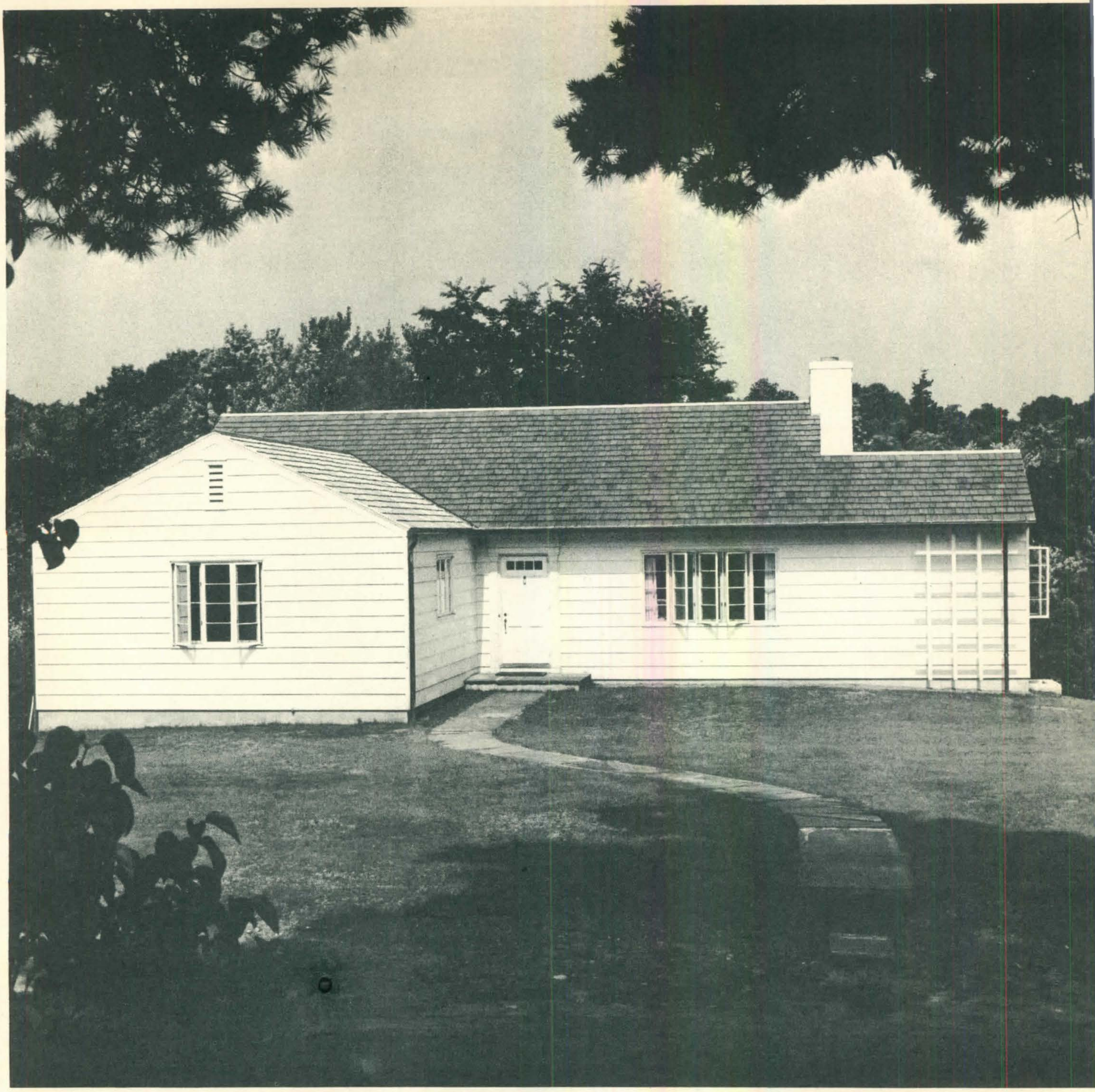
ONE OF THE TERRACES

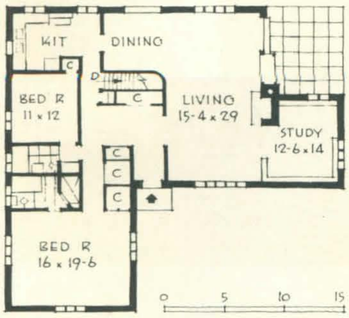
LIVING-ROOM WINDOW



LIVING ROOM, toward dining area

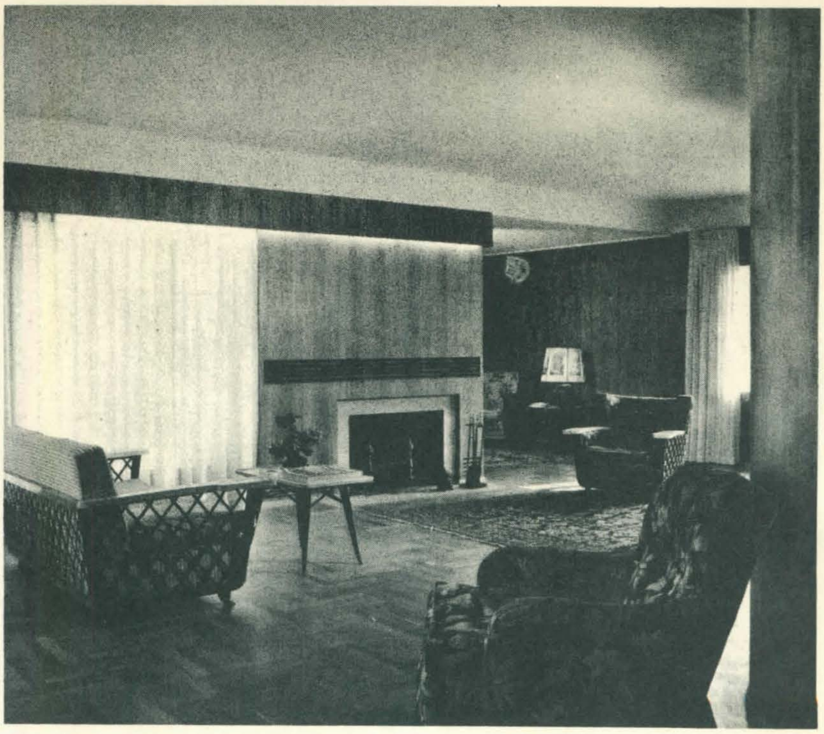
LIVING ROOM, toward entrance stairs





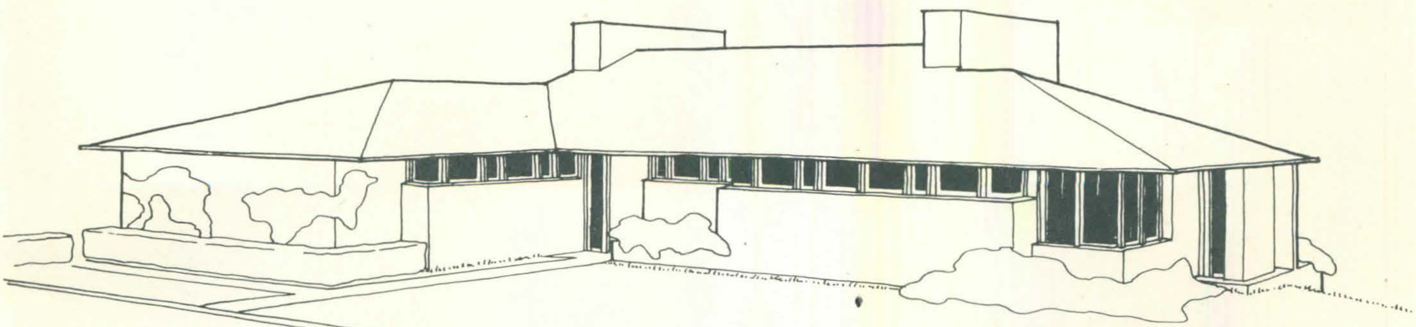
OSCAR FISHER, DESIGNER: RESIDENCE FOR MR. AND MRS. ANDREW T. STANTON IN RIVERDALE, N. J. An unusually open plan in a small house of traditional exterior designed as a permanent residence for two persons. The Z-shaped living space divides into living, dining, and study areas without the use of partitions. As the grade slopes downward from the front wall, there are two full stories at rear; garage, recreation room, and heater room are thus provided under the main floor. Construction is wood frame on concrete foundation. Plywood is extensively used, except for roof, exterior walls, and floors. Interior walls are of plywood, in various veneers. Lighting is fluorescent.

HALL



LIVING ROOM. View toward study area

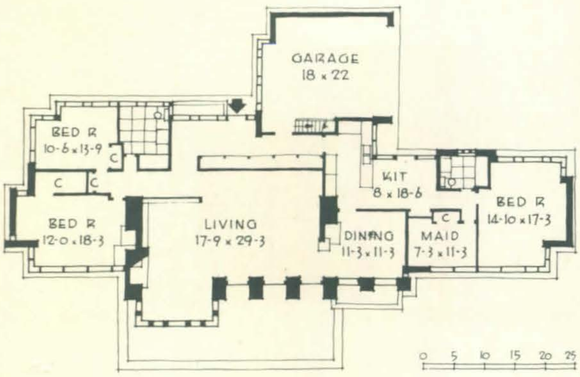
LIVING ROOM. General view



HOUSES

EDOUARD J. MUTRUX AND WILLIAM A. BERNOUDY, DESIGNERS: RESIDENCE FOR DR. AND MRS. HUDSON TALBOT, IN ST. LOUIS, MO.
A one-story, brick residence whose design directly expresses climatic needs. Entrance is on the north side; here windows are sparingly used. The south wall has a generous amount of window area—both fixed and movable. Wide overhanging eaves reduce glare in summer, but are designed to admit winter sunlight. Above the cantilevered canopy is a continuous band clerestory windows, through which supplementary light is admitted. The large room in east wing is a playroom for a small nursery school operated by Mrs. Talbot. Its location is such that there is no conflict with living routine. Ceilings and other walls are of plaster, with wood trim. The house is heated by pipe coils laid under the concrete floor from which heat is radiated to the rooms.

DETAIL OF CANOPY on south side.



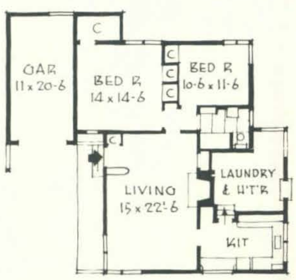
ENTRANCE DETAIL, north side.

LIVING ROOM. View from dining room

LIVING ROOM

KITCHEN

HOUSES



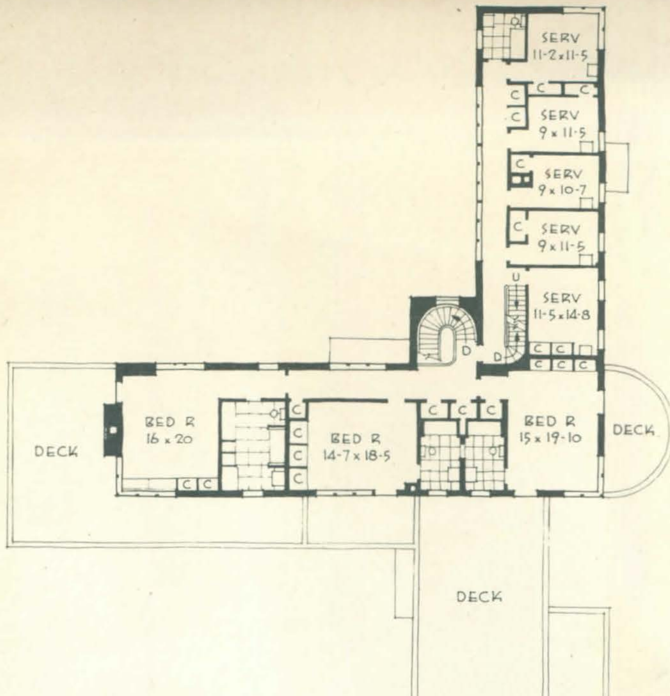
LIVING ROOM

BEDROOM

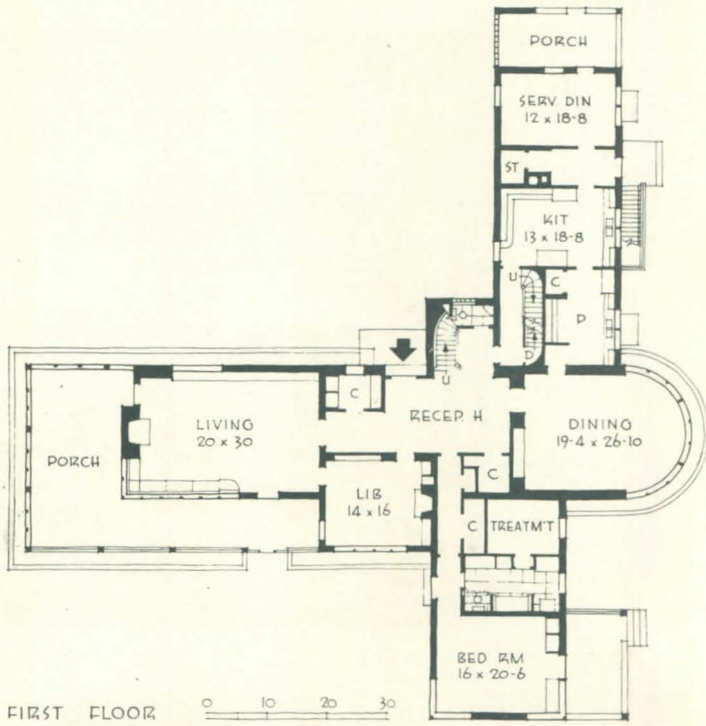
DONALD DWIGHT WILLIAMS, ARCHITECT: RESIDENCE FOR MR. AND MRS. D. D. WILLIAMS, SEATTLE, WASH. A compactly planned, two-bedroom house on a single floor. Construction cost was pared by inclusion of a general utility room, centrally located at the rear, in place of a basement. This room serves as both heater room and laundry. The exterior is surfaced in cedar; trim is blue green.

HOUSES

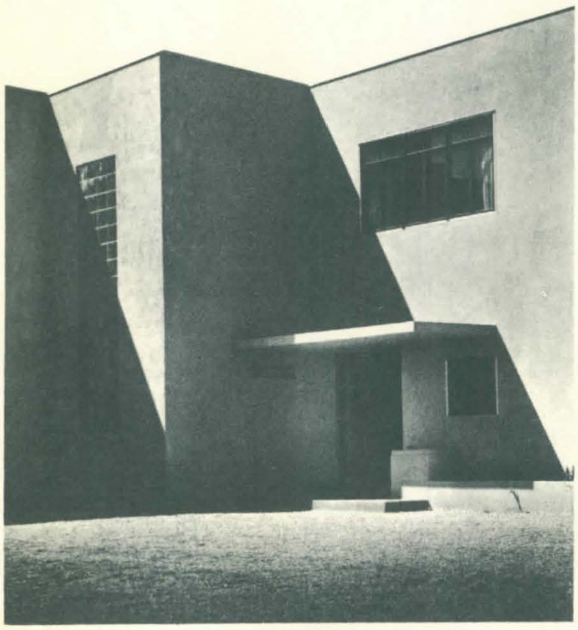
RICHARD A. MORSE AND ARTHUR T. BROWN, ARCHITECTS: RESIDENCE FOR MARGARET, COUNTESS OF SUFFOLK, NEAR TUCSON, ARIZ. Located in the foothills of the Catalina Mountains, this house, for winter residence, takes full advantage of the surrounding views. Considerable wall area in all main rooms is devoted to windows which command far-flung desert views. For outdoor living, there are covered porches and roof decks. The exterior walls and interior bearing walls are of brick. On the interior, trim was kept to a minimum, and a generous use was made of built-in fittings—cabinets, bookcases, window seats.



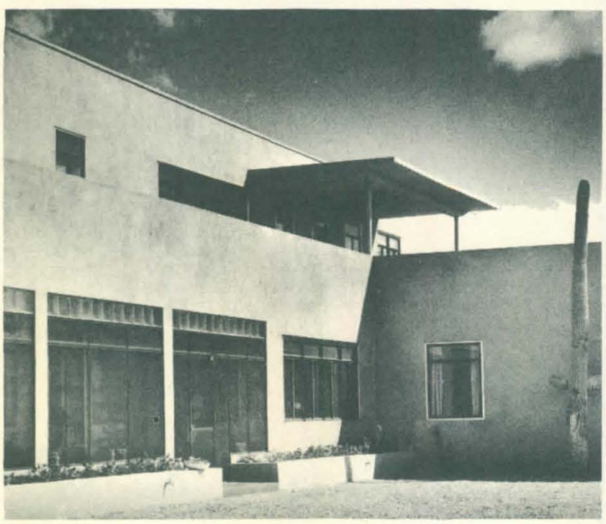
SECOND FLOOR



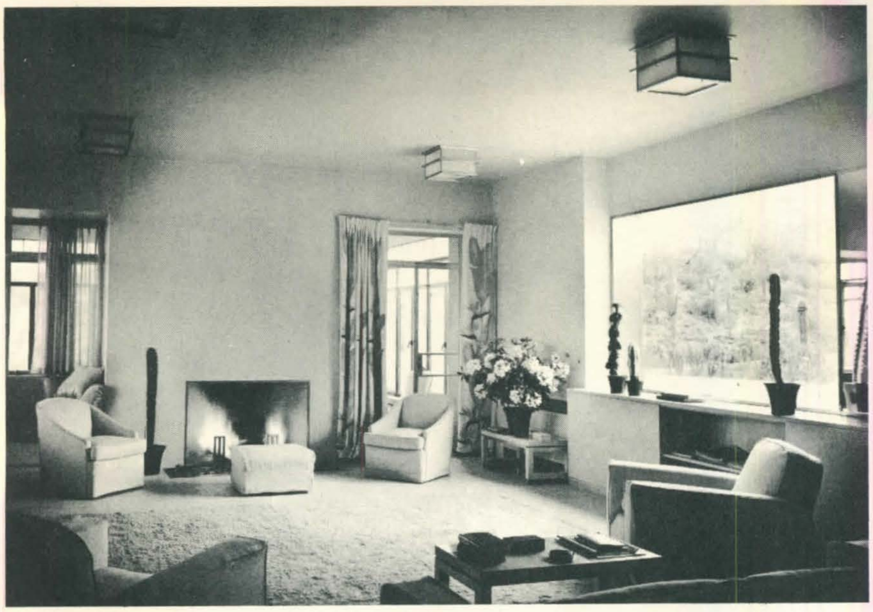
FIRST FLOOR



ENTRANCE DETAIL

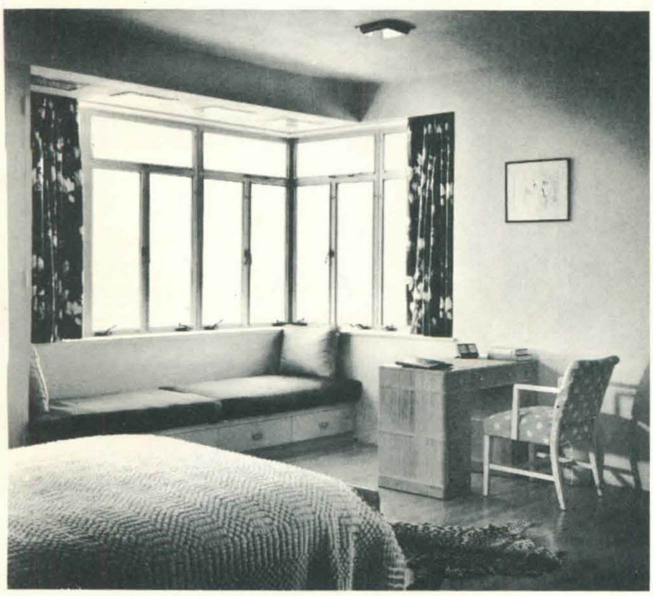


WEST SIDE. Angle formed by library and master bedroom. Right: dining-room bay.



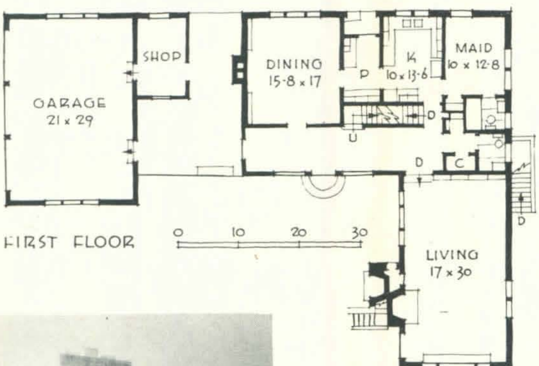
LIVING ROOM

DINING ROOM



BEDROOM

HOUSES



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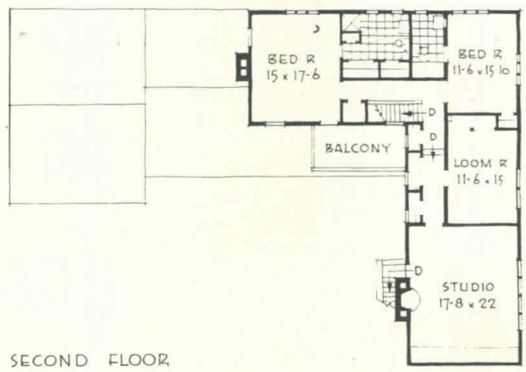
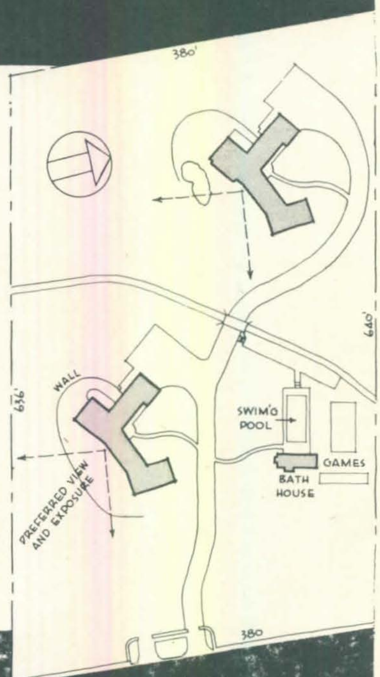


SECOND FLOOR

OUTDOOR FIREPLACE

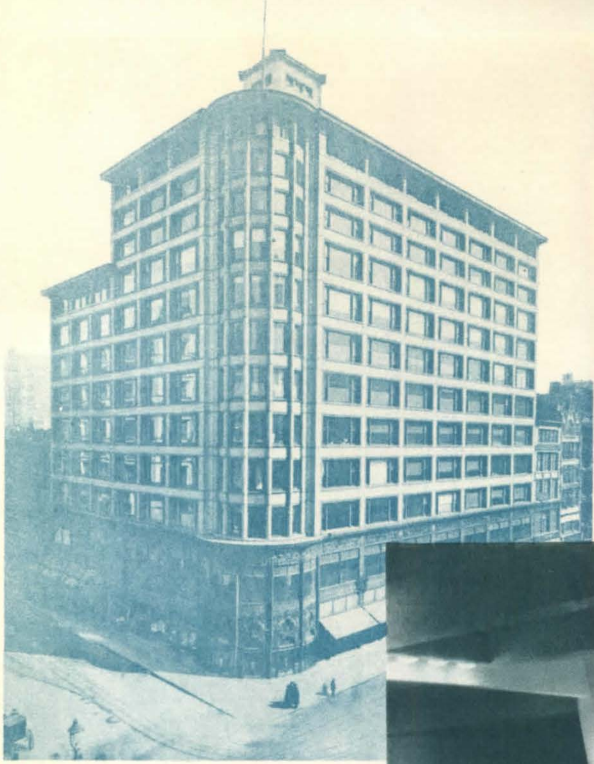
SEWALL SMITH, ARCHITECT: RESIDENCE OF MR. AND MRS. ROY MASON, BATAVIA, N. Y. The artist's desire for a secluded studio plus the need for space for display of his paintings were basic design considerations. Arrangement of rooms in a broad L-shape plan, with the service area occupying the heel of the L, made possible the long entrance hall which serves as both hall and water-color gallery. The garage is connected to the house proper by a flagged, covered passage, providing an outdoor sitting loggia. In the forecourt is an outdoor *fireplace* with a stair that winds around the large chimney up to the studio.

HOUSES



***J. R. DAVIDSON, DESIGNER: TWIN RANCH HOUSES FOR THE MAURICE BERKSON FAMILY, ENCINO, CALIF.** A pair of houses, one for the parents, one for married children, on a six-acre ranch site. The houses share recreational facilities, such as the swimming pool.

**To be treated more extensively in a later issue.*



Louis Sullivan, Architect

COMMERCIAL

1891-1941 *One of the great pioneer architects in the commercial field was Louis Sullivan. Reporting on his building (left) for Schlesinger and Mayer (now Carson Pirie and Scott) in Chicago, an early RECORD comments: "It is a logical solution of the commercial building . . . the latest and best achievement producd in this country." Today's commercial job requires detailed knowledge of diversified merchandising principles. The scope of the problem is indicated in examples on following pages.*

Department stores by William Henley Deitrick, Architect, (above) and Williams and Grimes — Albert R. Williams, Architects (right).

COMMERCIAL

TWENTIETH-STREET FACADE

ENTRANCE after remodeling

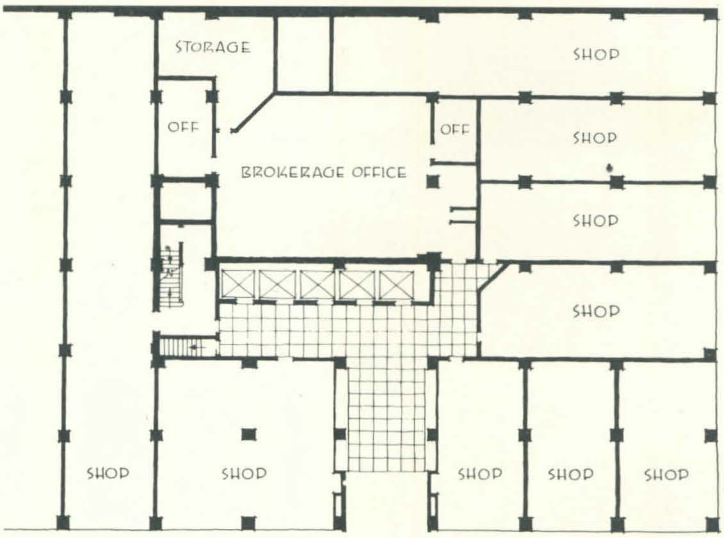
BEFORE MODERNIZATION

SHOPS

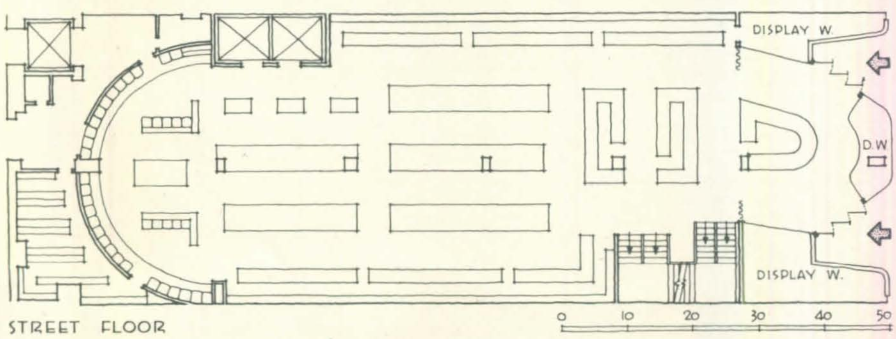
MILLER, MARTIN & LEWIS, ARCHITECTS AND ENGINEERS: MODERNIZATION OF THE FRANK NELSON BUILDING, BIRMINGHAM, ALA. Formerly the First National Bank Building, the Frank Nelson Building is near the center of Birmingham's business and shopping districts. The ground-floor construction was stripped to the steel frame, and old offices were replaced with 10 modern shops. While each is laid out to meet individual requirements, all conform sufficiently to present unified street facades. The main entrance lobby is surfaced with coral marble; the floor is terrazzo. Uninterrupted show cases at either side of the lobby display merchandise of the shops that adjoin. The entire exterior of the building was cleaned and painted. Cost of improvements and renovations amounted to $150,000.

ELEVATOR LOBBY

SECOND AVENUE, NORTH

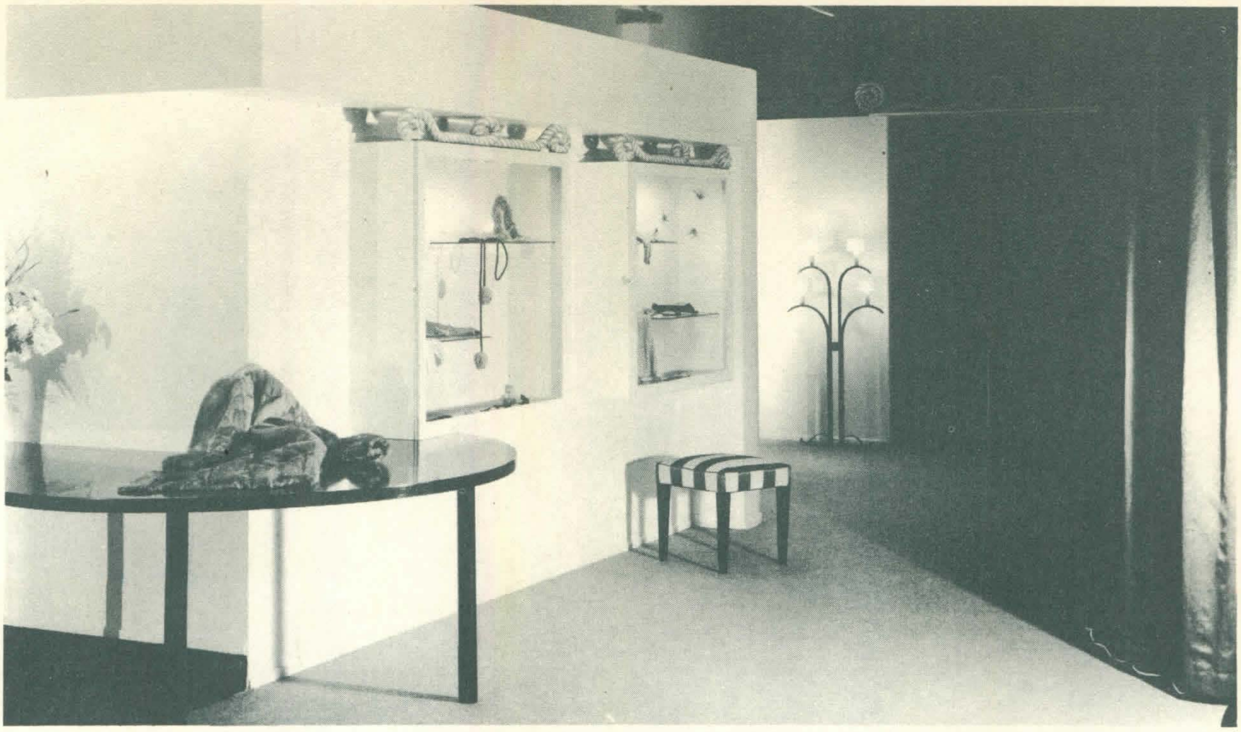


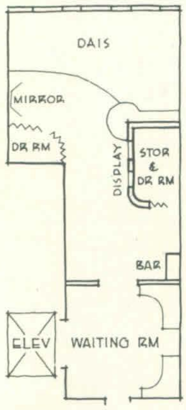
MAIN LOBBY



GENERAL

RAYMOND LOEWY, DESIGNER: MACY'S OF SYRACUSE, SYRACUSE, N. Y. A remodeled store in which display technique is of paramount interest. Large plate-glass panels are used on the display cases in the arcade, with heavy glass doors set at an angle to the street. This arrangement permits a clear view of the special sales counter and the entire store. At night, a curtain, drawn behind the counter, makes the whole area a display window.





FURS

PAUL BRY, DESIGNER: BARBARA FUR SHOP IN NEW YORK CITY. A small shop designed for the display of furs to wholesale buyers. Main considerations were to provide an effective setting against which models could show the merchandise, and a decorative, comfortable place for viewing displays. The dais at the back of the shop is raised slightly above floor level. A dressing room is provided behind curtains at one side.

COMMERCIAL

COSMETICS

MORRIS SANDERS, ARCHITECT: COSMETIC SHOP FOR TOURNEUR, INC., BOSTON, MASS. *An* 8-ft.-wide shop for display and sales. Mirrors used continuously along one side of the shop increase the apparent size of the room and also provide a looking-glass for customers.

ACCESSORIES

MORRIS LAPIDUS, ARCHITECT FOR ROSS-FRANKEL, INC.: RAINBOW STORE, BROOKLYN, N. Y. A women's accessory shop. In illuminating the store, a distinction was made between general lighting, for which incandescent fixtures are used, and merchandise lighting which employs fluorescent fixtures. Colors used are coral and powder blue, on an off-white background.

EQUIPMENT

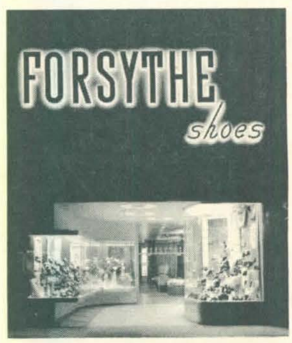
WALTER DORWIN TEAGUE, DESIGNER: MIMEOGRAPH SHOP, IN CHICAGO, ILL. A showroom in which the objects are displayed against a simple and restrained background of neutral-color wallboard. Machines are set up for testing by customers.

FURNITURE

GILBERT ROHDE, DESIGNER: HERMAN MILLER SHOWROOM IN MERCHANDISE MART, CHICAGO, ILL. Curved wall surfaces and irregular openings in partitions contribute to the effectiveness of this wholesale display area. A variety of materials was used on walls: walnut plywood, quilted patent leather, and wall paper.

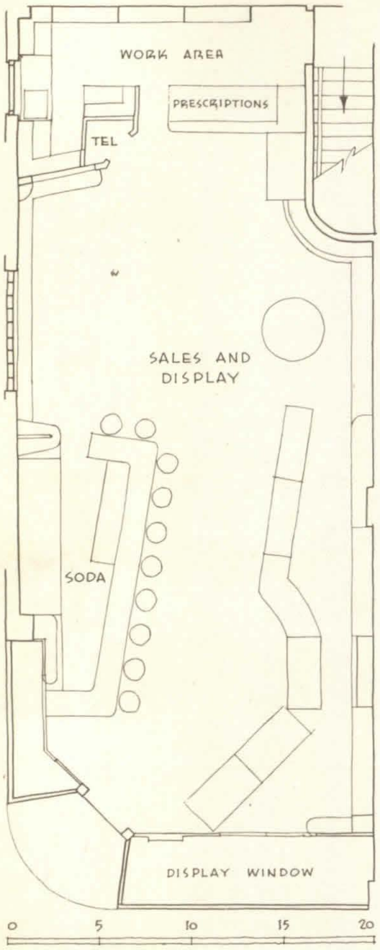
FLOWERS

TIMOTHY F. PFLUEGER, ARCHITECT: ROSSI FLOWER SHOP IN SAN FRANCISCO, CALIF. Large areas of plate glass on the facade make the entire interior of the shop visible from the street and provide plenty of natural light.



SHOES

MORRIS LAPIDUS, ARCHITECT FOR ROSS-FRANKEL, INC.: FORSYTHE SHOE STORE IN LOUISVILLE, KY. Exterior is of black structural glass with bronze trim. The large showcase is used to dramatize the merchandise; the small one offers a close-up view, at spectators' eye level, of the merchandise. General lighting, incandescent; display lighting, fluorescent.



DRUGS

SEBASTIAN J. TAURIELLO, ARCHITECT: WRIGHT DRUG STORE, IN TONAWANDA, N. Y. Ease of operation and maintenance were prime requisites in this plan; a "flow sheet" was used in studying the arrangement. The solution is a compact design which does not appear overcrowded with a capacity stock, nor empty with minimum stock. Fluorescent lighting is used for wall merchandise; incandescent for counter displays.

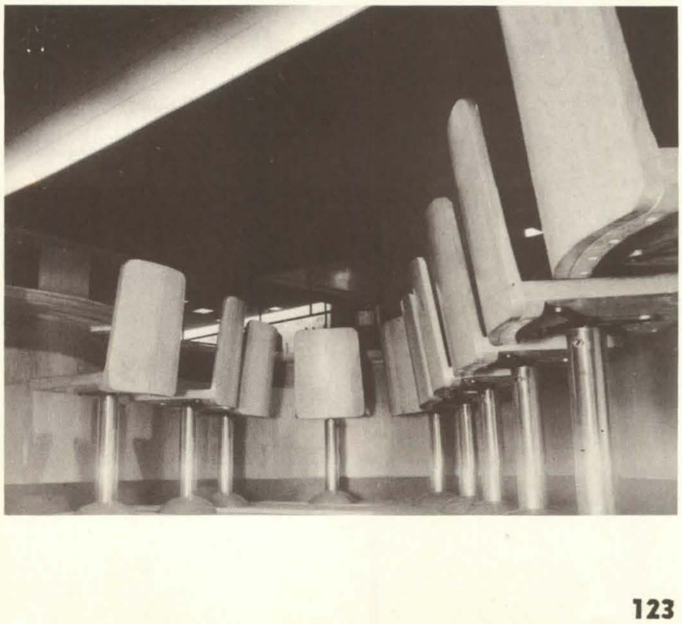
NIGHT CLUB

ANTON REFREGIER, MURALIST; ROBERT CRONBACH, SCULPTOR: CAFÉ SOCIETY, NEW YORK CITY. One of the most highly specialized of all architectural problems is that of designing the background for a night club, since each club has a special "atmosphere" which constitutes its main attraction. Using the premises of a former club, with practically no structural alterations, the artists have succeeded in creating for the owners of this famous New York café the brilliant and satiric atmosphere desired. Dominant features are the two arcaded murals and the suspended sheet-aluminum sculpture in main dining room. The color scheme of the entire club is taken from the murals—pinkish browns, greys, and blacks.

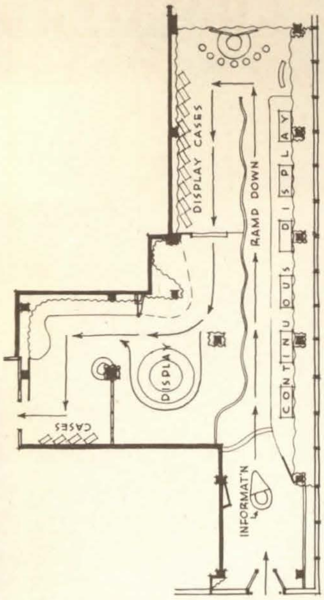
TEA ROOM

SKIDMORE, OWINGS & MERRILL, ARCHITECTS: TEAROOM IN L. S. AYRES & CO., INDIANAPOLIS, IND. Part of a larger program of store-wide modernization by the same architects, this new tearoom was designed to provide attractive surroundings for moderate-priced meals. Of interest in both plan and construction are the serpentine counters and simplified chairs.

COMMERCIAL

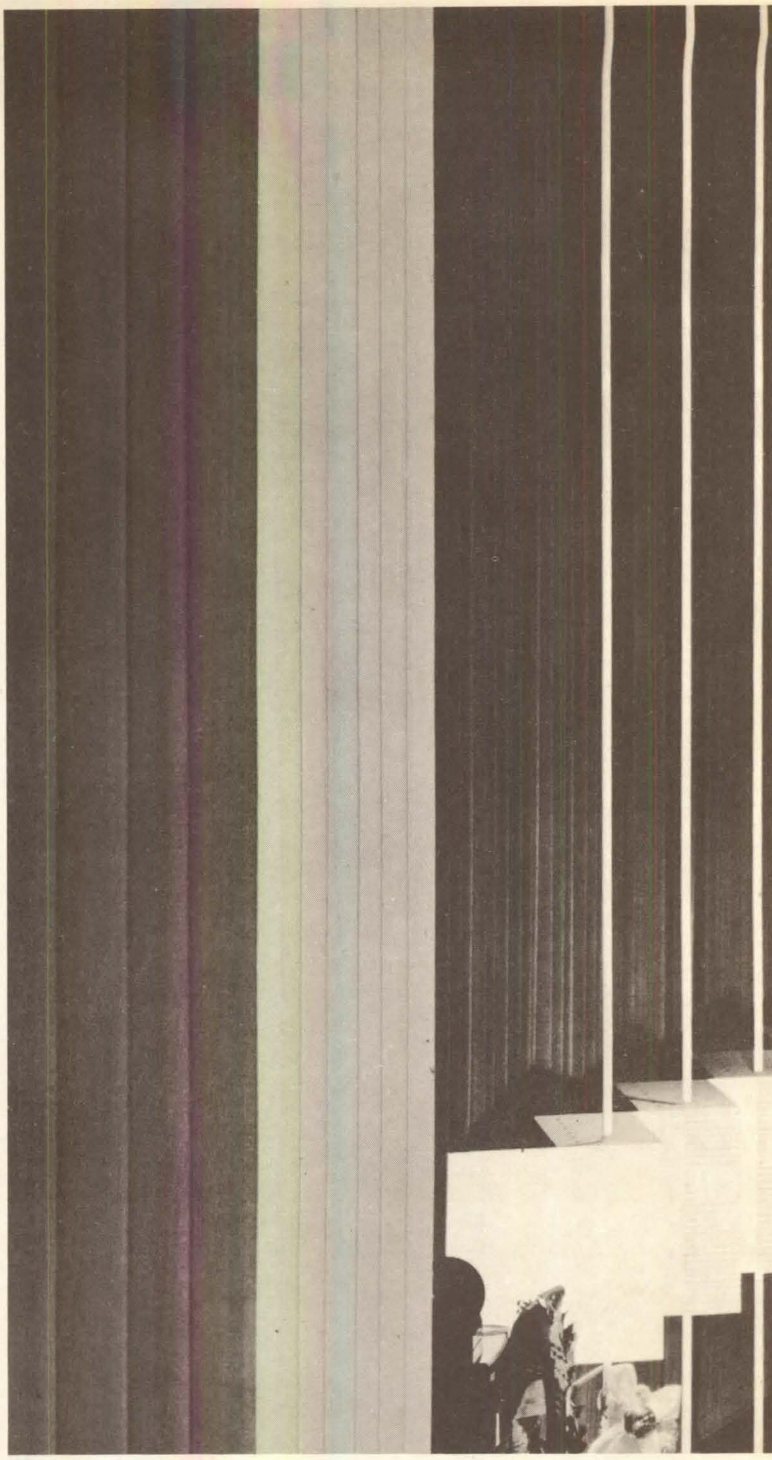


COMMERCIAL



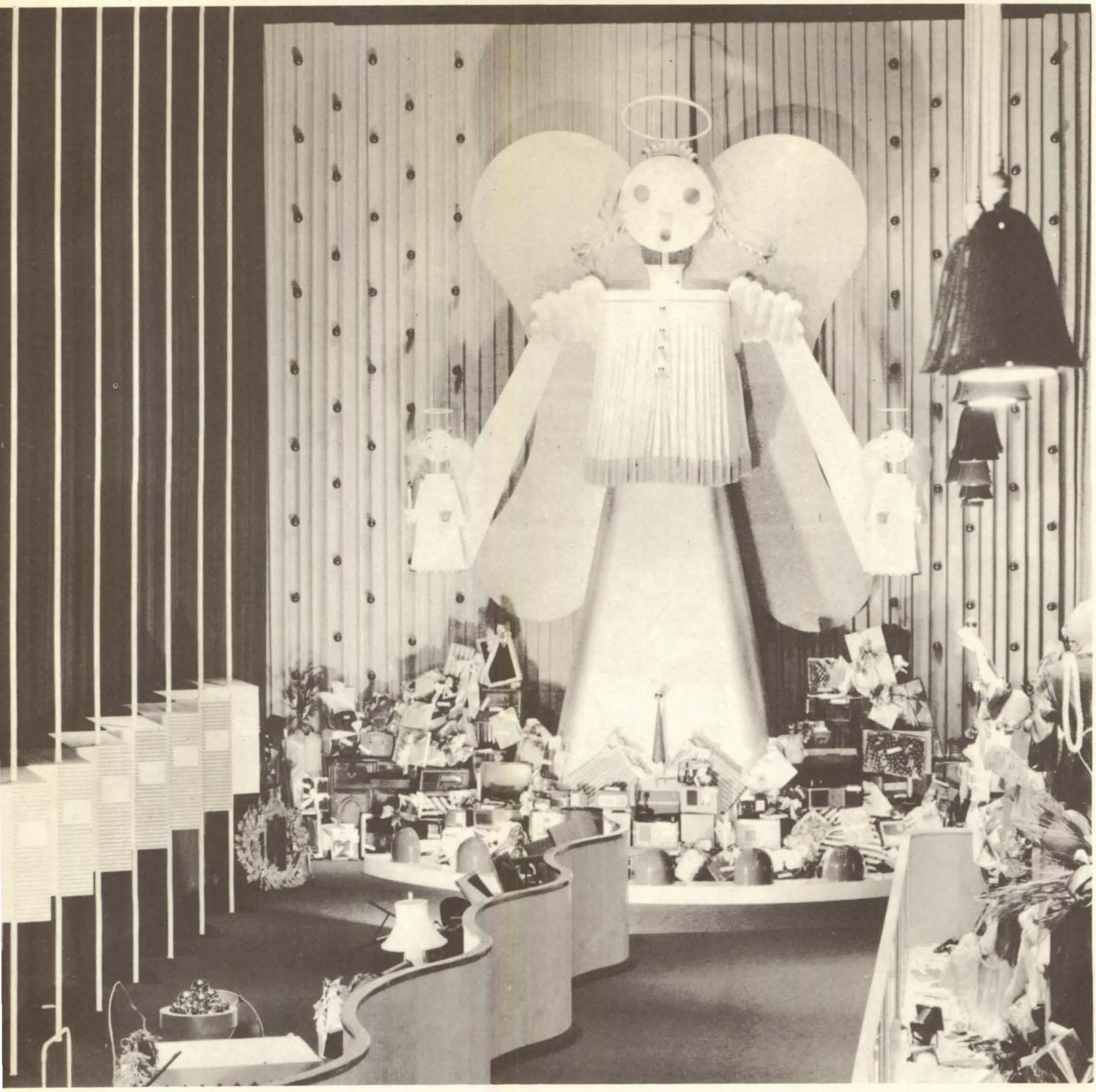
GENERAL DISPLAY

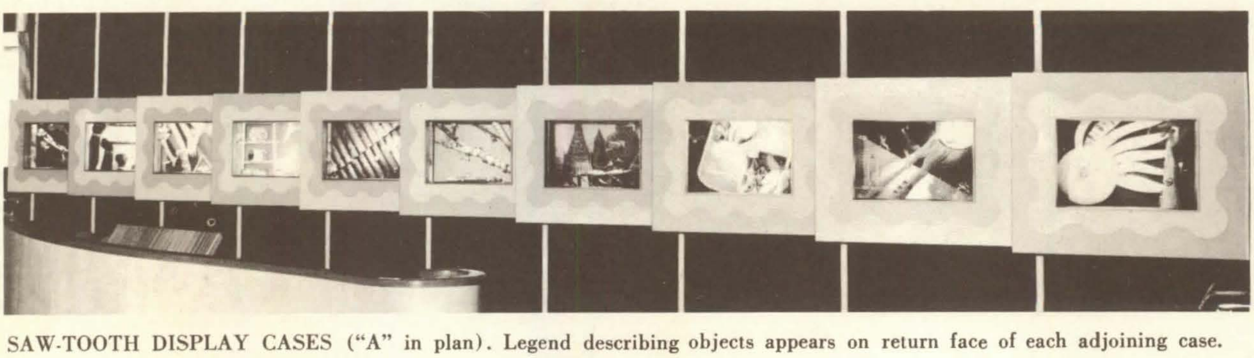
ROBERT HELLER, DESIGNER: ESQUIRE'S CHRISTMAS FAIR, ROCKEFELLER CENTER, NEW YORK CITY. A dramatic seasonal display of products advertised in Esquire Magazine. Arranged for easy passage of crowds of visitors, the Fair serves as a glamorous showcase for shoppers who like to look before they buy. Though none of the objects is sold on the site, prices and source names are clearly marked. Flow lines on the plan (above) show the course that visitors follow. Objects at the right of the ramp are seen both at eye level and below floor level, either over the rail or through the glass balustrade.



EXTERIOR

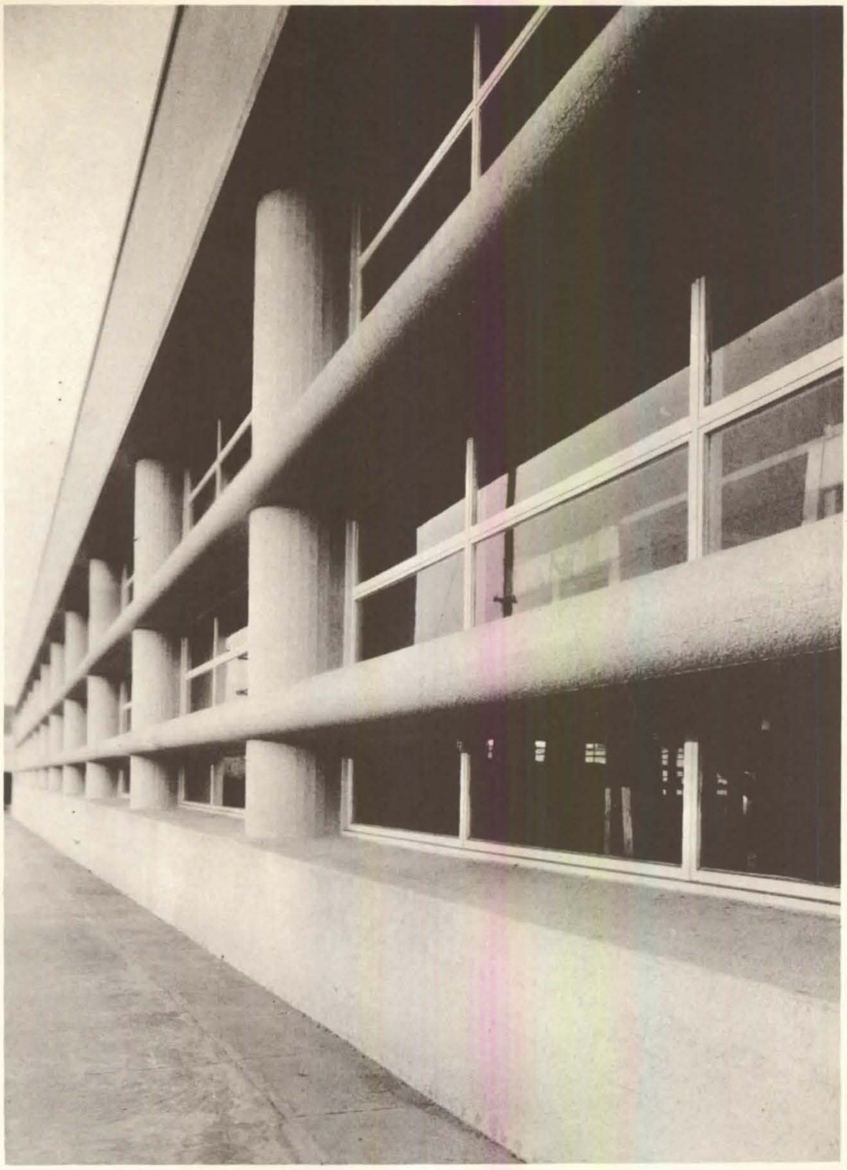
DISPLAY ALONG RAMP, glass panel balustrade





SAW-TOOTH DISPLAY CASES ("A" in plan). Legend describing objects appears on return face of each adjoining case.

COMMERCIAL



DETAIL, TYPICAL WALL

WAREHOUSE

RICHARD SUNDELEAF, ARCHITECT: WAREHOUSE FOR WOODBURY & CO., PORTLAND, ORE. The unusual wall system employed here resulted from the owners' desire for an attractive exterior appearance at moderate cost. Windows are of standard construction and are continuous around entire building, with largest glass area at top for best interior lighting. Roof is framed with wood trusses, three to a row of 196 ft. and spaced 22 ft. 6 in. o.c.

ENTRANCE FRONT

INTERIOR

DELIVERIES BY
ROLLER SKATE

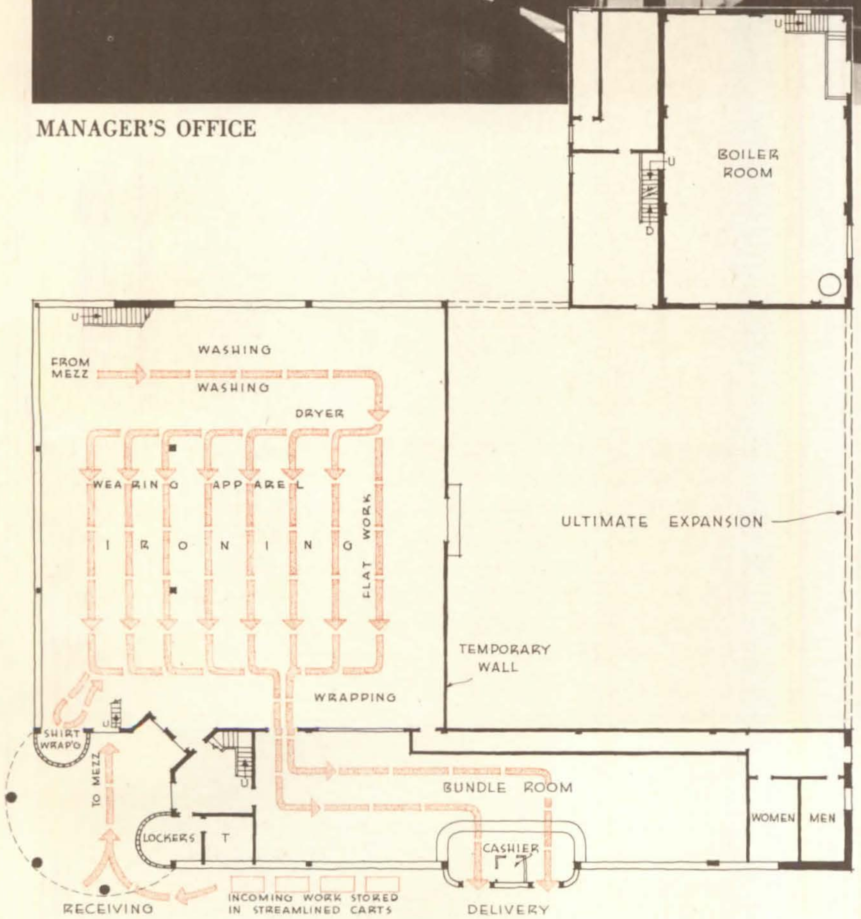
LAUNDRY

EMMONS H. WOOLWINE AND JOHN HARWOOD, ARCHITECTS: RAINBOW LAUNDRY, NASHVILLE, TENN. A new "cash-and-carry" plant for a motorized clientele, this new laundry's design is based on exhaustive studies with laundry-machinery manufacturers and experienced laundry personnel in order to determine the routing of the bundle from the time it is received at the plant until it is delivered to the customer.

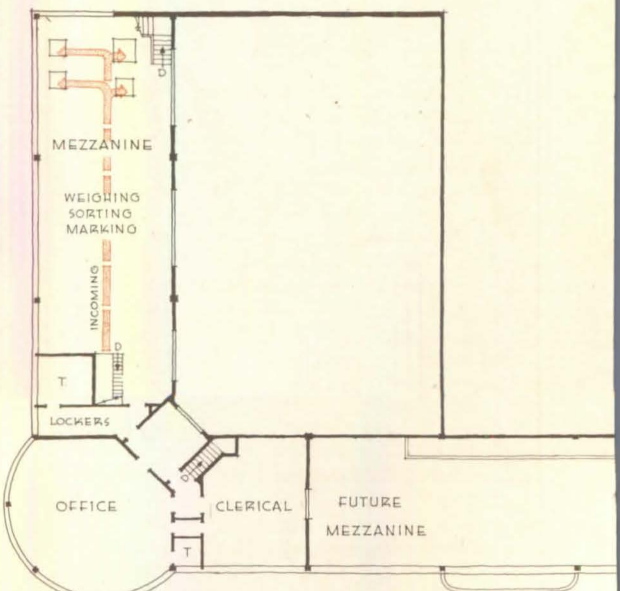
Construction is steel frame with solid brick masonry walls; veneer is of structural glass and glass block. Ground floors are concrete and wood on concrete; mezzanine floors are plank on bar joist construction. Built-up roof with metal skylights is equipped with ventilators and heat-absorbing glass.

The plan as executed contemplates an ultimate increase of 100% in area allotted to the laundry processing space. This production area will be supplemented by increasing the present bundle room to double its size by dividing its present height into two stories; parking facilities will likewise be increased by extending concrete parking area along north face of building.

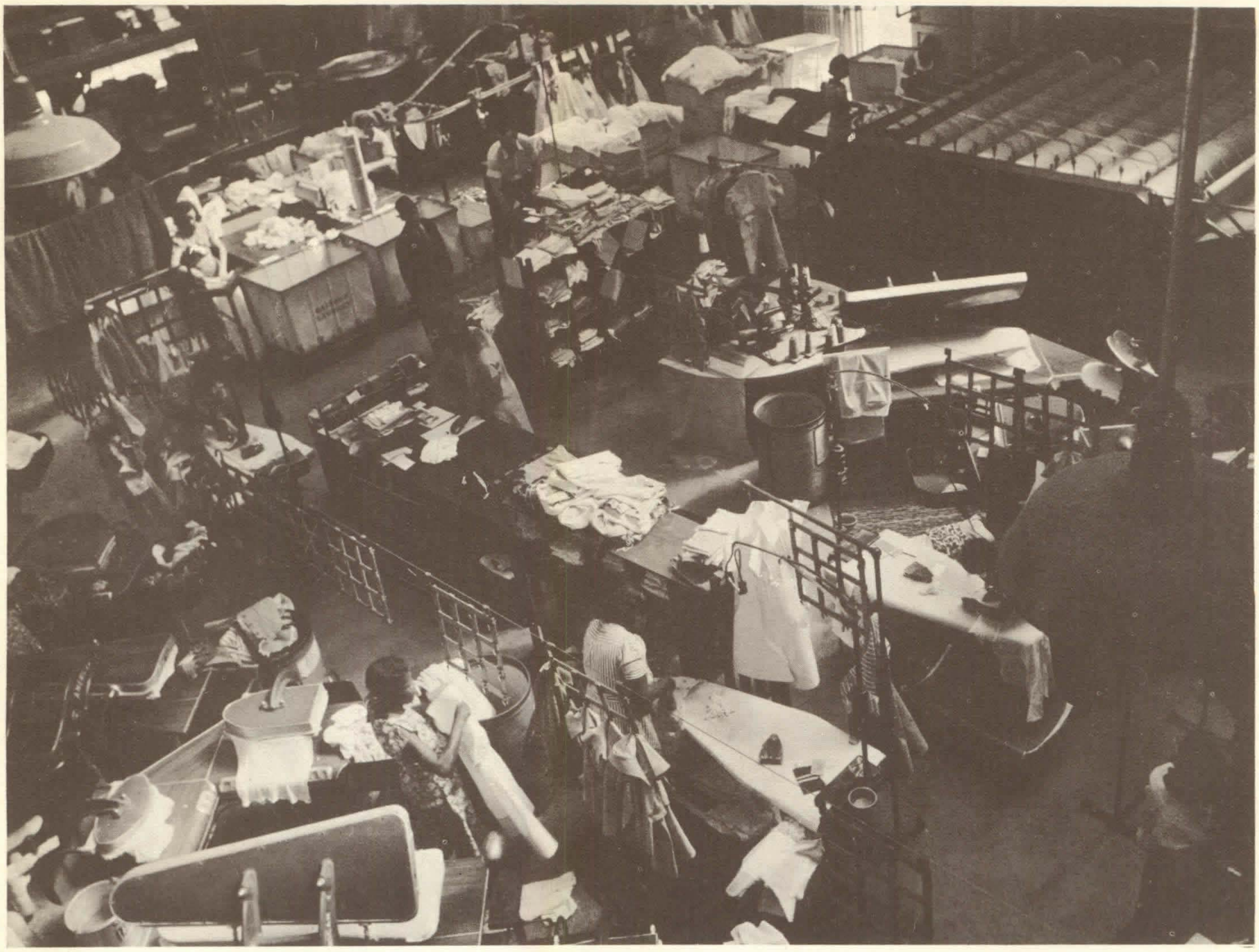
MANAGER'S OFFICE



FIRST FLOOR



MEZZANINE FLOOR

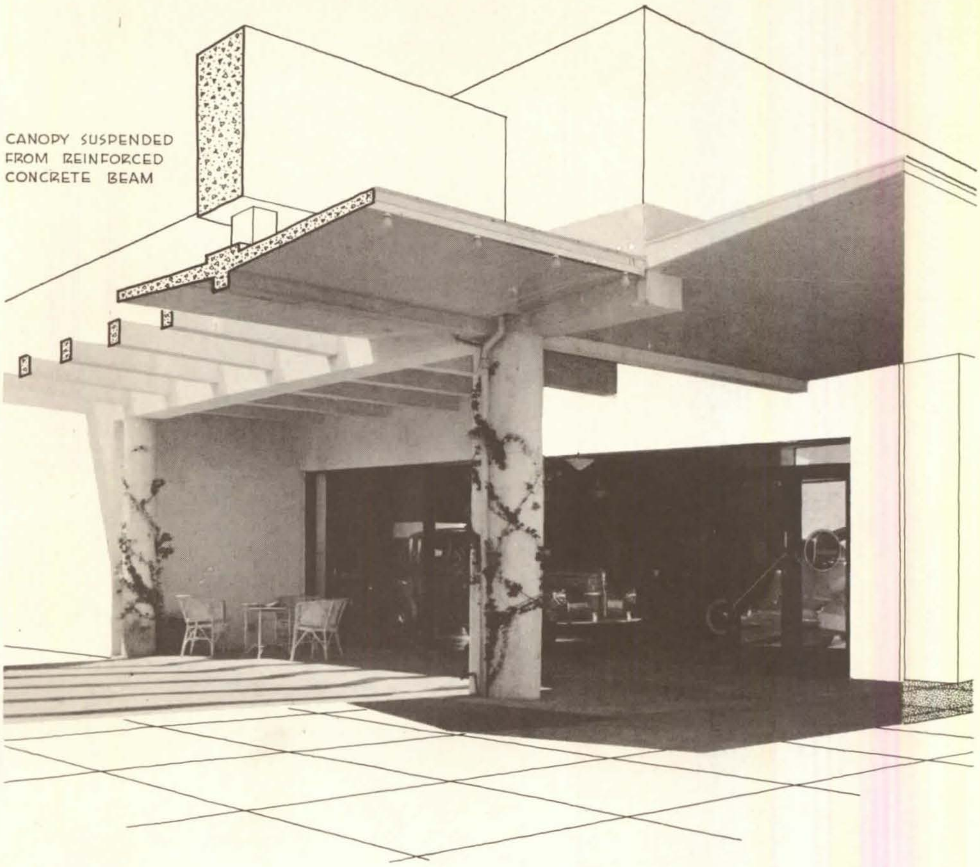


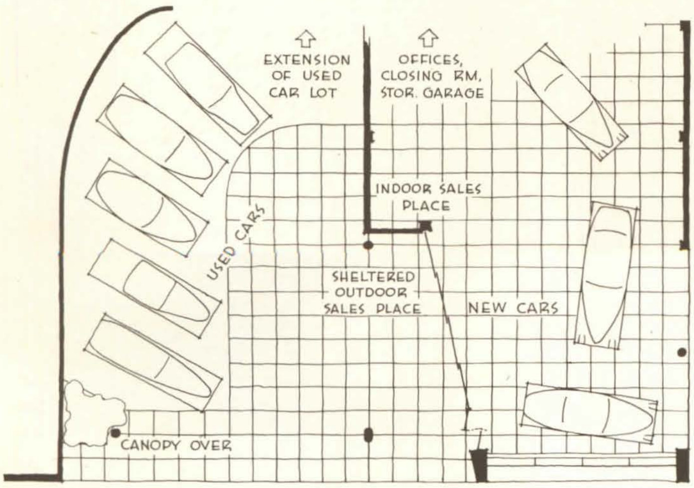
PROCESS ROOM

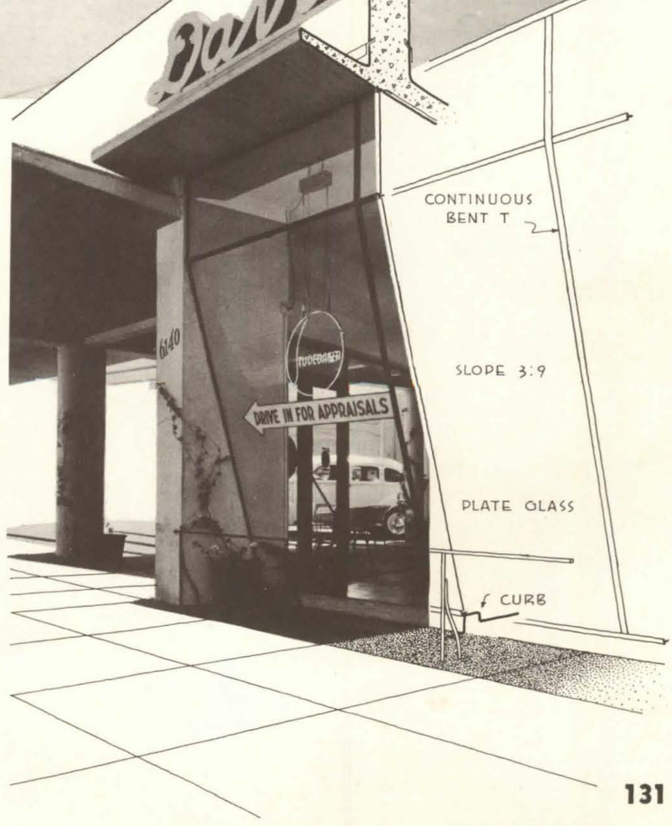
FLOW CHART: During rush hour, bundles are placed in *streamlined* carts in which they are stored until receiving drops off. They are then carted to an electrically operated inclined conveyor which carries them to mezzanine floor. Here they are assorted, marked, and dropped through automatically operated hatches to the process room where they are routed directly through washers, dryers, ironers, etc. to the bundle room. Here they are stored alphabetically. Loud-speaker system from the outside together with the assistance of bundle clerks on roller skates insures almost immediate delivery to the customer. Open space under the administration office acts as a shelter for incoming bundles and for bundle boys in wet weather. The administration office is so placed and designed as to afford an unobstructed view of both present and future parking areas, while the clear-glass partition in the foyer off the administration office commands a view of the entire plant. The bundle room is likewise visible from the clerical office so that with a minimum of steps all functions of the plant may be readily observed by the management.

ONE OF THE WASHERS

COMMERCIAL

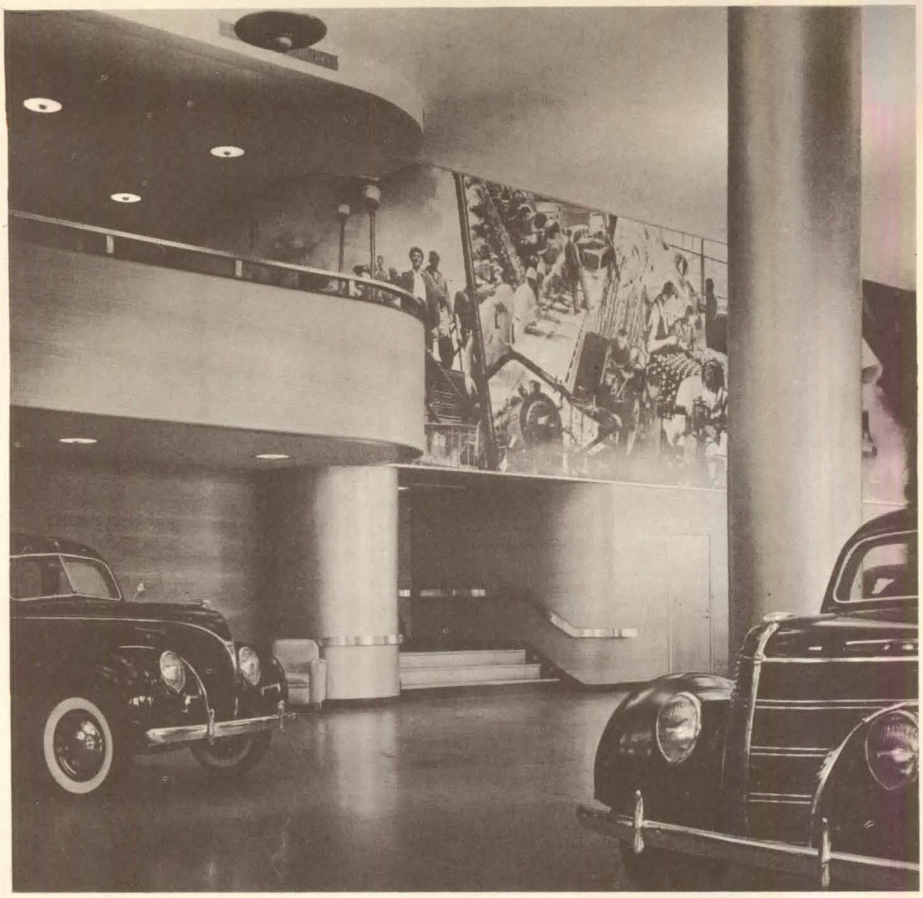

CANOPY SUSPENDED
FROM REINFORCED
CONCRETE BEAM


EXTENSION
OF USED
CAR LOT
OFFICES,
CLOSING RM,
STOR. GARAGE
INDOOR SALES
PLACE
USED CARS
SHELTERED
OUTDOOR
SALES PLACE
NEW CARS
CANOPY OVER



AUTO SALES

C. B. TROEDSSON, ARCHITECT: STUDEBAKER AUTO SALES BUILDING FOR DAVID J. BRICKER, INC., NORTH HOLLYWOOD, CALIF.
The problem was to provide sales areas for both new and used cars and yet to unify these two departments. Because the local climate permits the frank use of open space, the whole corner was opened up. Distinction between indoors and outdoors is minimized, both by the planning and by the use of color. An aid to visibility of displays is the slanting glass area in the main display room; the angle is such that reflections from the street are avoided.



MOTOR-CAR SALESROOM

COMMERCIAL

SALESROOM AND SERVICE STATION

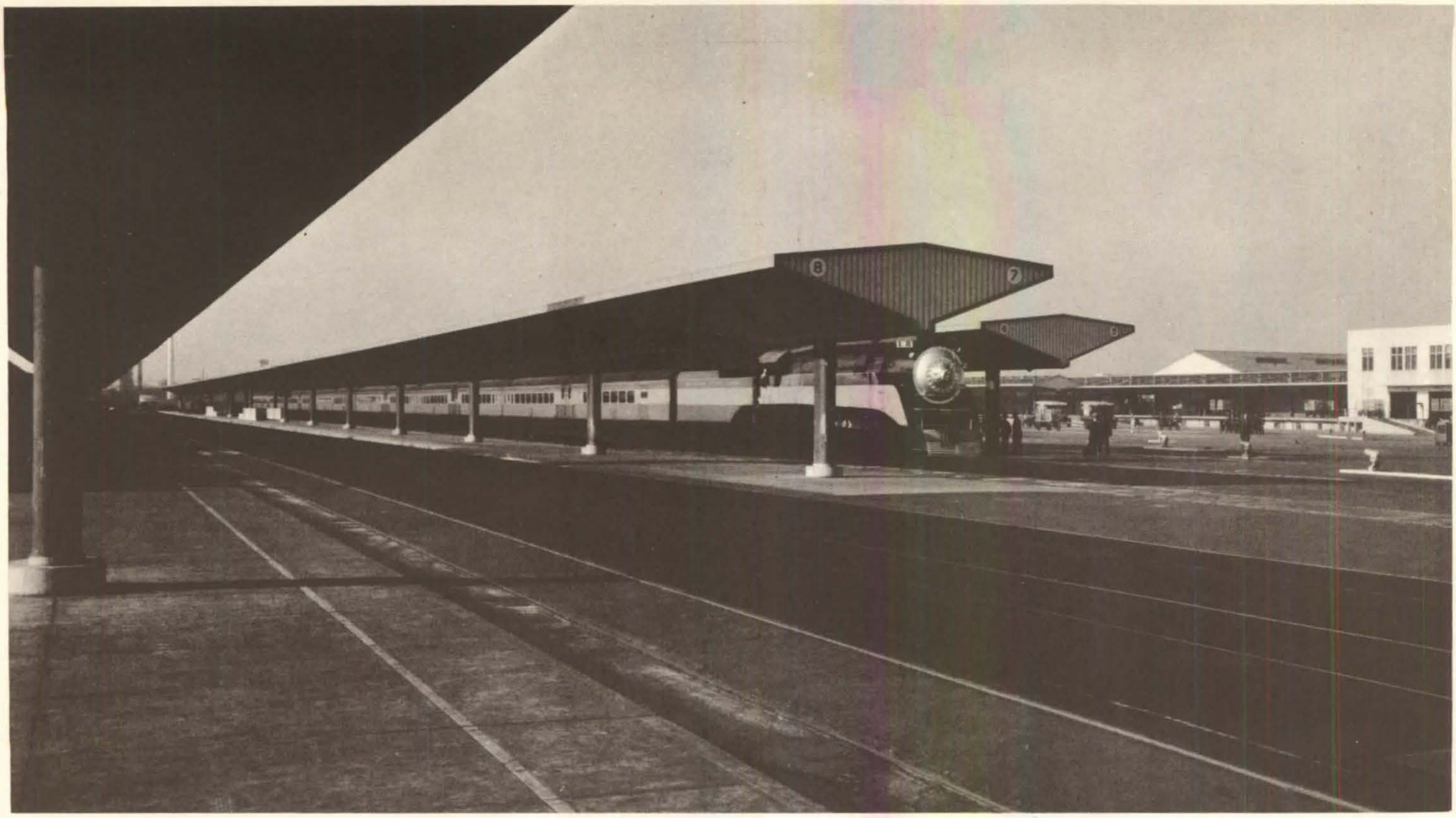
WALTER DORWIN TEAGUE, DESIGNER. Designed for New York City, the salesroom (above) is a reconstruction of the first floor of an existing office building. A main sales floor area provides for display of various models, while mezzanine balconies are used for accessories. The service station (below) is one of many built from a standard structural system and basic plan.

TYPICAL SERVICE STATION

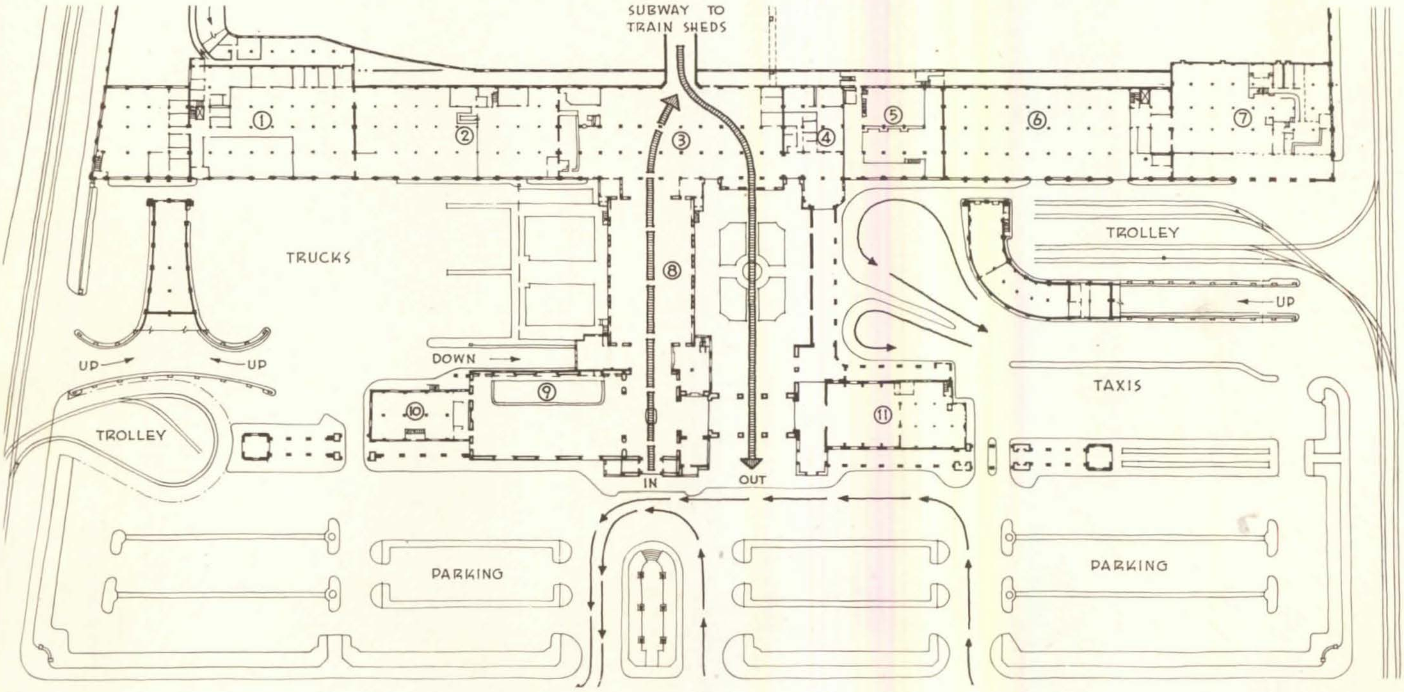
RAILROAD STATIONS

1891-1941 *By the time the RECORD appeared, the American railway system was being rapidly completed; and the design of its passenger terminals was the subject of lively discussion, even for that gargantuan era. "A station is a difficult problem to treat without doing violence to its conditions," said an early RECORD in its critique of the station shown at left. "Almost every architect who has tried to do anything with it has been forced to introduce at least a clock tower to give some dominating feature to the design." Recent years have seen only a few metropolitan terminals rebuilt—retaining the clock if not the tower—of which the Union Terminal in Los Angeles, Calif., shown below, is largest and newest.*

"The clock tower appears here but . . . the front has grace as well as strength, and the roof that surmounts it, and the tower that unites and dominates the whole, is one of the most harmonious and picturesque groupings." Mott Haven Station; R. H. Robertson was architect.



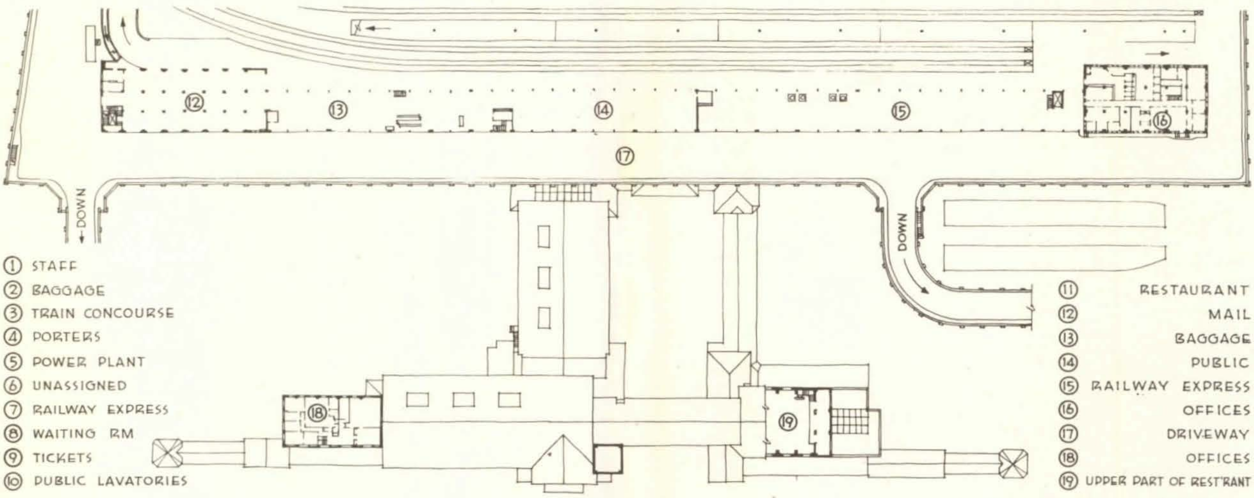
TRAIN SHEDS



J. H. CHRISTIE, H. L. GILMAN, R. J. WIRTH, ARCHITECTS; DONALD B. AND JOHN PARKINSON, CONSULTING ARCHITECTS: UNION PASSENGER TERMINAL, LOS ANGELES, CALIFORNIA. Providing for present and future needs of one of America's fastest growing cities, the new Terminal is designed to provide for the freest possible movement of incoming and outgoing passengers, baggage, and mail. Important to achieving this flow are the unusually large parking areas, and the separation of taxi, private car, and truck traffic. Typical of climate-conscious Los Angeles are large patio waiting rooms.

RAILROAD STATIONS

MAIN WAITING ROOM



UPPER (TRAIN SHED) LEVEL

GENERAL VIEW showing parking area in foreground

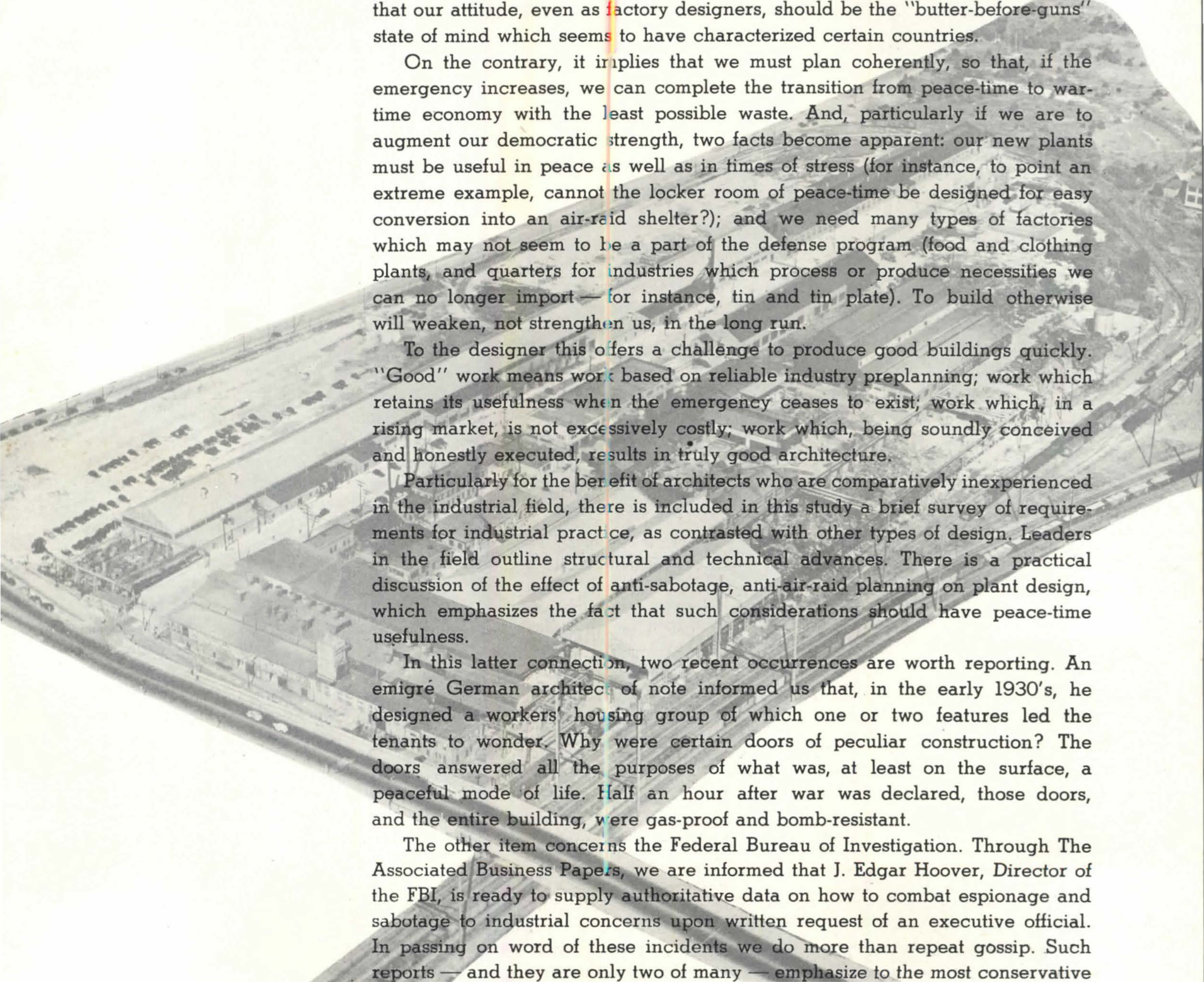
LAS VEGAS, NEV. Station for Union Pacific Railroad. H. L. Gogerty, Architect

RAILROAD STATIONS

TYPICAL of the kind of branch station now being built are these two —one in the far west, the other in the middle west. Their design shows a greater freedom of expression with more reliance on the basic consideration of the function of such a building. Both buildings are planned for efficient use.

LA CROSSE, WIS. Station for the Burlington Road. Holabird and Root, Architects

FACTORY DESIGN



Very naturally the words "national defense" come to mind in any treatise on manufacturing plants. When we examine the requirements of the defense program as it applies to factory construction, expansion, or remodeling, we find the factors which have always existed, intensified, and with added emphasis on speed.

For it seems at present as if we still have time for sound planning; that there is not yet — and, God willing, there may never be — need for the frantic scramble to produce which marks the last-ditch effort. This does not imply that our attitude, even as factory designers, should be the "butter-before-guns" state of mind which seems to have characterized certain countries.

On the contrary, it implies that we must plan coherently, so that, if the emergency increases, we can complete the transition from peace-time to war-time economy with the least possible waste. And, particularly if we are to augment our democratic strength, two facts become apparent: our new plants must be useful in peace as well as in times of stress (for instance, to point an extreme example, cannot the locker room of peace-time be designed for easy conversion into an air-raid shelter?); and we need many types of factories which may not seem to be a part of the defense program (food and clothing plants, and quarters for industries which process or produce necessities we can no longer import — for instance, tin and tin plate). To build otherwise will weaken, not strengthen us, in the long run.

To the designer this offers a challenge to produce good buildings quickly. "Good" work means work based on reliable industry preplanning; work which retains its usefulness when the emergency ceases to exist; work which, in a rising market, is not excessively costly; work which, being soundly conceived and honestly executed, results in truly good architecture.

Particularly for the benefit of architects who are comparatively inexperienced in the industrial field, there is included in this study a brief survey of requirements for industrial practice, as contrasted with other types of design. Leaders in the field outline structural and technical advances. There is a practical discussion of the effect of anti-sabotage, anti-air-raid planning on plant design, which emphasizes the fact that such considerations should have peace-time usefulness.

In this latter connection, two recent occurrences are worth reporting. An emigré German architect of note informed us that, in the early 1930's, he designed a workers' housing group of which one or two features led the tenants to wonder. Why were certain doors of peculiar construction? The doors answered all the purposes of what was, at least on the surface, a peaceful mode of life. Half an hour after war was declared, those doors, and the entire building, were gas-proof and bomb-resistant.

The other item concerns the Federal Bureau of Investigation. Through The Associated Business Papers, we are informed that J. Edgar Hoover, Director of the FBI, is ready to supply authoritative data on how to combat espionage and sabotage to industrial concerns upon written request of an executive official. In passing on word of these incidents we do more than repeat gossip. Such reports — and they are only two of many — emphasize to the most conservative among us the present urgent need for speed, and the increased demand for careful, economical planning.

— The Editors.

A BUILDING TYPES STUDY

FACTORY

INDUSTRIAL PRACTICE DISCIPLINES THE ARCHITECT

By Frederick J. Woodbridge, AIA, of Evans, Moore & Woodbridge

ARCHITECTS who undertake the design of factories are faced with considerations different in many respects from those to which they have been accustomed. These differences are perhaps more in degree than in kind, for the same fundamental principles apply to all types of architecture. In the industrial field they are simplified, are more clear-cut and uncompromising than in most others. Here function is actually the predominant factor, followed closely by economy. No esthetic consideration can prevail unless it is completely consonant with these other factors. This is a matter not arguable, especially with industrial clients. Such a concept is really very wholesome. The type of discipline involved might very well improve almost any practitioner of our art.

NOT A ONE-MAN JOB

There is no magic which precludes the undertaking of industrial work by any competent architect. Unless, however, he has had special experience and possesses a comprehensive organization, he may find himself in difficulties if he ventures alone. He should arrange to work in close co-operation with competent engineers, structural and mechanical, and this before he begins rather than after. He must also be prepared to do quite accurate estimating and business-like accounting and managing. With this external equipment, what he needs most is a great store of common sense and open-mindedness, because industrial architecture demands complete freedom from canons and prejudices which often govern other types of design.

Factory design is just the opposite of magic. There is no necessity of knowing all about line production or manufacturing processes. Most plant managers have very definite ideas on these subjects. The architect's job is to listen, question intelligently, and interpret the requirements practically. Generally speaking, he must provide a convenient entrance for raw materials, a convenient egress for the finished product, and the greatest possible flexibility in between. This ordinarily involves much greater spans and wider column spacing than are usual in other types of building. Albert Kahn states that every column absorbs at least 8 or 9 sq. ft. of floor space. Clear heights to under sides of beams or bottom chords of trusses are also of supreme importance. So is provision for crane runways and other types of shop transportation. Ample lighting, locker and toilet facilities, and other arrangements for the comfort and efficiency of workers seem too obvious to mention. Yet it cannot be too often emphasized that these very practical matters must take precedence over any artistic considerations if the job is to be successful.

DESIGN OFFERS A CHALLENGE TO EVERY ARCHITECT

ARE STRUCTURAL MATERIALS AVAILABLE?

Similarly, economics take precedence over esthetics. It is vastly important to know what types of construction are actually best and cheapest for any particular case. Here the help of engineers and contractors is invaluable, because costs vary greatly and the availability of materials vitally affects the picture. This latter factor is particularly important at present. Due to other demands for steel it is difficult if not impossible to get certain sizes and weights of members. Obviously, such a factor affects design—might even eliminate steel altogether. This is perhaps the most dramatic instance of the effect of availability of materials. It is by no means the only one.

COSTS — COSTS — COSTS!

The industrial client cannot be put off with guesses about costs. He wants *to know how much* so many thousand square feet of space will cost him; and the given price must be pretty well all-inclusive. The architect must have precise information about the cost of every element of construction. It is also more important than ever that the architect's estimates be reliable. The industrialist is thoroughly a business man—his plant must pay. He cannot, therefore, afford to be misled, and he should not be urged to spend money on any purely architectural fancy. The architect who does so probably will not last long in the industrial field. On the other hand, it is highly desirable to keep the owner informed of all economies and advantages achieved. Once the client gains confidence from a demonstration of practical competence, the architect will undoubtedly be allowed a nearly free hand on the aspects of the problem nearest his artistic heart.

HERE TIME IS REALLY OF THE ESSENCE—

Before he wins this, however, he must prove himself in another respect: in good management, and in skill in expediting both his own work and that of construction. The practice of consuming quantities of time in studying, often desirable in other fields, is out of place in industrial architecture. Speed, and quick, unerring decisions, are vital. Promptness and precise fulfilling of promises are also essential. In short, the bad habits of an easy-going practice, to which many of us fall prey, cannot be tolerated.

DESIGN?

It must be recognized that all these warnings and demands are really applicable to the practice of architecture in general and are not peculiar to the industrial field. It is important to emphasize them because in industrial work the necessity of heeding them is crystal clear. On the other hand, it must not be supposed that these practical requirements leave no scope for design. In this field form does follow function. As a matter of fact, the very size of factory buildings is a challenge. Their long lines and their masses, when kept simple and well proportioned, are beautiful. Architecture is here reduced to fundamentals. The opportunities are not to be despised.

—AND ALL THIS MEANS:

It is not possible to give some "Open Sesame" which will bring the riches of the industrial field to every architect, nor can a complete compendium of advice be offered here. What has been attempted is to show first that here is an opportunity and an interesting one; that there is nothing inherent in the problem which a good architect cannot master. The second point is that common sense and practical competence are necessary even more than in other fields; that the assistance of experienced engineers is vital. In this connection the most complete co-operation with the owner and contractor is a *sine qua non*. Finally, the design of manufacturing plants can produce fine architecture on a scale to which most of us in the last few years have unfortunately been all too unaccustomed. It is a discipline and a challenge which architects would do well to meet.

Photos courtesy Ferro-Enamel Corp.

Conveyor takes finished ware to assembly line

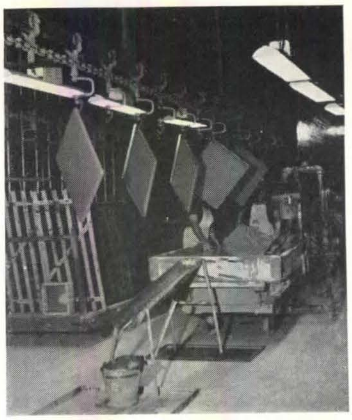
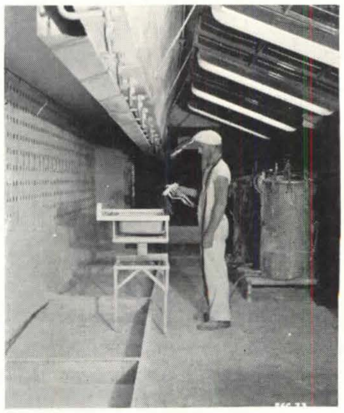
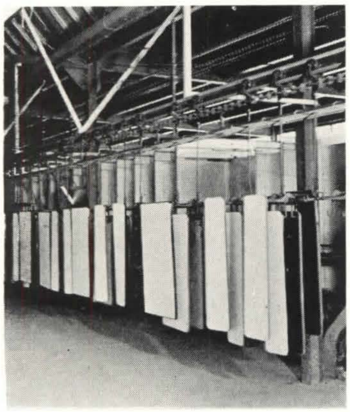


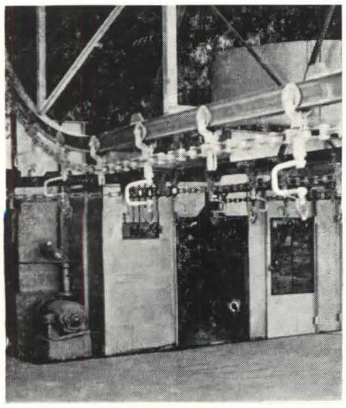
Table tops are dipped



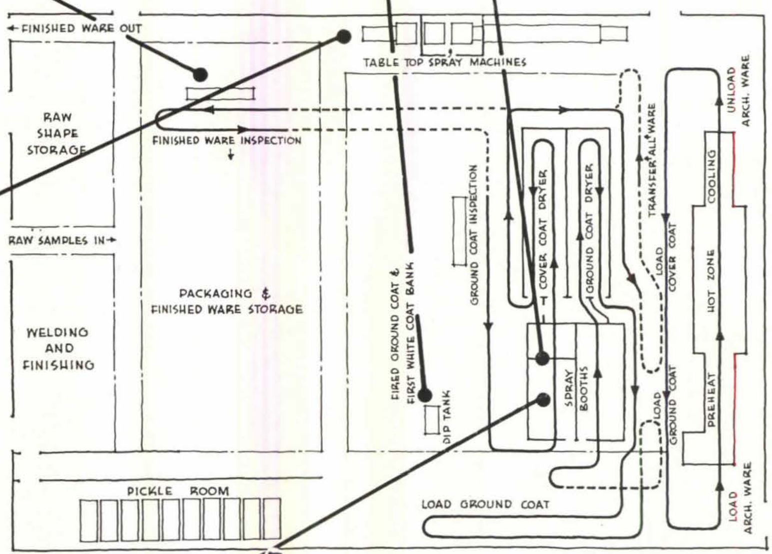
Air-conditioned spray booth



Sprayed tops travel to furnaces

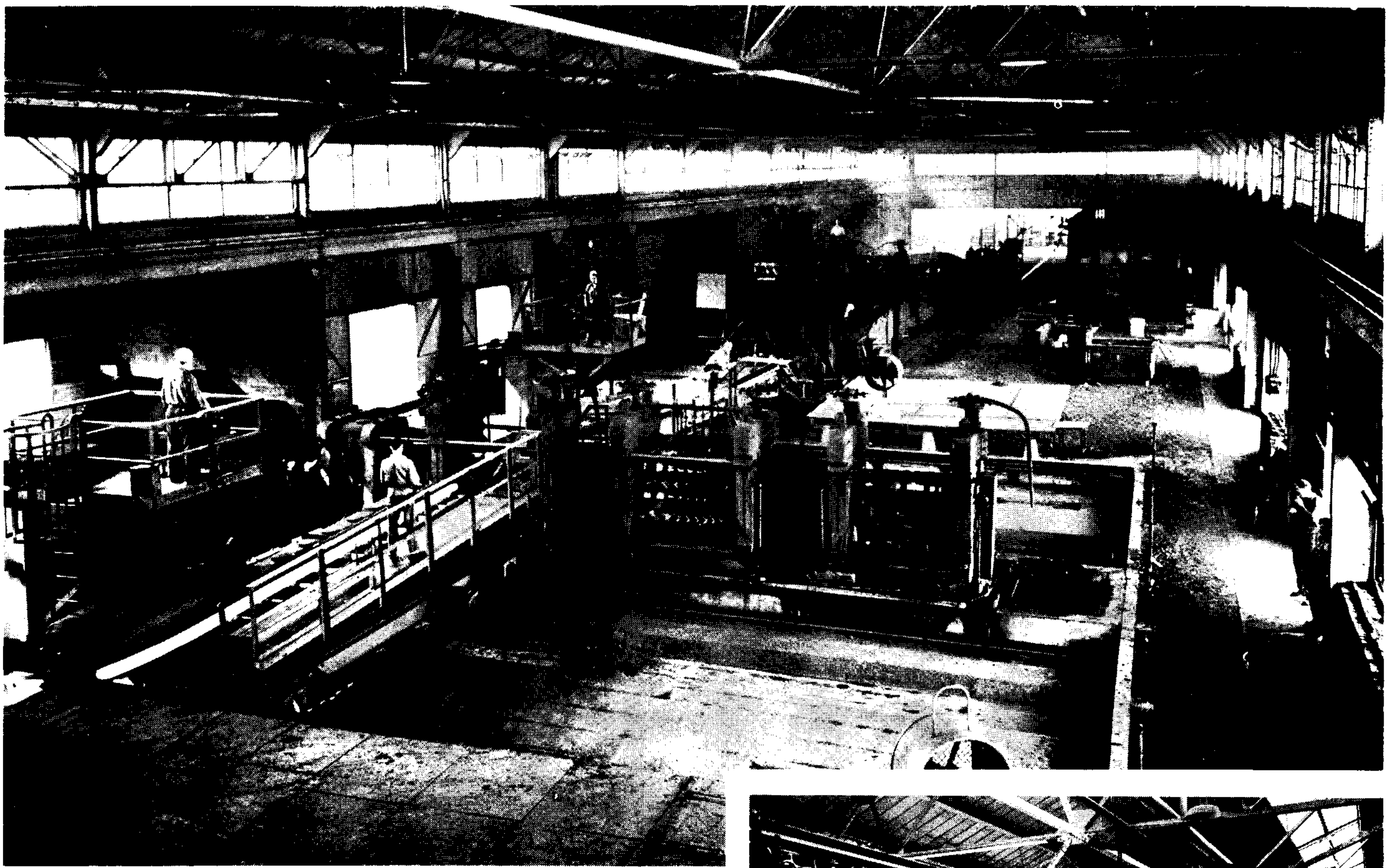


Entrance to spray room



"FLOW" LINE FITS TYPICAL STRUCTURE

ADDITIONS and alterations make the Davison Enamel Company's porcelain enamel shop one of the outstanding installations in the country. Structure is typical of many process plants. Use of heated fresh air in some parts, air conditioning in others, and fluorescent light in inspection areas aids precision.

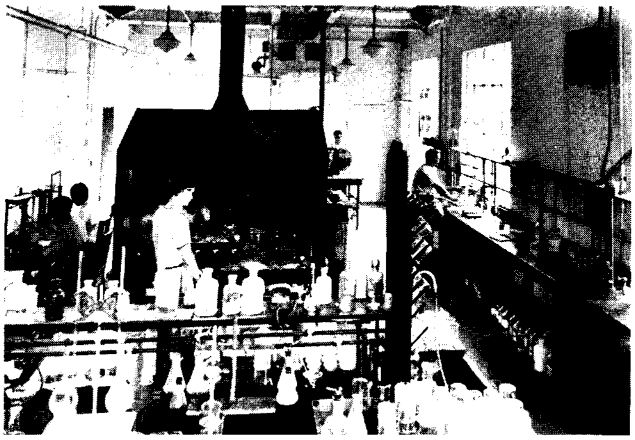


Photos by J. H. Shaefer & Son

Milling machines require continuously open space

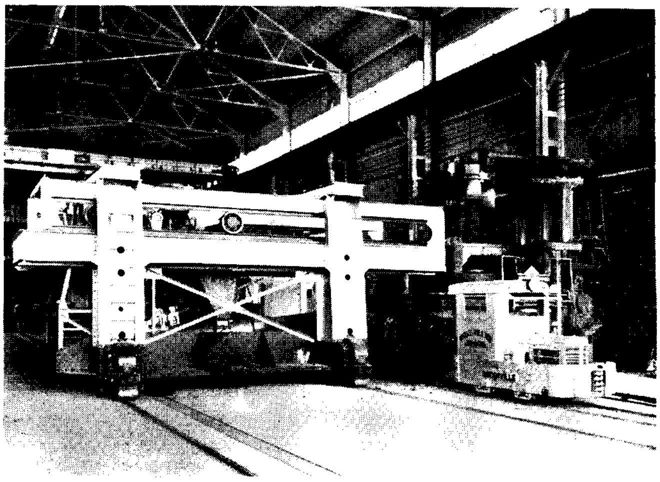
Suspended conveyors add to truss load

Research laboratory



EXPANSION CAN BE PLANNED IN ADVANCE

THE PLANT of the Rustless Iron and Steel Corporation has been enlarged in accord with a policy inaugurated in 1935. Various parts of the process required special structural considerations; in the coordinated expansion program, all have been provided to produce a unified result.



Furnace-charging area needs special flooring and foundations

Photographic Service Co.

RECENT TRENDS AID THE FACTORY DESIGNER

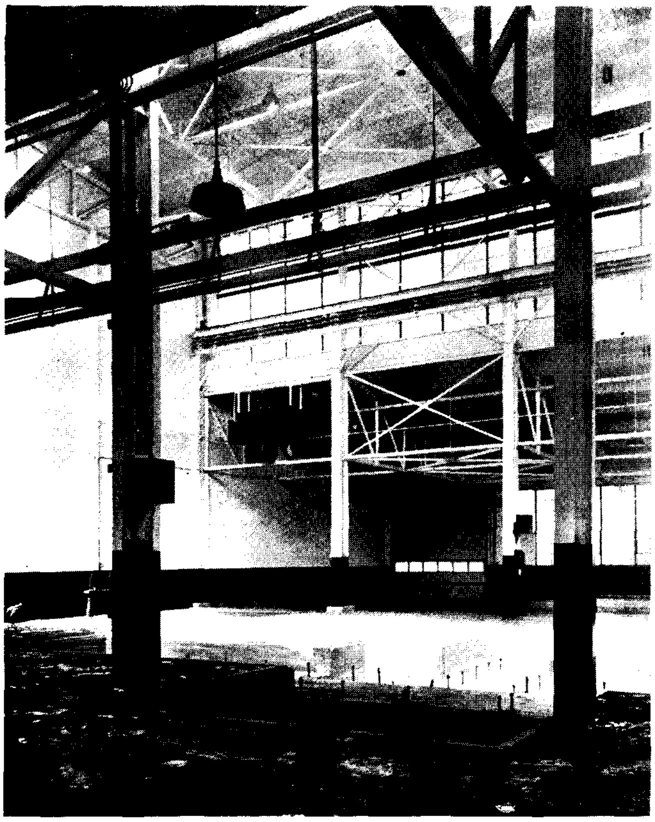
On these and the following pages some of America's prominent factory designers report briefly on trends and techniques in factory design—on principles which have changed design and construction methods radically in the last few years. First of these is a short summation of today's problems by ALBERT S. LOW, Vice-President and Chief Engineer, The Austin Company.

EMERGENCY AND ACCUMULATED NEEDS

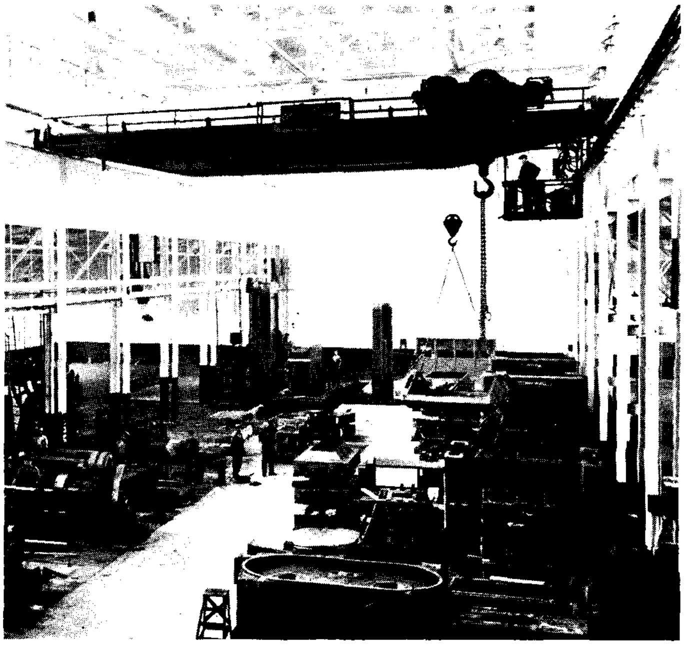
IN THE WIDE RANGE of building activity required for the national defense program, the two phases which have a truly constructive bearing upon our future as a nation are in the fields of civilian housing and industrial plants.

While much of the housing and many plants will be expedients for the emergency, the accumulated need of many years has centered the attention of men responsible for community planning and industrial development upon projects of lasting value. They are converting defense dollars into basic assets of sound economic value—assets whose self-liquidating character can only be assured by efficient construction of buildings which will insure maximum efficiency in use.

Industry's problem is to provide, speedily, the production facilities which may be required to meet emergency demands—always wary of any over-expansion which could be avoided by a fuller utilization of existing or projected plants.



Photos courtesy "The Austin Co."



Jones

Above and at left, three interiors of a 34,000-sq.-ft. addition to the Cleveland Punch and Shear Works, Austin-designed, of which the frame is entirely welded. Note provisions for heavy machine installations. Crane aisle spans 55 ft.; low side aisles, 50 ft. At right, interior of a "windowless" plant, also Austin-designed, where complete control of atmosphere aids precise manufacturing.

CONTROL OF PLANT CONDITIONS

In this situation, windowless or controlled-conditions plants provide uniform working conditions for multiple-shift operation and have the inherent lightproof qualities needed for "blacking out" a plant, and are consequently gaining increased acceptance. The desirability of operations under completely controlled atmospheric and lighting conditions has been established by the experience of several companies engaged in the manufacture of aircraft engines, cutting tools, and other precision equipment. Their experiences point the way toward realization of maximum output from the limited available supply of skilled men and production equipment vital to the whole defense program.

The commercial development of fluorescent lighting, the perfection of automatic air-conditioning equipment, and the improvements in general ventilation, insulation, and acoustical controls have made this type of plant a timely and practical solution to the challenges which confront many industries.

INDUSTRY'S PROBLEMS INCREASE

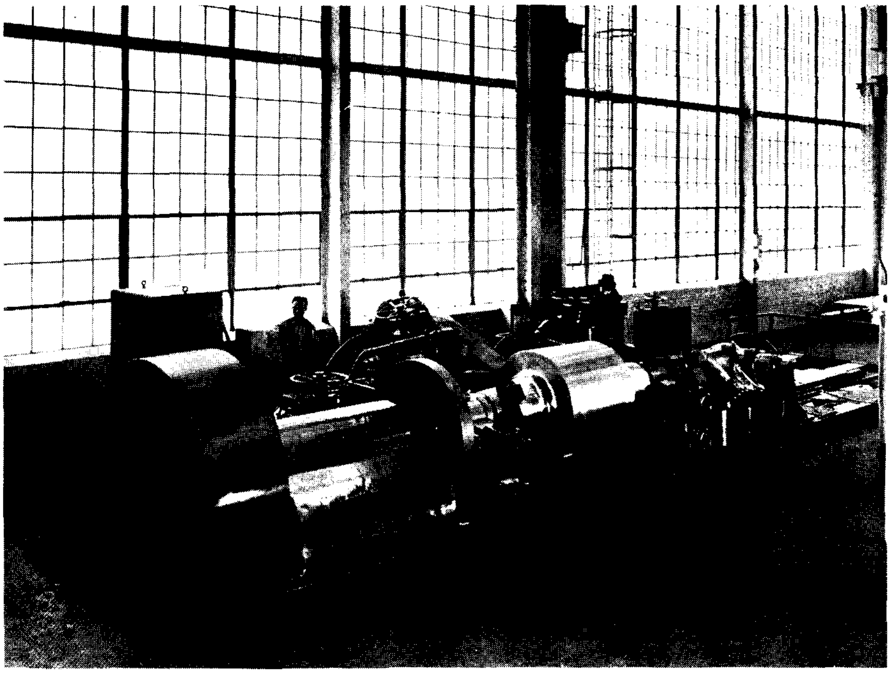
All industries which depend upon high personal efficiency, modern equipment, and private investment funds for successful operation and continued growth are bound to face increased personnel, mechanical, and financial problems created by the stress of the times. Such problems should be minimized if they guide their expansion programs along whatever channels offer, with the least expense, the advantages which are part and parcel of controlled-conditions plants.

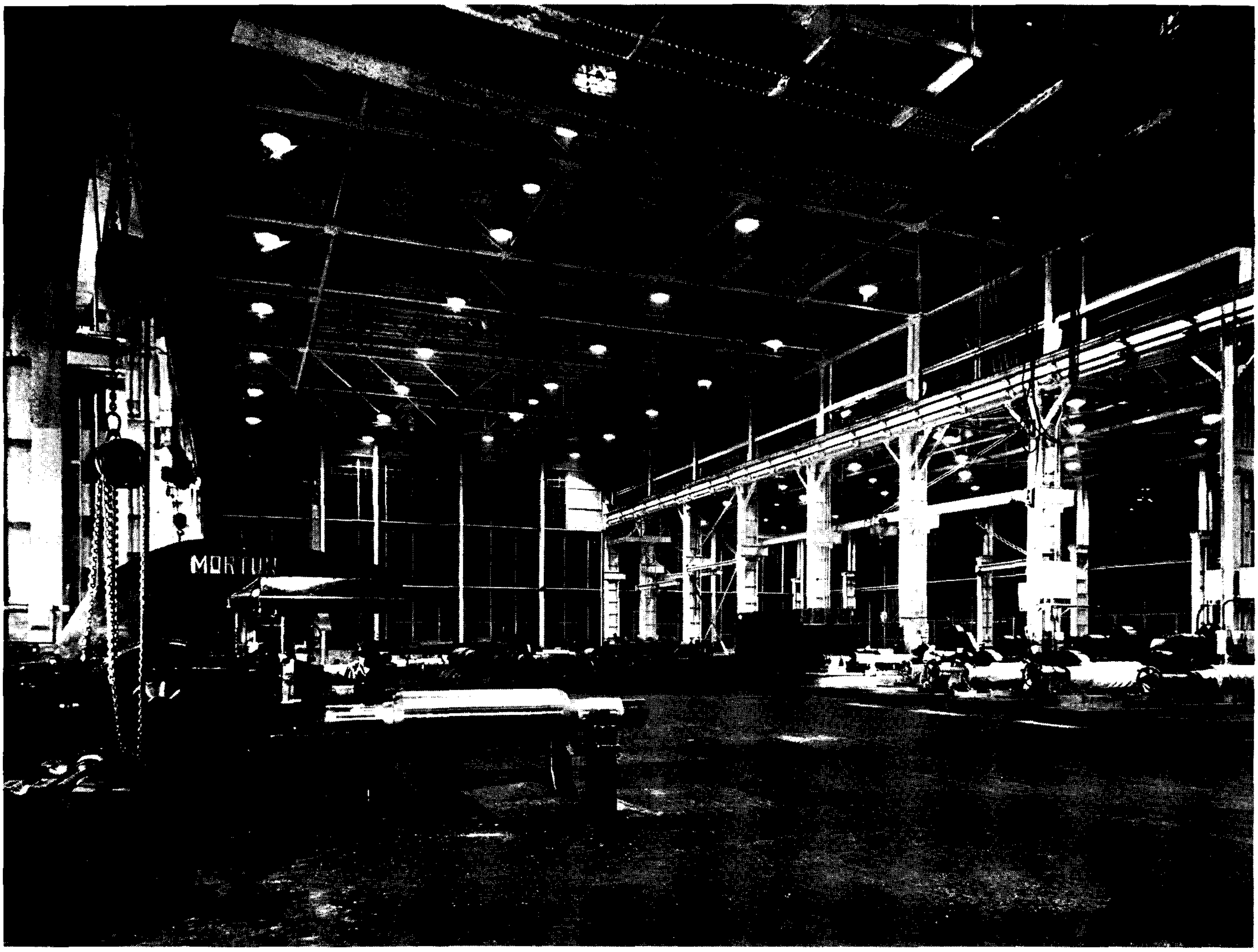
Photos by Hedrich-Blessing

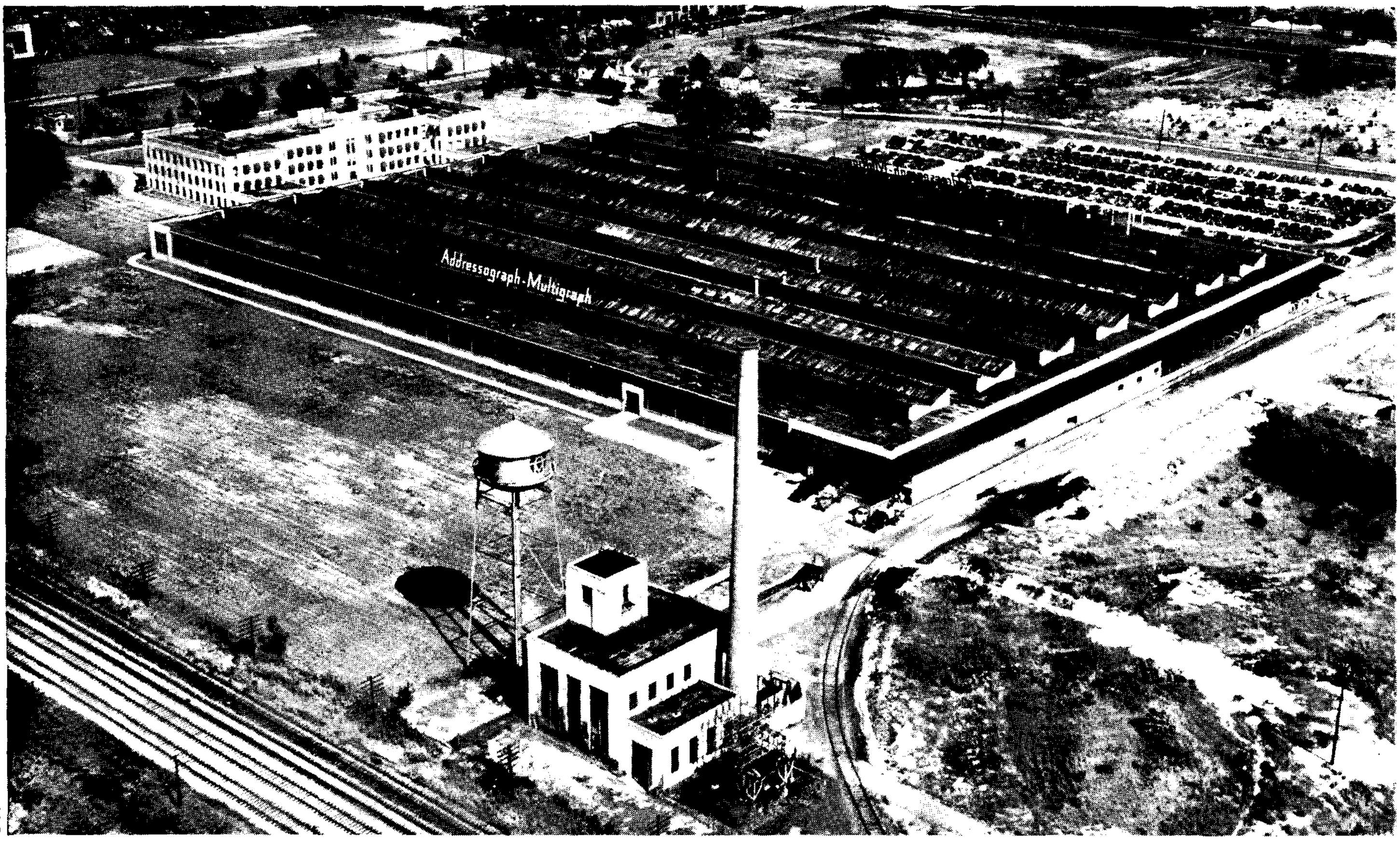
GLASS WALLS ON STEEL FRAME DAYLIGHT A FACTORY: ALBERT KAHN, INC., ARCHITECTS

Wide spans, emphasized in the tremendous center bay, permit utmost freedom in layout of plant processes: shifts in production flow can be made without restraint. Notice the suspended directional unit heaters.

Right, machines placed so operators receive full benefit of natural light. Below, interior is illuminated at night by blended fluorescent and incandescent light.







Fairchild Aerial Surveys, Inc.

Addressograph-Multigraph plant, Cleveland, Ohio; H. K. Ferguson Co., designers and builders

NEW TECHNIQUES MEET CHANGED CONDITIONS ECONOMICALLY

By H. K. FERGUSON, President, The H. K. Ferguson Co.

ONE-STORY PLANTS IN THE COUNTRY

PROBABLY THE MOST important single development in factory designing in recent years is the continuing tendency toward large areas of one-story floor space in outlying locations. Some contributing reasons for this trend are:

(a) The manufacturer's desire for large clear areas, unobstructed by columns, partition walls, stairs, elevators, etc. Such space readily houses a proper "flow sheet" arrangement of equipment. It also facilitates later changes in production layouts, as required by research, new products, availability of improved and higher-speed machinery, and varying needs for raw and finished storage. Improved possibilities for transportation, supervision, and inspection, in single-story buildings, with clear floor space, are also very helpful.

(b) The first cost and subsequent taxes on centrally located industrial properties and plants are usually high. Buildings designed to carry heavy floor loads, high in the air, also cost more than one-story structures where such loads are carried directly on the ground.

(c) The constantly improving ability of labor to come longer distances from home to work, due to the increased use of small automobiles for group transportation, has lessened the need for central plant locations. This emphasizes the need for large parking areas, usually available only in outlying districts. The absence of traffic congestion, improved railroad and truck facilities, and plenty of room for future expansion are all additional factors influencing manufacturers toward sizeable sites, near large cities.

NEW TECHNIQUES

Various improvements in factory designs, materials, and construction have appeared in the last few years, some of which are as follows:

(a) New structural steel shapes and techniques use the material required to much better advantage; the use of shop and field welding for structural steel for factory buildings has materially reduced weight, cost, and appearance, and often improved sturdiness, as compared to riveting.

(b) Maintenance costs are being reduced by better paints and putties. Also by improved floor materials; and gypsum plank, or other permanent and non-combustible materials for roofs, instead of matched lumber, and improved fixtures for plumbing and other facilities are all very useful.

(c) The fluorescent type of electric lighting, while still quite expensive, is taking an important place in factory illumination.

WITH WINDOWS, OR WITHOUT?

Fluorescent lighting has worked in particularly well with the new types of windowless factory buildings, which are, of necessity, air conditioned, and provided with automatic temperature, and sometimes, humidity controls. Such plants are particularly useful for three-shift operation, for the reason that they provide uniform working conditions on all shifts. Where two- or three-shift operation is regularly practicable, the added first cost of such plants is more than offset by the intensified use of machinery and plant.

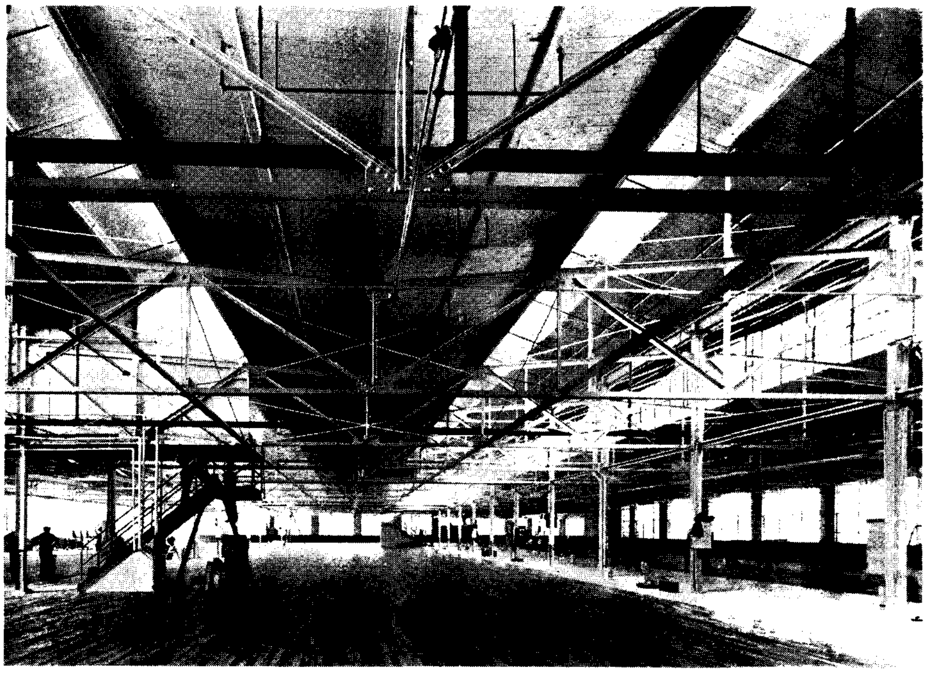
There is still, however, in many instances a continuing prejudice on the part of labor against working in walled-in areas, where no daylight or outside air are directly available. The present tendency is toward the use of windowless buildings for certain operations, rather than entire factories.

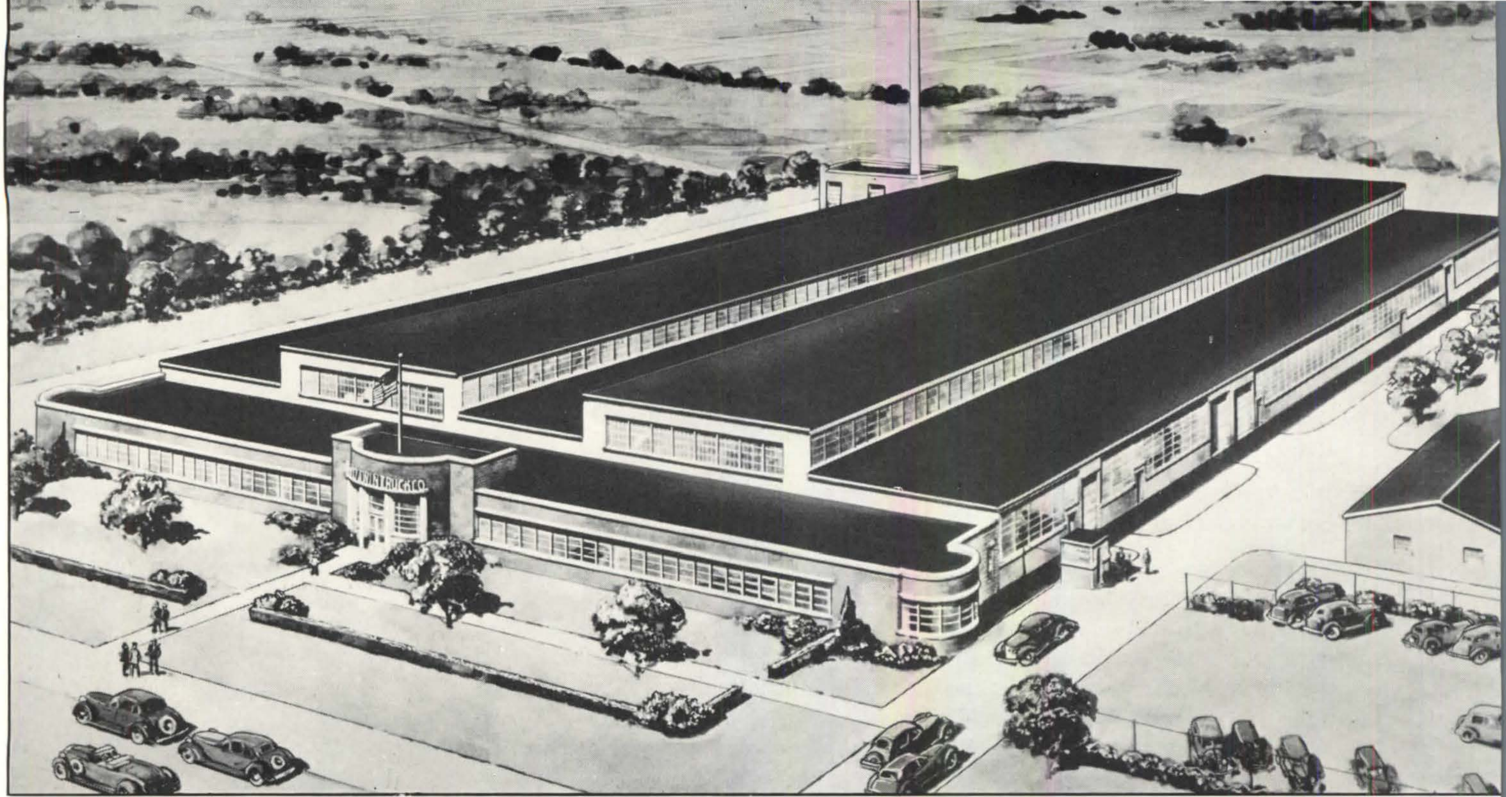
Other buildings are frequently provided with roof insulation, actinic or other heat-resisting glass, good ventilation, and similar improvements, to provide better working conditions at much less cost.

PREFABRICATION FOR DEFENSE

The defense program has again put special emphasis on speed. To any manufacturer, standardization and speed are closely related. In consequence, there is a renewed interest in the better types of standardized one-story industrial buildings, which are available for quick completion. Such structures are easily dressed up with attractive exterior architectural treatment, or to conform to adjoining existing plant buildings. They are ordinarily delivered, ready to occupy, in 60 working days.

Interiors of Ferguson-designed plants demonstrate new trends. Below, Addressograph-Multigraph plant; right, National Cash Register Co., Toronto, Can.





★ **DIVCO-TWIN TRUCK COMPANY:** Total steel tonnage reduced by cantilevered framing

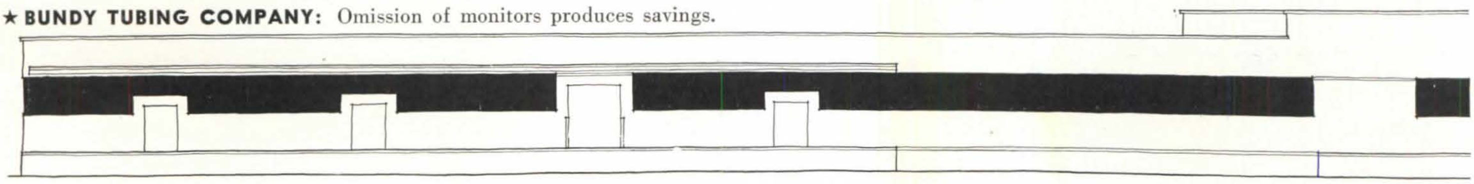
4 FACTORIES DESIGNED BY SMITH, HINCHMAN & GRYLLS

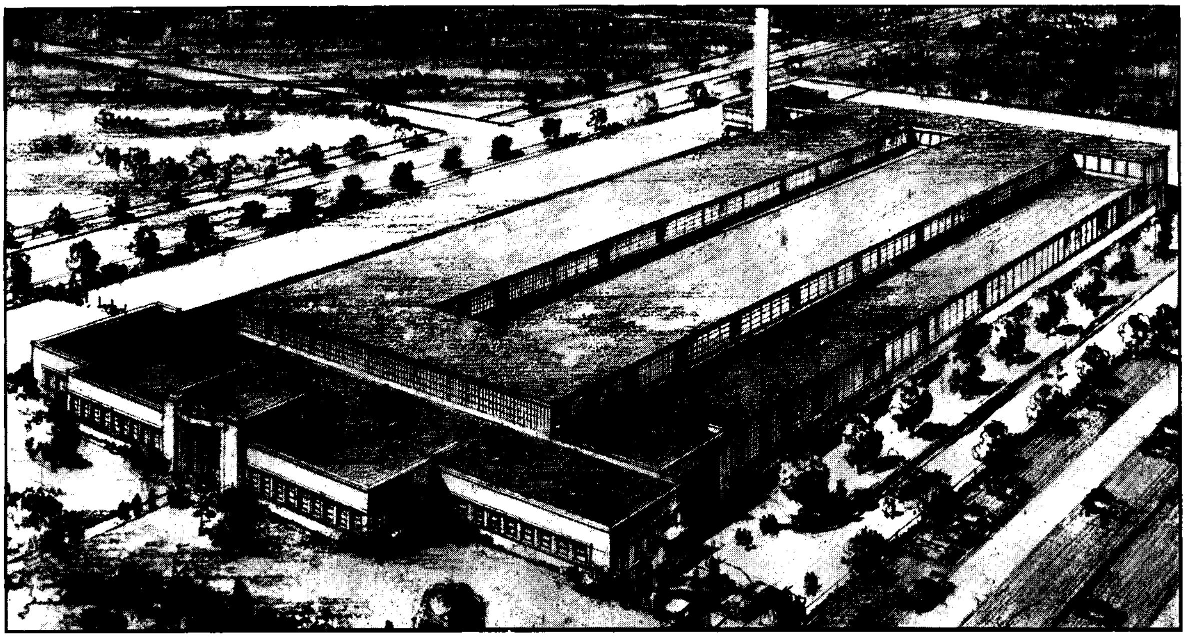
All four of these projects are examples of the designers' ingenuity in overcoming structural difficulties. In every case, the object was to achieve a maximum of economy consistent with sound construction and manufacturing requirements.

★ **DIVCO-TWIN TRUCK PLANT:** Bays are 40 by 50 ft. The 50-ft. dimension is spanned with a 21-in. girder, the other with 12-in. purlins. Girders in high bays cantilever over columns and carry hangers which pick up girders in low bays. This has the effect of giving continuity over columns, thereby greatly reducing moments in 50-ft. girders, especially positive moments. Purlins also cantilever over girders and are spliced about 7 ft. 6 in. from girder center line. This greatly reduces the moment for which purlins had to be designed. By these means, steel was reduced to 8.2 lbs. per sq. ft. (total tonnage, including door frames, girts, sash framing, mezzanine floors for toilet rooms, crane girders, trolley-beam supports, unit-heater supports, etc.)

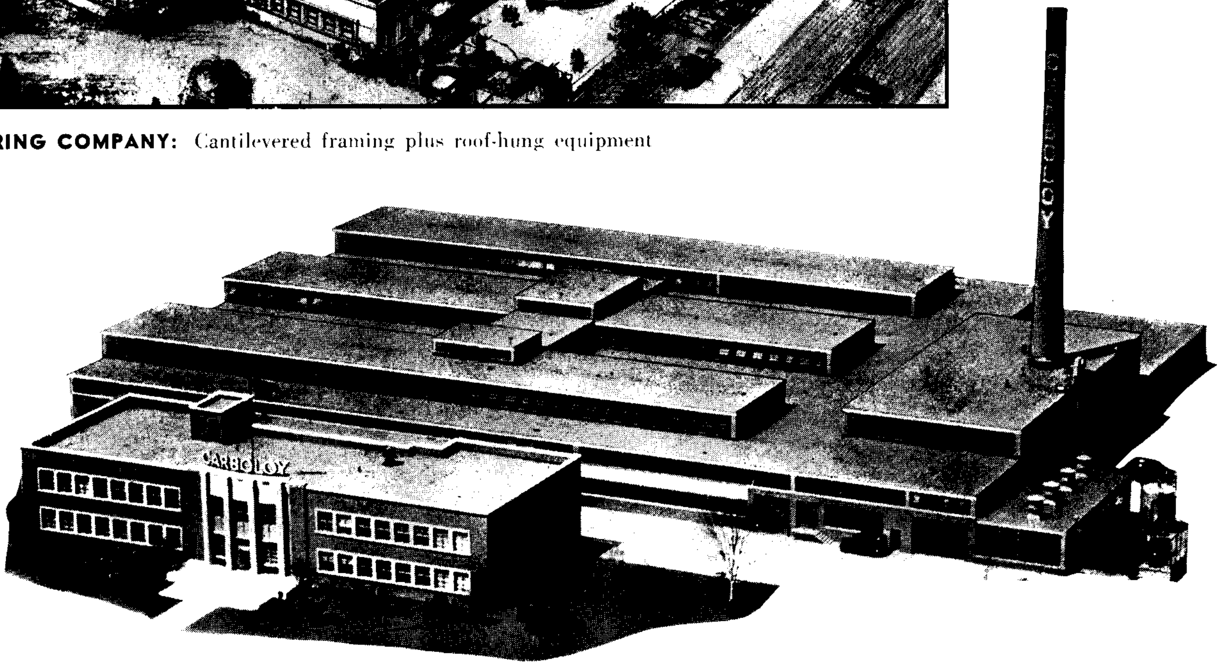
★ **BUNDY TUBING PLANT:** Considerable thought was given to the desirability of reducing the amount of glass usually provided in such buildings. It was decided to omit all monitors and skylights and provide instead a line of sash 6 ft. 10$\frac{3}{8}$ in. high around the outside of the building. Below this sash, a masonry wall was used, and above, corrugated asbestos-cement board with insulation backing. This produced a substantial saving in cost of the building's shell. Cost of the lighting installation was not increased—possibly slightly reduced. The building was not air conditioned; to compensate for monitor ventilation, a blast system was used for heating the central part of the building, and arrangements made so that fresh air from the outside could be taken and distributed throughout the building when desired. Elimination of moni-

★ **BUNDY TUBING COMPANY:** Omission of monitors produces savings.





★ **SOSS MANUFACTURING COMPANY:** Cantilevered framing plus roof-hung equipment

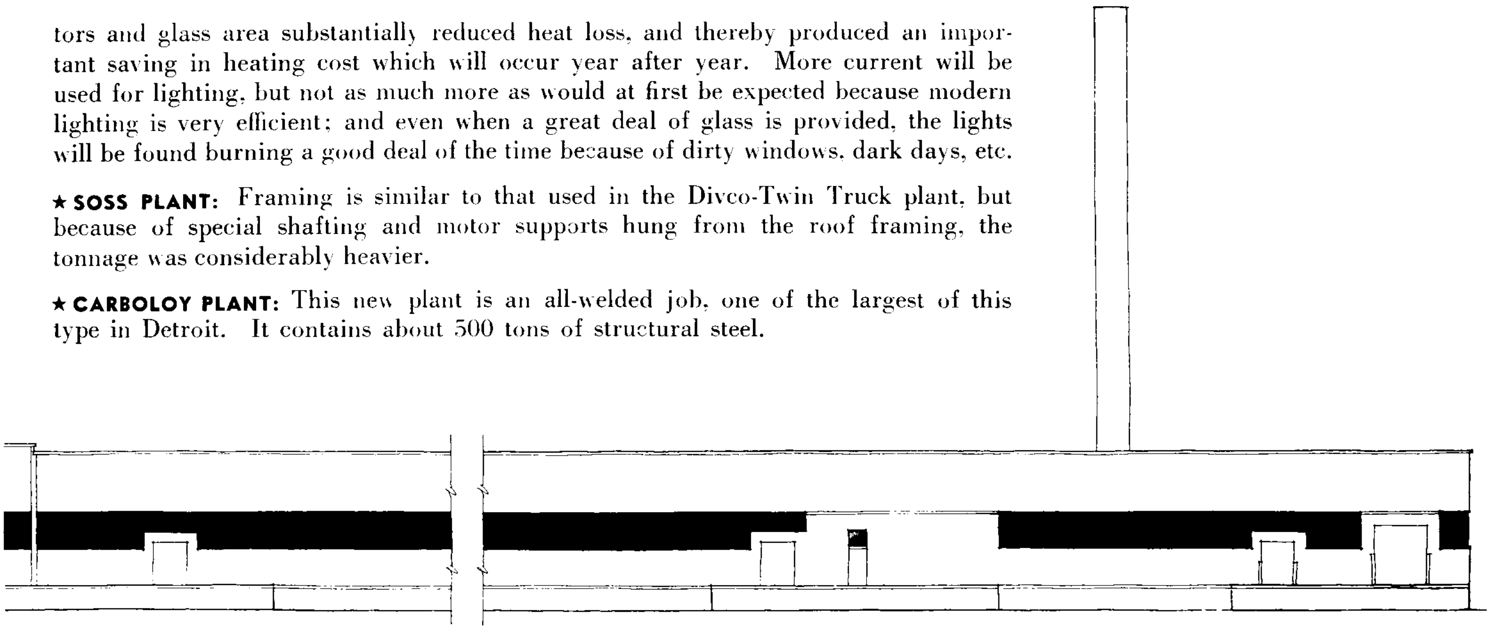


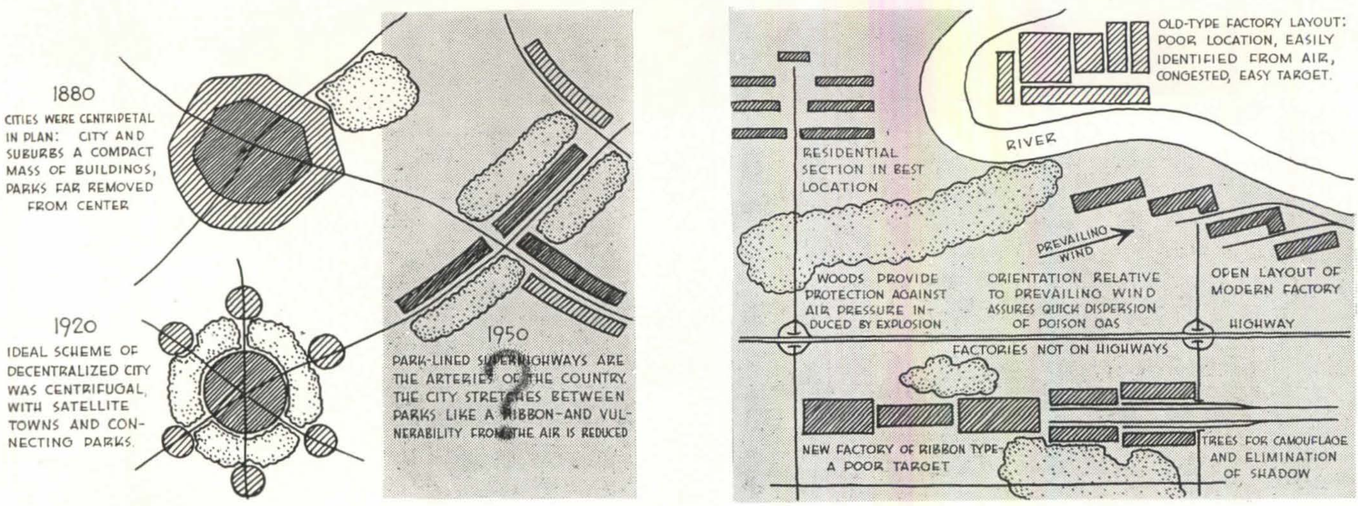
★ **CARBOLOY, INC.,** division of GENERAL ELECTRIC COMPANY: All-welded steel framing

tors and glass area substantially reduced heat loss, and thereby produced an important saving in heating cost which will occur year after year. More current will be used for lighting, but not as much more as would at first be expected because modern lighting is very efficient; and even when a great deal of glass is provided, the lights will be found burning a good deal of the time because of dirty windows, dark days, etc.

★ **SOSS PLANT:** Framing is similar to that used in the Divco-Twin Truck plant, but because of special shafting and motor supports hung from the roof framing, the tonnage was considerably heavier.

★ **CARBOLOY PLANT:** This new plant is an all-welded job, one of the largest of this type in Detroit. It contains about 500 tons of structural steel.





MILITARY CONSIDERATIONS may alter city and factory planning. Structures widely scattered, or in lines, form poor targets.

PREPARATION FOR FACTORY A.R.P. EXPANDS

DODGE THE BLOW OR RIDE WITH IT

PERFECT ARMOR against modern projectiles is not a possibility. Not only is construction of impenetrable hoods over cities, factories, even houses, uneconomical; as fast as armor becomes "bombproof," projectiles capable of penetrating it are developed. The architect can best compete with the armament technician in fields where the technician is powerless: by intelligent planning the factory designer can reduce the probability of direct hits; by proper design he can minimize damage when hits occur.

New considerations include layout of buildings on the plot, and design of individual buildings toward the end of localizing damage when it occurs. An intelligent plan also includes, from its very inception, facilities for protection of employees, usually by means of shelters, at least by means of emergency exits. And, since some damage can be expected, facilities for quick, easy repairs are essential.

To achieve a reasonable degree of security we have to take into account stresses which, though similar to those now recognized as design factors, react in strange, almost unexplored fashion: terrific pressures resulting from explosions; suction, opposite in action to recognized forces and almost unmeasurable; earth tremors, which introduce new impact loads into foundation design; new live and dead loads, superimposed on normal loads, and caused by impact and accumulation of falling debris; and torsion, cantilever action, and distorted bending moments, initiated by partial collapse of a structure. And, though poison gas may not now be used, it would be folly to neglect precautions against it.

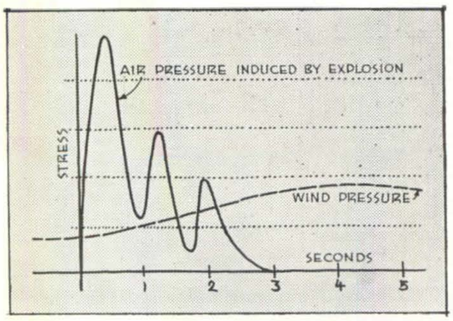
CONTRADICTIONS IN PRINCIPLES

Many apparent contradictions confront the architect who attempts a building program which recognizes these new factors. A plant whose buildings are widely dispersed will sustain relatively few direct hits. When exterior considerations cause a congestion of factory buildings, the chances of direct hits become greater.

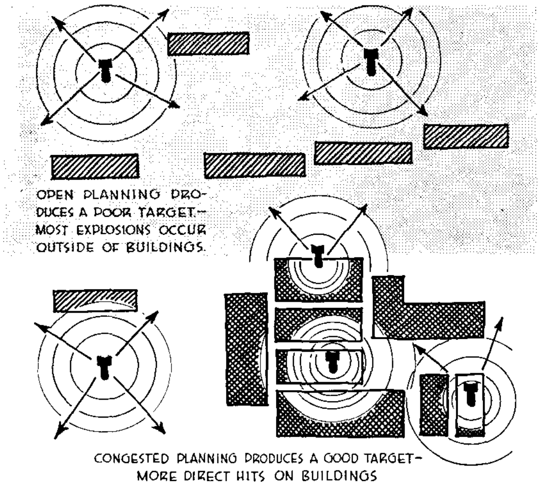
European experience indicates an exactly opposite method of procedure for congested buildings than for dispersed buildings. In the one case, structural damage

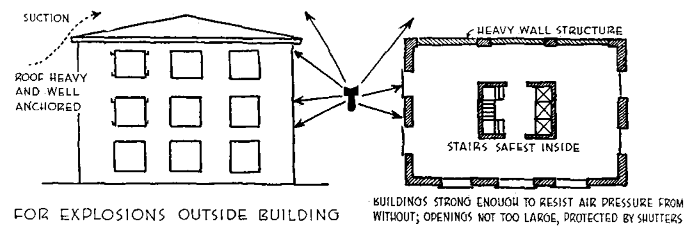
Paradoxically, peace-time principles can be successfully applied to anti-sabotage, anti-air raid design. From arrangement of buildings to design of doors which may ultimately have to be gasproof, new devices, new structural methods, new stresses have to be *considered*. So much is true; but we must utilize our experience in research, design, and construction in finding solutions to these new problems. Thus only can uneconomical construction be avoided.

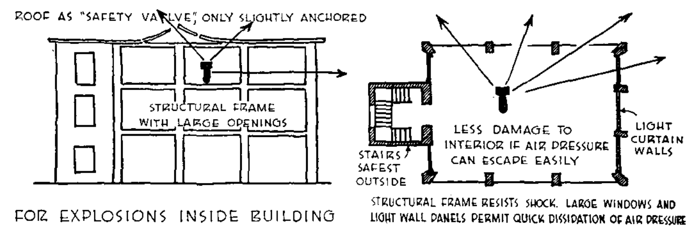
KONRAD F. WITTMAN, Architect, who discussed the effects of war on city and factory planning in the September 1940 RECORD, here analyzes changes in factory design which result from protective planning, and outlines practical procedures.



EXPLOSION-INDUCED PRESSURE approaches in violence the force of impact of heavy, rapidly moving solids.







. . . . The poor target suffers fewer direct hits, and requires different precautions against damage, than the good target.

PEACE-TIME PRACTICE TO NEW FIELDS

from direct hits, or other *internal explosions*, can best be minimized by providing a strong frame and a flimsy envelope. In the other, damage from adjacent hits, or *external explosions*, is best combatted by more nearly uniformly strong construction. When a plant is obviously of primary military importance, it is best to apply to its design procedures suitable for congested buildings, since every attempt will be made to achieve direct hits. However, when anti-aircraft provisions are adequate to force raiding airplanes to great heights, precautions suitable for dispersed buildings are most satisfactory.

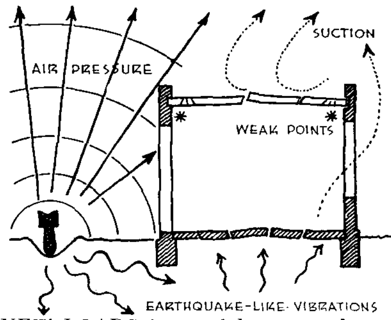
The foregoing principles derive from another, which may be stated as follows: *The force exerted by expanding gases and air pressure is in proportion to the strength of the resisting surfaces. An explosion confined by strong masonry is tremendously increased in violence because it is so confined.* An explosion in a narrow court is much more vehement than the same burst in an open street. This principle is recognized by designers of cereal processing plants, grain elevators, and other structures where there is danger from explosive dust. "Explosion" sash have been developed to provide low-resistance lines of escape for expanding gas, and so to reduce pressure against remaining obstacles.

PROTECTION FROM INTERNAL EXPLOSIONS

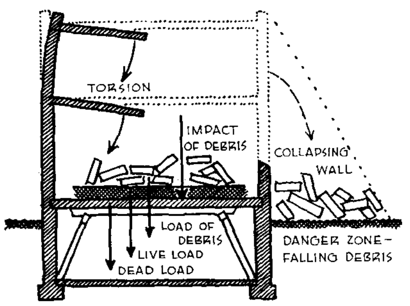
Observations of explosions of many types prove this thesis: The more window panes are blown out, the less damage is done to structure and equipment by internal explosions. Destructive force is decreased by increasing the number of windows and doors.

A structural frame of steel or reinforced concrete, with light curtain walls and large window openings, is eminently satisfactory for buildings which, due to uncontrollable circumstances, are congested in comparatively small areas. The roof can provide another such "safety-valve." Sometimes it is far better to permit the roof to be blown off rather than cause damage to valuable machinery or to the building's structural frame. In such a case, the roof is anchored as lightly as possible, or may, like exterior walls, consist of a strong frame and light filler panels.

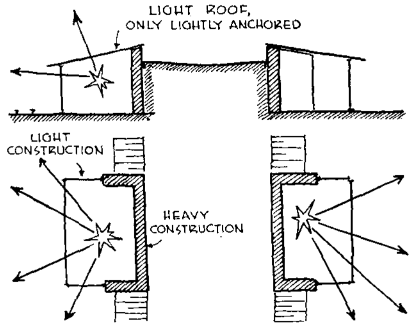
New, standardized materials: Under these conditions an ideal material for window glazing could be blown out without breakage, and wall—possibly roof—panels are preferably so standardized that their immediate replacement from stock offers no problems. *(Continued on page 152)*



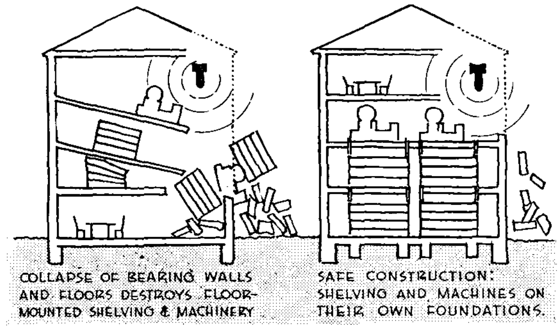
NEW LOADS imposed by external explosions . . . .



. . . and by collapse of damaged parts.



"SAFETY-VALVE" buildings provide relative safety from internal explosions.



IN MULTI-STORY PLANTS, collapse of part of building can destroy heavy equipment as effectively as bombing unless it has independent foundations.

Windows: Present types of glazing materials all react like other known products. Glass breaks. Wire glass breaks like ordinary glass, though in larger fragments. Glass block reacts like solid masonry. Some type of weather-resistant, non-brittle, transparent plastic may be developed to meet all requirements; however, such materials remain in the laboratory stage at present.

PROTECTION FROM EXTERNAL EXPLOSIONS

To resist the shock of an explosion outside a building, the entire structure, walls, floors and roof, as well as frame, must possess strength; wall openings have to be reduced in size and number.

These provisions hold true particularly for explosions in the vicinity of a building, but not immediately adjacent. The greatest destruction is caused by debris which damages expensive machinery, disrupts plant processes, and takes lives. Window glass is broken inward by concussion; interior finish and decorations fall as a result of violent shaking; roofs are torn off by the vacuum which an explosion induces on the lee side of the structure. If the windows themselves cannot be made small, they can be divided into small panes. The roof needs secure anchorage.

Explosions immediately adjacent to a building can best be offset by a strong structural frame with strong, rather than light, curtain walls. Experience with earthquake-resistant construction is valuable here. The curtain walls require more secure attachment to the frame than is necessary in the case of internal explosions.

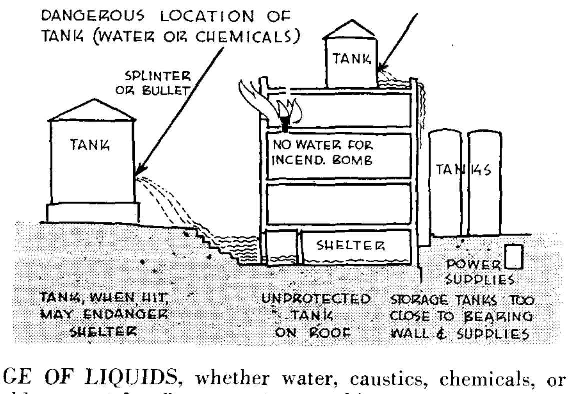
For both near-by and distant external explosions, windows can be protected with temporary or permanent shutters to resist the first shock. Further considerations include protection for roofs and reinforcing of floors against flying splinters, shell fragments, debris; design of protective doors, usually steel, for resistance to distortion and for easy operation under all conditions. Sandbags do not offer the best protection, since flying sand may prove more devastating to machinery and equipment than a few shell fragments would be. For the same reason, an elastic type of pavement, which breaks into large pieces, is more satisfactory than paving made up of numerous small units; because the latter may become a shower of missiles as destructive as shrapnel.

Vacuum: Precautions against exterior forces on one side of a building will not always prove satisfactory on the other. The characteristic suction, induced by the vacuum left behind obstructions in the path of expanding gases, reacts oppositely to recognized structural forces. Secure anchorage of wall members, of casings at openings, and of roofs; and elimination of all projections which may afford leverage for the force, are the principal means of avoiding excessive damage.

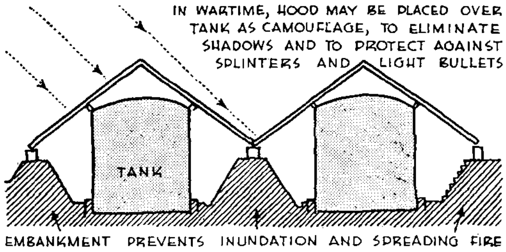
NEW TECHNICAL REQUIREMENTS

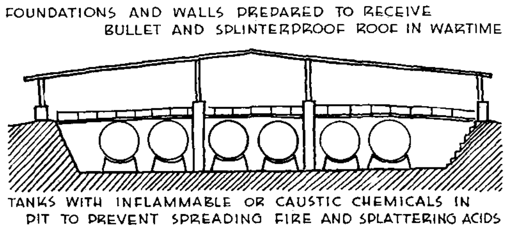
Modern technical and manufacturing requirements are so complex that each case has to be studied independently. Very often the designer has to accept greater vulnerability rather than encumber the manufacturing process with an uneconomical layout (for instance, when the process requires compact arrangement of buildings). However, many details and operations can be rendered less vulnerable without disrupting production flow. To insure continuous operation under all conditions, a check has to be made of every line of traffic, all supply lines, all buildings and every detail of each building, under the assumption that damage may be sustained from direct hits, bullets or splinters, or, at the very least, air pressure. Some of the most vulnerable spots are as follows:

Exits: Are exits so protected that falling debris cannot block them? *(Continued on page 154)*

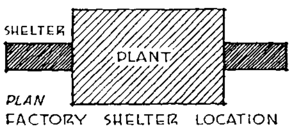


STORAGE OF LIQUIDS, whether water, caustics, chemicals, or inflammable material, offers a serious problem. Hoods indicated at right are proof against light projectiles only; construction to receive them can serve in peacetime as protection against normal hazards.

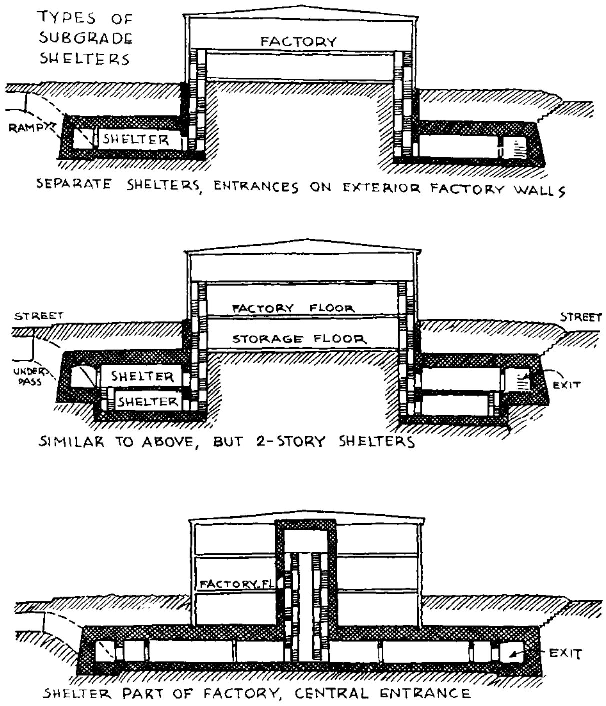


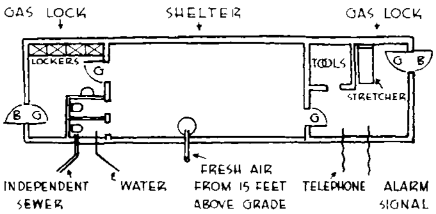


AIR-RAID SHELTER DESIGN

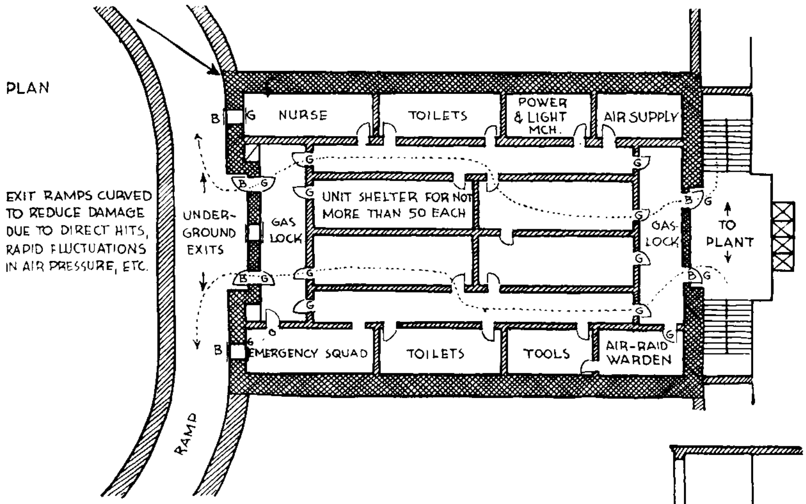


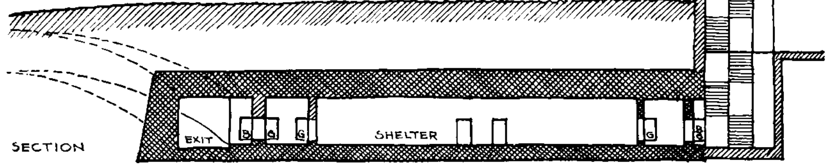
PEACE-TIME LOCKER ROOMS can become war-time air-raid shelters. Above, diagram indicates satisfactory location for locker-room-shelter, with emergency exits removed from plant building to prevent their being blocked as a result of explosions. At right, three types of subgrade shelters. When chances of direct hits are good, entrances from plant are best located near exterior factory walls (top scheme). When explosions are most likely to occur outside plant, center entrance (bottom) is best.

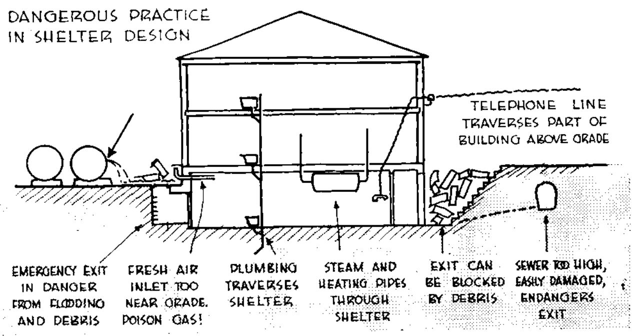


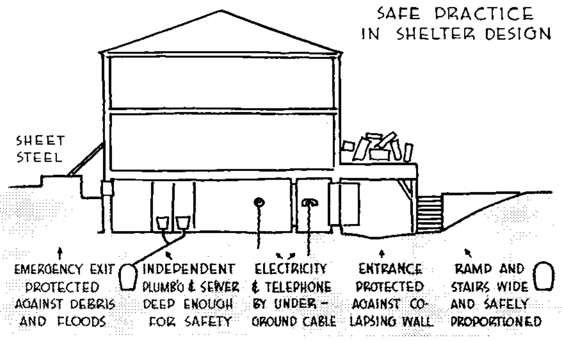


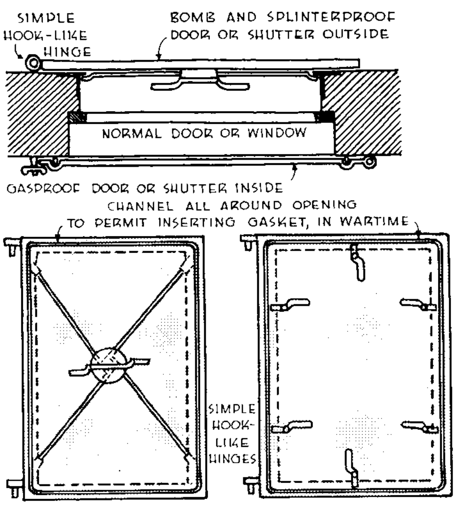
TYPICAL SHELTER has two basic parts: gas lock, and shelter proper. It has been found most satisfactory to limit capacity of one unit to 50 persons. At right is scheme for multiple unit shelter for 200 persons: in all diagrams, **B** indicates bombproof door, **G**, gasproof door. Below, "dos" and "don'ts" which may save lives.



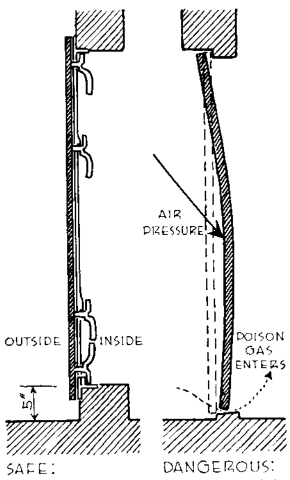






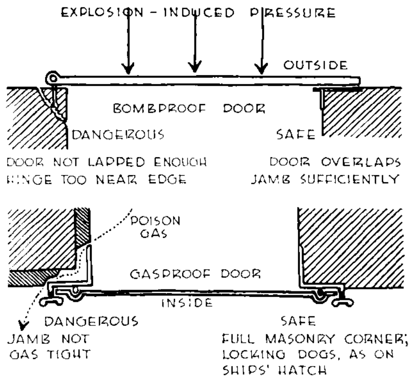


GASPROOF STEEL DOORS LOCKED FROM INSIDE
BY MULTIPLE BOLTS OPERATED BY ONE LEVER — OR BY INDIVIDUALLY OPERATED BOLTS



SAFE: CURB AT SILL; OVERLAPPED DOOR USUALLY REMAINS GASPROOF, STILL OPERATES, ALTHOUGH DAMAGED

DANGEROUS: DOOR IN NORMAL REVEAL WARPED BY EXPLOSION HINGES WILL NOT OPERATE



GASPROOF AND BOMBPROOF DOORS have to be extremely simple in design, to insure their operation even though damaged, and to facilitate repairs. Doors set in normal reveals are unsatisfactory. All doors operate from within. Interior door has curb at sill: gasket *seals opening.*

Spacing of buildings: Can collapse of a wall damage an adjacent structure, or block a street?

Employee safety: Has every precaution been taken to prevent employees from being injured by debris?

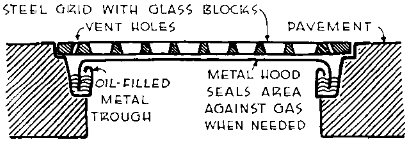
Supply lines: What happens when electric power is disrupted? Are electrical fire hazards eliminated? Are supplemental power lines available? Are steam piping, and other supply and process lines, protected? If damaged, are they located and identified in such a way as to facilitate repairs? Are supplemental sources available?

Sprinkler system: Is the water supply for sprinklers protected? A supply tank on the roof is an excellent target: can another location be found?

Fire prevention: What means are provided for checking fires if the water main is destroyed?

Sewers: Are they adequately protected? Are sewers for air-raid shelters independent of others? Vulnerability of sewers concerns Londoners more than destruction of houses.

Repairs: Are all the small, intricate details of the structure—for instance, doors and door latches, hinges, sash operators—of the simplest possible design? If at all complicated, their repair will be extremely difficult. Are doors applied to the face of a wall, rather than set in reveals where explosions may jam them tight? Are all parts of the structure of types which can be replaced with local materials, by local workmen? Many ingenious, complicated products cannot be obtained in an emergency.



SECTION, GASPROOF AND SHOCK-RESISTANT AREA GRATING

SIMPLE MEANS of protecting the areaway of a subgrade window

AIR-RAID SHELTERS

Air-raid shelter requirements have been modified to a great degree in the light of today's European experience. They require some further adaptation to fit into American economy.

In the first place, shelters were originally designed as temporary refuges. Today's air raids last hours, even whole nights. Obviously, more is needed in the way of accommodations than was first contemplated, even though the accommodations satisfy only the primitive needs: physical safety; pure air and water; medical care; toileting, feeding, sleeping; communication.

On the other hand, grandiose shelter-towers, each to protect 1,000 persons or more, reflect an unwise enthusiasm for monumental construction. Not only would such medieval fortresses be uneconomical; they might also endanger morale by their presence.

Underground shelters have many advantages over surface shelters. Both types may be so designed as to have peace-time usefulness; the underground shelter, among other things, is less visible and therefore is a poorer target; it is more quiet; it may have several feet of earth fill over it for additional protection.

Peace-time use: Particularly in factories, every shelter should be designed for some use in peace time, preferably for a use similar to its war-time purpose. And the change from the uses of peace to those of war has to be accompanied by a minimum of alteration. In the average plant, the combination of employees' entrance, locker rooms, and stairs is entirely satisfactory for shelter use, provided overcrowding is eliminated. The two types of functions are similar; natural light is not mandatory for either; every man has his assigned locker space; constant use assures their instant readiness in emergency.

A typical unit shelter is illustrated herewith. Individual units preferably accommodate no more than 50 persons; larger numbers are accommodated by providing more units. It is particularly important that emergency exits be protected from collapsing walls, bursting tanks, and proximity of inflammable materials. Easy accessibility is also essential to prevent delays and confusion.

THERMAL EXPANSION—FACTORY BUILDINGS

Data on this sheet were obtained from reports of the British Building Research Station, from other publications, and from current engineering practice. Material was prepared by Jule Robert von Sternberg, Architect.

THERMAL EXPANSION

Two types of temperature variation induce movement in a factory structure. First of these is the slow, seasonal change from winter to summer; second, relatively rapid fluctuations which take effect within a few hours. Design of almost any industrial building involves consideration of both. In ordinary buildings, the more rapid fluctuations are most likely to cause damage.

Fortunately, concrete and medium steel have similar coefficients of expansion. Masonry has the advantage of being able to take up movement in its joints. Where buffers must be provided between stressed materials, expansion joints, properly protected against wear and weather, usually suffice.

EXPANSION JOINTS

Where such a building—or one of its parts—is restrained from moving by the pressure of an adjoining building, or other mass, provision must be made to take up the thrust. Expansion joints, therefore, normally occur between new and old buildings; between a wing of a building over 150 ft. long and the main body of the structure.

Movement also takes place between parts of the same structure exposed to different temperatures. Ordinarily, roofs become much hotter, and expand more, than walls, especially shaded walls. To prevent damage, roofs are frequently ringed with expansion joints. In addition, the roof structure, particularly if it is rigid, may be large enough to require a transecting expansion joint; one which passes through the roof, walls, and sometimes lower floors. Such transecting expansion joints vary in size and design with the size and construction of the building, and location of the joint.

In monolithic reinforced concrete buildings, expansion joints should completely divide the structure, cutting roof, walls, and floors completely. Joints are sometimes provided 100 ft. on centers. Usual practice is to space them every 200 ft. By using longitudinal reinforcing, buildings up to 300 ft. in length have been successfully constructed without expansion joints.

Steel-framed buildings: Practice varies in the steel-framed building with curtain walls. Although expansion joints that completely divide the buildings are also used in this type, 200 to 250 ft. o. c., many successful slab-roofed buildings have been constructed with expansion joints in roofs and top-floor walls only, stopping at the top floor line. The expanding roof slab moves faster and farther than do the walls. Flexibility of the top-floor steel columns is relied upon to yield to the thrust set up by the roof slab, completely absorbing it and preventing its transmission to lower stories. Movement of masonry in lower floors is taken up in individual joints, and is further restrained by the steel framing.

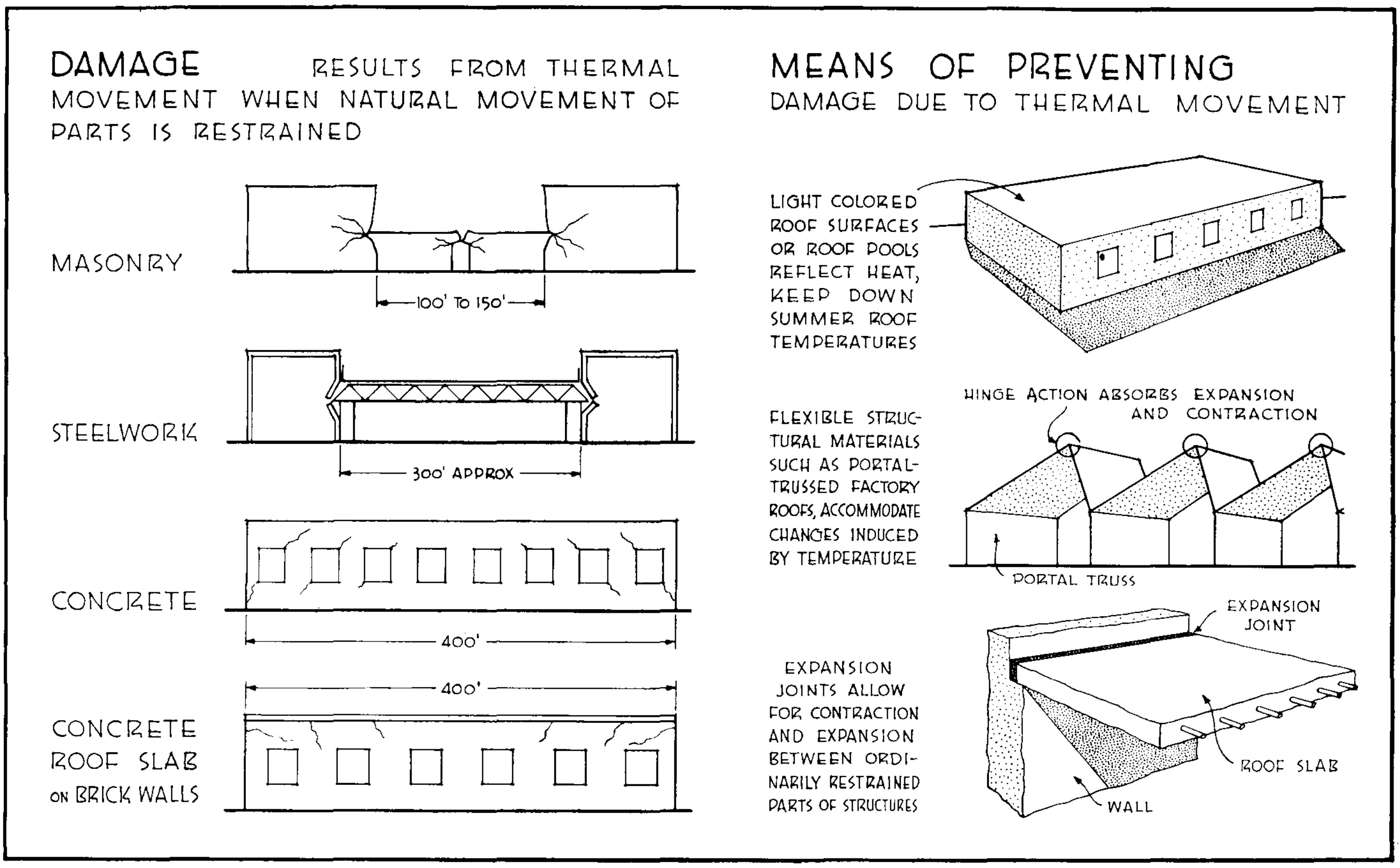
Solid masonry buildings: Free-standing solid masonry buildings usually require joints about 100 ft. on centers. With an average winter-summer temperature differential of about 100° Fahrenheit, a masonry wall will expand about 0.4 in. in every 100 ft. of length. Expansion joints at 100 ft. intervals must be approximately ½ in. wide, and are easily concealed in the average mortar joint.

PROVISIONS AT GRADE

Provision needs to be made for the building equipped with transecting expansion joints to slip on its foundation. In the case of solid masonry buildings, the mortar joint between concrete foundation and masonry wall is found a satisfactory slipping surface. Monolithic buildings, however, require slip joints between the walls and foundation to permit movement of the superstructure. The foundation, being buried in the ground, with little temperature differential to influence it, is not affected by temperature fluctuations of the air.

SPECIAL BUILDING TYPES

Structures in which there are maintained unusually low summer temperatures, as in breweries and cold-storage warehouses, must allow for much greater expansion than other factory types.



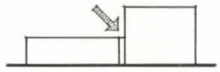
THERMAL EXPANSION JOINTS—FACTORY BUILDINGS

COEFFICIENTS OF LINEAR EXPANSION
(In inches per degree)

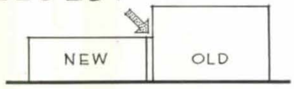
METALS, ALLOYS	
aluminum, wrought	.0000128
brass	.0000104
bronze	.0000101
copper	.0000093
gray cast iron	.0000059
steel, hard	.0000073
steel, medium	.0000067
steel, soft	.0000061
STONE, MASONRY	
ashlar masonry	.0000035
brick masonry	.0000031
cement, Portland	.0000059
concrete	.0000079
concrete masonry	.0000067
granite	.0000047
limestone	.0000044
marble	.0000056
plaster	.0000092
rubble masonry	.0000035
sandstone	.0000061
slate	.0000058
TIMBER, parallel to fiber	
fir	.0000021
maple	.0000036
oak	.0000027
pine	.0000030
TIMBER, transverse	
fir	.000032
maple	.000027
oak	.000030
pine	.000019

Note: Average winter-summer temperature range is 100°F.

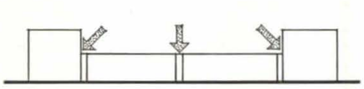
EXPANSION JOINTS ARE NEEDED:



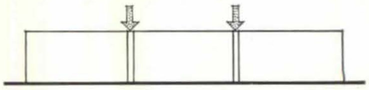
1 WHERE A LONG LOW STRUCTURE ABUTS A RIGID MASS.



3. WHEN A NEW BUILDING ADJOINS AN EXISTING BUILDING



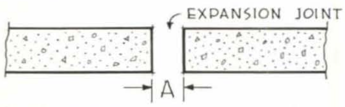
2. AT ENDS OF A LOW STRUCTURE BETWEEN TWO HEAVY MASSES AND AT APPROPRIATE INTERVALS - USUALLY EVERY 150 FEET



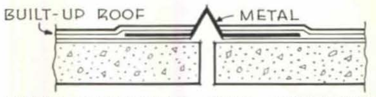
4. IN FREE STANDING BUILDINGS, THROUGH EXPANSION JOINTS ARE REQUIRED AT INTERVALS OF APPROXIMATELY 200 FT.

5. WHEN INTERIOR AND EXTERIOR TEMPERATURE DIFFERENTIALS ARE EXCESSIVE, AS IN A COLD STORAGE BUILDING.

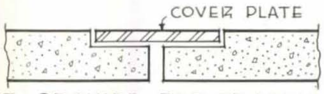
FUNCTIONS:



MUST PROVIDE FOR MAXIMUM THERMAL-INDUCED MOVEMENT LIKELY TO BE ENCOUNTERED. [WIDTH OF JOINT "A" = SPAN (INCHES) X 100 (AVERAGE WINTER-SUMMER TEMP. DIFF.) X n (COEFFICIENT OF EXPANSION OF THE MATERIAL)]



MUST EXCLUDE THE WEATHER IF EXPOSED



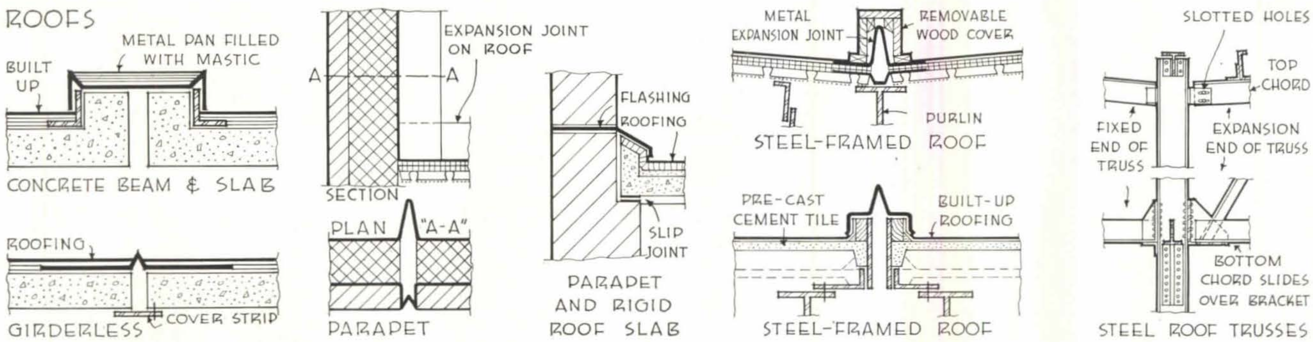
MUST PROVIDE FOR TRAFFIC, IF USED IN A FLOOR.

MUST BE CONCEALED IF IT IMPAIRS APPEARANCE.

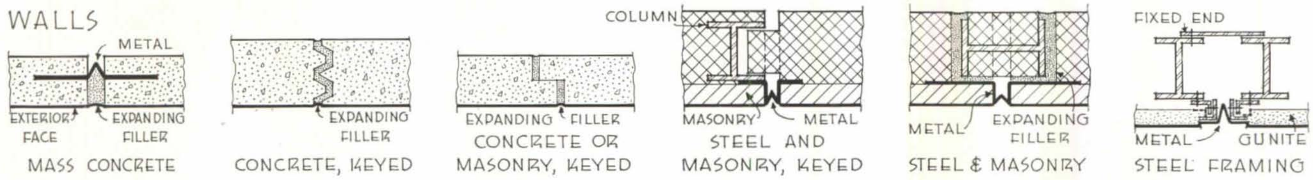
TYPICAL EXPANSION JOINTS:

NOTE: DRAWINGS NOT TO SCALE

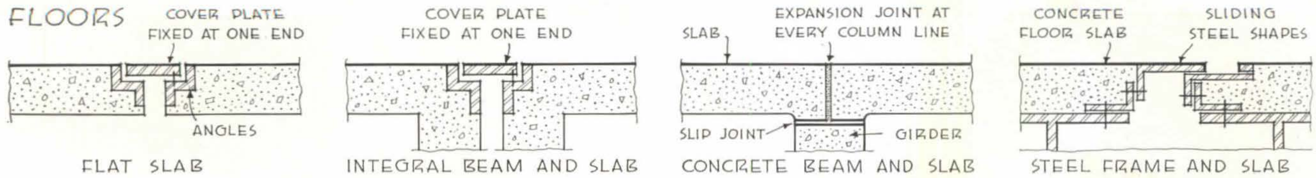
ROOFS



WALLS



FLOORS



FACTORY TOILETS AND LOCKER ROOMS

Data in this Time-Saver Standards sheet offer means of determining numbers of fixtures, clearances, and areas for factory toilets and locker rooms. Information was prepared by Jule Robert von Sternberg, Architect, from Labor Code provisions and from current practice.

Factory sanitary facilities are of several general types. Most important is the "change" room (hereafter called "locker room"). This may consist of a locker room proper, containing lavatories, lockers, and showers, plus a separate toilet room. Showers are sometimes in a separate room. Requirements vary from industry to industry, from factory to factory. In a compact, one-building plant, one pair of locker rooms is ordinarily provided close to the employees' entrance. In plants which occupy several buildings, locker rooms are usually provided in each main unit. Occasionally they may be in a separate building.

Whatever the general location, locker rooms have to be as close to the job as possible. However, they must not interfere with plant operation. They are often in an adjoining "tower" building; sometimes on a mezzanine above the working floor.

Architectural finish: Walls, floor, ceiling have to resist penetration of water and water-borne dirt; ceilings are often acoustically treated; floors have to stand up under heavy traffic, soap and water, acid and alkali; every piece of equipment has to withstand punishment.

Ventilation: Windows are not vital toilet equipment. Artificial light and forced ventilation are often substituted; usually to advantage, for they permit close control of light and air. Number of air changes varies from 10 to 20 per hour.

Lighting: Illumination has to be at a high enough level to promote cleanliness and employee comfort. In general, 6 to 8 lumens per sq. ft. are provided. Lights are placed to give direct illumination to lockers, lavatories, and occasionally showers. Lighting in toilets is placed to discourage reading.

Size varies with industry requirements. A general rule is: the dirtier and hotter the work, the greater the demand for showers and lavatories.

Least standardized are lockers. Type usually recommended is the individual locker 12 in. wide, 18 in. deep, 72 in. high, with a built-in lock. A number of smaller-sized lockers are used, however. Some manufacturers (of jewelry, etc.) do not install lockers for fear employees will secrete company property in them. These require that all clothing be hung in the open where it can be watched.

Arrangement: The locker room is preferably laid out so traffic flows with least confusion. Toilets, lockers, showers, lavatories have to be selected and arranged so the entire working force can use them in the shortest time. To achieve this, consideration must be given to relative usefulness of each type of equipment, numbers of shifts and of men per shift, work habits of men, and relationship of factory work areas and parking areas to locker room.

Expansion: Because no modern factory is designed to remain fixed in form and function for its lifetime, locker rooms, whenever possible, should have provision for expansion.

Other types of toilets: toilet facilities must be provided for workers at convenient intervals: i.e., so the average worker need walk only 100 to 125 ft. to a toilet. In areas where only a very few men work, distance may be increased to 200 ft.—an outside limit. These secondary toilets contain water closets, urinals, and lavatories.

A separately housed toilet may be provided in the yard if a large number of men are employed in it. If not, yard workers use boiler-house or plant toilets.

Toilets are also provided for office workers and visitors in the administration building. These are similar to office building provisions.

Women's rest rooms adjoin women's toilets. These must conform to local codes, and usually contain space for a couch and reclining chairs. It is also customary to provide women's showers with private dressing booths.

MINIMUM FIXTURE REQUIREMENTS

(N. Y. State Labor Code)

No. of MEN	Water Closets	Urinals	No. of WOMEN	Water Closets	No. MEN or WOMEN	Wash Basins
1–9	1	0	1–15	1	1–20	1
10–15	1	1	16–35	2	21–40	2
16–40	2	1	36–55	3	41–60	3
41–55	2	2	56–80	4	61–80	4
56–80	3	2	81–110	5	81–100	5
81–100	4	2	111–150	6	101–125	6
101–150	4	3	151–190	7	126–150	7
151–160	5	3	191–240	8	151–175	8
161–190	5	4	241–270	9	176–200	9
191–220	6	4	271–300	10	201–225	10
221–270	6	5	301–330	11	226–250	11
271–280	7	5	331–360	12	251–275	12
281–300	7	6	361–390	13	276–300	13
301–340	8	6	391–420	14	301–325	14
341–360	8	7	421–450	15	326–350	15
361–390	9	7	451–480	16	351–375	16
391–400	10	7	481–510	17	376–400	17
401–450	10	8	511–540	18	401–425	18
451–460	11	8	541–570	19	426–450	19
461–480	11	9	571–600	20	451–475	20
481–520	12	9	601–630	21	476–500	21
521–540	12	10	631–660	22	501–525	22
541–570	13	10	661–690	23	526–550	23
571–580	14	10	691–720	24	551–575	24
581–630	14	11	721–750	25	576–600	25
631–640	15	11	751–780	26	601–625	26
641–660	15	12	781–810	27	626–650	27
661–700	16	12	811–840	28	651–675	28
701–720	16	13	841–870	29	676–700	29
721–750	17	13	871–900	30	701–725	30
751–760	18	13	901–930	31	726–750	31
761–810	18	14	931–960	32	751–775	32
811–820	19	14	961–990	33	776–800	33
821–840	19	15	991–1020	34	801–825	34
841–880	20	15			826–850	35
881–900	20	16			851–875	36
901–930	21	16			876–900	37
931–940	22	16			901–925	38
941–990	22	17			926–950	39
991–1000	23	17			951–975	40
					976–1000	41

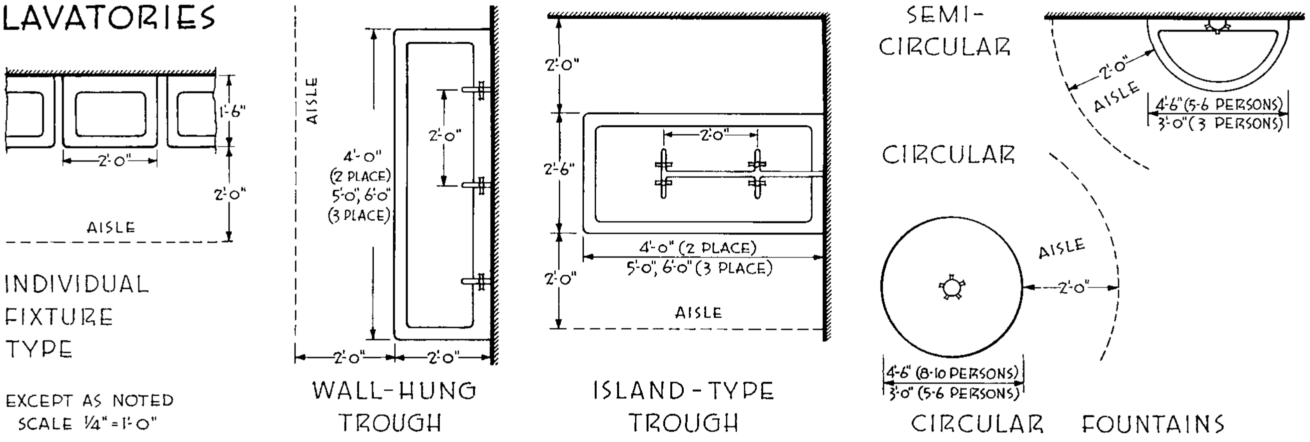
WASH FOUNTAINS REQUIRED

Number of Fixtures	Persons Accommodated By: 54" CIRCULAR (8 each)	54" SEMI-CIRCULAR (4 each)	36" CIRCULAR (5 each)	36" SEMI-CIRCULAR (3 each)
1	1–175	1–80	1–100	1–60
2	176–375	81–175	101–225	61–125
3	376–575	176–275	226–350	126–200
4	576–775	276–375	351–475	201–275
5	776–975	376–475	476–600	276–350
6	976–1175	476–575	601–725	351–425
7		576–675	726–850	426–500
8		676–775	851–975	501–575
9		776–875	976–1100	576–650
10		876–975		651–725
11		976–1075		726–800
12				801–875
13				876–950
14				951–1025

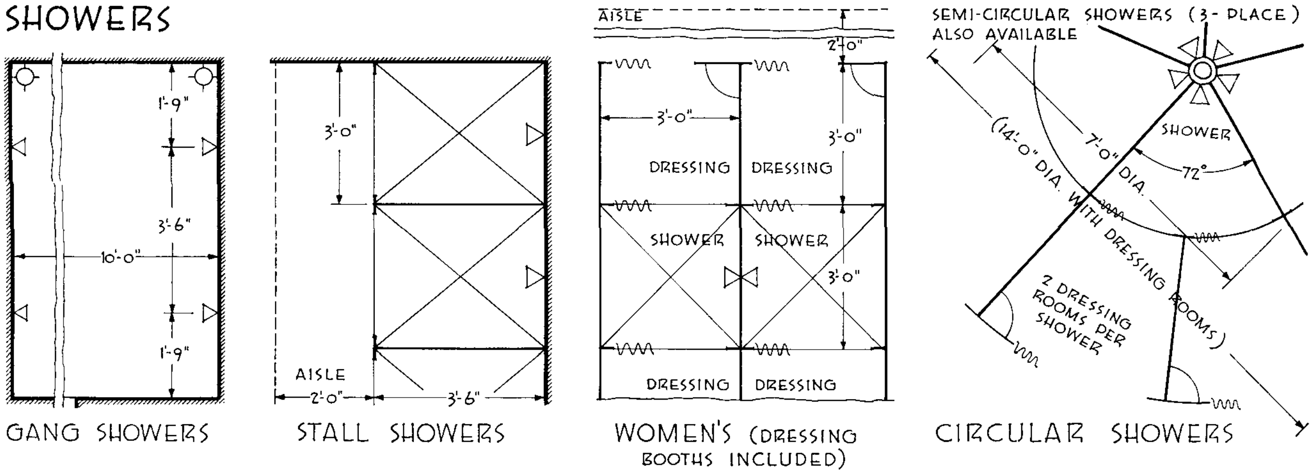
Courtesy Lockwood-Greene Engineers, Inc.

FACTORY TOILETS AND LOCKER ROOMS

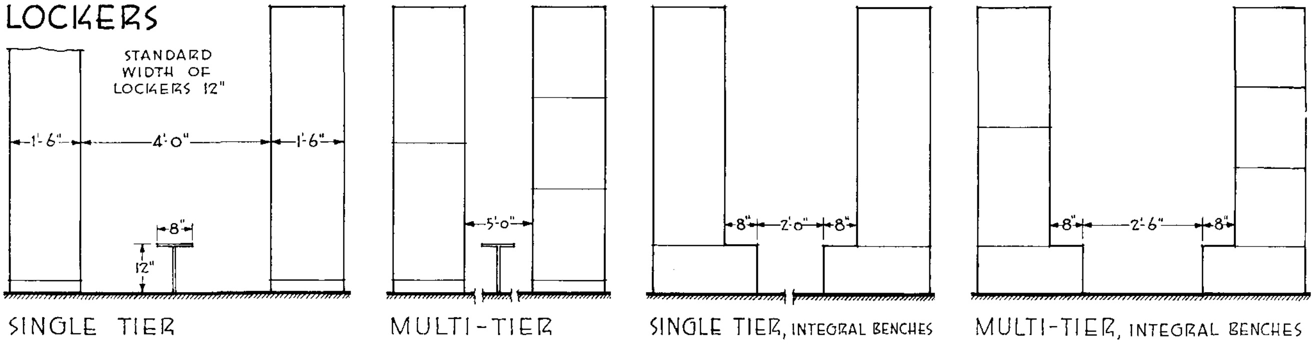
LAVATORIES



SHOWERS



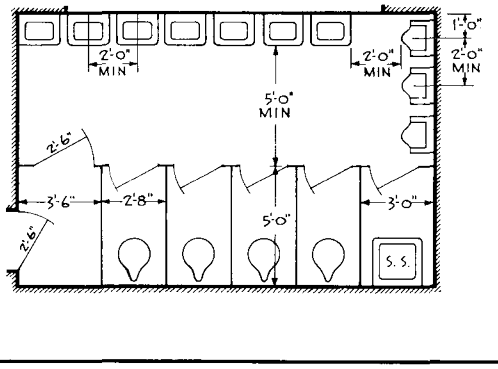
LOCKERS



TYPICAL MINIMUM TOILET CLEARANCES

(NEW YORK STATE LABOR CODE)

SCALE OF PLAN 1/8" = 1'-0"

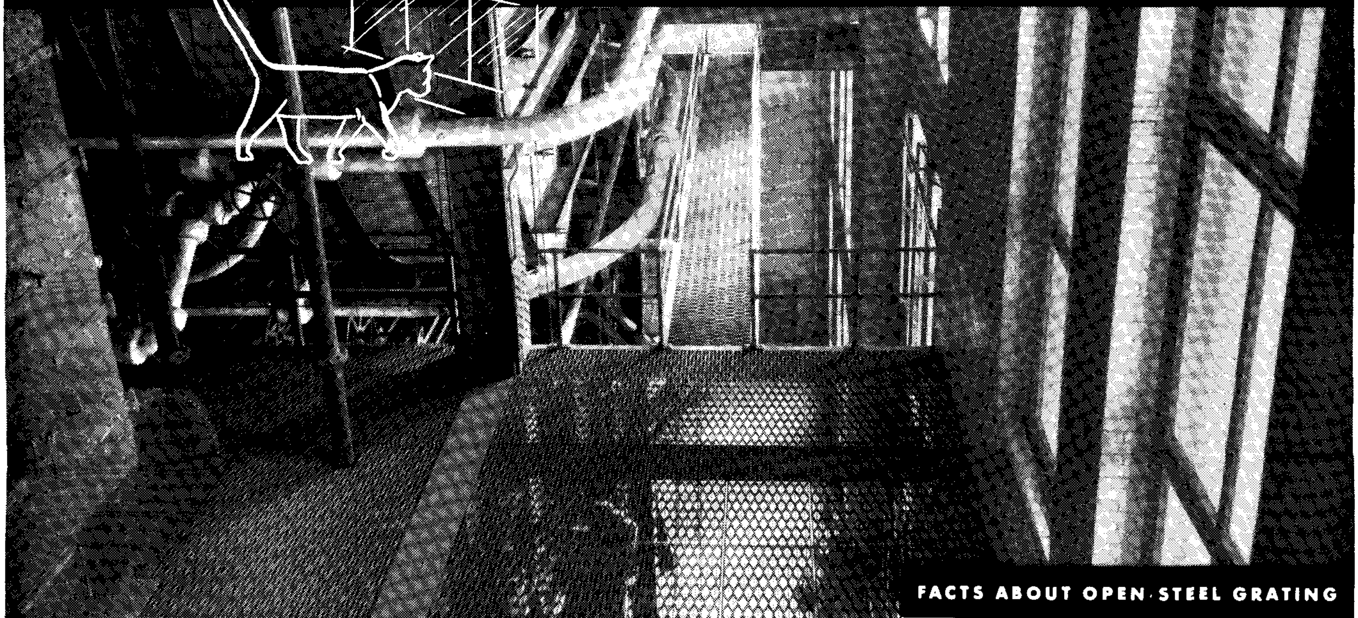


WOMEN'S DRESSING ROOMS REQUIRED AREAS			
PERSONS	SQ. FT.	PERSONS	SQ. FT.
0-4	NONE	300	640
5-10*	60	400	840
25	90	500	1040
50	140	600	1240
75	190	700	1440
100	240	800	1640
150	340	900	1840
200	440	1000	2040

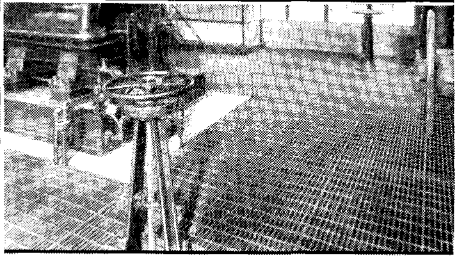
*BASED ON 2 SQ. FT. ADDITIONAL PER EACH ADDITIONAL PERSON OVER TEN (NEW YORK STATE LABOR CODE)

COURTESY LOCKWOOD-GREENE ENGINEERS, INC

THESE FLOORS DOUBLE AS WINDOWS



FACTS ABOUT OPEN STEEL GRATING



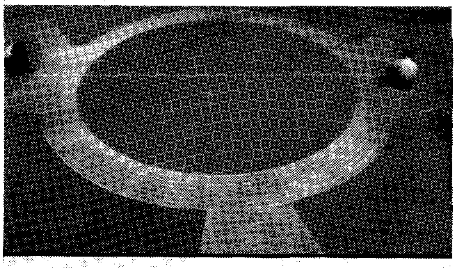
SELF-CLEANING. Open Steel Gratings do not accumulate dust, dirt, grease, oil or moisture. Their construction makes them virtually self-cleaning.

ONE of the primary functions of Open Steel Grating floors and steps is to admit air and light to the areas above or below their surface. No other flooring material performs both these functions in a manner as efficient. Not only does this strong, rigid flooring provide free circulation of air and escape of fumes, gases and heat, but it also admits light.

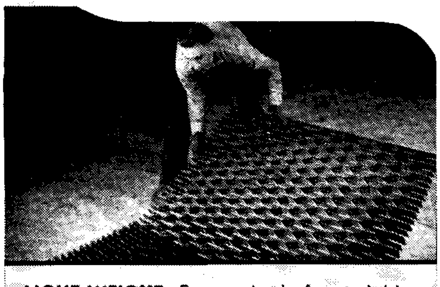
Open Steel Grating is permanent and durable. Because of its open construction, it does not accumulate dust, dirt, grease, oil or moisture. When used for outside walks it will not collect ice, snow or water. It is factory fabricated from a combination of structural members rigidly connected by riveting, welding or interlocking.

Open Steel Gratings are built to the requirements of the individual job, insuring fast and economical installation and a perfect fit. For more detailed information on this strong, non-slip, rigid flooring that admits the passage of air and light, write today for the free booklet shown below.

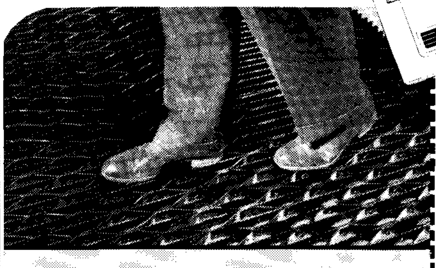
OPEN STEEL FLOORING INSTITUTE, INC.



ECONOMICALLY INSTALLED. Every section of Open Steel Grating is built to the requirements of the individual job. This factory layout insures speedy installation and perfect fit.



LIGHT WEIGHT. Every pound of material is used, with maximum efficiency to carry or distribute loads — meaning less dead weight, lighter supports, reduced erection costs.



NON-SLIP SAFETY. Open Steel Gratings cannot accumulate skid-inducing substances — provide an even, non-slipping, stumble-proof surface.

OPEN STEEL FLOORING INSTITUTE, Inc.
Dept. AR-141
American Bank Building,
Pittsburgh, Pennsylvania

Send me, without obligation, your new booklet, "New Ideas in Functional Floor Design."

Name ____________________

Address ____________________

City ____________ State ____________

NEWS OF MATERIALS AND EQUIPMENT

Figure 1

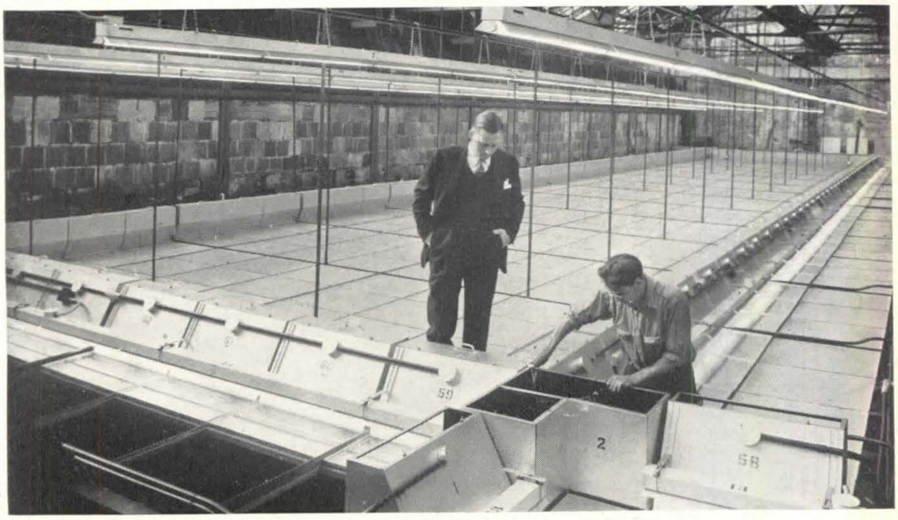


Figure 2

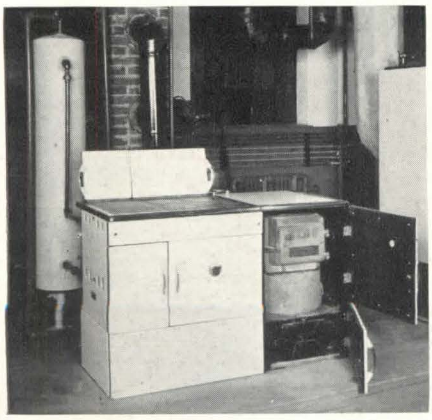


Figure 3

Corrugated Enamel Sheathing

A CORRUGATED ENAMEL sheathing is said to combine the advantages of formed roofing and siding with the corrosion-resistance, smooth surface, and color of porcelain enamel, and should be especially adaptable to industrial structures. The sheathing may be applied on steel or wood framing, solid roof decks or side wall surfaces; is finished, including edges and bolt holes, with white porcelain enamel inside and a range of colors outside. It employs a new type of lock joint to assure weather-tightness without chipped enamel. Sheets, machine-punched for fastening to a structure, are 24 in. wide after interlocking and come in standard lengths from 5 to 10 ft. Porcelain Enamel Steels, Inc., Cleveland, Ohio. (See figure 1.)

Natural Lighting System

A NEW SYSTEM of illumination that produces a daylight effect, announced recently, should have important applications in various fields from art galleries to industry. The outdoor light effect is gained by a special combination of incandescent and fluorescent lamps, which shine through a ceiling of heat-treated, water-white glass. Adjustment of lamp angles and special lenses control the highlighting of certain areas as desired. The system is in use in the Carnegie Institute Gallery in Pittsburgh. Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa. (See figure 2.)

Range and Heater in One

ROCK-BOTTOM heating-cooking cost for low-rent housing projects is the purpose of Anthracite Industries Laboratories in developing, with USHA, a combination hot-water heating boiler and cooking range, with water back, that burns coal. It is expected that the unit, not yet in commercial production, will heat a six-room house and can be produced for $125 or less. The heater is designed to be placed against the kitchen wall, with one flue for cooking and heating fires, and pipes to radiators in the other rooms. It will be insulated to prevent overheating of the kitchen. The finish is white enamel and chromium. Anthracite Industries Laboratories, Primos, Pa. (See figure 3.)

Mantles for Fluorescent Lights

A NEW PRODUCT which utilizes spun glass to reduce the glare of fluores-

(Continued on page 162)