THE ARCHITECTURAL FORUM

MARCH 1927

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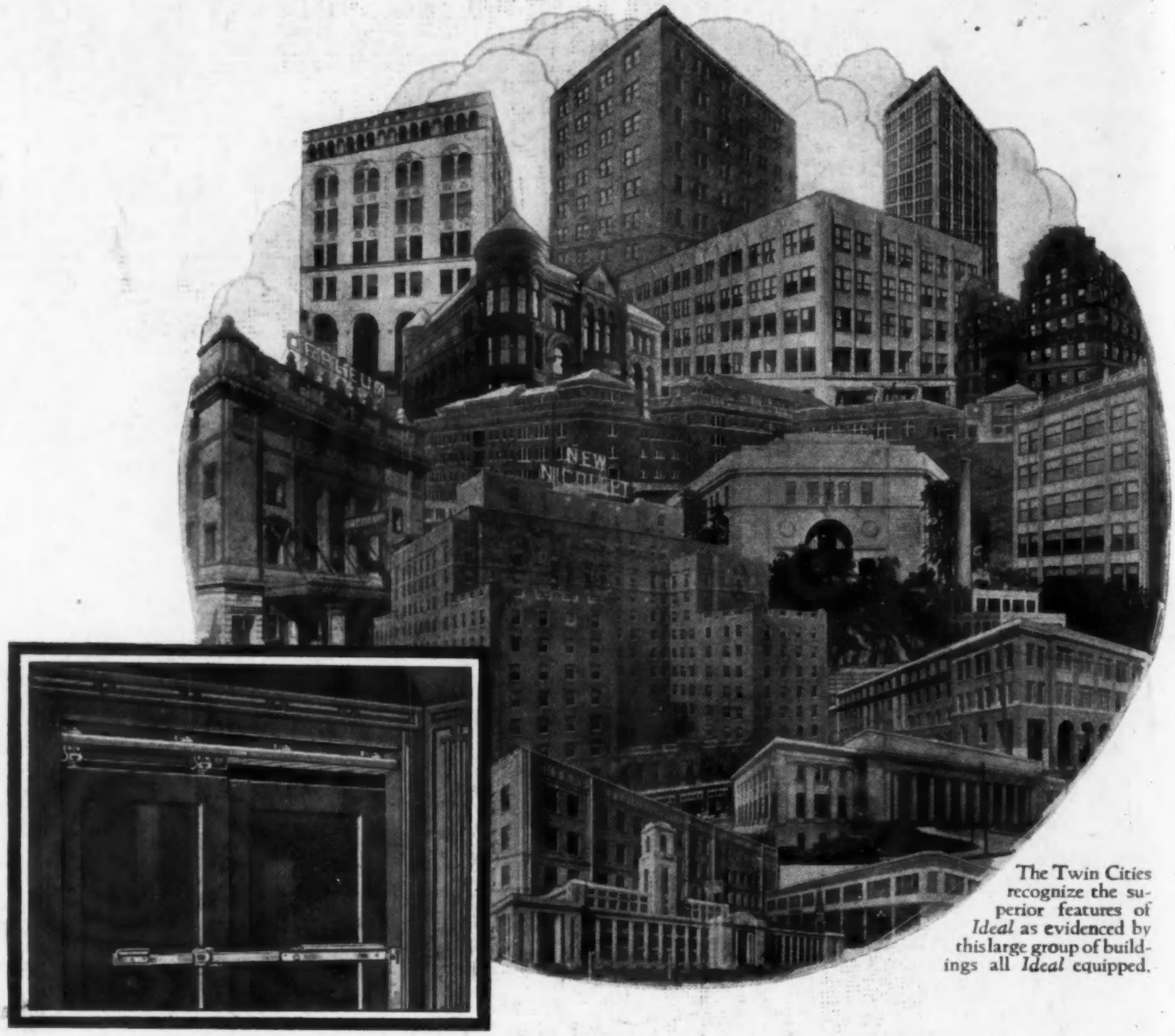

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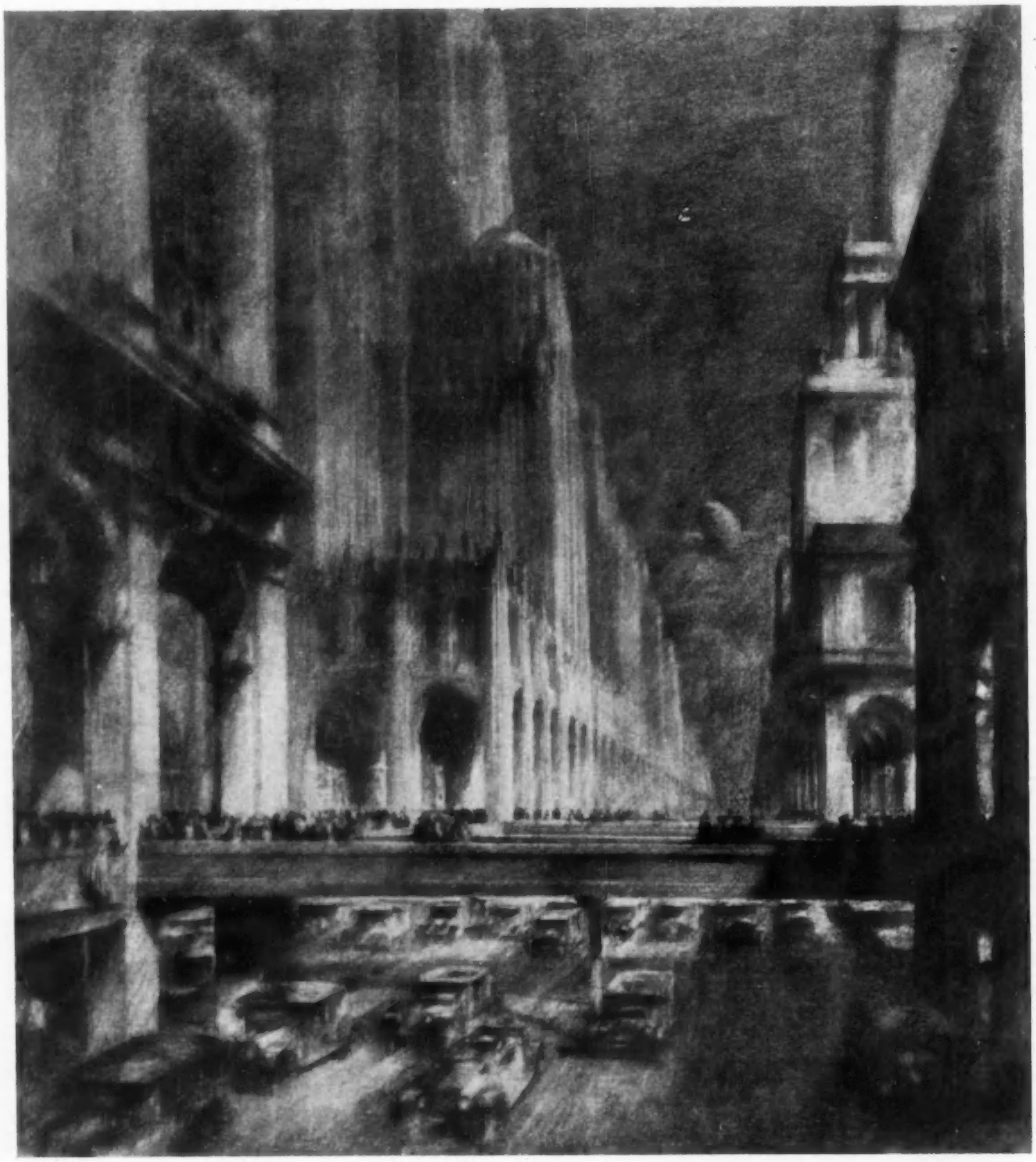


A VIEW IN THE NEW YORK OF THE FUTURE

FROM A DRAWING BY HUGH FERRISS

The
ARCHITECTURAL
FORUM

Volume XLVI MARCH 1927 Number 3

The Problem of Traffic Congestion, and a Solution

By HARVEY WILEY CORBETT

THE problem of planning for a city of the size and growing international importance of New York is so great, so involved and so complicated, embracing as it does so many and varied interests subject to multiple and diverse influences, that in order to make a beginning one must start by setting down certain limitations and then confine one's efforts within these limitations. In doing this, I realize that it necessarily excludes from consideration an infinite number of things which could and very properly should bear upon the problems I have in hand. I do not wish to underestimate or belittle the importance of any of these. In fact, before proceeding with this problem and defining the limitations under which I propose to work, I vigorously recommend that the fullest study be given to such general principles and fundamental considerations as:

1. The possible increase in the stringency of the "zoning for height" law, so that the bulk of future buildings may be limited, thereby limiting to some degree the increasing congestion in the streets, which naturally results from this increasing bulk.

2. The possible increase in the number and extent of "residence zones," so that workers may be nearer their places of employment, and the city thereby saved the economic waste resulting from transporting a great part of its population twice daily,—down town every morning, and home every evening.

3. The possible increase in "zoning for use," so that various types of manufacturing may be grouped with reference to the hours of workers, and to the movement of raw materials and finished products.

4. The possible application of the zoning idea to the complete elimination of certain types of manufacturing from the Borough of Manhattan; to the placing of theaters and places of public assembly at distances from each other great enough to avoid the crowding that now occurs in our present theater center; and to the purchase by the city of many small squares in "dead" zones, for the creation of small parks, which in New York are now lamentably few.

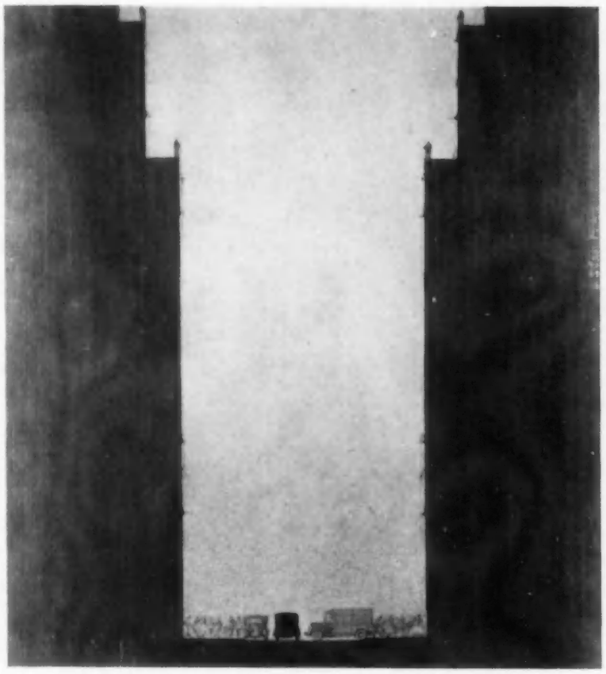
5. Possible increase in the police powers for the further control and regulation of street traffic; extension of the "pulsating" system for all crossings; regulation of hours for truck and van movements; limitation in the number and use of taxis and pleasure cars, with certain zones and hours for their use; limitation in the use of gas-burning motor engines; and even the possible ultimate requirement that deliveries and parking must be done within building lines, not on public streets,—a detail of great importance.

I believe that all of these principles,—and many more developed by engineers, sociologists, town planners and statisticians,—will eventually be put into effect. I find it difficult in discussing this subject to avoid drifting into these very questions, as the solutions they offer seem so alluring. We all have ideas along these lines and would be glad to offer them for whatever they may be worth, but we still feel that in spite of all these ideas being put into effect, the fundamental problem still remains unsolved. My belief is based upon the fact that a city is composed of human elements which may constantly present changing equations. The city may be likened to a living body, with arteries, veins, and capillaries. As the corpuscles of the blood carry the nutriment through the arteries, slow down to deposit it in the capillaries, take up the waste and carry it away through the veins,—so, metaphorically speaking, do the various forms of conveyance in the city carry the people and freight, which are the food of the city, through the avenues, slow down in the side streets, stop and deposit their loads in the buildings, take up new loads, and again continue the cycle. This movement of traffic is just as essential to the life of the city as the movement of the blood is to the life of the body. Thin traffic like thin blood represents an anæmic condition. Congested traffic, like excessive blood pressure, threatens the health of the body, that is to say, the normal and proper growth of the city. I view city planning as the study of the city's proper growth, and with this in mind have set down these limitations as what, after very careful study seem to be to be a basic method of procedure:

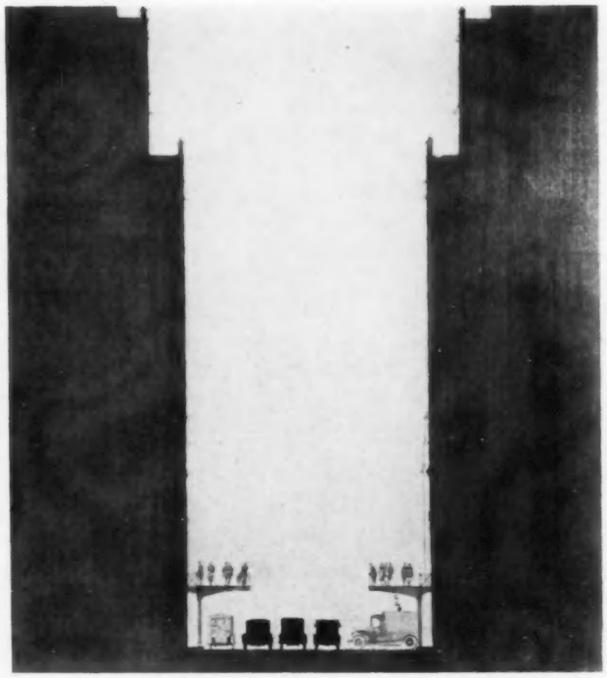
1. Increase in population and bulk of buildings, which is both necessary and desirable.

2. Fast movement of traffic of all forms, which is essential to healthy growth.

I feel that I must limit myself to the study of the physical aspects of the city as determined by these



Present Condition on an Average Street



First Step toward Improvement

two basic principles. Growth,—why is it both necessary and desirable? It is necessary because it is an essential element in the continued vitality of a city. The "dead" portions of any city are those which are not growing—i.e., not increasing in number and bulk of buildings. It is desirable because a great concentration of population in the business heart of a world city like New York makes for efficiency in business relationships and coöperative effort. Representatives from every part of the world can be in close business and personal touch with those from every other part. Circulation,—why is it necessary to growth? It is necessary because lack of it has already shown, in many sections of New York, that growth will stop for lack of food,—people and freight,—and a locality once "dead" is difficult to revive. Growth in number of buildings increases congestion in streets. Opening up the streets to relieve congestion makes way for increased circulation and for increase in number and bulk of buildings, and what seems to be a "vicious circle" is created. Can some method be devised whereby growth and open circulation can both continue without the one operating against the other?

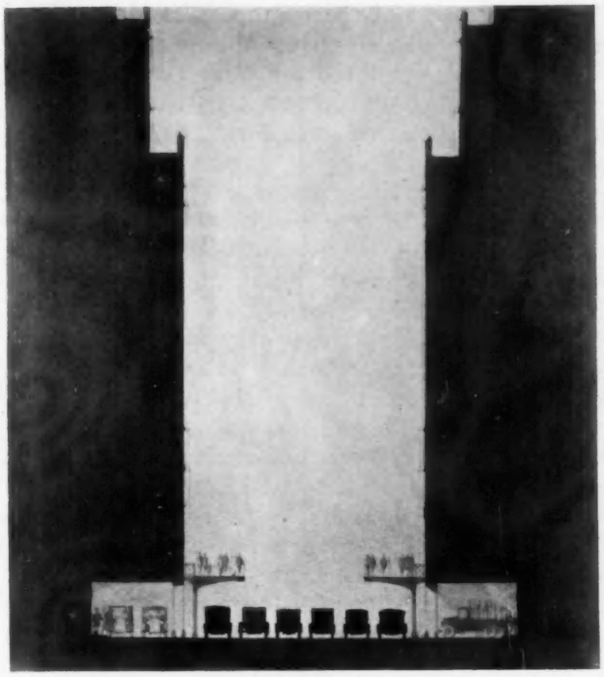
A study of the relation of building areas to street areas shows that in the standard "gridiron" section of New York for every acre of building area there is a half-acre of street area. This seems to be the largest proportion of street area to building area to be found in any large city in the world outside the United States. Therefore, I suggest this further basic policy as a guide to efforts in city planning, that the general relation of building area to street area should be kept as it is. Widening existing streets or cutting new streets is always a "capital operation," because to be of any real value the widening or cutting has to extend for long distances and involves an endless number of individual property owners. To retain existing property lines, in principle, even though the city increases the restrictions over what may be done within those lines, is always simpler than any attempt to change those lines. I therefore question the desirability of a wholesale cutting of new streets or a widening of present streets, but since the city must grow, the streets must be increased in capacity, and since they can't be widened or increased in number, some form of double decking must be used. The double decking of streets is not a new idea. Leonardo da Vinci proposed it in a scheme to replan Milan. Most European cities have portions in which streets are at differing levels and have some form of double decking. Chicago has an important boulevard which is double decked for a considerable distance. But before proposing a system of double decking for the streets of New York it would seem only proper that a very careful study be made of traffic to determine if there is not a rational division or separation in the various forms of traffic, which could become the basis of determining the form and character of the double decking. I find that a careful analysis of traffic in all its forms leads one to the inevitable conclusion that it is of these three different and distinct types:

Foot: All forms of pedestrian traffic.

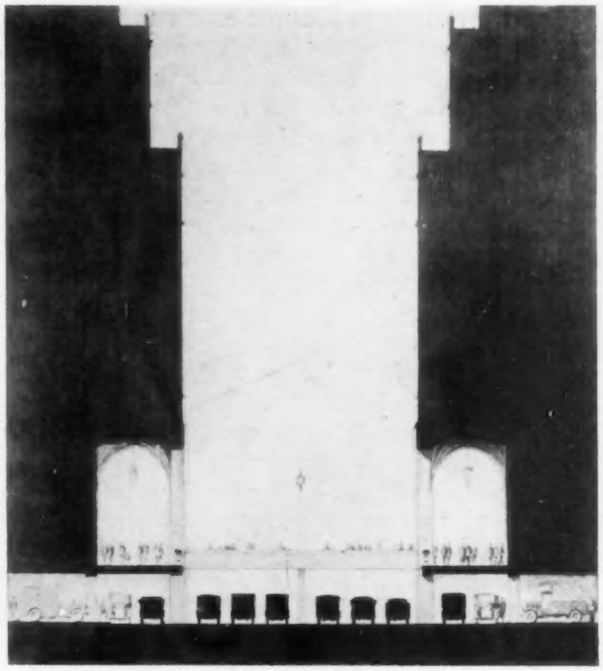
Wheel: All forms of vehicular traffic.

Rail: All forms running on fixed rails.

I feel, furthermore, that in the congested centers of the city, at least, these three forms of traffic (the horse is eliminated from consideration in the city) do not belong on the same level. It has been accepted as axiomatic that the "grade crossing" of roadway and railroad is a serious menace. Rail and



Parking Space Provided beneath Buildings



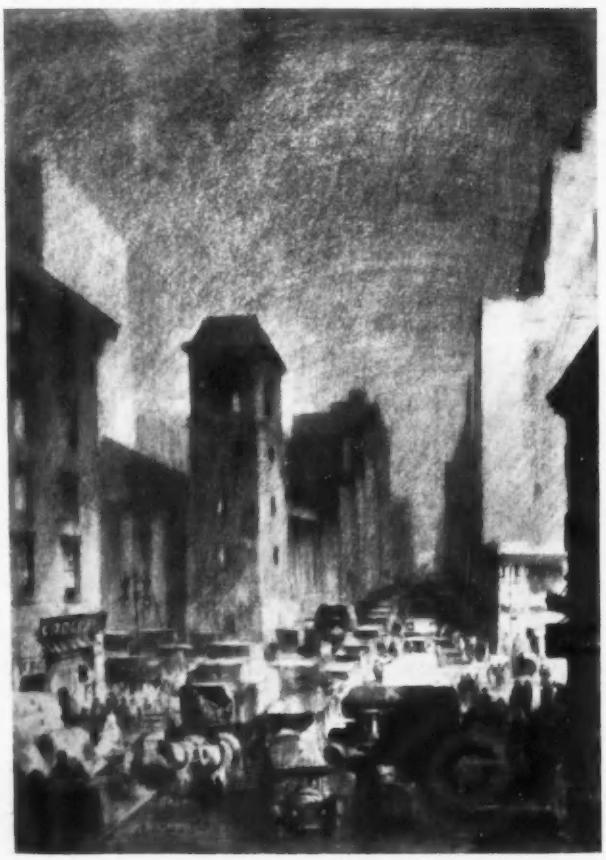
Arcaded Sidewalks within Buildings

wheel do not belong on the same level at the same point. Why should not this principle apply to wheel and foot traffic? In the United States over 12,000 people were killed by automobiles in one year. One can imagine the much larger number injured and maimed! It seems logical that some steps should be taken to correct a condition that each year becomes more serious. I find in studying these three forms of traffic,—rail, wheel and foot,—that rail, in its present form, at least, is the heaviest in weight, wheel next, and foot, of course, the lightest. Furthermore, of the three forms, wheel has increased beyond the bounds of all imagination, and is continuing to increase at a rate no one would attempt to estimate. On the other hand, rail traffic as a freight carrier, within the city, is certainly becoming less and less important, and as a passenger carrier, except in subways, is beginning to give place to wheel. It seems rational, therefore, in any scheme proposing to divide traffic into its three natural divisions through a process of double or triple decking the streets, that we start by placing the wheel traffic, the largest and most rapidly growing, on the present street level, which is already there and requires neither to be dug out nor built up; that all rail traffic be placed underground, as subways; and that foot traffic be raised one story above the street level, carrying bridges across at all corners, and at one or two points in the long blocks as well, so that people can move uninterruptedly throughout as large a district as is covered by the expansion of the double decking idea. Double decking, while difficult, is not impossible.

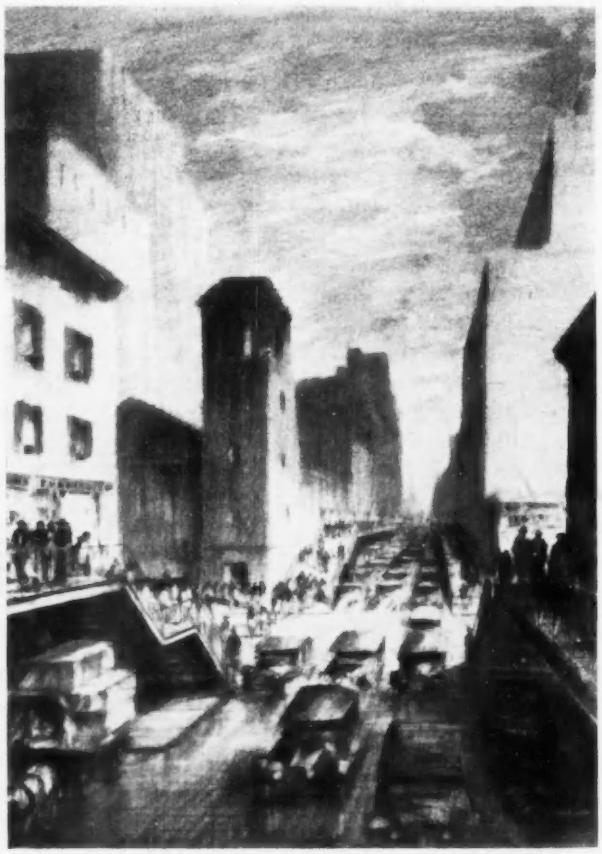
I recognize the almost insurmountable difficulties of the problem and the very radical nature of the suggested solution, and yet I believe such a solution can be brought about by a very gradual process which will make it possible of realization. The most serious criticism of this proposed division of traffic in levels is not aimed at the principle of division; everyone seems to concur in the basic theory that such a division is sound logic, but it is aimed at the position given to the rail traffic. The idea that all future city population must spend a portion of each day underground where the air is of doubtful freshness, to say the least, and where artificial light is the only possible kind; that thousands would move from their homes into these holes in the ground, come out only to enter artificially lighted offices and then return to the underground and back to their homes after dark; that the one chance of most of the workers for getting a little fresh air and daytime outlook would be lost for six days a week;—these ideas are repugnant to every student of this problem. However, everyone agrees that rails could not remain on the streets or over them in elevated structures as at present, and they must go down, or else go far up, as has been proposed and is now being seriously developed, in so-called "airways," i. e., light suspension bridges of open construction supported by pylon buildings at station points, the rail level being so high, 200 feet or more above the city, and the type of car so light, that none of the objectionable features of the present "elevateds" would be retained. The real point about rails is that they must "go out of the picture" as far as the visual aspect of the streets is concerned. That matter has become a transit problem, on which many experts are now engaged. While I have many ideas on the subject, such as that just cited of a natural objection to subways, I do not consider transport by rail as part of the immediate problem. The division of traffic proposes to gradually remove all rails from the streets, so that *where* they go does not concern us in solving the highly difficult and complex problem of traffic.

Before outlining in more detail this process of traffic division and the steps one would take in accomplishing the desired result, let us look for a moment at the future city. Let us assume that the steps suggested here have been taken, and let us see if the desired result is worth the effort we all realize must be made to achieve it. We see a city with sidewalks, arcaded and with solid railings. We see the smaller parks of the city, of which we trust there will be many more than at present, raised to this same sidewalk-arcade level, public parking space for autos being provided underneath, and the whole aspect has become that of a very modernized Venice, a city of arcades, piazzas and bridges, with canals for streets, only the canals will not be filled with water but with freely flowing motor traffic, the sun glittering on the black tops of the cars and the buildings reflected in this waving flood of rapidly rolling vehicles. From an architectural viewpoint, and in regard to form, decoration and proportion, the idea suggests all the beauty, and more, of Venice. There is nothing incongruous about it, nothing strange. The New York of the future, thus adapted to the requirements of a far greater population, is no stranger than the New York of today. But it will be infinitely more convenient and harmonious. In Venice there is the adaptation of a city to the necessities of the site on which it is built. The New York of the future will be an adaptation of the metropolis to the needs of traffic, freeing the city from the unsightly congestion and turmoil of the present. Pedestrians will move about through arcaded streets, out of danger from traffic, protected from the snows of winter and the glare and heat of the summer sun. Walking would become a pleasure, instead of, as it is now, one of the most hazardous of occupations; shopping would be a joy; the over-wrought nerves of the present New Yorker would be restored to normality, and the city would become a model for all the world. This seems worth while, worthy of a great effort, and it certainly warrants a trial,—provided, of course, that it accomplishes what we start out to accomplish, viz.:—a system of traffic division so perfected that the city can continue to grow and the streets can still take care of the increasing traffic.

If street capacity is to keep pace with the increasing number and bulk of buildings, an elastic method of enlarging the street capacity must be provided. How can this be done if streets are neither to be widened nor increased in number? I find in certain sections of New York, where buildings are now up to and beyond the bulk limit set by the zoning law, that traffic, in spite of one-way direction and many other stringent police regulations, still moves,—although it moves haltingly. I believe that if the existing capacity of such streets could be increased, say, several hundred per cent, the process being gradually applied, we would be safe in assuming that suffi-

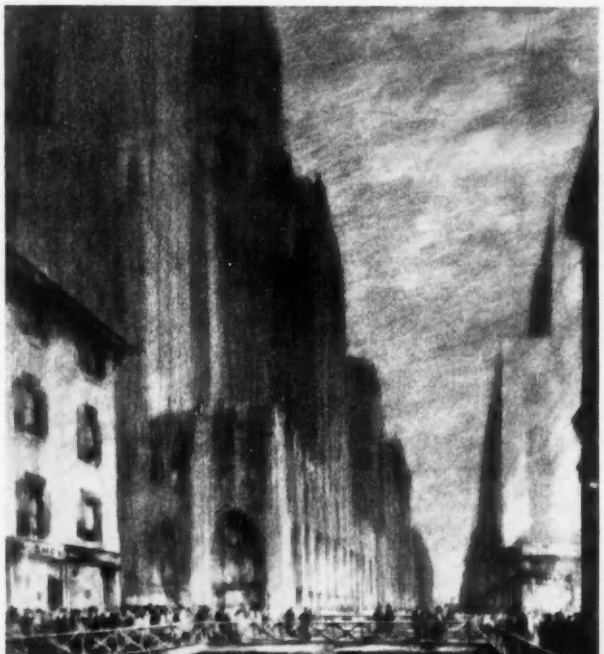


Present Condition of Traffic Congestion

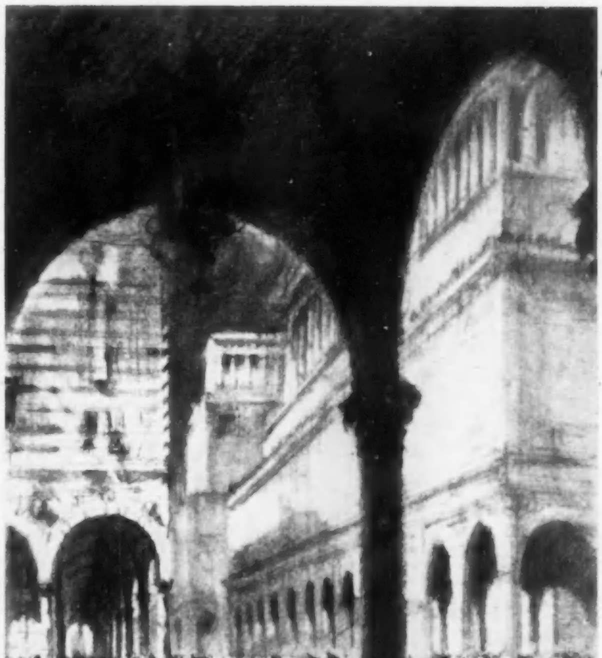


Elevated Sidewalks Provide Wider Roadways cient capacity is assured for all time. Can such an increase of capacity be secured? Let us examine conditions in a typical cross street in the gridiron section, such as one finds between Fifth and Seventh Avenues in the thirties. Here we have only one-way streets, 30 feet from curb to curb. In order for business to continue, vans must stop in these streets, to load and unload, other trucks and vans must move through, autos must park at least temporarily. Even the casual observer notes that these streets are not only one-way, but that *one machine at a time* can barely get through! This one machine is often stalled for several minutes during which there is no movement whatever, and this is not caused by the stoppings at the corners for north and south traffic, but merely by stopping necessary to the life of that particular block. Assuming, then, that these streets at congested hours have only a one-machine roadway left open, that means that the effective street space is only at the most 10 feet wide. Let us now take the first step in this contemplated change of levels, and build a raised sidewalk the length of the block on both sides. This could be constructed on piers built a foot or two from building lines. The old sidewalks become additional street areas, the necessary room for loading and unloading vans and parking autos is provided, and the portion of street left free for moving traffic is increased from 10 to at least 30 feet, an increase in capacity of 200 per cent! Let us assume that this in turn becomes crowded in time. What is the next step? A law is passed, along with a building act similar to many already on the statute books. regulating the height of the second tier of beams of all future buildings in certain zones, also a fixed spacing of column points, and a certain clear arcade height on the second story level. When a block has been rebuilt (not so long a time as one might imagine, when one sees the rate at which buildings change in New York), the temporary cantilever sidewalk is removed, the new arcade sidewalk opened, and the space under the sidewalks opened for vans loading or unloading or for motor parking. The street width available for moving traffic has widened to 60 feet, an increase of 300 per cent, making a total of 500 per cent. Supposing even this to become crowded, what is the next move? Additional area under the buildings is taken for all motors at rest, the space under the arcaded sidewalks is taken for slow-moving traffic, and the street width has been increased in capacity by another 200 per cent!—and the process can continue, thanks to the fact that the foot traffic area has been raised, *ad infinitum*. In fact, it could continue until the entire surface under the buildings is available for traffic, if ever such a condition should demand it, and it is not impossible that it may.

We have been considering only a narrow cross street and have shown a method of gradually increasing its effective traffic capacity up to and even beyond 700 per cent! All this applies with equal or

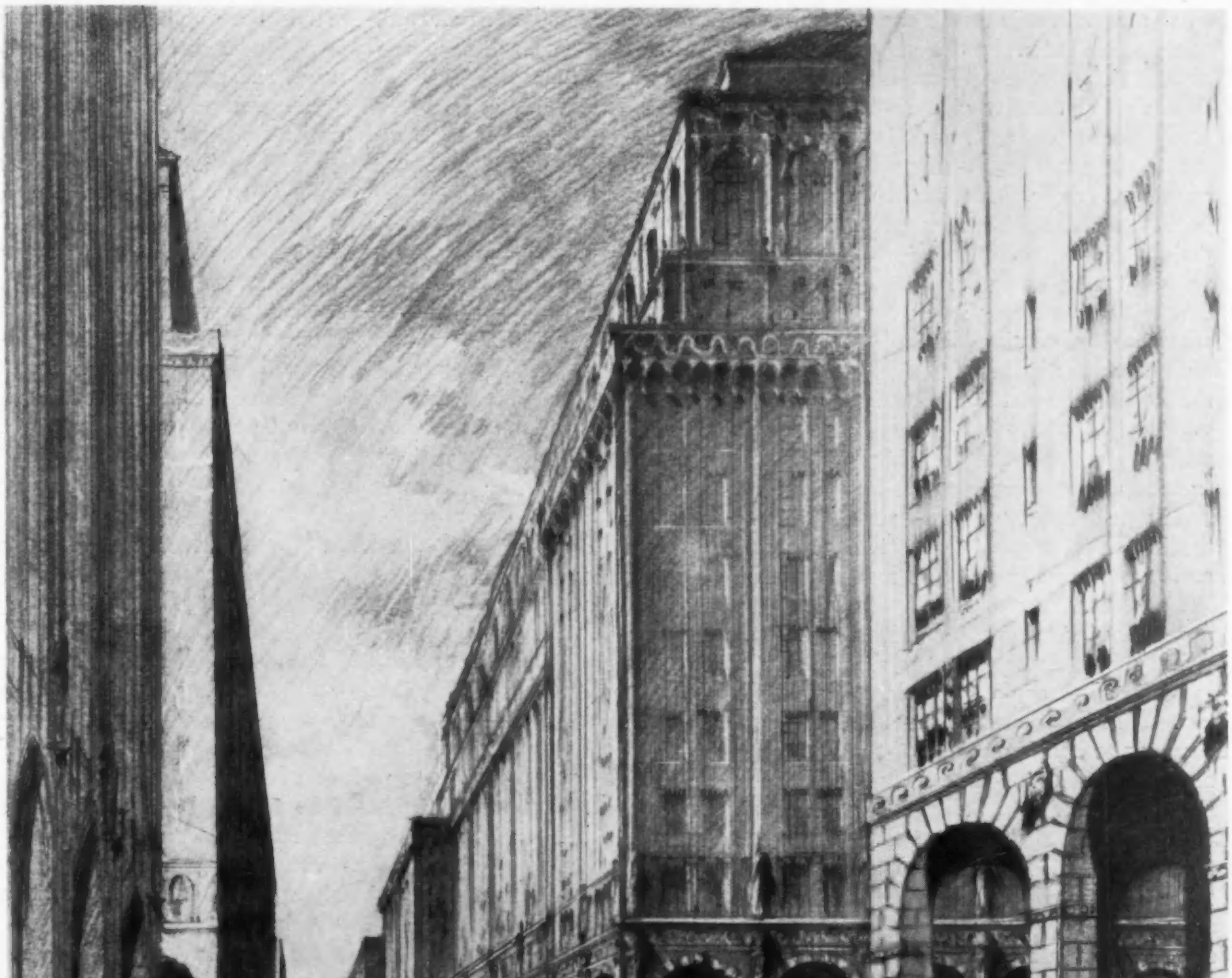


Raised Sidewalks and Bridges Provide Safety and Street Space



Possible Architectural Treatment of Sidewalk Arcades

ELEVATED SIDEWALKS AND BRIDGES ACROSS AVENUES AND STREETS PROVIDE UNINTERRUPTED FLOW OF TRAFFIC



AN AVENUE OF THE FUTURE, SHOWING ELEVATED SIDEWALKS, PASSENGER CAR ROADWAY, AND TUNNEL FOR TRUCKS greater force to the wide north and south avenues of the city. Their traffic capicity could be increased to the same extent by the same gradual process. But, as Mr. F. A. Delano has pointed out, this still leaves unsolved the conflict of *slow*- and *fast*-moving vehicular wheel traffic and, what is even worse, the crossing at the same grade of north and south with east and west traffic. He, therefore, proposes that the north and south arteries of Manhattan Island be double decked their entire width, providing thereby an uninterrupted upper level for fast-moving vehicles with connecting ramps to the lower level only at such points as the wide cross streets, such as 14th, 34th, 57th, etc. He further says that in undertaking this work we must begin where we can do the most good and where the need is greatest. The avenues near the water fronts are ideal places to undertake the high level development, because there the high level will extend the view over the water, and there the low level is needed for the trucking of freight and for the heavy rail and steamship traffic.

I am favorably disposed to this suggestion of the upper level boulevard or motor speedway along the rivers which flank the city. These marginal streets in most cases are very wide. The elevated speedway could be extended from the building line on the city side to half the width of the marginal street and provide an ample speedway. Furthermore, this speedway, being at the edge of the city, so to speak, would not have to be crossed to any great extent by pedestrians, it being years before the raised pedestrian level would be likely to extend to these river streets. Ample room could be found for the occasional access ramps from the general wheel level of the city, and because of the narrow shape of Manhattan Island, such an elevated marginal speedway would be easily accessible for fast-moving long distance traffic from any part of the city. I do not view with favor the idea of double decking, even in the distant future, of all north and south avenues. I feel it to be a wrong principle to close over these streets from building line to building line and to depend for ventilation of the space underneath, where the slow-moving and heavy gas-burning trucks would travel, on the narrow openings at the cross streets, and to rely on artificial illumination as the only means of making the lower level possible for traffic. Is there not some other effective way of separating slow and fast wheel traffic and of avoiding the conflict at the same grade of north and south with east and west traffic?

I concede that the pulsating system of traffic regulation, even when extended to the whole city, is still far from perfect and is now, even on Fifth Avenue, the cause of the most serious blocking of traffic that occurs. Let us examine for a moment the possibilities offered by some form of "basket weaving" the streets at the crossings. Remembering again that the foot traffic level has been raised, and that of necessity, the shopping level, store front level and business level have all gone up with it, one of the principal obstacles to "basket weaving" the streets has been removed,—that is the objection to a varying level of store fronts. Under our present system of street, sidewalk, and store front all on the same level, any change of grade such as occurs when one street passes over or under another, creates a condition bad for appearance and bad for business. But by raising the people and the shops we should have only the traffic to deal with, and "basket weaving" the crossings becomes comparatively simple, with the result that a motor could then move from any point in the city to any other point at any time without a single stop. I do not attempt to estimate what percentage of increase this would mean, but anyone who has noticed how rapidly a street clears when interruptions cease must realize that such a system would probably be the greatest factor of all in facilitating traffic movement. Now as to fast- and slow-moving traffic, two methods are possible,—one, that of reserving certain avenues for fast-moving traffic, as Fifth Avenue is now, and another that of reserving the central spaces of all avenues for fast-moving traffic. When one realizes that the effective width for moving traffic has been extended from building line to building line,—and that carrying half of each cross street under the avenues leaves the full effective width free for uninterrupted movement, it seems as if zoning the middle of the road for the faster moving vehicles should be sufficient to overcome the conflict of slow and fast traffic.

In conclusion, I believe that there is offered in these suggestions a solution of the traffic problem of New York, particularly of Manhattan Island, which is sufficiently comprehensive to meet all contingencies,—sufficiently gradual in its progressive development to be possible of realization. I therefore recommend to all groups of town planners that the basic principles of which I give a concise resume be adopted by all in the development of plans for the particular districts under their control.

BASIC PRINCIPLES

1. Growth of the city is necessary and desirable.
2. Circulation is essential to healthy growth.
3. Streets in their present area and number should be made sufficiently elastic for circulation.
4. Growth of streets is provided by traffic division.
5. Traffic division falls naturally into three levels, —foot, wheel and rail.
6. Foot traffic goes up one story, and takes sidewalks, shops and small parks with it.
7. Wheel traffic stays on the street level, extending under buildings to meet growing demands on capacity.
8. Rail traffic goes underground or up in the air and becomes a special transit problem outside the province of the architects.
9. Long-distance fast-moving north and south traffic is to have marginal elevated speedways.
10. Traffic interruption to be ultimately eliminated by what is termed "basket weaving" the crossings.

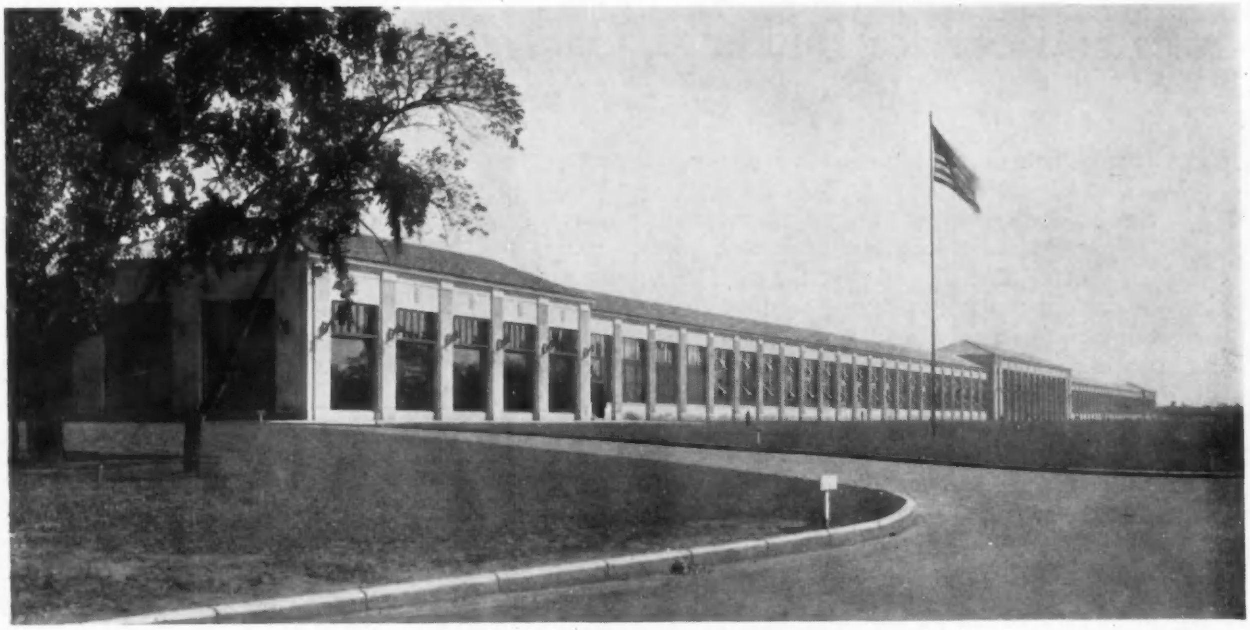
Sales and Service Buildings, Garages and Assembly Plants

By ALBERT KAHN

THE growth of the automobile industry has been the marvel of the past 20 years. Prophecies anent the futility of trying to make the horseless carriage move long ago took their place with the dodo and other like relics of the past. Even the more modern prophecies having to do with the "saturation point" have been very nearly forgotten. As the far-visioned man who conceived one of the vast automobile manufacturing groups remarked years ago, "there is no such thing as the saturation point." So the making and selling of motor vehicles for both pleasure and business goes merrily on, and no reason presents itself as yet for believing that any marked cessation in automobile manufacturing will take place. It was not commonly recognized in the early years of the history of the automobile industry how great a part the motor car would play in our transportation development. As we have come to realize that the business of transportation is the great keystone of our whole industrial structure, we have also perceived that the greatest single factor in the business of transportation is the self-propelled or motor vehicle, whether it be truck, motor bus or private motor car. The function of the railroad is becoming more that of carrying the long-haul traffic.

As automobile producing began to assume large proportions, the problem of the retail marketing of the product and the necessity of providing facilities for the care and repair of cars in the purchasers' hands became so great that it is not surprising that

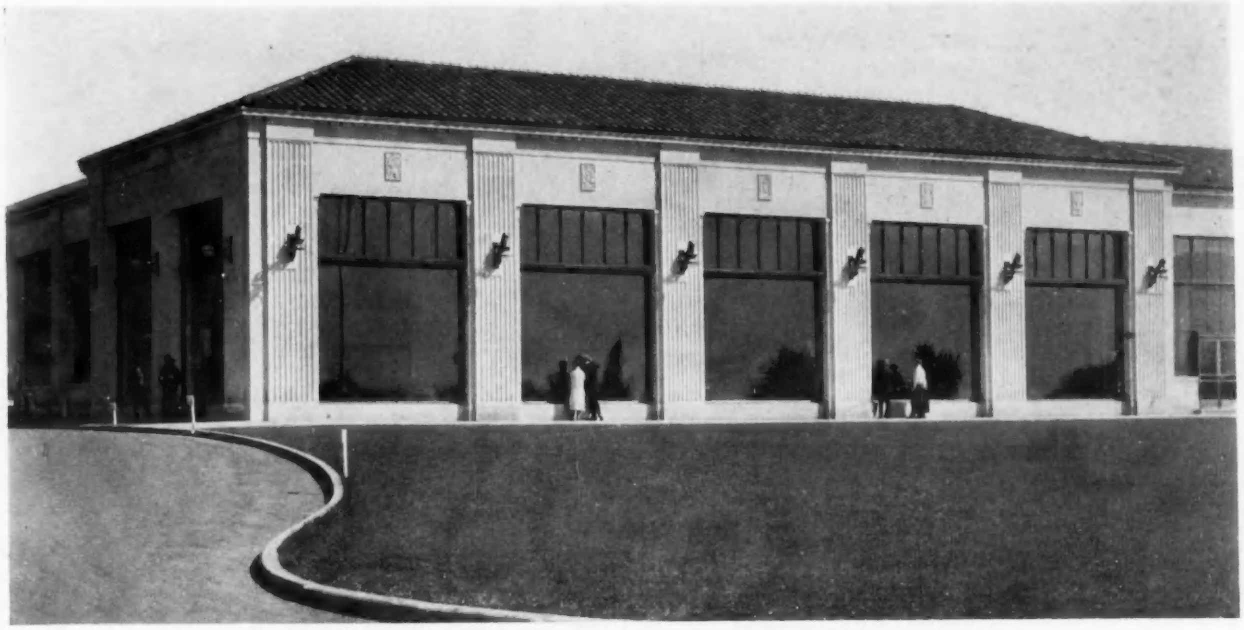
Ford Motor Car Company Sales and Service Building, New York
Albert Kahn, Inc., Architects



Ford Motor Car Company Assembly Plant, St. Paul
Albert Kahn, Inc., Architects

manufacturers were glad to shift this burden from their own organizations to those of dealers who conducted their own stores and garages. Very few of the manufacturers of motor cars now conduct their own service stations, although they must exercise a measure of control over them and in many cases possess a direct financial interest. It is, therefore, necessary to consider two distinct types of building devoted to the sale and upkeep of cars, as well as a separate type used by some companies as branch manufacturing buildings. The first type of sales and service building is that devoted exclusively to the sale of cars and their attendant service. Interesting show rooms are a part of such buildings. It is, of course, advisable that new cars be shown separately from used cars. Thus a secondary show room is required, —naturally of lesser importance architecturally, however important it may be from the standpoint of the dealer's profit. Accompanying such a sales room group will be found, in most cases, a garage and the necessary office space. In common with the experiences of manufacturers of automobiles who have found it desirable to eliminate, as far as possible, the vertical transportation of bulky materials, the modern service building is likely to be a single-story structure spread over a considerable area of ground. In some instances such structures are two or three stories high, depending on ramps rather than on elevators for transportation of cars from floor to floor. In truth, the extensive use of ramps in this type of

Workshop, Ford Motor Car Company Assembly Plant, St. Paul
Albert Kahn, Inc., Architects



Ford Motor Car Company Exhibit Department, Assembly Plant, St. Paul
Albert Kahn, Inc., Architects

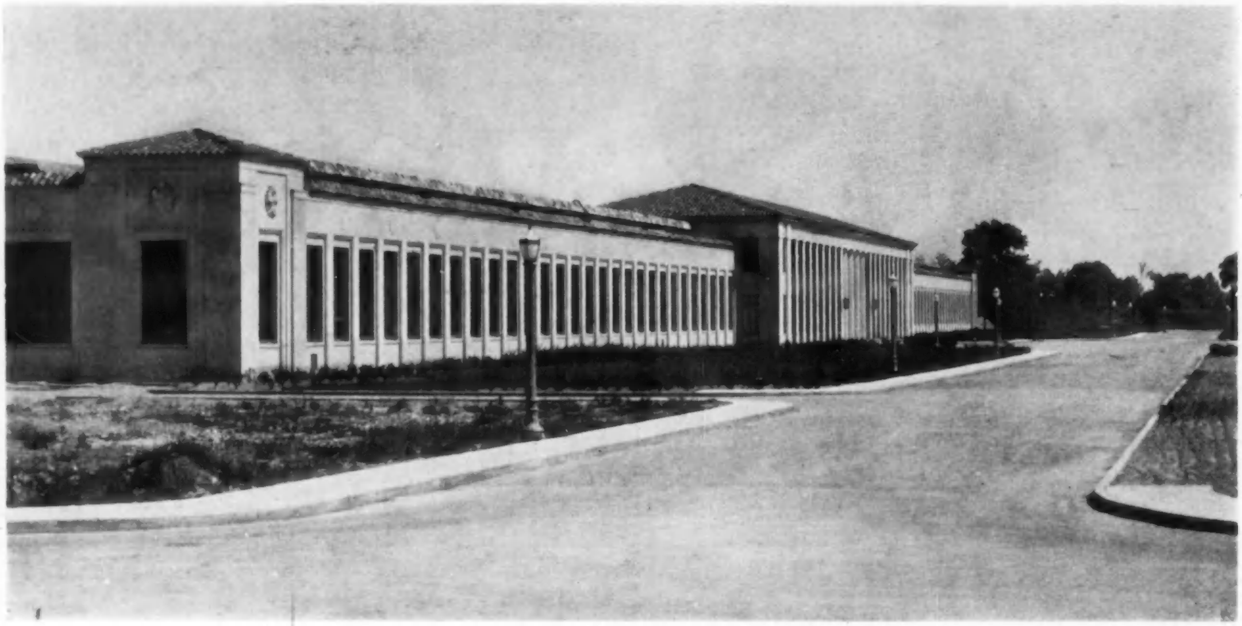
building is a striking example of modern adaptation to changing conditions. The plan of the Richards-Oakland Service Building, now under construction in Detroit, shows a typical example of the use of ramps.

The problem of servicing the automobile is so important that dealers usually endeavor to provide well for this particular feature of their work. In congested localities, where land is particularly valuable, it has been found desirable to separate the sales and service departments in different buildings. Thus, we find a building like that of the Packard Motor Car Company of New York, which is now being erected on Eleventh Avenue, and near by a similar structure erected a few years ago for the Buick-Oakland Companies' service. The use of different parts of the same building by two different makers of cars, as in the case of the Buick-Oakland Service Station, is exemplified in a much more striking manner in the case of the General Motors Building in Detroit.

Plants for the manufacture of motor vehicles resolve themselves into two types. In the one we find a large central factory, where the entire product is manufactured. The factories of the larger and higher priced cars generally come under this head. In the case of the makers of smaller cars, such as the Ford and the Chevrolet, we find that much of the product is manufactured in one plant and assembled in different plants scattered about the country.

The modern tendency toward the building of one-story structures, located in places where the price

Exhibit and Sales Room, Ford Motor Car Company Assembly Plant, St. Paul
Albert Kahn, Inc., Architects

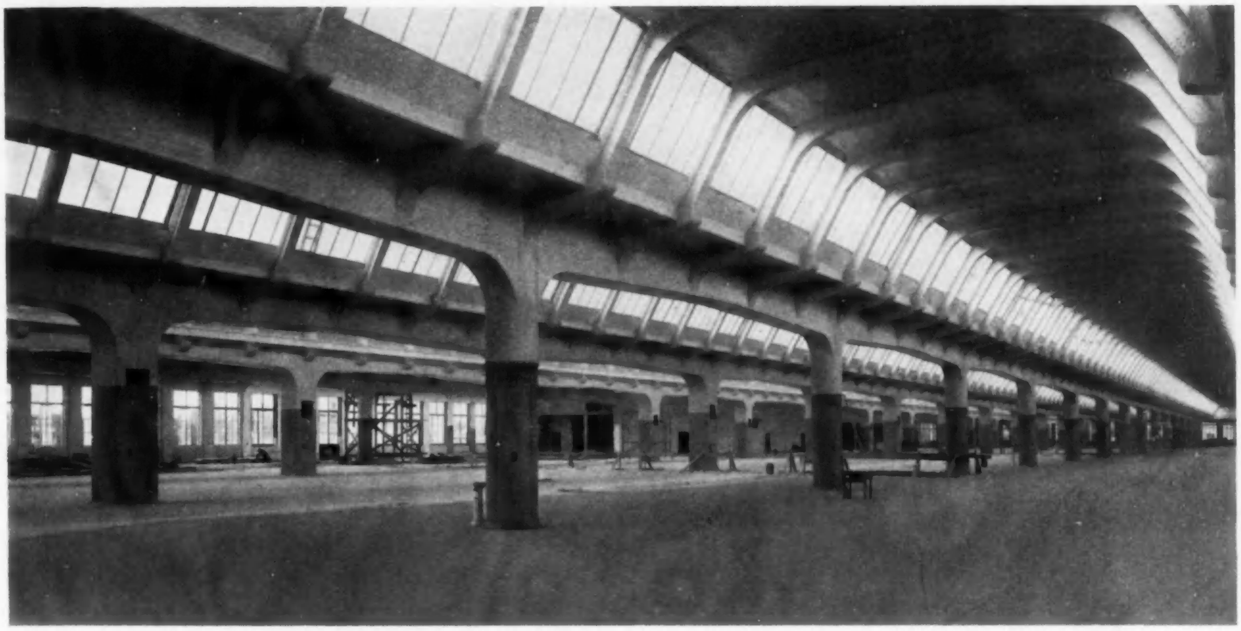


Dearborn Engineering Laboratory, Dearborn, Mich.

of land is low and where railroad facilities are satisfactory, has been given a considerable impetus by the foresight of large automobile builders in erecting this type of construction. The management of an assembly plant does not greatly concern itself with the retailing of cars. Nevertheless, in some instances, show rooms are provided even in these assembly plants as a convenience to the district dealers for demonstration purposes. They are also of considerable advantage to the small retailer, affording him the opportunity of showing a prospective customer the full line of cars, which he will not always have room to show or the funds to keep on display.

The development of the large commercial garage constitutes a considerable subject by itself. Much has been written regarding this type of structure, and the construction of such buildings can no longer be classed as general news. There are a few principles in the designing of garages, however, which are worthy of consideration. The plan adopted in the

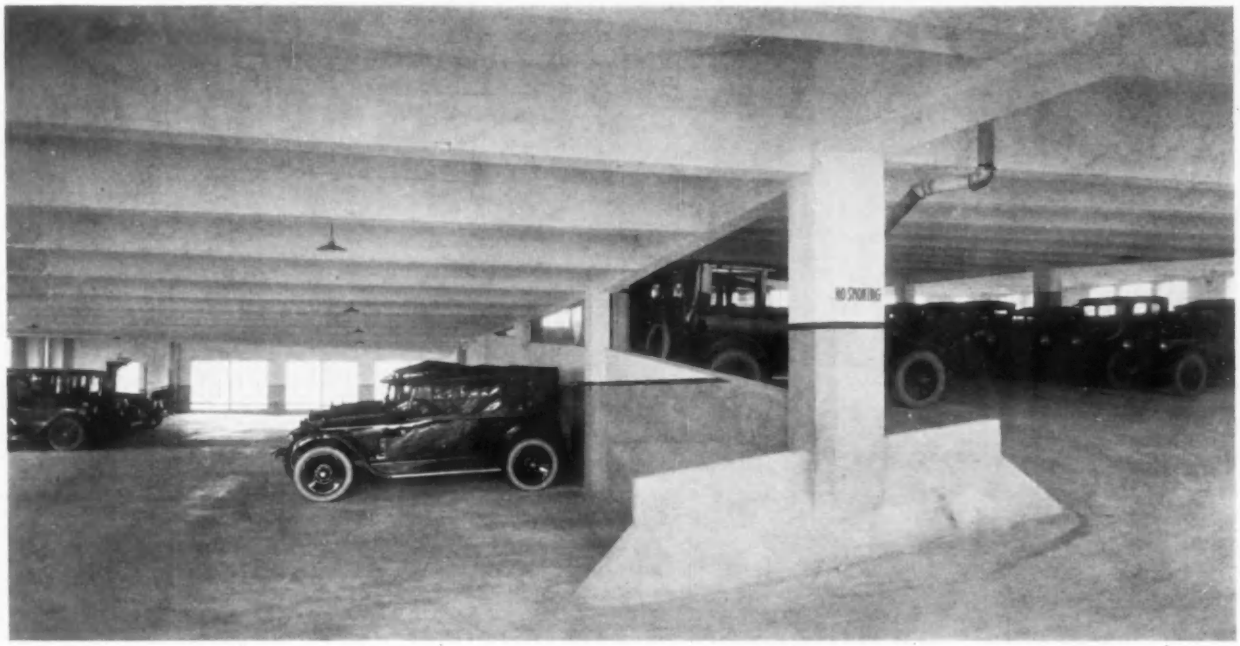
Detail, Dearborn Engineering Laboratory, Dearborn, Mich.
Albert Kahn, Inc., Architects



Dearborn Engineering Laboratory, Dearborn, Mich.

Fort Shelby Garage, Detroit, has proved successful. The entire floor is given a slight incline of approximately 4 per cent,—one-half the story height being negotiated in one direction, the other half in the opposite direction. The turns at both ends are inclined about 15 per cent. Thus it is posbsile to drive continuously from the entrance to roof, four stories above, without mounting any sharply pitched ramp. The cars are parked upon these inclined floors as shown in the illustration on page 214. The floor construction spans the entire distance of 50 feet. In this building the typical spacing of columns is 21 feet, 3 inches by 50 feet. The building is situated on a corner, the portion adjoining the more important street being constructed with a level floor. The lot being 130 feet wide by 150 feet deep, only two of the 50-foot widths are thus inclined. The only objection which has been found to this garage is that the building could not be used for other purposes. This, however, would hardly seem a just criticism, since

Main Entrance, Dearborn Engineering Laboratory, Dearborn, Mich.
Albert Kahn, Inc., Architects



Ramped Floors, Fort Shelby Garage, Detroit
Albert Kahn, Inc., Architects

garages have become as much of a necessity as have hotels, office buildings, theaters, etc., each of which is distinctly planned for its one and only purpose.

In many large garages an improved plan is used. In these the floors of two adjacent units are staggered, and inclines form passages from one level to the other. The result in this type is, therefore, the same as in the inclined type of the Fort Shelby Garage in that cars may be driven continuously from ground to top floor. The garage lately built for the *Detroit News* has been built on this latter plan.

A notable thing about the garage buildings mentioned here in the long-span construction. The width of the spans between the columns in these buildings allows practically clear floor space for both parking and aisles, eliminating free-standing columns.

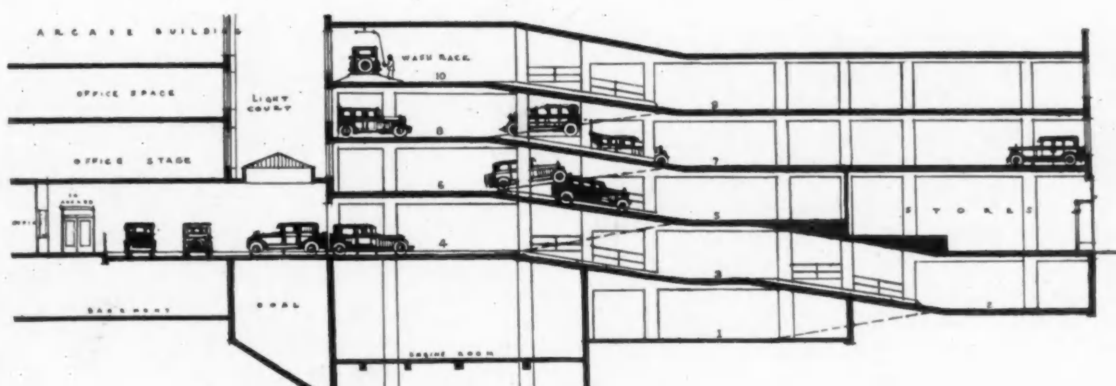
New Building for The Detroit Garages, Inc., Detroit
Robert O. Derrick, Architect

An Analysis of Garage Design

By ALBERT O. LARSON

THE problem of parking automobiles in the business district of a city has resulted in an intensive study of the possibility of utilizing expensive downtown property for garage purposes. The cost of such property is ordinarily so high that in order to get a location convenient to office buildings, theaters, etc., the plan must be such that the greatest number of cars can be accommodated at a minimum construction and operating cost.

The staggered floor system with ramps probably results in the greatest amount of storage space in a given area and represents the only solution for the exit of several hundred cars within a few minutes each day, which would be impossible with any system of elevators. The amount of space required for enough elevators to take care of rush hour traffic together with the cost of operation, more than offsets any possible advantage that elevators might have. A study of car sizes and the amount of area required for their storage shows that an aisle, with cars parked on either side, should not be less than 50 feet or more than 55 feet wide; therefore, a garage plan should be in multiples of 50 feet in at least one direction,—that is, the waste of space in a lot 80 feet wide is too great to make possible economical planning. The spacing of columns is very important. Contrary to the general belief, the elimination of all columns in a parking garage is of no advantage, because of the difficulty of maintaining definite stall divisions and the consequent waste of space by diagonal parking. Two systems of handling cars are being used in public garages. In the first instance, where all the handling of cars is taken care of by the attendants, the three-column bay may be advisable in that there is a slight saving of space, and if the garage is used at all for truck storage, such an area will accommodate two trucks. In garages where the cars are driven to the stalls by their owners, a two-car bay will be found preferable. This arrangement minimizes the amount of damage done to cars in parking. Ramps should not, in any event, be less than 20 feet wide in the clear, which allows two cars to pass each other. With narrower ramps, it is necessary during rush hours to maintain one-way traffic which greatly slows up service. An important item in the locating of ramps is that the visibility from floor to floor be as clear as possible, with no such interruptions as elevator shafts, closed-off rooms, or stairways. A practical grade for ramps is from 15 to 17 per cent. Steeper grades will result in frequent accidents on account of poor brakes. It is important that the finish of the ramps be roughened to prevent skidding. The use of grooves has been found unsatisfactory, because of the collection of dirt in them, and also because the spaces between the grooves get slippery. By far the most economical and satisfactory finish, both for ramps and aisles, is a rough wood or carpet float finish. The use of a



Cross Section of the Baker Garage, Minneapolis
Larson & McLaren, Architects

metallic hardener in the finish will add years to the life of the floors, important, since they are much used.

The ceiling heights in garages should be governed entirely by the usage. If truck storage is to be accommodated, ceiling heights will have to conform to the required clearances, but if the garage is to be used solely for the parking of pleasure cars and possibly light delivery trucks a clear ceiling height of from $8\frac{1}{2}$ to $9\frac{1}{2}$ feet is entirely adequate. Where a limited amount of truck storage space is required, construction costs may be reduced by limiting such storage space to certain parts of the lower stories.

The mechanical equipment in a garage is as important as the general planning. By careful study, the cost of such equipment can be kept within a reasonable proportion of the total cost. The number of floor drains required need not be large if they are properly located. The proper location for drains on a storage floor is at the rear of the line of stalls, rather than in the aisles. If melting snow runs off the cars into the aisles, the danger of skidding is greatly increased. Men's and women's toilets should be located conveniently to the entrance, and provision should be made for accommodations for the garage employes, possibly in the basement. Air and water should be provided at a central location on each floor, since they are required for many uses.

A considerable saving in operating cost and on the initial installation can be made in heating by the use of fan-driven unit heaters instead of either cast iron or pipe coil radiation. One unit should always be provided facing each door to the outside. Ample heating at these points will eliminate use of a good many heating units on the upper floors. In ramp garages, in particular, it will be found that very little heating will be necessary on the upper floors on account of the easy rising of heat up the ramps. Care should be taken that the bottom of any unit heater is sufficiently high above the floor for car clearance, otherwise injury to vehicles might result.

The illumination needed in a garage may be confined simply to rows of lights from 15 to 20 feet apart in the main aisles and ramps. A generous amount of illumination should be provided in the ramps and at the entrances. These lights should all be controlled from a master switch in the office, thus preventing the necessity of having the garage attendant go up through the building to turn lights on and off, a detail more important than it might seem.

A number of satisfactory door openers are on the market, but the points to be considered chiefly are simplicity of design and control features. The operator with worm gear, operated directly from a motor, is possibly the sturdiest built. It has the instantaneous reverse feature, which enables the garage attendant to immediately reverse the action of the doors at any point. Numerous accidents will take place with any type of operator which has to complete the full closing or opening action before being reversed. Careful attention should be given this detail.

The operations of greasing and washing in the modern garage may be made profitable if ample provisions are made for this work. Grease racks which are open clear to the floor, or the pneumatic type, which raises the car on a platform above the floor, are to be preferred rather than the open pit in the floor, which represents a real hazard to the life of the garage mechanic on account of accumulation of carbon monoxide gas. Ample space should be allowed for washing and polishing. A rack for the washing and cleaning of the chassis, raised about 2 feet above the floor, will cut the labor of such washing down one-half. The washing and polishing of the body are better done from the floor level. Various patents have been devised for washing cars, most of which are either very expensive to operate or are so positive as to destroy the finish on the cars. The system used in most of the largest garages consists simply of an overhead hose connected from an ordinary mixing valve with both hot and cold water. A practical arrangement for washing is with two men on the chassis and two men on the washing and polishing of the body. The time required for washing with such an arrangement may be computed at 15 minutes for the chassis and 15 minutes for washing and polishing the body, making what is really a unit cost of one hour's time for one man per car.

The whole operation and management of a public parking garage have grown from a haphazard, hit-or-miss proposition to a scientific business, and proper handling, together with a well-planned building, will put such a business on a revenue-producing basis. A good example of the latest type of a large city parking garage is the Baker Garage in Minneapolis, which was planned as one unit of the Terminal Block development, which covers an entire city block in the center of the business district. The large size of the city blocks of Minneapolis often means the loss of a great portion of the inside lot arrangement. In this development the diagonal arcade through the block, with shops and a large garage, has meant the utilization of the entire ground area of the block on a high rental-producing basis. The Baker Garage has utilized a patented ramp construction involving staggered floors with ten levels and provision for the future construction of 18 additional levels. The size of the building is 100 by 155, with additional space on the ground story. The construction is reinforced concrete throughout with removable metal forms. The first story has a double entrance, with office, women's waiting room, etc. Two greasing pits are located on the first floor, and the tenth level has been utilized for the wash racks.

The successful operation of a city service garage is now attended with so much competition that it requires the most careful and ingeniously thought out planning and equipment to render it possible at all. To provide such planning and equipment is of course the function of the architect, and to do this he must avail himself of every aid and adjunct which experience can suggest or skill provide. It is particularly difficult in that no two instances are alike.

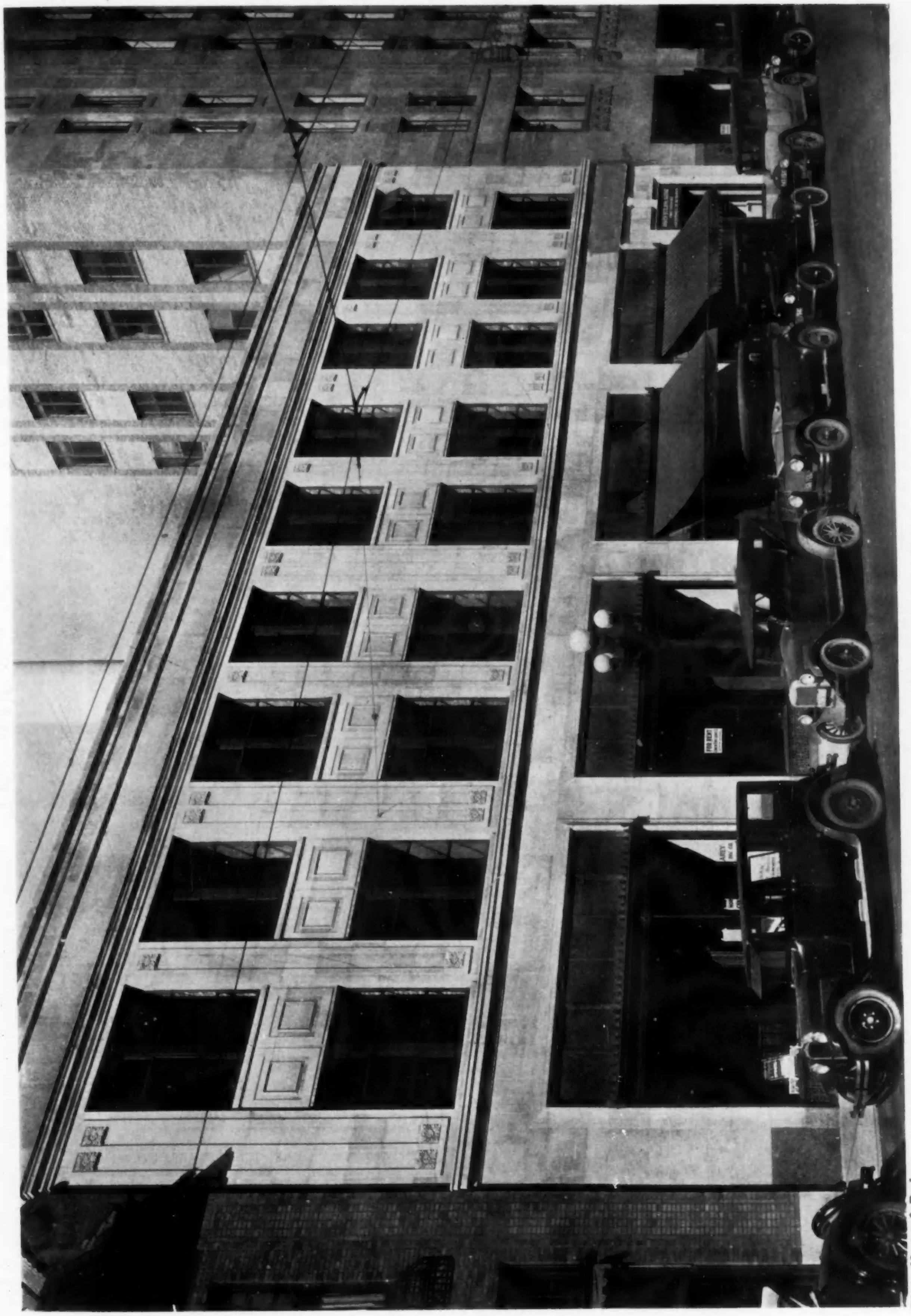


Photo. Norton & Peel

BAKER GARAGE, MINNEAPOLIS
LARSON & McLAREN, ARCHITECTS

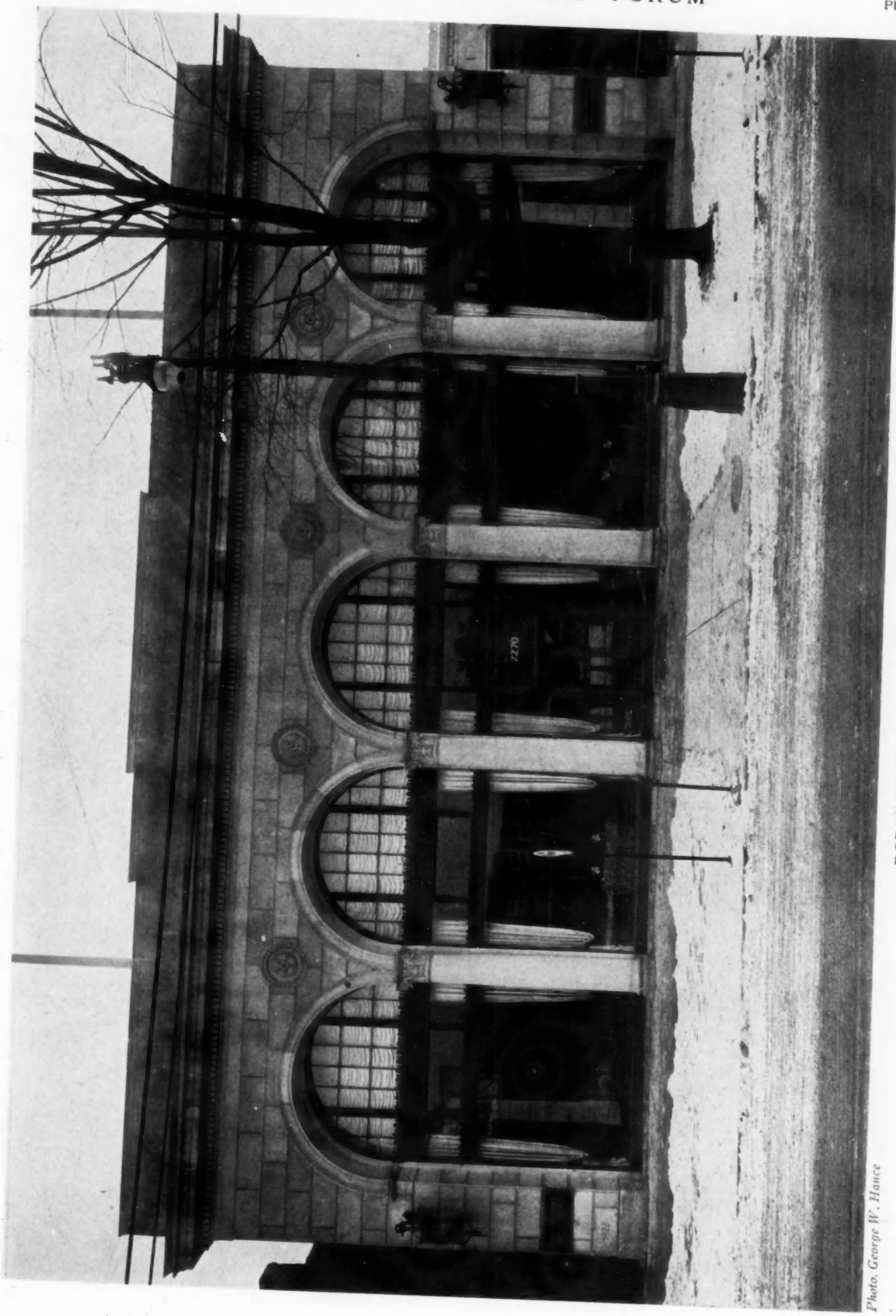
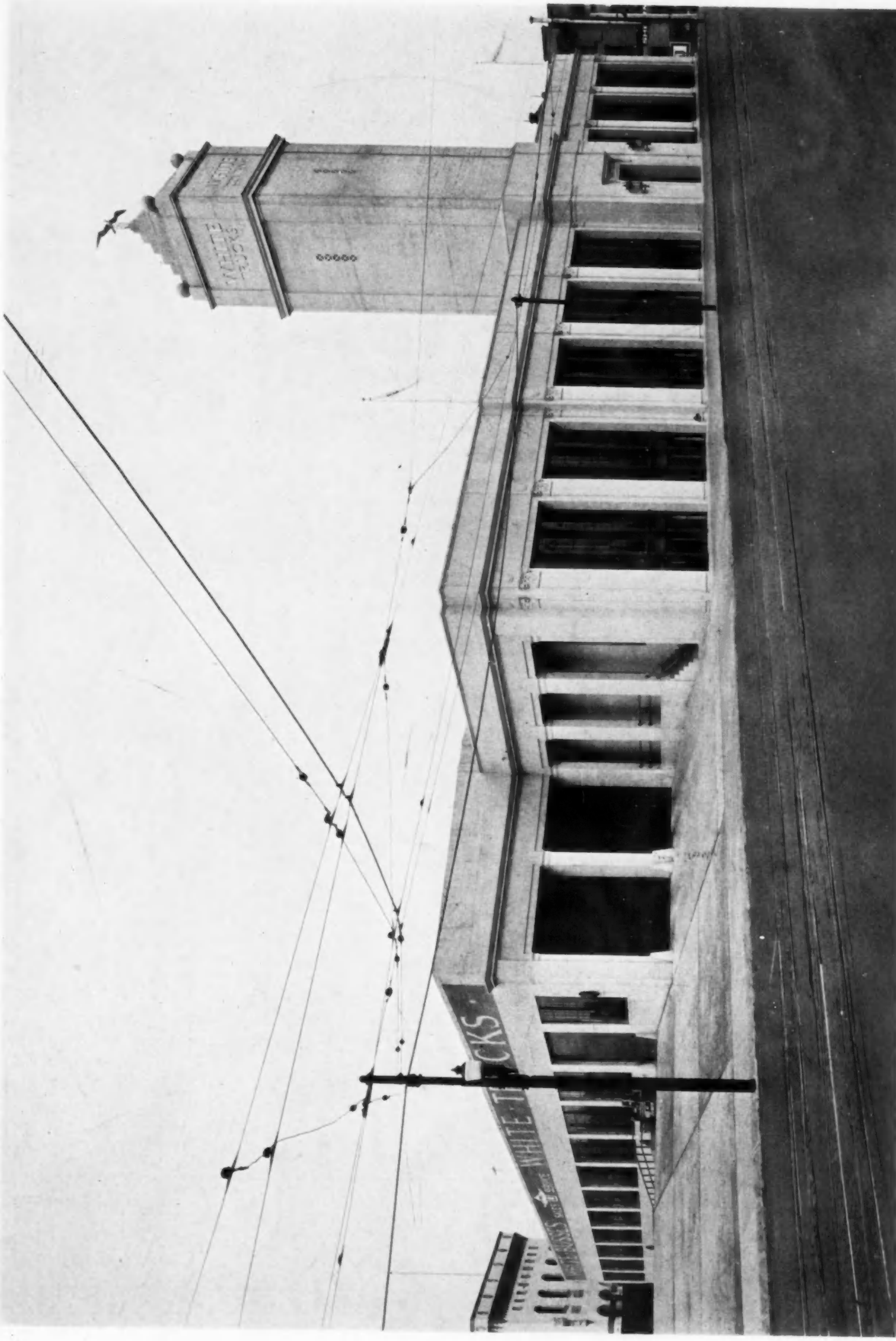


Photo. George W. Hance

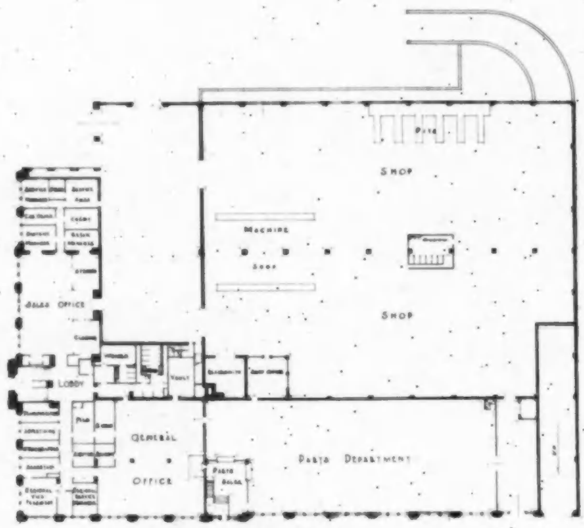
DODGE BROTHERS' SALES ROOM, DETROIT
ALBERT KAHN, INC., ARCHITECTS

PACKARD SALES AND SERVICE BUILDING, DETROIT
ALBERT KAHN, INC., ARCHITECTS

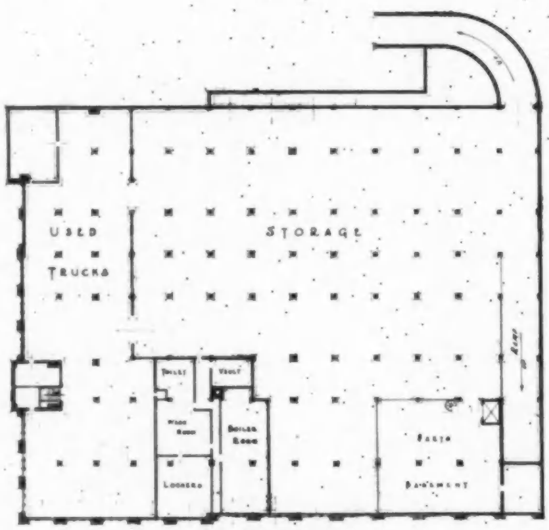


WHITE TRUCK CO. GARAGE AND SERVICE BUILDING, SAN FRANCISCO
HENRY H. GUTTERSON, ARCHITECT

Plans on Back



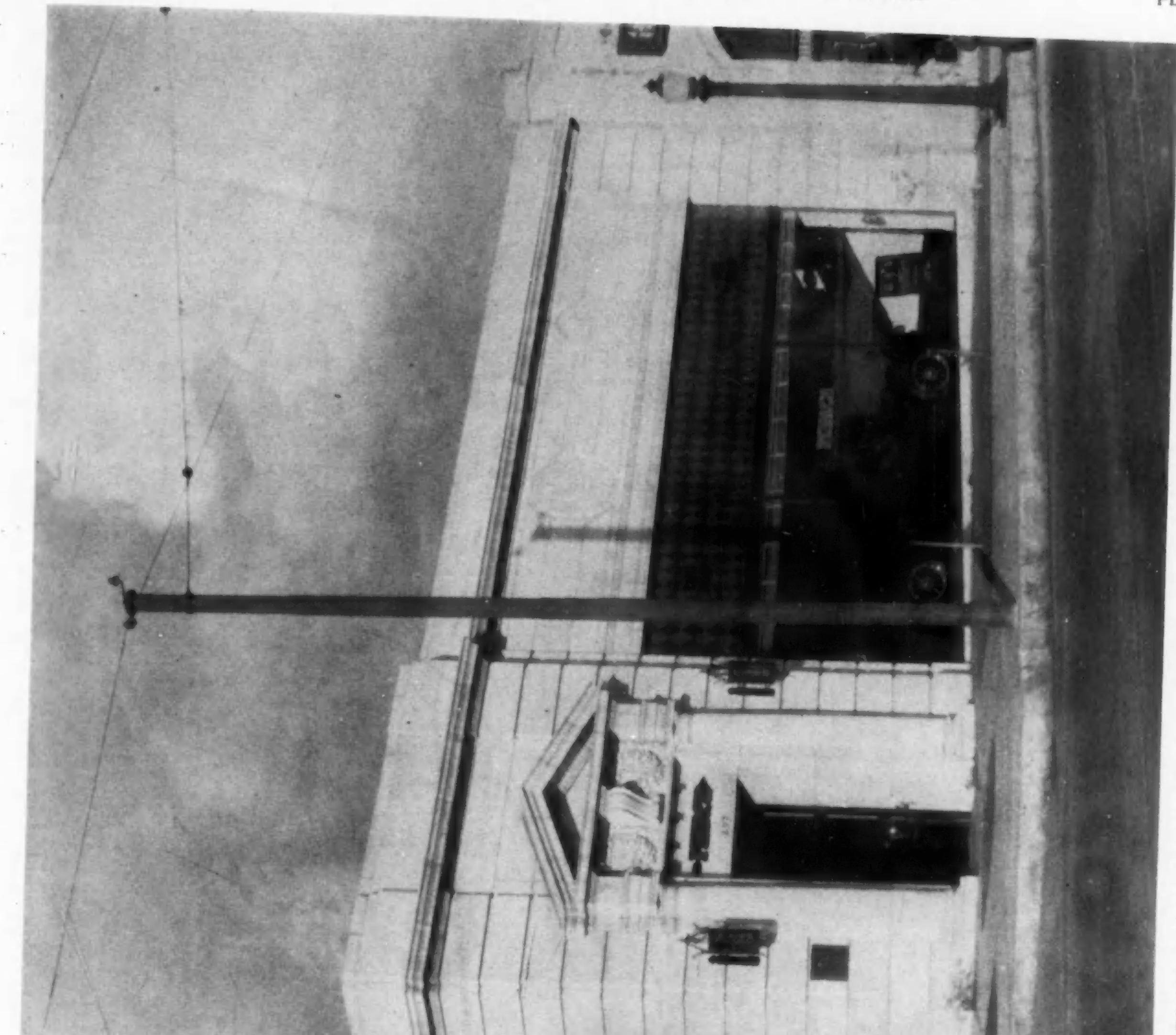
MAIN FLOOR



BASEMENT

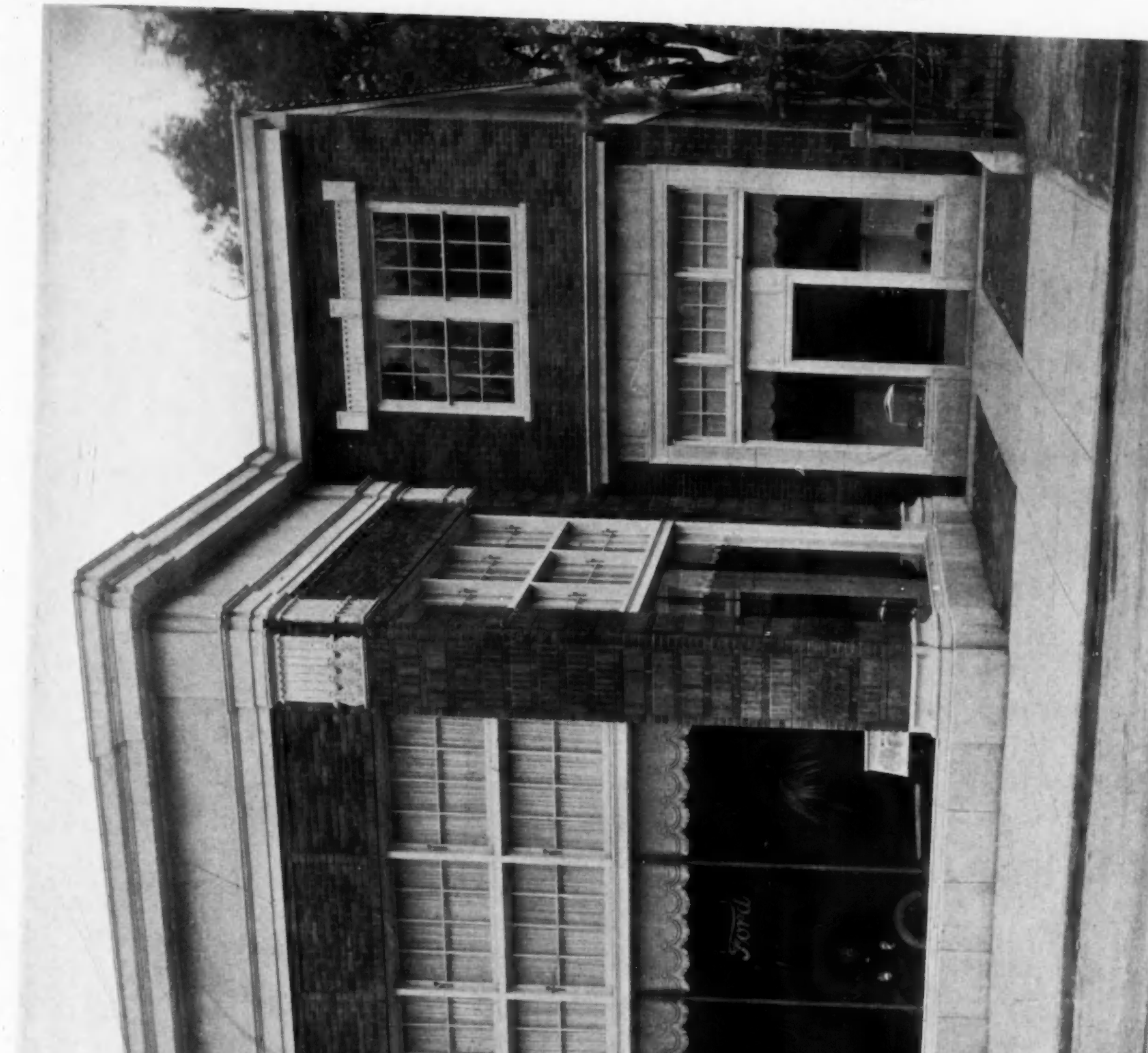
PLANS, WHITE TRUCK CO. GARAGE AND SERVICE BUILDING, SAN FRANCISCO

HENRY H. GUTTERSON, ARCHITECT



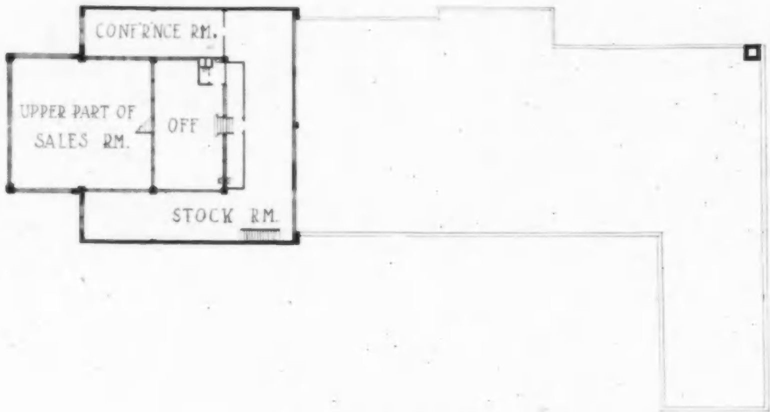
Photo, Margaret Craig

PIERCE ARROW SALES BUILDING, PASADENA
MARSTON, VAN PELT & MAYBURY, ARCHITECTS

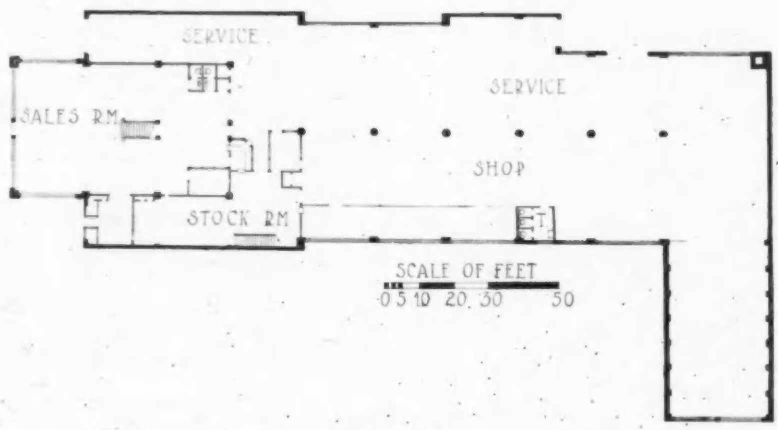


Plans on Back

SHOW ROOM AND ACCESSORY SHOP, FORD MOTOR CO., PHILADELPHIA
PHILLIP S. TYRE, ARCHITECT



SECOND FLOOR ROOF



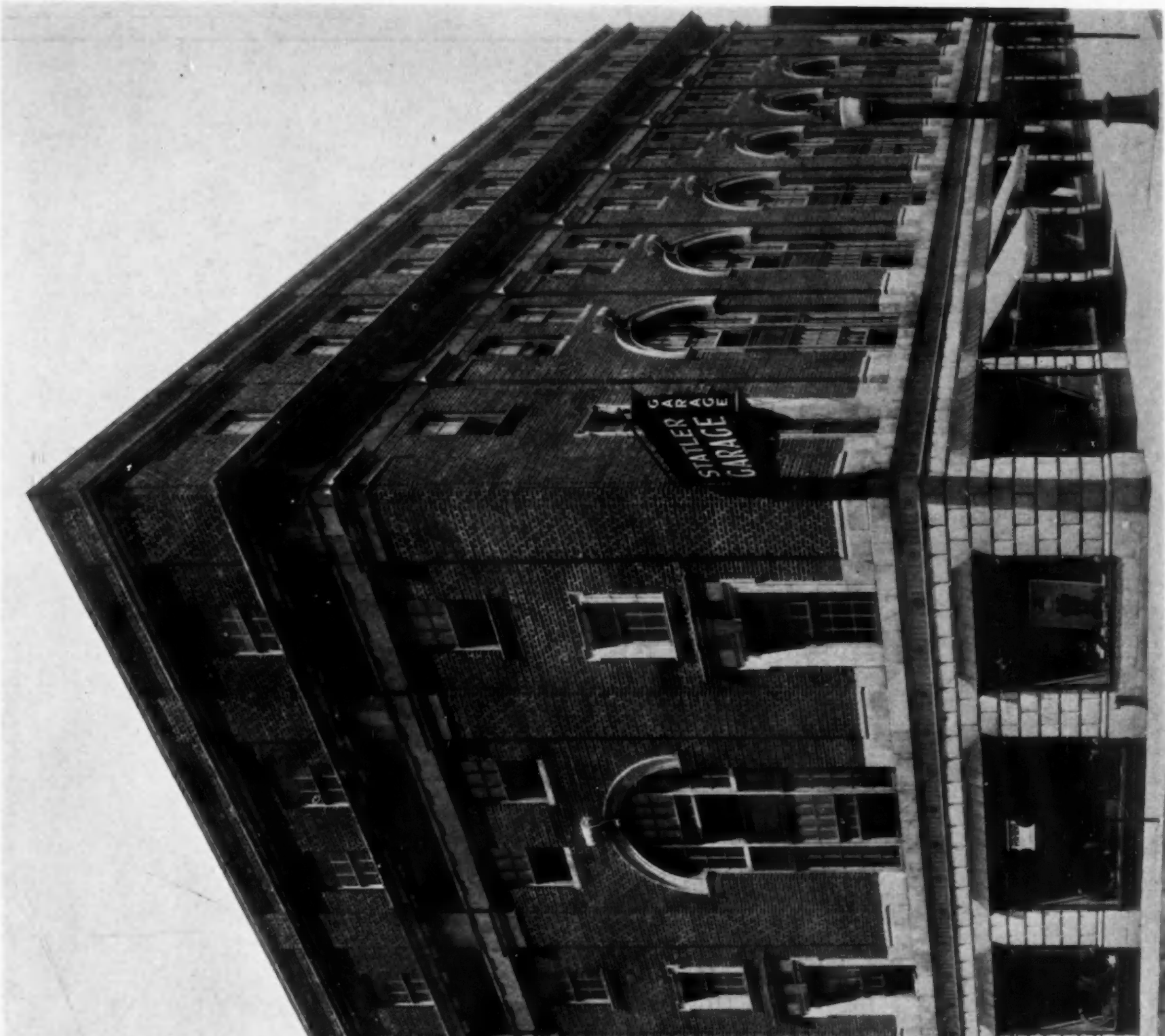
FIRST FLOOR

FLANS, SHOW ROOM AND ACCESSORY SHOP, FORD MOTOR CO., PHILADELPHIA

PHILLIP S. TYRE, ARCHITECT

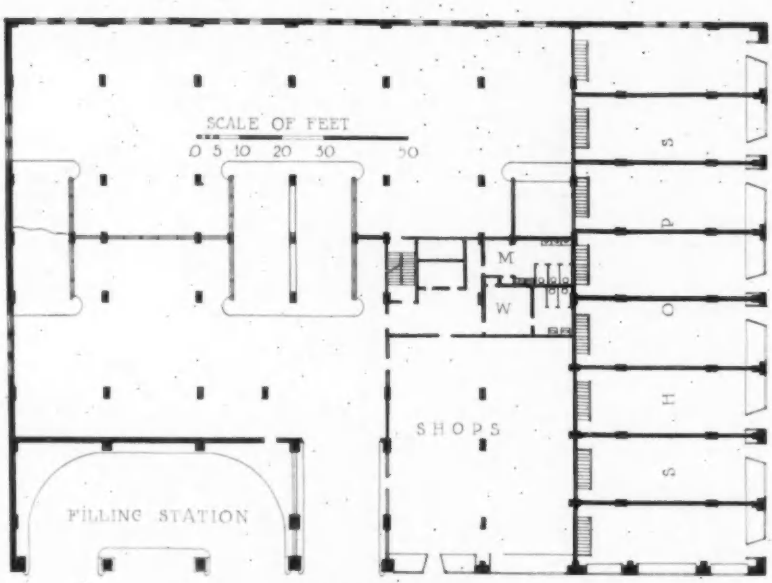
Photo. Commercial Photo Co.

PACKARD SALES ROOM, WASHINGTON
GEORGE N. RAY, ARCHITECT



Plans on Back

HOTEL STATLER GARAGE, BUFFALO
GEORGE B. POST & SONS, ARCHITECTS



FIRST FLOOR

PLANS, HOTEL STATLER GARAGE, BUFFALO

GEORGE B. POST & SONS, ARCHITECTS

The City Parking Garage

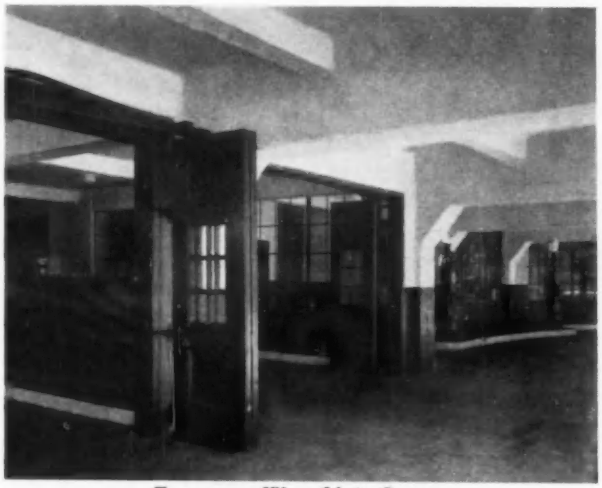
By ROBERT O. DERRICK

BECAUSE of the tremendously increased production of motor cars and because of the proportionate increase in their use for transportation purposes there has been, and will be, a continued and growing need for public parking garages in all large cities throughout the country. This may be more true in the case of the usual middle western city than in the east and other sections of the country, because of the lack in the middle west of other good means of transportation, such as elevated railways and subways. The surface transportation, consisting of trolleys, buses and jitneys, is entirely inadequate to handle the crowds, and distances are so great that, without the tremendous number of automobiles in daily use, these cities could hardly have grown to their present sizes.

Street parking is dangerous and a nuisance and only complicates the existing difficult problems confronting police departments, fire departments and traffic officials. Outdoor parking in the larger cities is being gradually discontinued as the number of available vacant lots decreases and as police departments more and more prohibit street parking. The public takes much better care of its cars than formerly, perhaps because they are now so well made that they last longer, and also because owners are taking more pride in their performance and appearance. They are also gradually realizing the bad effects of outdoor parking in "sand lots" or on the streets where their cars, although not in motion, are yet at the mercy of the elements as well as of reckless, inexperienced and unscrupulous drivers. Police departments in any city will coöperate to the fullest extent with garage owners and welcome every improvement in service, and in many instances they will prohibit street parking in the vicinity of the garages in order to keep the streets clear for moving traffic. It is quite obvious that with clear streets, the difficulties of fire departments are considerably lessened, and for this reason the public garages are a great help to them, and they encourage their growth.

With all this in mind, several Detroit business men, headed largely by motor car manufacturers who are vitally interested in increasing rather than permitting the decrease in the use of their products in the downtown streets of the principal cities of the country, grouped themselves into a substantial organization to do two things, which seemed quite possible:

One of the New Buildings for The Detroit Garages, Inc.
Robert O. Derrick, Architect



Entrance, West Unit Garage

Up and Down Ramp, East Unit Garage

Views in Two Pittsburgh Garages; Robert O. Derrick, Architect

1. To build, as a laboratory experiment, three modern garages in the city of Detroit, to see whether by proper designing and proper management such garages could not be made almost immediately profitable in a large city.
2. To form, if the experiment proved successful, a larger corporation to operate garages in other cities of the country, following the same lines, general design and management.

The first company was The Detroit Garages, Inc. Toward the close of 1925, when the Detroit experimental garage had been built and in operation for a year and had proved its earning capacity and the correctness of its basic theory, a second corporation, The National Garages, Inc., with a capital of a half-million dollars was formed, including in its stockholders and directorate nationally known men, bankers, business men, and others of wide prominence.

Combination Garage and Sales Room, Stockton, Cal.

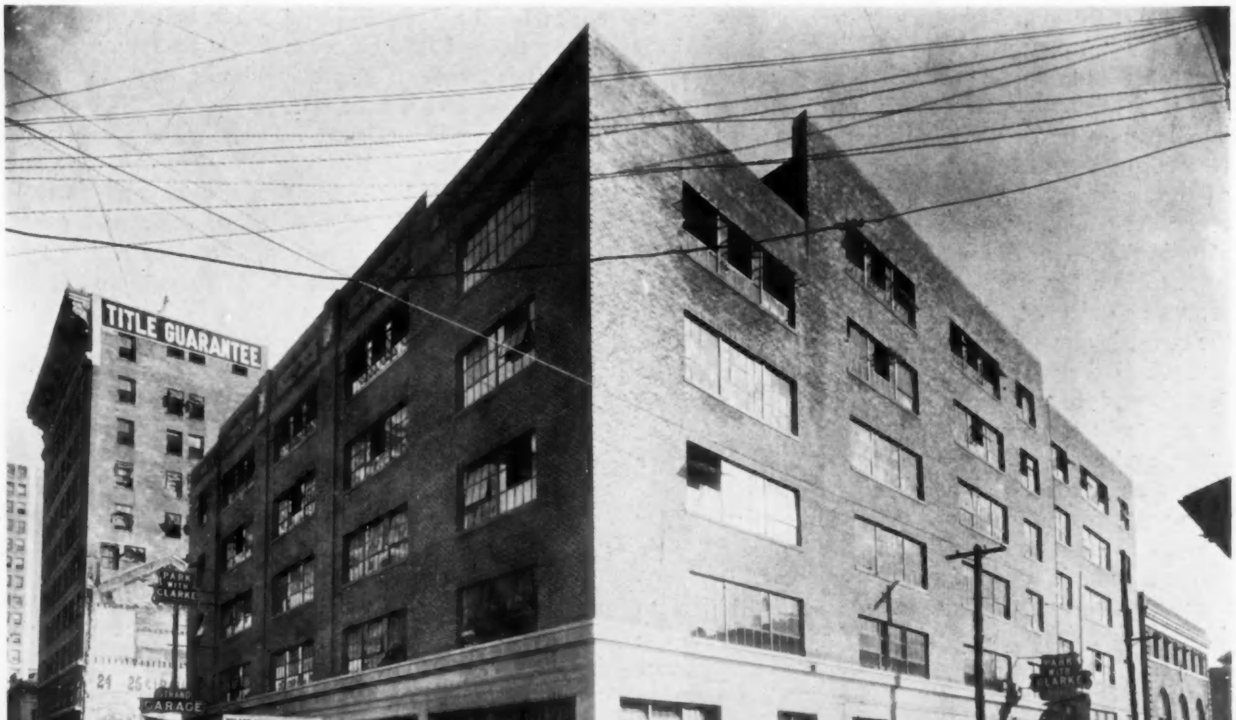
Detroit Garages, Inc. Filling Station
Robert O. Derrick, Architect

Exit, Baker Garage, Minneapolis
Larson & McLaren, Architects

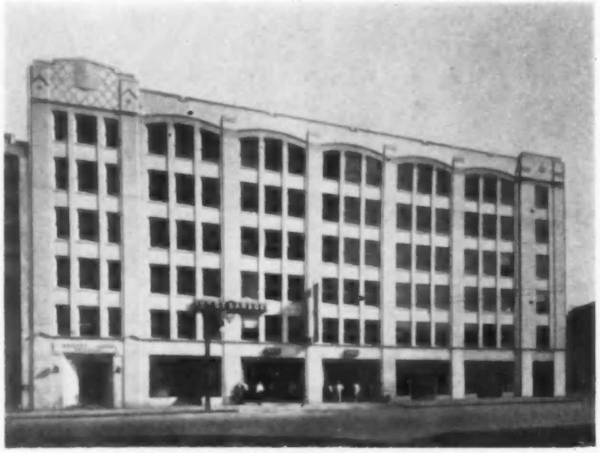
Three years ago we were requested by The Detroit Garages, Inc., to take up the study of this problem, and, after a thorough investigation lasting over six months, with frequent visits to cities where large parking garages had been operating successfully, we designed the first unit, and four and one-half months later the structure was in operation. The building of other units followed almost immediately, not only in Detroit but in other large cities as well. The National Garages, Inc. is associated in ownership or operation with these well conducted garages:

3 units in Detroit;
2 units in Pittsburgh;
2 units in Portland, Ore.;
1 unit in Syracuse, N. Y.;
1 unit in Huntington, West Va.,

and it is associated in the same way with subsidiary corporations which are building structures in Colum-



Clarke's Strand Garage, New Orleans
Favrot & Livaudais, Ltd., Architects



Bolling Jones Building, Atlanta
Lockwood Greene & Co., Inc., Engineers

Grand Circus Garage, Detroit
Smith, Hinchman & Grylls, Architects

bus, O., Memphis, and Birmingham, Ala., all of which structures we have designed on the same general plan, either directly or in association with local architects, a plan which often has much in its favor.

In our original investigation and from our experience gained by carefully watching the operation of each unit after completion, we obtained valuable information which should be closely followed in order to produce a profitable investment for owners. Of course the location is of extreme importance. For instance, as a general rule, a garage on a very important downtown street cannot operate successfully because of the value of the property, and also because of the heavy automobile traffic in the streets. The heaviest traffic periods in the garage and on the streets are between 12 and 2 o'clock, in the middle of the day when a great number of cars go out and others come in, and again about 5 o'clock in the afternoon, when the building must be practically emptied in a few minutes. Five or six hundred cars cannot be quickly taken in or out of a building when the street is already crowded. Consequently, an ideal location is that situated just on the edge of a busy section and on a corner if possible. This corner location will usually permit the pedestrian entrance, lobby, and offices on the more important of the two streets and nearer the center of activities, and the motor entrance and exit on the less important, quieter street. But by no means allow the motor entrance and exit to be located on a one-way street. The reasons for this are obvious. People do not object to driving their cars half a block or so farther to the garage, but when they walk to or from the garage it is important to have the pedestrian entrance as near as possible to the center of the section served by the garage. A corner location will also usually permit a gasolene station, which should be profitable and is always desirable. The cost per square foot must be kept at a minimum in order to produce a profitable investment, and only the cheapest methods of construction should be used, without decoration or use of ornament. This in itself is another reason why a location on an important street is not feasible. Being merely factory buildings, they look the part and would be considerably out of place in the immediate vicinity of monumental public buildings, office buildings and other important structures. There are many exceptions to this, and there is no doubt that these buildings are operating profitably, but they might be more profitable were it not for their more elaborate and costly elevations and interiors, made compulsory on account of their locations. The location itself might be too valuable and one where an office building would bring a far better return, as is the general rule on expensive property on an important downtown street in almost any large city.

The interiors of the garage proper, while of the greatest simplicity, must be bright and clean, with good ventilation and light. They must be inviting and present an appearance as different as possible from that of the old fashioned, dark and grimy garage. The lobby, however, should be attractively decorated, well furnished and of generous size, for it is here that the patrons wait for their cars to be brought down from the upper levels. The attendants are no longer in overalls, but in clean, neat chauffeurs' uniforms and are trained to give chauffeur service should it be required by garage patrons.

Unless the available ground area is very small and valuable, requiring great height to the building, ramps will usually be preferable. In the first place the cost per square foot of constructing a ramp is hardly more than the cost of a level floor. Then there are no repair, upkeep or operating expenses in connection with a ramp, and the patron pays with his own fuel the cost of moving his car in the garage. On the other hand the original installation cost of elevators is considerable, and the same is true of the maintenance and operating costs, with the company, instead of the patron, paying for the transportation of the car while in the building. Again, in a 10-story ramp garage, for instance, without crowding there can be 40 cars in motion in the aisles and on the ramps, while in an elevator garage the number of cars in motion is limited to the number of elevators. By increasing the number of ele-

Accessories and Garage Building, Detroit
Albert Kahn, Inc., Architects

Ramp Garage, Atlanta
Pringle & Smith, Architects

vators the car storage is proportionately decreased. The same is true to a greater extent in the elevator and conveyor type of building, where the cars are never driven under their own power, but are moved vertically by elevators, automatically placed on conveyors, and parked mechanically. The installation cost of such a system, as well as the operating and maintenance costs, would be prohibitive, although fewer employes are required, while a breakdown in the mechanical equipment would cause the most serious traffic delays in the garage. A patented ramp, which we have frequently used with great success, takes up no more room per floor than an elevator, leaving the same amount of space for car storage.

This ramp is only one of several, but this particular type will permit very easy grades by the use of mezzanines, so that the car travels up or down on the ramps only half a floor at a time, and this will permit the parking of all cars on level floors. The mezzanines as well as the regular floor levels contain aisles and parking spaces, with no room whatever wasted. The floor heights can be kept very low, thus tending to reduce the grades of the ramps and necessitating less building and less heating surface, which in turn reduces the original, operating and maintenance costs of the structure. Another kind of ramp is the double or single circular type, which works out advantageously in certain cases, due usually to the size or shape of the property. The continuous ramping of the floors is also excellent in many instances, as it will allow more storage spaces, with all cars parked on a sloping floor; the convertibility feature is far more difficult, and the expense of erecting this type of building is considerably more than one equipped with a ramp such as has just been mentioned. This type also requires property with a large street frontage, which often increases the amount of the original investment, at the same time reducing somewhat the possibilities of a high return. The grades of the floors in such buildings are extremely easy, however, sometimes as low as 5 per cent, depending on the size of the property. Using any type of ramp, however, the principle of low story heights is extremely important.

Except in the type of building just mentioned, where the entire floor area is ramped, it is extremely advisable to provide double ramps for about one-third to one-half the height of the building. We have also found that only enough boiler capacity and heating surface are required to produce a temperature of from 40 to 50°, and it is advisable to concentrate most of this heating surface on the lower floors. There should be clear vision ahead at all times, and all walls possible should be eliminated inside the building, especially on typical floors. We have found that the only walls necessary are those enclosing the passenger elevators and stairways, leaving the floors and ramps quite open except for the necessary beams and columns. This will tend to speed up traffic and greatly reduce the number of accidents, two considerations which are important.

It is advisable from the point of view of both operating and initial cost to completely fill in the concrete or steel frame of the exterior walls with glass where permissible, as it is cheaper and gives a far brighter and better lighted interior. Care should be taken with the artificial lighting to produce the best effect, and in some cases "Stop" and "Go" signal lights are necessary, controlled by an employe as traffic officer. Such a system will also help considerably in speeding up traffic in both directions and eliminating accidents, especially where single ramps only are used. Automatic door openers, operating from a trip in the sidewalk or near it as the cars come in and on the inside of the garage near the doors as they go out, are practical and valuable, but the same advantages can be had with push-buttons if desired. It takes the weight of a car to operate the trip, and it should be placed quite close to the doors, thus making it necessary for all cars to come to a full stop before entering or leaving the structure. Careful attention should be given to this.

If the building department will permit it, a basement will be found very useful for repairs as well as for storage. It must, however, have excellent ventilation and light. The aisles should be of generous width, to permit easy handling of cars. From the operating point of view columns should be spaced to allow only two cars in each bay. The bases of the columns are designed to guide the cars into the spaces close to the columns, thus allowing the maximum amount of room between the cars when parked. The use of three or more cars per bay increases the cost per square foot, strange as it may seem, and is awkward from an operating point of view, usually necessitating an additional expenditure for concrete curbs to act as guides when parking the cars. The two-car bay is almost always preferable.

The administration offices should be concentrated immediately adjacent to the lobby and should consist of the manager's office and general work space directly connected with the lobby, where one attendant can take care of the office work and the sale of accessories, cigars, cigarettes, magazines and papers which are displayed on one side of the room. The cashier's office should have a window opening into the lobby, where care checks can be received and payments made, and another opening into the garage proper, where the checks can be turned over to an attendant or chauffeur. A superintendent's office is alsc necessary, opening into the garage. A passenger elevator and stairway opening in the lobby and wash room facilities for men and women somewhere adjacent complete the requirements. An employes' wash room should be located elsewhere. The garage must furnish gasolene, oil, air and water service inside, and outside if possible, while a wash rack for cars in proportion to the capacity of the building is desirable and should be profitable. Ignition service and tire repairing should also be furnished, and the sale of accessories in the lobby is usually profitable and desirable for the management.

In the location of the ramps every effort must be made to place them as far as possible from the motor entrance and exit, thus leaving the maximum aisle space and car storage on the ground floor to be used as a clearing space during the rush hours. This is important, as cars cannot be taken to upper floors by attendants as fast as they come in. Those that cannot be taken up immediately must be stored out of the way until they can be moved, after the rush is over. Experience has proved that most people refuse to do more than drive their cars into the ground floor of the garage, where they leave them to be placed by employes, and the same is true when they leave. However, there are still some people who insist on driving their own cars, and there is a limit to the number of floors they will travel. Ten to 12 stories have proved to be about the maximum height for the practical operation of a ramp garage. A

Entrance to Republic Building Garage, Denver
G. Meredith Musick, Architect

higher building with elevators and conveyors appears to only increase the expense, difficulties and problems of operation, to say nothing of the amount of the original investment. During the normal traffic conditions a car can start under its own power on the first floor in the North Unit of The Detroit Garages, Inc., and arrive on the eighth floor in one minute without hurrying, which is better than most elevators can do. Use of these ramps is most successful.

A reinforced concrete structure is the cheapest to erect, but where cities are growing rapidly the owners often think it advisable to use steel construction so that should the property become too valuable to maintain a garage it can more easily be converted into an office or loft building. To procure the most profitable garage investment, however, the building should be designed and erected without regard for conversion possibilities, and it should be built its full height immediately, with no thought of later adding additional stories. It may have fewer floors and a smaller capacity as a result, but it will be more profitable as, in general, several small units properly located will be far more successful than one large building. This is one of many things to be considered.

All, excepting the larger of the middle-western cities, have the business, financial, hotel, theater and shopping districts concentrated in a reasonably small area, and a garage on the outskirts of this area will probably draw patrons from all these sources. In the larger cities these districts are often quite distinct and apart, and smaller units serving each district are far more advisable than erecting one or two large units and expecting them to draw from the more remote sections. Four to five blocks is the limit a person will walk to and from his garage, and it is surprising to find what a difference one block will make in the mind of the public. A garage may be operating successfully, but if another is erected one block nearer the center of activities the patrons of the old will move to the new, providing it is properly designed and operated. If there is not enough business for both, the old garage will disappear. In purchasing service the public is fickle.

Our experience in designing and erecting garage buildings in many different cities and in carefully watching their operation has proved that certain facts are invariably to be met. Night business in a garage is extremely desirable and valuable. In general, hotels and theaters are practically the only sources of night revenue other than from light trucks and delivery wagons. It would not be profitable to erect a garage to accommodate the small available heavy truck business because of the initial expense necessary to take care of the increased floor

Entrance to Baker Garage, Minneapolis
Larson & McLaren, Architects

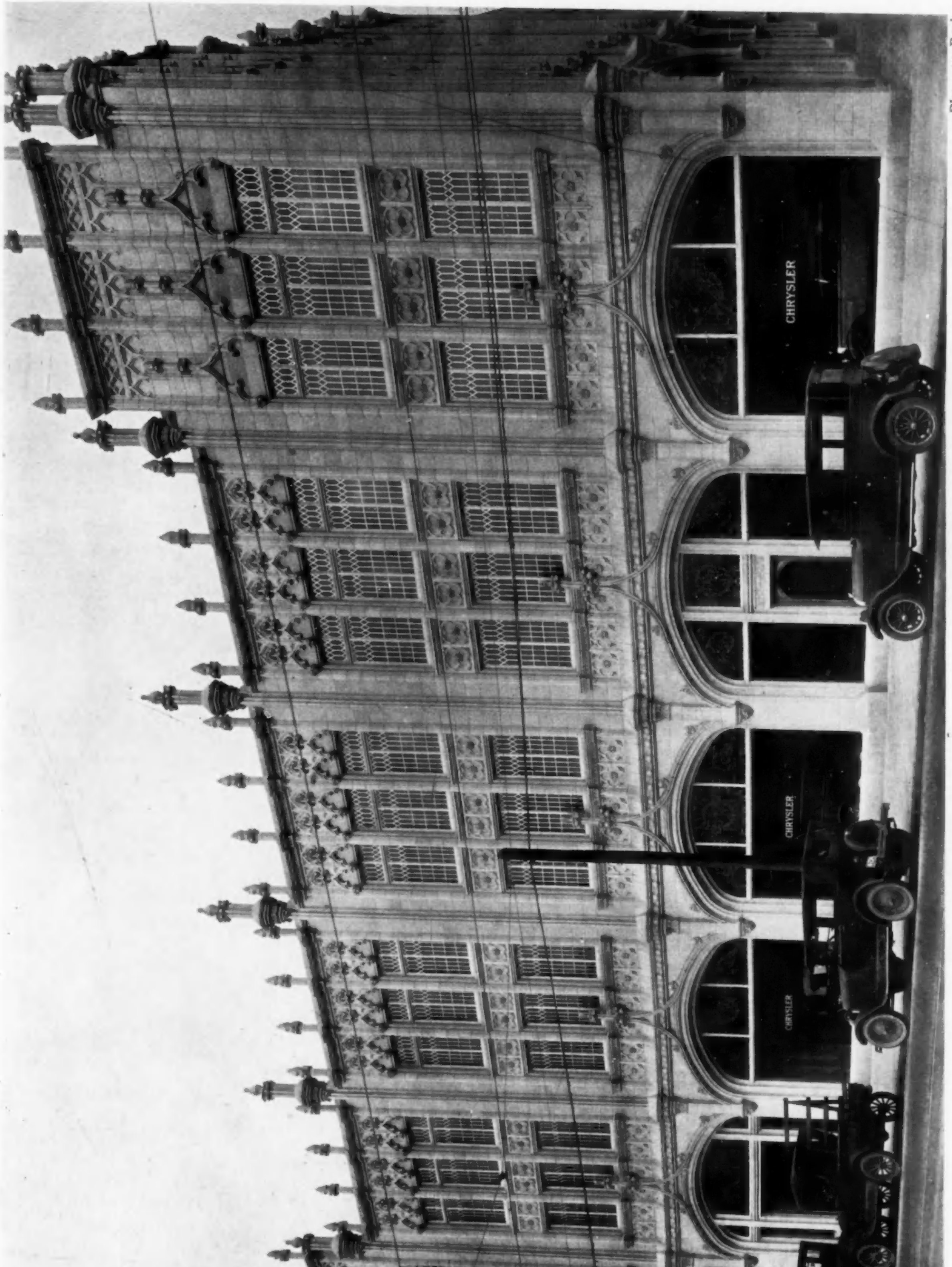
Ten Story Ramp Garage Building
Robert O. Derrick, Architect

Automobile Parking Garage, Pittsburgh
Robert O. Derrick, Architect

loads, higher clearances, and wider car spaces. Moreover, the leasing of space for light trucks and delivery wagons presents difficulties enough without the added burden of the heavy truck business. Although their leases should stipulate that they should be out of the building before the rush hour in the morning and should not return until the close of the rush hour in the evening, such regulations will not, and in many instances, cannot be enforced. Consequently, they will seriously interfere with the regular traffic, especially during these rush hours, thereby reducing the efficiency of the building and tending to defeat its original purpose, and seriously impairing the main income-producing business of the garage. Both The Detroit Garages, Inc., and The National Garages, Inc., have been compelled in several instances to discontinue accepting this class of trade, in order to properly take care of the business for which their garages were originally intended.

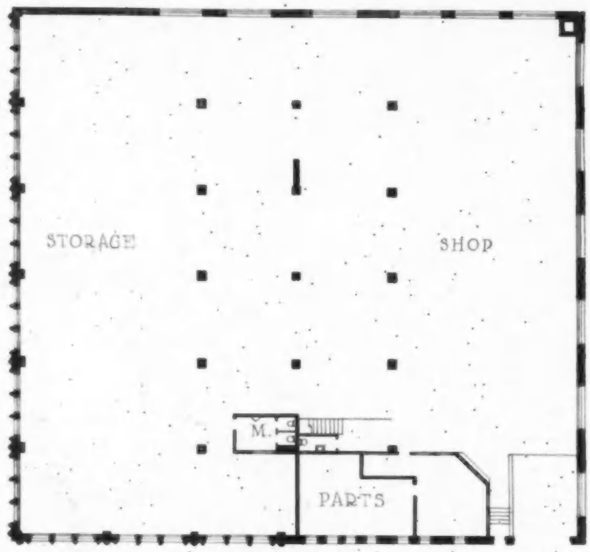
The financial and business section is an excellent area to draw from, although there is little night business available. The patrons are mostly quite responsible and realize the value of their leases, being careful not to let them lapse; and little effort is required to sell garage space in a congested financial and business center. As a rule hotels produce only a moderate amount of business during the day or night, while theaters produce considerable patronage during the day and more at night, when they prove to be very profitable. The shopping district is perhaps the best, and where it is combined with the theater district a garage properly located to serve such an area will nearly approach the ideal,—that of operating on a 24-hour basis. An enormous amount of work must be accomplished to educate people to use a parking garage if they are not familiar with their operation and if their city has not supported one or more before. Extensive advertising is necessary, and salesmen must be employed to sell monthly and yearly leases. These will occasionally be canceled, and in the end all will run out and many will not renew for one reason or another. In general this selling of leases must be continuous, and the space should be leased up to 100 per cent or over. If this can be accomplished the building will about carry itself with little or no net profit. The net profit is derived from transients and the selling of different kinds of service and accessories All the regular tenants on lease will never have their cars in the garage at one time. Consequently, all the transients can be taken care of except in extreme cases, or where the location is of unusual excellence. It is well to remember, again, that a small building always well filled with little or no effort is far more profitable than a large building not completely filled and requiring effort to keep it 100 per cent occupied. This is one detail of management.

The garage problem is continually increasing in importance, improvements are made repeatedly, and a great many details and features too numerous to mention in these pages are only learned by experience. The problem, while at first glance it may appear to be extremely simple, like all others, proves in the end to be one with the usual difficulties and complications, requiring intensive study to arrive at the proper solution, and offering an unusual amount of interesting work for the architect,—a condition which demands the best an architect has to give.

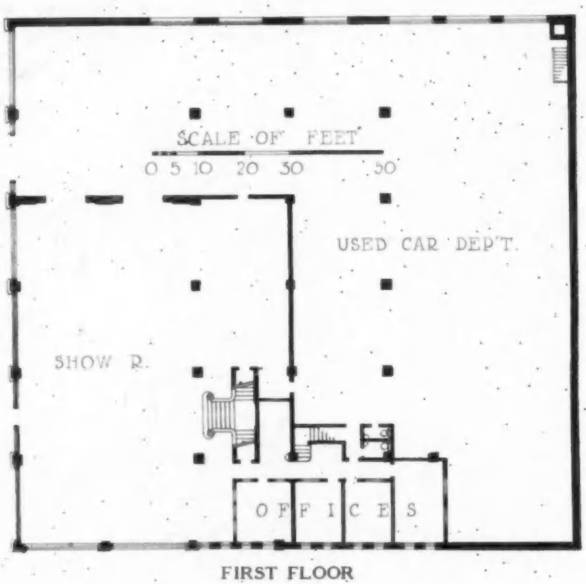


Plans on Back

BROADWAY ELEVATION, F. C. CULLEN GARAGE, DENVER
J. B. BENEDICT, ARCHITECT



SECOND FLOOR



FIRST FLOOR

PLANS, F. C. CULLEN GARAGE, DENVER

J. B. BENEDICT, ARCHITECT

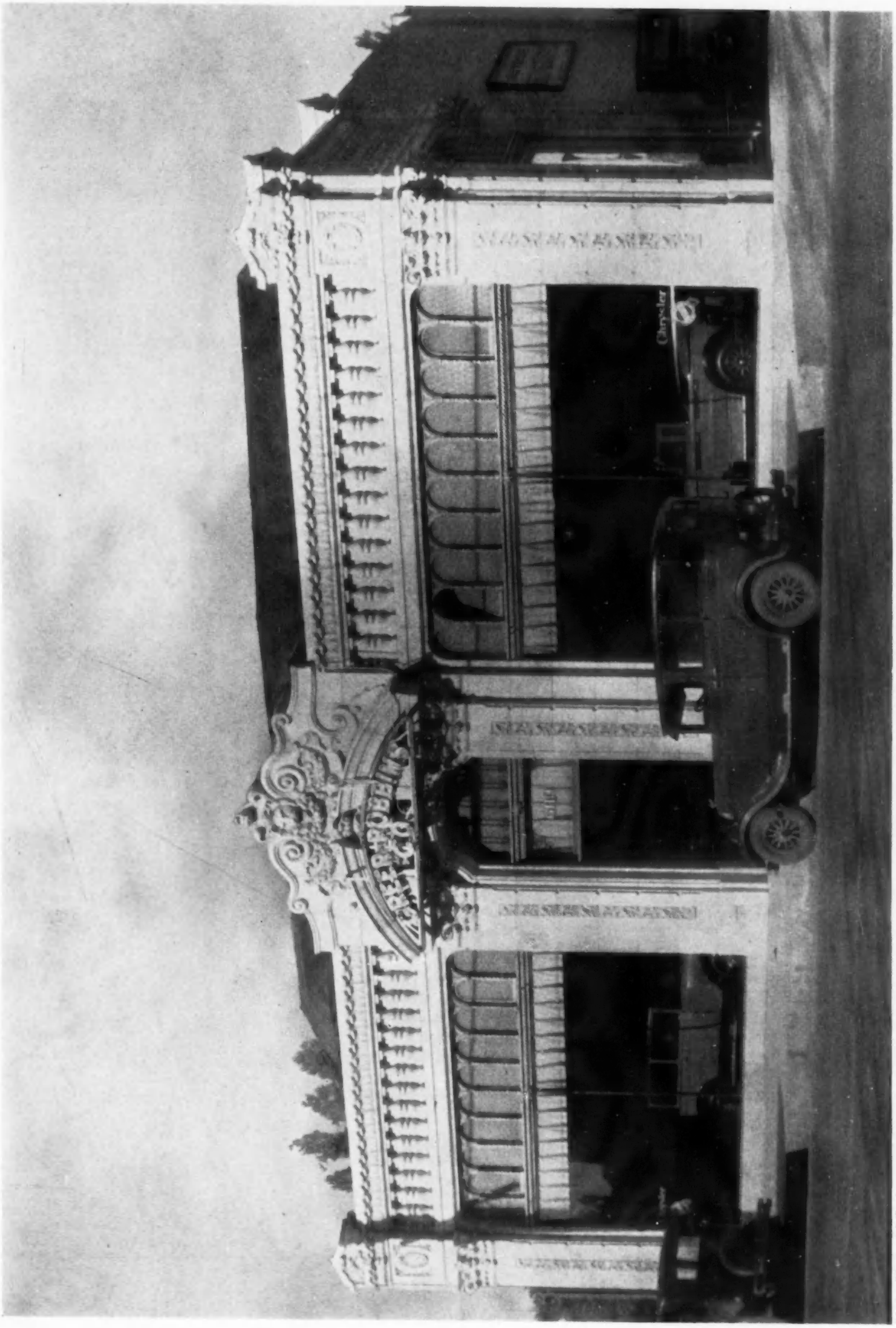
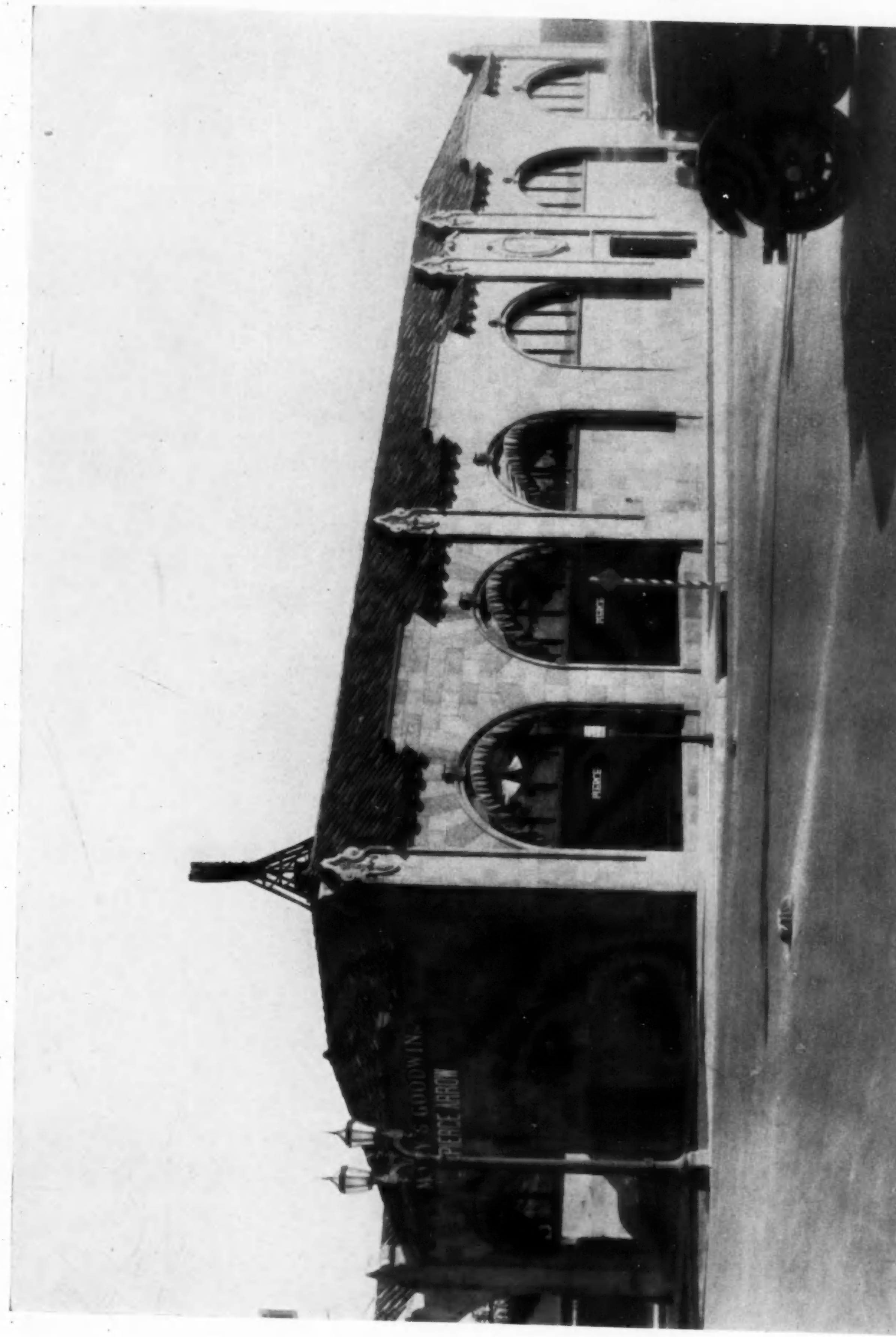


Photo. Margaret Craig

CHRYSLER SALES ROOM, PASADENA
JOHN N. COOPER, ARCHITECT



Photo, Margaret Craig

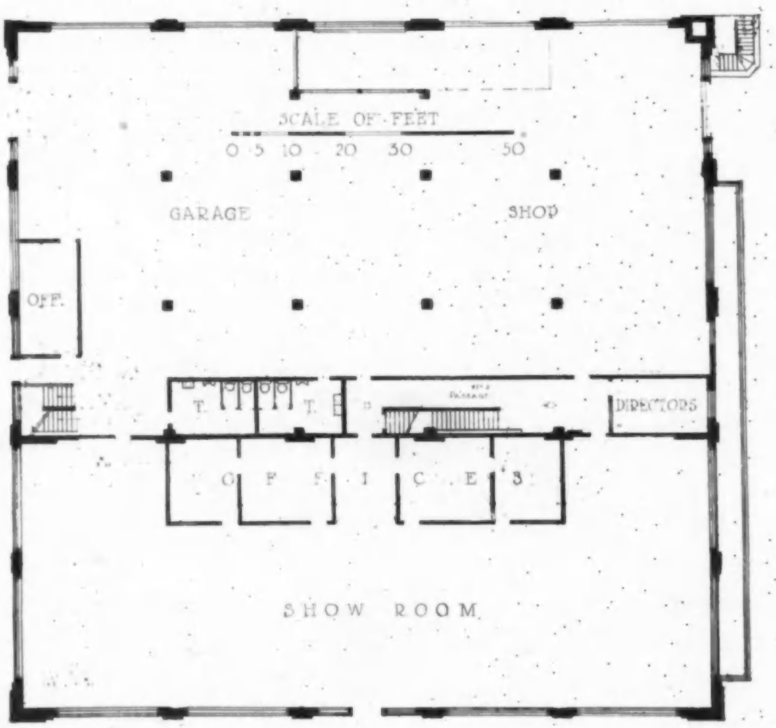
PIERCE ARROW SALES AND SERVICE BUILDING, HOLLYWOOD, CAL.

C. R. SPINK, ARCHITECT

Plans on Back

GARAGE AND SALES BUILDING, BUICK MOTOR CO., DENVER

MOUNTJOY & FREWEN, ARCHITECTS



PLANS, GARAGE AND SALES BUILDING, BUICK MOTOR CO., DENVER

MOUNTJOY & FREWEN, ARCHITECTS

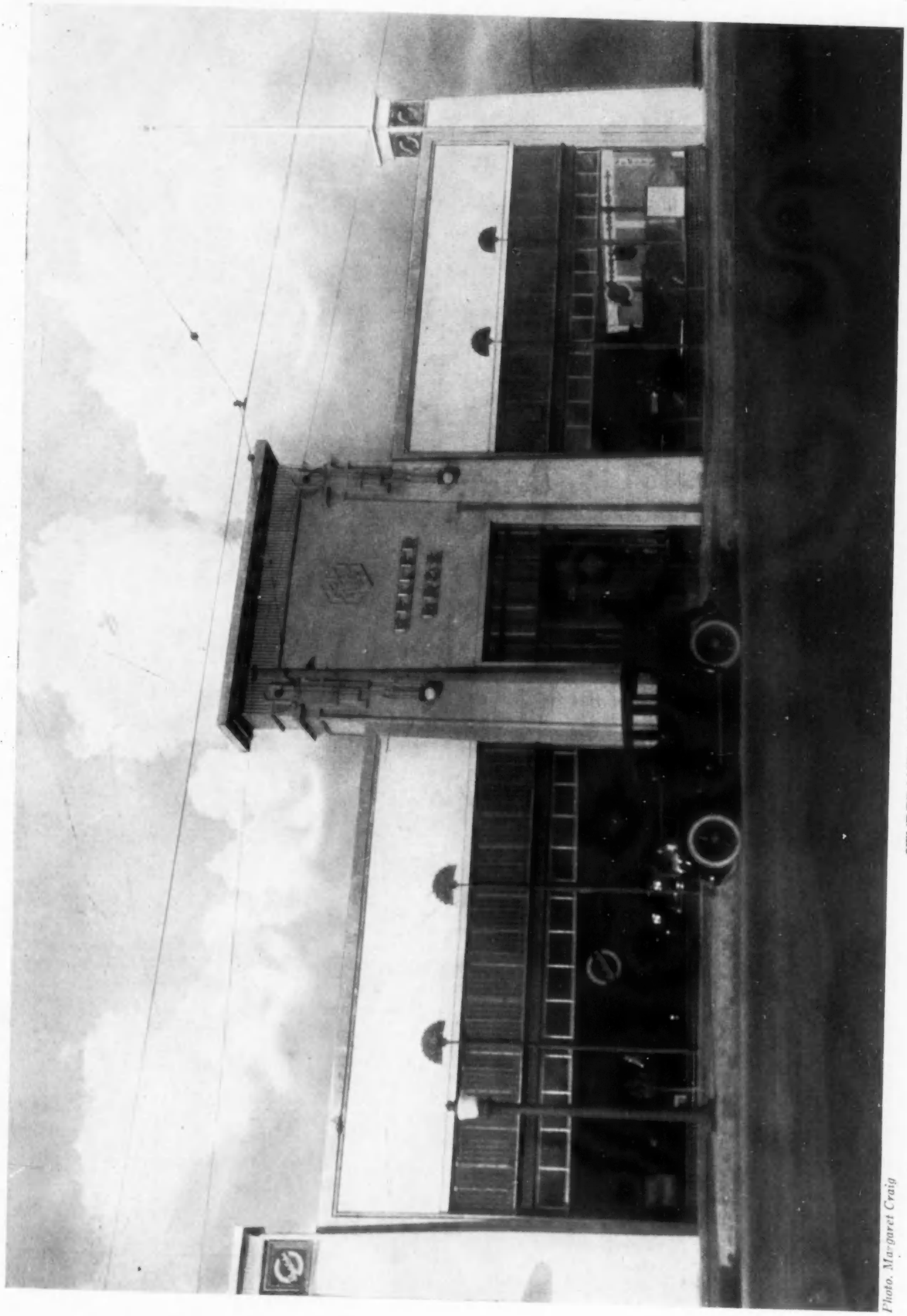


Photo. Margaret Craig

STUDEBAKER SALES BUILDING, PASADENA
FREDERICK KENNEDY, ARCHITECT

Plans on Back

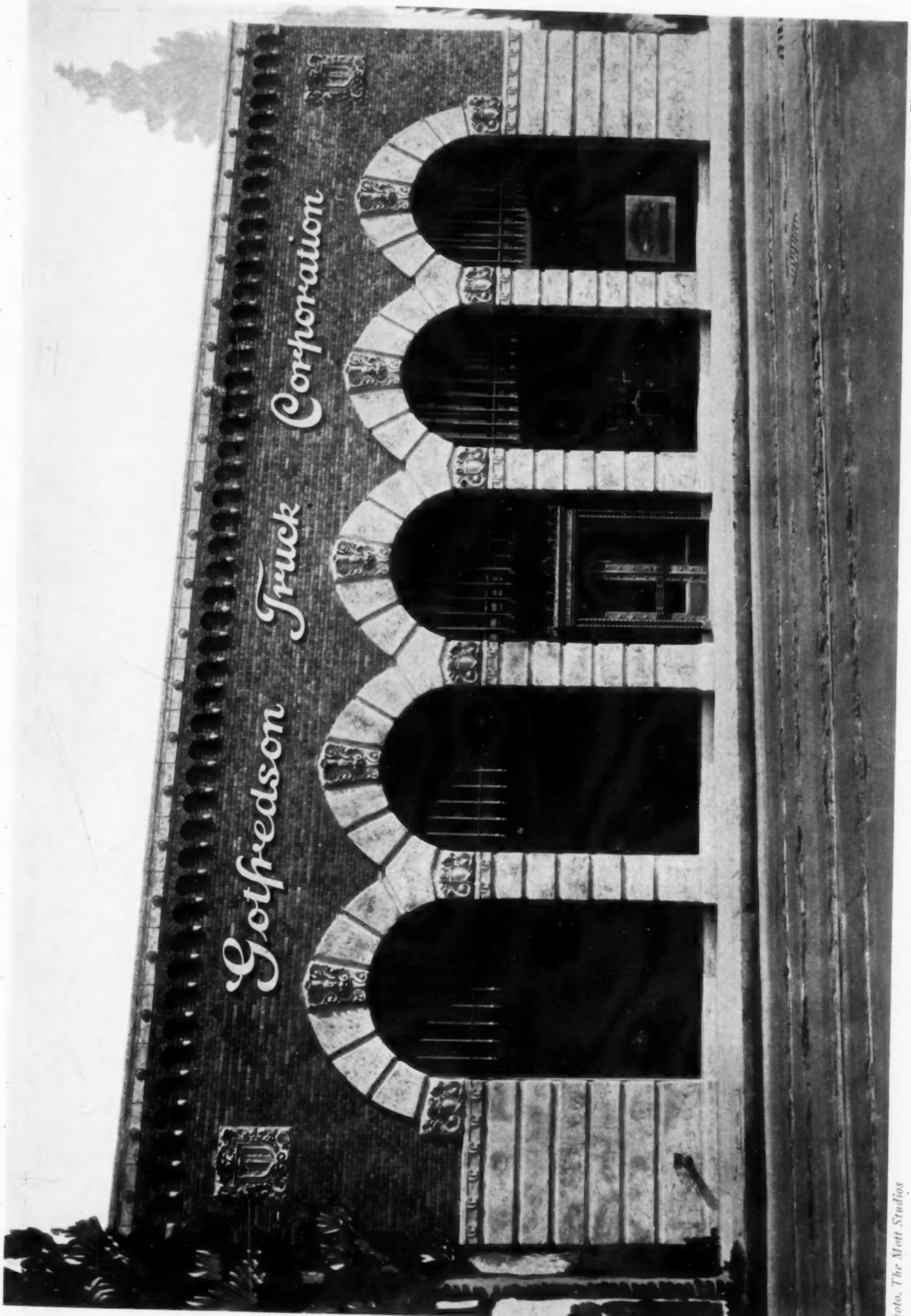
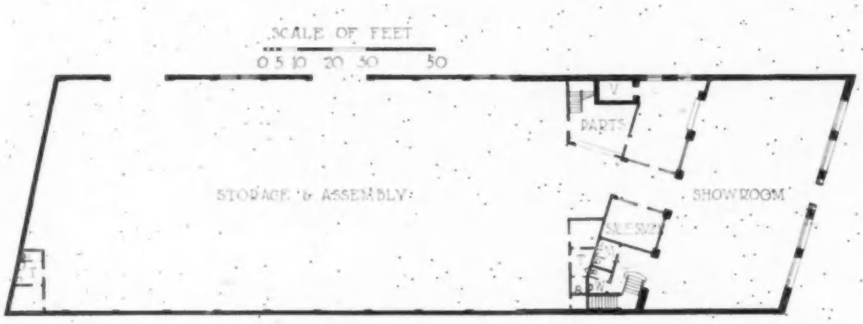


Photo. The Mott Studios

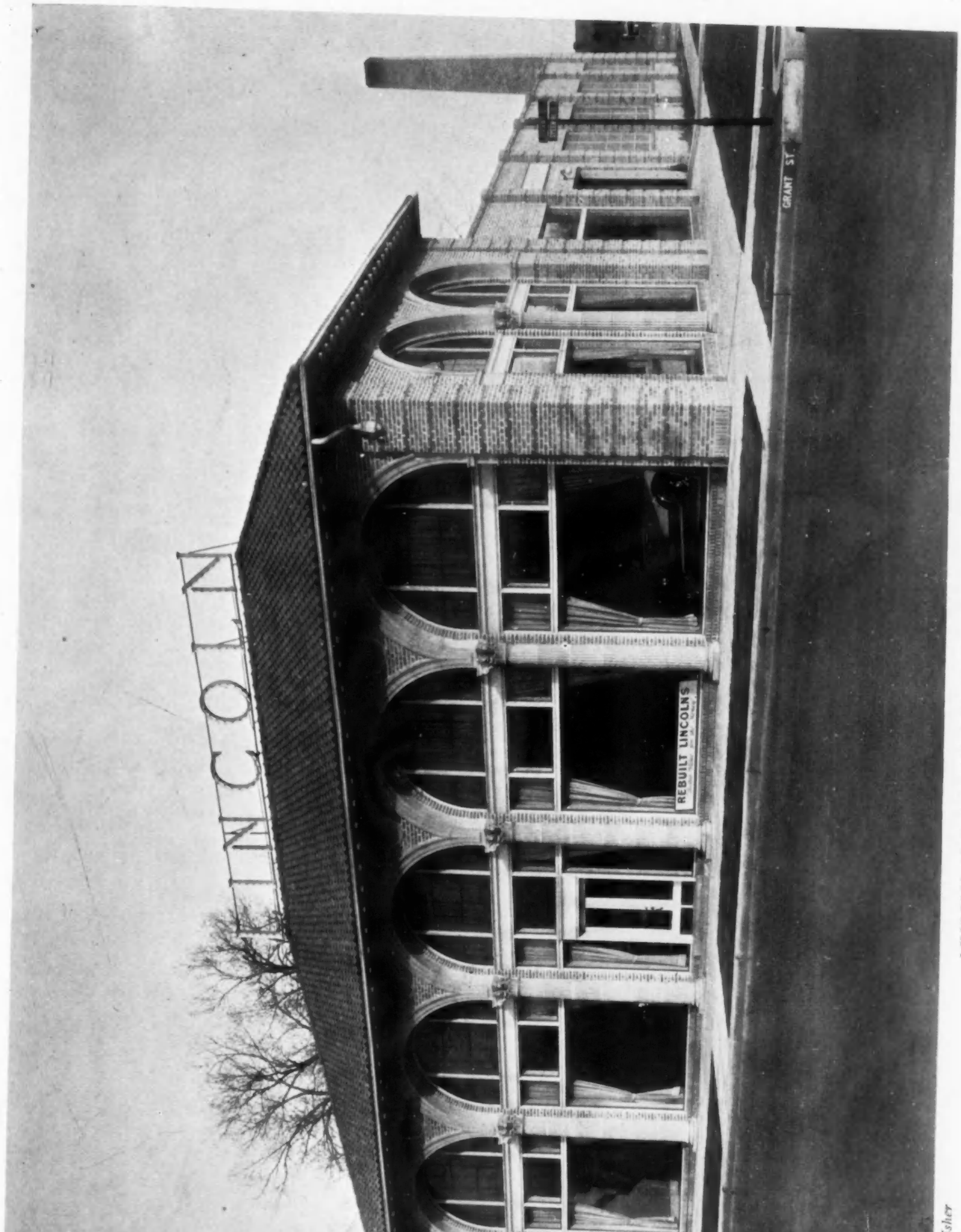
SALES AND SERVICE BUILDING, GOTFREDSON TRUCK CORPORATION, LOS ANGELES
MORGAN, WALLS & CLEMENTS, ARCHITECTS



FIRST FLOOR

PLANS, SALES AND SERVICE BUILDING, GOTFREDSON TRUCK CORPORATION, LOS ANGELES

MORGAN, WALLS & CLEMENTS, ARCHITECTS



Photo, Theodore M. Fisher

LINCOLN AUTOMOBILE AGENCY BUILDING, DENVER
MOUNTJOY & FREWEN, ARCHITECTS

NASH MOTOR CAR CO., SHOW ROOM, HAVANA
CESAR E. GUERRA, ARCHITECT

Heating and Ventilating of Garages

By WALTER TUSCH
Of the Firm of Tenney & Ohmes

THE steadily growing use of the automobile for both pleasure and business purposes, with the attendant need for urban storage space with service facilities, is creating a demand for garages, for both transient and regular patrons in neighborhoods immediately adjacent to the centers of the greatest business and social activity.

Speaking as a heating and ventilating engineer, I approve the idea of underground, multi-storied, and inside plot garages, as they open up new fields for engineers' services; and I am pleased to note that the newspapers and other publications are calling attention to the dangers of unventilated garages. The owner or operator of a public garage is thoroughly conversant with the hazards attendant upon the presence of gasolene fumes and the unconsumed products of combustion of gasolene, and will insist upon proper provision being made for their removal.

The proper heating and adequate ventilation of the average private garage does not usually present any great difficulties. It is desirable, and mandatory in many localities, to avoid use of a heating device employing an open flame, so that the best practice dictates that steam or hot water pipes be brought from the central plant in the residence or some other building, or that the boiler be installed in a separate compartment in the garage without openings communicating with the car space. Steam, vapor, and hot water heat are equally suitable, although greater care must be exercised with the latter to avoid freezing of radiators and piping by the inadvertant leaving open of windows or doors in very cold weather. The greatest economy in heating a small garage would be secured by locating the heat radiator as near the radiator or hood of the car as practicable, as this is where the heat is most needed. As a usual thing, an owner will be satisfied if he has the assurance that the temperature is maintained at not more than 50°, which will represent a material saving in his fuel bill. The ventilation of the small garage can usually be sufficiently obtained by gravity vents through the roof or side walls, windows or the door. These should naturally all be kept closed when the car is out or is in dead storage, for the sake of economy in heating, but should be opened to their limit when dispensing gas or experimenting with the motor. The larger and more elaborate private garage might possibly be provided with an exhaust fan to be run only at such times as required to remove smoke and fumes, although if I ever own a large and elaborate garage I should prefer to let the motor smoke outside. In other words, prevention is better than cure, and common sense should dictate to the owner such action as will preclude the possibility of there being disastrous results or a fatality, due to the architect's not having designed a garage fool-proof in the way of ventilation.

The main object of this article is to mention some factors deserving serious consideration in the design of the larger public garage in reference to the provisions advisable to be made for the heating and ventilating apparatus. The public garage in this climate must be heated, both for the protection of cars and the comfort of patrons. Sometimes the more simple the problem may appear to the layman the more difficult it is in reality. The one almost insurmountable difficulty is to overcome the chilling effect produced by the opening of doors for the entrance and exit of cars. The best device for the purpose is probably a power-operated door, of the "jack-knife" type, hinged at the top and provided with a horizontal joint in its center, so that when the door is fully open the two parts rest at the ceiling practically in two parallel horizontal planes. In any event the larger part of the heating equipment should be concentrated as near the doors as possible. This leads to a second difficulty, which is to provide proper space for the heat radiation where it is most required. The radiators or coils should be located as near the floor as possible and yet sufficiently high to avoid being damaged by the impact of cars, and locations must be selected which will not sacrifice valuable floor area. Column centers are usually selected to give maximum car space with minimum clearances, and little space can be spared for radiators. Ceiling heights are also worked out for minimum headroom, so that even overhead unit heaters entail a loss of valuable floor area. All rising lines of the piping system should also be located so as to be safe from possible car impact.

The heating designer must also bear in mind that a building without interior partitions and entirely undivided, as is the case in the garage, requires a greater expenditure of heat to produce satisfaction, especially on windy days. The reason for this is that cold air entering through leaky window construction, often found in garages, has a clear and unimpeded sweep across the entire floor to the leeward side of the building, where the warmer air is forced out through all openings. So it is a good investment to provide for calking airtight both inside and outside between window casings and masonry.

The multi-storied garage brings to the fore in an aggravated way another factor, which cannot be overlooked,—that is "updraft." In every heated building the tendency of the warm interior air is to rise and escape through crevices, open windows or vents on the upper floors, to be replaced by cold exterior air entering through opened doors, crevices or windows in the lower stories. The taller the building and the more open its interior arrangement, the more marked is this effect. Thus a multi-storied garage, with its open floors and the usual ramps connecting its various levels, offers less resistance to this effect than practically any other kind of building. Add to this the frequent opening of doors for the entrance and exit of cars and a careless or too liberal opening of windows and ventilating outlets on the upper floors, and the garage may become a veritable cave of the winds in its lower stories, and at the same time be greatly over-supplied with heating surface on the upper floors. In general the heating apparatus should be designed for 55° temperature in zero weather, but very liberal allowances must be made for the main doors, and for ventilation, as hereafter mentioned. A large amount of heat is both radiated from entering cars and discharged from their exhausts, but this is such a variable quantity as to be undependable. All departments other than space used distinctly for car storage, such as waiting and supply rooms, toilets, and store rooms included in the building, should be served by separate mains for purposes of economy, as they will require heat at times when it is not needed in the garage proper. Such rooms should of course be heated to 70°.

Generally speaking, steam is to be preferred as a heating medium, although hot water has certain advantages if freezing pipes and heating surfaces in exposed places are carefully guarded against. If steam can be secured from a steam service corporation at attractive rates, and if a timing control device is installed to automatically shut off the steam in accordance with the hour and the weather, it may be far cheaper to purchase all steam required. The necessity of banking fires, and starting them up again as required by a change of weather is one of the disadvantages of the private boiler plant, which cannot as economically take care of fluctuations of load as can a corporation selling steam for both heating and power. The designing engineer should carefully and conscientiously analyze the relative costs of purchasing, versus generating steam, taking into account charges for cost of construction, of space for the plant, cost of plant, maintenance and depreciation, taxes and insurance, extra labor, cost of coal, and ash removal, and be guided by the result.

The limitations of this article preclude a discussion of the theoretical requirements for ventilation, and it is doubtful if they could be successfully applied to a problem of this sort. So many factors enter that no workable formula is possible. As many windows as possible are installed, as a usual thing, which even when closed, through leakage, afford a means for the ingress of a considerable amount of fresh air. When fresh air is most required, that is when many cars are in motion and discharging the maximum amount of exhaust, the entrances and exit doors are also most open and are providing an excess of fresh air. Bearing in mind that traffic, which is the measure of ventilation requirement, is not occurring in all parts of the building at the same time, it is advisable to be very liberal with the areas of the flues and exhaust outlets, but to keep the capacity of the fan or fans at less than the flue capacity. An attendant is usually stationed on each floor, so that with good management, transient cars arriving are parked on certain floors or in certain areas. The attendant should open the exhaust outlets during such times, keeping them closed when traffic is light. The through traffic on the ramps will not noticeably affect an idle floor, as the updraught will carry all exhaust gases to the upper floors, where the cars are being berthed, and where the exhaust outlets should be fully open. This arrangement of design effects the maximum economy of installation and operation, but the attendants must be trained to coöperate or failure will be the result.

Without intending to define a standard, because the requirements of every building will vary with its type, a few figures for a successful installation might be given as an example. Suppose the building is of five stories, exposed on all sides, on a plot 130 by 180 feet. It is provided with a fan capable of exhausting 60,000 cubic feet per minute. With various toilets and shops, rather intensively ventilated, this allows about 10,000 cubic feet per floor of car storage, or two and one-half changes per hour. With half of the outlets closed this could be increased to practically five changes per hour, or once in 12 minutes for any selected floor. This active air change, of course, materially increases window leakage and chilling effect. In this building about 3,000 square feet of additional radiating surface was installed to take care of this loss of heat, although this additional surface will actually heat only about 12,500 cubic feet of air from 0 to 65°. The location of the vent openings will necessarily be largely determined by the general arrangement of the floor plan. It will usually be impossible to run any horizontal ducts at the ceilings to secure the refinement of an even distribution of the exhaust, and the outlets will usually be located directly in the walls of the vent shaft or shafts leading immediately to the exhaust apparatus located in the roof house. It is evidently advisable to locate the exhaust in the center of the floor plan, if the building has window exposure on all sides, or as remote from the windows as possible where window exposure is lacking on one or more walls. For evident reasons also the exhaust should not be located too near the ramps, where the air is in most active circulation, but rather so as to remove the air at the point of greatest stagnation. Exhaust would also be desirable at gasolene-dispensing points throughout the garage.

While this brief article is not intended to be, nor can it be, used as a manual of instruction for the complete design of heating and ventilating apparatus, I have attempted to dwell briefly on the most important factors to be considered. The proper ventilation of a garage has a great deal to do with the comfort and convenience with which it can be used, while the matter of heating is, if possible, of even more importance, since it affects the maintenance of property which is sometimes of far greater value than the garage itself. Planning the ventilating and heating apparatus for such a building should receive careful study by the architect responsible for its erection if its purpose and function are to be well served.

The Mechanical Equipment of the Garage

By RALPH HARRINGTON DOANE

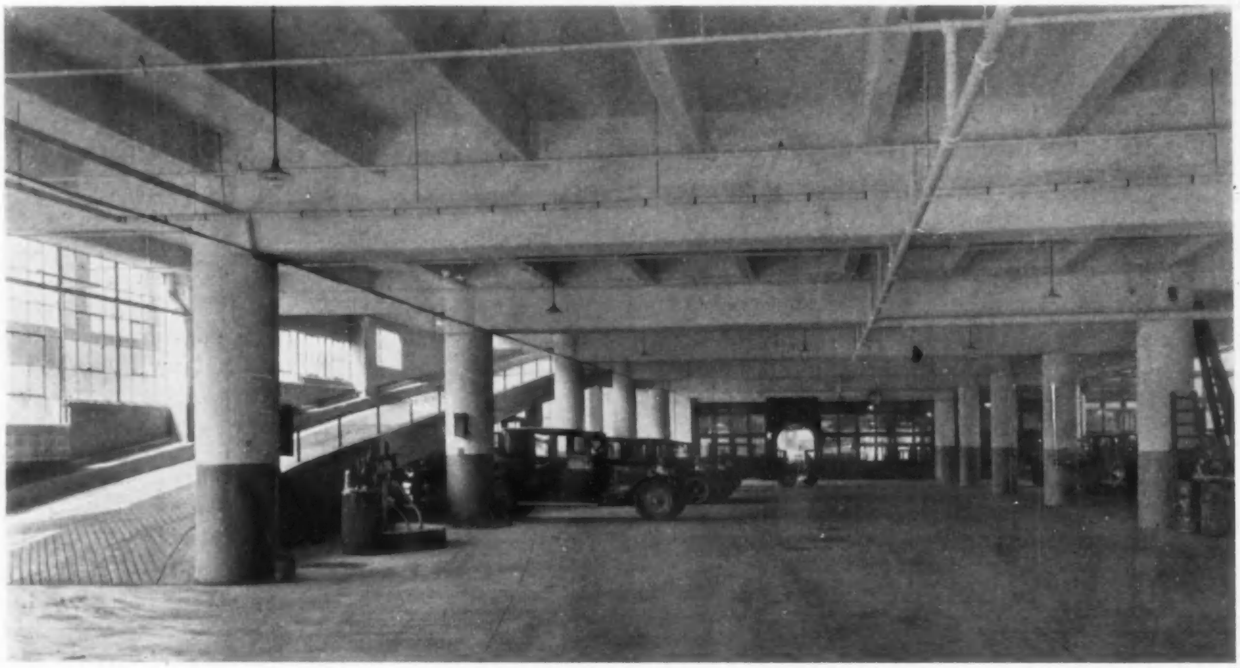
Exit Ramps, Bowdoin Square Garage, Boston
Ralph H. Doane, Architect

MUNICIPAL traffic regulations and the ever-increasing influx of automobiles into congested districts have necessitated the erection in the principal cities throughout the country of large public garages which have presented for solution some very difficult architectural and mechanical problems new to the building industry.

Forming a basis for the present study are two new modern storage garage buildings, — the Bowdoin Square Garage, Cambridge Street, Boston, having an area of 27,000 square feet per floor, seven stories in height, with a capacity of 850 cars in parking stalls, and the New Motor Mart Garage, Park Square, Boston, having a floor area of 52,500 square feet per floor, eight stories and basement in height, with accommodations for parking 2,000 cars at one time. Each building embodies many practical special mechanical installations, none of which is absolutely standardized garage equipment, since the designs vary considerably with the layout of buildings, as to the location of parking areas, traffic aisles, service stations, and particularly the automobile entrances and exits. Each building presents its problem.

Throughout the eight floors and basement of the New Motor Mart Garage, said to be the largest garage in the world, there are 18 gasolene service stations, 27 oil distributing stations dispensing three grades of motor oils, and 44 stations where air for tire inflating and water for car radiators may be obtained. The gasolene equipment is a so-called hydraulic system, based principally on the specific gravity of gasolene and water in which water displaces each gallon of gasolene withdrawn from the two 2,500-gallon storage tanks located beneath the basement floor. Within each tank is a patented unit consisting of two seamless copper floats mechanically designed to by-pass water to the sewer in the event that all the gasolene is withdrawn, thereby eliminating the possibilities of floating water through the panels at the distributing stations. Also connected with the storage tanks is a 2-inch water riser, which terminates at the seventh floor, 94 feet above, where two water tanks of 15-gallon capacity are located, supplying sufficient buoyancy to float gasolene to the eighth floor distributing panel. All panels are equipped with nozzle-control dispensing hose, remote electric control operating a solenoid switch in basement, which regulates the supply of water to storage tanks, and cut-out valves to stop the flow of gasolene in the event of the hose becoming severed. The oil delivery system of the New Motor Mart Garage, however, differs entirely in design from that of the gasolene system, although there are distributing stations on all floors supplied by three storage tanks which are located under the basement floor slab. These tanks have a total capacity of 1,750 gallons, two of them being of 500-gallon capacity for light and heavy oils, the other holding 750 gallons for medium oil. In conjunction with each storage tank there is a working tank of 40-gallon capacity supplied by gravity from the storage tank. The working tanks are under a varying air pressure, as desired, with a maximum of 180 pounds, sufficient to discharge oil to the highest point of the system approximately 100 feet above the storage tanks, and they are so piped and fitted with horizontal and vertical check valves as to eliminate any pressure upon the storage tanks, the supply of air also being dried and filtered so as to avoid condensation from compressed air being mixed with the oil and emulsifying it. At each distributing station there are three reservoirs, each of 65-gallon capacity, equipped with self-closing pressure supply bibbs and sealed handpumps for the measuring of oils. These reservoirs are filled each day from the storage tanks, and tabulation is made of the contents, the attendant being charged with the amount of oil dispensed, an accurate check being kept.

The car-washing facilities in the New Motor Mart Garage are unique in design, and so efficiently equipped for cleaning and washing in progressive stages that they probably represent the most advanced ideas in car-washing equipment. Fifteen cars can be accommodated simultaneously in the various stages of washing, each car being completed in 20 minutes' time for the entire process. Motors are thoroughly cleansed with kerosene spray under 180-pound pressure, upholstery dry cleaned, and the whole interior of the car vacuum cleaned. The body and running gear are washed with a warm soapy spray of varying pressure of from 90 to 300 pounds, and then rinsed with clear cold water at 90-pound pressure, chamoised, and dried with air blowers and jets of 180-pound pressure, removing all moisture from crevices and edges of glass win-



Ramp to Second Floor, Packard Garage, Philadelphia
Phillip S. Tyre, Architect

dows, windshields, doors, etc. Throughout the 150-foot length of the washing and cleaning department are two 3-inch depressions in the floor, forming a track of sufficient width to accommodate the largest vehicle, which guides the car passing through the various stages of operations and eliminates the necessity of using the steering wheel and also the opening of the doors after the interior of the car has been cleaned. Suspended from the ceiling, parallel to and at both sides of the floor guide rails, are trolley tracks containing roller-bearing trucks to which the various lines of hose are connected, eliminating the necessity of swinging a hose around a car, particularly a limousine, in order to wash both sides. The slightest tension on a hose causes it to travel along the trolley track. This device minimizes the danger of damaging cars with the hose, and it also facilitates the frequent handling of the hose.

Four compressing machines, each operated by a 5 h. p. direct-current motor, equipped with rheostats and square "D" switches, constitute the equipment for high-pressure water washing. Each machine is a unit in itself, the enclosed motor, belts, pulleys, pump cylinders, electrical controls, pressure gauges, by-pass piping and suction hose being mounted on a single base and so protected that all electrical connections are impervious to water and immune to the possibilities of short circuiting. The capacity of each pump is in excess of 18 gallons per minute at a maximum pressure of safety in the amount of 300 pounds, and the pumps are so constructed as to be practically fool-proof by the system of by-pass piping and pressure relief, should the motor be allowed, by neglect, to run continually when the hose nozzles are not in use. Each pump produces sufficient pressure and volume of water to supply four spray guns or nozzles, so constructed with diaphragms that by a quarter-turn of the hand wheel the discharge can be changed from a driving stream to a fine, light mist. The guns are small in size and can readily be placed under the mud fenders without coming in contact with a tire, thereby enabling the car washer to work in confined places, using the pressure to its full advantage. Also connected to the overhead track and in conjunction with the high-pressure washing apparatus at each of the eight wet stands are two independent hose lines of 90-pound pressure, hot, cold or tempered water being supplied directly from the domestic service. The domestic water service serves the purpose of showering or dowsing a car, before it is washed by high pressure, and also for the rinsing which completes the operation on the wet stands. Two-inch cold water, 2-inch hot water, and 1-inch hot water circulation returns, all brass, constitute the water supplies to the washing department, the hot water being supplied from a 2,200-gallon generator containing a steam heating element of sufficient capacity to heat contents of the tank once an hour to a temperature of 190° Fahr. Mixing chambers and automatic non-scalding temperature control valves are installed to temper water for either machine or domestic use. To avoid vibration due to varying changes in pressure, check valves have been incorporated in the piping. The dry stands of the washing department are equipped with portable vacuum cleaning machines which are fitted with at least 12 different types of instruments for vacuum cleaning. The hose from these machines are connected to the overhead trolley track in the same manner as in case of the washing machine equipment.

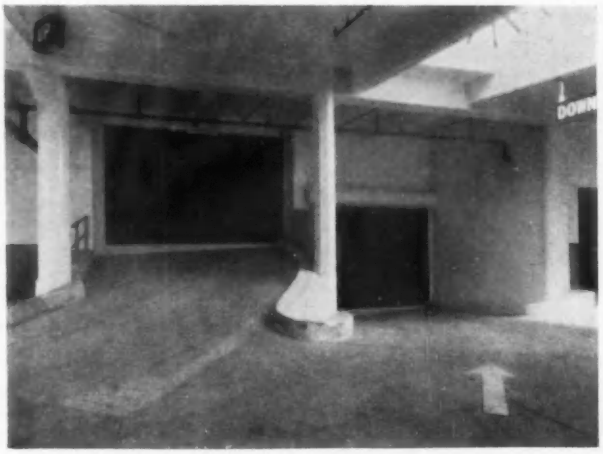
Garage management and the mechanical layout are inextricably inter-related. Speed in receiving

Service Room and Parking Area, Packard Garage, Philadelphia
Phillip S. Tyre, Architect

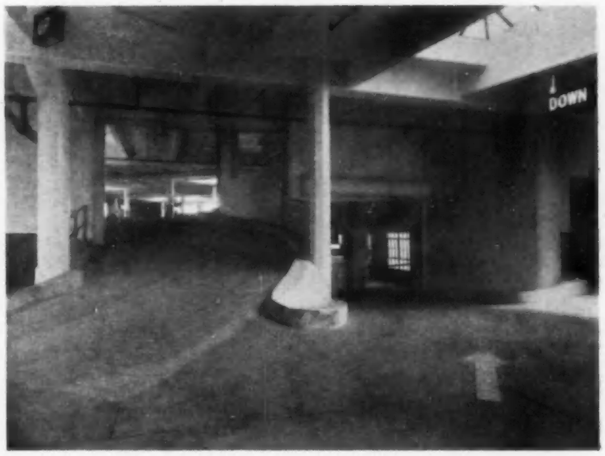
and clearing cars and customers is essential to the success of the enterprise. In both the Bowdoin Square Garage and the New Motor Mart Garage, the control of traffic by traffic squads has been augmented by the installation of pneumatic tube receiving and dispatching systems as well as telautograph service, call bell signals, telephones, time clocks, time stamps, and a modified block signal system of annunciators. Due to the installation of duplex ramps in the New Motor Mart, with exits and entrances on two different streets, the block signal system is designed accordingly with controls on each of the seven typical floors at the extreme ends of the ramps. The floor areas are divided into two sections for parking purposes, and at each car entrance on the first floor are grouped two annunciators connecting all floors and notifying the car dispatcher of parking conditions on each floor. The annunciators are also grouped at the ramp extremes on the second floor, which is customarily the car dispatcher's station during active periods, thereby eliminating the stopping of cars at the auto entrances at street levels. Each floor captain notifies the dispatcher of the parking conditions in his particular section by throwing a switch which lights one of the three vari-colored lights in the annunciator cabinet indicating the number of vacant parking spaces. The dispatcher, in turn, notifies the parking captain of the number of inbound cars by throwing a switch which first sounds a gong and then turns on a light which remains lighted until a specified number of cars have been directed to the parking areas as indicated by the annunciators. This of course prevents congestion.

Floor draining in garages is a problem seldom planned for in a manner satisfactory to all garage operators and managers, as they differ greatly in their opinions as to the correct locations and types of floor drains. The various types of floor construction have a direct bearing on the problem. Where concrete floors are poured monolithically, it is necessary that the drains shall be in closer proximity to each other than is necessary when a granolithic finish is added to a precast base, since it is nearly impossible to grade monolithic finish properly, due, in part, to the usual sloppy mixture of the concrete and also to the necessity of there being a great number of men, using varying pressures upon their trowels, employed to complete the operation of surfacing large areas before the setting of the concrete takes place; it is seldom possible to eliminate depressions, regardless of the fact that screeds are used. Securing absolute evenness is most difficult.

The two garages mentioned here embody two distinct methods of floor draining, with similar equipment, and it is a question which is the more advantageous. In one instance, floor drains, approximately 40 feet on centers, allowing the maximum grade of 2 inches to occur in a radius of 20 feet, are located in the traffic aisles, while in the other the drains are located at the rears of the parked cars and approximately at the same dimensions on centers. The former system involves the objection that it is nearly impossible to keep the aisles perfectly dry, as traffic is continually moving over them, but this method does permit the use of squeegees,—while the other method does not permit accessibility for cleaning, but does keep the aisles dryer. Floor drains should contain hinged, non-removable dirt receivers and be equipped with back-water valves, so installed as to close when receivers are in an uplifted position, thereby shutting off the flow of water and mud deposited on the floor from uplifted re-



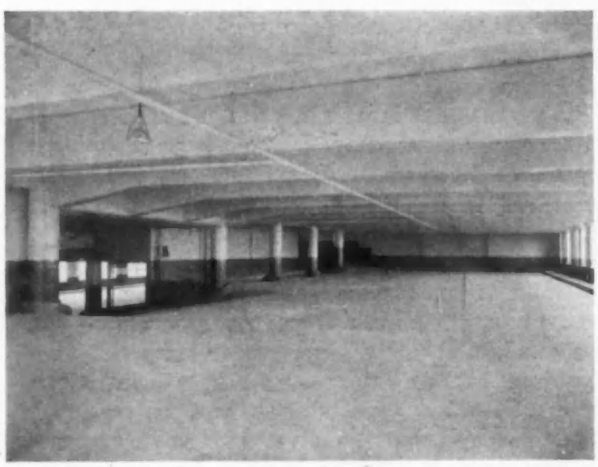
Up and Down Ramps with Roller Doors
Bowdoin Square Garage, Boston



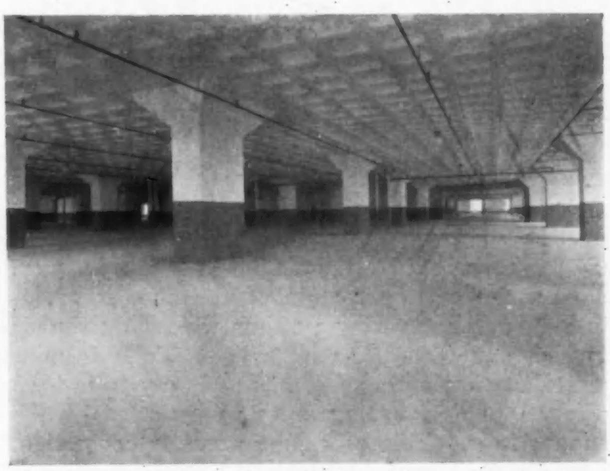
Up and Down Ramps with Doors Rolled Up
Ralph H. Doane, Architect

ceivers. When dirt is shoveled from the floor, the receiver is replaced within the floor drain and the backwater valve opens, permitting uninterrupted flow.

All floor drain piping is oversized by design, as accumulating grease, oil, mud, etc. which form corrugated mounds within them, in time resulting in masses which it is impossible to move by the method of flushing or rodding. Eight-inch soil pipe is used wherever possible, into which running cleanouts are introduced as nearly at 20 feet on centers as possible. A 4-inch soil is extended 6 feet beyond the actual floor drain location, turned up and finished flush with the floor grade, with an inverted cleanout calked into the hub. The reason for this extension is to locate the cleanout outside the possible area of a water pool which will form if the floor drain is neglected to the extent of permitting the dirt receiver to become filled and also defeat the purpose of draining the floor through the cleanout and past the trap. All floor drains located more than 12 feet from main stacks are vented with 4-inch wrought iron vents tied into the main 8-inch vent, which is a continuation of the horizontal soil drains and is carried to the roof undiminished in size. The drains are piped to sand and gasolene traps which are also vented to the roof by means of two individual 4-inch vents. Sand and gasolene traps are often required by city ordinance, and usually descriptive designs and specifications are issued. However, it is seldom that the designs are for traps of sufficient capacity to be installed in garages similar to those being considered here. In both the Bowdoin Square Garage and the New Motor Mart Garage the sand and gasolene traps have been designed so that it is necessary to clean them not more than once every 10 or 12 months. The largest of three such traps installed in the New Motor Mart Garage has a capacity of 10,000 gallons and is constructed of waterproofed reinforced concrete. It is composed of two chambers,—the receiving chamber, and the delivery or cleanout chamber, which are separated by an 8-inch concrete partition, arched at the bottom and permitting a flow from one chamber to the other. The receiving chamber is a sealed compartment, except for the vent to the roof which carries off all gasolene and oil fumes, and it is accessible only through an airtight hatch cover. The inlet to this compartment is located approximately 2 feet above the sewer outlet from the delivery chamber and, therefore, is always above the water level of the



Evening News Garage, Detroit, Showing Up and Down Ramps
Albert Kahn, Inc., Architects



Portion of Typical Floor Parking Area, Motor Mart Garage, Boston
Ralph H. Doane, Architect

Up and Down Ramp Arrangement
Albert Kahn, Inc., Architects

Ramp Garage, Atlanta
Pringle & Smith, Architects

trap. The exhaust chamber is equipped with 6-inch I-beams so installed as to form a support for a wood plank platform inserted for use in cleaning out the trap. Eyebolts are located in the ceiling for use of blocks and tackle, and swinging iron doors, airtight when closed, are installed on the side of trap above the water line. This arrangement proves to be excellent.

The workshop of a modern garage forms an important part of the establishment, particularly when every kind of service is rendered, even to the painting of cars as well as reconditioning and rebuilding of bodies, motors, upholstering, and the repairing of radiators and mechanical parts. Such services necessarily require specially designed apparatus and installations. Quantities of compressed air are used in the workshop as well as in other portions of the building, as all oiling, greasing, and cleaning of parts are done under pressure. The air-compressing equipment comprises the installation of two 15 h. p. motor-driven compressors of 42 cubic feet per minute capacity for each pump, equipped with safety valves set to blow at the maximum required pressure of 225 pounds. In conjunction with the compressors there are two tanks or reservoirs, each being 3 feet in diameter and 10 feet in length, manifolded so as to work together. The motors are equipped with self-starting rheostats, operated by a mechanism connected to the air lines, thereby keeping the reservoirs completely filled with air at maximum pressure. The air delivery system is also equipped with auxiliary reservoirs located near equipment demanding quantities of air for operation, such as the air outlets in the car-washing department, previously described, and the pneumatic sewage ejectors. It also provides the means of operating other details of equipment, such as oil delivery system, tire-inflating stations, greasing and oil-lubricating system, and four "rotary lifts," for which air is also required.

The "rotary lifts" are of special design and will raise the heaviest passenger car 5 feet above the normal floor, on an open base constructed of structural channel irons and so designed as to rotate when in an elevated position. Pressure of 180 pounds is sufficient to operate these lifts, as they are worked on a semi-hydraulic principle, the plunger cylinder being full of oil which becomes compressed with the admission of the air, causing the piston to elevate. By expelling the air rapidly through a gate valve, the lift will gradually return to its normal position, but an arrangement is also provided whereby the

Workshop in a Garage in Los Angeles

Service Department, Garage in Denver

Wall Benches, Chevrolet Workshop, Detroit
Albert Kahn, Inc., Architects

Another View in Chevrolet Workshop, Detroit
Albert Kahn, Inc., Architects

oil within the cylinder can be delivered in very small quantities, through a small orifice in a nozzle attached to a quarter-inch hose 12 feet in length. The use of the hose decreases the pressure within the cylinder very gradually, permitting the use of the oil for lubricating and spring oiling, and retards greatly the downward course of the car. The lifts are set within circular pits 12 feet in diameter, with wells in the centers to accommodate the plungers, these pits concealing and providing space for the superstructures of the lifts when level with the floors. All air controls are installed 4 feet above the floor, next to a side wall, and so isolated as to be protected from damage by moving cars or by cars being rotated on the lifts. The controls consist of simple hand-operated gate valves. Grouped about each "rotary lift" are four grease gun outlets supplied by an air-operated plunger in a reservoir of 80 pounds of grease. The piping for this installation is 1¼ inches in diameter, each outlet being fed through a half-inch armored cable 12 feet in length and equipped with a patented grease gun. Also within the workshop is an adequately equipped battery room with charging apparatus; acid-proof sink and drain connected independently to the city sewer; tire-changing apparatus; small overhead portable lifting cranes; and a novel arrangement of portable lights.

Located in the boiler room, in lieu of an incinerator, which in Boston is not permitted within the garage, is a rubbish bin 10 feet by 14 feet and 22 feet in height, protected against spontaneous combustion by the installation of sprinkler heads. The rubbish bin is connected to all eight floors of the garage by a ⅜-inch steel plate flue or chute, 26 inches in diameter. At each floor there is an opening into this chute, so designed that rubbish can be dumped into it, or floor sweepings swept into it when the single door is opened. All rubbish is burned in the boilers.

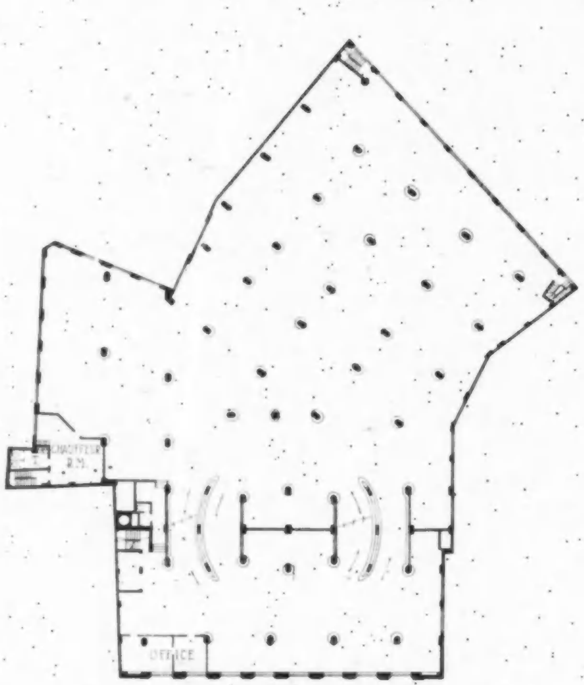
Other details of special garage equipment of interest installed in these buildings are the automobile entrance and exit doors and the electrical signal device warning pedestrians of the approach of outgoing cars. There are two types of doors used,—the horizontal sliding type and the vertical lift type. The vertical lifting doors are made in two parts of approximately the same dimensions, totaling 4,000 pounds in weight. They are electrically operated by 3 h.p. motors so geared that the lower sections raise and lower at exactly double the speed of the upper portions of the doors, and are controlled by push-buttons. The push-buttons are so arranged that only a touch contact is necessary for the uplifting operation, while for the closing of the doors it is necessary for the doorman to hold the contact throughout the length of the downward course, thereby requiring the operator's attention to be directed toward the moving door and reducing the possibilities of accident. The door control system is also provided with a safety stop switch connected directly to the emergency brakes installed in the operating equipment. The doors, already described, rise to a full height of 14 feet in five and one-half seconds, and each exit and entrance door is 22 feet in length, making door openings for both incoming and outgoing cars 14 by 22 feet, there being four such doors in the New Motor Mart Garage. The sliding doors operate in a similar manner, other than that they slide horizontally, and the equipment is nearly identical. Recessed in the floor approximately 20 feet to the rear of the exit doors is an electrical signal device so designed as to sound a gong attached to the exterior of the building, near to the doors, warning pedestrians of the approach of a car. It consists of a so-called floating metal plate 25 feet in length and 8 inches wide, supported by coil springs within which are the electrical contacts. This plate is so located that all four wheels of a car, approaching and passing over it from any angle, will cause the gong to sound, giving notice of a car's approach.

Mechanical installations, necessary in all modern garages as well as other buildings, and incorporated into the design of the buildings mentioned here, include fire alarm signal system; watchman's clock system; heating and ventilating system with use of heating units eliminating radiators; passenger elevators; parcel rooms and parcel room lifts; telephones; sprinklers; first-aid risers; standpipes; rolling steel shutters; ash hoists; and coal conveyors.

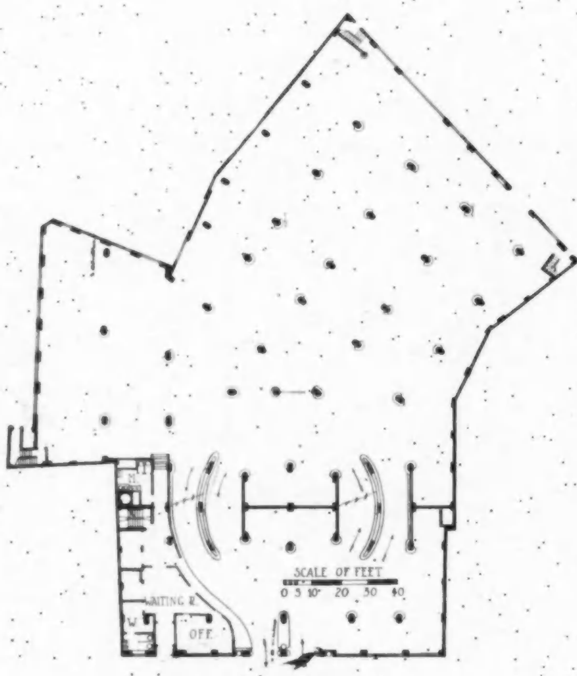
Photo, Paul J. Weber

Plans on Back

BOWDOIN SQUARE GARAGE, BOSTON
RALPH HARRINGTON DOANE, ARCHITECT



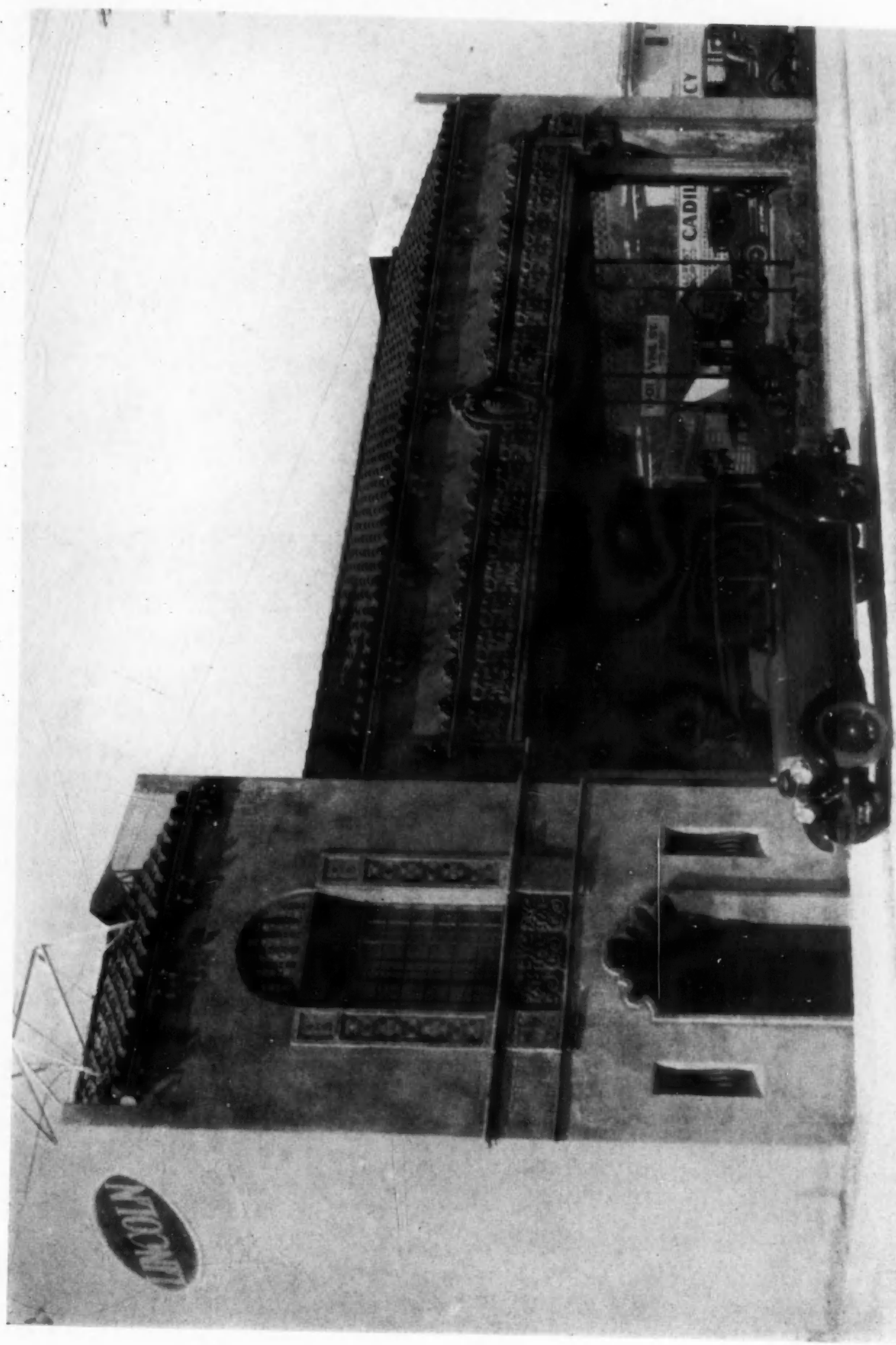
SECOND AND THIRD FLOORS



FIRST FLOOR

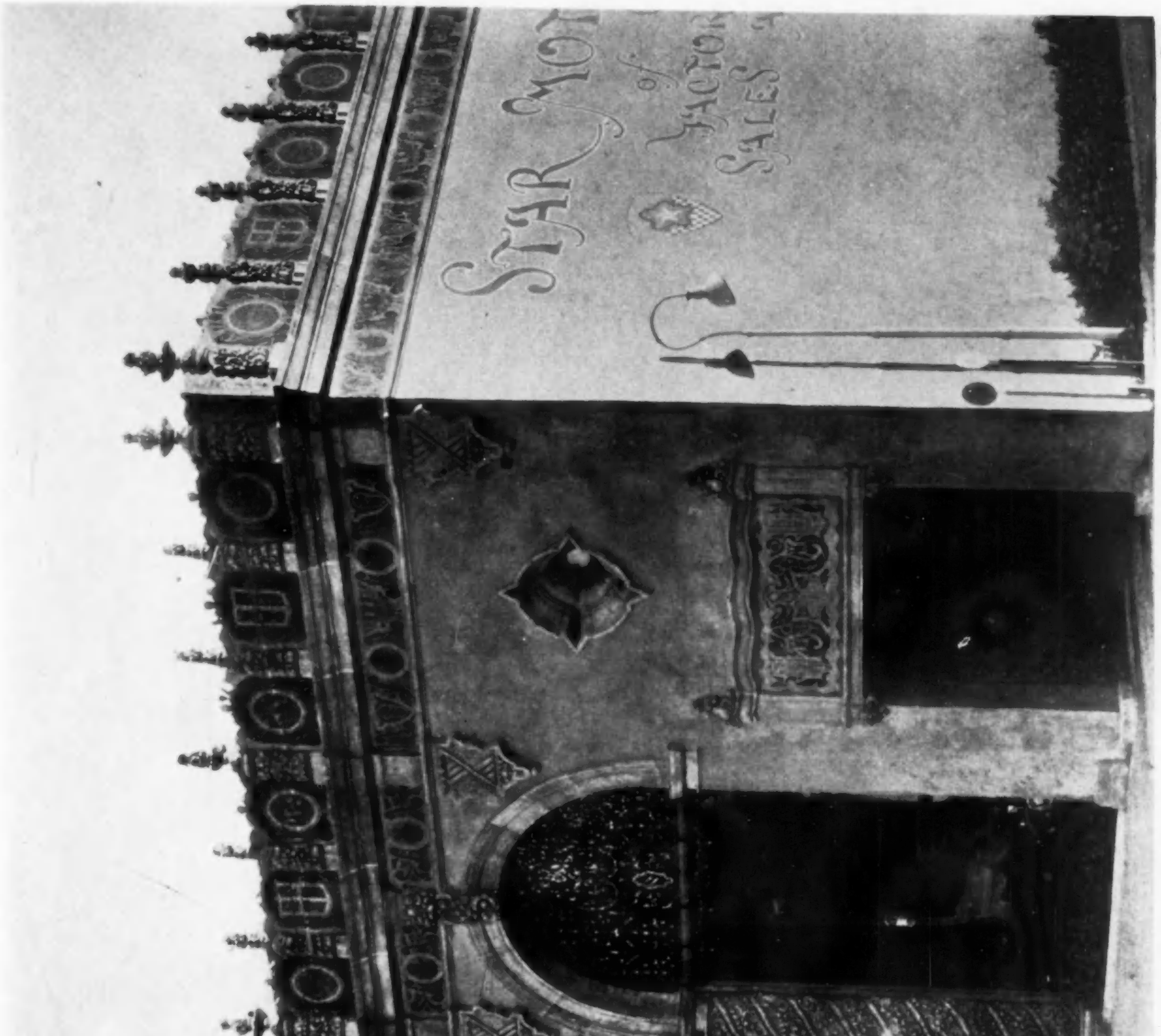
PLANS, BOWDOIN SQUARE GARAGE, BOSTON

RALPH HARRINGTON DOANE, ARCHITECT



Photo, Margaret Craig

LINCOLN SALES AND SERVICE BUILDING, HOLLYWOOD, CAL.
HARRY L. PIERCE, ARCHITECT

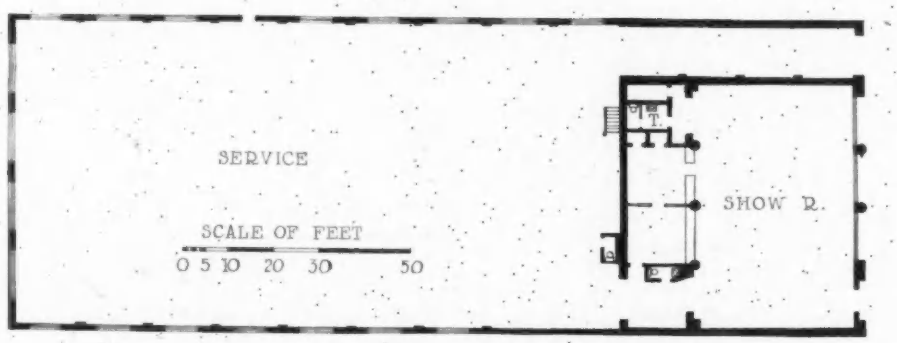


Plans on Back

STAR MOTOR CAR CO. SALES BUILDING AND GARAGE, HOLLYWOOD, CAL.

MORGAN, WALLS & CLEMENTS, ARCHITECTS

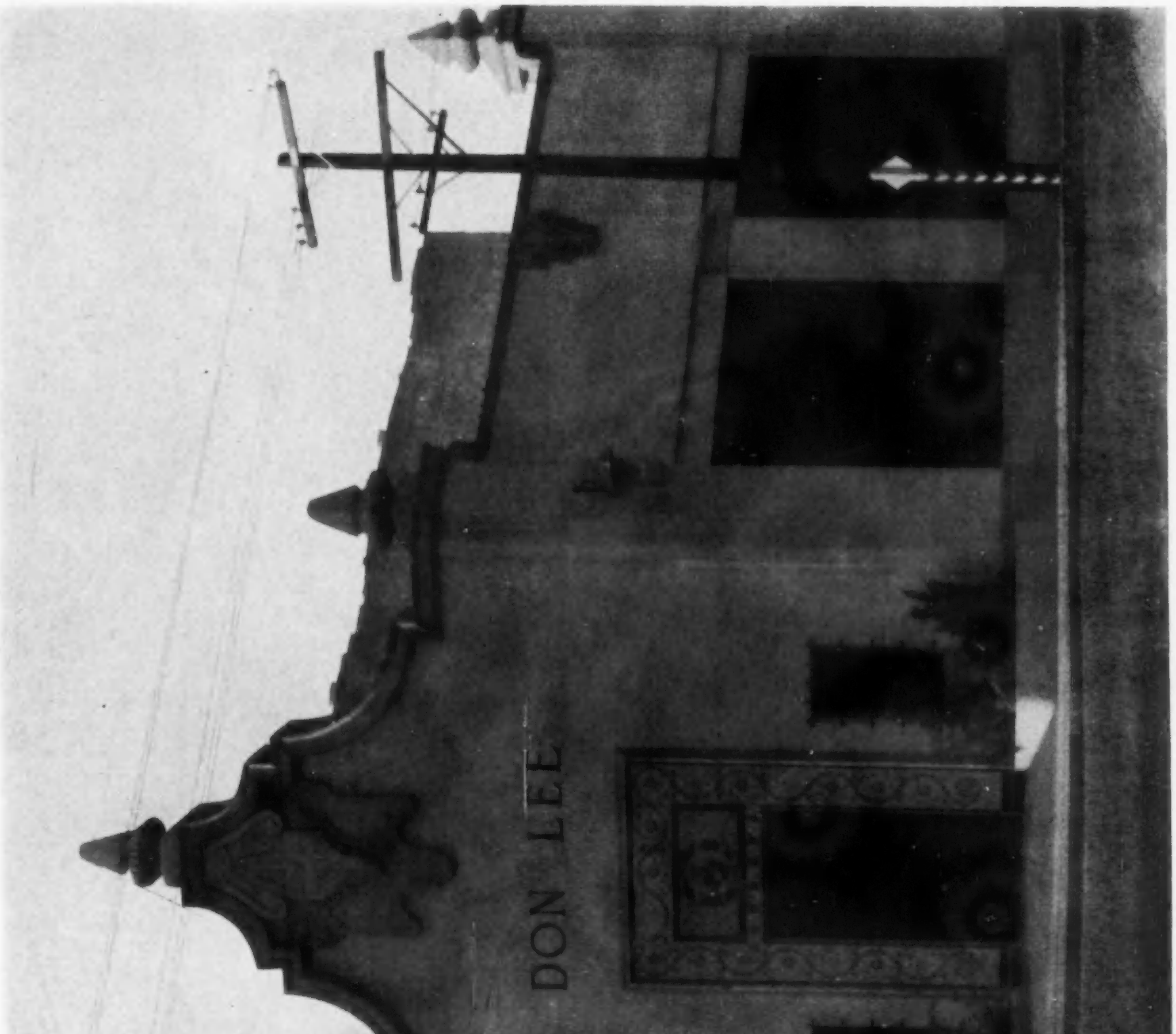
Photo, The Mott Studios



FIRST FLOOR

PLANS, STAR MOTOR CAR CO. SALES BUILDING AND GARAGE, HOLLYWOOD, CAL.

MORGAN, WALLS & CLEMENTS, ARCHITECTS



Photos. Margaret Craig

AUTOMOBILE SALES BUILDING, SAN FRANCISCO
MARSTON, VAN PELT & MAYBURY, ARCHITECTS

Photo. Margaret Craig

STUTZ SALES AND SERVICE BUILDING, HOLLYWOOD, CAL.
H. F. HALDEMAN, DESIGNER

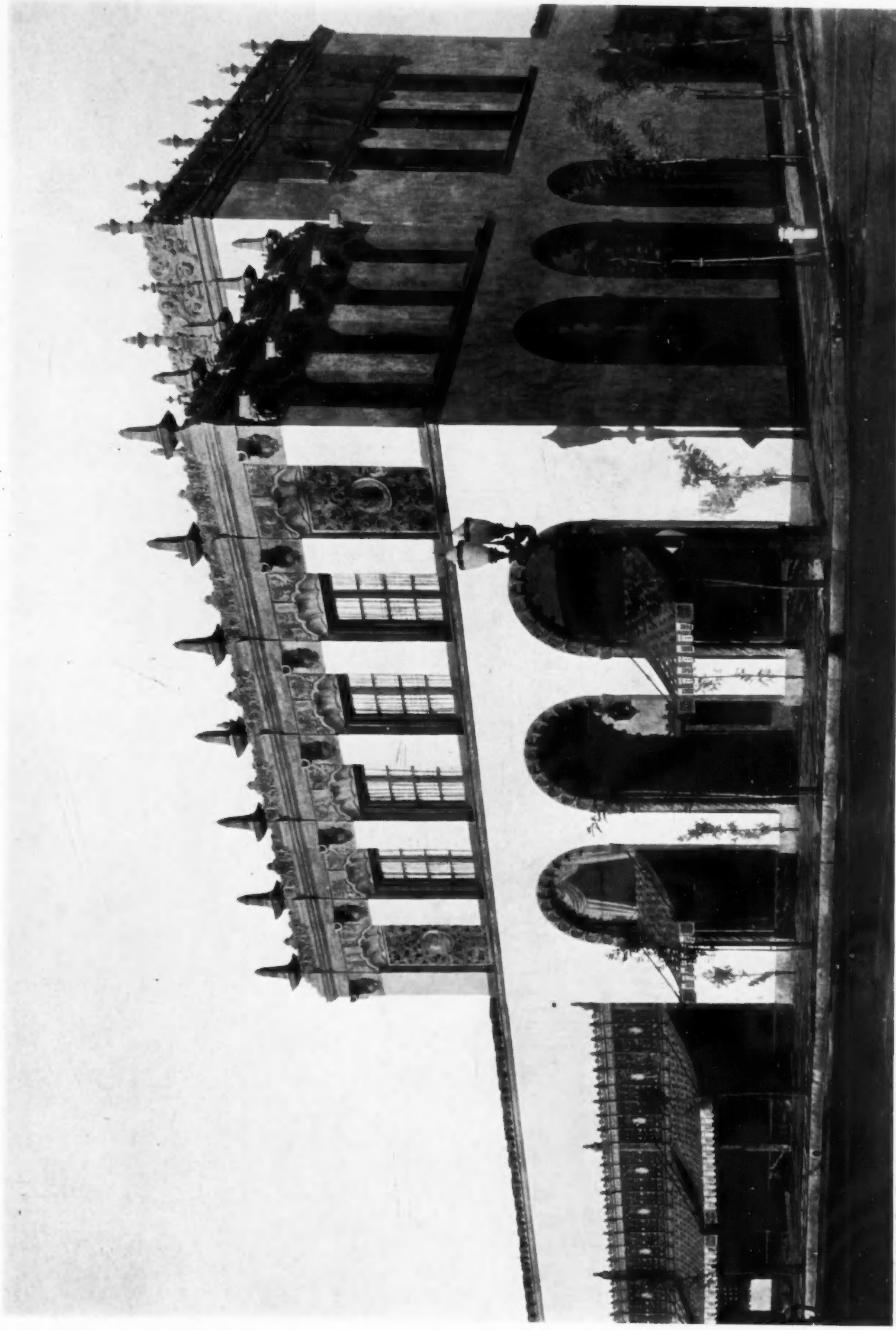


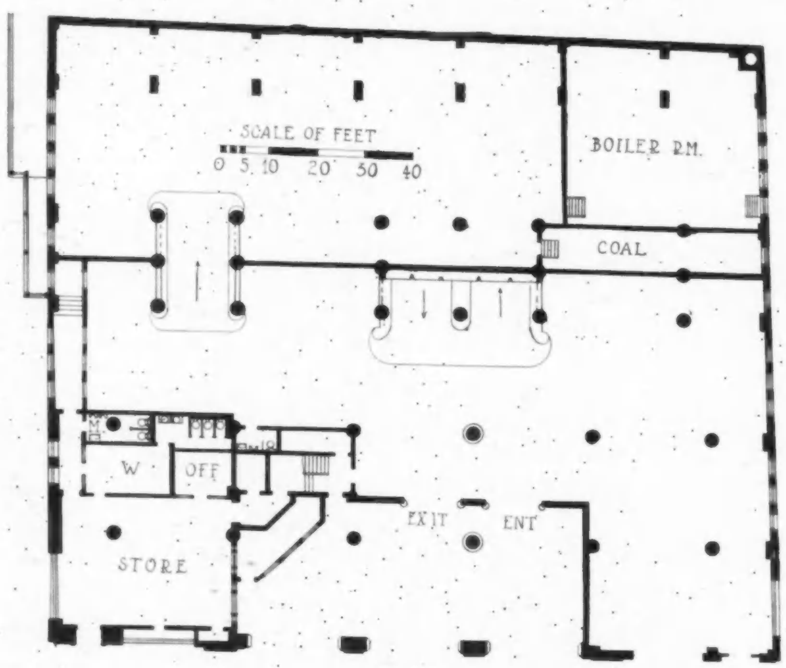
Photo. The Mott Studios

SHOP, GARAGE AND OFFICE BUILDING, HOLLYWOOD, CAL.
MORGAN, WALLS & CLEMENTS, ARCHITECTS

Plans on Back

WASHINGTON TERMINAL GARAGE, NEWARK
MARSHALL N. SHOEMAKER, ARCHITECT

Photo. William F. Cone



FIRST FLOOR

PLANS, WASHINGTON TERMINAL GARAGE, NEWARK

MARSHALL N. SHOEMAKER, ARCHITECT

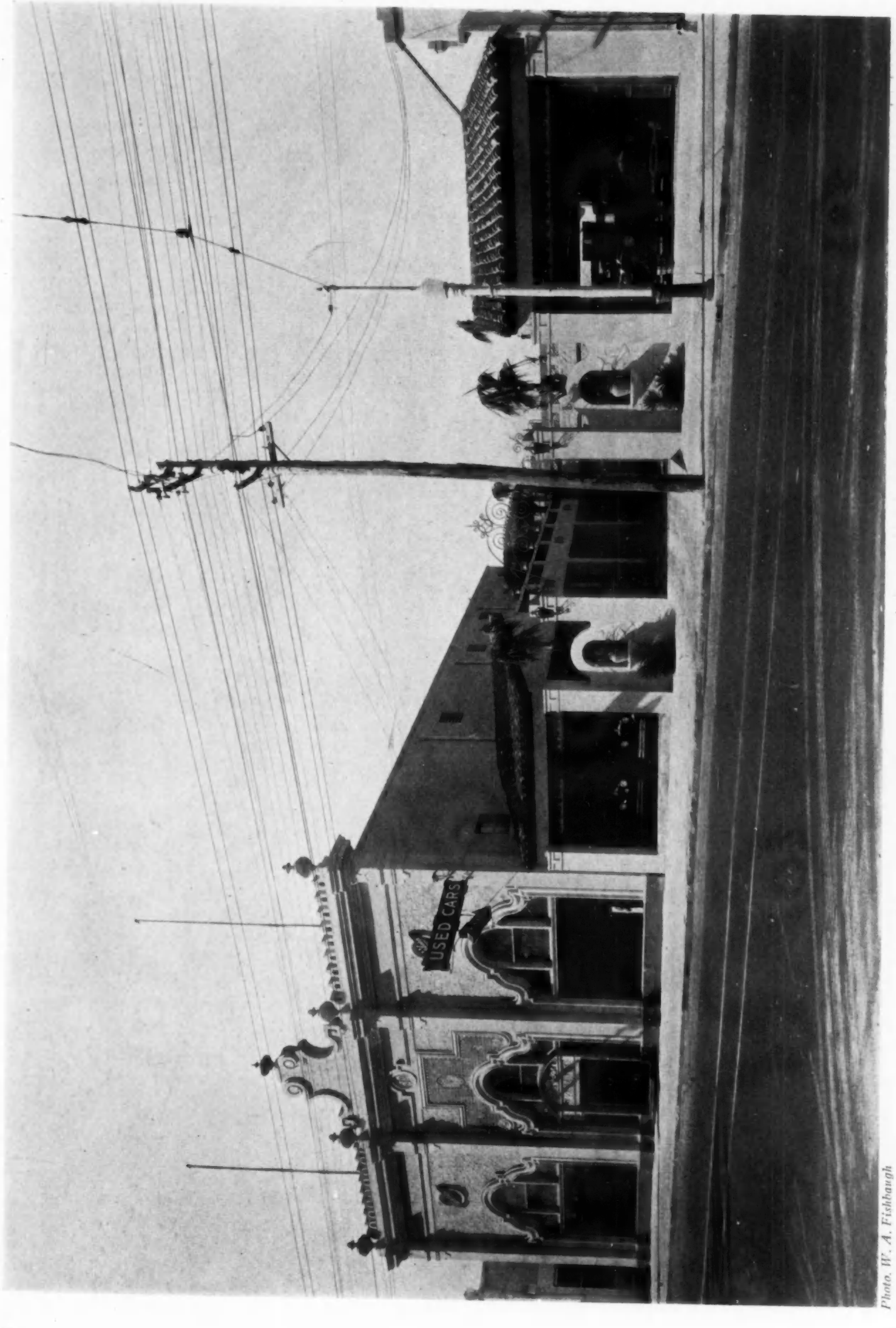


Photo. W. A. Fishbaugh

STUDEBAKER SALES, SERVICE AND GARAGE BUILDING, MIAMI

The Layout of Automotive Buildings

By HAROLD F. BLANCHARD

Technical Editor, "Motor"

AUTOMOTIVE buildings are different from all other kinds of structures in that they are built largely to house a single article, averaging in size about 6 by 15 feet, movable lengthwise, and having a limited turning radius. Practically all other types of structures are designed to house a variety of articles. Because of the highly special character of automotive buildings, the locating of columns and other limiting features becomes a matter of prime importance, greatly influencing the storage capacity, whereas column location only slightly influences the efficiency with which the space in other types of buildings may be utilized. Then too, the automotive building must be laid out so that cars may be put into and taken out of their parking spaces readily, and this presents a problem which does not occur in most other types of buildings. The storage of cars in a show room obviously cannot follow any set system, but in the repair and storage departments economy of space utilization demands that the arrangement of cars be carefully planned, and here it should be emphasized that layout in the repair or service department is as important as in the storage areas, and in fact the main difference between planning a shop and planning a storage garage is that the cars in the shop require more space.

It is desirable to discuss the layout of the garage first. Therefore let us note that the economy of any garage layout is determined by the smallness of the area devoted to aisles, passages, ramps, elevators, and other non-productive features, and that every proposed layout should be checked according to this principle. While the foregoing may seem to be an obvious statement, an analysis of numerous existing buildings shows that it has received scant consideration. Figure 1 shows the four fundamental ways in which cars may be arranged in a garage. For convenience these may be called the one-, two-, three- and four-row arrangements. All garage layouts are combinations of these. From a car storage standpoint, the one-row arrangement is least economical of space and the four-row arrangement most economical. Use of the one-row arrangement is inexcusable except in rare cases; the two-row arrangement is standard and possesses the advantage that every car fronts directly on the aisle. The three-row arrangement has much to recommend it; it permits the storage of an additional row of cars without requiring any additional aisle space, and it is sufficiently flexible to meet most requirements provided the correct method is used in parking the cars; —when a car enters the building, its owner is asked when he is planning to leave. If he says "early," his car is placed in row B; if he says "late," it is put in row C; and if he is uncertain, in row A. The terms "early" and "late" have a meaning according to the character of the patronage of the garage. If it is an all-night garage, the terms refer to the next morning; if it is a day-parking garage, the terms refer to late afternoon for business men and shoppers and to late evening for theater-goers. This method is used in numerous garages and is fully satisfactory. The four-row method is rarely used, although it is ideal from the standpoint of space economy; but it is objectionable because it makes no provision for customers who are doubtful as to time.

However, dimensions of garage plots must be taken as they come; they are rarely made to order. Therefore, it may happen that a given plot may not lend itself to either the two-row or the three-row arrangement and yet it might be feasible to divide it into two rectangles, one making use of the two-row plan and the other of the four-row arrangement in Figure 2, the net result from a standpoint of convenience being about the same as if the whole building were laid out on a three-row basis.

Before carrying the discussion further, it is desirable to set down a few dimensions. The average car, as already said, may be considered as measuring 6 by 15 feet; large cars are rarely of more than 17 feet, and Fords are 11 feet in length. Thus a garage meant for average-sized cars will be satisfactory if the usual depth of car space is figured as 15 feet, and the aisle width as from 18 to 20 feet, while frontage per car should be 7 feet (6 feet plus a 1-foot space). The frontage per car is net, and to it there must be added any frontage wasted by columns. Not allowing 1 foot for the wall thickness, the breadths of buildings employing the one-, two-, three-, and four-row arrangements are respectively approximately 35, 50, 65 and 80 feet, as indicated in Figure 1. Usually one dimension of the plot will approximate either sums or multiples of these dimensions, or more accurately, since we are mainly interested in the two- and three-row arrangements, we must divide the plot up, if possible into sections measuring approximately 50 and 65 feet. In other words, if a plot were 100 by 110 feet, other things being equal, it should be divided into two 50-foot units 110 feet long. If 100 by 115 feet, it would be divided into two 50-foot units 115 feet long, or into two units, one 50 feet wide and the other, 65 feet wide, each 100 feet long. These arrangements are indicated in Figure 3. Looking at C in Figure 3 it should be noted that while this layout consists fundamentally of a two- and three-row arrangement, row Y is purposely placed adjacent to row X instead of adjacent to row Z, for with the arrangement shown the cars in row X are exposed whenever cars are absent from either row W or Y. With this arrangement there is twice the chance of getting at the cars in row X.

While it is usually desirable to lay out the entire

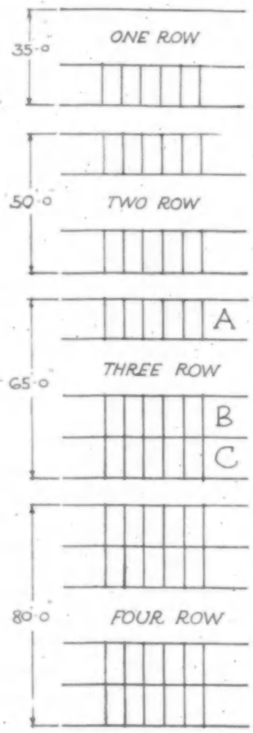


Figure 1

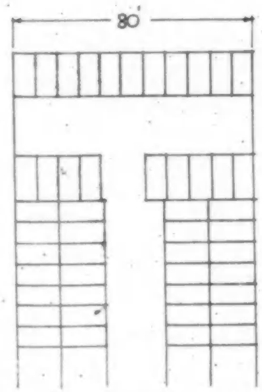


Figure 2

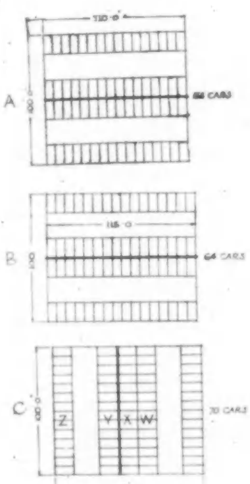


Figure 3

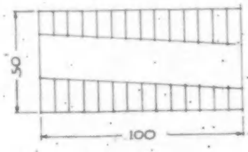
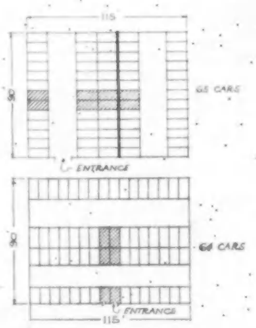
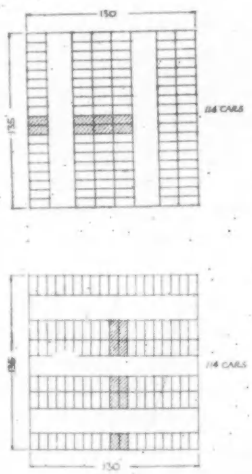


Figure 4

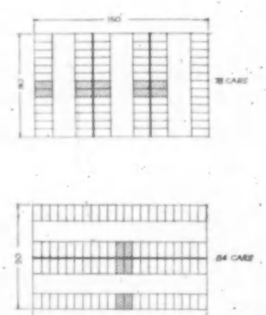


NOTE: THE SHADED AREAS ON THIS AND FOLLOWING PLANS INDICATE CARS WHICH MUST BE REMOVED IF THE STREET IS PARALLEL TO THE ROWS OF CARS INSTEAD OF AT RIGHT ANGLES TO THEM

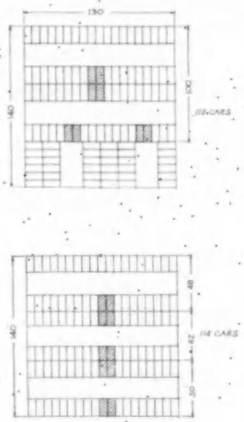
Figures 5 and 6



Figures 7 and 8



Figures 9 and 10



Figures 11 and 12

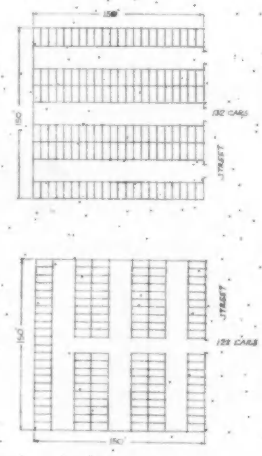


Figure 13

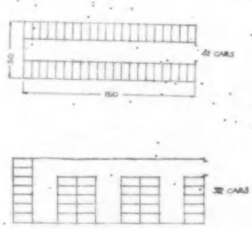


Figure 14

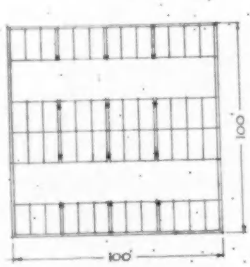


Figure 15

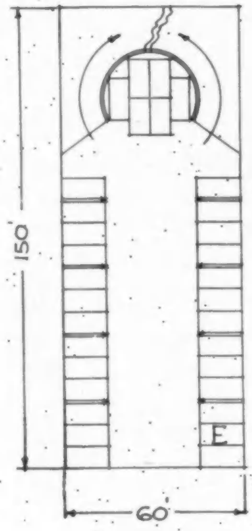


Figure 16

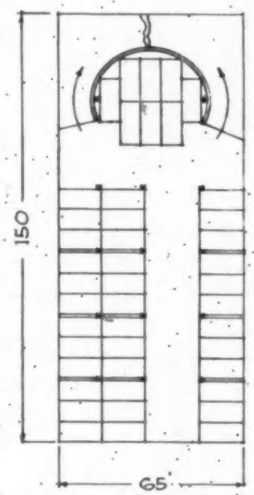
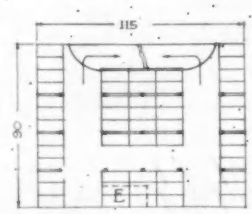


Figure 17



NOTE: E WITHIN DOTTED AREA INDICATES POSITION FOR ELEVATOR IF USED

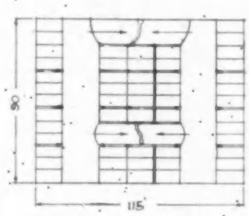


Figure 18

building for cars having an average length of 14 or 15 feet, there are times when better results will be obtained by segregating cars according to their sizes. As already said, Fords are only 11 feet long, and other cars in this class are only a trifle longer. Therefore if one section of the building is set aside for Fords and other cars of similar size, and assuming that a 16-foot aisle is sufficient for 11-foot cars, the net breadth of a two-row building becomes 11 plus 16 plus 11, or 38 feet, and similarly a three-row building would be 49 feet. On the other hand, conditions may warrant making the building, or at least one section of it, exclusively for large cars, say averaging 17 feet, with a 22-foot aisle. Thus the net breadth for a two-row arrangement becomes 56 feet and for a three-row arrangement 73 feet. The need for a large-car section is, however, exceedingly rare except in the wealthiest sections of our largest cities. In most cases the large cars may be averaged with the smaller so that more than a standard width section is unnecessary. Where the breadth of the building is limited, as it would be for example in erecting a garage on a 45-foot plot, the best results will be obtained by arranging the cars progressively according to length as is shown here in Figure 4.

Before comparing the layouts in Figures 5 to 12, it is necessary to note that while the standard frontage per car is about 7 feet, some garages may have frontages of as little as 6½ feet, while a few may even have 7½ feet or more. Obviously the less the frontage per car the greater is the storage capacity of the building, and 7 feet represents a fair compromise between economy and convenience. For reasonable convenience, exceptionally wide aisles permit some reduction in the frontage per car as given here.

These diagrams, by the way, up to Figure 14, represent the *internal* dimensions, to which the thicknesses of the walls should be added. Figures 5 and 6, 7 and 8, 9 and 10, 11 and 12 are pairs of plans showing comparative arrangements for the same plots with advantages and disadvantages explained. Figures 5 and 6 accommodate 65 and 64 cars. Figure 5 has the advantage that all spaces are of standard size, and Figure 6 has the advantage that all cars face directly on aisles. Figure 5 has the disadvantage that one row of cars does not face directly on the aisle, and Figure 6 has the disadvantage that one section of the garage is only suitable for Fords, being 40 feet wide, while the other is suitable for all cars, being 50 feet wide, although by storing medium-sized cars in both sections, with cars arranged so that the aisles are of equal width, the garage becomes two 45-foot sections. This may be done after the building is erected, as it does not involve any change in building construction. In short, this is a feasible layout for a 90-foot plot and might be preferable to Figure 5, depending on the type of patronage.

Comparing Figures 7 and 8, it is to be noted that both accommodate the same number of cars,—114. Figure 7 has the advantage that car spaces are of standard depth, and also the slight disadvantage that there are six rows of cars served by two aisles. Plan 8 has all cars facing directly on aisles, but the dimensions are less than standard, although satisfactory for most locations if the cars are segregated in three sizes to fit the 40-, 45- and 50-foot dimensions. Figure 9 has the disadvantage that it accommodates six less cars than Figure 10 and the advantage that spaces are of standard size. If the floor space has no columns, as might be the case in a one-story building, either arrangement could be used at the option of the operator. Figure 12 is preferable to Figure 11 in that it accommodates more cars more conveniently. While the middle section is of only 42 feet, the end sections are of 50 feet, and where advisable cars may be arranged to reduce the breadth of the end section, thus increasing the breadth of the middle section, and if all three sections are made the same breadth they will be 47 feet, 4 inches, which is fairly close to the 50-foot standard already mentioned.

For simplicity the introduction of columns, ramps or elevators on these diagrams has been ignored, while the shaded portions indicate car spaces that may have to be left vacant to provide connecting passages between the aisles. In Figure 5 if there is a garage entrance at one end of each aisle no connecting passage will be required, whereas if the entrance is placed at the left or right of the plan it will occupy two car spaces, while the connecting passage takes up six car spaces making eight altogether, reducing the car storage capacity to 57. In Figure 6 if there are two entrances at right or left, no connecting passage is required, but if the entrance is at top or bottom, six cars are lost. The reader may make similar analyses for the other plans. In some cases the car capacity lost in passages may determine the layout as shown in Figure 13, which illustrates two ways of laying out a plot 150 by 150 feet. Assuming that this is not a corner lot, whether the rows run vertically or horizontally makes a difference of ten cars. And similarly in Figure 14, the way in which the cars run makes a difference of ten.

In one-story garages it is hardly necessary to use columns for roof supports if the spans are of 75 feet or less, and trusses are not prohibitively expensive for spans running in excess of 100 feet. Generally speaking, the fewer the columns the more useful the building. In case the fact has been overlooked, let it be emphasized here that the layouts of all structures, including one-story buildings without columns, should be carefully worked out in detail. While it is true that the area in a one-story building without columns lends itself to different arrangements of cars after it is erected, which arrangement is most satisfactory often depends on the location of the entrance doors and other features which cannot be conveniently changed after the building is completed, although they can usually be moved around at will on the plan. To illustrate this point, suppose a 90 by 115-foot building without columns were erected and the entrance placed as indicated in Figure 6, and that after the building was finished this layout for

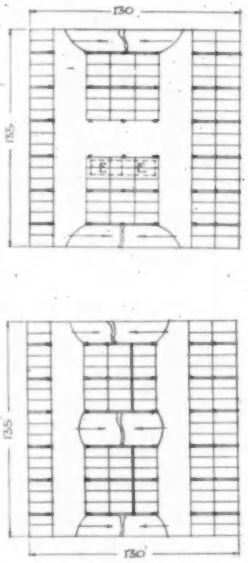


Figure 19

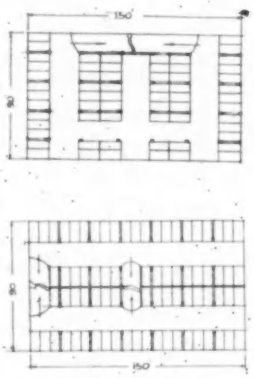


Figure 20

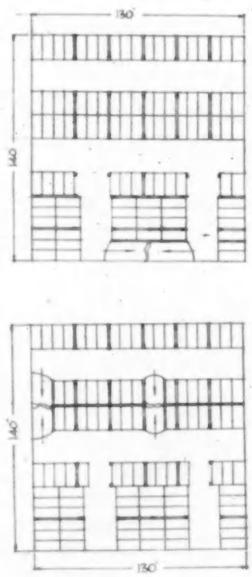


Figure 21

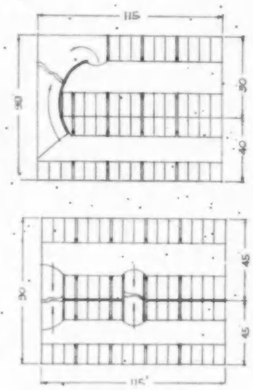


Figure 22

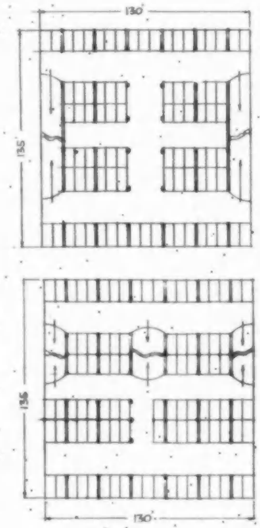


Figure 23

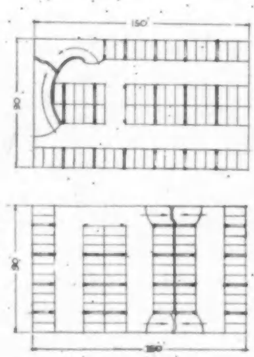


Figure 24

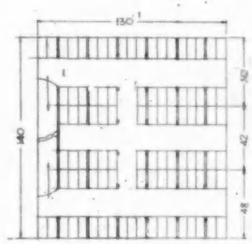


Figure 25

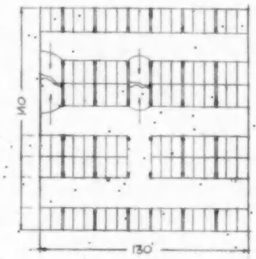


Figure 26

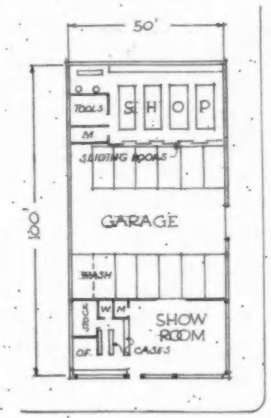


Figure 27

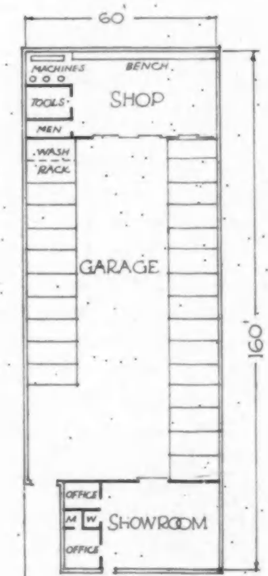


Figure 28

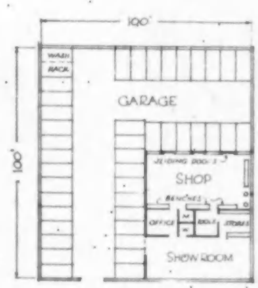


Figure 29

some reason was felt to be inferior to that of Figure 5. Changing the car arrangement to that of Figure 5 would be impossible unless a new entrance were built opening on one of the aisles, whereas if the entrance had been placed at this point originally, the arrangement of either Figure 5 or Figure 6 could have been used at will after the building was finished.

In very small garages, say of 50 by 50 feet and less, the method of car arrangement is not of much importance, since as business increases the owner invariably packs the space full, and obviously a garage without any aisle represents 100 per cent storage efficiency regardless of what theory of arrangement was used in its design. A glance at Figures 5 and 12 will show that if roof columns are to be used, if they are placed along the black lines they will not interfere with car storage so long as the layout indicated is followed, and in some cases the columns which support the roof may be located so that they do not interfere with two possible arrangements. For example, in Figures 9 and 10, if the roof columns are placed at the intersection of the black lines when the two plans are superimposed they will serve equally well with either car arrangement. Figure 15 illustrates the column arrangement for a building 100 by 100 feet. Ordinarily there should be a column for every three car spaces. If this building had no columns, 14 cars could be placed in each row, but with columns a foot or more in thickness, the introduction of even three columns per row reduces the number of cars in the row to 13. Thirteen divided by 3 is $4\frac{1}{3}$ bays. Figure 15 shows three three-car bays and one four-car bay, though some might prefer two two-car bays and three three-car bays.

In general, the fewer the columns the greater the frontage per car in a given layout. In other words, in Figure 15 the use of one four-car bay limits the columns per row to three, whereas two two-car bays would require four columns per row, and in some cases this would reduce the car frontage sufficiently to make the four-bay arrangement decidedly preferable,—or it might eliminate one car per row. For the sake of economizing car frontage it is desirable to limit the widths of the columns measured along the frontages to 18 inches if possible. In tall buildings requiring columns more than 18 inches in diameter to support the lower floors, this requirement may be fulfilled by using elliptical or oblong columns in place of circular or square columns. The columns should not extend into the aisles beyond the fronts of the cars, and it is still better to put the columns back so that the car fronts are 2 or 3 feet in front. Obviously, the farther away the columns are from the aisle the less they interfere with moving cars in or out of their stalls, a detail of importance.

It is now customary to build garages of 11 feet from floor to floor, whereas the figure used to be much larger; but even 11 feet is by no means the minimum height for passenger car garages. There are no cars built today and very few cars in use today with a height of $7\frac{1}{2}$ feet; in fact, there are few cars today with a height of more than $6\frac{1}{2}$ feet. If $7\frac{1}{2}$ feet is taken as the maximum dimension, it is only necessary to add the thickness of floor and beams plus whatever clearance is required for piping. It is rarely that this total will exceed $2\frac{1}{2}$ feet, which brings the height from floor to floor down to 10 feet.

If the structure is more than one story high, some means of transportation between the floors is necessary unless the building is located on sloping ground, in which case it may be possible to have direct entrances to the various floors. Generally speaking, ramps are preferable to elevators, although ramps are usually out of the question in very small buildings and particularly in structures with one dimension of much less than 60 feet, since such a building is narrower than the turning circles of some cars.

Whether to use a ramp or elevators is a question of economy plus convenience. An elevator costs a certain sum to install and a certain sum to maintain. Having calculated the total charges incident to using an elevator, it remains to determine how many more (or less) cars may be stored with an elevator or elevators as compared with a ramp. Then estimate the probable total yearly income on these car spaces and see how it compares with the total cost of running the elevator. On the whole, a ramp is so much more convenient and satisfactory than an elevator that the modern tendency is to select the ramp without giving the elevator any consideration at all. The ramp gives vastly quicker service, requires no operator, cannot break down, and involves no operating expenses, although if the building is only two stories high and the upper floor is devoted wholly or largely to repair work, the tendency is to use an elevator, because it takes up less area and is reasonably satisfactory considering the small number of cars to be transported to and from the second floor. For similar reasons elevators are still largely used in service stations, although as already said they have been almost entirely abandoned for ramps in the construction of storage garages. If possible, the ramp grade should be limited to 15 per cent, although grades running up to 20 per cent may be used where circumstances prevent the use of grades less steep. In fact the main reason for advising a 15 per cent limit is the prejudice that exists against steeper grades. A 20 per cent grade is perfectly safe, especially with four-wheel brakes. Ramps of many grades are in use.

In laying out a multi-storied building, usually best results are obtained by first determining the ideal plan for a one-story structure. This plan is then followed for all floors, introducing ramps or elevators as required. Column locations should not be determined until after the most suitable one-story layout is decided upon, yet in calculating the number of cars per floor some allowance must be made for columns; hence it is often convenient to add a column allowance of from 4 to 6 inches to the car frontage of 7 feet, whether to use 4 or 6 inches depending mainly on the height of the building. If columns of 1-foot section are to be employed, use 4 inches, and for $1\frac{1}{2}$-foot columns use 6 inches. In the latter case the frontage per car, including column allowance, becomes $7\frac{1}{2}$ feet. After the ideal one-story layout is obtained on this basis, columns may be introduced where required without changing the number of cars per row. This gives a successful plan.

For the sake of space economy it is usually desirable to use the same ramp location on all floors, that is, the ramps should be located like flights of stairs, one over another. The older method was to start the ramp at one corner of the building and allow it to run to the top in one unbroken sweep along the outer walls. This method is generally wasteful of area because of the space above and beneath the ramp that cannot be used for car storage. Inasmuch as the whole principle on which a garage is laid out is rectangular, curves are always wasteful of area and should not be used unless there is no alternative. In other words, ramps with few exceptions should be straight and should be placed at right angles to the aisles. A width of 9 feet is ample for a straight ramp directly approached, but since most ramps are approached from an aisle at right angles to the ramp, the width of the ramp should be two car spaces wide, or nearly so, and never less than 12 feet. If the ramp is to be wide enough to accommodate two cars going in opposite directions, it should not be much less than three car spaces wide. The ramp should have curbs about 8 or 9 inches high, and the floor should have cross corrugations to give good traction to moving cars when wet.

Before laying out the ramp it is necessary to determine whether a single roadway or a double roadway is required. An absolutely exact answer to this question cannot be given, but under average conditions of traffic in and out of the garage the dividing line is probably for a garage of about 300 cars. For buildings accommodating 300 cars or less a single-track ramp will usually be satisfactory, and larger buildings should have double-track ramps. In buildings, with single-track ramps, provided the traffic is not too heavy (and it is not likely to be too heavy in a 300-car garage) little or no difficulty is experienced by cars approaching from opposite directions, mainly for the reason that the ascending car is in second or low gear and thus makes sufficient noise so that the operator of the descending car has ample warning. With a single-track ramp it is necessary to have points at which two cars may pass readily, and with a properly laid out ramp system this is secured by allowing the cars to pass in the aisles. Figure 16 illustrates a ramp layout for a 60-foot building. The use of a circular ramp is unavoidable. A straight ramp along one side wall might be used instead, but it would not permit the storage of any more cars than indicated. The main portion of the building is wide enough for three rows of medium-sized cars instead of two rows as shown. Figure 17 shows a 65-foot building with a circular ramp. Right and left halves of this ramp are laid out on a 30-foot radius, inasmuch as a 30-foot radius is sufficient for all but an occasional large car. Using the maximum radius of $32\frac{1}{2}$ feet cuts down the number of cars that can be stored in the floor area.

Figures 16 and 17 illustrate about the only exceptions to the statement that a straight ramp is preferable. In both these cases, straight ramps could be used, but no space or other advantages would be gained. On the other hand, these two circular ramps are not objectionably wasteful of area and may be employed to advantage in buildings of this size, displacing elevators. These ramps are practically continuous circles, so a width of 10 or 11 feet is sufficient.

Figures 18 to 25 show Figures 5 to 12 equipped with ramps. It will be recalled that Figures 5 to 12 are for one-story buildings without columns. So that an accurate comparison of these same layouts with ramps can be made, columns have simply been "squeezed" into Figures 18 to 25. This is incorrect, but it is pardonable for the sake of comparison. If there seems to be a sameness about these ramp designs it is explainable by saying that the designs follow the well established principles of planning convenient, economical layouts. It is freely admitted that many other ramp arrangements might be used, but none with the same economy and convenience. In these plans, let it be emphasized, the floor patterns and the ramp locations are the same on all floors.

Principles of layout demand that the ramp be fitted into the layout instead of building the layout around the ramp, and, furthermore, that the plan utilized be what would be considered an ideal layout for a one-story building. In other words, the proper way to develop a plan for a ramp garage is to make several layouts assuming that a one-story building is to be built on the plot under consideration, and then to install the ramps with as little change in these layouts as possible. After this has been done, the most attractive layout should be selected. And it was to illustrate the principle of using a one-story plan in a multi-storied building that Figures 18 to 25 have the same general layout as Figures 5 to 12.

Incidentally it should be noted that with some plots one or more layouts may exhaust all the possibilities, whereas with others there may be ten or even 20 possible layouts, all of which should receive careful consideration. Figure 18 has a single-track ramp, which should be sufficient for a building of this area even if built five or six stories high. Figure 19 is shown with two ramps, one for up and the other for down travel, but a single ramp should suffice if the building is of less than four stories high, including the first floor but not including the basement. Obviously in determining whether a garage is large enough to require a double-track ramp, only the capacity above the first floor is of interest since cars going to the basement or the first floor do not add to the congestion of the upper ramps. In Figures 18 to 25, after a car leaves one ramp it reaches the next ramp by driving along the aisles and through the passages connecting the aisles. These passages are shown as two-cars wide, an ample width even where separate up and down ramps are used, since all the rest of the system is double-track. However, in actual operation there is no reason why the passages may not be three cars wide except occasionally when extra storage space in the passage is required.

There are a number of special ramp designs, some of which have merit and some of which have none. The Commodore-Biltmore Garage in New York, for example, has two flights of U-shaped ramps branching from each side of the central aisle. This ramp design is highly ingenious, but it is wasteful of space, and the ramp designs shown herewith considerably exceed it in economy of car storage. In addition this design requires a building about 140 feet along one dimension.. A garage in Boston has a circular ramp running up and down through its center with separate tracks for up and down travel. There is no criticism of this ramp from the driver's standpoint, but it has a most serious shortcoming from the garage owner's point of view, since it occupies an enormous amount of good car storage space and thus greatly lessens his possible revenue. It is about typical of what happens when a circular ramp is used.

Some garages have even been built with continuously sloping floors, but it is questionable whether any of them will accommodate more cars than buildings with conventional ramps, and there are some disadvantages. A structure with sloping floors is a special building which can never be used for anything but a garage, regardless of how conditions may change. Cars cannot be pushed conveniently by attendants, and it is understood that the sloping floor garage costs considerably more to build. This type of building has also received some criticism, in that any car standing in the aisle will run away in case the operator fails to set the hand brake. Another disadvantage is that in a building of less than extraordinary size all cars are in the traffic stream, and also it is a long distance from the top level to the street,—at least twice as long as in ramp garages, often more.

A patented ramp design which has become very popular is shown in Figure 26. Rights to use this system are sold on a basis of so many cents per square foot of the total building area. A glance at this drawing shows that the building plan is cut in two halves, and that the floors in one half are placed half-way between the floors in the other half, with ramps connecting the half stories. This method of construction has the advantage that short ramps may be used. Due to the fact that short ramps may often be fitted into a layout more successfully than long ramps, there are numerous garage designs in which more cars may be accommodated with this ramp construction than with the usual straight ramp. All ramps should be built with open sides and should not be closed in to form tunnels. Obviously, a ramp with open sides is safer, since it gives the driver a view of the aisle which he is approaching. Stairways are usually conveniently located in the space that would otherwise be occupied by one car. In some instances building laws require a little more breadth for the stairway than one-car space affords, in which case if the stairway is placed adjacent to a column the width of the space occupied by the column is also available, and almost invariably this space is sufficient for the requirements. When a passenger elevator is required, it may also be placed in the front half of a car space adjacent to the stairway, the rear half being possibly used for a toilet.

If elevators are used for moving cars from floor to floor, the space required per elevator is usually about 10 by 20 feet, the dimensions of the elevator platform being somewhat less than this overall figure. The number of elevators required depends on the amount of traffic, the height of the building, and the speed of the elevators. For a given building it is advisable to obtain the advice of some elevator manufacturer, although a rough figure is one elevator for every 100 to 150 cars. Since an elevator platform is about 5 feet longer than the average car, it must jut out into the aisle 5 feet when placed alongside a row of cars, and yet to place it elsewhere usually complicates the problem further. Referring to Figures 18 and 19, fair results may be secured by locating the elevator at the points marked E. In a long and narrow building, the best location for the elevator is usually in one corner, as in Figure 16, which forces the removal of three or four cars, immediately in front of it to secure an approach.

So far the discussion has been devoted entirely to garages, and so it remains to consider now the layout of repair shops, show rooms, stores and offices in connection with garages. For brevity all these features will be considered together. The first step is to determine how much area must be allotted to each. This is most readily done by answering these questions: (1) How many cars in show room? (2) How many desks in general offices? (3) How many private offices? (4) What lavatory facilities for show rooms and offices? (5) How much counter and shelf space for accessory sales? (6) How much shelf and bin space in accessory stock room? (7) How much shelf and bin space in parts department? (8) How much space in tool room? (9) How many cars in shop? (10) How many cars in quick service department? (11) How many cars in new car department? (12) How many cars in used car department? (13) Ditto for all other departments. (14) What machine tool equipment must be provided for? What wash rack capacity is required? Very few buildings will have all of these departments. The majority of buildings will be limited to a show room, offices, accessory and parts departments, repair departments and car storage. The last need not necessarily be public storage, for it may be the total of cars that must be housed in connection with a general sales and service business.

Insofar as possible, each department should be laid out to occupy an unbroken rectangle,—bays and alcoves should be avoided, for usually they represent waste space. Approximately 250 square feet should be allotted to each car in the show room, 175 square feet for each car on storage, and about 225 square feet for each car in the shop; but these figures do not include space for rooms adjacent to the shop, such as those intended for the parts, tools, etc.

Having calculated the approximate size of the building, it remains to arrange the details of the layout. There are so many possible plans that it is out of the question in the brief space remaining to do more than give the general idea of how the layout should be worked out. Figure 27, for example, shows show room, accessory store, garage and shop layout for a corner plot 50 by 100. Note that the plan divides into three rectangles consisting of sales, service and garage. A series of sliding doors separates the shop from the garage. A feature of the shop layout is that the cars in the shop may be moved directly in or out of the spaces which they occupy without any maneuvering. Cars adjacent to the shop, if in the way, are easily moved, although during the day these spaces are likely to be vacant. Figure 28 illustrates a layout for an inside plot 60 by 160. There is no accessory store in this layout. Three rows of medium-sized cars may be accommodated instead of two rows as shown. The car entrance to the left of the office should be open, with the garage doors at the rear of the space so that light and air may reach the rooms on this side of the building. If this particular plot is on a corner, the cars may be ranged in four cross-wise rows with two garage entrances on the side street. Figure 29 shows one of the numerous layouts that can be used on a 100 by 100 foot plot. At first glance the shop may appear to be inaccessibly located, but the cars adjacent to the shop should either be cars undergoing minor repairs, in other words, cars that are coming and going frequently, or if this space is devoted to car storage the cars in this row should be cars that are always out in the daytime,—that is, during normal shop working hours. These few plans should serve to illustrate the method, since lack of space prevents the discussion of more plans, interesting as they are.

The design of a truck garage is no different from that of a passenger car garage excepting that the sizes of the units are larger. For convenience, it may be assumed that there are three sizes of trucks: (1) delivery cars, the same size as passenger cars, 6 by 15 feet; (2) medium-sized trucks, 6½ by 20 feet; and (3) large trucks, 7 by 22 to 25 feet. In locating columns it is necessary to know approximately what percentage of each will make up the total, although where this is unknown good results may be secured by making the breadth of the garage section from 60 to 65 feet for two rows of trucks and 75 to 85 feet for three rows of trucks. At the same time it is advisable to place the columns 26 or 27 feet apart along the aisle, for if this is done, a bay will accommodate either four delivery cars or three large trucks. For trucks, ramps and passages about 16 feet wide should be sufficient, while an elevator platform for trucks should be about 10 by 25 feet. Practically all trucks will turn in a circle of 70 feet. For most trucks, headroom of 10 feet is ample, although a few require 11 or 12 feet. A good way to solve this difficulty is to make the headroom on the first floor 12 feet, and 10 feet above.

Architects are often puzzled as to the number and location of wash racks as well as to the details of their construction, and this is not surprising, for it really requires an experienced garage operator to solve these problems. Generally speaking, the location of the wash racks depends on the character of the business. If in the garage under consideration it is likely that washing service will be included in the rental charge for nearly all car spaces, it is desirable to have at least one wash rack per floor for the sake of convenience. In such a garage it is customary to wash cars every day or nearly every day that they are in use, the washing being done at night.

In garages where washing is charged for separately, cars will be washed less frequently,—from once a week to once a month, depending on the character of the trade. In this case a wash rack may be placed on each floor, although in such garages there is a tendency to perform all the washing operations at one point, usually with the installation of so-called "auto-laundry" equipment. There are numerous manufacturers of this equipment; the details of the installations vary considerably, but in principle at least all modern auto laundries have at least four "stations" through which the cars pass progressively. At Station 1 interiors are cleaned with brooms, compressed air, vacuum, or combinations of these; at Station 2 the running gear is cleaned by water delivered at such velocity that it knocks the mud off without the need for much brush or sponge work; at Station 3 the body is washed off with a fine spray and sponges; at Station 4 the body is wiped dry, water being blown out of crevices by compressed air. The metal is polished at either Station 1 or 4. The four stations are strung out in single file so that the car may be rolled from one to the other.

Greasing racks have become popular in recent years, their sole purpose being to elevate the car so that a mechanic may walk under the car and thus grease it with maximum convenience. This is usually done by running the car onto rails. If possible it is preferable to have the rails set flush with the floor while the floor of the greasing pit is depressed about 4 feet. If this is done, no space is wasted in approaches, and the grease rack may be comfortably placed in the space occupied by two cars. If elevated rails are used with a flush floor, sloping rails must be used for the approach, and these take up space and obviously prevent installing a grease rack in a single row of cars, although there is room to install sloping rails in a double row of cars. If all rows are single rows, and depressing the grease pit floor is objectionable, an alternative arrangement is to buy a grease rack with rails that are raised by power. Thus the rails are at floor level when the car is driven on, and after the car is in place the rails are raised vertically 3 or 4 feet. There are several such devices.

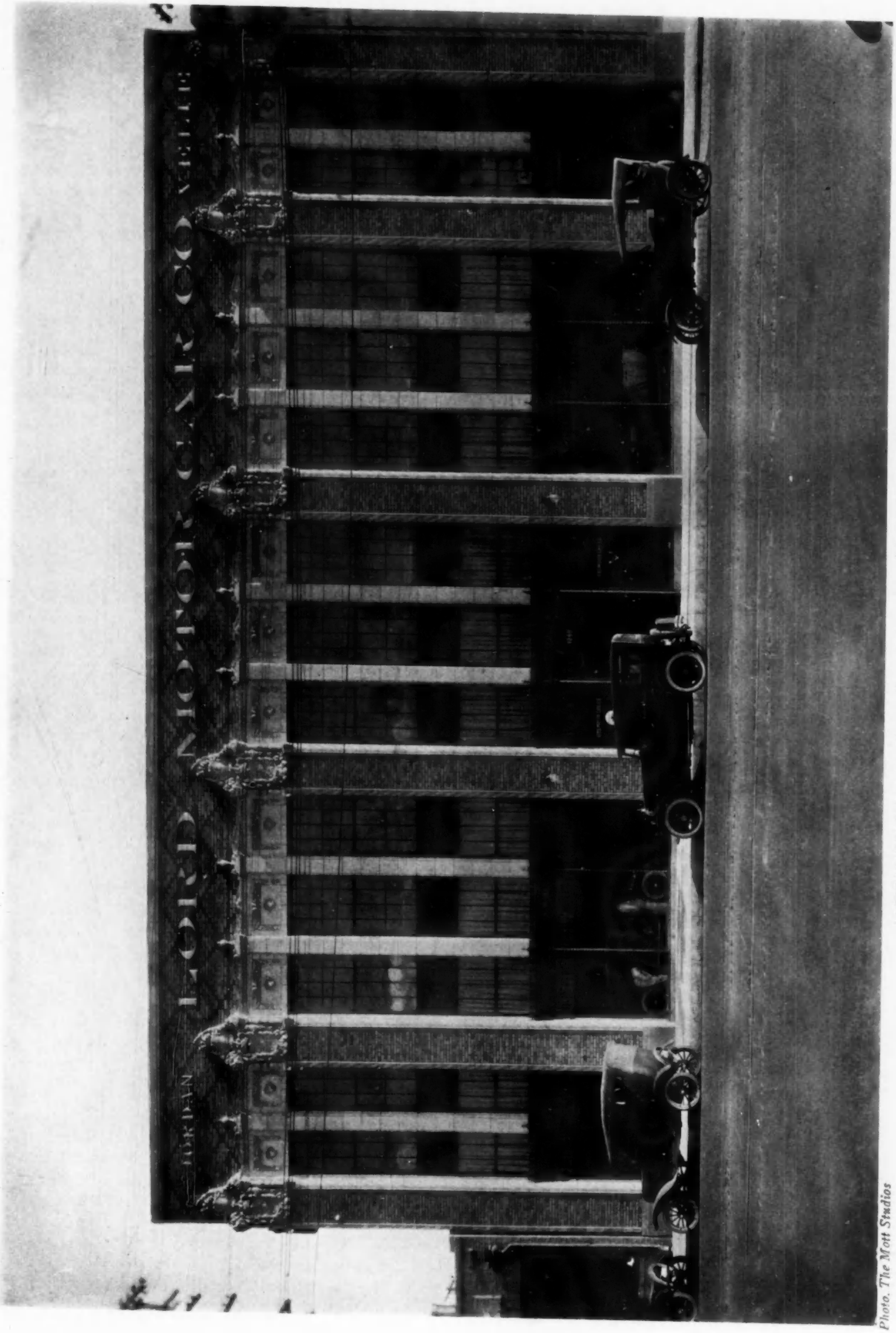


Photo. The Mott Studios

AUTOMOBILE SALES BUILDING FOR LORD MOTOR CAR CO.
MORGAN, WALLS & CLEMENTS, ARCHITECTS

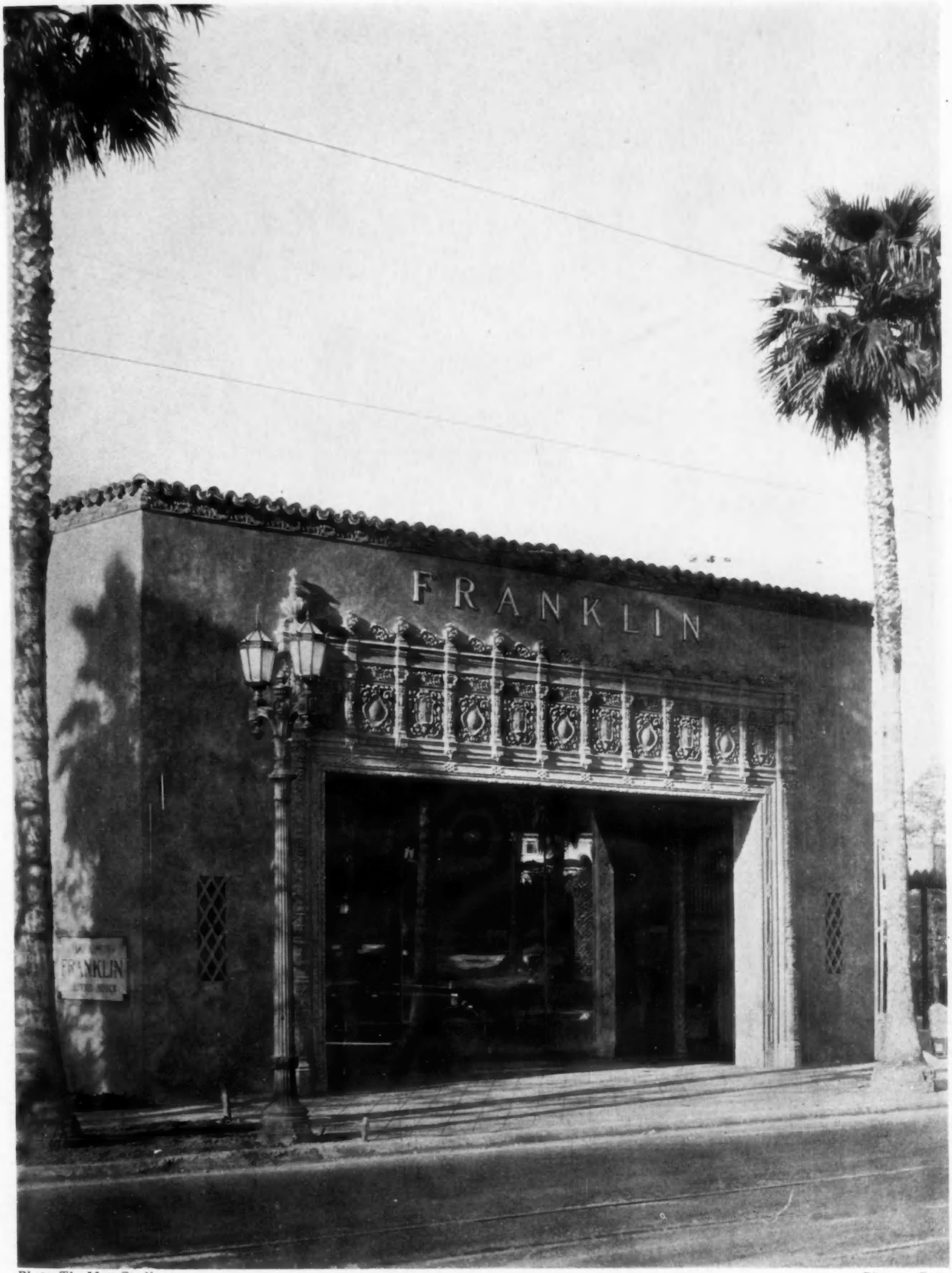
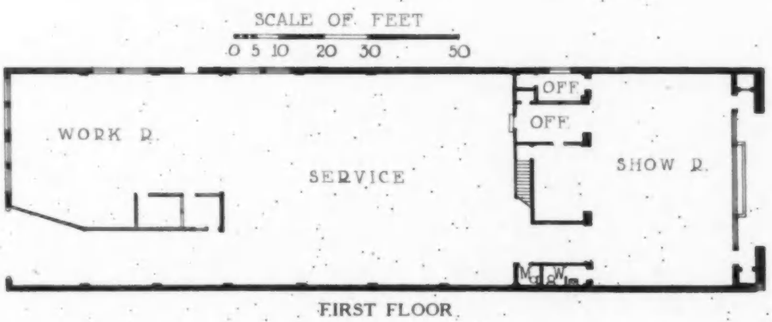


Photo. The Mott Studios

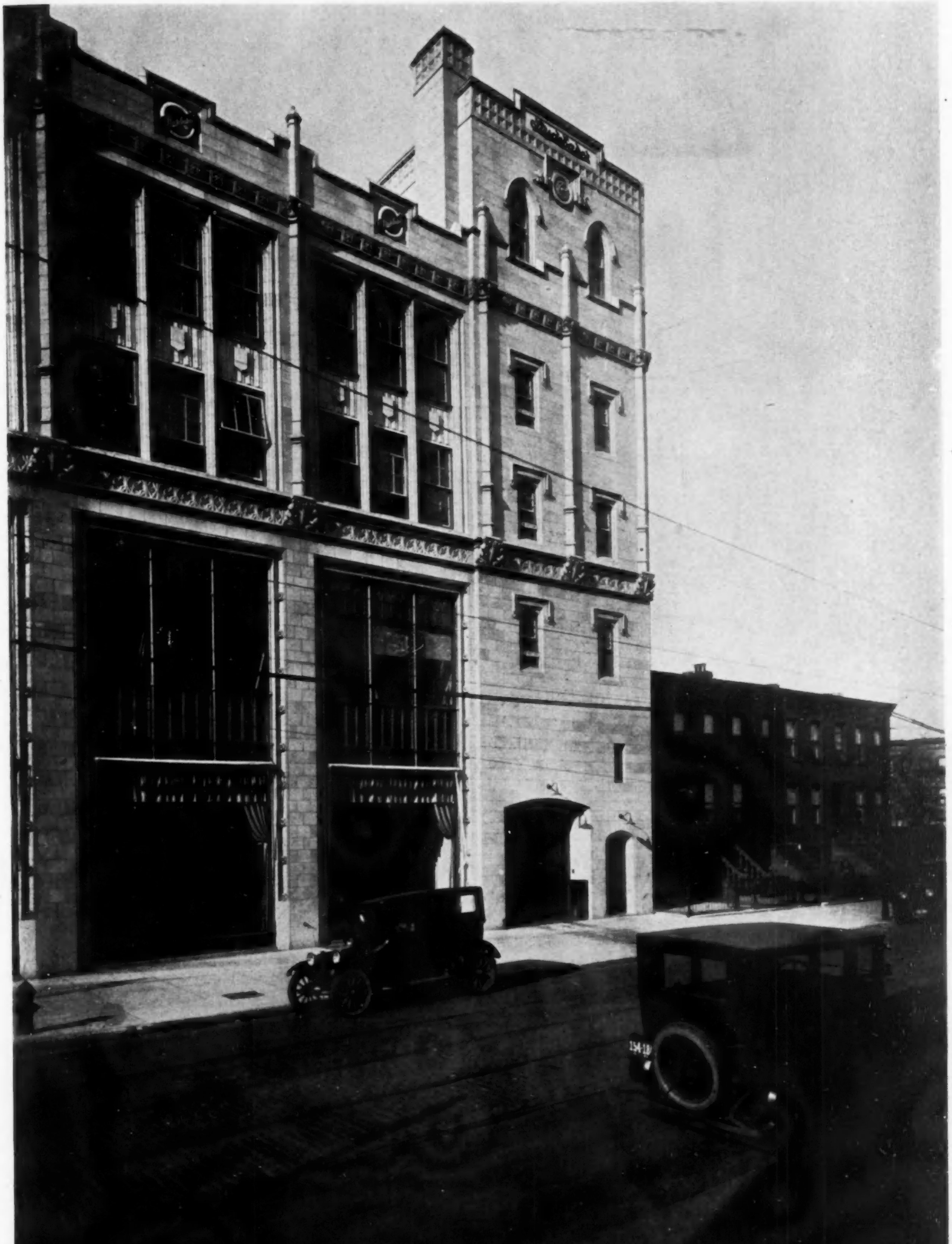
Plans on Back

AUTOMOBILE SALES AND SERVICE BUILDING
FRANKLIN MOTOR CAR CO., HOLLYWOOD, CAL.
MORGAN, WALLS & CLEMENTS, ARCHITECTS



PLANS, FRANKLIN MOTOR CAR CO. SALES AND SERVICE BUILDING, HOLLYWOOD, CAL.

MORGAN, WALLS & CLEMENTS, ARCHITECTS



STUDEBAKER SHOW ROOMS AND GARAGE, BROOKLYN
TOOKER & MARSH, ARCHITECTS

Photo. John Adams Davis

UPPERCU CADILLAC CORPORATION SALON, NEW YORK

CHARLES E. BIRGE, ARCHITECT

Photo. The Mott Studios

A PIERCE ARROW SALES AND SERVICE BUILDING

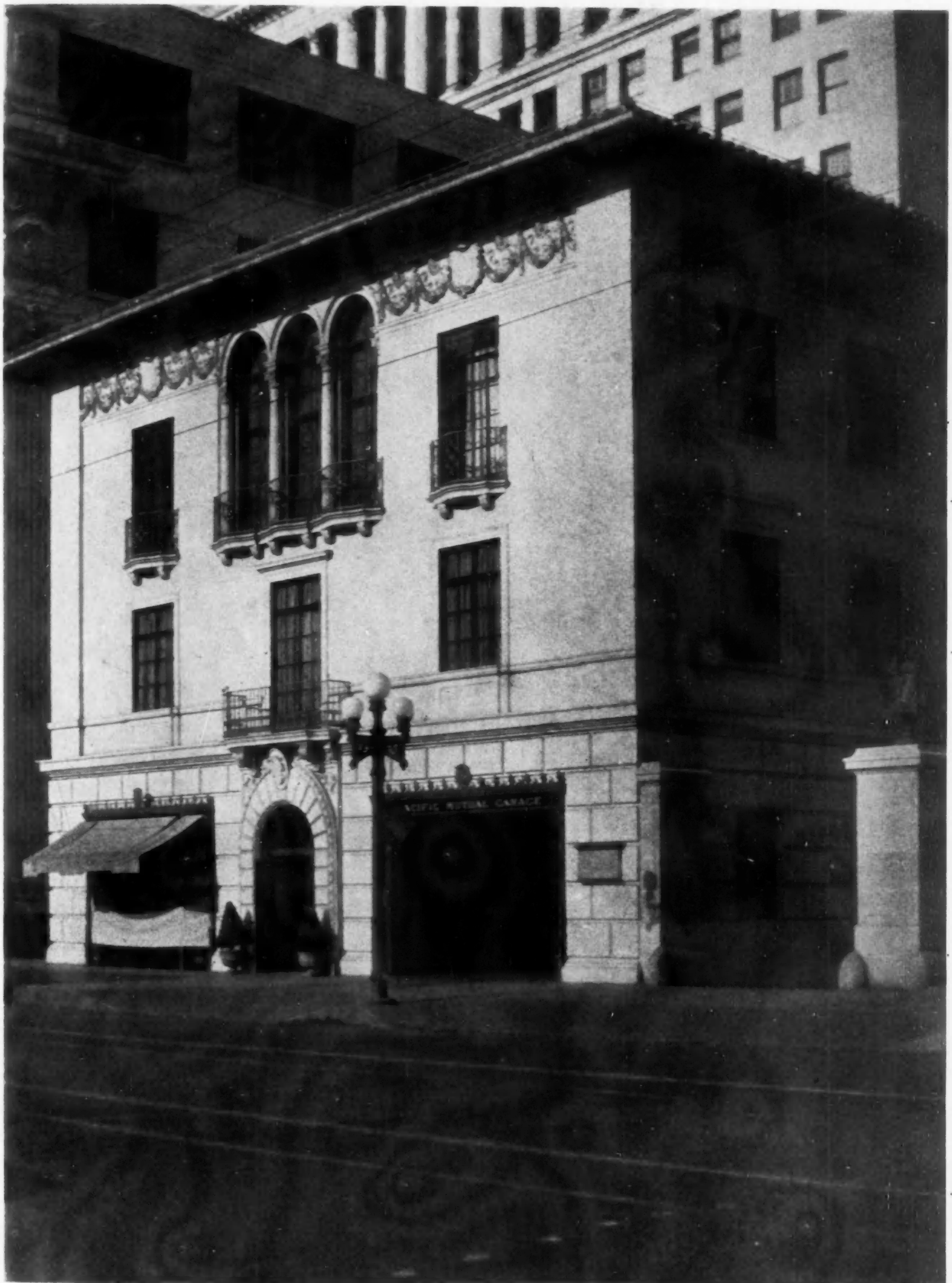


Photo. Margaret Craig

BILTMORE GARAGE, LOS ANGELES

SCHULTZE & WEAVER, ARCHITECTS

Photo. The Sensor Studio

STUDEBAKER SALES AND SERVICE BUILDING, SAN DIEGO

Photo. Thomas Ellison

PACKARD MOTOR CAR COMPANY, SALES AND SERVICE STATION, DETROIT
ALBERT KAHN, INC., ARCHITECTS

Architecture and Decoration of Automobile Show Rooms

By WILLIAM F. WHARTON

THE making and selling of automobiles have rapidly grown to be one of the foremost industries of America; it is likewise one of the most spectacular. Within a comparatively few years the automobile industry has leaped to the front in a manner nothing short of amazing. Its effects are felt and seen in every direction. From the congested traffic in the streets of our cities to the pages of every magazine and newspaper we pick up, we are constantly reminded that we live in the "Age of the Automobile." One of the most conspicuous details attending this development is the creation of the display rooms maintained by manufacturers where the latest models of every type of motor are displayed in a manner becoming their importance and prestige. These show rooms, almost without exception, bear witness to a determination on the part of the makers to hold up their end of the many-sided spectacle by displaying their creations in an environment carefully devised to appeal to the eye and to win the interest as well as the approval of the most exacting customers. Even in the smaller cities and larger towns, the automobile show rooms present a spacious air of distinction that marks their presence and their purpose so unmistakably that the most casual passer-by cannot fail to be impressed. In the larger cities, the architecture and decoration of show rooms have been carried much further, and their designing and equipment have become significant and highly specialized fields of architectural and decorative endeavor by well known designers.

The keen rivalry in creating automobile show rooms that shall be imposing from their sizes and their fitness for the adequate display of the cars, and inviting to the eye of the prospective purchaser at the same time, is a peculiarly American expression. Of course the maintaining of these splendid exhibition places is all part and parcel of a carefully built-up system of advertising and salesmanship, and their effect upon patrons has been duly considered. The expenditure of the large sums involved cannot by any means be set down to mere vainglorious "swank." It is natural, therefore, that the direction of this movement and the expense which it involves should be subjected to close scrutiny, and watched in every detail with more than usual interest. It is natural, too, in the absence of any considerable body of long established precedent or experience, that the pioneers should not always tread with the assured confidence of those who know exactly where they are going and just how to get there. Some of the efforts have necessarily been a trifle tentative and

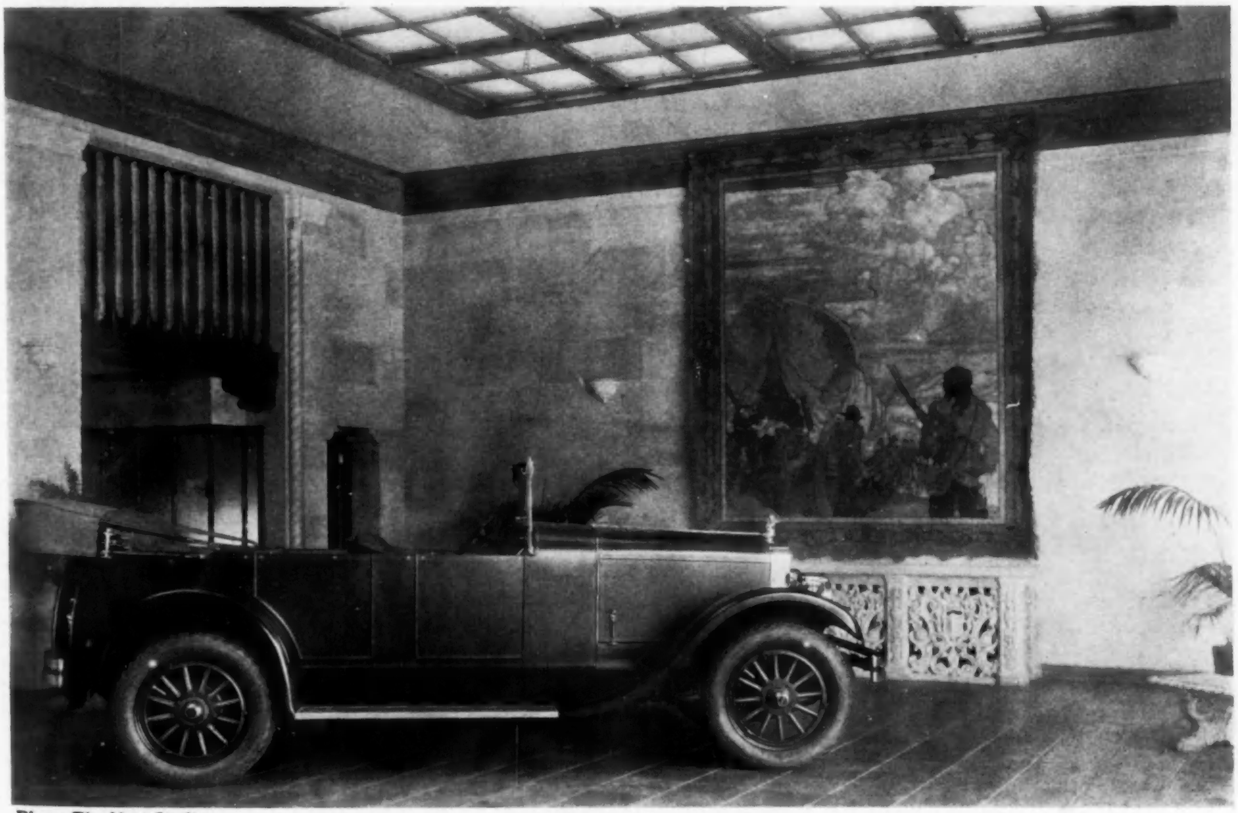


Photo. The Mott Studios

Effective Architectural Treatment of an Automobile Sales Room
Morgan, Walls & Clements, Architects

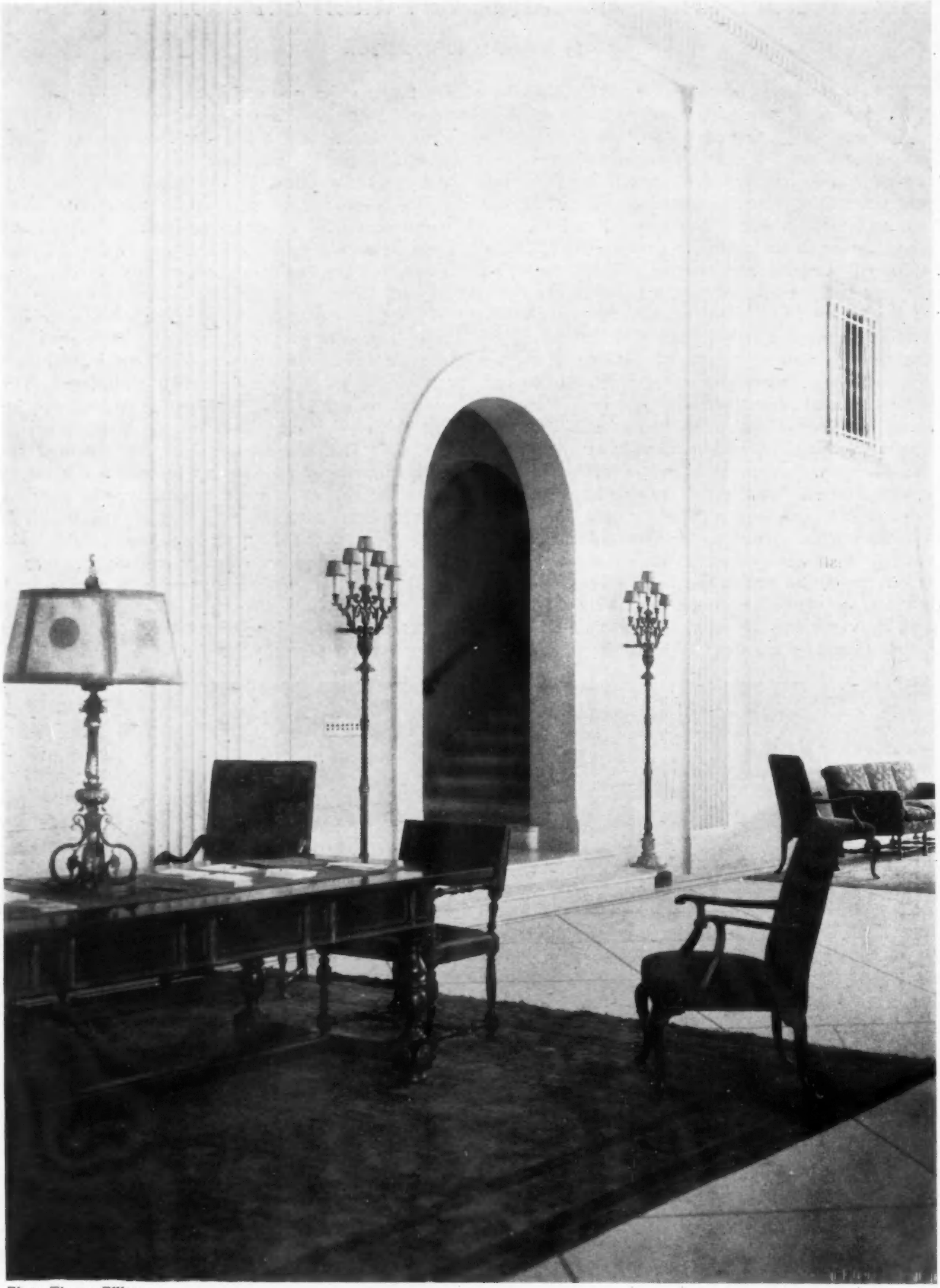


Photo. Thomas Ellison

DETAIL, SALES ROOM, PACKARD MOTOR CAR COMPANY, DETROIT
ALBERT KAHN, INC., ARCHITECTS

Photo. The Mott Studios

SALES ROOM FOR STAR MOTOR CAR CO., HOLLYWOOD, CAL.
MORGAN, WALLS & CLEMENTS, ARCHITECTS

Packard Motor Car Co. Show Room, Chicago
E. E. Roberts, Architect

experimental; some, too, have been distinctly happier than others in their conception and in the finished results. Many display rooms are excellent.

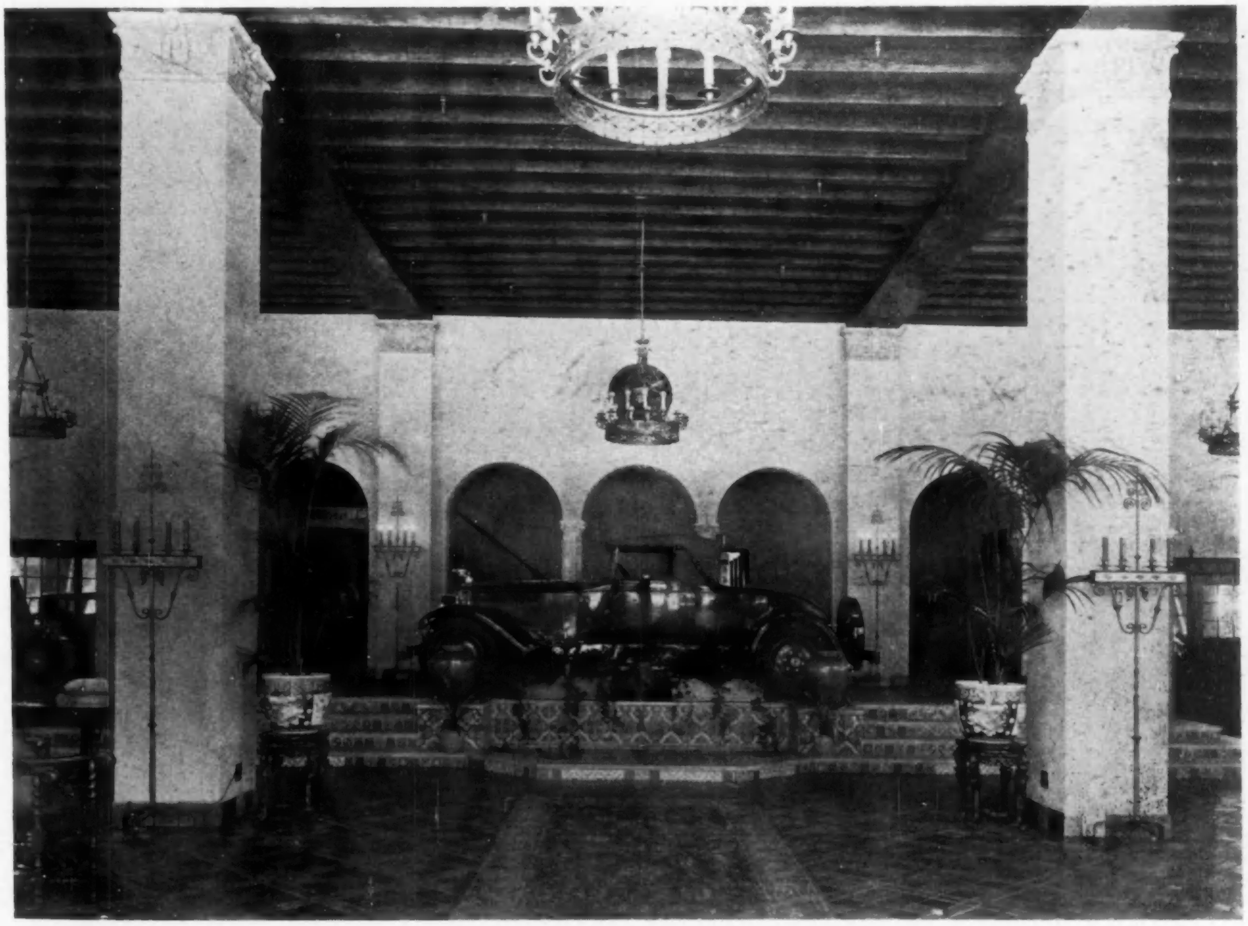
The one aim apparently common to all who have embarked upon the broad program of embellishing their show rooms has been to invest them, as far as possible, with an air of luxury and leisurely detachment from any insistent suggestion of mere commercialism. The patrons, who presumably are accustomed to and appreciative of luxury, and who are looking with fastidious eyes at the qualities of the cars before them, are to be welcomed amid congenial surroundings. They are to be entertained,—not hurried,—in their inspection. The technicalities and formalities of sale and purchase are not to be over-emphasized by an obtrusive array of desks, typewriters, filing cabinets and other office paraphernalia. The whole conception is, of course, admirable. It is only in working out the many minor details of the scheme that questions arise over the best and most direct way to get at the results proposed. The whole conception has also about it a good deal of originality. It is much easier, however, to be fairly original in roughing out the foundations of a scheme or the large masses of a composition than it is in following all the details to their ultimate finish. The sea, in this particular case, be-

Spanish Details Successfully Used in This Sales Room
Morgan, Walls & Clements, Architects

ing more or less uncharted, we cannot do better than to compare the results achieved in different show rooms and thus arrive at a clearer grasp of the problem along with a rational appraisal of features to be either commended or avoided in designing such rooms.

In announcing the opening of its new building on East 57th Street, New York, the Cadillac Corporation declares that the structure (Plate 60, page 309) "was conceived and executed not as an example of fine architecture, but as a background for fine automobiles." This, in its opinion, is the keynote to the whole situation. Architecturally speaking, the building has had every consideration lavished upon it. A rectangular entrance hall, undisturbed by show window complications; an arched central hall, where the cars are chiefly displayed; and a vaulted rear hall, adorned at its far end by a painting of the Mediterranean and the Riviera seen from Monte Carlo,—these are the outstanding features of the composition. The materials employed throughout, the finish of the walls and ceiling, the wrought iron and gilt lighting fixtures, and the richly elegant movable appointments all conduce to the distinguished luxury of the *ensemble*. This part of the general conception has been extremely well brought to fulfillment. To quote again the corporation's announcement, "this building is a permanent *salon* designed for the pres-

Sales Room, Cadillac Corporation, New York
Charles E. Birge, Architect



Sales Room, Packard Motor Car Co., Philadelphia
Phillip S. Tyre, Architect

SHOW ROOM, MARMON MOTOR CAR CO., LOS ANGELES
JOHN M. COOPER, ARCHITECT

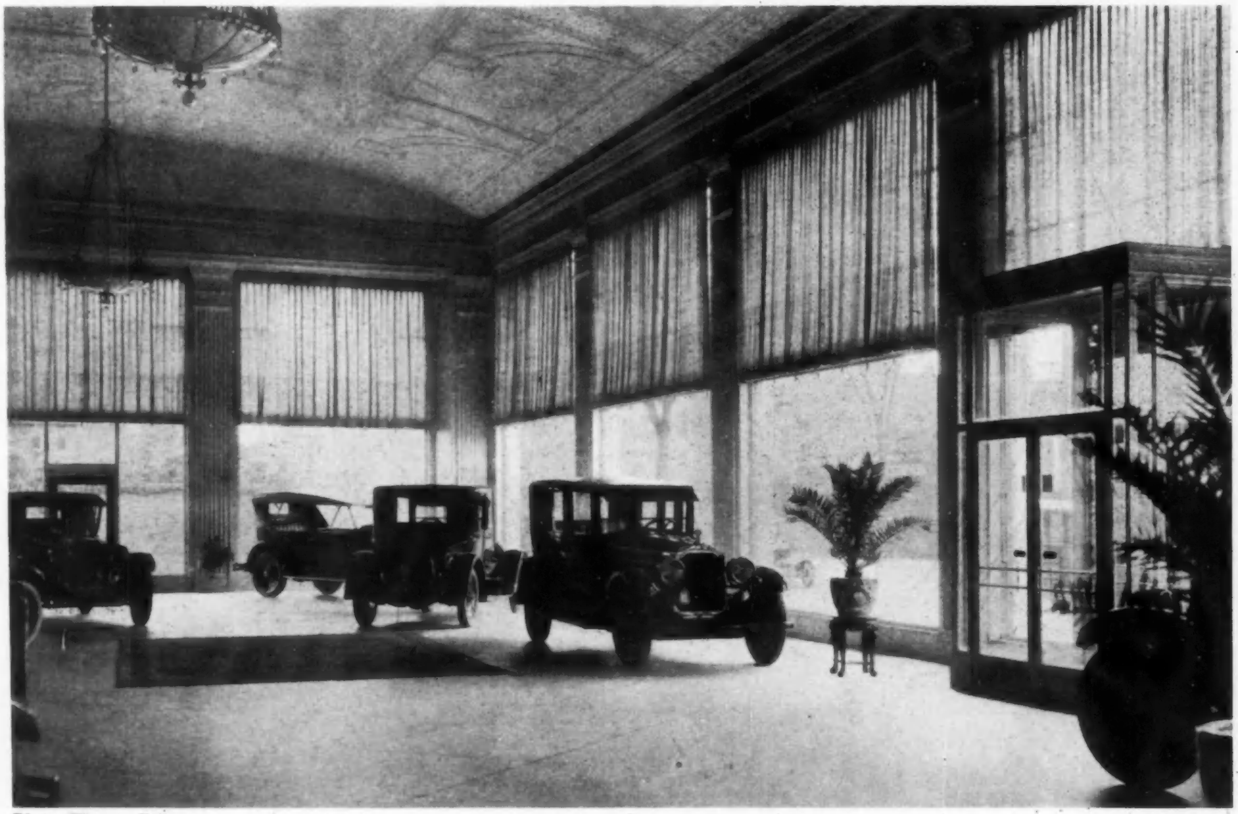
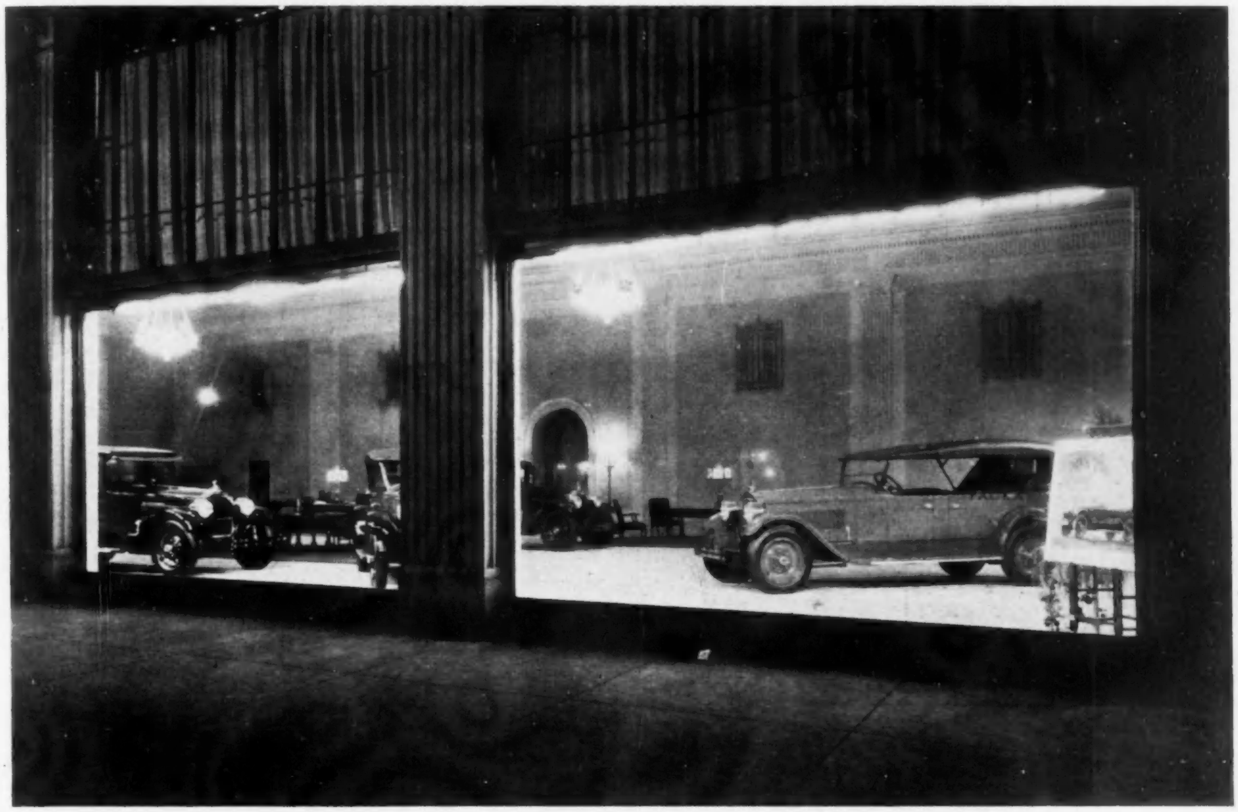


Photo. Thomas Ellison

DISPLAY WINDOWS, PACKARD MOTOR CAR CO., DETROIT
ALBERT KAHN, INC., ARCHITECTS



WINDOW LIGHTING, PACKARD MOTOR CAR CO., DETROIT
ALBERT KAHN, INC., ARCHITECTS

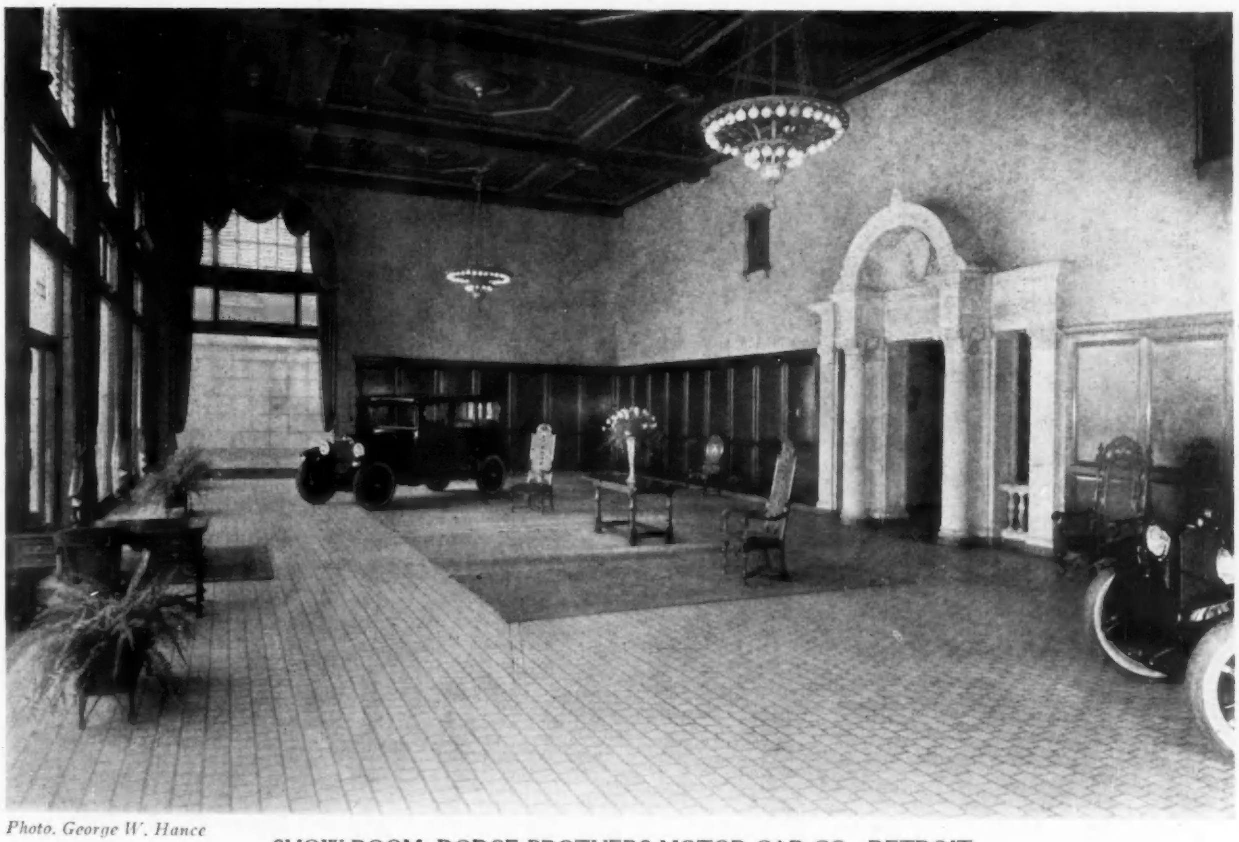


Photo. George W. Hance

SHOW ROOM, DODGE BROTHERS MOTOR CAR CO., DETROIT
SMITH, HINCHMAN & GRYLLS, ARCHITECTS

entation of custom-built automobiles in the setting and atmosphere of a gallery." That is exactly what this carefully studied automobile show room is,—a gallery. But just here a question arises regarding the fundamental appropriateness in the *method* of working out the entire scheme. Admitting the three chief premises that in a gallery, which is to serve as a background for the display of automobiles, there should be (1) an air of luxurious welcome for patrons; (2) adequate display facilities for the cars; and (3) the suppression of obtrusive commercial appointments, no exception can be taken to the appointments of this sumptuous gallery,—as a gallery. The announcement continues: "Here visitors may observe the newest creations of the master body-builders in surroundings of the character to which they are accustomed in viewing other works of art." But there is just the crux. The automobile is distinctly an *out of doors* creation of the manufacturers' art and is normally seen out of doors. It is scarcely feasible, to be sure, to create a luxurious show room out of doors, and this difficulty has no doubt been duly appreciated by architects and designers who have realized the impracticability of creating even the semblance of an out-of-door setting for cars which would not appear unduly artificial and theatrical as well as not be extremely costly. They have probably decided that the best which can be done is to create a dignified, tasteful setting, planned upon an appropriate scale, to emphasize a car's excellence.

Several of the other show rooms illustrated here suggest danger in arranging their appointments. The fault of over-elaboration, in cases of this sort, is very easy to fall into, and the temptations are many. Those responsible for many of the show rooms have doubtless found it exceedingly difficult to steer a safe course between "too little" and "too much." One of the show rooms that seems to be of appropriate luxury, to possess adequate display space, and to present absence of too-apparent office fittings, is the Hollywood gallery of the Star Motor Car Co. (page 307), and yet there is nothing to suggest that the automobiles have been wrested from their natural setting and transformed, for the time being into drawing room furniture or museum exhibts. Another Hollywood show room, that of the Franklin Motor Company, displays the same spirit of consistency in its equipment. There is a tapestry on the wall, it is true, but the main part of the floor is left to the automobiles without any incidents to detract from their prime importance. The Studebaker show rooms at Lakewood, O. and San Diego; the Peerless show room in New York; the Packard show room in Detroit; and various others might be mentioned where all requirements of sumptuous taste have been complied with, and yet one feels that the outdoor nature of the automobile has not been unnecessarily compromised by inconsistency of association. Their designing is probably typical of the best.

That this latest development of the automobile show room into a spacious and beautifully appointed gallery, different by far from a garage, is matter for sincere commendation few of course will dispute, but in making this advance it is not safe to shut our eyes to the inherent nature of the wares displayed or to the importance of maintaining in the setting a character which will accord with that of the article itself. It is an instance in which good taste counts for much, taste not only in actual designing but also in choosing the character of the setting.

Sales Room, Thompson Motor Car Co., Denver
J. B. Benedict, Architect