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APRIL, 1914

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CONSTRUCTION

A · JOURNAL · FOR · THE · ARCHITECTURAL ENGINEERING · AND · CONTRACTING INTERESTS · OF · CANADA

MUTUAL LIFE BUILDING
WATERLOO

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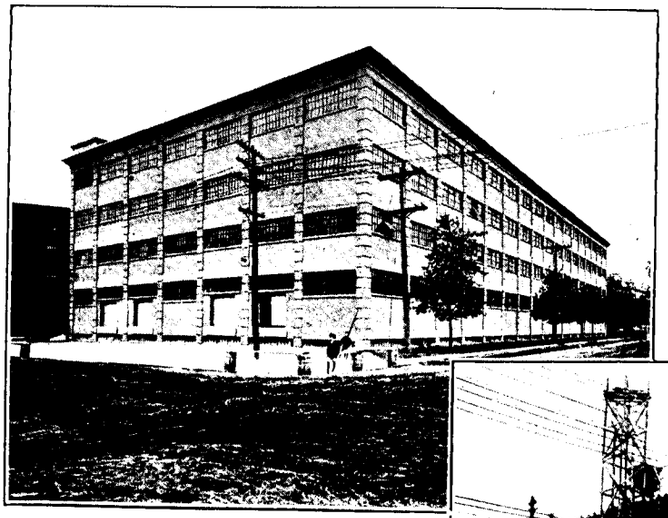
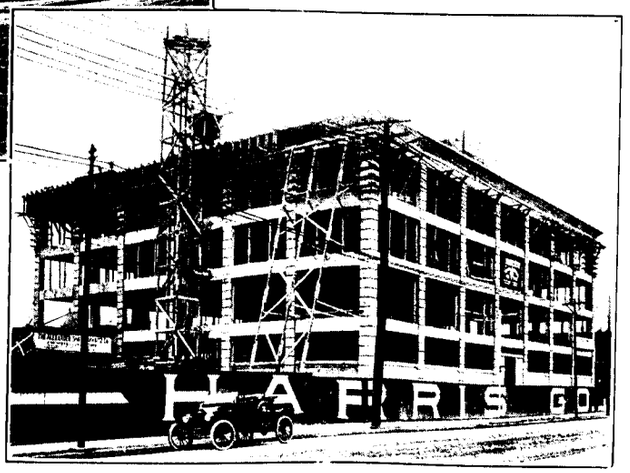


Factory Buildings of the Massey-Harris Co., Limited, Toronto, Ont.—Another striking example of how concrete construction is valued by large manufacturers.



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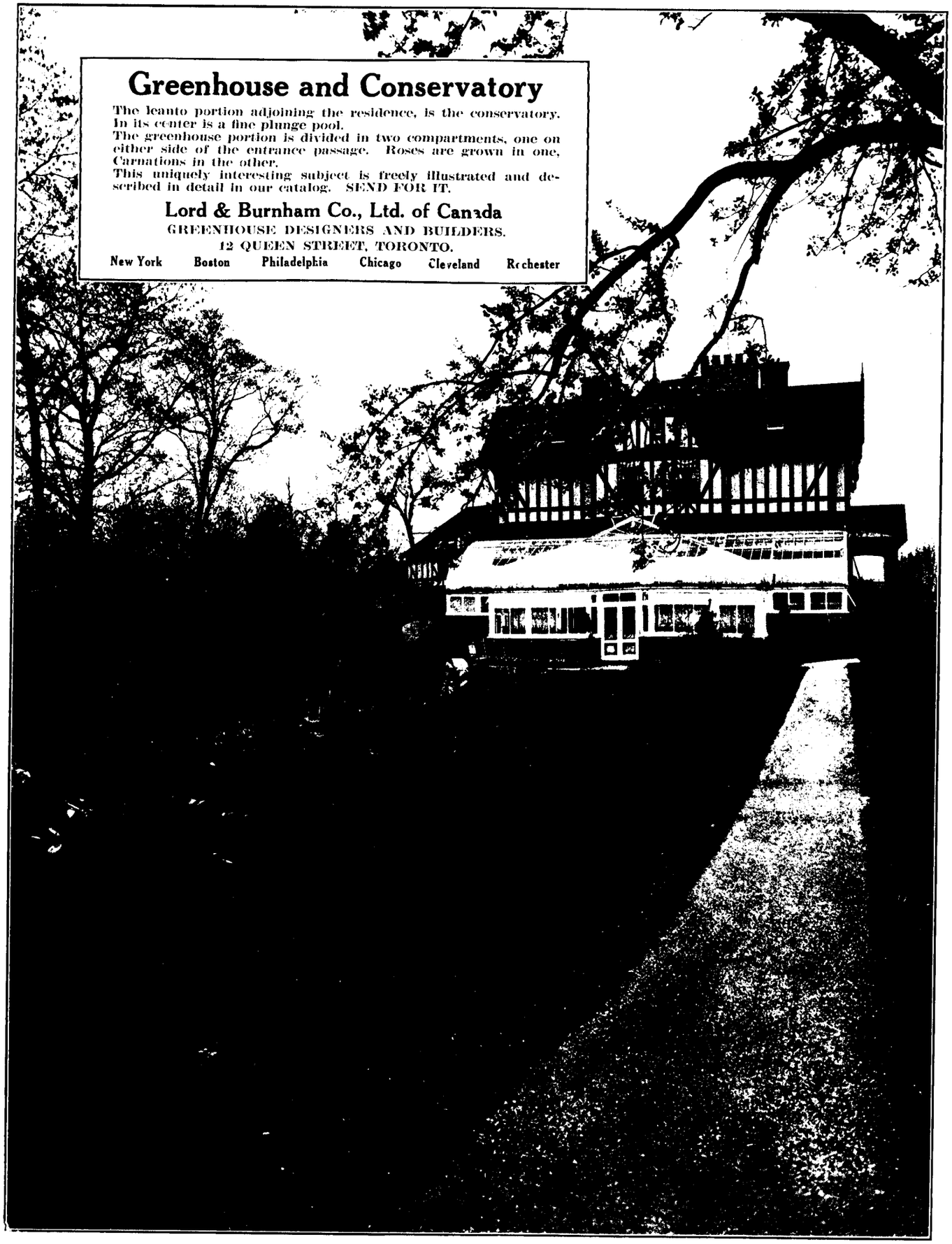

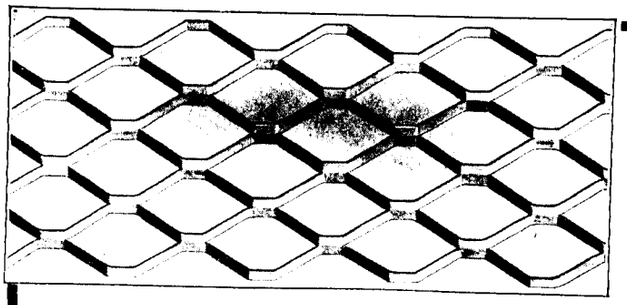

Fig. 1—Expanded Lath.

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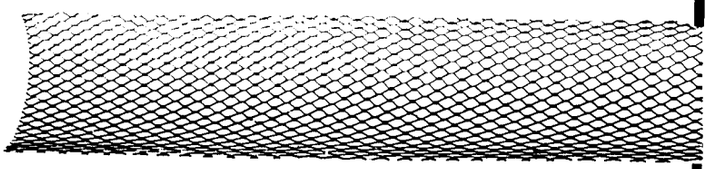

Fig. 2—Lath Cove.

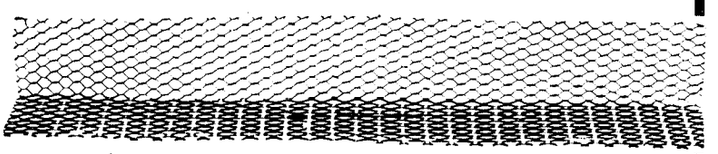

Fig. 3—Lath Corner.

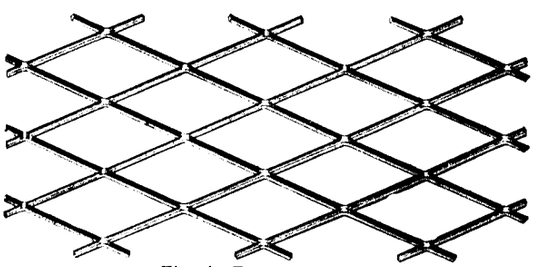

Fig. 4—Expanded Metal.

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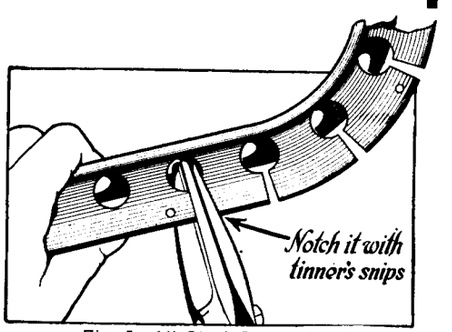

Fig. 5—All-Steel Corner Bead.

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Fig. 6—Metal Wall Tie.

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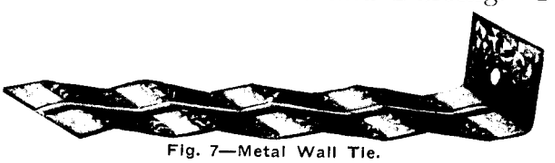
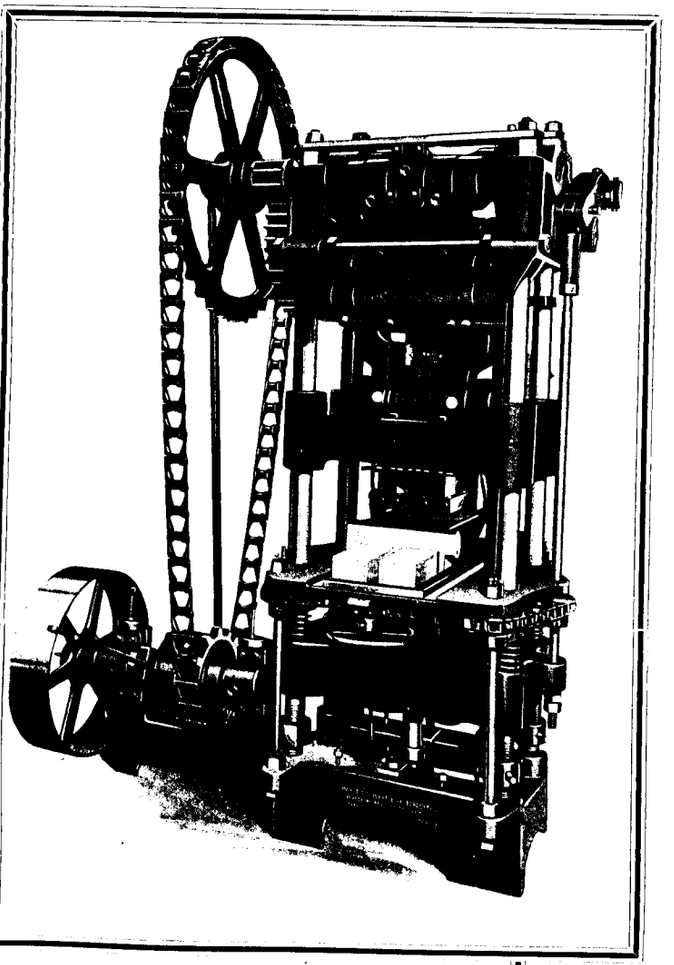


Fig. 7—Metal Wall Tie.

This Equipment May Make all the Difference Between Profit and Loss



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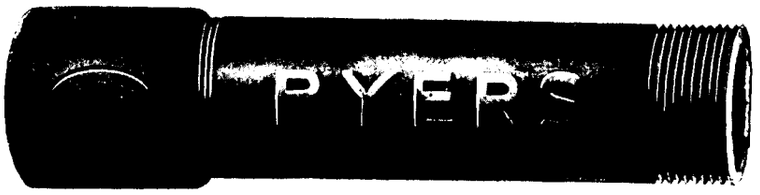

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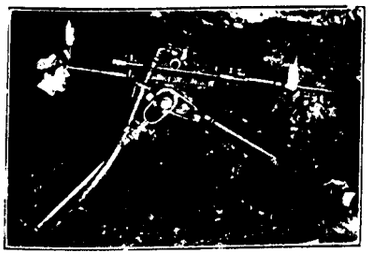
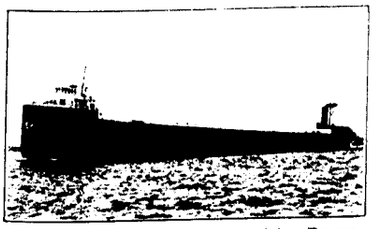
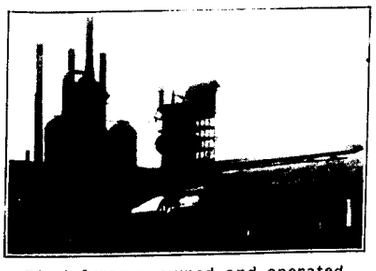


Taking iron ore from one of the Byers mines.



Ore steamer built and owned by Byers.



Blast furnace owned and operated by Byers.

In one of the Byers rolling mills.

FOR fifty years it has stood for all that is highest and best in pipe history, in pipe manufacture, and in the records of pipe service.

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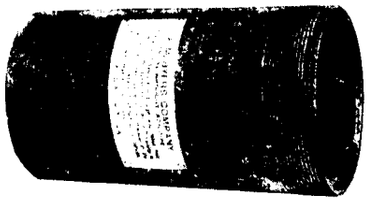
It had been underground for 28 years of uninterrupted service, and had lost not over 3 per cent. in weight.

The thread shown is the original cut in the Byers mill 28 years ago.



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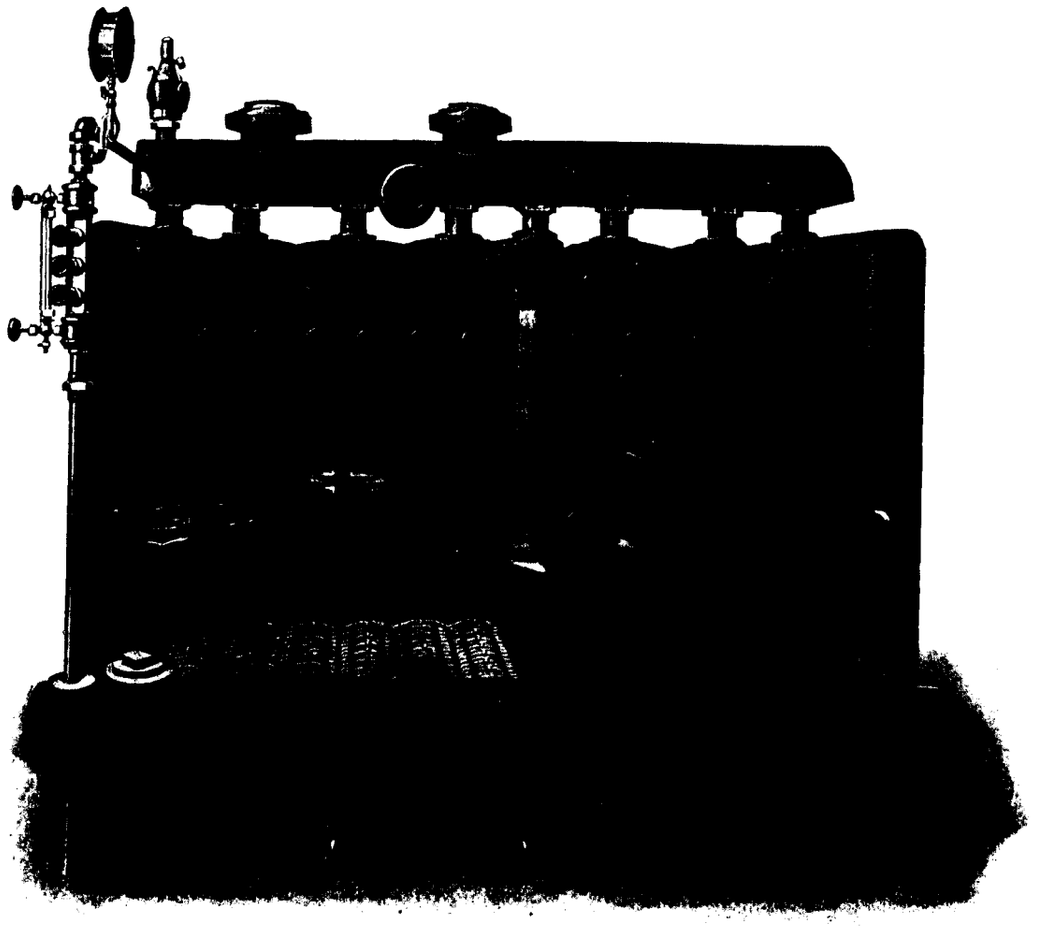

The interior construction of the Gurney Smoke Consuming Boiler, showing how the heavy smoke from soft coal slack instead of passing up the chimney to waste, passes over a secondary fire and is consumed.

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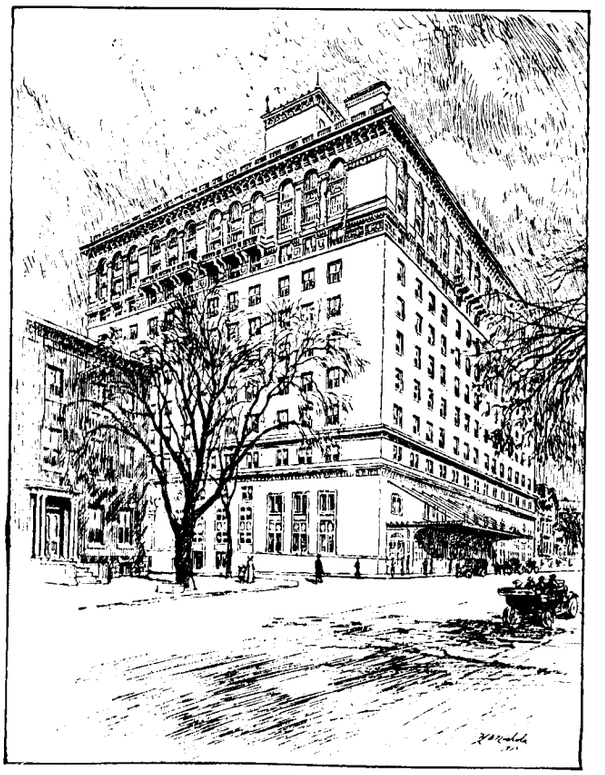

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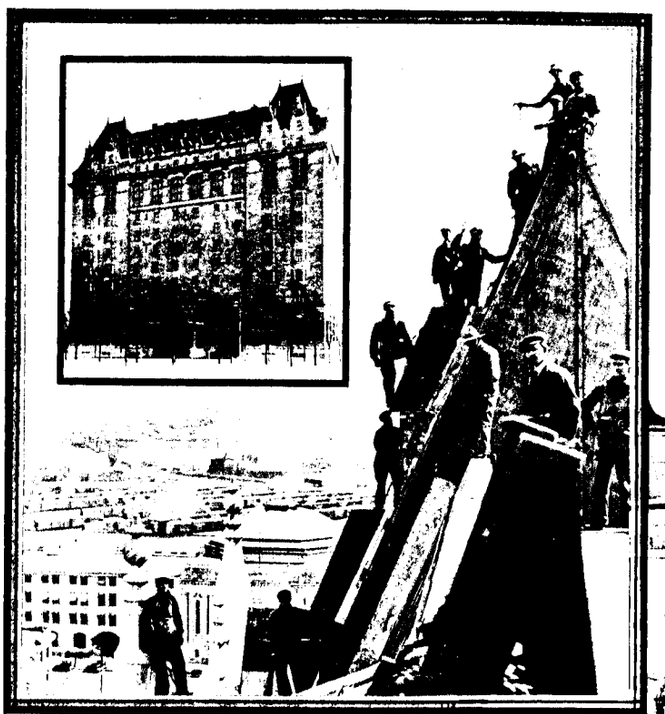

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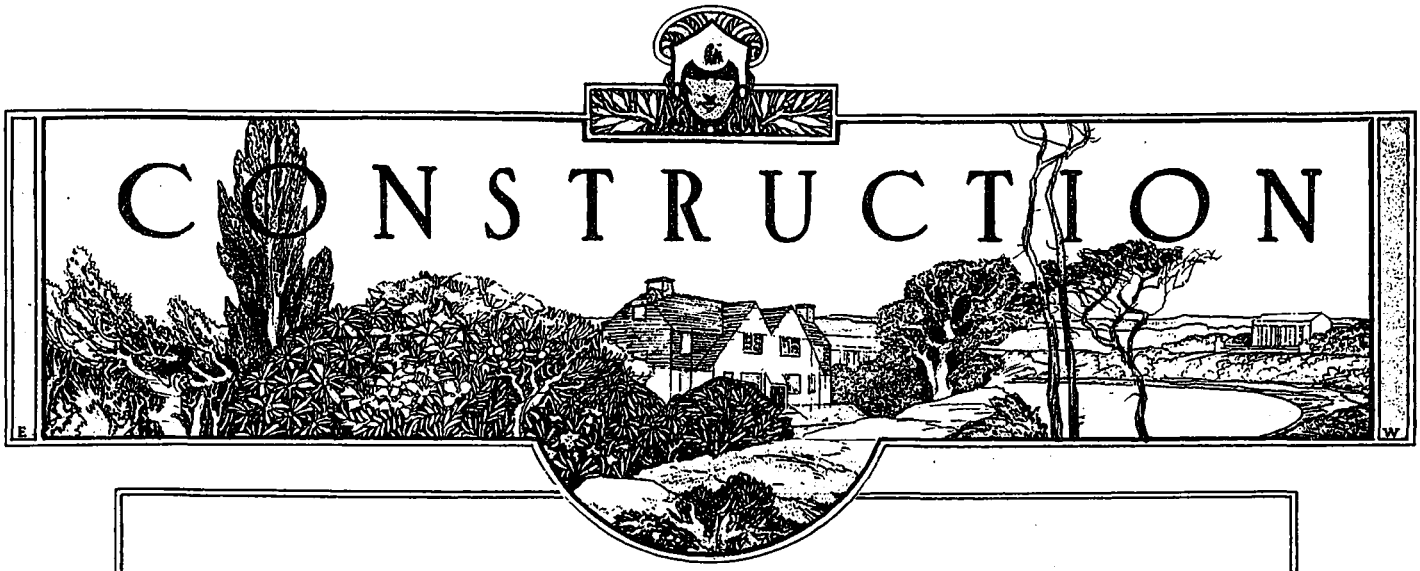

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Full Page Illustrations

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GRAPHIC ARTS BLDG., TORONTO, CANADA

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MUTUAL LIFE ASSURANCE COMPANY
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DARLING & PEARSON, ARCHITECTS.

The great loss by fire—Reasons why it is so much greater in Canada than in Europe, and methods for remedying same—Better fire escapes needed.

THROUGH IGNORANCE partially and recklessness mostly, Canada and the States lost $196,029,500 by fire during the year 1913. The number of conflagrations during the first three months of the present year promise a total for 1914 far in excess to the one just quoted. In Canada alone the loss per capita for the last three years has been $2.90. An appreciation of what this means may be realized from the fact that for each person, man, woman and child, the assessment amounts to $5.63 if we include the interest upon debentures, and maintenance of fire departments.

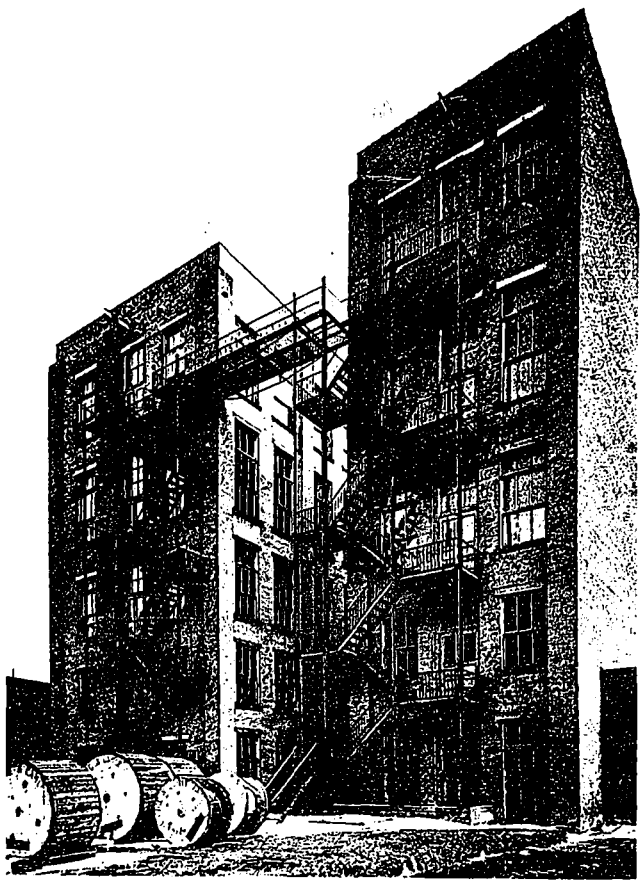
In order to find the causes leading to preventable fires, the New York Fire Department compiled the following statistics: Number of fires from matches, 1,629; carelessness with cigars, cigarettes, etc., 1,273; carelessness in the use of illuminating gas, gas lights, ranges, radiators, etc., 849; bonfires, brush fires, igniting fences, etc., 849; heat from stoves, stovepipes, furnaces, steam-pipes, 844; chimney fires and sparks from chimneys, 784; children playing with matches or with fire, 657; carelessness with candles, tapers, etc., 500; electric lights, wires, defective insulation, 424; total, 7,819. The Bureau of Municipal Research in Portland issued the following table: Number of fires from burning flues, 285; defective flues, 28; sparks, 83; electric wires, 25; burning grass, 32; burning grease, 15; burning brush, 23; cigars, 16; bonfires, 15; over-heated stove, 22; over-heated furnace, 10; matches, 16; total, 570.

The appalling feature of this wanton carelessness does not centre in the loss of material substances so much as it does in the loss of life. It is impossible to measure the hardships, suffering and death of those who barely manage to escape with their lives. If it were a condition impossible to overcome then we might accept the inevitable, but when we consider that the average per capita in the large European cities is only forty-nine cents then a condition confronts us which is worthy of immediate and prompt action. So much stress is laid upon the carelessness of using matches, cigarettes, etc. Are these not a factor in foreign life? The great difference in the annual loss by fire does not centre in the habits of the individual as much as it does the structural phases of our buildings. Let the various cities of Canada permit structures of inflammable materials to be erected in the heart of their commercial districts and all the laws imaginable will never prevent the great conflagrations with their tremendous destructive tendencies.

So many rules have been formulated which, in themselves, are admirable, but are necessitated through the shameful neglect of our councils and proper authorities. Why erect school houses which prove to be nothing more or less than fire traps and then try to escape the danger by constant fire drills? Why allow an office building of mill construction which will burn like chaff, and then force the owner to undergo the expense of a sprinkler system? Why encase the elevator shaft of a ten-story structure with fireproof walls and neglect the fire escapes? All preventives like the above are wholesome and should be enforced, but they must not be used as blinds to hide the real dangers.

Another factor working against the proper enforcement of fire protection was brought out in the recent investigation into the causes of the Woodbine Hotel fire, Toronto, where a number of lives were lost. The city building by-law states that all buildings exceeding thirty-five feet in height to be used as hotels must be fireproof throughout. This by-law was overruled by the Board of Control, who accepted plans calling for timber construction, one fire escape accessible through a private room, inside toilets, and electric wiring without conduits. Such

power in the hands of incompetent men is one of the reasons why our cities are being continually threatened with fire disasters. If the modern up-to-date structures are to be erected with inflammable materials and license is given to disregard the simple factors of safety as stated in our building by-laws, then let the matter of fire escapes be carefully looked after, for herein lies the only means of protection. The accompany-



BELL TELEPHONE COMPANY BUILDING, TORONTO.

ing cut of the Bell Telephone Company's building in Toronto exemplifies a proper consideration for the large number of employees, the fire escape connecting the two buildings and being amply lighted at each landing.

It is one of the unfortunate conditions in life that lamentable disasters are soon forgotten and thorough investigations do little more than pacify the public until its attention is attracted elsewhere. In order to eliminate the great conflagrations it will be necessary to have building by-laws providing for absolute fireproof structures with the inspection of same under one head, so that there will be no chance for the responsible party in case of neglect escaping due punishment. Furthermore, these laws must be final, with no opportunity for a prejudiced or unscrupulous board to set them aside. Then and only then will we reduce our fire loss to a minimum.

Tapestries brought into America during recent years —Their value to the future generations in the development of art along similar lines.

THE PRETENTIOUS and formal residence which plays such an important part in the lives of the present age, furnishes the incentive for enriching our country with the artistic treasures of former generations. No stone mansion or brick palace is complete without the large wall spaces upon the interior being covered with valuable tapestries. Each succeeding year finds many valuable examples taken from their European homes and brought into America to satisfy the ambitious rich. Eventually when these rare and priceless masterpieces become the property of public museums the inclination will be to study at home instead of in foreign fields. Tapestries date back many centuries, the Boston Museum of Fine Arts containing a Coptic woven in 400 B.C. The work sought after and which is more accessible as well as fitting for decorative purposes, belongs to the Middle Ages. The early Gothic excelled between the years 1475-1520, the Italian and Flemish shortly after. Under the patronage of royalty the French became supreme through the establishment of the Gobelins and Aubusson factories. The preservation of many valuable productions is due to the monasteries, who obtained the tapestries from the various castles when the owners were forced to engage in warfare. These monks influenced the subjects depicted since so many early examples are stories of religion. To obtain an idea of the value attached to some tapestries, one woven in Nuremberg during the latter part of the fifteenth century and now in this country, weighs six and one-half pounds and cost $40,000. The group "Scipio Africanus," acquired by an American, ranks among the greatest in existence, consisting of the three subjects, "L'Armee Navale," "La Conference," and "L'Incindie." Other well known tapestries brought to America are the sixteenth example of Flemish work depicting the lives of Henry II and Diana of Poitiers; the Barbarini collection of one hundred and thirty-five pieces on the Triumphal March of Charles V, made by weavers from Gobelins; the famous fifteenth century tapestries from the Bordac collection. Probably our best example was purchased by J. P. Morgan for the sum of $340,000. It is called the "Kingdom of Heaven," woven in Brussels in 1510, and belonged at one time to the King and Queen of Spain. Many others might be mentioned, which only goes to show the great inroad money has made upon this valuable phase of art among European countries. While deprecating such vandalism, still we cannot help but appreciate the great value accruing therefrom to future growth along aesthetic lines.

BOARD ROOM IN MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONT.

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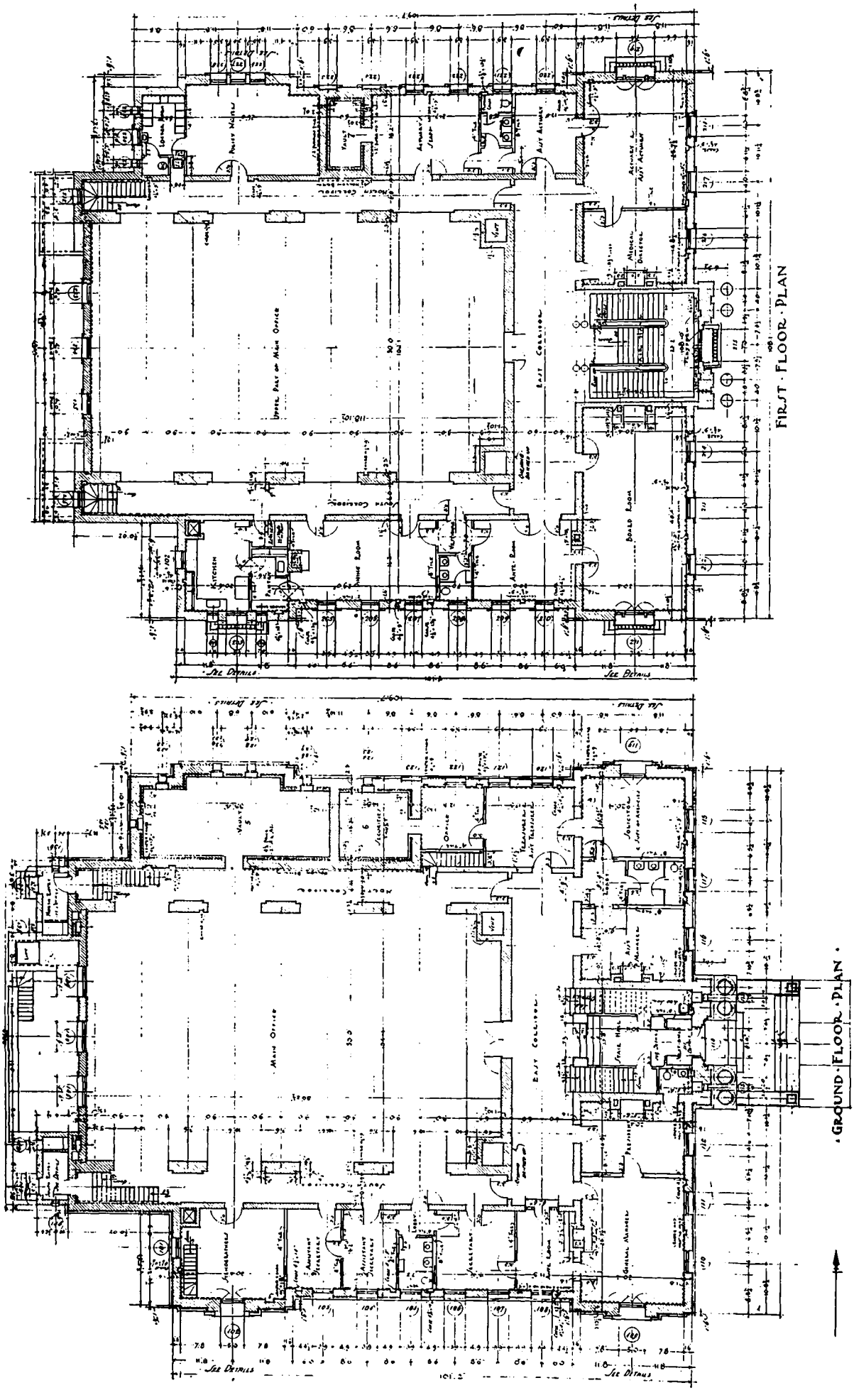

PLANS OF MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONT.

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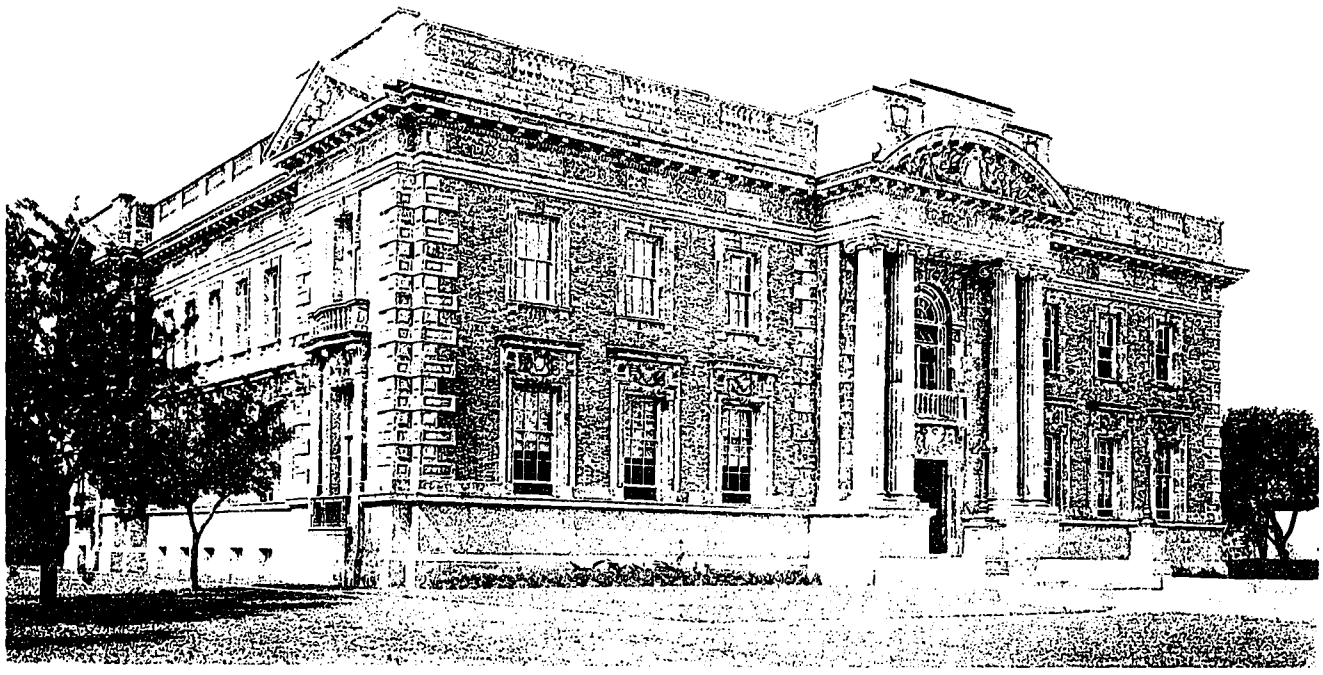


Waterloo, Ontario

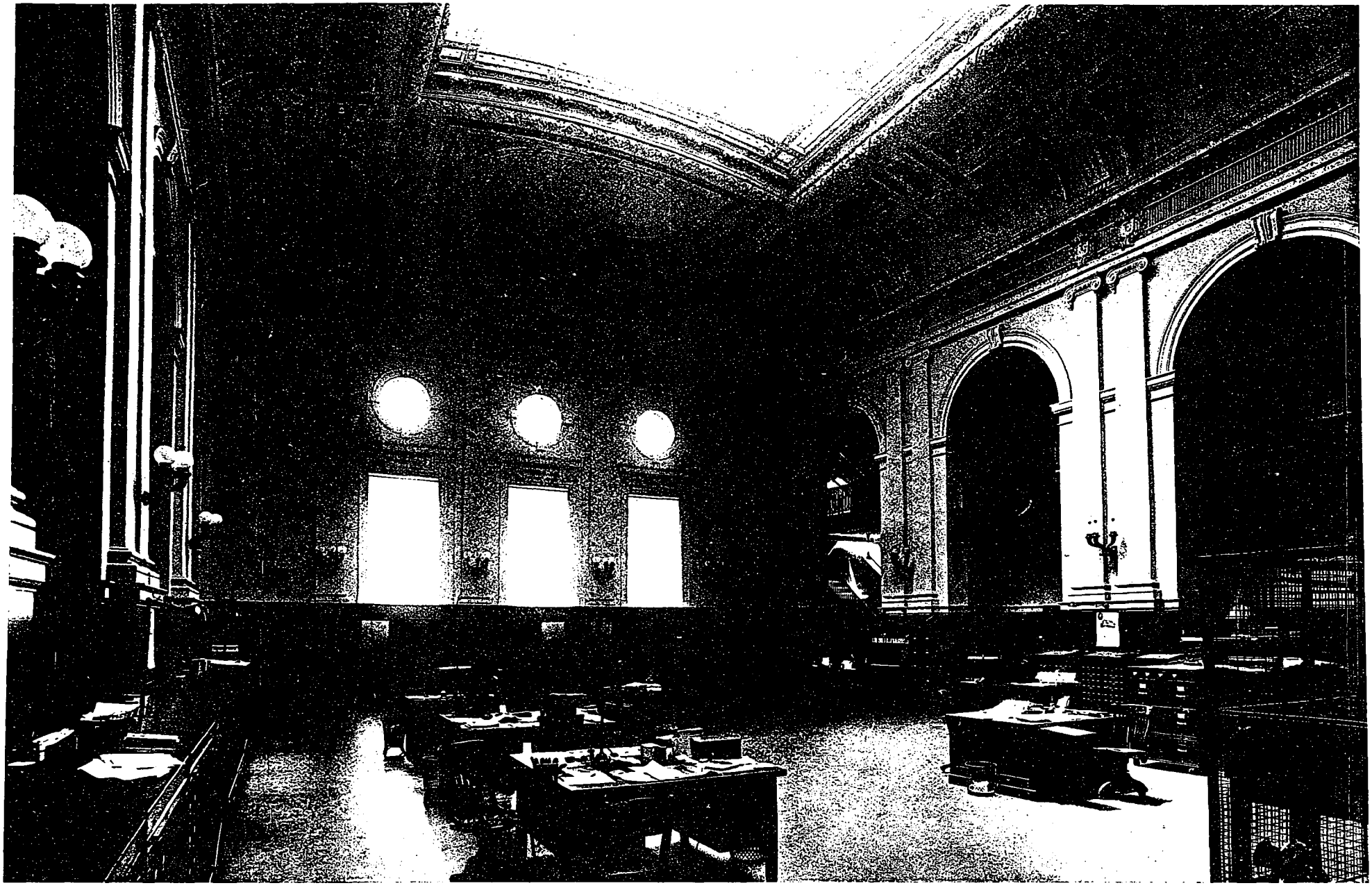
Building for Mutual Life Assurance Company of Canada

Darling & Pearson, Architects

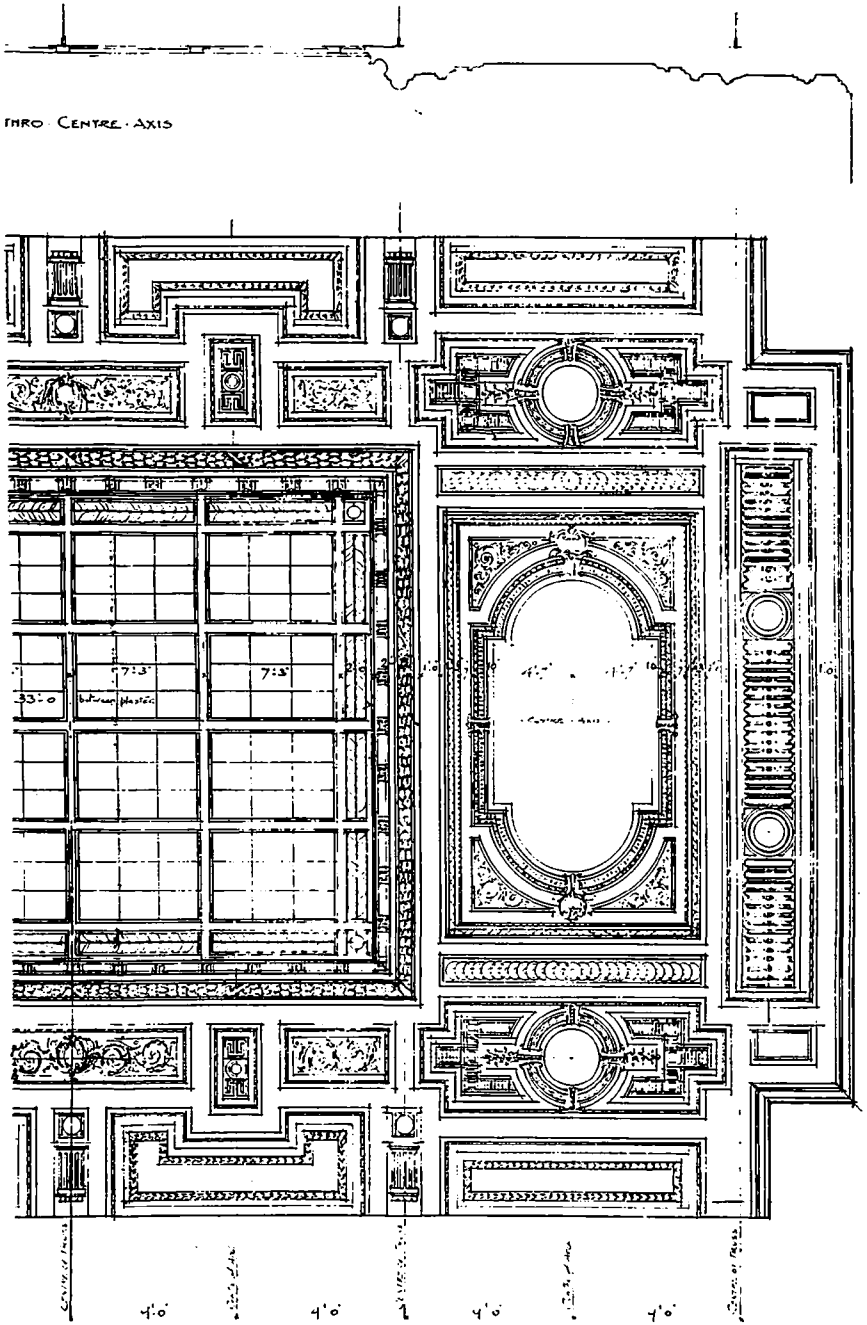
ONE of the characteristic signs of permanency and future growth in our smaller cities is the high class of buildings being erected. This fact alone is indicative of the commercial activities therein, without which no community can ever hope to reach a prosperous size. The town grows and if this progress is stunted by narrow minded citizens who feel that the structures of yesterday are good enough for to-day, there is little chance of its ever developing beyond the limitations of the people. This lack of confidence prevents internal growth and keeps away many foreign industries which would, otherwise, become established in that vicinity.

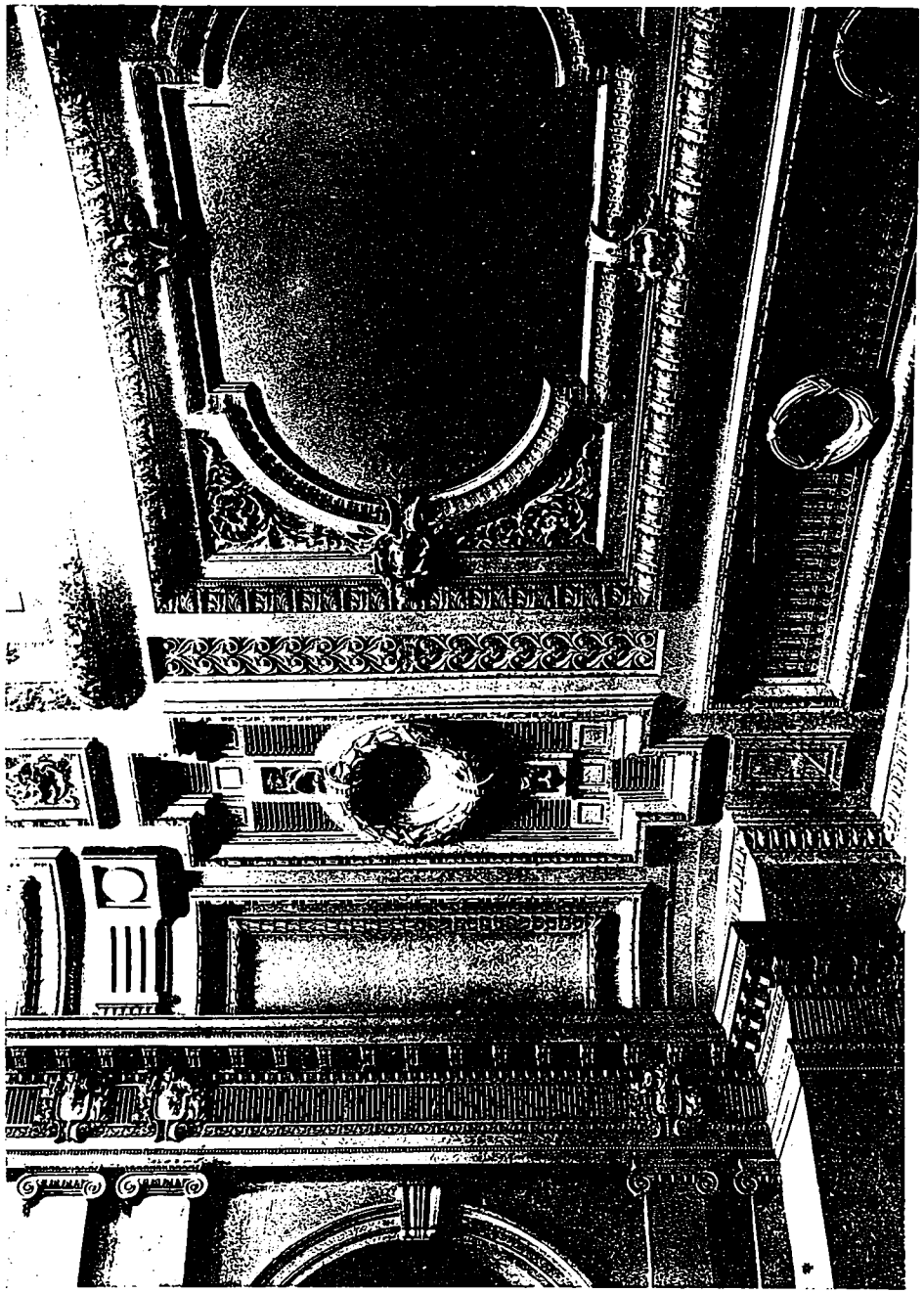
Waterloo may be justly proud of the Mutual Life Assurance Company of Canada building, which is typical of the progressive spirit in that community. It stands a dignified Renaissance structure of Canadian made buff brick and light terra cotta of a harmonizing nature. Directly in front of the building is a circular court paved with block stone in geometrical patterns. The whole lot is surrounded by a wrought iron fence eight feet high. Entering through walnut doors with heavy raised panels, one passes through the entrance hall, lined with Canadian marble, into the corridor, which is treated in plaster panels set between pilasters of verde antique marble and marble tiled walls. Surrounding and on the outside of the corridor are the office rooms with mahogany woodwork, plaster finish and quarter-sawed white oak. The building is fireproof throughout, heated from a boiler house some distance away, and ventilated by means of two exhaust fans located in a pent house on the roof. One of the fans exhaust the air from the main office and rooms on the first floor, the other from the toilet and locker rooms.

One other feature which hinders the growth of towns in addition to the lack of commercial enterprise, is the failure to look ahead and grasp the needs of future expansion. Once more Waterloo is to be commended for her progressiveness. The Civic Association of Berlin and Waterloo—two adjoining towns—engaged C. W. Leavitt, of New York City, an expert on town planning, to prepare an elaborate scheme covering improvements of existing conditions and systematic studies for the future. Mr. Leavitt presented an extended report along with the plan. After reviewing the history and settlement of that district, which commenced in 1799, he states that Berlin has a higher sea level than Gravenhurst, in the so-called Highlands of Ontario, which is less than 900 feet. The highest point on the Grand Trunk Railway in the same region has an elevation of 1,197 feet, while Waterloo County has an average elevation of 1,100 feet. The heart of the peninsula of Southwestern Ontario with its vast surrounding fresh water expanses, the great lakes forming a

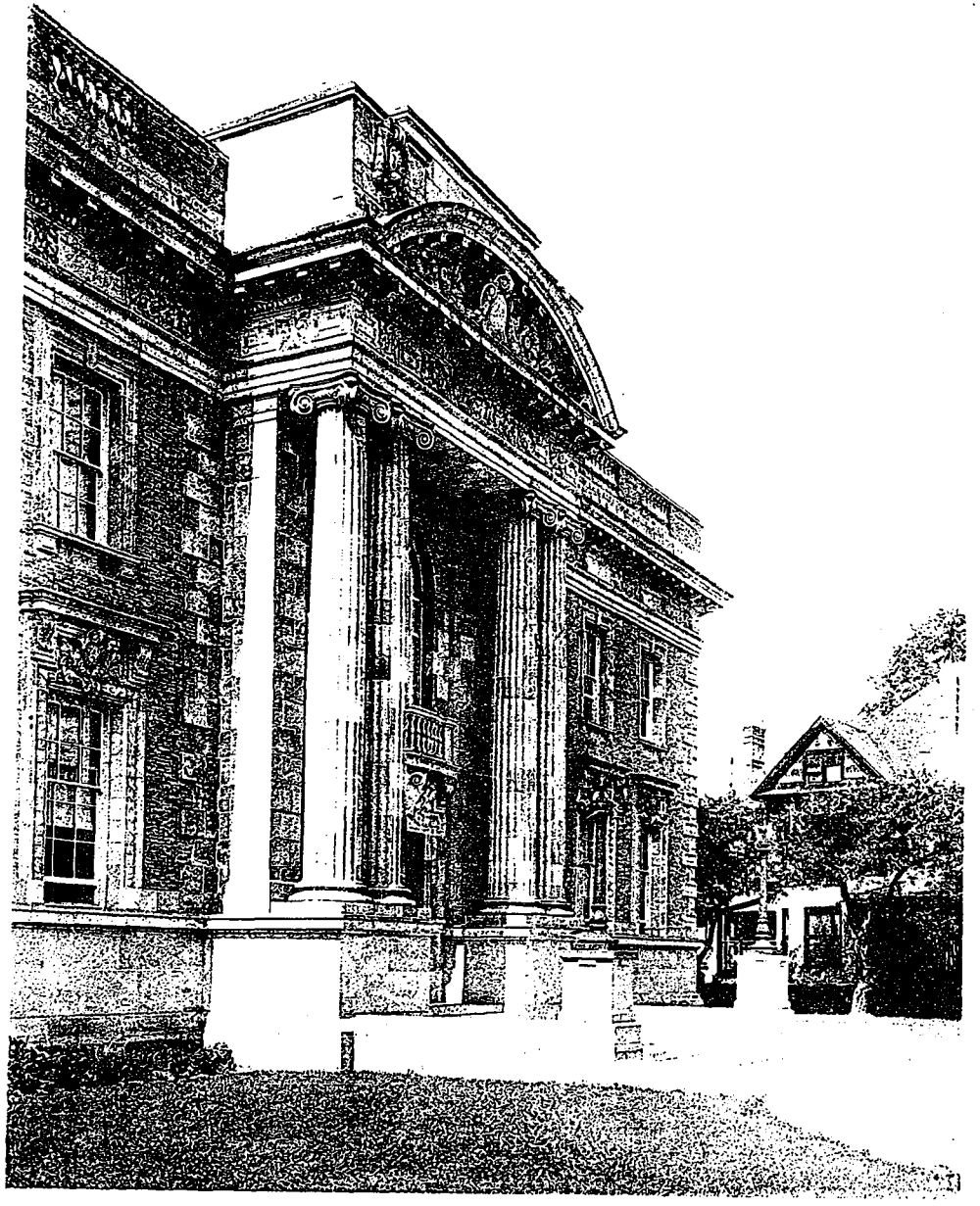


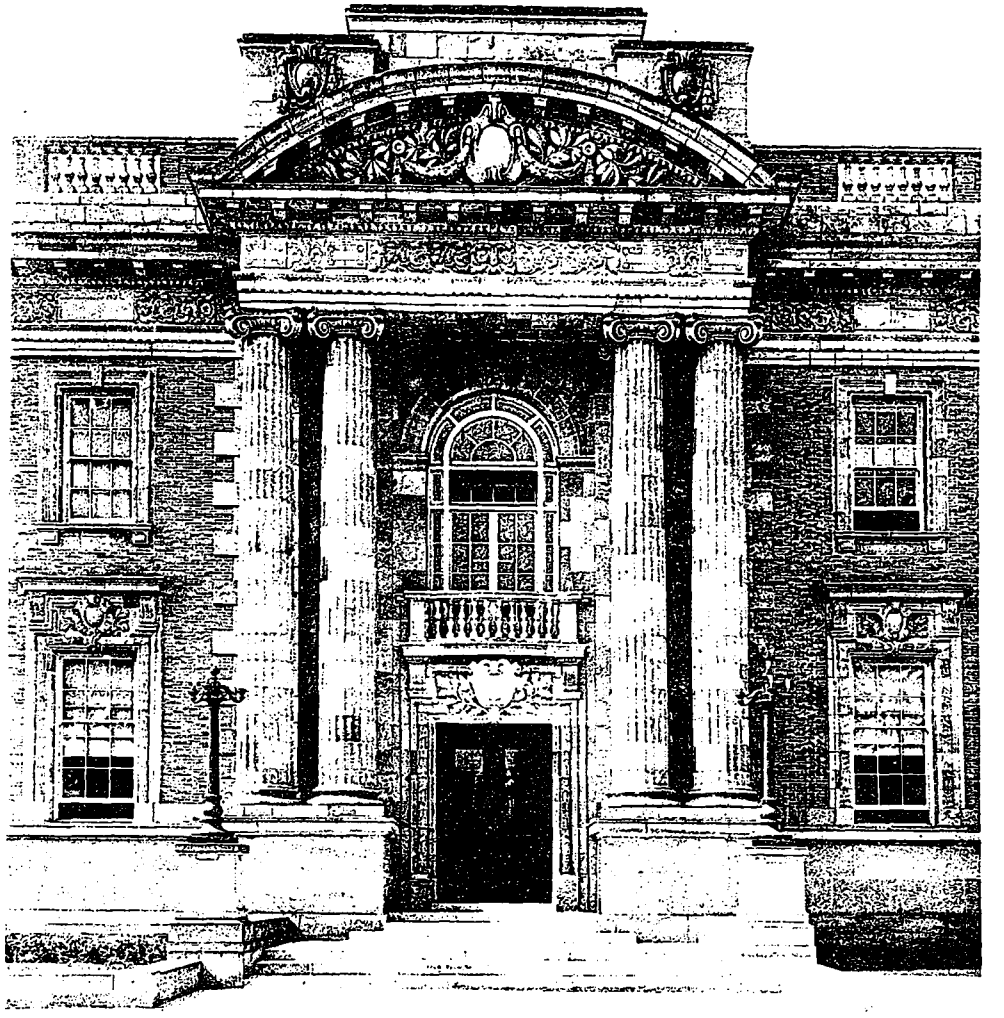
MAIN OFFICE. MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONTARIO. DARLING & PEARSON, ARCHITECTS.





DETAILS OF CEILING IN MAIN OFFICE. MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONTARIO. DARLING & PEARSON, ARCHITECTS.

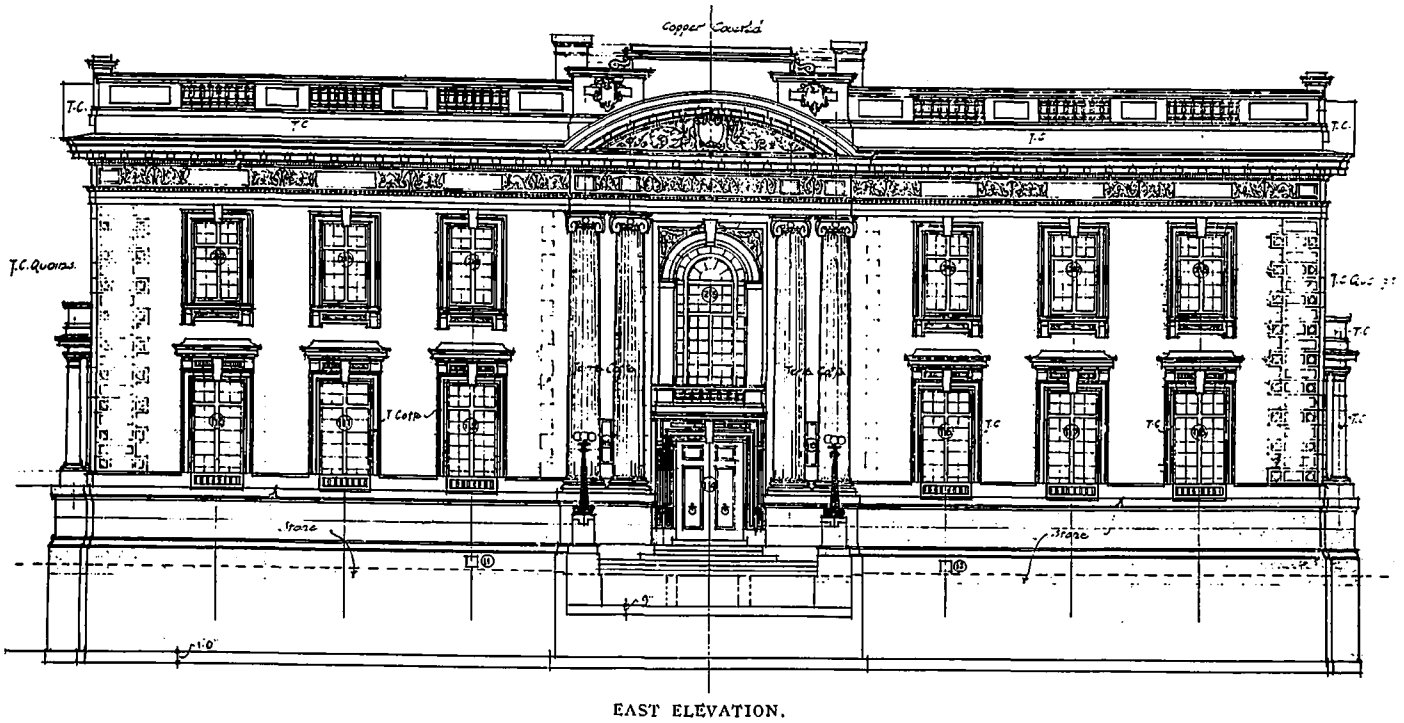




DETAILS OF MAIN ENTRANCE.

MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONT.

DARLING & PEARSON, ARCHITECTS.

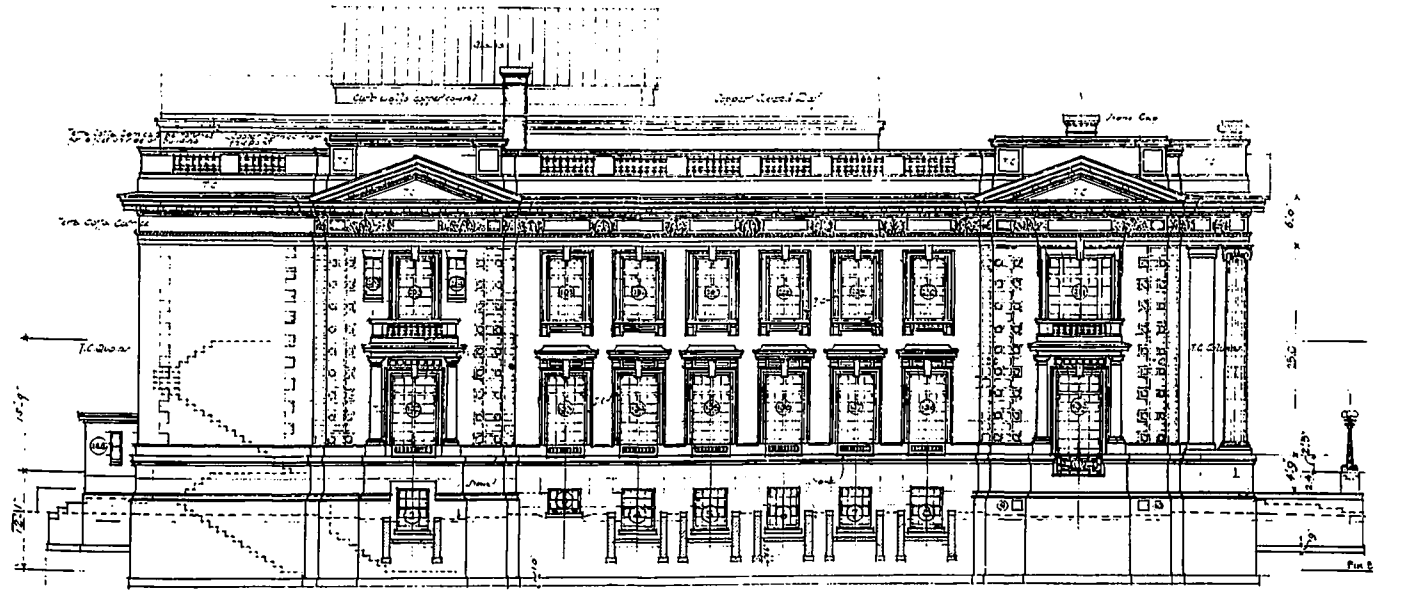


EAST ELEVATION.

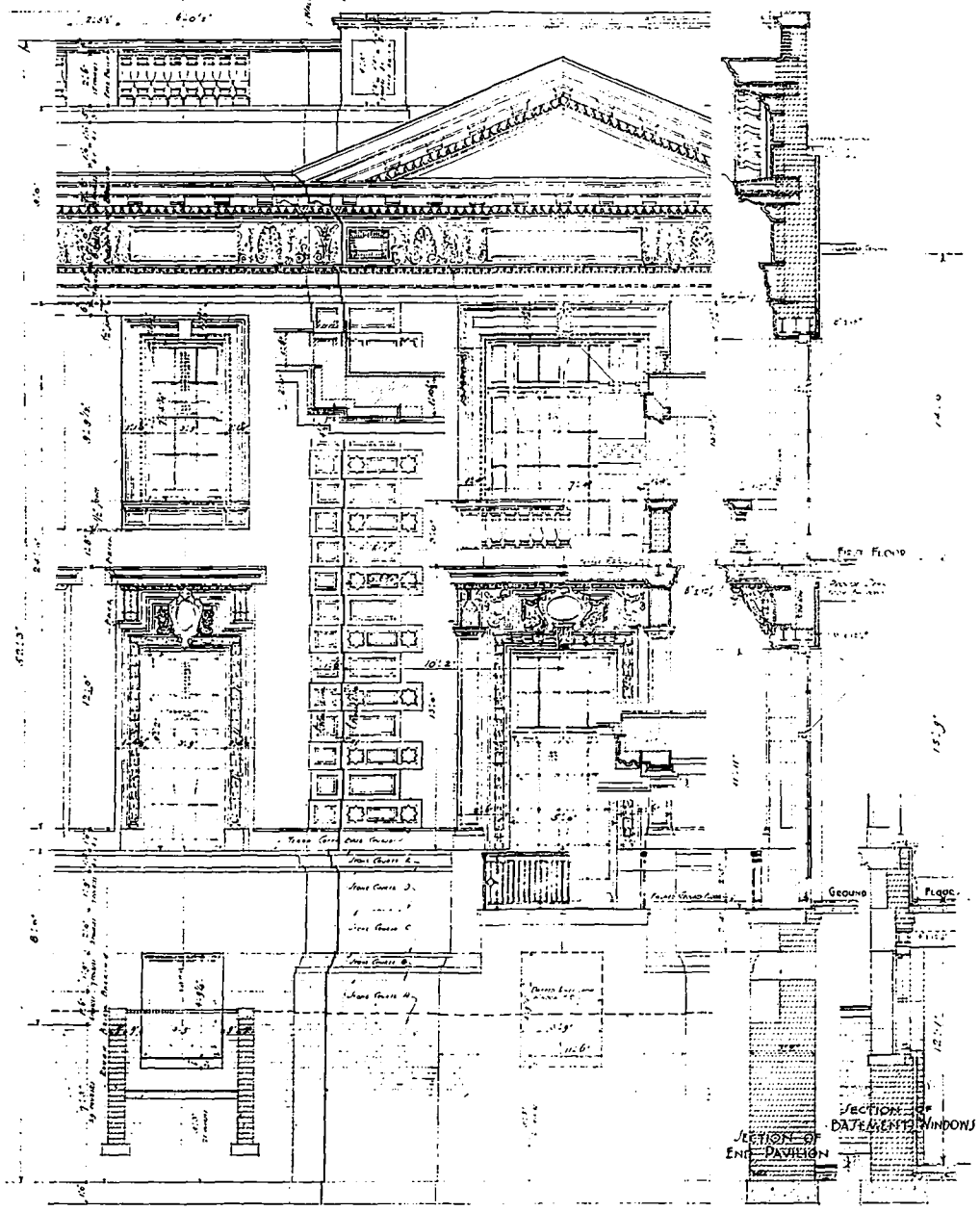
barrier against extreme meteorological disturbances, a fine salubrious climate combined with extraordinary fertile land, well watered, and with never extreme periods of drought. "Such," he says, "are the attractions for settlers and such remain the unique advantages of this territory."

In predicting a population of 100,000 for Berlin and Waterloo in twenty-five years, Mr. Leavitt says that these are large figures and bear analysis. The increase in this vicinity from 1903 to 1913 is 75.2 per cent., from 1904 to the conservatively estimated figure for the present year, the increase is 82 per cent. Applying the smaller percentage for two successive decades and half a decade more is obtained in twenty years from 1914, 60,650, and in twenty-five years 83,450 for Berlin alone, not counting Waterloo, which adjoins, and which is already in many respects part of the same community, and not counting on the tendency of city growth to increase in ratio as population increases. The people of Berlin and Waterloo, it is said, see other larger cities performing gigantic operations to rectify past mistakes, see them loading themselves with debt to pay the price of these necessities, and have decided to forestall such waste as far as possible, and to plan in order that their people should have a well ordered and convenient city where health and wealth may go hand in hand; where the children can be reared and educated in environment which, built upon clean, intelligent and useful lines, will insure good citizenship and make them permanent citizens of the locality.

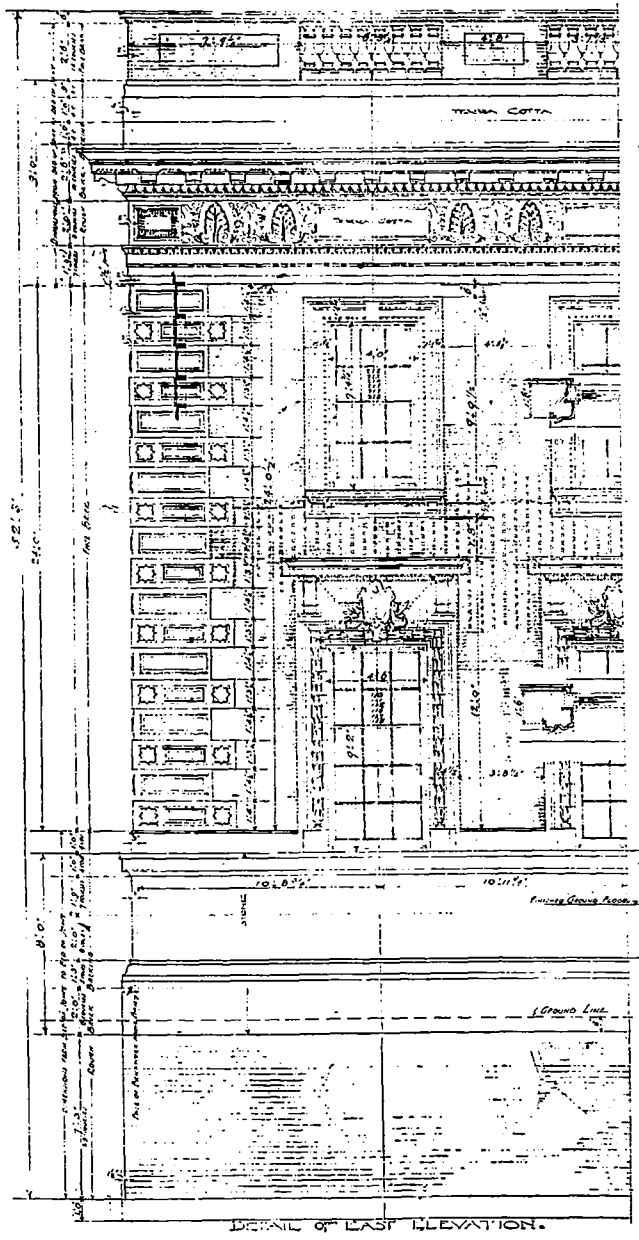
The association being formed of active citi-

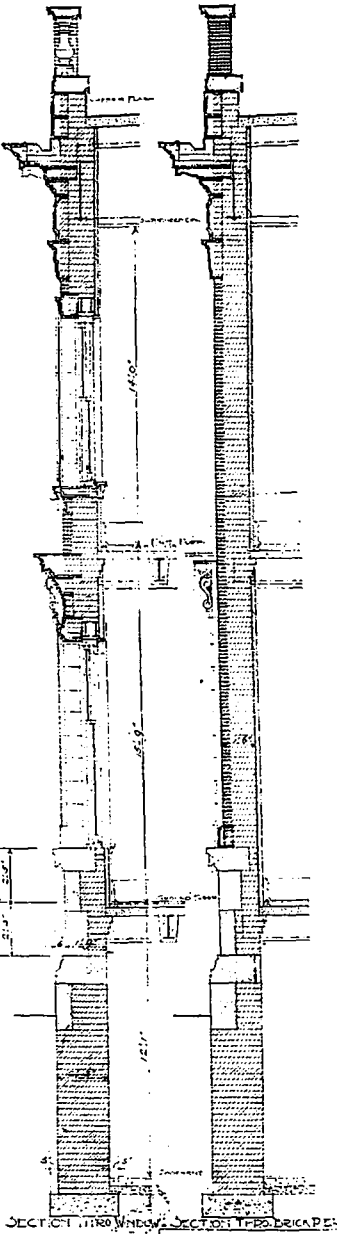


SOUTH ELEVATION.



DETAILS OF NORTH ELEVATION.

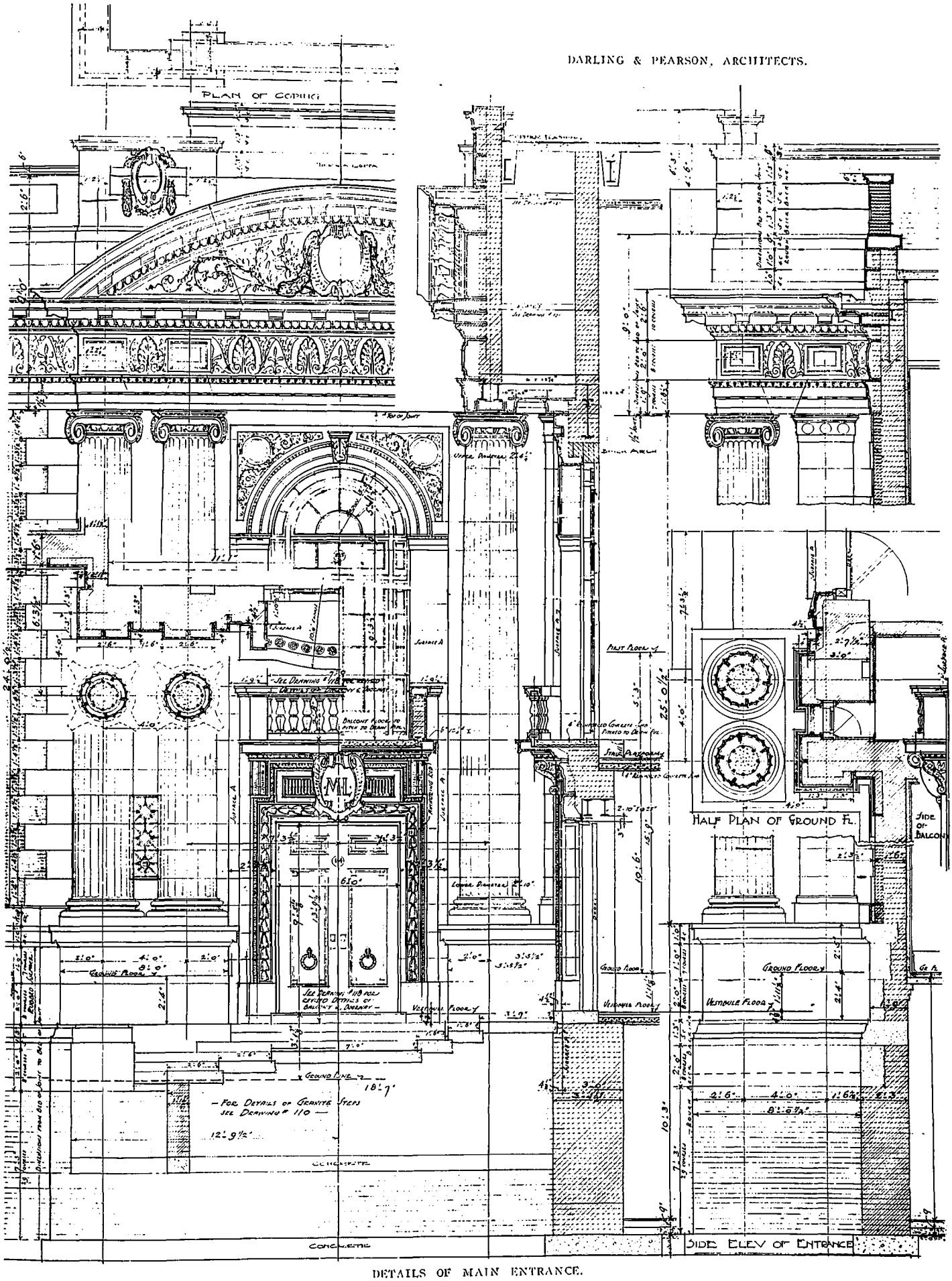




DETAILS OF EAST ELEVATION.

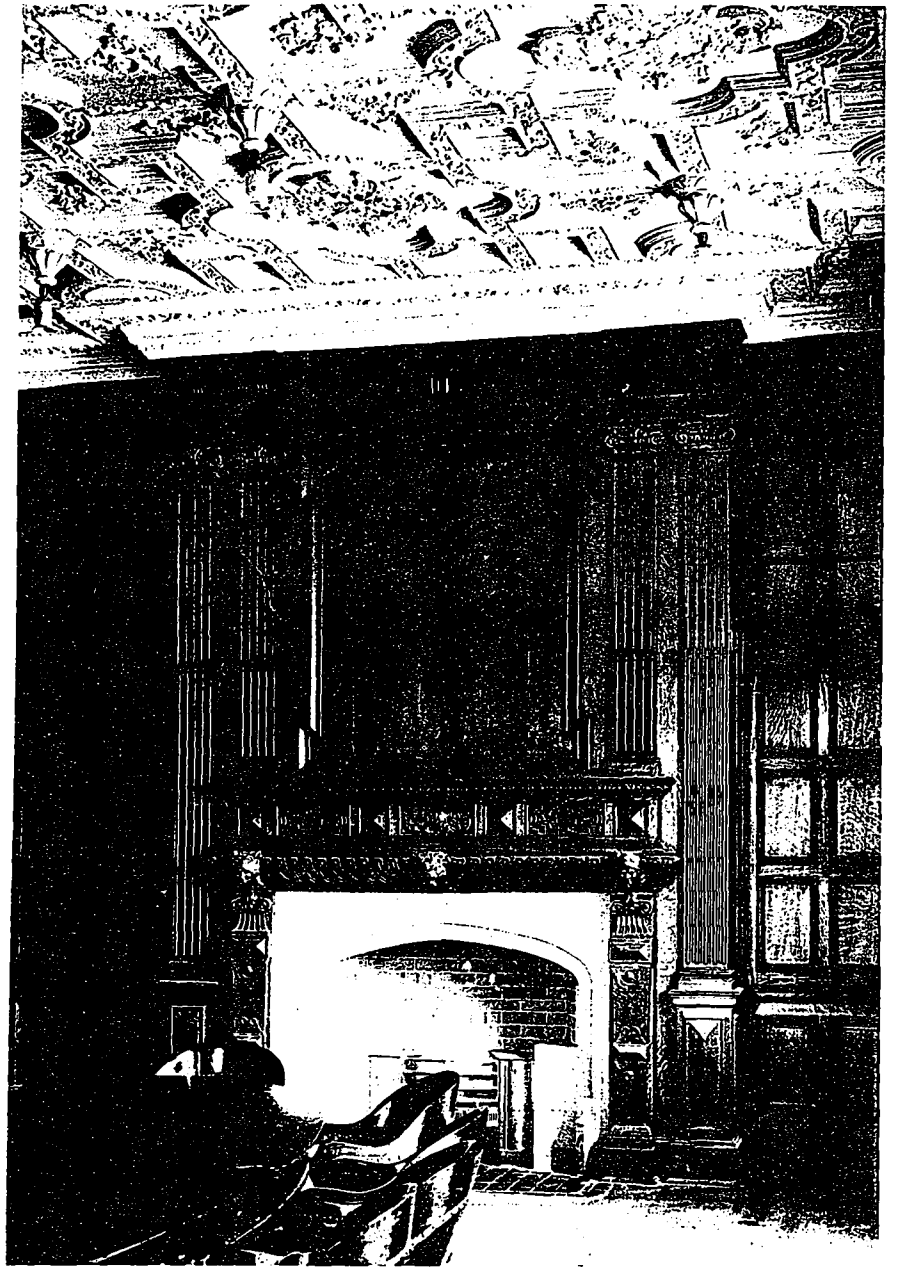
MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONT.

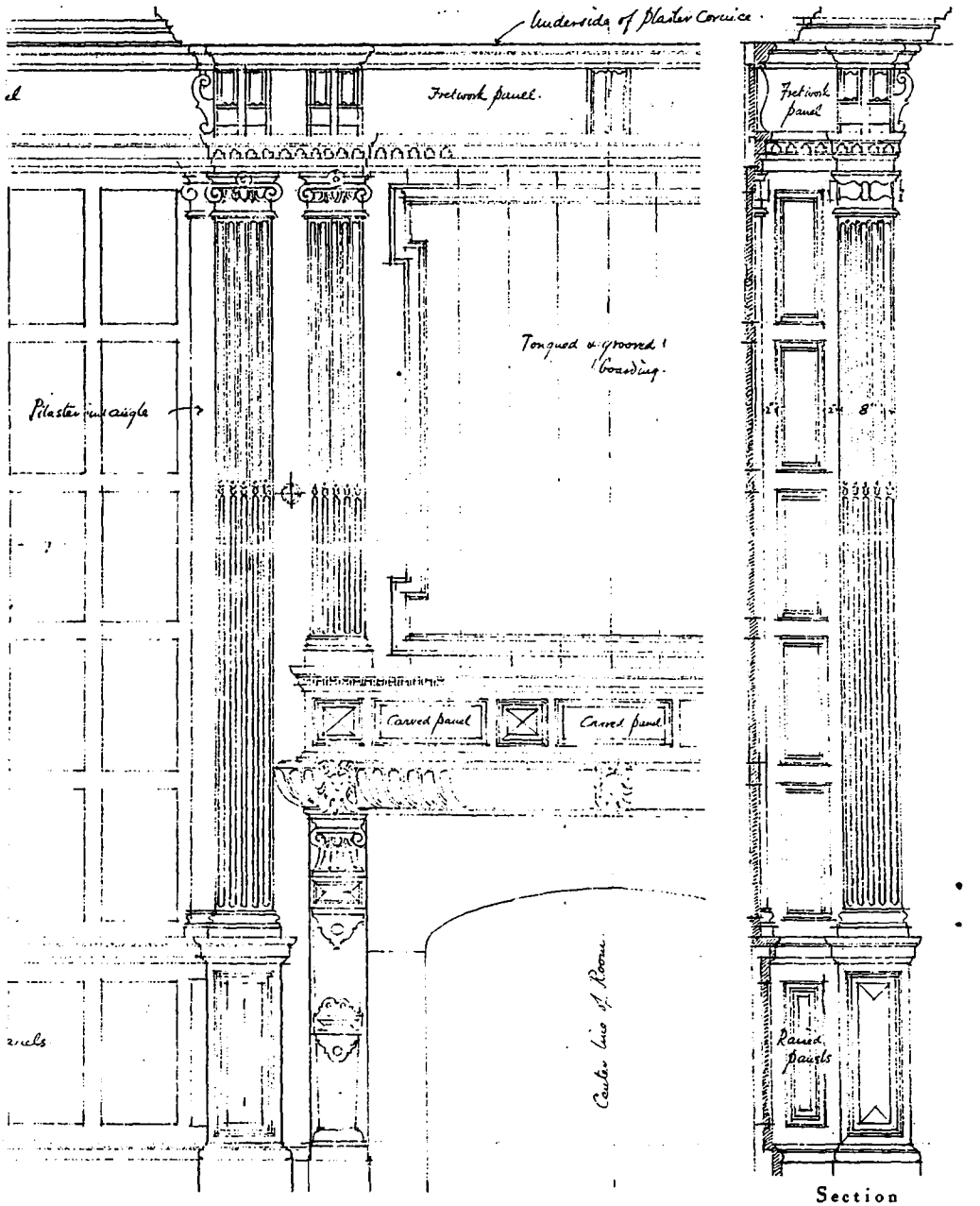
DARLING & PEARSON, ARCHITECTS.



DETAILS OF MAIN ENTRANCE.

MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONT.





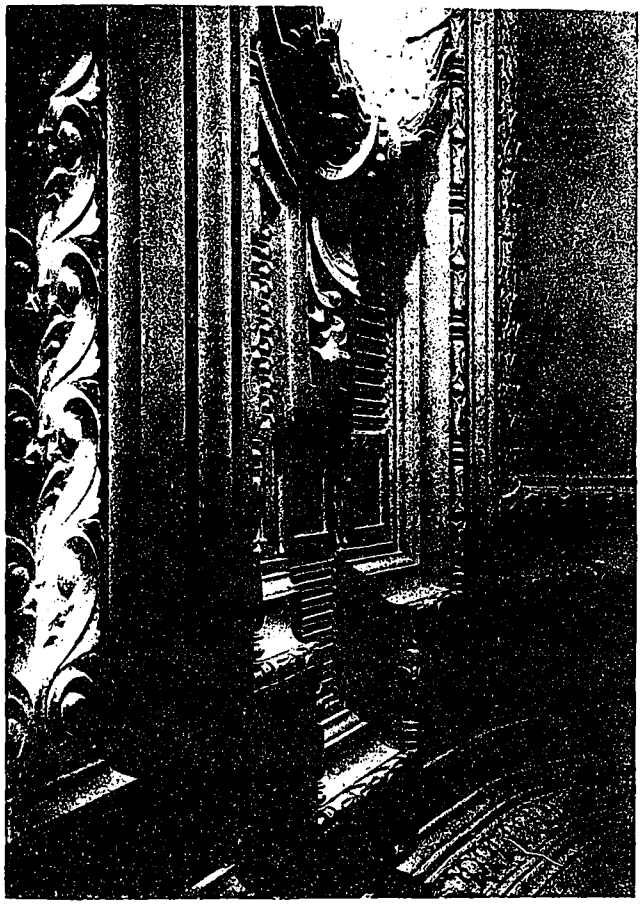
DETAILS OF FIRE PLACE.

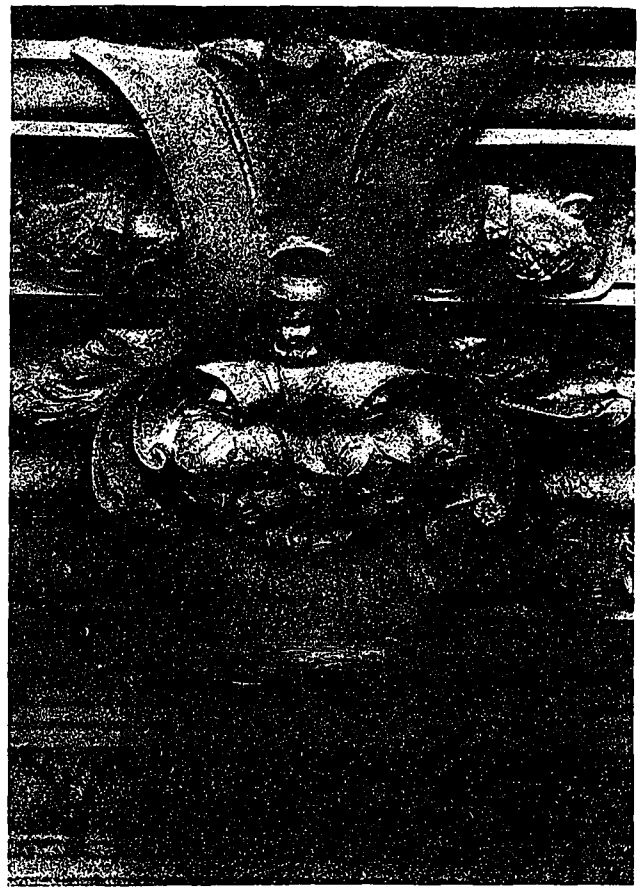
MUTUAL LIFE ASSURANCE COMPANY OF CANADA, WATERLOO, ONT.

DARLING & PEARSON, ARCHITECTS.

zens found the task a large one and committees were appointed to deal with the different phases of the work and worked in conjunction with the expert.

Among the main features suggested by Mr. Leavitt is that a wide boulevard encircling the city should now be laid out, 300 feet wide, to form the connecting link between the proposed parks. A union station is planned for all the railways, close to the present G.T.R. passenger station. Space has been provided for additional colleges and universities, public and separate schools. The expert advises that a limit to the height of all buildings is imperative. The consequences from skyscrapers must result badly for the lives of the people. The congestion of traffic, lack of proper light, poor ventilation, are only a few of the evils that may beset cities.





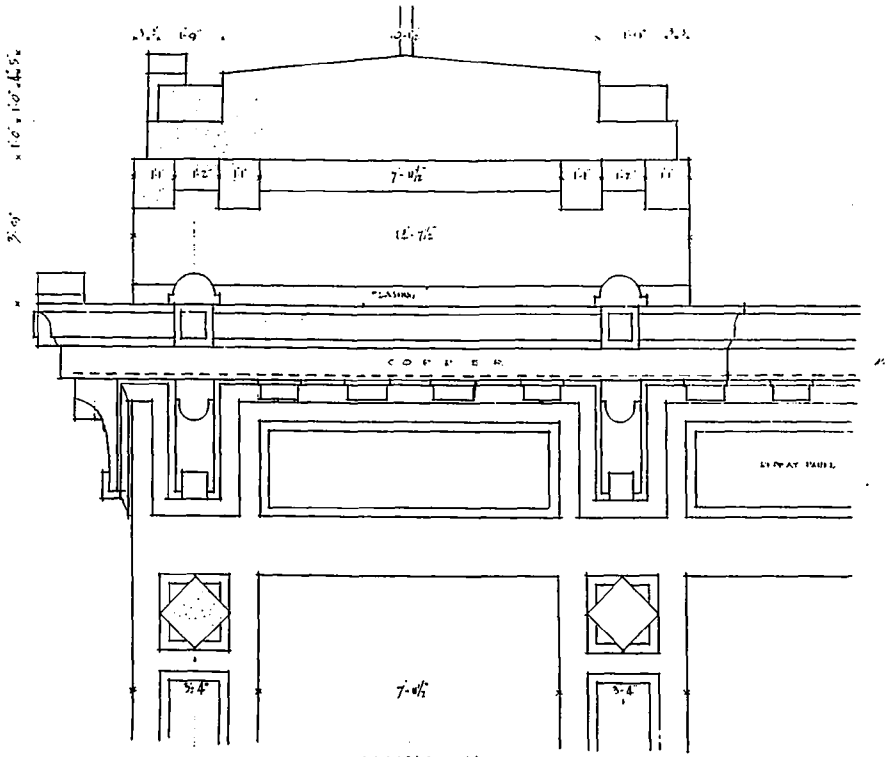
CEILING DETAILS, MAIN OFFICE.

IT IS MOST encouraging that the towns and cities of Ontario are awakening to the importance and advantages of Town Planning and Improvement. The larger cities of Canada and America have already become active in this respect. They have realized that if they are to escape the mistakes of older cities, and avoid the conditions which make possible these mistakes, they will require an active, constructive policy with respect to transportation, housing and sanitation. The time has come for national and provincial effort and for concentrated action in each community.

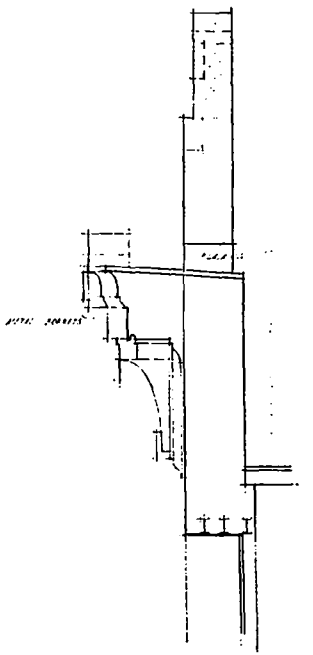
In most large cities nearly everyone has been bent on money-making, and a community thus absorbed can hardly be expected to give serious thought to the welfare of future generations or to the benefits which arise from the attractiveness of the home city. Now, however, a change is taking place. This is evidenced by the fact that over fifty Canadian and American cities have adopted some course for improvement of existing conditions and systematic plans for the future.

The general subject of civic planning embraces all of those allied subjects such as street routes and widths, depths of blocks and lots, buildings, street circulation and transportation; housing with its light and air problems, sanitation and cleanliness, railroad locations, distribution of factory areas, parks, playgrounds, boulevards and in general all matters which influence the lives of the people in the community.

The ideal, therefore, of city planning is that in which all these branches are harmonized to secure for the people of the city such conditions as will obtain a maximum of efficiency in work and of enjoyment of life; in other words, to make the city a good place to work and live in. —*C. H. Mitchell, C.E.*



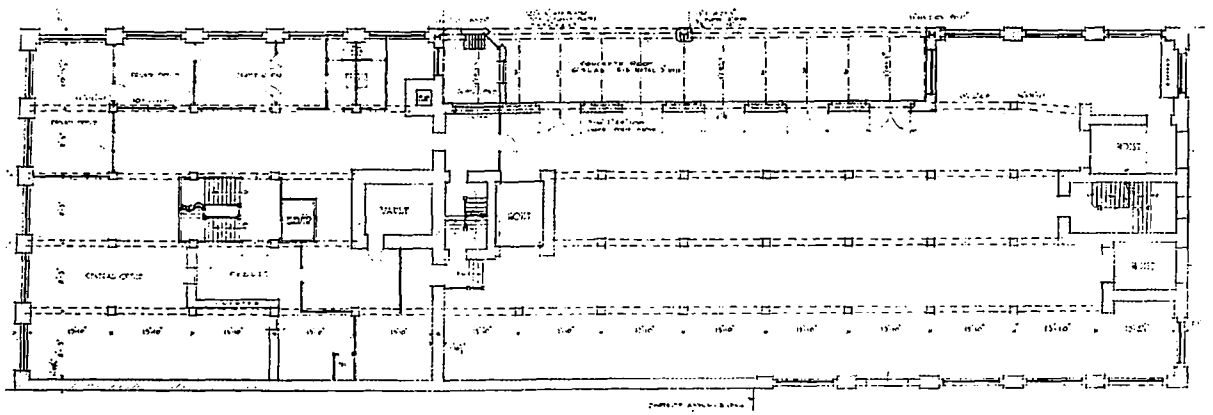
• ELEVATION •
ONE HALF INCH SCALE



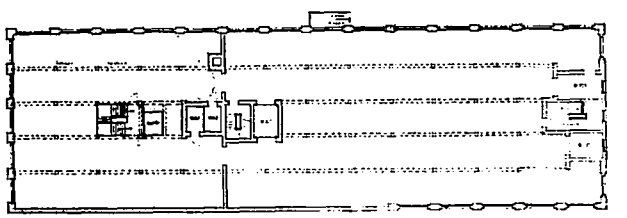
• SECTION •
ONE HALF INCH SCALE

T. J. FOY COMPANY BUILDING,
TORONTO, ONTARIO.

CURRY & SPARLING, ARCHITECTS.



FIRST FLOOR PLAN.



TYPICAL FLOOR PLAN.

Office and Loft Buildings, Toronto, Ont.

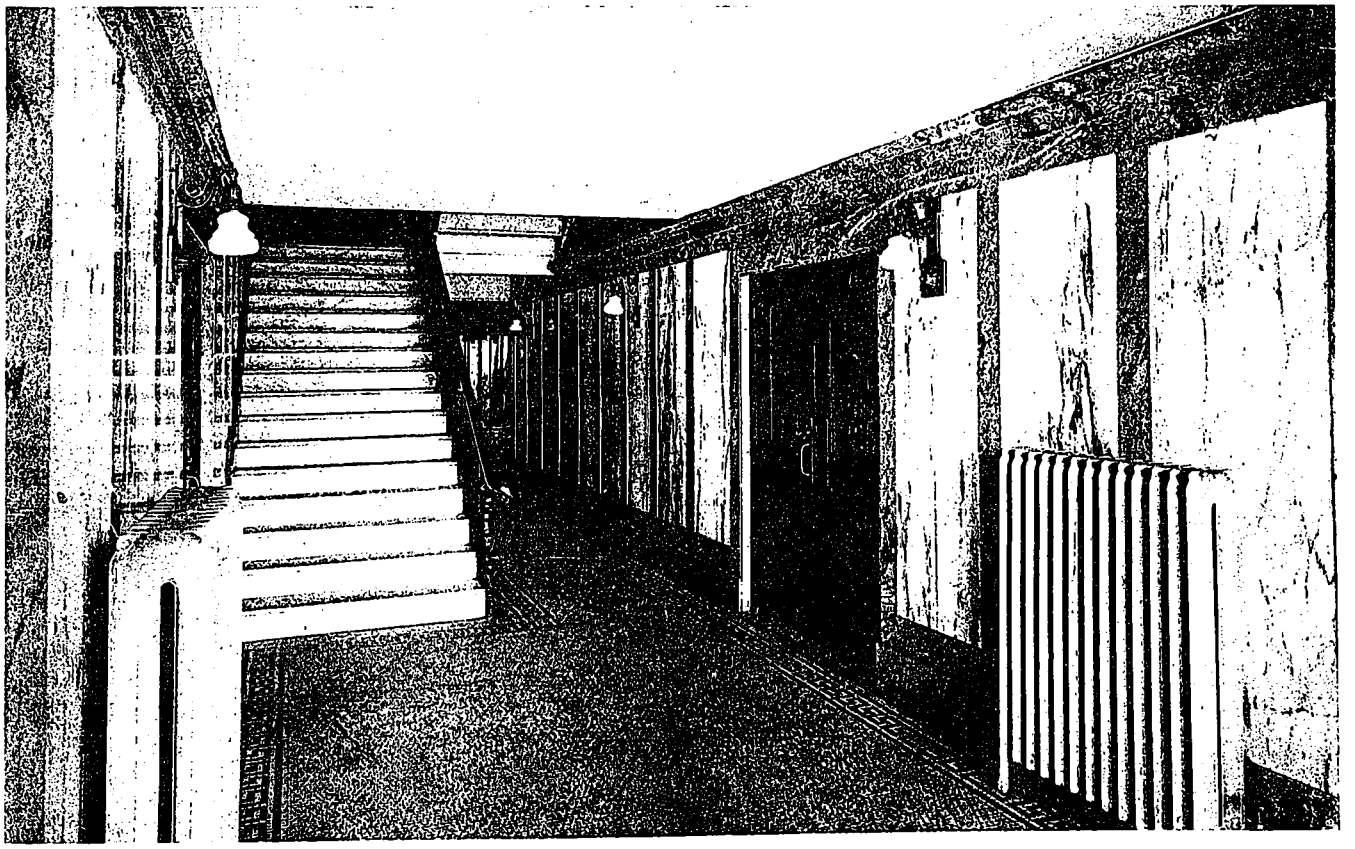
TORONTO, like the other large cities of Canada is constantly erecting all types of commercial buildings which are an important factor in the artistic appearance of the neighborhood in which they are built. Several illustrations are given herewith which are characteristic of the work being done, together with brief description.

G. J. Foy Company.—This building carries out to a large degree the necessary requirements for structures of this kind erected in the vicinity of Toronto. It is of mill construction with extra heavy posts and beams supporting a seven-eighths inch maple flooring laid on asbestos roofing material which in turn covers two by five inch spruce pieces set on edge and well spiked together. The several floors are designed to carry from one hundred and fifty to four hundred pounds per square foot, regulated by the nature of the goods consigned to each floor. For the sake of economizing space the upper part is extended over the shipping well and carried on heavy box girders. The building proper is planned with the elevators and stairways so located that the upper floors may be let to different parties with proper accommodations for each division. The front or office portion is separated from the warehouse by a heavy wooden wall with double fireproof doors in order that only one portion of the building can be affected by fire at the same time. An additional protection is furnished by the installation of a sprinkling system. The sides and rear of the structure are equipped with steel sash; the work below ground being of concrete, thoroughly waterproof. The cost of the building was $200,000.

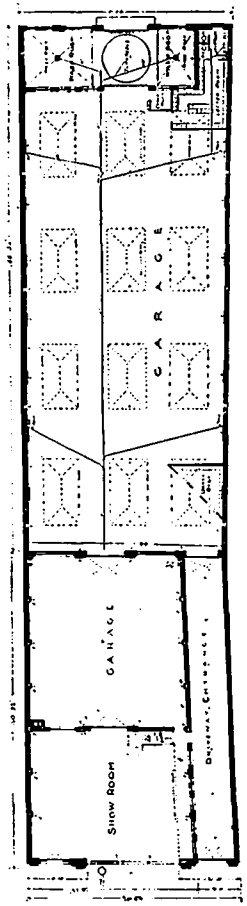
Wolseley Motor Car Company.—Erected on one of the residential streets, this building has been carefully designed in red brick and Indiana limestone. Hardwood floors have been used in the showroom with suitable trimmings. The structure is of concrete and iron construction, making it thoroughly fireproof. Lockers, storerooms, etc., have been arranged in the basement in addition to the steam heating plant. The building cost $60,000.

Crown Tailoring Company.—This building is designed in red stock brick and artificial stone of a harmonious shade. Mill construction has been used throughout, the roof being treated with asbestos. The office has been tastily handled in Circassian walnut. Sprinkler and steam heating systems have been installed. The coal in the large bin feeds itself automatically into the boiler by means of a concrete hopper floor. The cost of the building was $50,000.

Temple-Pattison Building.—The exterior is of red brick and artificial cut stone. Built of mill construction, the floors are of Georgia pine and maple with asbestos between, and designed



ENTRANCE LOBBY OF G. J. FOY COMPANY'S BUILDING.

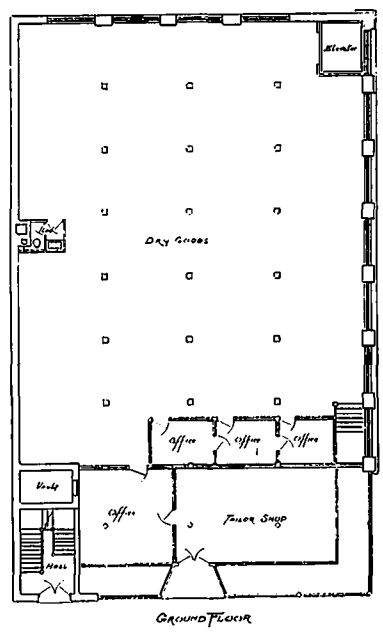


WOLSELEY
MOTOR CAR
COMPANY
BUILDING,
TORONTO, ONT.

E. J. LENNOX,
ARCHITECT.

to carry a load of 150 pounds. The windows are of steel frame; the walls plastered and painted white. Cost of building, $50,000.

Hermant Building.—Built for the Imperial Optical Company, it represents one of Toronto's latest and most up-to-date office structures. It is of the skeleton type, constructed entirely with reinforced concrete and finished in a light shade of semi-matt glaze terra cotta above the first story, which is faced with stone. The terra cotta is secured to the piers by a system of plates and anchors supporting the weight at each floor. Vertical rods run the entire height of the building, to which the concrete is anchored in every case by heavy galvanized iron anchors. In order to secure a maximum amount of light, steel mullions and spandrels are placed between the concrete columns in the front facade. The floors and stairs are of concrete finished with terrazzo; the sash entirely of steel. Passenger and freight elevators have been installed, as well as a system of steam heating. The cost of the building was $85,000.

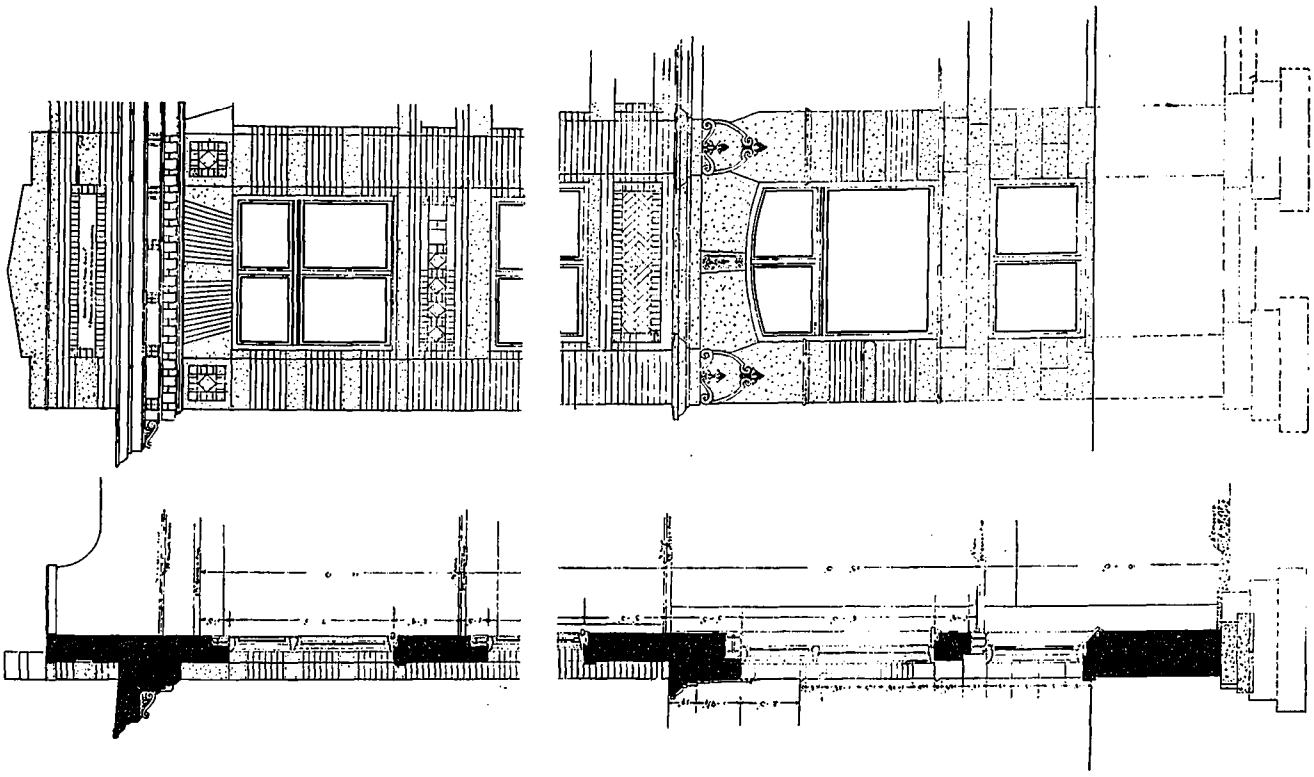


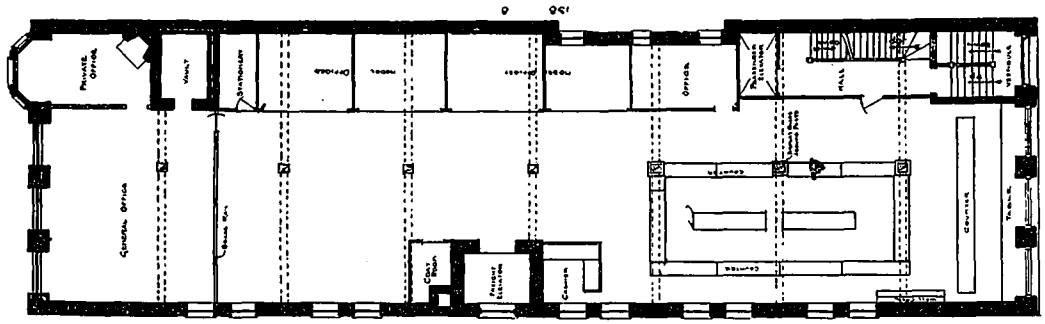
CROWN TAILORING CO. BUILDING.
C. F. WAGNER, ARCHITECT.

Chapman & Walker Building.—The design is in maroon tapestry brick and artificial stone. Built of mill construction, hardwood floors, metal frame and wire glass above ground and first floor, which has plate glass. Buff pressed brick is used for the walls of the ground floor. Cost of building, 14 cents per cubic foot.

Cooper Cap Company.—The building is of mill construction, with exterior of red pressed brick, artificial stone trimmings, and gravel roof. Upon the interior the offices are of quarter-cut oak, all other floors being of maple. Vaults are supplied on all floors; freight and passenger elevators; sub-basement for heating plant under driveway at end of building; vacuum and low pressure heating systems. Cost, $70,000.

Buildings of a similar character from other cities will be illustrated during the coming months as a stimulus to better work.

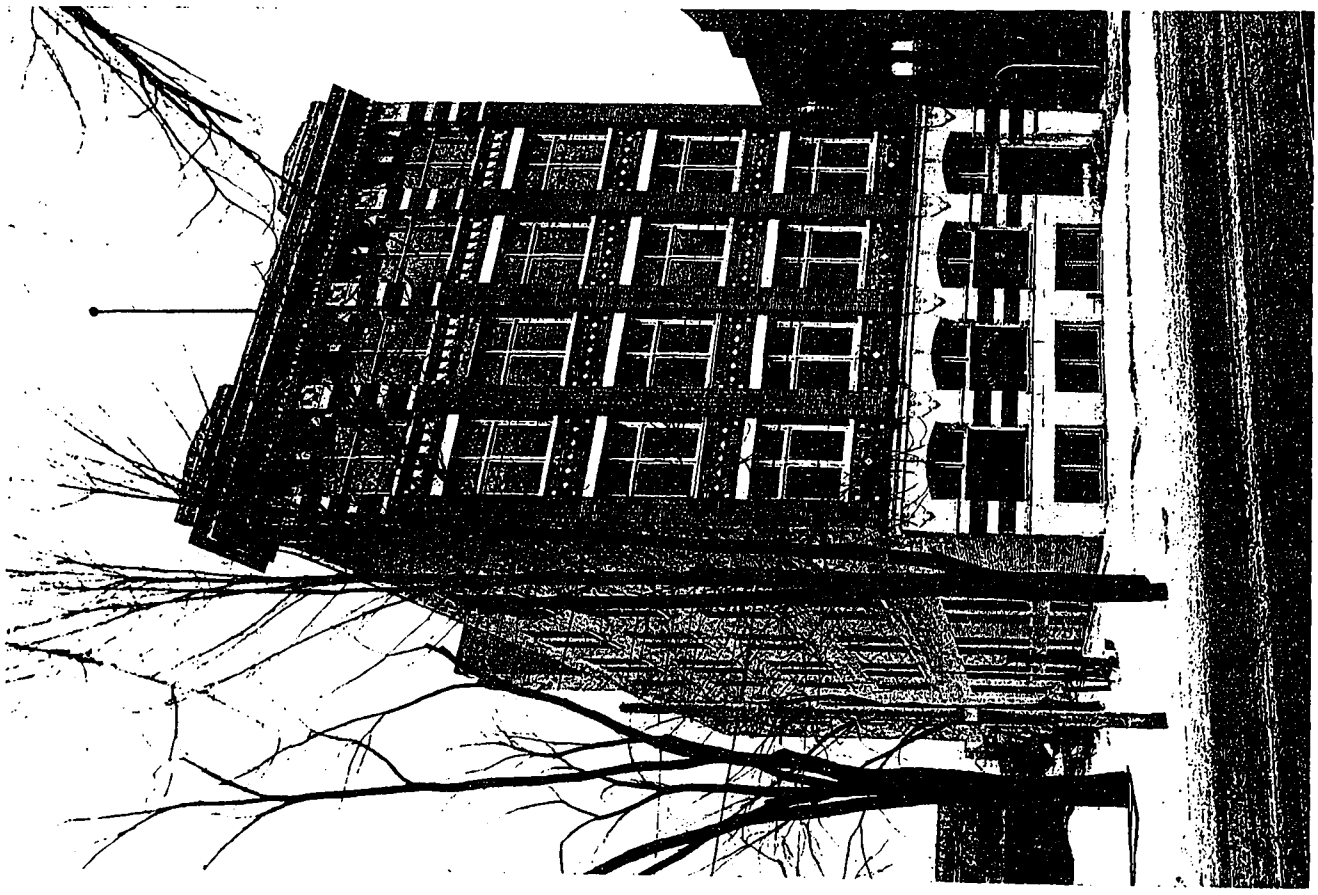


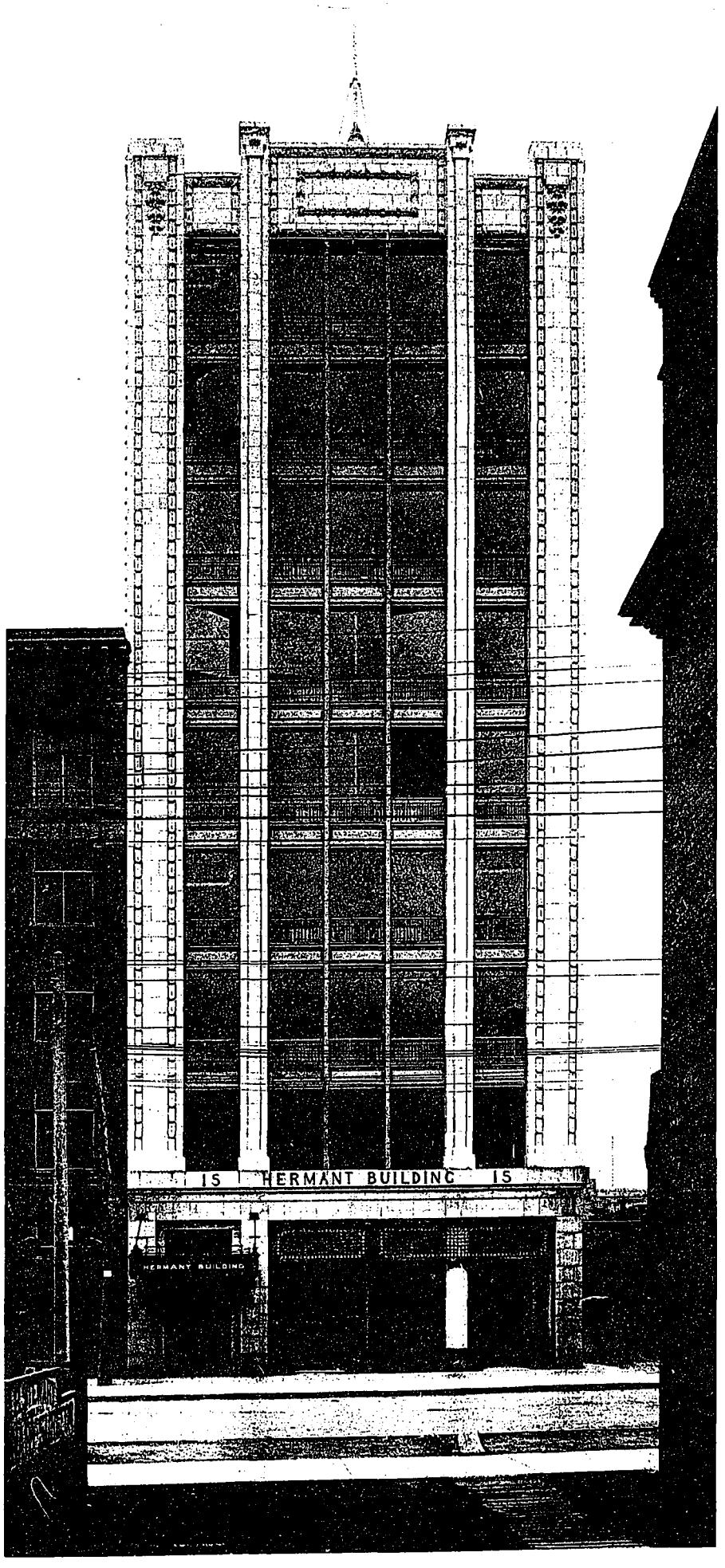


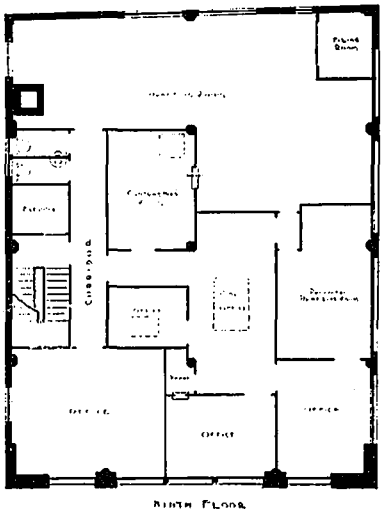
Ground Floor

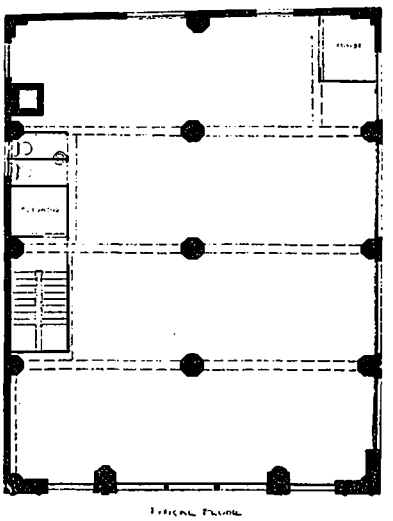
TEMPLE-PATTISON BUILDING. TORONTO, ONT.

DENISON & STEPHENSON, ARCHITECTS.



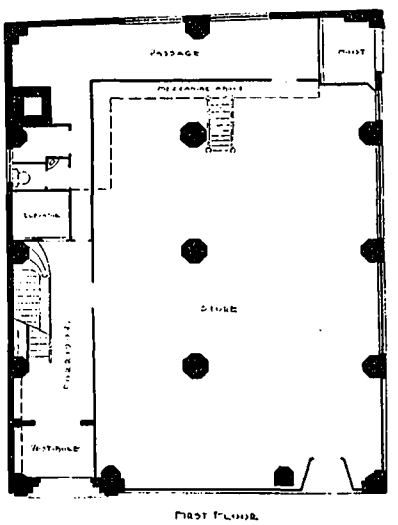


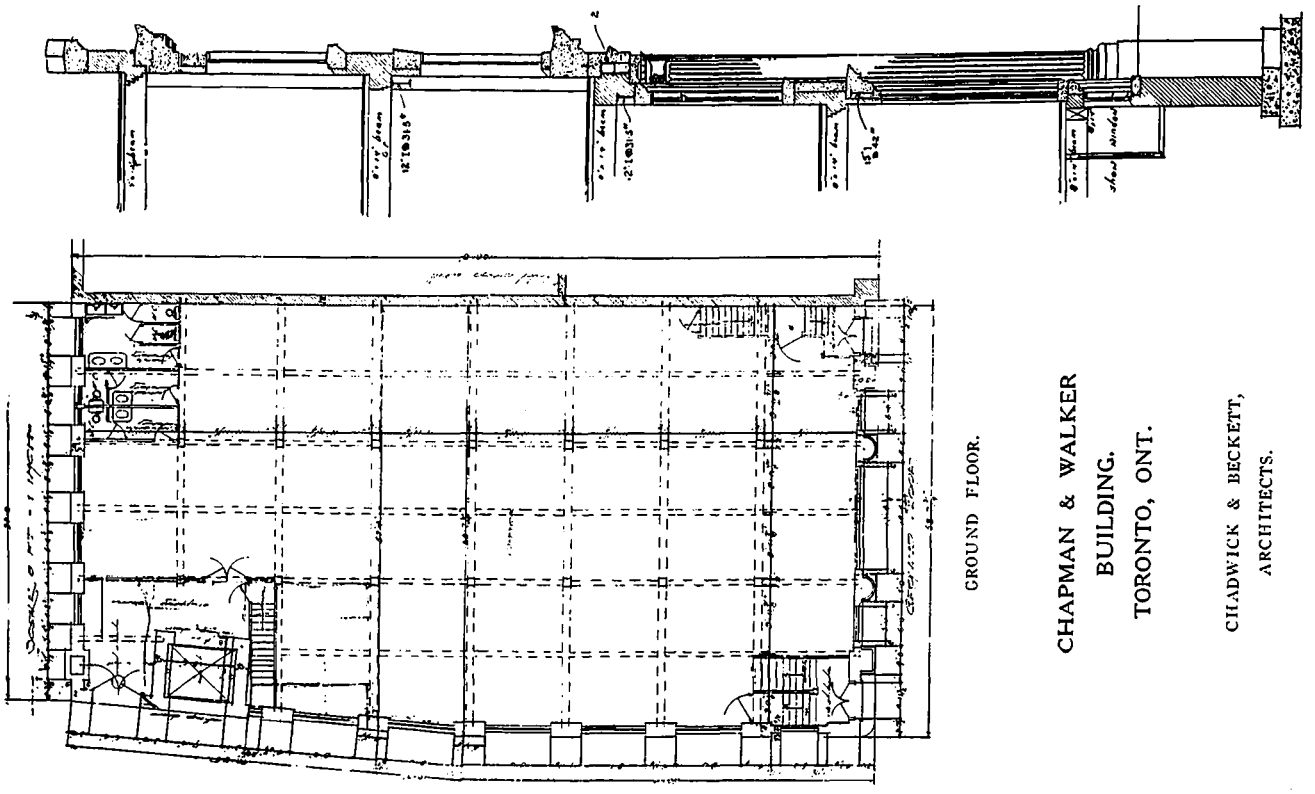




HERMANT BUILDING,
TORONTO.

BOND & SMITH,
ARCHITECTS.

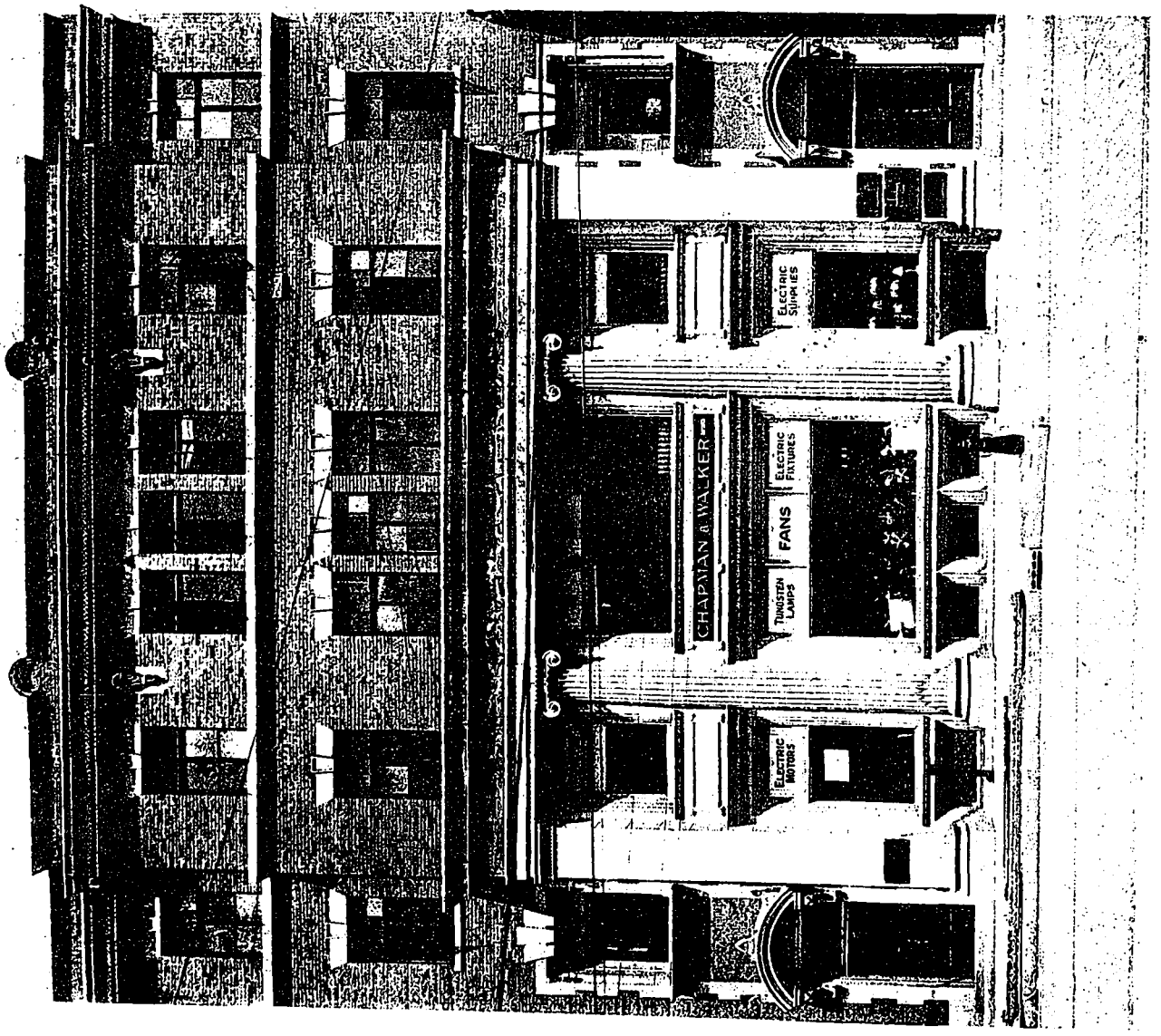




GROUND FLOOR.

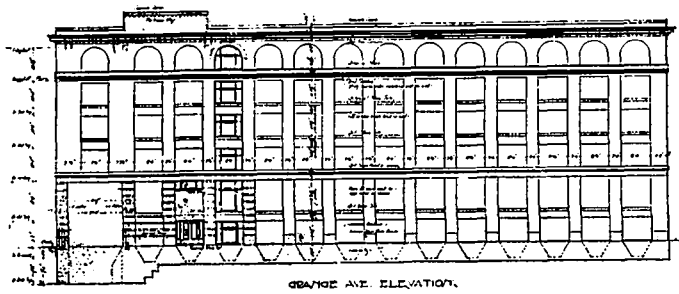
CHAPMAN & WALKER
BUILDING.
TORONTO, ONT.

CHADWICK & BECKETT,
ARCHITECTS.

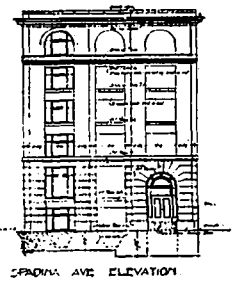


COOPER CAP COMPANY
BUILDING,
TORONTO, ONT.

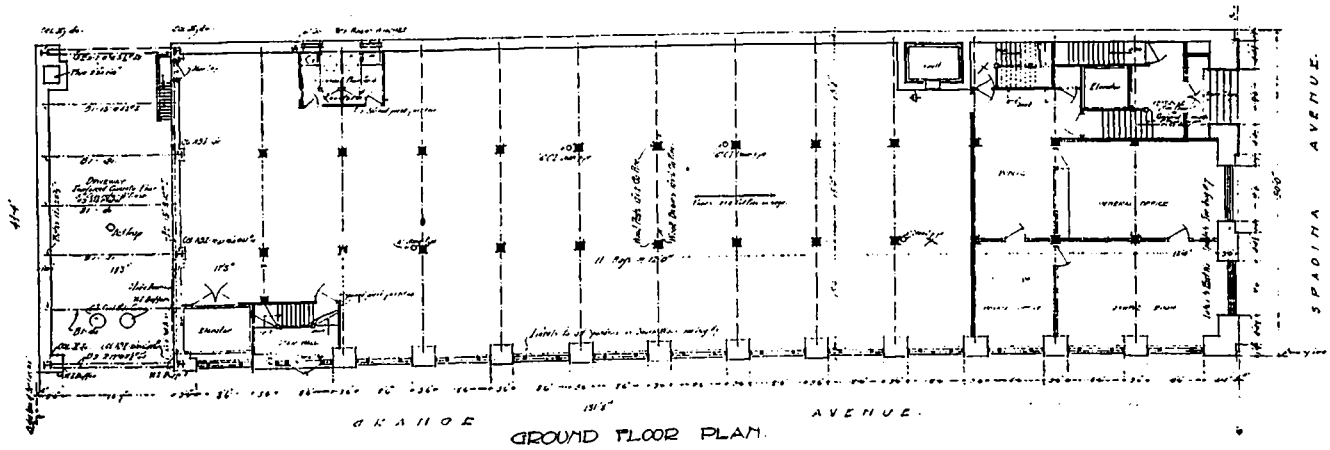
I. FELDMAN,
ARCHITECT.



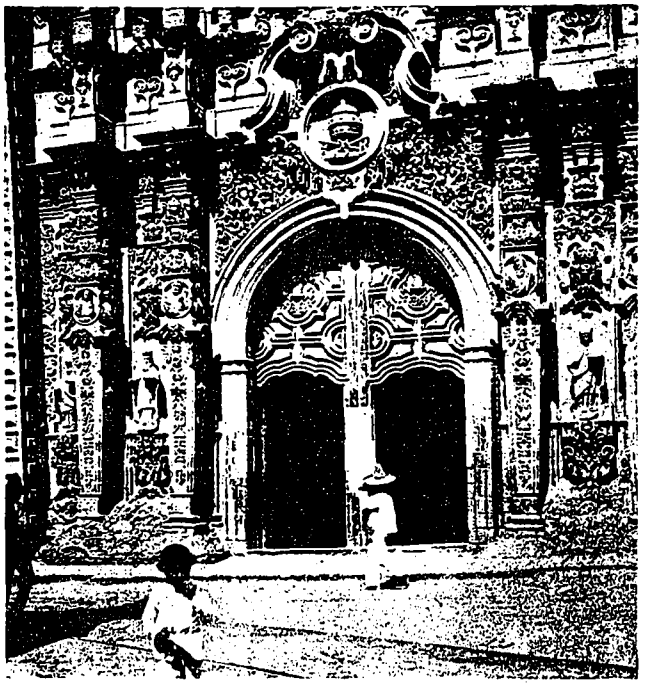
GRANGE AVE. ELEVATION.



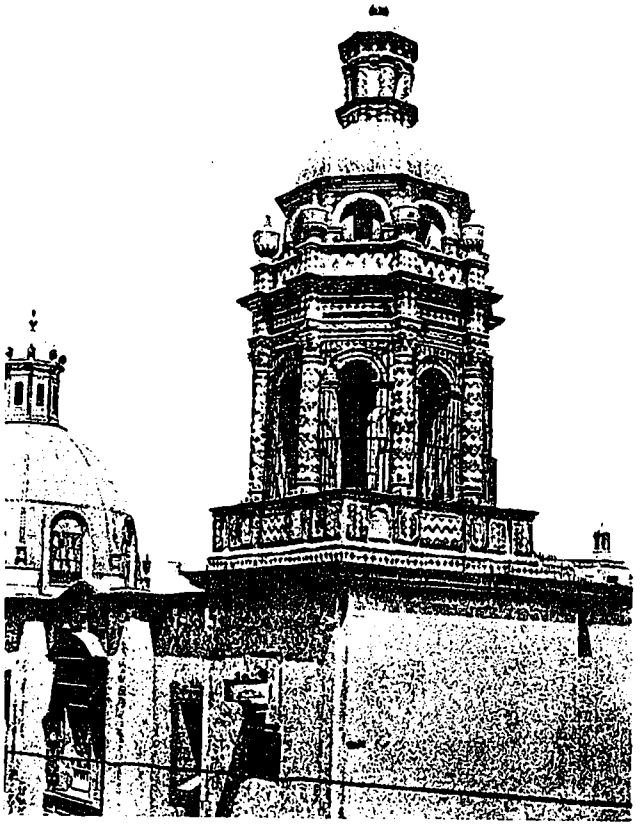
SPADINA AVE. ELEVATION

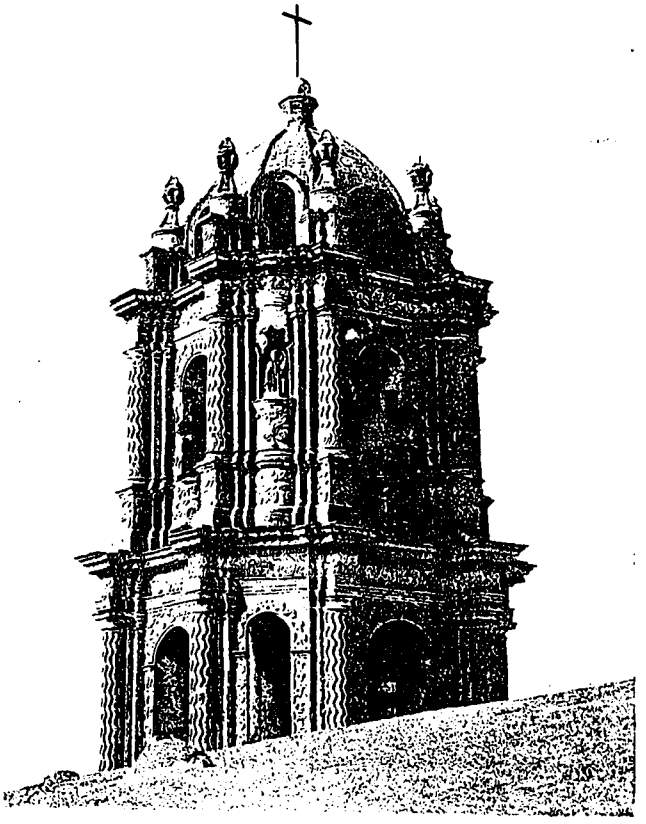


GROUND FLOOR PLAN.



DETAILS OF ARCHITECTURE
ILLUSTRATING ARTICLE
ON MEXICO
BY
F. R. MAJOR.

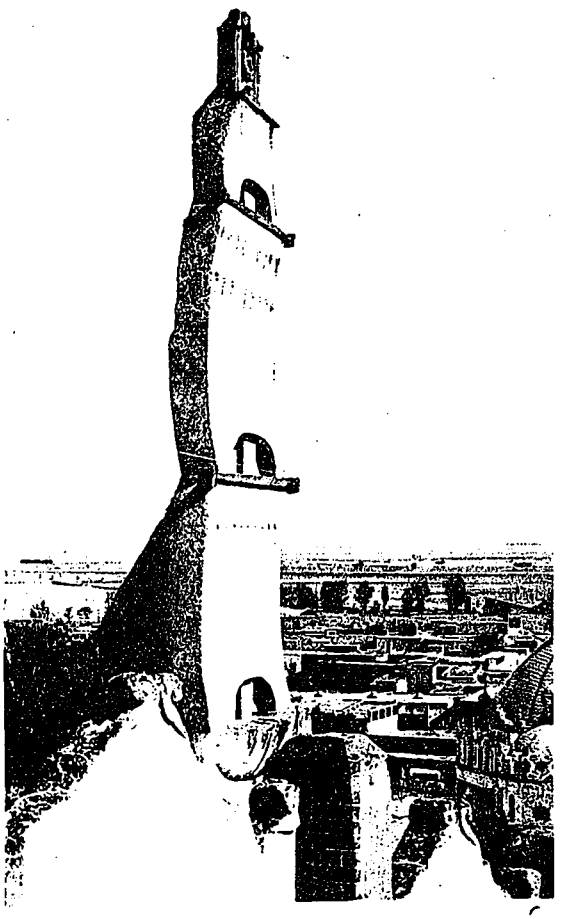




Mexico of Yesterday and Today

F. R. MAJOR

"FROM what I have seen and heard concerning the similarity between this country and Spain, its fertility, its extent, its climate, and in many other features of it, it seems to me that the most suitable name for this country would be New Spain." Thus wrote Cortez, the Spanish conqueror of the Aztec empire. He also wrote of its teeming markets twice as large as the one in Salamanca, surrounded by arcades and the great temple of which no human tongue could adequately describe its greatness and beauty, the principal tower being higher than Giralda in Seville. From the early part of the sixteenth century until Hidalgo, in 1810, raised the first cry for freedom, Mexico was drained of its wealth by Spanish rulers. In 1825 Mexico became free to work out her own salvation, and for some fifty years she endured internal strife, emerging under the constructive work of Porfirio Diaz. During the reign of this great man the population increased from nine to nineteen million; the railways from four hundred to fifteen thousand; the unwieldy tribes into a united people and vast commercial enterprises. While such prodigious results seem to have met a reverse in the present internal struggle, still it is only a natural result of a young nation and will eventually terminate in a solidarity of spirit and feeling that will bring about a brighter and more glorious progress than experienced under the potent personality of Diaz.



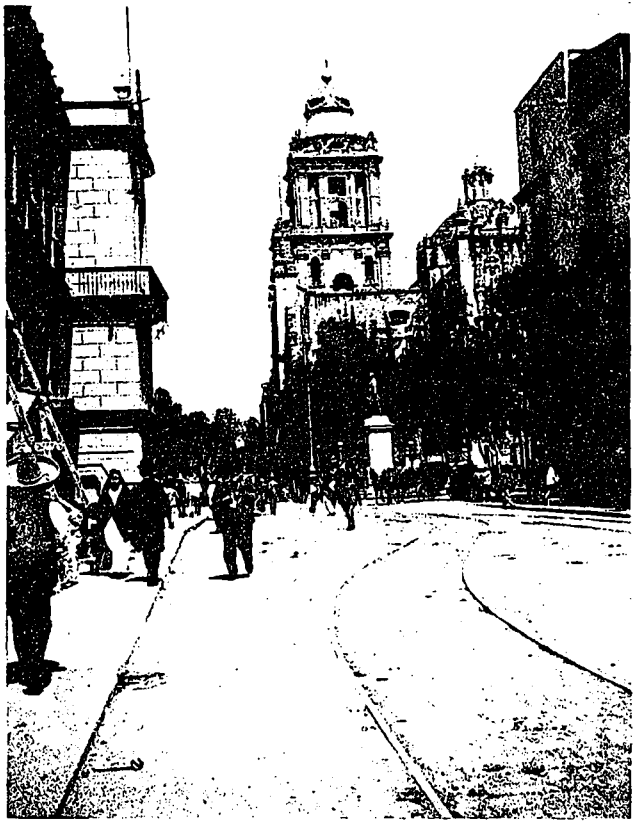
STONE SAILS.

Characteristic of all Spanish nations, Mexico takes your thoughts back to the mother country. The life—manana—the religion, the art, all are indicative of the traits of the people who discovered America and who at one time ruled the civilized world and a large portion of this continent. The church, the barracks and the Government house form the square from which radiates all other life. The houses themselves look as if they sprung from the plans of Spanish builders; the interior patio with gallery over wide entrance and grilled windows. The Government furnishes free to the people serenatas, for everybody is fond of music. Promenading round the public square, the citizens enjoy life in the free and easy way so natural to Latin races. In some cities two promenades are provided, one for the elite, the other for the Indian class, and each enjoy their own wholly indifferent to the presence of others.

Two ways are open to the Mexican traveller. one across the arid plateau of the north, with its scattered cities replete with interest; the other by way of the Gulf of Mexico to Vera Cruz, a city of beauty as beheld from the water, towering above Ulna, the last stronghold of Spain. By taking the latter route it is necessary to pass through the intervening plains and mountains until we reach the Great Plateau, upon which is found the famous Valley of Mexico and its famous capital. First we find a region of perpetual summer with its tropical trees, fruits and flowers, rivers and lagoons all enriched by the birds of variegated colors. From this hot and malarious country we wind among the awe-inspiring rock formations until we reach a different country on the summit above.

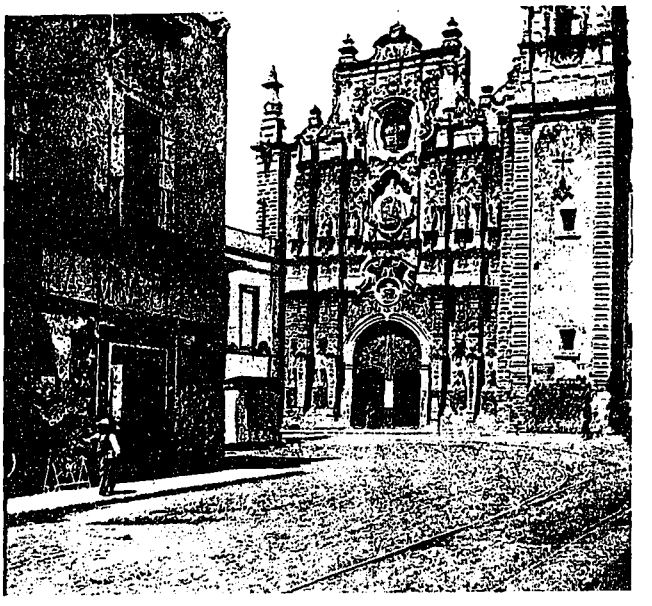
The City of Mexico is not only beautiful in her natural environment when viewed from afar, but is an exceptionally attractive city from within. The image of a primitive state is soon dispelled through the architectural merits of her public buildings as well as the extent and character of her boulevards and parks. Built over the ruins of Fenochtitlan, pride of the Aztecs, she has maintained her Spanish feeling, the principal streets lined with shops, churches located in every part of the city—one hundred and twenty—picturesque facades to the house with patios and fountains within. The great cathedral is four hundred feet long with the main facade finished

in the beginning of the nineteenth century and composed of the Doric, Ionic and Corinthian orders, upon the interior are twenty large Doric columns, while the walls are covered with old pictures, one being a Murillo and one a Velasquez. The building stands as solid as ever, although suffering from earthquakes and built upon soft soil which has affected other buildings. The Paseo de la Reforma, when the military band is playing and the display of fashions is opportune, presents a wonderful study with its smooth roads, trees and magnificent vista terminating in the heights of Chapultepec. Here stands the equestrian statue of Carlos IV, weighing twenty-two and one-half tons, by Manuel Tolsa. Another statue of greater fame



commemorates the heroic defence offered by Cuauhtemoc in 1521. Above two fine bas-reliefs are the names of Indian patriots surmounted by a bronze Indian with spear uplifted.

Some interesting engineering problems have been worked out in Mexico, as will be seen in the following description: "The position of the city of Mexico near Lake Texcoco, which receives the waters of all the other lakes of the system, has ever rendered it liable to inundation, and to a saturated and unhealthy subsoil, conditions which, were it not for the healthy atmosphere of the bracing uplands whereon the valley is situated, would surely make for a high death rate. The drainage and control of the waters of the valley have formed matters of thought for Mexico's successive Governments for more than four

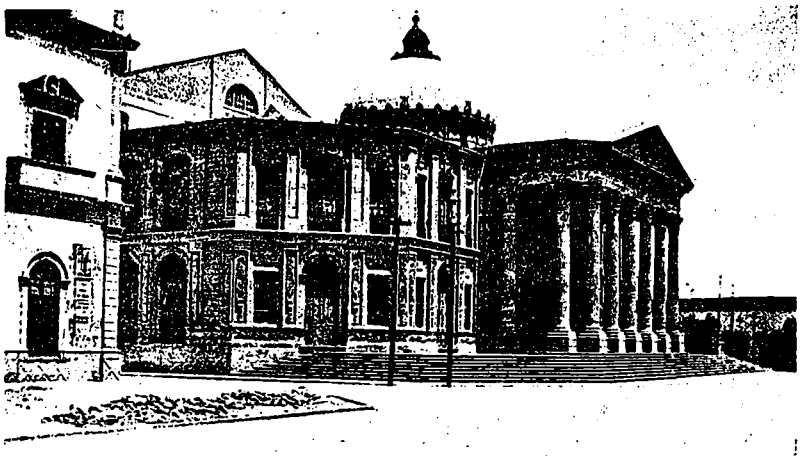


centuries. Work to this end was begun under Montezuma in 1449. During the colonial regime further works were undertaken, in 1553 to replace those destroyed by Cortes, followed by other works in 1604 and 1708. But only after the Republican regime was established was the work carried to completion, upon a plan brought forward by a Mexican engineer. These works, which were mainly carried out during the closing years of last century by English firms of engineers and contractors, consist of a canal and tunnel. The canal is thirty miles long, flowing from the city and bearing its sewage and storm-waters, and taking the overflow from Lake Texcoco; and discharging thence into a tunnel, perforating the rim of the valley, about six and a half miles long. This in turn empties into a discharge conduit and a ravine, and the waters, after having served for purposes of irrigation and for actuating a hydro-electric station, fall into an affluent of the Panuco River and so into

the Gulf of Mexico. This work, which is the climax of the attempts of four hundred years or more, reflects much credit upon its constructors and upon the Government of Diaz, which financed it at a total cost of sixteen million Mexican dollars.

How often a country and its people are misjudged by the talkative and all important critic who bases his opinions on a few impressions obtained in the principal city of that country. It would be just as ridiculous to judge Mexico by a hasty visit to its capital as it is to hear others tell of French morality and stability when they have only had a superficial touch of Parisian life. No, the only way to appreciate a people is to visit the various cities, travel through the rural sections and learn to know the classes which form the

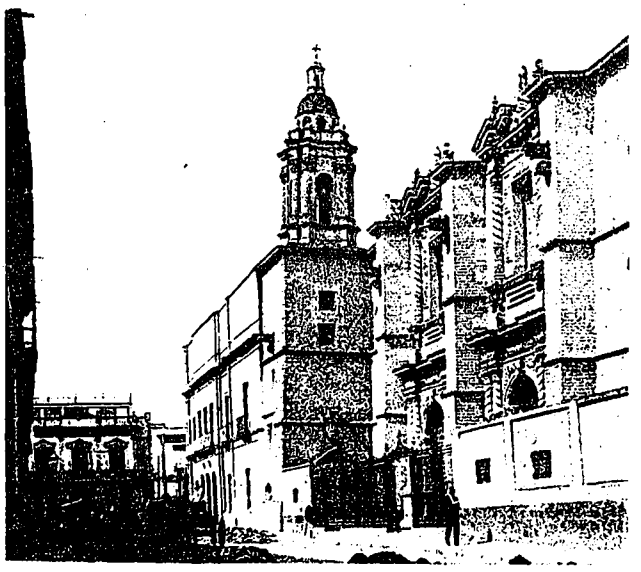
backbone of any nation. The traits and customs of the people change in ratio to the diversity of climate and to elevation of the country. In many places we may journey in a few hours from the tropical lowlands to the regions of pine and oak, and the cold and cloudy climate of the high mining districts. There is the tropical regions around Vera Cruz, where palms shelter the adobe houses enriched in turn by flowers of all colors. Between here and the capital city we have deep gorges and hills covered with cactæ, hibiscus, oleander, gardenias, etc. Then there is the great plateau extending from the north and tapering southward until it terminates in the valley of Mexico, encircled by volcanic hills. Leaving the great plateau on the west, we descend rapidly and the bitter cold of the uplands soon gives way to the vegetation of the torrid zone. To the south, in the State of Guerrero, the country is rugged and wild, a region alive with interest to the archæologist, the botanist, the ethnologist and the sportsman. As one author puts it, "Away from the main route of travel lie sequestered old sugar estates, and villages of romantic and picturesque charm, yet untouched by speculator or capitalist. Antique piles of stone buildings are there, redolent of that peculiar poetry of the pastoral life of Mexico in the tropics. The old Spaniards built well; their solid masonry defies the centuries; and their most prosaic structures were invested with an architectural charm which the rapid money-seeker of to-day cares little for, in his corrugated iron and temporary materialism. Near to the arches, columns and turrets of the old haciendas the garden lies, replete with strange fruits and flowers."



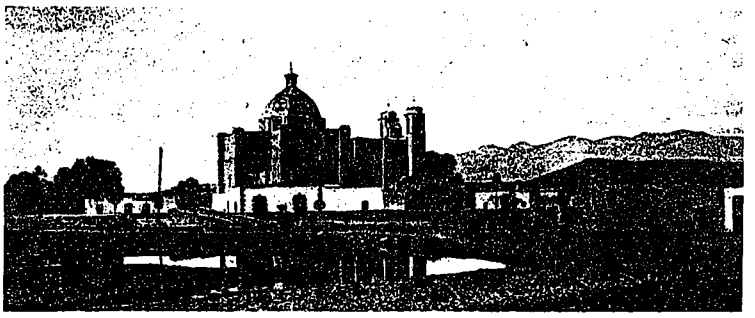
Morelia, situated to the west of Mexico City, lies upon a hill reached by gradual slopes and known for its many plazas and perfection of landscape gardening. Among the churches is the cathedral, with its decorative towers and graceful outlines, surrounded by trees and open space, and the Las Monjas, which forms an interesting grouping with the girls' college on one side and the barracks on the other. The short trip from here to Patzcuaro extends through rolling prairies and high mountains, from which place it is easy to reach Tzintzuntgan with its old church tower showing above the olive trees and its attractive ruins of old palaces.

Queretaro, of unusual historical interest, is about six hours' run from Mexico City, cleanly and picturesque, with a height of six thousand feet. Her churches are unusual and she is equipped with a hospital, orphanage, five schools, state college, etc. The Church of Santa Rosa has an Oriental feeling with tower, dome and quaint flying-buttresses. Upon the interior the gold and green ornamented side altars are by Tres Guerras; the sacristy has a large painting depicting the old convent garden and the nuns among the flowers. Here also is the famous patio of the Federal Palace with its fountain, corridors of rose-colored local stone, tastily carved. In the Plaza de la Independencia is a finely carved statue by Guillen of the Marques in noble proportions and life-like pose. In mentioning the aqueduct of Queretaro it is best described in "The Man Who Likes Mexico": "Another example of wonderful building is the great aqueduct which brings an abundance of crystal-clear water to Queretaro. First you must see it by day. Note its seventy-two arches, the centre one more than sixty feet in the clear, and its great length of over six hundred meters. Then go again at moonrise. The arches cast their long shadows across the quiet valley and the ruined hacienda lies white and silent in the moonlight. Aqueducts lend a certain stateliness to a city, like that given a mansion by a long approach between rows of trees. They are monuments to courage, skill and untiring labor and they confer on the city to which they pay tribute, all the dignity that these terms convey. Queretaro owes her aqueduct to her noble benefactor, the Marquis de la Villa del Villar del Aquila, who gave $88,000 from his private purse. The total cost of construction was something over $131,000. It was begun in 1726 and completed nine years later."

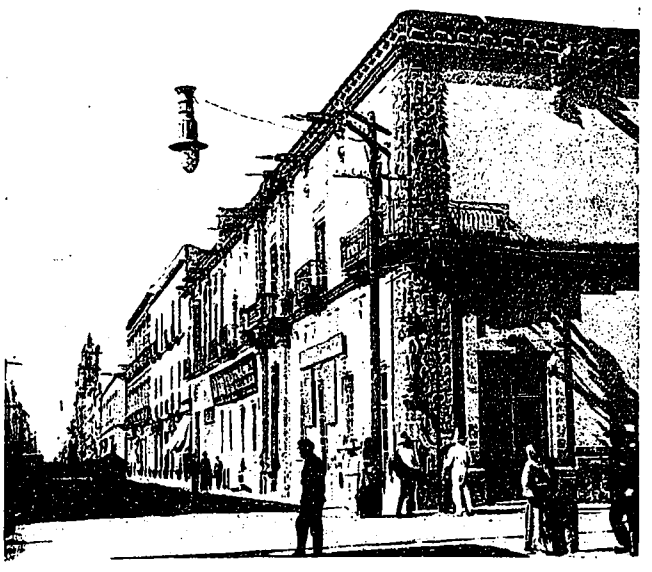
Guanajuato, a short distance from Queretaro, is most picturesquely

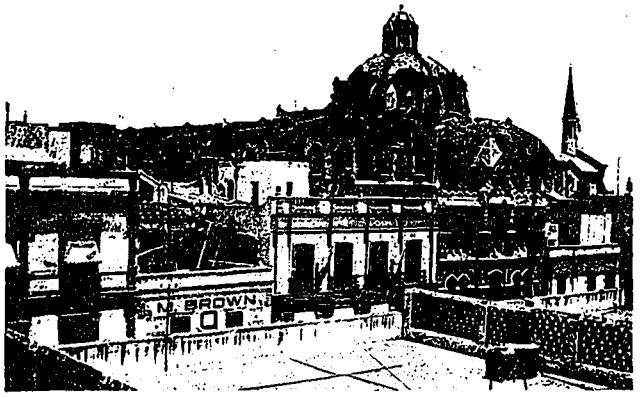


situated in a canyon of the Sierra of Santa Rosa, and on the sides of its steep hills. The streets are extremely narrow and form a maze hard to unravel. In addition to a number of tasty architectural residences; a fine city park; the historic palace of the Granaditas, costing over two hundred thousand dollars, there is the Juarez theatre. This building is constructed of local stone in three shades—gray, rose and light green—which form a perfect symphony in connection with the bronze ornament and figures. Upon the interior the walls and ceiling are a mass of colored ornament, the hangings of crimson velvet and gold. In planning this theatre arrangements were made to run the baggage street cars underneath the stage. The entire cost was $800,000, of which the furnishings for the foyer alone amounted to $30,000. The houses are built of a local freestone which is easily worked and hardens by weathering.



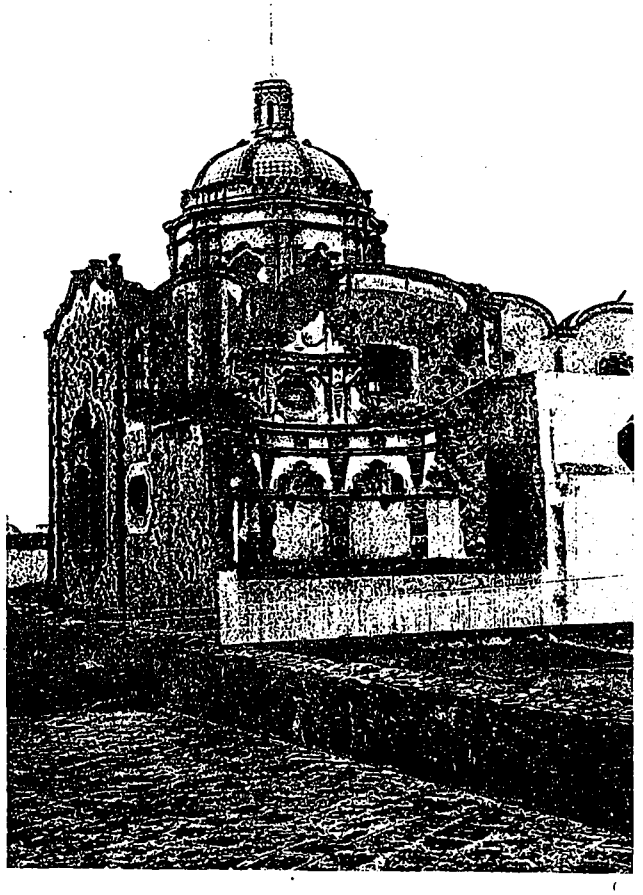
Scattered throughout the mining regions are many ancient and ruined churches. In many cases the miner was not content to build his memorials above ground, but erected chapels and images in the caverns where he worked. An excellent example of an underground shrine is at Guanajuato, where two hundred candles light up the gloomy depths. Obregon, however, built the fine Church of Valenciana in this city at a cost of one million dollars in return for his great strike in the mine bearing the same name. Here also the Marquis of Sardaneta erected the buildings



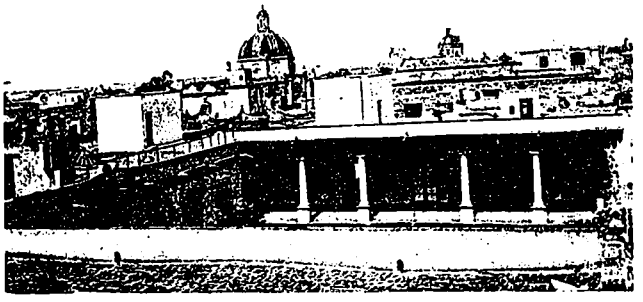


of the Rayas mine with features of flying buttresses, massive walls, and sculptured portals. Instead of rough props for sheds he used arches, pillars and walls of solid stone, cut and carved with sculptured images above the entrances.

From Queretaro it is a delightful trip to Guadalajura, "the home of the friendly," in the State of Jalisco, bordering the Pacific Ocean. It is a city where the citizens spend their evenings mostly out of doors or else have the homes wide open for the nights are warm. The band furnishes music in the evenings on the Plaza de Arms, which is quite similar to the breathing spots of other cities. Facing the plaza is the cathedral with its pointed towers and the Governor's palace, a fitting background to the palm garden whose benches are shaded with orange trees. This city has over 100,000 population and is well known for its large number of artistic buildings, public monuments and religious institutions.



The ride from Mexico City to Puebla, the "City of the Angels," is fascinating with the ever changing scenery and scent of flowers and pine timber. The freedom and cleanliness of the city impresses one while the various points of interest are unusually attractive. In commenting on Puebla, Mr. Gillpatrick says he did not appreciate the cathedral at first, but to use his own words: "I ended by enjoying Puebla's cathedral. The rains had washed the marble figures of the saints snow-white, and made the gray building-stone more sombre. I place a great deal of importance on color in buildings and their surroundings. In this connection I



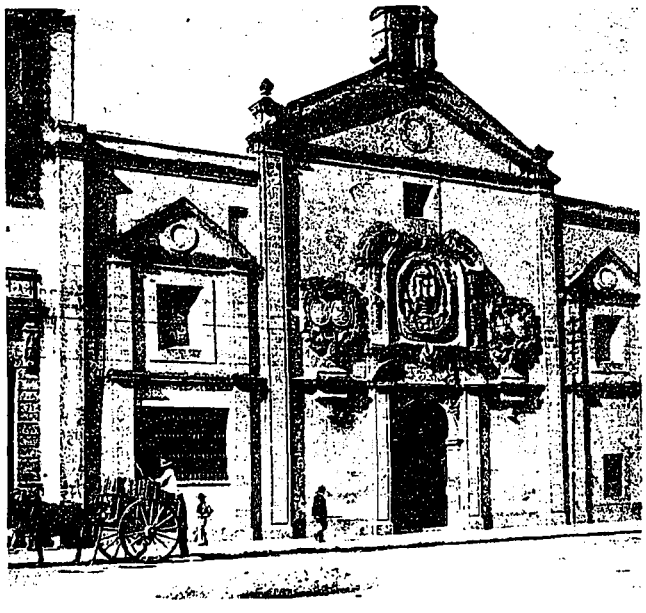
fancy cloudy skies and dull gray days suit this cathedral better than the golden light and the bright blue heavens that seem the fitting environment for Morelia's. I never realized until now how I had unconsciously allowed these great churches to make for me the atmosphere of their respective cities. Mexico's cathedral is big, massive, commanding, generous and spreading, rather than towering in its proportions. That of Morelia has something fairylike about it; its romantic beauty seems to dominate the half tropical city, with its silent houses, sleeping gardens, and air of mysterious repose. Puebla's cathedral is cold, severe, magnificent. It towers to heaven. While Mexico's cathedral bells make a deafening tumult, cheery withal, and Morelia's bells are silver chimes, the bells of Puebla's great temple are deep-toned, solemn, austere. The city itself is dignified. The people have an air of quiet composure and there is little evidence of frivolity." Here also are to be seen the exceptionally rich tapestries given by Carlos V of Spain, which adorn the sacristy of the cathedral.

The hospital of Puebla is an enormous and very splendid structure, filling the whole of one square. The entrance is adorned with a row of superb columns, and the front of the central or main portion is entirely of red, yellow and black bricks, disposed in an agreeable design and making a fine color effect. The other edifice of first importance is the Palacio Municipal, an elabor-

ate structure of gray stone, fronting on the plaza. Puebla's houses are famous for their tiles, which give a picturesque variety of color, peculiar to this city alone. Often the fronts are of bright glazed tiles, with overhanging cornices of stone, elaborately carved and pointed. You get the impression that the old residents were magnificent in their tastes; though such profuseness of ornament in building could only have prevailed where labor cost little. Many of the houses, where not of tiles, are painted in delicate colors. I saw one which was a fine old rose, with its wide, richly carved cornice and balconies painted white. The balconies were filled with geraniums, which made a blaze of color.

Two monuments of merit are found in Puebla; one a plain gray stone shaft with the bronze figure of Nicolas Bravo and an angel of victory about to crown him with laurel; the other is a marble shaft with bronze figures clustering about it. Near to Puebla is the pyramid of Cholula, on which is built the graceful Church of Nuestra Senora de los Remedios.

From Puebla to Jalapa is several hours' journey through a level country up to a tableland which descends again through beautiful scenery. The mountains back up the city with her terraced garden plaza and fountains. The homes in Jalapa are mostly low houses of cool shades like light blue, terra-cotta and white; those on the outskirts have walled gardens containing coffee shrubs and banana trees. The cathedral is quite a picturesque structure, as is also the large imposing city market, surrounded



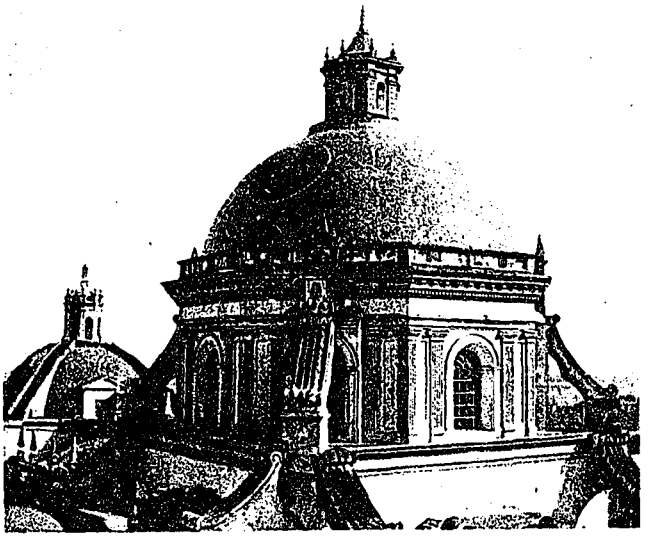
by broad corridors, fine arches, and entrances between rows of massive pillars.

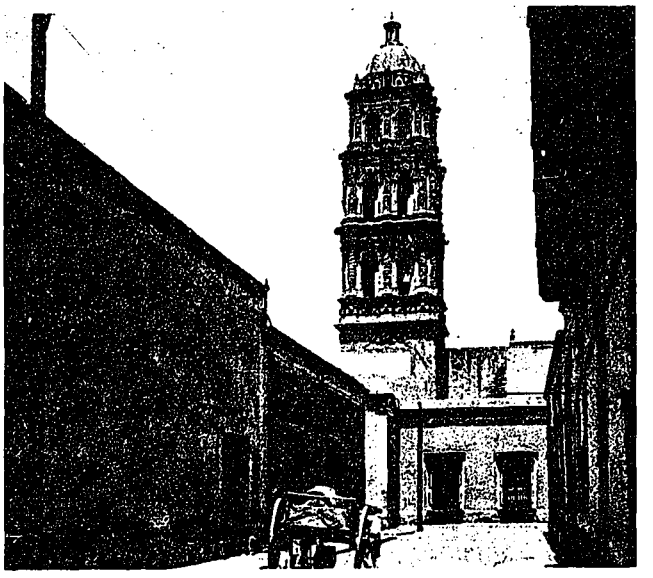
At Tlaxcala, midway between Mexico City and Jalapa and just north of Puebla, is an old palace dating from the sixteenth century, revealing some beautiful stone carving about the entrances

in which the Spaniards excelled. In the large plaza the parterres were all outlined by borders of black and white pebbles, with ornamental designs containing Grecian and Indian figures. One should visit the museum at Tlaxcala, which contains a large number of old relics most interesting from an architectural standpoint. This city was the site of fierce conflicts in the conquest of Mexico, resisting first and then finally supporting the cause of the Spaniards under Cortez.

From Mexico City to Cuernavaca the train crosses the high ridge of mountains which surrounds the capital, affording a charming view of the city with its churches, trees, etc. The vista on the other side of the mountain is equally as fine. A plain flecked with fields of sugar-cane, encircled with rugged and broken hills, part of which are huge masses of rocks. Cuernavaca is picturesque with its large number of churches, possessing thirteen domes, towers and cupolas. The walls of the houses are washed in colors which afford pleasing effects after years of weathering. Many of the streets have borders of oleander trees, while everywhere are bushes of blue plumbago, tall shrubs, roses and geraniums. An enjoyable side trip is to Tlaltenango, situated amid Italian cypress trees. Here is to be found a quaint church having a campanile and fountain, all forming a delightful rest after the climb all the way from Cuernavaca.

To the north of Queretaro and Quanjuato lie





a series of interesting cities scattered along the great plateau which sprang into existence centuries ago near the mountains which held the silver responsible for their growth. Leaving Guanajuato, the first city is Aguas Calientes, with its great smelting works. Here are located the famous hot springs from which the name of the State and capital came. It is located 6,000 feet above sea level and is both healthy and attractive. To the east is San Luis Potosi, connected to the Port of Tampico by the Mexican Central Railway. The population of this town approximates 70,000 people, who enjoy the life of their artistic city. To the northwest of San Luis Potosi is situated Zacatecas, bearing the coat of arms with the title of "Noble and Loyal." The church of Guadalupe is famous for its architecture and for its paintings. A special charm pervades this Mexican church with her mysterious stairway, dark and silent corridors, and dusty walls hung with ancient paintings. A chamber located between the sacristy and church is entered through a heavy floor door. Here is found a crypt with tombs, one of which is constructed in wood and contains ossified mummies. A closed cell contains the form of a priest so well preserved as to leave the impression of a marble statue—the robes and dog at the priest's feet being as natural as the body itself. The large state hospital of brick and stone in this city is severely plain, with an inside court and fountain.

The city of Durango stands upon a broad barren plain, 6,350 feet above sea level, with a population of 30,000. Durango is one of the foremost of the Spanish-built cities and, like the other places on the plateau, owes its wealth and attractiveness to the gold, silver, iron and copper which is found in large quantities in the mines nearby. The mountain peak of Tcyra, 9,240 feet, affords a magnificent view of the surrounding country and is remarkable for the growth of three zones—bananas growing at the base, pines on the sides and cryptogamous plant life above. Far to the north and in the heart of the vast northern desert is the fine city of Chihuahua. Here amidst the intense heat and cold of the great plain is an excellent example of modern life situated far from other commercial centres. The climate is healthy and the natural resources are a guarantee of its future prosperity. In this part of the country are ruins which rank among the oldest and most interesting from an archæological standpoint that exist in Mexico. The famous Mexican calendar stone, weighing fifty tons, which was brought to the capital, is one of the best existing examples of sculpture work. At Monte Alban the mountains have been cut into until the whole country is one continuous ancient ruin.

Bridge Substructure*

JOHN W. DOTY

THE PURPOSE of this paper is to give a few examples of substructure work constructed by the pneumatic method in Canada during the last few years, and the reason for the adoption of this method in each case. During the past few years the following bridge substructures have been constructed by this method: Two bridges over the Red River at Winnipeg; bridge over the St. Lawrence River near Lachine; bridge over the Harrison River at Harrison Mills, B.C.; bridge over the St. Lawrence River near Quebec; bridge over Mud Luke, near Perth, Ontario.

The pneumatic method has been developed to meet treacherous water and soil conditions, and to insure the founding of a structure on a suitable, properly prepared bottom in the shortest possible time and for the minimum cost considering the conditions encountered. It is naturally the most expensive method of construction, but it is possible to build the structure where all other methods would fail. To emphasize the importance of this method it might be well to classify foundations in general in the order of their relative cost, provided, however, conditions are favorable for the use of the class or type selected—Class 1, spread footings; class 2, piles; class 3, piers constructed by open method; class 4, piers constructed by pneumatic method; class 5, piers constructed by a combination of classes 3 and 4.

Foundations under Class 1, spread footings, are usually placed on the soil a few feet below the ground level. This class of foundation may be subdivided into the following types: Timber grillages, concrete footings, reinforced concrete footings, steel grillages imbedded in concrete.

Foundations under Class 2, pile structures, are generally used where the material at the bottom of the footing is not capable of supporting the load and it becomes necessary to drive piles to some better strata of material in order to obtain a safe support. This class of foundation may be subdivided into the following types: Sand piles, wooden piles, concrete piles moulded in the ground, concrete piles built up, seasoned and then placed; steel tubular piles driven and filled with concrete.

Class 3, piers constructed by open method. These foundations are usually carried a considerable depth below the general ground level to hardpan or rock, and can be subdivided into the following types: Timber sheet pile constructed cofferdam, steel sheet pile constructed cofferdam, timber or steel boxes built up and sunk as excavation is made, timber lined construction, or where the sides of the excavation are lined with timber as the excavation is made; caissons built and filled with concrete before sinking, monolithic concrete caissons which are moulded before sinking.

Class 4, piers constructed by pneumatic method, are usually carried a considerable depth below the ground level to hardpan or rock, but the limit of depth to which this method is practical is 100 feet below water level. This method can be divided into the following types: Caissons built of timber or steel and filled with concrete before sinking, monolithic concrete caissons which are moulded before sinking.

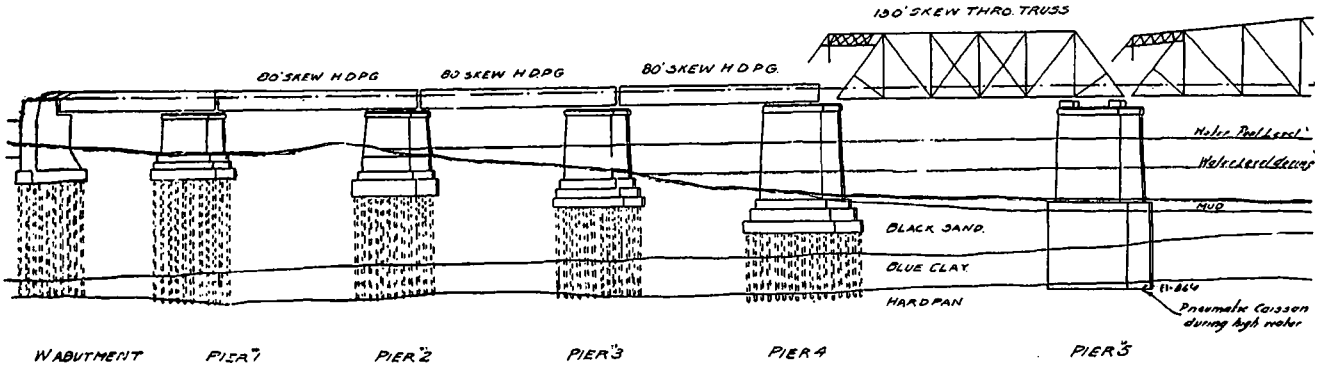
Class 5, piers constructed by a combination of classes 3 and 4. The two last types of class 3 referred to can be readily commenced by the open method and completed by the pneumatic method.

The principal conditions governing the selection of the class and type of any foundation for any particular purpose are as follows: The magnitude and distribution of the loads to be supported; the nature of the soil on the proposed site; the depth to rock or to suitable bearing material below the water level; the elevation of water level; the value of the structure to be supported; the surrounding conditions, such as adjoining structures, etc.; speed of completion; the possibility of the disturbance of the material in which the foundation is resting; the economy of construction. The type of foundation selected for any particular purpose should be the one that safely fulfils all the above conditions and is the cheapest to construct.

The importance of the foundations for structures makes it imperative that the engineer should take a conservative attitude in selecting the type to be used. Time limits the discussion in detail of the advantages and disadvantages of each particular type of foundation. However, it might be well to note the reasons for the failures of some of these types.

Class 1.—Overloading the soil; placing footings on a soil overlying a soil of lesser bearing value; designing eccentric footings and not taking into consideration the maximum pressure due to the load not being evenly distributed; designing reinforced concrete footings on the assumption that the pressure will act uniformly on the soil, no allowance being made for the lack of uniformity of the soil; placing heavy loads on reinforced concrete footings where they are extended below the water level; not carrying footings deep enough to prevent frost action; not

*Read before the Canadian Society of Civil Engineers.



NO. 1—RED RIVER BRIDGE NO.

carrying footings deep enough to prevent undermining by scour; not carrying the footing deep enough to provide protection against the material under the footing being disturbed by adjoining construction operations.

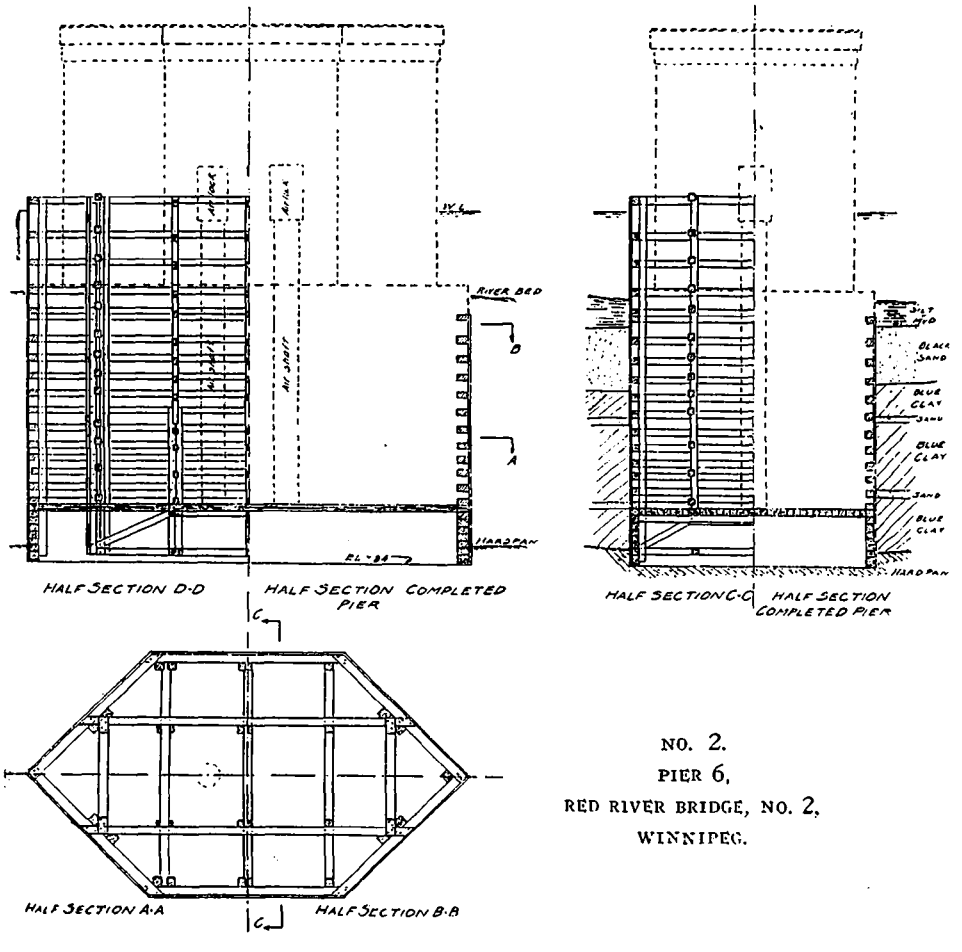
Class 2.—Wooden piles which have not been driven to a firm underlying stratum or driven to a sufficient penetration; wooden piles which are overdriven and broken; where a great many piles are driven at close centres it is, in many cases, impossible to drive all the piles to a firm stratum on account of compressing the upper strata: a readjustment of the soil might take place and permit the structure to settle, as all the piles were not driven to a firm underlying stratum; a steel tubular pile is as a rule overloaded and no allowances made for the reduced bearing value when the exposed steel has deteriorated, also due to the impracticability of founding the bottom of the pipe on a material capable of supporting the usual overload.

Class 3.—Failure of this class usually occurs when the foundations have not been founded on a suitable bottom, due to the impossibility of properly cleaning it off on account of the large quantities of water which are encountered. Failures due not to the completed foundations themselves but to the fact that the method of construction would not prevent the flow of material which will probably cause damage to the adjoining property, especially if the water or soil conditions are treacherous.

Class 4.—Failure or the impracticability of constructing this type of foundation where large quantities of water are encountered, or the nature of the soil is such that the action of the water on the soil will cause it to flow, making the conditions impossible to reached the assumed bearing elevation.

Class 5.—Failures in this class are due only to poor workmanship or unavoidable accidents, but these, with the present day methods, are very improbable.

From the above data it will be noted that the pneumatic method is classified as the most expensive, but one that overcomes the difficulties in reaching a suitable footing and permits the proper preparation of the bottom on which to found the structure, and the construction below adjoining structures where water and soil conditions are serious, without damage to the ad-



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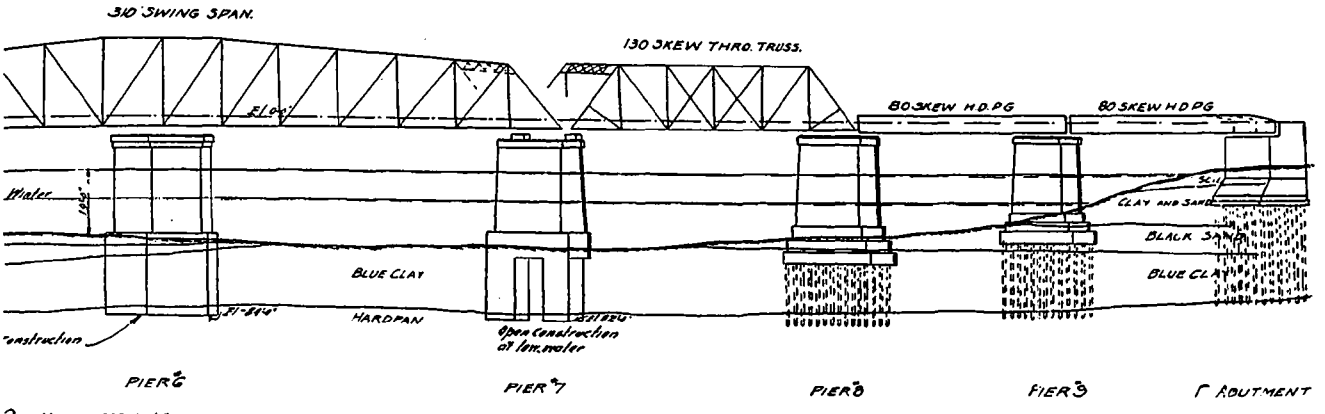
PIER 6,
RED RIVER BRIDGE, NO. 2,
WINNIPEG.



2 AT WINNIPEG, MAN.

joining structures. The pneumatic method has developed during the last fifty or sixty years with the advent of the heavy and expensive structures. It might be of interest to note that this method is derived from the principles used in the diving bell. This appliance was conceived by the ancient Greeks, developed and used in America for the first time on bridge substructure work about the year 1860, the present method having been worked out during the last fifty years.

It might be of interest to explain briefly the principles of this method. A pneumatic pier usually consists of three parts, the working chamber, the shaft and the cofferdam. To this structure should be added the equipment necessary to control the air pressure, which is the air shaft, air lock and air supply pipe line. The working chamber can be explained as an inverted box with an open bottom, on which is placed a portion of the concrete shaft, and extending above and around the perimeter of this concrete shaft is the cofferdam. The steel air shafting is built into the concrete shaft and connects the working chamber with the air lock. The working chamber, air shaft and air lock are designed to withstand safely pressures of at least 50 lbs. per square inch, which is the practical limit of the pneumatic method. The air lock consists of a shell with two diaphragm plates to which are suspended two doors. These doors permit the passing of men and materials from the atmospheric pressure to the increased pressure in the working chamber without allowing any appreciable decrease of the higher air pressures in the working chamber. In addition to the equipment on each caisson, it is necessary to operate an air compressor plant. It is not the intention to discuss the detailed design for the construction of the pneumatic caissons nor the equipment, but the above brief outline gives the principle of the method and equipment for operation, and shows the reason for the expense in constructing work by this method.

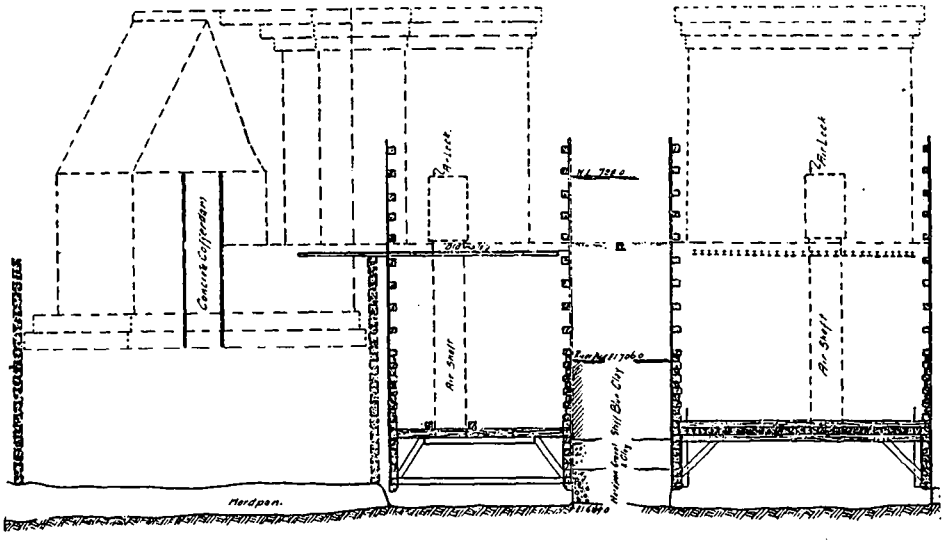
Red River Bridge No. 2.—The first work to be discussed is the construction of the piers for Red River Bridge No. 2, at Winnipeg, Manitoba. Drawing No. 1 gives the elevation of the bridge, showing the depth of water and the depth to rock, also the nature of material on the site overlying the rock. In general, the water in the river is approximately 28 feet in depth, while the rock is about 62 feet below water level. The soil overlying the rock varies from a stiff clay on the east bank to a fine flowing sand on the west bank, and in certain places both of these materials were found in different strata. Generally speaking, the soil in and about Winnipeg flows or is displaced by surcharged load or vibration, and although some clays might be loaded safely on the basis of two tons per square foot, the use of spread footings would be impracticable for a heavy or expensive structure, especially where vibration due to rolling stock would aggravate the conditions. Also on account of the general movement of the soil in this vicinity it is not possible to put a structure of this type on a spread footing at any cost.

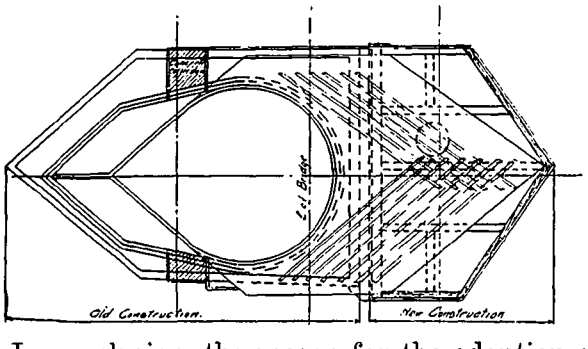
Considering Class 2 or pile type of foundations, these were adopted for the two abutments and piers 2, 3, 4, 8 and 9, which supported the flanking or fixed spans; but on account of the nature of the material and the general movement which has been referred to, it was deemed inadvisable to use this type on piers 5, 6 and 7, which support the drawspan, and would cause trouble and inconvenience if any settlement or movement took place, whereas on the flanking piers a slight movement or settlement would not seriously affect the structure. For this reason it was decided to carry piers 5, 6 and 7 to hardpan or rock, which borings indicated would be encountered at a depth of 65 feet below water level eliminating Classes 1 and 2.

Class 3, dredging types, were considered inadvisable on account of the stiff clay and sand strata which were encountered at the site of these piers. Stiff clay is a material which cannot be economically excavated from the inside of a box through any great depth of water. It was inadvisable to use the open cofferdam type and excavate in the open, on account of the numerous water bearing sand strata which were encountered at depths which were not economical for unwatering. Also because of the necessity of founding the piers on a uniformly hard bot-

tom in the hardpan and at such depths below water level, it was impracticable to pump out the cofferdam in order to make this excavation in the open, and dredging this nature of material through the water at such depths is expensive and unreliable.

Another item which had to be taken into consideration was the time allowed to complete this structure. The plans were approved by the Government on December 28th and it was necessary that this structure be completed not later than September 1st, and an open method, if possible, with its numerous contingencies with this depth of water would be uncertain and date of completion not positive.



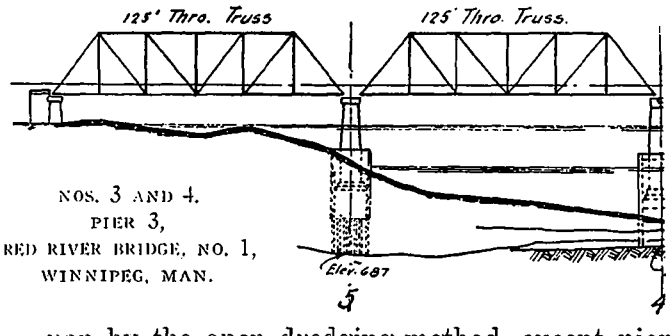


In conclusion, the reason for the adoption of the pneumatic method on this work was: The loads to be supported; the vibrating load to be supported; the elimination of any possible settlement or movement which might interfere with the operation of the drawspan, necessitating the pier being founded on good uniform hardpan or rock; the impracticability of dredging or excavating the clays to hardpan through the water by any economical method; the impracticability of unwatering; the speed necessary in order to insure completion.

Pier No. 6, sheet No. 2, was the largest and last pier constructed. The working chamber was built on the shore and placed on the site on the 25th of June, 1913. It was bottomed by the 19th of August. This pier, which contained 3,192 cubic yards of concrete, was completed in fifty-five days from the date the caisson was placed on the site. The total substructure was completed by August 28th, or within eight months' time. Pier No. 5 was constructed by the pneumatic method at high water period. Pier No. 7 was constructed by open method at low water period. It required twice the length of time as pier No. 5 and was considerably more expensive.

Red River Bridge No. 1.—Drawing No. 3 shows the elevation of this bridge, the depth of water, the distance to rock, and the nature of material on the site overlying the rock. This structure is within three miles of the bridge known as Red River Bridge No. 2, and the general conditions are similar, except that the clay does not contain layers of sand as at the site of Red River Bridge No. 2.

The work consisted of extending the piers of the old bridge for the purpose of double tracking. The old piers were constructed by the dredging method some years ago, and the substructure required approximately two years to complete. The old piers were all carried to hard-



NOS. 3 AND 4.
PIER 3,
RED RIVER BRIDGE, NO. 1,
WINNIPEG, MAN.

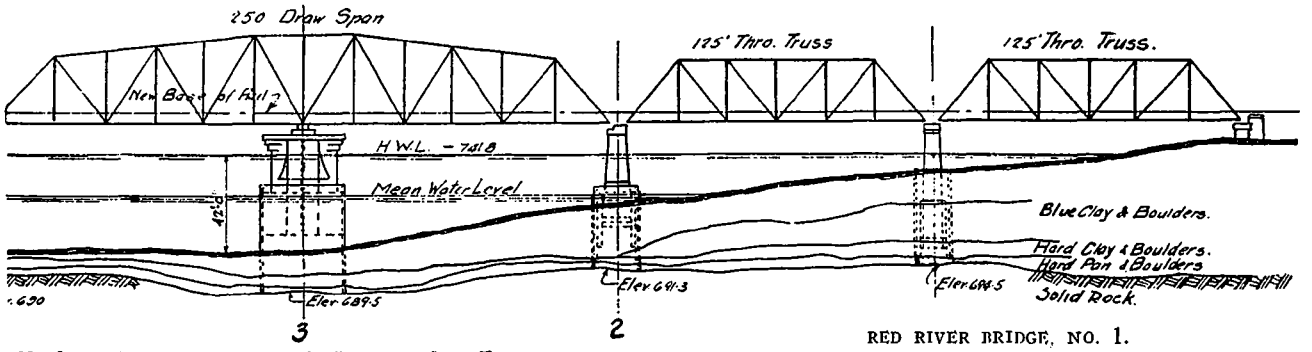
pan by the open dredging method, except pier No. 5, which was founded on piles. The reason for founding this pier on piles was on account of the impracticability of carrying the same to hardpan or rock by the open method because of the material flowing into the caisson as the excavation was being made, and the impossibility of making progress in excavation sufficient to overcome the inflow. The extension to piers Nos. 1 and 2 was built by the wooden sheet pile method (Class 3), which was practical on account of the stiffness and pervious nature of the clay. The extension to pier No. 5 was founded on piles. The excavations were made to the elevation of the old foting by the use of the steel sheet pile cofferdams. Old piers 3 and 4 were founded on hardpan by an open dredging method and the concrete deposited through the water.

The probability was that some slight settlement had taken place during the past years, but had come to rest, and the only safe manner of insuring against even a slight settlement of the new portion of the piers when combined with the old was to carry the new portion of the piers to rock. This necessitated excavating several feet below the footings of the old piers, and to make this excavation economically, considering both the nature of the material and the absolute necessity of not disturbing the hardpan under the old portion of the pier, the pneumatic method was used. Sheet No. 4 shows the manner of extending the centre pier No. 3. As stated above, it required about two years to complete the substructure of the first portion of the bridge, whereas the extension of the piers had to be completed in less than seven months. The contract for this work was awarded in February, and the construction was all completed by August.

In reference to the use of the pneumatic method on the double tracking of the St. Lawrence River Bridge, this plan and method was used for the extension of the piers. The conditions existing and the means of overcoming the difficulties were similar to those found and overcome on the Red River Bridge No. 1. A number of the old piers of this bridge were founded on rock, but a great many were resting on hardpan, and to eliminate any possible splitting of the piers when the old piers and the extension were bonded together, the extensions of all the piers were carried to rock. In one case it was necessary to carry them to a depth of 9 feet below the footing of the old pier. The greatest depth of water was 42 feet.

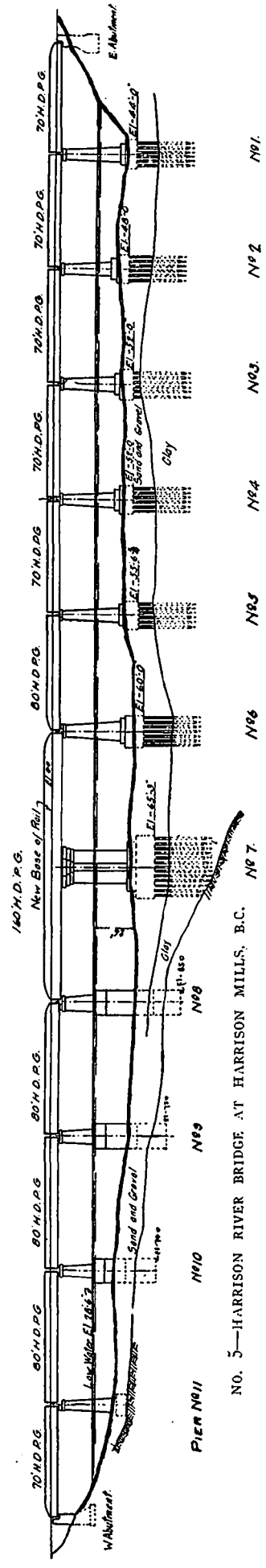
Harrison Mills Bridge.—This work is now under construction over the Harrison River, at Harrison Mills, B.C. Drawing No. 5 gives the elevation of the proposed structure, the depth of water to rock, and the nature of soil overlying the rock. The soil being principally sand and gravel, with a little clay on the east portion of the bridge, it was deemed practical to build the eastern half of the bridge on wooden pile foundations, and the western portion of the bridge on rock by the use of the open caisson method on account of the shallow depth of the rock. Additional borings made on the site after the work was begun showed that the rock on the western portion of the bridge sloped at an angle of from 30 to 40 degrees.

On pier No. 8, sheet No. 6, the depth of water was approximately 25 feet, the depth to rock on the downstream side of the pier was 30 feet, and the depth to rock on the upstream end of the pier was 55 feet. The soil overlying the rock was principally sand and gravel with traces of clay. It was necessary to carry the footing of the pier into the river bottom at least 8 feet to protect the pier against scour. This depth would bring the downstream end of the pier on rock, whereas the upstream end would be approximately 25 feet from rock. It was not practical to use a spread footing class of foundation as one end of the pier would be resting on rock and the other end on sand, gravel and clay, which would no doubt settle and cause it to slip out of line. It was also not practical to consider the use of piles on account of the short length of these at the downstream end of the pier. It was also not possible to construct an open dredging caisson in one mass at the site of this pier, because of the steep slope of the rock and the large expense to be incurred if the rock was excavated sufficiently to enable the caisson to be carried to a uniform rock level. For these reasons it was finally decided to found the pier on rock, using either an open method or pneumatic caisson on the downstream or shallow end and a pneumatic caisson, on account of the depth of the water, on the upstream end of the pier, the rock being stepped off in the working chamber so as to prevent sliding. It was also decided that the concrete shaft of the pier should be built on these two independent caissons, the shaft to extend to a depth of approximately six feet below low water to the coping, the whole design being reinforced so as to combine the two caissons, and the shaft to take up all strains to which this type of pier would naturally be subjected. This design and method of construction is used on piers 8, 9 and 10.



RED RIVER BRIDGE, NO. 1.

The Quebec Bridge.—On account of the magnitude of this structure it was necessary to found the piers on a stratum which would absolutely preclude the possibility of settlement, and to carry the footings to such a depth as to eliminate any possibility of scour.

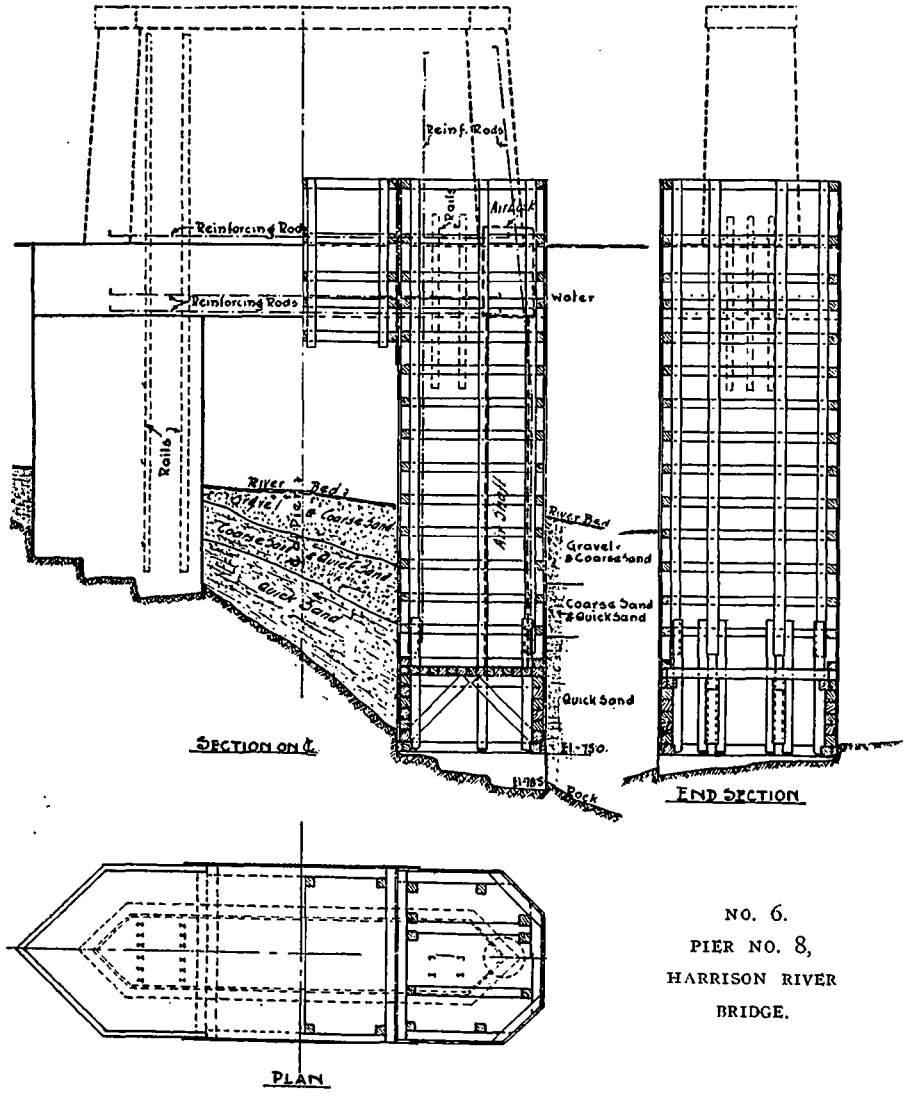


NO. 5—HARRISON RIVER BRIDGE AT HARRISON MILLS, B.C.

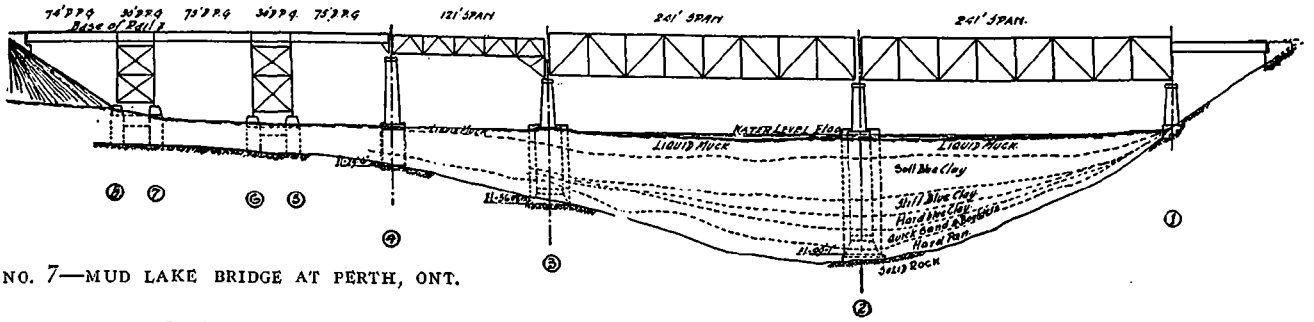
The nature of the material on the south pier was such that pneumatic caissons could be founded on rock at an elevation of approximately 85 ft. below the water level, and it was necessary to use this method in order to excavate to rock and properly prepare the rock surface. The north pier was founded on hardpan at a depth of approximately 60 feet below the water level. It was necessary in either case, in order to reach the stratum on which the piers were founded, to do the work by the pneumatic method as it was impracticable to remove the large boulders and other material by any dredging method, and when the hardpan or rock was reached, this bottom had to be prepared in such a manner as to preclude any possibility of settlement.

In the north pier, which did not reach rock, the engineers carried on an exhaustive test on the soil before permitting any concrete to be placed.

Mud Lake Bridge.—Drawing No. 7 gives the elevation of the bridge over Mud Lake, near Perth, Ontario. It also shows the depth of water, the depth to rock and the nature of the material on the site overlying the rock. The conditions on this site are rather unique in many ways. At the site of pier No. 2, sheet No. 8, the water is about 8 feet in depth, but for the next 50 feet the material is a liquid clay. Below this liquid clay is encountered a stratum of stiff clay to a depth of 12 feet, under this is a stratum of boulders, sand and clay, which is very firm and compact and below this stratum, and overlying the rock to a depth of about 10 feet, is a stratum of cemented sand, rock being encountered at the site of this pier at a depth of from 108 to 115 feet. It is quite obvious that a spread footing



NO. 6.
PIER NO. 8,
HARRISON RIVER
BRIDGE.

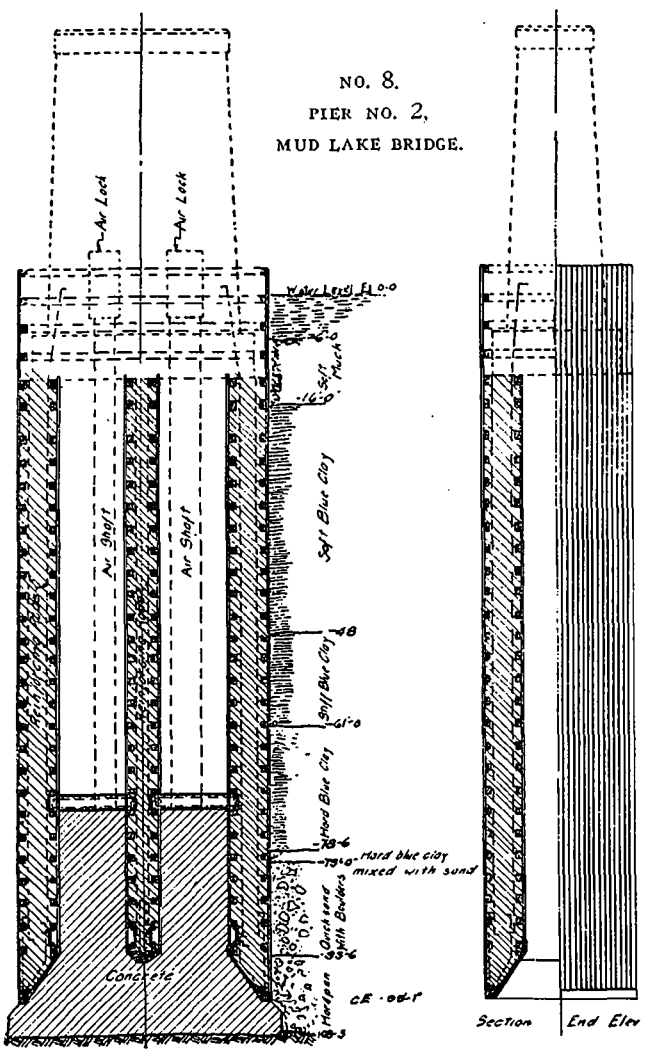


NO. 7—MUD LAKE BRIDGE AT PERTH, ONT.

design foundation would not support the load. A pile type of construction would be inadvisable on account of the great depth of liquid mud which would not give the piles lateral stability, the small amount of penetration which the piles would obtain in the stiffer underlying stratum of clay, and the probability that the piles could only be driven to the stratum of boulders and no further. The constant vibration and the stresses due to traction would so affect the foundation that the lateral stresses could not be resisted by the upper portion of piles in the liquid clay, and the working or slight movement which the vibration would cause in the foundation would soon affect the soil adjoining the piles in the stiff clay stratum and cause it to soften.

In the liquid clay mass encountered on this site there is no assurance that the whole mass is not following some progressive movement, which might be slight, but in years to come might move any structure which did not receive its support from some underlying fixed surface which would preclude the possibility of movement. The pier should be so designed that in case of a movement of this nature it would be strong enough to resist it and to permit the material to flow around it. For this reason it was deemed inadvisable to place the foundations of this structure on any substance other than a material equivalent to hardpan, or, if possible, on rock. An open caisson type could be carried to the stiff clays, but this type is impracticable in stiff clays at this depth on account of the great troubles encountered in dredging and removing it. The boulder stratum below this stiff clay was not deemed of sufficient stability for the support of this pier, and it would not be economical to remove this nature of material by an open dredging method. It was also deemed advisable to carry the pier some distance into the cemented sand, so as to be certain of obtaining a uniformly hard surface before placing concrete. It would be impracticable at this depth to do this by an open method. For these reasons it was finally decided to construct an open dredging pier and carry it into the stiff clay stratum, at which elevation the dredging caisson was converted into a pneumatic caisson and carried through the stiff clay and boulder stratum into the cemented sand until a uniform surface was reached and properly prepared. To add greater stability to the pier the bottom was belled or carried out a distance of 18 inches beyond the perimeter of the caisson, and the whole lower portion concreted to form the base to support the pier. The excavation was carried to a depth of 103 feet 8 inches, which is the deepest bridge pier in Canada, and, with the exception of one, the deepest in America.

In conclusion, it is quite evident that the pneumatic method, although the most expensive one in the general classification of foundations, is the most economical, considering the conditions which were encountered in the above examples, and brings out clearly the certainty of securing a suitable footing beyond any doubt, the speed of completion and the positive manner in which difficulties can be overcome.



Engineering Books

Theory and Practice of Surveying.—Recognizing the many and rapid improvements in apparatus as well as in field methods, Leonard S. Smith, C.E., has thoroughly revised and in a large part rewritten J. B. Johnsons book on the Theory and Practice of Surveying. The changes consist of the rearrangement of the subject matter; the omission of certain portions, notably the chapter on Railroad Topography; the use of over one hundred new and additional illustrations of apparatus and methods of its use; the addition of over one hundred pages in re-writing chapters on the Engineer's Level and Transit; Land, Topographic, Hydrographic, City and Geodetic Surveying; the supplying at the end of each chapter of many leading references to the best literature on the subject. The work is divided into three books, the first treating of the adjustment, use and care of all kinds of instruments used in field and office; the second section describing the theory and practice of surveying methods in the various departments mentioned above; the third part discussing the measurement of base lines; the measurement of the angles of the triangulation system; the astronomic determinations of latitude, longitude and azimuth. Published by John Wiley & Sons, New York, at a cost of $4.00.

* * *

Concrete, Plain and Reinforced.—A treatise of the materials, construction and design of concrete and reinforced concrete, written for practising engineers and contractors, as well as a work of reference for engineering students. The authors, F. W. Taylor and S. E. Thompson, have consulted specialists in regard to each feature presented and have included chapters written by such authorities as R. Feret, W. B. Fuller, F. P. McKibben and S. B. Newberry. Each phase of cement construction receives proper attention and is thoroughly discussed under the following headings: Definitions; Process; Specifications; Choice and Proportion of Ingredients; Classification of Kinds; Chemistry; Testing; Tables; Mixing; Effects of Sea Water, Freezing, Fire and Rust; Manufacturing Process. Appendix I gives methods of chemically analyzing cement materials; Appendix II presents formulas for reinforced concrete beams compiled by Professor McKibben. Over two hundred pages of new matter have been added to the first addition. The work is published by John Wiley & Sons, New York, and costs $5.00.

* * *

Design of Highway Bridges.—This work furnishes a treatise on the calculation of stresses in bridge trusses and presents a discussion of the details and design of highway bridges. The author, Milo S. Ketchum, C.E., appreciates how little attention has been paid to the design of highway bridges and consequently has laid great stress upon this phase of the problem, treating of the superstructure and substructure. Various materials, such as stone, concrete, and reinforced concrete are taken up, together with the cost, showing their influence upon economic designing. The book is divided into three parts: Stresses in steel bridges; the design of highway bridges; problems in highway bridge details. An appendix treats of the general specifications for steel highway bridges under the general headings of design, loads, unit stresses and proportion of parts, details of design, materials and workmanship. The McGraw-Hill Book Company of New York are the publishers. The cost is $4.00.

* * *

Letters and Lettering.—As stated by the author, Frank Chouteau Brown, this book intends primarily to exhibit the letter shapes and has been arranged to show how the letters compose into words. The application of classic and mediæval letters to modern usages has been, as far as possible, suggested by showing modern designs in which similar forms are employed. The work is divided into five chapters: Roman Capitals; Modern Roman Letters; Gothic Letters; Italic and Script; To the beginner, and includes a large number of illustrated examples. Standard forms of every individual letter in each of the two basic styles, Roman and Gothic, is shown by a diagram with a detailed description of the method for drawing it. The book is published by Bates & Guild Company, Boston, costing $2.00.

* * *

Chambers' Mathematical Tables.—A new edition of these tables has been published by the D. Van Nostrand Company, New York City, consisting of logarithms of numbers from 1 to 108,000. The work comprehends the most important mathematical tables necessary in the sciences of trigonometry, mensuration, land-surveying, navigation, astronomy, geodetic surveying, and are carried to seven decimal places. As accuracy is the most important element in such tables, the greatest care has been bestowed in collating the whole with the best editions of the tables of Taylor, Hutton, Callet, Kohler, Schron and Shortrede. The book is edited by James Bryde, F.E.I.S., and costs $1.75.

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Any or all of the above mentioned books may be secured from Eugene Ditzgen Co., Ltd., 116 Adelaide street West, Toronto, or their Western agents, Strains, Limited, 313 Portage avenue, Winnipeg.

CONSTRUCTION

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CONTRIBUTIONS—The Editor will be glad to consider contributions dealing with matters of general interest to the readers of this Journal. When payment is desired, this fact should be stated. We are always glad to receive the loan of photographs and plans of interesting Canadian work. The originals will be carefully preserved and duly returned.

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Vol. VII Toronto, April, 1914 No. 4

CURRENT TOPICS

PROFESSOR PARKS, who has recently conducted an extensive investigation into the building stone resources of Ontario, Quebec and the Maritime Provinces, says that building stone, on account of the difficulties of transportation, is one of the few things which remains characteristic of a locality, Toronto, for example, through lack of stone, being a brick city, while Montreal is largely built of limestone. Professor Parks stated that Eastern Canada possesses plenty of sandstones and limestones, but unfortunately the increasing use of concrete is militating against their use. Granite is coming more into use with increased wealth, but, although there is plenty of marble of excellent quality, and the most variegated and beautiful varieties, its use is not increasing as it ought, largely because of the prejudice and lack of knowledge on the part of architects of the resources of the country in this respect. As a result, the lecturer pointed out, architects go to considerable extra expense to import marbles which are no better and often inferior to the native stone. Since the many different quarries throughout the country all possess marbles which differ in some respect from practically all others, Professor Parks predicted a profitable industry in this class of stone as soon as its good qualities become better known.

* * *

DR. GLINZER, Director of the State Building School in Hamburg, says that to make oil paint adhere to cement the surface of the material should be coated with diluted sulphuric acid (1 part concentrated acid to 100 parts of water), which afterwards must be washed off and the surface allowed to dry. Or the surface may be covered with diluted silicate of soda (wasserglas), the solution to be 1 to 3 or 1 to 4, and applied three times in succession. Still another method is to apply two coats of building "fluat" at least 24 hours apart. Practical builders state, however, that the applications of sulphuric acid are not made by them, and that such success as they have results merely from careful work and the use of good materials. Dr. Glinzer also says that oil paint should be applied to cement in the following manner: "The surface is given one coating of linseed-oil varnish, to which is added a first coat of white lead when the varnish is dry. A second coat is then added, also containing white lead, together with more or less coloring matter, as the building laws forbid the use of absolutely white paint on the exterior of structures. In this climate the use of oil paints is recommended, as they are waterproof and present smooth surfaces which attract a minimum of dirt. Painting according to this method costs here about ten cents per square yard. Applied to iron, linseed-oil varnish when used by itself flakes off readily. It should be thoroughly mixed with red oxide of lead, caput mortuum, or other graphite. This mixture serves as a first coat after the perfectly clean and dry surface has been gone over with the ordinary hot linseed-oil varnish. When the dead color has dried, another coat of the color desired is applied. The oil, being partly converted into resin, combines with the coloring material, making a thick coating that is the more impervious to water accordingly as the color is finely ground or not. Lead should be used when the paint is exposed to water. The water colors so frequently used in Germany as a rule have silicate of soda as their base. These colors can be used on cement, plaster of paris brick, or glass. Liquid casein paints are easily worked and are said to be durable. The discoloration of cement buildings results very frequently from the class of cement employed rather than from the color applied afterwards."

WITH THE CORDIAL co-operation and largely at the instance of the Manitoba Architects' Association, the University of Manitoba established a chair in Architecture at the beginning of the present academic year with Arthur Alexander Stoughton in charge. Mr. Stoughton comes from New York City, where he has been actively engaged in the practice of architecture with his brother under the firm name of Stoughton & Stoughton, also as a city planner. Among other works the firm is responsible for the Soldiers' and Sailors' Monument on Riverside Drive in New York City, as well as the large group of the Canton Christian College in China.

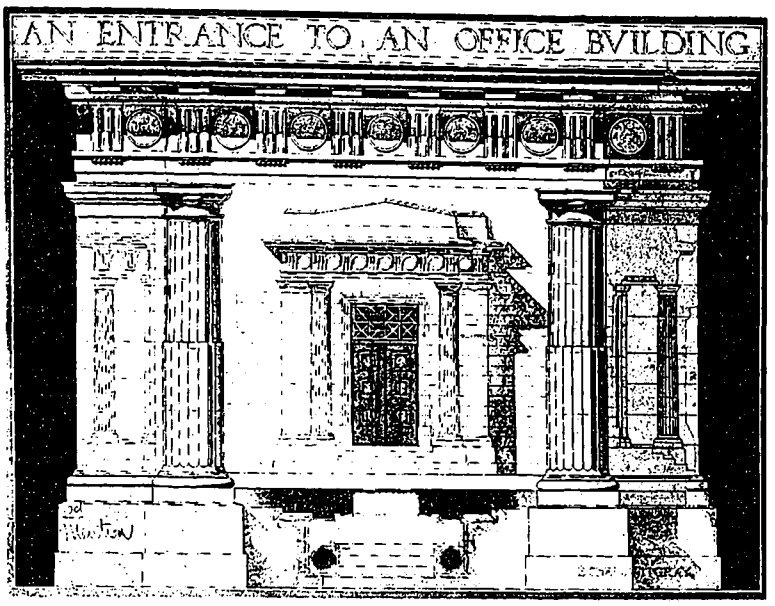
The outline of a comprehensive four years' course, theoretical and practical, has been laid down and the present year has seen students in two classes doing the prescribed work. The course of study and routine are modelled on those of the best Eastern schools, his training at Columbia and in Paris and the practical experience of the head of the Department guiding him in the selection of methods. By a revision of the Architects' Act graduates of this Department are admitted to practice without further examination, after having spent two years in practical office work after graduation.

Besides the regular course leading to the degree, the Department admits students to partial work in an evening course of design, where instruction in the elements of architecture and shades and shadows is given preliminary to participation in designs from given programmes. The class is composed principally of draftsmen from the various offices who follow programmes, usually occupying one month each, which thus far have alternated between "order" and plan problems. The work in this class is similar to that of the Beaux Arts ateliers, some of the "mentions" in the first order problem being given in this issue, "An Entrance to an Office Building" in the Roman Doric order. The Department will occupy one floor of the Engineering Building shortly to be erected on the new site of the University at St. Vital.

* * *

WHAT WILL BE the largest hydro-electric power station in Canada is now rapidly approaching completion at Cedar Rapids, in the St. Lawrence River, near Montreal. When this shall be first thrown into operation it will have a rating of 100,000 horsepower, which will be nearly doubled subsequently. It will ultimately have a capacity of 160,000 horsepower. Contracts for 80,000 horsepower were made before the work of building had been commenced. In many respects the equipment will resemble that of the Keokuk Dam, on the Mississippi, which was recently completed. The turbines, with a rating of 10,800 horsepower, are said to be the largest ever built.

THE TWENTY-EIGHTH annual convention of the National Brick Manufacturers' Association, held at New Orleans, was attended by three hundred and eleven members, representing the States and Canada. President Rogers in his annual address referred to the large and widely scattered delegations: "It is a great pleasure to look into the faces of so many of the representative manufacturers of clay products from all sections of the country. There are members here from most of the States of the Union, and I am especially pleased to note a large delegation from Canada. This is particularly pleasing inasmuch as this is the first time in the history of our Association that we have convened in annual convention so far from the geographical centre of our membership. After due deliberation your Executive Committee, with whom rests the responsibility of determining time and place of meeting, deemed it advisable to invite an expression on the part of the members as to the preferred place of meeting. With great unanimity you chose New Orleans. This diversion indicates anew the national scope and character of our organization, an incident which I am sure must be very gratifying to us all. . . . It is scarcely more than a decade since the building of improved highways was taken up in earnest by most of the States. What wonderful strides have been made and what a conspicuous part brick has taken in its solution is well known, and it is generally conceded that brick is superior to all other materials not only in the city streets, but in highway building as well. . . . What is true of brick as a paving material for streets and highways is true of brick for structural work: the initial cost being but slightly in excess of wood, admit of their use in the construction of the humble home. On the other hand, if desired, buildings can be embellished by artistic terra cotta and tile no matter how lavish the design or how extravagant the idea of the architect or owner. Brick and terra cotta meet every requirement of the builder whether for a modest home or a richly decorated edifice. . . . The general public welcomes conservation of our resources by National and State authorities. The time is not remote when all will realize how important a question it is, though little attention has been given it. The preservation of the forests is important: it conserves the water power that thirty years ago could only be used at the banks of the streams, since then the development of means for generating electricity, for transmitting it long distances and transforming it into light, heat and power at a low cost. Our country is comparatively new and so rich in resources that we are apt to forget they can be exhausted and will be if care is not taken to protect them from waste and exploitation. The policy of conservation is one of the



ENTRANCE TO AN OFFICE BUILDING.

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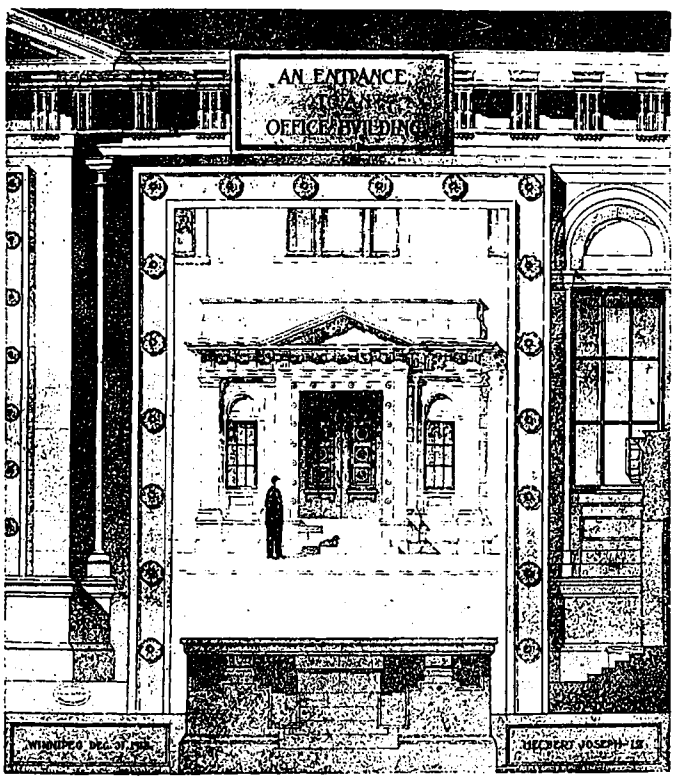

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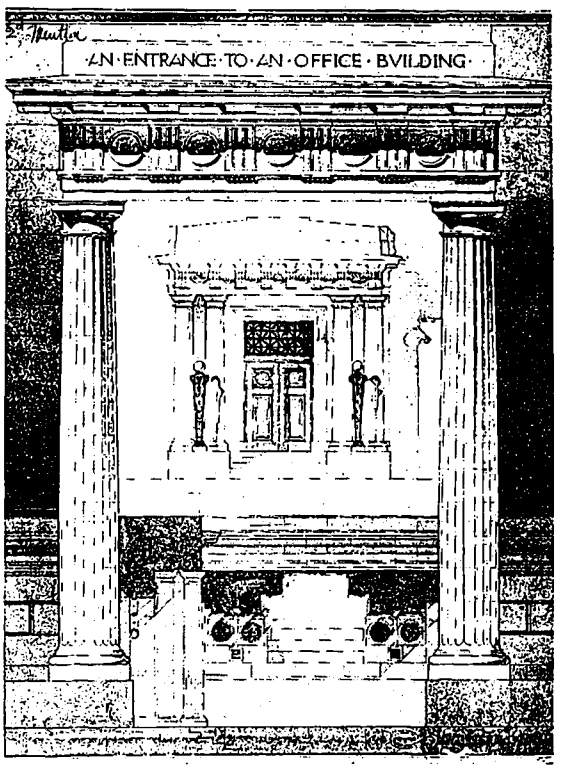

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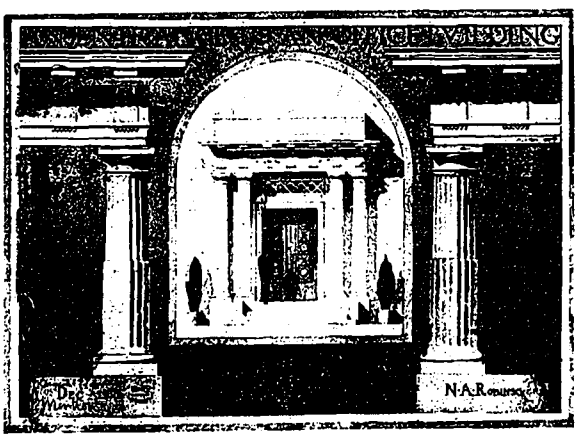

ORDER PROBLEM. EVENING CLASS OF DESIGN.

UNIVERSITY OF MANITOBA, WINNIPEG.

DESIGN BY NORMAN A. ROBINSON.

most important of our day and one in which we should all take an interest in seeing economically developed."

The following officers were elected for the ensuing year: President, Eben Rogers; vice-presidents, C. P. Moyer, C. Deckman, F. Salmen; secretary, T. Randall; treasurer, J. Sibley. The delegates were royally entertained during the convention, excursions being held between sessions. The annual banquet was held at the Grunewald, L. E. Bentley, of New Orleans, presiding. J. S. McCannell, of Milton, Ontario, was the first speaker, and responded to the toast, "Our Border Line." Other speakers scheduled were: D. V. Purington, Ocean Springs, Miss., "Our Chart;" Dr. William McF. Alexander, "Our Hobbies;" John C. Boss, Elkhart, Ind., "The Road to Happiness;" J. J. McLoughlin, New Orleans, "How to Throw a Brick;" Charles J. Deckman, Cleveland, Ohio, "Every Brick Man;" Herbert N. Casson, New York, "Shock Absorbers."

* * *

FOR THE FIRST TIME in the history of Canada, a definite and scientific plan has been developed in one of the Provinces, by which the public is to secure the benefit, in the form of increased revenue, of the rise in stumpage values on crown lands which will inevitably come as a result of limited timber supplies and steadily increasing demands. This plan is set forth in a bill now before the Legislature of British Columbia, which was introduced by Hon. W. R. Ross, Minister of Lands, following a most careful investigation by the Forest Branch, and a series of conferences with the limit-holders concerned. It is understood that the Bill harmonizes, so far as practicable, the interests of both the Government and the lumbermen, and that its early enactment into law seems assured.

In other Provinces, as also on the Dominion crown lands, there is no definite and well-understood plan for the gradual increase of stumpage dues, to be paid to the Government as timber values increase. Instead, this matter is taken up at more or less irregular intervals, usually at the end of ten-year periods, and the outcome is the result of a contest between the needs of the Provincial Government for greater revenue, and the natural opposition of the lumbering interests to material increases in the royalties. This situation, through the increase in timber values, has resulted in many of the limits acquiring a large speculative value, which is taken into consideration in transfers from one person or corporation to another, and this absorption of the surplus value has in turn made much more difficult the re-adjustment of terms between the Government and the limit-holders. Apparently, this difficulty will now largely disappear in British Columbia, under the new plan developed by the Minister of Lands and the Forest Branch. The settlement of the controversy will likewise be of great benefit to the lumbering interests, since it will materially facilitate the financing of lumbering operations, by removing the uncertainty which has hitherto prevailed as to tenure and amounts of royalties to be paid.

The essentials of the plan provided for in the royalty bill are explained in the following extract from the address by Hon. W. R. Ross, in presenting this matter to the Legislature for its consideration: "The Royalty Bill comprises these four things: It fixes the royalty increase for 1915, and establishes a level of lumber prices on which future increases will be based. It provides seven five-year periods for royalty adjustment; and it provides that for each of these periods a given percentage of the price increment for lumber shall be added to the royalty. This percentage is twenty-five per cent. for the first five years, and rises gradually to forty per cent. for the last five-years period. The fourth of the accomplishments of the Royalty Bill is to re-adjust the rentals between the coast and the interior, and fix them for the whole period of the Act."—*Conservation.*

* * *

THE TALLMAN Brass and Metal Company, who are making a specialty of electric fixtures, have secured the following contracts during the month of March: First Methodist Church, Hamilton; St. John's Presbyterian Church, Hamilton; First Presbyterian Church, New Glasgow, N.S.; office building for the Great Lakes Dredging Company at Port Arthur. Special designs of this work will be submitted on application.

* * *

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* * *

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