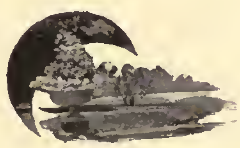
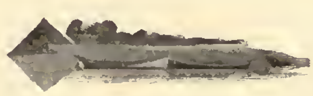
32

INDUSTRIAL CHICAGO

THE BUILDING INTERESTS



ILLUSTRATED



Chicago
The Goodspeed Publishing Company
1891

JOHN MORRIS COMPANY
PRINTERS AND BINDERS

Table of Contents.

CHAPTER I.

TOPOGRAPHY, LIMITS AND SURVEYS.

CHAPTER II.

SANITARY PLUMBING.

CHAPTER III.

PLUMBERS' ASSOCIATIONS.

CHAPTER IV.

SANITARY DRAINAGE AND SEWERAGE.

CHAPTER V.

GENERAL SANITARY DRAINAGE.

CHAPTER VI.

HOUSE HEATING AND VENTILATING.

CHAPTER VII.

GAS AND ELECTRIC LIGHTING.

CHAPTER VIII.

THE WATER AND PAVING SYSTEMS.

CHAPTER IX.

THE LUMBER INTERESTS.

CHAPTER X.

BUILDERS' METALS AND HARDWARE.

CHAPTER XI.

PAINTING AND DECORATING.

CHAPTER XII.

RECENT AND MISCELLANEOUS BUILDING EVENTS.

CHAPTER XIII.

MANUFACTURERS OF SEWERAGE, BUILDERS' IRON AND LUMBER MATERIALS.

CHAPTER XIV.

DECORATORS, PAINTERS AND PAINT DEALERS.

CHAPTER XV.

PLUMBERS, HEATERS AND VENTILATORS.

CHAPTER XVI.

ROOFERS, GALVANIZED IRON WORKERS, BRASS AND IRON FURNISHERS, GLASS DEALERS, ETC.

CHAPTER XVII.

OFFICIALS, BUILDING PROMOTERS, ELECTRICIANS, HOUSEMOVERS AND ELEVATOR DEALERS.

ILLUSTRATIONS.

INDUSTRIAL CHICAGO:

THE BUILDING INTERESTS.

CHAPTER I.

TOPOGRAPHY, LIMITS AND SURVEYS.

CHICAGO is in latitude 40 degrees 50 minutes 1 second north, and longitude 10 degrees 33 minutes 40.4 seconds west, being the determined location of the late Chicago university, on Cottage Grove avenue. Forty-one degrees 53 minutes 48 seconds latitude, and 10 degrees 35 minutes 1.77 seconds longitude, was the determined location of the old church of the Holy Name, between Huron and Superior streets, on Wolcott street, and 41 degrees 53 minutes 6.2 seconds latitude, and 10 degrees 33 minutes 39.38 seconds longitude that of the city building. While the first given latitude and longitude have been authenticated, the observations leading to the other measurements were true, and are nearer the results obtained in a majority of the nine principal geodetic and astronomical surveys made, though another survey places the courthouse in latitude 41 degrees 26 minutes. Other surveys are as follows:

Fort Dearborn* 41 deg. 52 min. north, 87 deg. 35 min. west, 10 deg. 31 min. 58.7 sec.
Chicago City hall* 41 deg. 53 min. 6.2 sec. n., 87 deg. 36. min. 1.2 sec. west, 10 deg. 32 min. 59.9 sec.
Church of Holy Name 41 deg. 53 min. 48 sec. n., 87 deg. 37 min. 47.73 sec. w., 10 deg. 34 min. 46.43 sec.
Iron light-house* 41 deg. 53 min. 24.9 sec. n., 87 deg. 36 min. 59 sec. w., 10 deg. 33 min. 57.7 sec.
Chimney I. C. R. R. shops L. F.* 41 d. 51 m. 50.5 s. n., 87 d. 37 m. 21.27 s. w., 10 d. 34 m. 19.7 s.
Station Washington street** 41 deg. 52 min. north, 87 deg. 35 min. west, 10 deg. 31 min. 58.7 sec.
Southeast corner Madison and La Salle† 41 d. 53 m. 4 s. north, 87 d. 37 m. 45 s. west, 10 d. 34 m. 43.7 s.
Old Chicago university‡ 40 deg. 50 min. 1 sec. n., 87 deg. 36 min. 41.7 sec. w., 10 deg. 33 min. 40.4 sec.
Center Nautical almanac 41 deg. 50 min. 1 sec. n., 87 deg. 36 min. 26 sec. w., 10 deg. 33 min. 15.7 sec.

The congressional description is townships 37, 38, 39, 40 north, ranges 13, 14 and 15 east of the third principal meridian. The west line of range 14, at Western avenue is seventy-eight miles east of the third principal meridian and one hundred and forty-four miles east of

*United States topographical survey. **Signal service. †Capt. Powell. ‡T. H. Safford.

the fourth. The first principal meridian is the division line between Ohio and Indiana, and the second principal meridian is a little west of the center north and south line of Indiana.

Chicago is in reality 103 degrees 9 minutes west of the natural or major meridian or 118 degrees 9 minutes west of the great Pyramid of Egypt. New York city, through which the minor meridian passes, is 90 degrees west of the major meridian.

The Chicago river and its branches form the interior boundaries of the three divisions of the city under the act of 1853. The main river divides the north and south divisions, while the north and south branches are the dividing lines between these and the great west division. All are short streams, but subject to floods in wet weather, the south branch being particularly subject to the overflow of the Desplaines.

The Calumet river, Calumet lake, Hyde lake and Wolf lake are now within the city limits in township 37 north, range 14 and 15 east. There are, in fact, three Calumets, like the three Chicagos—the Little, the Grand and the Calumet. The two branches unite just north of the south line of the city, whence the main river runs northwest to Calumet lake, and thence northeast to Lake Michigan. Calumet lake is a shallow sheet of water, three miles long by two miles wide—all that remains of the marsh which covered a great area of Hyde Park within the memory of men now living. On the west shore of this lake are the towns of Pullman and Kensington, and stretching westward to the west line of Blue Island ridge is a plateau, on which many settlements have been made since 1882. The elevations above the level of Lake Michigan south of the old city limits are given as follows: Wabash and Fifty-fifth street, eleven feet; meadow, Washington park, ten feet; Hyde Park, ten feet; Pullman, five feet; Chicago Lawn, twenty-five to thirty feet; Englewood on the Hill, thirty feet; Normal Park, ten feet; Englewood, ten feet; Stickney, twenty feet; Evergreen park, thirty-five to forty feet. The elevations on the west are Riverside, thirty-five feet, thirty-nine feet at railroad depot; midway between Greggs and East Grove, one hundred and eighty feet; Downer's Grove, one hundred and forty-two feet; Austin, forty-five feet; Douglas Park, fifteen feet; Hawthorne, thirty to thirty-five feet; Lawndale, ten to fifteen feet; Western Springs, ninety-three feet; Oak Park, sixty feet; Ridgeland, thirty to forty feet; River Forest, forty to fifty feet; Park Ridge, fifty to sixty feet; La Vergne, thirty-two feet, Grossdale, forty-three feet, and La Grange, sixty-six feet. The elevations on the north are Norwood Park depot, seventy feet; Mont Clare, seventy feet; Franklin Park, ninety feet; Irving Park, twenty-five feet; Maplewood, fifteen feet; Edgewater, ten feet; Ravenswood, twenty-five feet, and Montrose, thirty-five feet.

The necessity of elevating grade will be better understood by the following general statement of the topography of its original surface. From the fort, at Rush street bridge, south on Michigan avenue, the surface of the ground was, as it is now, about nine or ten feet above the surface of the lake. The surface drainage was from Michigan avenue west to the river, and from State street west was nearly a level plain, elevated some two or three feet above the river. The topography of the north division was similar, the surface declining from Rush street toward the west. The surface water cut large gullies in the soil, known as sloughs, three of which opened into the river. One at State street was about sixty feet wide at the mouth and extended in a southwesterly direction to the site of the present Tremont house. Another had its outlet between Clark and La Salle streets, and extended inland across Lake street. The third and most formidable one was on the north side, near Franklin street, being eighty feet wide at the river, and extending north through the Kingsbury and Newberry tracts to Chicago avenue.

The natural accretion, north of the Chicago river equaled four hundred and twenty feet between 1821 and 1833; three hundred and sixty feet between 1833 and 1838; two hundred and fifty-six feet between 1838 and 1843; three hundred and sixty-four feet between 1843 and 1849; one hundred and twenty feet between 1849 and 1854; one hundred and thirty feet in the succeeding decade; one hundred and eight feet between 1864 and 1869; one hundred and forty-two feet between 1869 and centennial year, or nineteen hundred feet in fifty-five years. During the four years ending in 1880, a strip about forty feet in width was washed away, leaving the area of natural accretion about ninety-eight acres. During the period that accretion was carried on north of the river, erosion was at work south of the river, and the old shore line of 1821 was gradually washed away, until the east curb of Michigan avenue became the shore line of 1869, between a point north of Monroe and a point south of Jackson, while a line running southeast to the Illinois Central tracks and Park Row marked the extent of the erosion. In later years the action of the water on the north shore has been rather of an erosive than an accretionary character, and hence shore protective measures are necessary to hold abutting property. South of the river erosive action always obtained, so that the debris of a burned city and the filling of the years since 1871 show only a small tract compared with that which the waves swept away between 1821 and 1871.

The strata upon which the city rests must always be an interesting study for the geologist, and a profitable one for the builder. Draw a line south on State street to Sixty-eighth, and thence southwest along Vincennes avenue, and you will have the eastern limit of the older lands of the city. From that line to the lake shore, south of Thirty-eighth street, the soil has been naturally made within a short period of geologic time, and north of Thirty-eighth street to the main river, within the historic period by artificial means. North of the main river to the ancient shore line the land has been made by natural accretion, except the small area filled in with debris since the fire or taken from the waters by the Lincoln park commissioners and others. South of Fifty-fifth street the work of conquest goes onward under the direction of the South park commissioners, and, were Chicago enterprise and cupidity left unchecked, the whole lake bottom, from the mouth of the river to the lake's eastern shore line, would be lifted up to city grade. The two past decades point out, unmistakably, the extent to which this land-making system has been carried; while the discussions of 1890–91, on extension of shore line for Worlds' Fair and railroad purposes show the trend of thought in this direction.

Over the tract described the waters of the lake have left evidences of their occupation, of their rise and fall. Indeed geology refers to the time when the lake rose thirty feet above its present level, and submerged a greater area than is now embraced within the limits, drowning out the forests as well as the mammal habitants. The gradual recession of the waters is also shown by sand terraces, evidences which time and improvement have not wholly removed. The rise and fall of the lake is due sometimes to heavy winds, but generally to some unaccountable agency which science herself can not yet explain. The variation in feet of the lake waters, above and below city datum, is recorded as follows:*

	Max.	Min.	Mean.		Max.	Min.	Mean.
1854	....	....	1.83	1867	2.60	0.06	1.49
1855	3.45	0.15	1.56	1868	2.58	–.41	1.01
1856	3.05	0.42	1.60	1869	2.13	–1.00	1.13
1857	4.35	0.60	2.42	1870	3.25	0.41	2.09
1858	4.69	1.33	2.90	1871	2.80	–.30	1.77
1859	4.45	1.31	2.98	1872	1.80	–.40	0.81
1860	3.53	1.30	2.54	1873	2.70	–.76	1.40
1861	4.40	0.90	2.56	1874	2.80	–.20	1.67
1862	3.30	1.20	2.50	1875	2.90	–.90	1.42
1863	3.30	0.70	2.10	1876	4.20	–.10	2.51
1864	2.80	–.80	1.57	1877	3.90	1.10	2.31
1865	3.66	–.40	1.30	1878	3.30	0.40	2.06
1866	2.50	1.08	1.07	1879	3.30	–.50	1.14

The average hight of the lake waters above Chicago datum, from 1854 to 1874 inclusive, was one foot and eighty-four-hundredths, as derived from tri-daily observations taken by Col. Graham in 1854–5, and at the city pipe yard on the river since 1856.

The meteorological records of this city give the following as the number of inches of rainfall or its equivalent during each of the last ten years:

Year.	Rain.	Year.	Rain.
1881	44.18	1886	26.77
1882	41.34	1887	29.13
1883	45.86	1888	30.86
1884	34.61	1889	34.95
1885	44.37	1890	32.69
Average	42.07	Average	30.88

The rainfall of the last five years has averaged nearly one inch per month less than the average rainfall for the half decade ending in 1885.

The alluvium and drift deposits, sometimes seventy feet in depth, rest upon the thick limestone conformation common to this section of Illinois. Outcrops of limestone exist west of Wood street near Eighteenth, on Halsted near Twenty-seventh, Stony Island avenue near Eightieth, on West Ohio near Rockwell, and other localities named in the pages devoted to lime kilns and quarries. The true dip of this rock is northeast.

The sand and clay covering of this limestone sometimes exceeds seventy feet in depth, and, even in the neighborhood of an outcrop, shows unusual depth for covering. On the surface a thin layer of black muck is generally found resting on a bed of sand, ranging from seven to fourteen feet in depth, which in turn rests upon a compact blue-clay bed of from three to seven feet in depth. Below this dry blue clay is the great, compact damp deposit of

*The numbers preceded by a dash signify that the lake level was then below city datum.

blue clay, sometimes exceeding fifty feet in depth and always resting on the limestone. The dry blue-clay strata, or the dividing line between the saturated sand and the saturated blue clay, must be considered the true basis of solidity above bed rock. This conformation was unknown when the beginnings of Chicago were made, and thus builders had to contend with difficulties now obviated and very nearly forgotten. It will be remembered that the original surface of the ground was swampy and but slightly elevated above the level of the river, thus making cellars or basements impracticable. The strata underlying the city, as known to the pioneers, was a black loam, a foot in depth, then three or four feet of quicksand to a solid stratum of blue clay, the latter impervious to water. This sand, in wet seasons, became thoroughly saturated with water, which could not sink through the clay and could not flow away. Evaporation was the slow method of its removal; so that in excavations, for foundations or postholes, the work was generally carried on in a sea of mud and water. A majority of the frame buildings rested on posts sunk through the quicksands to the clay. The greatest difficulty was experienced in the arrangement of vaults, as they would fill with water to the surface, rendering a system of levees necessary.

In preparing the foundation for the Rialto building, four boriugs were made on a hundred and seventy-five foot line east and west. This examination resulted in the information that the bed of blue clay was irregular and without geological drift or trend and varying in thickness from forty-five to ninety inches. In February, 1886, "The bearing capacity of Chicago soil" was discussed before the Illinois State Architects Association. Frederick Baumann, who first formulated the idea of isolated piers, and in 1873 published a work on the art of preparing foundations in Chicago, lead in this discussion. He first described the soil peculiar to Chicago, the bed of blue clay found underneath the layer of loam, and the yielding muck beneath the clay. He then gave the theory of the formation of such a soil as elaborated by Ignatius Donnelly, in his "Ragnarok," and stated that such a soil was not found in eastern Asia, Australia, or western North America. This clay, as found in Chicago, was, when dry, hard and very good for foundations, but when wet it was softeued and difficult to treat. There were beds of streams and small rivers running through this stratum of clay which were filled with soft wet clay, and very difficult to treat. There was one where the Holy Family church on Twelfth street is located that caused infinite trouble when the tower was constructed. The use of this clay bed as a base for foundations lies in its capacity to resist pressure. The first requisite in foundations is to find a ground as a base which is as unyielding as possible. The pressure of buildings always comes on the ground itself and not on the foundations; hence, the ground is the prime subject for consideration. On this, a substance must be placed which is not yielding in itself. It need not be dimension stone necessarily. That is used so frequently only because it is cheap and abundant.

He laid down as a first principle, the fact that the areas of base must be in due proportion to the superincumbent loads, and the centers of these areas of base must coincide with the axes of their loads. To illustrate the second portiou of this principle, he would take a piece of plank, one foot square, resting on water. If a stone be placed directly in its center the plank will keep its true level, but. if placed upon one corner, the plank assumes an inclined position, and the axis, which must retain its original angle with the base, is thrust out of its perpendicular line. Therefore, when a base is laid on this clay, and the axis is placed away from its center, there is a corresponding settlement toward the side having the least projection of base. He would establish a rule, therefore, to make the outside projection a little the larger, so that the settlement of the walls, if any, would be inward, where the joists would keep them apart. If the settlement be outward, there is nothing but the anchors to keep the building from parting, and anchors are never strong enough to do this. In cases where there are high and heavy outside walls, with light inside walls, unless the foundations for the inside walls are constructed proportionately to the weight they have to carry, the walls will go over every time. Before this principle became known, and learned by experience, there were many failures of buildings in Chicago. In building the storage reservoir for the old waterworks in 1854, on the old "rookery" lot, where Burnham & Root constructed a building in 1886, there was a circular wall three feet in thickness, upon which the tank was supported. In the center was a light wall which contained the inlet and outlet pipes. When the water was let on, the resistance to pressure on the inside wall being less than it should have been, the ground under the center was forced up and threatened the collapse of the structure. The water was let out as quickly as possible, and a wall constructed intermediately between the outside and center walls, thus equalizing the pressure. If these principles are observed, there can be no remarkable difficulty in building foundations in Chicago.

D. Adler, speaking on this subject referred to his experiences in the construction of Central Music hall. A prominent architect protested against the smallness of the foundation for the corner pier. He was sincere, but misinformed, overlooking the fact that the foundation was constructed directly in proportion to the load put upon it. Incidents are numerous illustrating the correctness of the theory. In many instances it is a positive error to make a foundation large. In 1881 Adler & Sullivan constructed a store building between two heavy party walls, between which were two piers designed to carry a light iron and glass front. The building was rushed through without as close supervision as should have been bestowed upon it. When the work was completed, the mason contractor said that he had done a good job on the center piers. He had put in "busting" good foundation stones, instead of using small stones as specified. The architect became alarmed, and upon examination found that instead of stones two feet six inches square, as specified, he had put in one three feet by four feet six inches, and the other over four feet square. By and by the building was up and, as expected, the walls at the side began to go down with the center piers rigid. The long stone had to be drilled off, and, as it was impossible to drill the other off, the corners were cut off, and a man had to be kept employed for several days in keeping the soil loose underneath the outer edges of the stones, until, in ten days, the trouble was corrected. In many cases where breaks occur in fronts it is due to a like cause. Another condition of Chicago soil makes foundations suffer. Once in a while a soil which is a mixture of quicksand and clay is met with. If the foundations are lower than the sewers, it makes a good substratum for buildings. But if rains come during work and fill the trenches, the foundations will suffer more than in other soil. There is no remedy except to scoop out the wet slush and fill up with dry. Another source of difficulty is an error which is made by all in all kinds of buildings, in calculating too high for the load which is to be imposed on the floors when constructed. The interior pier foundations are made too heavy, and the result is that the outside walls go down and the inside piers go up. Allowance is almost always made for a load which will never come. Again, in small buildings, there seems to be a holding in of the soil by outside walls, causing a convexity of surface (*vide* chapter on foundation work). The foundation at Jackson park shows the cap of a fifty-foot clay bed, seventeen feet beneath the surface.

Several years ago, when the excavations were made for the McCormick university, the workmen found imbedded eight feet from the surface in a sand-gravel-and-shell formation two oak trees of the black and white variety, lying across each other. Modern excavations disclose other mysteries. In October, 1890, while workmen were engaged in excavating for the foundation of the Newberry Library on the old Ogden property, on the north side, they made an interesting discovery. Imbedded in a formation of clay and sand they found several pieces of black oak and cedar driftwood in a fairly good state of preservation. The wood lay about eight and one-half feet below the present surface on what was undoubtedly an ancient beach of Lake Michigan.

In April, 1891, while the excavation for the foundation of Dr. Price's laboratory were being made on Illinois street near Rush street, a scull was brought to light, and the antiquarian realized that it was that of John Kinzie's victim. The following letter from Gurdon S. Hubbard, dated June 25, 1881, gives an outline of the tragedy:

I think that Mathew Irwin was not sub-agent at Fort Dearborn, but that he was United States factor, acting also as Indian agent. His duties were principally confined to Indian affairs, under the direction of the commanding officer when he was not specially instructed by the department at Washington. As regards the unfortunate killing of LaLime by John Kinzie, I have heard the account of it related by Mrs. Kinzie and her daughter, Mrs. Helm. Mr. Kinzie never, in my hearing, alluded to or spoke of it. He deeply regretted the act. Knowing his aversion to converse on the subject, I never spoke to him about it. Mrs. Kinzie said that her husband and LaLime had been for several years on unfriendly terms, and had had frequent altercations. At the time of the encounter, Mr. Kinzie had crossed the river alone in a canoe, going to the fort; and LaLime met him outside of the garrison and shot him, the ball cutting the side of his neck. She supposed LaLime saw her husband crossing, and, taking his pistol, went through the gate purposely to meet him. Mr. Kinzie, closing with LaLime, stabbed him, and retreated to his house covered with blood. He told his wife what he had done, that he feared he had killed LaLime, that probably a squad would be sent for him, and that he must hide. She, in haste, took bandages and with him retreated to the woods, where as soon as possible she dressed his wounds, returning just in time to meet an officer with a squad with orders to seize her husband. He could not be found. For some days he was hid in the bush and cared for by his wife. LaLime was, I understand, an educated man and quite a favorite with the officers who were greatly excited. They decided that he should be buried near Kinzie's house, and he was buried near the bank of the river, about the present terminus of Rush street, and within two hundred yards of Mr. Kinzie's house, in plain view from his front door and piazza. The grave was inclosed by a picket fence, which Mr. Kinzie in his lifetime kept in perfect order. My impression has always been that Mr. Kinzie acted, as he told his wife, in self-defense. This is borne out by the fact that, after a full investigation by the officers, whose friend the deceased was, they acquitted Kinzie, who then returned to his family. In some of these details I may be in error, but the fact has ever been firm in my mind that LaLime made the attack, provoking the killing in self-defense. Most certainly Kinzie deeply regretted the result, and avoided any reference to it.

When John H. Kinzie donated one hundred feet square on this corner to St. James Protestant Episcopal society, a mound over LaLime's grave existed. The building did not extend back to it, as a plat was reserved for cemetery purposes. Even after the old building was dedicated to business uses, the ground was left undisturbed until the coffin, ashes and scull met with a rude awakening at the hands of some Knight of Labor in April, 1891. The skeleton was taken to the Chicago Historical Society's library, at the instance of Major Kirkland. Under the title "What the new Chicago 'skyscrapers' are resting on," the *Tribune* says:

"The multiplication of buildings of great dimensions and correspondingly immense weight within the down-town business section of Chicago has furnished several interesting problems for civil engineers. Before the era of 'sky scrapers,' in the days when a six-story office building was considered to be about the limit of construction, the questions for architects and builders to consider were comparatively few and simple. Such buildings imposed no severe strain upon their supporting surface, and the plans were prepared by architects without much or any attention being paid to anything save making the walls strong enough to carry the floors and the roof. Occasionally a church or large public structure, such as the Federal building or the Courthouse and City hall buildings, demanded something more. In those days the only method of preparing foundations for large and heavy structures was by driving piles into the earth. This was done, for example, at the County building; was done by contract, not without suspicion of 'boodle;' and was done in a careless and slovenly manner, the effects of which are becoming more openly visible every year. For other large buildings the system of preparing an artificial foundation of concrete was tried, and in one notable instance —that of the Postoffice—with most disastrous results. The growth of the city and the enormously increased demand for office-room led to the erection of towering structures of fourteen and sixteen stories. Space being extremely valuable, any plan which would economize it carried its own recommendations. It had been customary to build from the ground up on pyramidal foundations of great strength, but of correspondingly great bulk, thus sacrificing practically all the basement. This basement area grew in value when the introduction of electricity for lighting purposes necessitated a dynamo-room in every important building, and the costly and wasteful system of bulky stone foundations was condemned. Substitutes had to be found and various plans were suggested and tried. It was no longer sufficient for an architect that he should be able to furnish a plan for a handsome exterior and a commodious interior; he must be capable of providing the maximum of strength and solidity, combined with the minimum of bulk in the supporting parts. The services of the engineer became more and more essential and in fact indispensable.

"Preliminary to the construction of any one of the mammoth buildings of which so many are at the present time under way, it is first necessary to ascertain with absolute accuracy the nature of the soil upon which the structure is to be erected. This can only be done by boring, and accordingly preliminary boring tests are made at frequent intervals over the whole surface. Throughout the business section the earth deposit upon which the city is built is of a fairly uniform character. First comes a layer of alluvium, then more or less of a moderately solid clay, which degenerates after a few feet into softer clay, often with an intermixture of sand. As the boring rod descends, the quality of the deposit is carefully noted and every change as carefully recorded. The alternations of the softer and the more solid clays continue, sometimes broken by a pocket of sand or an occasional bowlder, until at a depth varying from forty to sixty feet what is known as hard pan is reached. The underlying rock is not found until a depth of from eighty to ninety feet has been attained; that is, in the business section. South from about Twenty-sixth street the character of the soil changes from clay to sand, and the same is true of certain sections on the west side, where heavy deposits of sand and gravel overlie the clay. About Cheltenham Beach the underlying limestone approaches to the surface and crops out in places.

"Many curious things are brought to light by the boring-rod or during the process of excavation for new buildings. Where these are to be constructed on the site of older structures the workmen of course meet with artificial constructions and deposits which they would much rather not have to deal with. Thus, in clearing the ground for a large store now being built on Dearborn street, they found a well, and at the bottom of it a hundred feet of iron chain. This hole had to be filled to the top with concrete, and so made even with the surroundings. Occasionally they come upon the bed of an old and dried-up creek or rivulet, and near the lake traces of the former course of the Chicago river are found. From the deposits of sand discovered in many places evidences of the changes which hundreds of years have wrought, in the position of Lake Michigan itself are plainly discoverable. Sometimes a pocket of quicksand is struck, greatly to the disgust of builders, contractors, and all concerned. But quicksand pockets make less difference nowadays than of old time, for appliances have been invented for going through them, the device of freezing the entire mass solid being often used in tunneling. Of natural curiosities met with in boring and excavating in Chicago, among the most noticeable are the glacial bowlders, which furnish mute but undeniable evidence of the time when glaciers swept from the north over what is now Lake Michigan, and thence across what now forms the prairies of Illinois. These stones are found of all sizes, from a few inches to two or three feet in thickness and length. They are mostly rounded or elliptical in shape, but on one side they bear the scars which they gathered on their long journey in the glacier. The minute scratches which show the effect of attrition on these bowlders are, as a rule found to be filled up by a limestone deposit, but, this being carefully removed, the results of attrition are plain to the sight. Many of these bowlders, broken and angular pieces which formerly formed part of the rounded mass, are often found.

"Having ascertained satisfactorily the quality of the substratum, the work of laying the foundations for an immense commercial or office building is begun. Contrary to the general opinion that Chicago was originally built in a swamp, the fact is that the city offers as desirable building sites as could be asked. For ordinary buildings. residences and the like, all that is necessary is to strip off the purely alluvial soil down to the first solid clay, and in this dig trenches in which to build the walls. The subsoil of Chicago will carry any building of this character, and the settlement, if any there be, will be equal and regular. On the sandy soils, again contrary to the received opinion, a still better foundation is obtained. Notwithstanding the Scriptural warning against building one's house on the sand, the fact is that sand, being incompressible, will carry anything. That sand is incompressible is proven by the fact that it is impossible to drive a pile through it, while the pile would slip through clay as readily as through cheese. As an example, the piles which form the government breakwater were not driven but set in place by means of waterjets, which scattered the sand so as to permit the insertion of the piles, around which the sand immediately gathered and became firm. The system of strengthening foundations by means of piling has been known and practiced for ages. Venice and Rotterdam are built on piles, and very large buildings are thus supported. In these cases, however, the buildings are practically afloat, the immense number of piles used possessing sufficient buoyancy to support them. On the same principle a building could be constructed in Lake Michigan. But in piling in clay the aim is to reach the hard pan, which may be found at from forty to fifty feet below the city datum. When this is reached it is impossible to drive the piles any farther for the hard-pan would turn an edge tool, and simply blunts up the pointed ends of the piles. The length of the piles is therefore proportioned to the known distance between the surface and the hard-pan, and so much as projects above the surface is sawed off even. This, however, is not done exactly at the surface. To insure the life of piling it must be subject to the influence of water, and either under water or in wet clay its life is practically unlimited.

"In a modification or adaptation of the pile system in use in Chicago for some very large buildings, the piles are sawed off even a foot or so above the ground surface. Upon the tops of these heavy timbers are laid, and these are crossed transversely by railroad iron or steel rails. On the structure thus made a bed of concrete is spread. The system of piling, once almost the only one adopted for large buildings, fell into discredit and disuse in Chicago, largely because of the failures in regard to the Courthouse and other buildings. But in the case of the Courthouse all that was done was to drive thirty-foot piles into fifty feet of wet stuff. Finding no bottom then an attempt was made to supply the deficiency by driving twenty-foot piles on top of the others. As a matter of course the new piles slipped off into the mud and were lost, and the end of it was that the foundations of the Courthouse were soft clay with pieces of timber floating on it and resting upon nothing. A revival of the piling system, the piles being driven down until they strike hard-pan, is now advocated and is being carried into effect in some very large buildings. Of the merits of the controversy between the advocates of this and other systems this is not the place to speak. The plan of making a concrete foundation for the entire building, that is of constructing a smooth and even artificial bed for it, has been tried. So also has the system of connected bearings, as in the United States building, where it was sought to distribute the unequal weight of various parts over supports of varying strength. The condition of the building shows the imperfections of this system. The pyramidal plan for foundation walls proved also unsatisfactory.

It gave strength, but at great expense for stone and labor, and as has been said it sacrifices the whole or greater part of the basement. In one notable instance a pyramidal foundation was put in at great expense. Years passed and the building was not completed. Finally the lot was sold and an immense building, now in course of construction, was designed. But before this could be begun it was necessary to remove the old costly and cumbrous foundation, for space was too valuable to be sacrificed to it, and new methods of construction did not permit of its use. It took many weeks and a large outlay of capital to remove the old foundation, for it had become as solid as the everlasting hills and had to be loosened by dynamite.

"A system of foundation laying which has come into vogue of late years, and which is being applied on a large scale in the construction of Chicago buildings, is that known as the 'isolated pier' system. The surface having been removed until solid clay or hard pan is reached, a bed of concrete is spread. Upon this steel rails are laid to the number of a dozen or more. Crossing these are smaller rails, and these are crossed again by other rails, the whole being imbedded in concrete and finally boxed in. The center of the structure thus formed affords a resting place for one of the steel posts which serve to support the building. Larger or smaller pier-carriers, according as to whether they are to support the piers of the outer or inner walls, are used. It must be remembered that in the architecture of large buildings in Chicago at the present day a radical departure has been made. Formerly the walls were built to carry the floors and the roof. Now the floors carry the walls. One of these sixteen-story buildings of to-day consists of a homogeneous steel frame, all the parts of which are riveted together. The walls are a mere veneer of brick or terra cotta, and serve simply to keep out the weather. They are often of glass; they might be of canvas or paper if desired, for they have nothing whatever to do with the stability of the building. The walls of one, two, or half a dozen floors might be torn down and the rest would stand. The steel frame on the supporting piers constitutes the building, and the walls are no more essential to its standing than the stairs or the windows are. One great difficulty met with by engineers in devising large and heavy buildings is that of providing against the settlement of adjoining buildings of smaller size and weight. All sorts of devices have been tried to overcome this trouble, the principal one now used being the extension of the foundation of the new building under the old one. Of course this is not feasible where the new one is to be carried on piles while the original is not so supported. But where concrete is used it can be carried under the old building, and the systems in which steel rails are used can be extended to take in the supposably weak sister already in occupancy. Allowances have to be made in all such cases for the natural settlement of the new structure, and this is a matter involving great nicety of calculation. But Chicago engineers and architects are full of expedients, and, with the advantage of experience in the construction of immense buildings, they are able to grapple with each difficulty as it arises. It goes without saying that the bearing strength of all material used is known to a certainty, and that foundations are built amply adequate to the strain which is to be put upon them. Under such circumstances the people of Chicago can feel satisfied that the great 'skyscrapers' are built to stay, and they may be confident that, short of an earthquake, nothing can disturb their solidity."

The formation of part of the city's site is due to glacial force. The Stony Island anticlinal leaves no room to doubt the presence of glazial power in remote ages; for the great mountain of stone, which rose above the water a thousand feet and covered an area of 8,000x1,400 feet was moved from its bed by this power and carried away to be distributed on other sections of the elevated lands. So also with the stone beds at Blue Island and down the Desplaines. The irresistible glacier forced them forward, ground them into pebbles or rolled them into bowlders. High divides disappeared, and the country between the head of Lake Michigan and the Mississippi was given topographical possibilities, which appear, even now, to be little understood and only partially utilized; although the French explorers defined such possibilities over two hundred years ago.

The selection of a point above and near the ancient mouth of the Chicago river was made, so says tradition, under the tyrannic rule of love. Shortly after the treaty of Greenville the United States resolved to place a garrison somewhere near the head of Lake Michigan, and sent an agent hither to report on the site. Near the mouth of the Calumet river appeared to him well suited for the purposes of a fort, and his intention was to recommend it. Exploring northward he arrived at the Chicago settlement, where his mission being known, every effort was put forth to win his favor for the upper location, and, among the most subtle agents, working for Chicago, was the daughter of the trader, Le Mai. She was a pearl in the sea of rocky humanity gathered here, and for her sake and in answer to her pleadings, the Federal agent forgot the deep, wide Calumet river and harbor and recommended the upper river as the proper location. In 1803 the fort was built here. In 1833 the late Jefferson Davis, then a lieutenant of engineers, objected to the expenditure of money on the improvement of the upper river and urged in language which could not be mistaken the claims of the Calumet as the only place where a safe harbor could be made at a reasonable cost. The proposition was fought by the villagers round the fort. They won, and only in recent years has the true harbor received attention.

The first survey was completed in 1830, for the commissioners of the Illinois & Michigan canal, by James Thompson, on the south half of section 9, township 39, range 14, or from Kinzie street south to Madison, and from State street west to Halsted. On this tract a few cabins stood. That belonging to the agency occupied the center of North State street, near the river bank; that of McKee stood at the southwest corner of State and Kinzie, and extended into the present State street; Portier's cabin was a little southwest of McKee's and Wolcott's log house, on the river bank, southwest of Portier's; John Miller's cabin fronted on the river, at Wolf Point, between the north branch and the bayou, and Mark Beaubien's first frame house, on what is now the southeast corner of Lake and Market. This may be called the southeast quarter of section 9. West of the two branches, or the southwest quarter of the section, was the La Framboise store and cabin, on the river bank, just north of Madison street; Chief Che-chi-bin-quay's, or Alexander Robinson's store, stood on the west bank of the south river, almost due west of Beaubien's Point, and Elijah Wentworth's house, on the west bank of the north river, opposite Wolf Point. J. B. Beaubien's store, on the west bank of the old river, Fort Dearborn, at the corner of River street and Michigan avenue, Craft's store and house, on northwest corner of Madison street, opposite mouth of old river, and the Kinzie house, on the river front, between Rush and Pine streets, were all east of the original plat. On this tract of three-eighths of a square mile the name Chicago was conferred, by the canal commissioners, as it was the name given by the officers of Fulton county, Ill., to the election precinct established here September 2, 1823, and by the officers of Peoria county in August, 1826. The north side streets shown in the original plat are Kinzie, forming the north line, Carroll, running parallel with the river from Franklin to State, with North Water street forming the river front of Wolf Point and the northern extensions of Market, Franklin, Wells (Fifth avenue), La Salle, Clark, Dearborn and the line of State street. South of the river are South Water street, Lake, Randolph, Washington and the line of Madison, intersected by the north and south streets named above, with East Water street running along the west bank of the south branch.

The village was incorporated August 5, 1833, and the following named trustees elected: T. I. V. Owen, George W. Dole, Meadore D. Beaubien, John Miller and E. S. Kimberly. This body met August 12, that year, and designated the boundaries of the commune as follows: From the intersection of Jackson and Jefferson streets, north on Jefferson to Ohio streets, east on Ohio to the lake shore, thence south along the lake shore to the center of the Chicago river, west to State street in this river center, south on State to Jackson and east on Jackson to Jefferson street. The whole area was about seven-eighths of a square mile and the population about two hundred. The fact that one hundred and sixty frame houses were built that year would indicate a large addition to the number of inhabitants.

The town of Chicago as incorporated February 11, 1835, embraced sections 9 and 16 and north and south fractional sections 10 and 15, township 39 north, range 14 east of the third principal meridian. The act, however, provided that the authority of John S. C. Hogan, John K. Boyer, John H. Kinzie, Gurdon S. Hubbard and Ebenezer Goodrich, then trustees of the town, should not extend to south fractional section 10 until its evacuation by the United States. This territory was bounded on the south by Twelfth street, on the west by Halsted, on the north by Chicago avenue and on the east by the lake.

Under the act of March 4, 1837, the name "City of Chicago" was conferred and the limits extended to Twenty-second street on the south; Wood street on the west; North avenue on the north, with the lake on the east. A small tract on the lake shore, east of La Salle street and north to a line south of an imaginary extension of Armitage avenue east, was included, the congressional description of the whole being: "East half of the southeast quarter of section 33, township 40 north, range 14 east, and fractional section 34, township 40, range 14; also east quarter of sections 6, 7, 18 and 19, all of fractional section 3 and of sections 4, 5, 8 and 9 and fractional section 10 (except the southwest fractional quarter thereof, occupied as a military post, until the same shall become private property), and fractional section 15; sections 16, 17, 20, 21 and fractional section 22, township 39 north, range 14 east. For a whole decade the citizens were content with the size of their town, but were discontented with the character of improvements, so that they sought a change of some kind. The act of February 16, 1847, authorized the first extension of the "city," and constituted Western avenue the western line from North avenue to Twenty-second street, thus adding the western two-thirds of sections 6, 7, 18 and 19, township 39, range 14, omitted in the act of 1837. The east half of section 33, township 40, range 14 was also added, that part mentioned in the act of 1837 included.

The second extension of the city was authorized by the act of February 12, 1853. The erection of a few important buildings, the attempts at grading and sewering, and the growing opinion that in time the village might be something, suggested the idea of "spreading herself," and hence the legislative leave to spread. The north, south and west divisions are names applied in this act for the first time, for the limits are designated by divisions. All those parts of sections 31 and 32, township 40 north, range 14 east, lying east of the center of the north branch and the west half of section 33, township 40 north, range 14 east, were assigned or added to the north division, i. e. from North avenue to Fullerton avenue, and from the west line of Sedgwick street to the north branch. The addition to the west division embraced the angle formed by the south branch, Twenty-second street and Western avenue, or fractional sections 28, 29 and 30, in township 39 north, range 14 east, while to the south division were added all of sections 27 and 28, from the lake to Halsted, north of Thirty-first street, except the extreme northwest corner of section 28, within the angle assigned to the west division.

The third extension took place a decade later, in the midst of civil war—February 13, 1863. The house-moving and stone sidewalk and sewer era had been introduced some years before, and now the modest citizens were seeking a greater area to which the old buildings might be moved or on which humble ones could be erected. It was a wise measure, for it enabled the working man to purchase a lot and build a little home on the prairie that would hold him here and make of him a useful citizen. This act added parts of sections 31 and 32, from North avenue to Fullerton avenue, and from the north branch to Western avenue, to the north division, while to the south division were added the tract north of Thirty-ninth street, known as sections 31, 32, 33 and 34, from Western avenue to the lake, south of Thirty-first street, with fractional sections 29 and 30, north of Thirty-first, between Halsted and Western avenue, bounded north by the south branch. The extensions noted and the original town constituted the city as known until 1869.

The fourth extension was authorized by the act of February 27, 1869. It is remarkable that, as the town was incorporated in February, 1835, only one exception to the rule of approving acts in February, relative to the extension of limits, is known for over three decades, and that exception dates back to March, 1837. Could it be that the thoughtful executive took this means for warming the hearts of citizens in the cold month of February, as he did in that March of 1837, when the chill of panic was visibly removed by similar action? The addition made in 1869 equaled in extent more than one-half the city of 1868. With the exception of the south half of section 36 and a small angular piece of land in the southern part of section 35, township 39 north, range 13 east, the whole tract from Crawford avenue, or West Fortieth street to Western avenue, and from Thirty-ninth street to North avenue (about eleven and one-half square miles) was ushered into the city. The congressional description of this addition is known as sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26 and parts of sections 35 and 36, township 39 north, range 13 east.

At the close of the fiscal year, 1873–4, a city embracing an area of twenty-two thousand four hundred acres was presented. Within this area were: Six hundred and nine miles of streets, one hundred and seventy miles of sewers, three hundred and fifty-one miles of water-pipe, fifty bridges, lake, river and land tunnels, water works, one hundred and sixteen thousand and fifty feet of river, canal and basin, or two hundred and thirty-two thousand one hundred feet of interior river frontage. At the close of 1879 the thirty-six square miles known as Chicago, embraced seven hundred and eighty-nine acres of public parks and three hundred and eight-five acres of river, canal and shipping basins, or slips, or twenty-nine miles of river frontage and twelve miles of slip and basin frontage, seven hundred and sixty-one miles of sidewalks; over one hundred and thirty-nine miles of improved streets of the six hundred and fifty miles of streets within the city; thirty-two bridges and eighteen viaducts; four hundred and forty-three miles and six hundred and ninety-eight feet of water pipe; three thousand two hundred and thirty hydrants; two thousand nine hundred and ninety-two stop-valves; two thousand and sixty-seven water meters; ten thousand eight hundred and eighty-two street lamps; three hundred and twenty-two miles and one thousand four hundred and one feet of sewers constructed between 1855 and December 31, 1879, at a cost of $5,280,-894.85.

On May 16, 1887, the fifth addition to limits was made by the legislature. This is known as section 36, extending from Kedzie avenue east to Western avenue, and from North avenue to Fullerton avenue. The legality of the method of admission was tested in the courts, but the will of the people conquered that of the township officials and "section 36" became a part of Chicago.

The sixth extension, authorized by the act of April 29, 1889, added to the city parts of sections 35 and 36, township 39 north, range 13 east, south of the canal and known as Brighton Park, ignored by the act of February 27, 1869, in describing the fourth extension. Sections 3, 10 and 15, east of West Forty-eighth street, and the eastern two-thirds of sections 22, 27 and 34, east of West Forty-sixth street, extending to Crawford avenue or West Fortieth street, and from Thirty-ninth street to North avenue, formed the main portion of this addition, while section 25, known as Maplewood, bounded by Fullerton avenue on the south, Belmont on the north, Kedzie on the west and Western avenue on the east was also admitted.

The seventh extension was made under the general law of Illinois, providing for the admission of towns, townships, cities or villages into cities. The order of the County court of Cook county, filed July 15, 1889, declared that the special election of June 29, 1889, was legal in every particular, and that the east half of sections 4 and 9, township 39 north, range 13 east (or the area bounded by Madison and West Forty-eighth, North avenue and West Fifty-second street), formerly of Cicero township, was part of Chicago. The same order of July 15, 1889, admitted the city of Lake View, all of Jefferson township not hitherto annexed, the village of Hyde Park and all of Lake township. The annexation of this large and populous territory to Chicago was so zealously contested by the municipal officials of each district that the will of the people appeared, at one time, to count as nothing in opposition to the amphibological laws of the period and the interests of the office holders. At the close of 1889 the city extended from North Seventy-first street to South One Hundred and Thirty-eighth street, twenty-four miles north and south and ten and one-half miles east and west on the line of Eighty-seventh street.

On April 15, 1890, the village of Gano, two square miles, was annexed, thus increasing the area from seven-eighths of a square mile in 1833 and two and fifty-five hundredths square miles in 1835 to one hundred and seventy-five and five hundredths square miles in April, 1890. On May 5, 1891, the admission of the village of Fernwood occurred. The territory so added is described as follows: The west half and the west fifty feet of the east half of section 9; the east half of the southeast quarter and the southeast quarter of northeast quarter of section 8, and the south six hundred and sixty-six feet of northwest quarter and the west fifty feet of southeast quarter and west fifty feet of the south six hundred and sixty-six feet of the northeast quarter of section 4, all of township 37 north, range 14 east of third principal meridian.

This gradual building up is summarized as follows:

	Square Miles.		Square Miles.
August 12, 1833	.87	February 27, 1864	11.35
February 11, 1835	2.55	May 16, 1887	1.00
March 4, 1837	8.15	November and December, 1887	7.15
February 16, 1847	3.33	July 29, 1889	128.24
February 12, 1853	3.90	April 15, 1890	2.00
February 13, 1863	6.48	May 5, 1891	

The following parks and public squares are situated within the city.

	Acres.		Acres.
Lake Front park	41.00	Humboldt park	200.62
Ellis park	3.38	Garfield park	185.87
Washington square	2.25	Douglas park	179.79
Dearborn park	1.43	Jackson park	586.00
Congress park	0.7	Washington park	371.00
Union square	0.5	Gage park	20.00
Campbell park	0.5	Midway plaisance	80.00
Aldine square	1.44	Shedd's park	1.00
Oak park	0.25	Logan square	4.25
Green Bay park	0.25	Holstein park	2.3
Lincoln park	250.00	Woodlawn park	3.86
Wicker park	4.00	Groveland park	3.4
Union park	14.3	Douglas monument square	2.02
Jefferson park (old city)	5.5		
Jefferson park (former town of Jefferson)	5.00	Total	1,974.61
Vernon park	4.00		

FIRST PLAT OF CHICAGO.

Calumet lake covers an area of three thousand one hundred and twenty-two acres; Hyde lake three hundred and thirty and eight-tenths acres, and that part of Wolf lake west of the Indiana line, six hundred and forty-two and eight-tenths acres. The frontage on Lake Michigan is about twenty-two miles, and the river and canal frontage, within the present limits, about eighty miles (both banks).

The boulevards completed at the beginning of 1890 measured about sixty miles in length and embraced over one thousand acres.

When Chicago was first surveyed, its proprietors had no idea of its future destiny. They conceived a population of ten or fifteen thousand, and gathered their prospective family within the irregular quadrangle formed by the Chicago river, its south branch and the lake. They witnessed the union of fifteen thousand, and, like the farmer, who, as his family increases, makes additions to the old homestead, had streets surveyed on parallel lines to the original thoroughfares, leaving the regulation squares and the streets intersected by right angles, just as they appeared on the original paper submitted to them by the old straight up and down surveyors. Good souls! They never dreamed that within the eventful period of their own lives one million people would win health and bread on the marshy tract; their brightest day dreams could not picture it a location for a city of five million inhabitants, as many now expect it will be, and thus they lost sight of a most important feature in laying out a great city, even as a generation of their successors failed to see the omission.

Thus it was that no provision was made for quick transit for a large population on lines radiating from the great business center. It is true there are Cottage Grove avenue, from Thirty-ninth street to Twenty-second street; Archer avenue, from Brighton to Nineteenth and State streets, and Vincennes avenue, from State and Sixty-ninth streets to Halsted and Eighty-seventh streets, on the south side. They lead only to State street. On the west side, Canalport avenue, Blue Island avenue, Ogden avenue, Colorado avenue, Grand avenue, Milwaukee avenue, Elston road and Holcomb avenue exist, and on the north side, Hawthorne avenue, Clybourn avenue, Lincoln avenue and the northern extension of Clark street are found. Do you think the surveyor originated all those short cuts to and from the business center? Not at all. As a matter of fact, he was displeased with this infringement on his ideas of regularity and rectangular squares. The important and really useful avenues were opened by the farmers in the old days of prairie schooners, and their natural selections were merely followed by the surveyor. The channel of the river, the shore of the lake or the short line of an old railroad right-of-way suggested the others. The requirements of a great city had nothing to do with the adoption of such cut-offs, and it is doubtful if antipathy to centralization ruled subsequently when those streets were actually surveyed, even if they seem to be opened only for the convenience of a section. This improvidence of the past denies Chicago a true geographical business center; leaves the northman, who desires to visit the west side, to travel south in a direct line, and thence west in a direct line; treats the southsider similarly, and uses the westsider indiscriminately. To rectify this error of the past, millions of dollars must be expended, opening up new angular avenues and giving direct thoroughfares to all parts of the great city.

The Fort Dearborn addition to Chicago has a history both interesting and instructive. The seventy-five and sixty-nine-hundredths acres, known as fractional section 10, township 39 north, range 14 east, formed the Beaubien claim and, as such, was known in the courts of Chicago and Washington, until 1878. Even to-day fractions of it, known as Dearborn park and part of the lake front, make food for lawyers.

In 1812 Beaubien purchased Charles Lee's claim and cabin on the lake front; in 1817–8 he paid $1,000 to Dean for his house on the west bank of the old river, near the foot of Randolph street; later he purchased the American Fur Company's interest in the old building, known as the United States factory, and subsequently became owner of other improvements and lands by purchase. In May, 1835, he entered his pre-emption claim to the southwest fractional quarter of section 10, township 39, range 14, before E. D. Taylor, receiver, and James Whitlock, register of the United States land office at Chicago. Those officials consulted D. J. Baker, Sidney Breese and other lawyers, and on their advice issued certificates of entry to Beaubien and received $94.61 in consideration. A year later, a part of this tract, which the owner conveyed to Murray McConnell, a lawyer of Jacksonville, Ill., was introduced to the courts as an ejectment suit under the title "John Jackson ex-dem. Murray McConnell *vs.* de La Fayette Wilcox." Judge Ford's decision showed the validity of Beaubien's title, but, as the patent was not yet issued, ejectment could not be enforced, and proceedings to obtain a patent were suggested. The Supreme court of Illinois held similar views, and in 1839 the fight was transferred to congress. There, Henry D. Gilpin, solicitor of the treasury, presented the statements of James H. Collins, Buckner S. Morris and Justin Butterfield, three pioneer lawyers of Chicago, charging the United States receiver and register with collusion in issuing the certificate to Beaubien. This was enough for the congressional committee on claims, although the members knew Beaubien's certificate of 1835 to be as valid as the certificate issued to John Kinzie's heirs in 1831, for a fraction of section 10, north of the river. The claim was disallowed. In the United States Supreme court the claim was also presented in 1838. Every opposition was offered by this court, and in March, 1839, the judgment of the Illinois Supreme court was reversed.

The Chicago lawyers and other interested parties urged the prompt sale of Beaubien's claim, and, responsive to their desires, the secretary of war ordered the survey of Fort Dearborn addition to Chicago. In April lots were advertised for sale, and on June 20, the sale took place, Government Lawyer Collins buying five of the six lots, which Colonel Beaubien desired to hold. This action of Collins led to the indignation meeting of June 21, but he continued to reside here until 1854, when cholera in its most frightful form swept him away from the enjoyment of the old Beaubien homestead.

In 1840 the United States court took measures to cancel the certificate and receipt given to Beaubien in 1835, and on December 18, 1840, the pioneer presented the documents and received back the $94.61 paid into the land office. In 1878 the claim was re-presented to congress, but Senator Bayard, of the committee on private land claims, reported adversely.

Fort Dearborn addition extended from State street to the lake, and from Madison street to the river. The plat, made under order of April 23, 1839, was acknowleged June 6, 1839, and recorded June 17, that year. The tract east of the east line of block 12, south of the south line of blocks 10 and 11, north of the north line of block 15 and east to the lake shore, was declared public ground. The whole area was fifty-three and one-quarter acres, or fifty-six and one-half acres, including three and one-quarter acres of land carried away by the waves.

In 1848 was passed the act appropriating $10,000 for building a marine hospital on the northern part of block 5, with east front on Michigan avenue, or the south ten feet of lot 1 and lots 2, 3, 4 and 5 in block 5. The hospital was burned in 1871, the same as purchased by the Michigan Central Railroad Company.

In 1850 the Illinois Central Railroad Company purchased for $45,000 a valuable part of the reservation, and in 1854 lots 1 to 6 in block 4, fractional lots 8 and 9 in block 2 and the north 34 feet of lot 1 in block 5, or the old lighthouse site, were donated to J. B. Beaubien.

The lake front surveys have been before the legislature and courts for over two decades. The parties chiefly concerned are the government of the United States, the state of Illinois, the city of Chicago, the Illinois Central Railroad Company and the owners of property upon the west side of Michigan avenue, between Randolph and Twelfth streets. By a decree entered in the Circuit court of the United States for the northern district of Illinois, in accordance with an opinion rendered by Judges Harlan and Blodgett, in February, 1888, it was determined as between the parties to that suit,

First. That the Illinois Central Railroad Company was the owner of the made land north of Randolph street as far as the Chicago river, and of the made land south of Park Row and extending to Sixteenth street, because it was the shore or littoral owner. Second. That the Illinois Central Railroad Company had a right of way two hundred feet in width on the outer line of what is now open ground, between Randolph street and Park Row, known as the lake front. Third. That the city of Chicago was the owner of the open ground between Randolph street and Park Row, east of Michigan avenue, and the shore owner, notwithstanding the right of way of the Illinois Central Railroad Company, but in trust for the public.

That case did not settle the rights of lot owners on Michigan avenue opposite the so-called lake front. It was claimed there by the Illinois Central Railroad Company that under the act of the legislature of Illinois, of 1869, it was the owner, but without power to sell or convey the fee of the submerged land for one mile to the eastward of its right of way, between Randolph street and Park Row. This claim was denied by the court. An appeal was taken in this case by the government, in which the Illinois Central Railroad Company joined, and presumably other parties will join. The case is now pending at Washington. It will not be heard for two or three years.

In the case of the Catholic bishop of Chicago against the Lincoln park commissioners, lately decided by Judge Tuley, in 1890, it was held that the state was not the absolute proprietor of lands covered by the waters of Lake Michigan, in the same sense as it would be the owner of the land upon which the state house stands; that is, it holds the submerged land mentioned in trust for the public to preserve the right of navigation, subject, of course, to the paramount authority of congress. In the same case Judge Tuley also held that the riparian or shore owner had the right to fill out by artificial means to navigable water, so long as he should not be interfered with by the state or general government.

The whole lake-front question is a complex one in which the nation, state and municipality are interested, and, like many other questions affecting great interests, is dragged along slowly from court to court.

The message of Mayor Cregier to the council, published in April, 1891, refers to the city's boundaries, thus: "During the year ending April 27, 1891, our city's territorial limits have been extended on the south by the acquisition of portions of the villages of Gano, Calumet, West Roseland, Washington Heights and Fernwood (annexed the present week), embracing in the aggregate an area of ten and fifty-seven-hundredths square miles, bringing within the present municipal boundary one hundred and eighty-one and one-half square miles, equal to one hundred and sixteen thousand acres. From the incorporation of the original town of Chicago there have been ten extensions by annexation; nine of these were added during the past two years, embracing one hundred and forty square miles. The city's limits extend from north to south on the line of Halsted street, a distance of twenty-one and one-half miles; from east to west on the north line of Eighty-seventh street the city is ten and one-half miles wide, and on the south line of the same street the distance between the limits is four and one-half miles. This indeed constitutes a vast area within one city. Ordinarily men and women who have resided any considerable length of time in a city, become more or less familiar with its various localities. How many of our citizens, old or young, have ever traversed the great city of Chicago and are sufficiently familiar with different sections to point the way or even find their way throughout its length and breadth?"

Within these boundaries are thirty-two hundred and ninety acres of public park, seventy-four miles of driveways, twenty-five hundred and thirty-seven miles of sidewalk, twenty-two hundred and thirty-five miles of streets, including six hundred and sixty-nine and sixty-four-hundredths miles of paved streets; forty-one miles of river frontage, about twenty-five miles of lake frontage, twenty-nine viaducts, sixty-one bridges, thirty-seven thousand street lamps, nine hundred and twenty-nine electric street lights, twelve hundred miles of electric wire used by city, three hundred and ninety-five and one-third miles of street railroad track, thirty-five railroad termini, two hundred and eighty-six public schoolhouses, about one hundred denominational schoolhouses, four hundred churches, twenty-eight police stations, seven-hundred and eighty-four and one-half miles of water mains, nine and one-half miles of water tunnel completed with eight miles under construction and seven hundred and eighty-four and one-half miles of main sewers. The old tunnels connecting the north and south and south and west divisions with the driving tunnels now being constructed are important works.

CHAPTER II.

SANITARY PLUMBING.

YEARS before the introduction of Christianity the plumber was a certain communal quantity. Without him the great cities of antiquity never could have risen to importance, for Hygeia, the precise goddess of health, decreed that the plumber should be the foundation of municipal greatness as the laborer should be of national wealth. In the days of Antioch and Pompeii the plumber and the lead pipe were well-known institutions. Later, Rome, herself, won the workmen inside her walls, and for centuries, controlled the trade before it spread to Spain and France. In 1539 Robert Brocke was the first to cast short lengths of lead pipe, by the use of molds, in England. The lengths were jointed together by a process of burning. A native of St. Germain, in the reign of Henry IV. of France, invented a process by which the pipe could be made any desired length as follows: The mold was placed in a horizontal position, the metal poured in on top near one end, and when cast, was drawn out; only one or two inches were left in near the spout where the metal entered, so that when another length was cast the hot metal would melt the end thus left, and become a continuous part of the pipe, and so on until the required length was made. The practical making of pipe by the use of piston, cylinder and press, was begun in 1820, but it was talked of as far back as 1705, and plumbers were themselves inventors. The hatchet, straight soldering bolt, round-iron, torch, blowpipe and wipingcloth, completed the worker's simple outfit, but, nevertheless, great work was accomplished by the simple artisan, and the more simple implements of ancient times, as is evidenced by specimens rescued from the ruins of cities and buildings of long ago. In the museums of antiquities throughout the world, the work of ancient plumbers may be examined and, at Rome, their fittings may be seen in use. In the Cherchel museum is a piece of lead pipe made by rolling a sheet of metal, turning the edge over, and then running molten lead along the joints.

With the introduction of printing the useful arts improved, and in this improvement the plumber shared. His methods changed gradually, but so much like a snail's pace, that in 1850 a few more implements only could be found to mark his progress. Whatever work was accomplished, however, was solid in character, and, according to the light of those times, quite in keeping with the plumber's notions. A worker in Chicago for about thirty years, supposes a workman of 1851, to awake from a long sleep, in 1891, and visit the shop where he labored forty or fifty years ago. What a change he would find in the methods of work since he went away. The old-time workshop has been turned into a storeroom for materials. The well-planed straight-edge work-bench is sadly out of repair. One work-bench is to be seen where there were many before, and few tools belonging to the master are now to be found in the tool rack, except gasfitter's tools which were not known in a plumber's shop at that time. The round-irons which were so symbolical of the trade, a candle has to be lighted to look for them, and, after a search one may be found. One man is to be seen preparing or wiping a joint on a stopcock, or check and wastecock. He asks where are all the men, and he is told twenty men are at work on new and old jobs. The charcoal furnace and soft-coal stove are no more, but in their place is the gasoline furnace. The cast-iron trap mold and offset mold have been sold for old iron or may be found lying around the shop, but never used for its original purpose. The round-wood mandrel for forming lead soil pipe may be found, but is seldom used. Everything pertaining to the shop of fifty years ago has disappeared, and in its place a hundred new forms in brass, copper, iron and lead, may be seen. The old simple systems are all gone, and the working plumber of to-day, being no longer a manufacturer of raw material, is seldom found within the shop.

In February, 1886, J. J. Hamblin delivered an address on "Old time plumbing." At the end of the first day of his apprenticeship he was sorry he had undertaken to learn the trade, but, a few weeks later, he supposed he knew all about plumbing. To tell the truth he did not know the difference between the pull of a water-closet and the pull of a bell, both looking alike. He soon found out the weight of a coil of lead pipe, for he had to carry it up a three-story ladder on his shoulder. The plumber's boy of to-day would cut the coil in two, or tell the journeyman to carry it up himself. He soon learned how to heat solder, after burning a few pots and listening to "gentle" lectures for being careless. How soon a boy learns anything he takes an interest in! Not long after this he was melting some old lead. He happened to have a piece that was wet and put it in the pot. His hearers knew well the result. He did from that time on. After a while he began to look things squarely in the face. He made up his mind he was a botch. He resolved to turn over a new leaf and try to become a plumber. He considered all new devices and began to think for himself. He could now look back to a great many mistakes he made, which he could profit by if he were to go over the same course again. As to plumbing in the fifties, as compared with that of to-day, he thought there were much better mechanics then than now. They were mostly foreigners who had learned their trade under better discipline in the old country. At that time they did not have so many patents and curious devices as plumbers have to-day. There was no ventilation then—no back ventilation—they depended on the trap to keep out that monster sewer gas. All traps and most other fixtures were made by hand, and as to lead-workers, from which term the name "plumber" is derived, he had seen them equal to any of the present day. There is nothing worth greater consideration in the construction of a city dwelling than its plumbing. On the plumbing depends the health of the inmates, and on health depends the pleasure of living. From the sewer in the basement to the top of the ventilator shaft, death lurks in defective plumbing. Ill health, despondency, doctor's bills and death follow surely in the path of the ignorant or vicious or negligent worker in leaden pipe and traps, while health, hope and courage are generally found in that house which the honorable and intelligent worker fitted up on true sanitary principles.

The plumber of modern times must not only be a worker with his hands, but also with his head, a mechanic skilled in his trade, studious of the art, quick to learn from his experiences. He must differ widely from the solderer of a past age, who had only to provide the supply and waste pipes, set them in the place assigned by the architect, make a few simple joints without regard to taste, and charge a modest sum for his labor and material. He must have a practical knowledge of sanitary science, hydraulics, ventilation, heating and draining, and the will and strength to act according to such knowledge, for his success in business, as well as the health of his clients, must depend upon his intelligent appreciation of what is due to himself and to them. For good work he should demand good pay, and as one is the corollary of the other, the first should always be observed. The work of the ancient plumber was strong and rough, the work of the modern plumber must be durable and neat.

The model plumber is not a *rare avis* in Chicago, as pictured by Architect Pierce from an architect's point of view; he is everywhere throughout the city, but "mixed in" with him are others who are without principle, the same as in any other trade or profession. The writer says: "The journeyman plumber, like the journeyman of all other trades, is good, bad, or indifferent, not because he is a plumber, but because he is human, and because of the varying degrees of intelligent interest he takes in his work. Even the influence of that great leveler 'the union' has not yet succeeded in wiping out this personal equation and reducing all journeymen to a dead level of mediocrity or worse. If he is an indifferent or a poor workman, he is a thorn in the side of the conscientious architect or superintendent (and probably not less so in that of his employer), but not more so than the poor workman of other trades. But it is the contracting plumber which this article was intended to deal with, and the journeyman may be dismissed with the statement that if intelligent, capable and willing, he will coöperate with the architect to the extent of making the best of unfavorable circumstances and conditions; but if dull, vicious or slovenly, he will sometimes defeat the architect's intentions and make an indifferent job of the best planned work. The model contracting plumber may be considered under several heads, which I will take up in succession, assuming that the work under consideration is to be contract work. He may come with a letter of introduction or a testimonial, or he may be introduced personally by a mutual acquaintance who can vouch for his capabilities and character, or he may introduce himself. In either case the architect who has not already a long list of trustworthy plumbers to select from, will be glad to add to that number. And now, assuming that the applicant has satisfied the architect that he is capable, honest and trustworthy, and has been invited to figure upon plans of prospective work, the model plumber will develop about the following traits:

"Care in studying the plans and specifications, to find what the architect's intentions are, and, in case they are clear and unmistakable, as shown by plans and specifications taken conjointly, to assume that such evident intention is the architect's intention, and figure accordingly. In case of conflict, or obscurity of meaning, or of evident oversight in plans and specifications (taken conjointly), the plumber will make memoranda of such matters, and get the architect's explanations thereon, or, perhaps, a correction of the obscurity or oversight before submitting his tender. He will not remark that competing plumbers will probably take advantage of any obscurity or oversight, or that he (the orator) will do everything exactly as it should be done, whether specified or not. He will not be over-inquisitive to learn who his competitors are, either by 'pumping' assistants or the architect himself, but will assume that the architect's interest to have good work affords a reasonable guaranty of good faith that no one without a fair reputation for honesty and ability is likely to become his competitor, and if his mind is not clear upon that point he will excuse himself from figuring upon the job, leaving the architect to fill his place by some one else.

"But suppose now that he has found plans, specifications and architect satisfactory, and has made up his estimate; he will seal it, and address it to the architect, endorsing upon the outside of the envelope, 'Tender of A. B. for plumbing, Etc., of houses for C. D.,' and will send it in by mail or otherwise to await the action of the architect and owner, who, when all the tenders are in (and the two can take the time to go through the entire list), will consider them, and decide upon the award of the contracts. This may be within a few days or perhaps a week or more after all bids are in. The model plumber will not forget to send his bid in promptly; he will not send it to the owner instead of the architect; he will not ask that he be notified if some other bid is below his, as 'he would not stand for a few dollars;' he will not fail to put his name upon the outside of the envelope so that the architect may know when all bids are in, also to prevent premature opening. He will not go to either owner or architect after the bids are closed and ask to be taken in and allowed to figure, nor will he propose to either of the parties mentioned to take the job at or below the figures of some other plumber. He will not state the amount of his bid either to the architect or to any other person; neither will he hand in an unsealed bid expecting in either case to get some 'pointer' which will enable him to modify his bid if necessary to secure the work. While enterprising owners, and even architects, have been known to countenance such methods, the model plumber will join with the model architect in discountenancing them at all times. He will not besiege the architect's office as soon as his bid has been sent in to find out 'when those bids will be opened' upon some plausible pretext, but will, if he has been awarded other contracts meantime, which will prevent him from desiring the one in question, ask leave to withdraw his bid, stating frankly the reason.

" When the architect and owner open the tenders, they will find no equivocal wording in that of the model plumber. It shows exactly what he proposes to do the work for according to plans and specifications, and if any estimate of changes has been verbally asked for by the architect, he has not forgotten to state the change in price such modification would make. He is not the one who reasons that by forgetting to comply with this verbal request, he may stand a better chance to get the job, and can then, perhaps, get a better price for the changes.

And the clear presentation of his estimate will be one point in his favor, and may give him the award even if lower estimates have been made, indeed, one or more of the estimates may be so low as to insure their rejection upon the warrantable assumption that there has been some gross error, or inability to estimate correctly.

"When architect and owner have agreed upon the award of the contracts, notices will be sent to those selected, and the model plumber may receive one, either to call and sign contract, or to call for consultation in relation to changes that have been discussed subsequent to inviting tenders. If the former, it will be without any expectation that the plumber will discover an error in carrying out items, or in the footing of columns of figures, or in the omission of some important items of expense, which, when corrected, will increase his bid to a figure a little below that of a competitor (the amount of whose tender he has in the meantime obtained, 'now that the figures are all in and it can do no harm to compare notes'). The model plumber will not learn what tender has been made by other plumbers before the figures have been opened and contracts let, neither will he divulge what tender he has made; much less will he conspire with others to compare figures and so arrange them that this prospective job shall go to A, that to B and the other to C, etc. He will not be the plumber who goes to the architect after the tender has been sent in and states that he has inadvertently put one item in twice, or that he made a mistake in footing by carrying one too many, and that he wishes to withdraw his bid and put in a lower one, corrected as indicated. He will not (should he learn from the architect, or from another contractor, that lower tenders have been made) go to the owner or the architect to learn how much he will have to 'knock off' to secure the job, and will not say nor intimate to either owner or architect that the work can not be done for less than his bid, and that the successful bidder does not know how to figure on work, and can not do a good job, etc. All these, and other like methods, the model plumber is incapable of. He may well be aware that some of his business rivals have been known to practice some such strategic methods of securing work; possibly, that they have even secured good jobs by paying some sharp architect a bonus to induce him to award them the contract, but he has not discovered that they have gained either reputation or riches, certainly not the former, and is not overpoweringly tempted to resort to any such questionable methods to secure his share of business."

"The model architect from a plumber's standpoint," was written in March, 1889, by T. C. Boyd, in reply to a paper on "The model plumber."

"While not assuming to answer Architect Pierce's paper for the plumbers of Chicago or even attempting to meet all of the points he makes, there are a few observations that are, I think, pertinent to the issues raised in his description of the architect's ideal plumber. The architect's superintendent may be good or bad or indifferent, but he is generally good. It is the architect himself that we are now dealing with. His superintendent may be dismissed with the remark that, if intelligent, he will coöperate with the plumber to make the best sanitary job out of a poorly arranged plan. It would try the skill of both to do this, but they will do it if the architect's deputy be a man of any brains and training.

"The model architect may be considered under several heads. First we will take contract work. The intelligent plumber who wants to do work for the model architect, presents his card and is invited to estimate on plumbing, gas and sewer work. The first sensation experienced by the intelligent plumber will be surprise. He finds the plans are without ambiguity, and is thunderstruck at the absence of conflicting clauses or obscurity of meaning or oversight in the specifications. He will next be gratified to discover that there is no room for a dishonest competitor to take advantage of corrections or explanation, obscurities or oversights, intents or meanings in the plans and specifications. This is something so new to the experience of the inelligent plumber that he has to rub his eyes to discover if he is really alive and awake. When he has satisfied himself that he is neither dreaming nor dead and in the place reserved for plumbers in the world to come, he will take another look at the model architect's plans and specifications. He will find there distinctly marked a water-closet—not on an outside wall—a well lighted and ventilated room, whose soil pipe goes down vertically to the sewer, whose vent pipe goes as straight up a partition to the roof, all marked clearly on the plan. There will be no obscurity, no conflict of meaning. The same will apply to the bathtubs, the washbowls, the laundrytubs, the hot water boiler, the pantry sink fixtures, for all of these the same care will be taken by the model architect. He has made a practical study of the supply pipes feeding the above fixtures, keeping them away from outside walls to prevent them from freezing in the winter, running them through lead-lined troughs, where they cross ceilings, and where they go from one story to another—if he can not have them on the outside of a partition he will have built in the wall a recess with a front board even with the face of the plaster, fastened with round-headed screws, so that if they have to be examined no damage need be done to the house. No water pipes will be run into cold-air boxes by the model architect, because he does not draw his plans that way.

"After the model architect has drawn his plans he writes his specifications, being careful to conform strictly to the marks on his plans in relation to water-closets and traps, stands of supply pipe, bathtubs and cocks, hot and cold-water supply pipes; waste pipes, vent pipes, and so on through the entire list of the fixtures on his plans. He may then say: 'The fixtures to be furnished on this job are: In the kitchen, a boiler, a sink, and a set of three wash trays; in the pantry, a butler's pantry sink; in the bathroom, a water-closet, bathtub and a washbowl; in the front chamber, second floor, a washbowl: in the middle chamber, south, a washbowl; first floor, a washbowl; in the basement, a servant's water-closet.' No oversight in the plans and specifications of the model architect are to be construed to the disadvantage of the long-suffering plumber. The intelligent plumber will present his estimate to the model architect, and, if he be the lowest responsible bidder, he is awarded the contract. If there are changes in the plans and specifications consisting of a small addition, the model architect will ask the plumber what the alteration will be worth, and note it on the contract. If it is a large addition, the model architect will get a bid from the plumber who has the contract and one from the next lowest bidder who originally figured on the job, always giving the additions to the man who has the contract if his figures are not out of reason.

"If the plumber is dealing with the model architect he is safe, but heaven keep him if he is in the hands of the conjointly-oversight-intentions-obscurity-conflict-memorandum architect. In that case he will endeavor to put up a stack of soil pipe as crooked as a boodler's moral sense, endeavoring to strike the deformed partitions. When the poor plumber thinks that he has satisfactorily accomplished the most difficult job of his life, he is summarily told, 'It is not the intention to have the soil pipe there, I want it conjointly with that gas pipe in the other partition, and you must move it at your own expense, Mr. Plumber.' The plumber next runs a length of gaspipe from front to rear of the building close to the bearings, no marks being on the plans to warn him he is going to have trouble. He is about to put a gas pump on to test the pipes, thinking he has nearly completed the gasfitting, when he is cooly told: 'There was an oversight in not marking the hot-air registers on my plans, which have been buried in the obscurity of my desk until this morning. You will have to take out, at your own expense, that main running line of gas pipe on the second floor, putting it where it will not come in contact with the hot-air registers.'

"Still working for the c.-o.-i.-o.-c.-m. architect, the plumber builds his sewer from the front of the building to the catchbasin, builds the latter two feet ten inches from the rear of the building, places his vent cap four inches above the grass plat, and has all of his soil and waste pipes connected with the sewer. In his specifications he fails to find which calls for him to test the sewer pipes and soil pipes with water pressure. He has been congratulating himself that he has that job 'roughed in,' as we term it, ready for plastering. Now he expects to get his first payment on the work, and goes to the office of the architect for that purpose. I can not describe the plumber's consternation when he is informed by the architect: 'Your mode of building sewers conflicts with a memorandum that I happened to find regarding this work; I want you to disconnect all your soil and water pipes, plug up the lower ends and fill them with water; have them stand thus for three days; I will notify you when to empty them. Then disconnect the sewer outside of the front of the building, move the catchbasin three inches farther west. The vent of the sewer trap in the grass plat is six inches too far south; my intentions conflict with my memoranda, considered conjointly with the oversight and the obscurity of the whole subject matter, but, Mr. Plumber, you will have to conform to the memoranda before you get any money on this work.' That settles it. The plumber turns from a twilight color to a deep red as he thinks of the manufacturer and jobber, who are wondering how he is making out on the work. I could easily exceed the space occupied in describing 'The model plumber from an architect's standpoint,' but I will forbear and leave the subject to others after I have given one more illustration.

"The plumber is still working for the alphabetical architect, not he of the 'model' persuasion. He has completed his gasfitting according to the marks on his plans, when he is told by the a. a. and the owner to move a gaslight in the diningroom on account of shelves that were overlooked. 'Put a droplight in the kitchen,' he is told. 'Move the light in the library to suit the bookcase, change all the lights on the chimney-breasts to conform to the mantels.'

"Now the cost to the plumber for wages to the journeyman gasfitter to make these changes is $25. After his original contract is completed he charges this sum for labor and $2 or $3 more for materials. The a. a. invites the plumber to meet him in the building to check the bill over. The owner is living in the house by this time, and the plumber might as well try to find a needle in a haystack as to check up that bill from the house. New plaster, new paint, new everything. All the gasfittings that are to be seen are the ends of pipes sticking out of the partitions and ceilings. To show architect or owner where the labor had been put would have been as easy as to find perpetual motion, but the a. a. shows the obscurity of his intentions by the happy thought of proposing to count the gas brackets and droplights in the house. This is done. There are thirty-seven, all told. 'Now Mr. Plumber, we will count the fixtures on the plans.' This is done and the result is thirty-five. The $25 for extra wages while making that job conform with the owner's 'intentions,' cannot be counted so easily, for it has been paid out months before. 'I cannot allow you any extra pay for gas fitting,' says the a. a., 'for, taken conjointly, one light left out here and placed there, conflicts with the memoranda the doctor and I have of extra pay.'

"The plumber is still at work for the same architect. He has one of the improved bath-tubs to put up. His specifications call for tub, combination cock for hot and cold water, Fooley waste. It is set up and the water turned on. But it was the intention of the owner to have had an old-fashioned tubular over-head shower on that tub, but the oversight in the specifications conflicted, so it did not appear there. The plumber receives a quiet order to put in a tubular shower, but gets no more pay for the change than he did for the gasfitter's wages. The name I have given this architect to distinguish him from the model architect is obtained from the paper, to which is a partial reply, under the heading 'Estimates from plans.' The model architect is more numerous than he used to be, and there are more of him every season. By coöperation between him and the intelligent plumber, sanitary science is making great strides to the front. But the plumbers' paradise is yet to come."

The Chicago tin and copper worker was the predecessor of the plumber. In 1839 he was represented here by William Wheeler & Co., of 145 Lake street; Bottsford & Beers, corner of Lake and Dearborn streets; James Sinclair, 58 Washington street; I. B. Eddy & Bros., Nathaniel Butler, George Farwell, George Foot, Thomas George, C. D. Grannis, James Hageman, Orrin Hotchkiss, Chris. Metz, John Phelps, Hiram B. Smith, J. Spafford and Phillip Swain—all workers in tin, copper, lead and sheet iron. They knew little or nothing of the plumbers' art even as then practiced. In the old cities of the North Atlantic states the plumber proper was a scarce quantity, and the labor proper for him even scarcer. What was, was simple to a degree, and the tinner was at all times capable of mastering the intricacies of old-time plumbing. In the west, of which Chicago was then as now, the gateway, he was the plumber in disguise, making pots, kettles and pans, in the absence of leaden pipe, valves, traps and the thousand and one new fangled pieces of shaped metal which a newer civilization called for.

The tin and copper smiths of 1843 were George W. Bidwell, with S. J. Surdam, resided on Dearborn street; William Durrell, Williard Goodrich, Joseph Hageman, J. W. Hill, Charles H. Hodgson (died 1866), Orrin Hotchkiss, David Maxson, Chris. Metz (died 1886), James K. Murphy, Hiram B. Smith and Phillip Swain.

The history of plumbing, gasfitting and water and steamfitting in Chicago dates back to April, 1842, when the old water-works reservoir, on the corner of Lake street and Michigan avenue, was completed and consumers given the privilege of connecting their homes, stores or factories with it, at their own expense, on the payment of from $10 to $500 for the supply of water. At this time James Long, who owned the mills close by, agreed to do the pumping for the water company on condition that he could apply the surplus power of their twenty-five-horse engine to the running of the mill machinery. The plumbers' work of the period consisted in attaching a leaden pipe to the wooden main, and connecting this leaden pipe to an upright in the yard of the home, store or factory. This upright pipe the boys (who worked for the hardware dealers, then the plumbing contractors) dignified with the name of hydrant. Within the succeeding nine years there were eight hundred of such hydrants for houses and two hundred for stores and factories in use, while the wooden mains extended over nine and a quarter lineal miles. Thomas George, who had a mechanical shop at 201 Lake street, led in this primitive plumbing business, and his apprentices were known all over town, among his staff in 1849 being James S. Bassett, of the latter-day firm of Bassett & Beaver. In 1852 James Givens was journeyman, and in 1853 the firm of Thomas George & Co., Edward Hamilton being the partner, advertised their ability to do coppersmithing and plumbing. This partnership continued until 1858, though Thomas George continued business until 1861, when he failed.

The directory of 1849 contains the following names of journeymen and master tinners: Samuel Arentz, Clark and Superior; A. P. and M. Atherton, William Boys, Richard Clancey, Adam Deerfield, Carlton Drake, Harlow Evans, Mr. Filger, Patrick Fleming, Horace Gilbert, George Glazebrook (molder), Charles D. Grannis, 54 Lake; Michael Greenebaum, 116 Wells; Richard Hargrave (molder), Charles Hastings, Thomas Holmes, Sextus N. Wilcox, Augustus Leip, E. A. Miller, James K. Murphy, I. Rubel, Matthew Toughey, O. H. Sherwood, James Sinclair, E. Smith, Charles Stose and a man named Strong.

Michael Greenebaum established a hardware, tin and plumbing shop at the corner of Randolph and Union streets late in 1850 or early in 1851. Later he was joined by Jacob Greenebaum, but afterward the firm of Michael Greenebaum & Sons was formed, now Michael Greenebaum's Sons, 11 North Canal street. In 1849 Michael worked at the tinners' trade for Wheeler & Company, and, after entering business for himself, gave his special attention to plumbing affairs. Terence Maguire and Thomas Gaskell were here prior to 1853, as journeymen plumbers. In 1850 the first exclusive plumbers' shop was established, on the corner of Canal and Lake streets, by an immigrant named Alexander Raffen. The presence of a plumbers' sign insured trade, and this newcomer, from Cupar Fife, Scotland, had no more difficulty in winning trade than a German umbrella mender would have to-day, were he to place the signal of his trade above some State street basement. Alexander made marked progress, so much so that in 1852 he moved from the west side to the corner of Fifth avenue and Monroe street. In 1854 his shop was at 172 Fifth avenue, and the first master plumber's son, Alexander W. Raffen, was a partner in the concern. In 1858 the shop was moved to 261 Fifth avenue, where business was carried on until the beginning of the war, when Alexander W. and John T., his sons, entered an Illinois Volunteer regiment. In 1865 Alexander W. Raffen reëstablished himself at 166 Lake street, where he remained until his partnership with William Woodruff, in 1868, when their sign was placed over a basement at the corner of Madison and State streets. In 1870 the firm appears to have ceased business; but Alexander W. Raffen's name was connected with the plumbers' trade until 1876, when he was appointed superintendent of the Chicago postoffice. The pioneer master plumber—his father—died in 1873. He lived to see extraordinary changes in his trade. When he came here plumbing was not understood by early Chicago citizens. It may be cited that in the *Gem of the Prairie*, of June 15, 1850, a case of water-hammer in the house of the editor was mistaken for spirit rappings, but it was later decided that a fish, an eel, perhaps, had got into the conducting pipe from the reservoir. The plumber himself could not explain away the mystery, as he had no experience with water pipes prior to his immigration.

Under heavy water pressure plumbers invariably have what is known as "water-hammer" or concussion, to deal with or to dispose of. This is especially true when self-closing work, ground key work, or spring valves are in use. As water is nearly incompressible, when confined in a pipe and under pressure and running with great velocity it is like a rod of iron of the same dimensions and moving with equal speed. When suddenly brought to a halt, as when a cock or valve is shut off, a violent and vibrating shock is the result. This shock is often felt throughout the whole building, and is a severe strain upon the service pipe and upon the plumbing fixtures.

The advent of Raffen drove the hardware plumbers to activity. The Scotchman's hard, rough work, done at the lowest imaginable price, had to be competed with. Thomas George & Company employed Terence Maguire and Thomas Gaskell to contest the field with Raffen, and early in 1853 Andrew Lloyd opened a shop at 234 Lake street. About the same time Alexander Pederson and Samuel B. Kenney established their shop at 54 north Clark street, thus bringing six Richmonds into the field. There was work for all, however, and the antipathy to Raffen soon subsided. In 1853 H. L. Wilson established a shop at 161 Lake street, with John Hughes acting plumber. This Hughes made the first taps on the new iron water mains February 15, 1854, being assisted by David Rowlands. The same year Wilson formed a partnership with Foreman Hughes, and removed to 50 Dearborn. Four years later they carried on business at 44 Dearborn, but in 1860 the partnership did not exist. Hughes' shop, at that time, was on the northwest corner of State and Washington; but moving to 109 State, he continued business there until 1868, when he admitted his son, Kendrick, as a partner, and opened a shop at 81–83 Washington street. Several changes in location were made prior to 1876, when John Hughes died.

Late in the summer of 1854 Thomas W. Hutchison and Robert D. McFarlane came to Chicago, and, establishing a shop on Monroe street, west of the old gas works, and a store at the northeast corner of Fifth avenue and Randolph streets, entered at once on plumbing life in the West. In 1856, Hutcheson, who was not a practical plumber, sold his interests to McFarlane and retired to his wife's boardinghouse (then occupying the site of the present Chicago Club house, 43 and 45 Monroe street), where he died in 1871. In 1858 McFarlane, having sold the shop near the gas works, removed to 167 and 169 Washington, and died there in 1868. The manufacture of brass faucets, the specialty of the firm of 1854, was forgotten for the more lucrative bnsiness of plumbing and gas and steamfitting. Riley V. Wightman established a tinshop on West Randolph street, in 1855, in connection with his plumbing business. When he retired, in 1861, one journeyman, W. S. Verity, was capable of attending to the plumbing department.

James Brown opened a shop at 114 Dearborn street, in May, 1856; two years later, with Daniel L. Boone as partner, opened one at 145 State street. About the beginning of 1857 Boone became proprietor. In 1861 Brown re-established himself at 159 Dearborn street; in 1864 worked at the trade for Barnett & Murray, and died soon after the close of the war.

Thomas Garvey established a shop at No. 1 Dearborn street, in 1856, later accepted Mahlon McEntee as a partner, moved to 59½ North Clark street, again to 86 North Clark street, in 1863, and thence to New York City in 1865, where he established a liquor store.

From 1856 to 1861 George Lawson carried on a shop at 123 Wells street, but his saloon at 199½ Randolph street, known as "The captain's office," claimed the greater part of his attention. What effect this combination had upon the plumbers of that time is not related.

The directory of the city, for 1854–5, gives the names of new plumbers as follows: Terence Maguire, 32 Lake street; W. Monteney & Company, corner of Lake and Green streets; G. N. Williams, 369 South Clark street, near the Catholic church at the corner of Polk street. Terence Maguire, born in Fermanagh county, Ireland, in 1832, came to the United States in his childhood, learned the plumber's trade in New York City, and came to Chicago in 1852, with Henry L. Wilson (a brother of Wilson of the *Journal*) and John Hughes. In 1853 he opened his own shop on the northeast corner of Lake street and Wabash avenue, and in 1855 formed a partnership with Ludwig Wolff. They opened a shop in Couch place, in rear of 75 Lake street, at once. Ten years later they moved to 95–111 West Lake street, and the same year William Barry was admitted a partner. In 1868 Maguire sold his interests to Edward Boss and purchased Boss' distillery, at Rock Island, Ill. The same year Barry & Boss sold to L. Wolff, who, in 1877, capitalized the concern, under the title The L. Wolff Manufacturing Company. William Monteney knew all about gas meters, but nothing about plumbing. After some time he became an inspector for the Peoples' Gas Light & Coke Company, which position he held until about 1884, when he returned to England.

In 1884 there was presented to the Plumbers' association a list of the recognized plumbers of Chicago in 1856. The list was prepared by order of its publishers or of a circle of plumbers, neatly framed and marked "To be held until called for." The names enrolled are:

John Hughes, Bell & Irons, R. D. McFarlane, Jeremiah Scanlan,* John C. Ryan, P. Kearney, P. Meany*, Augustus C. Becker, J. O'Calligan, G. Powell & Company, Livingston* & Bassett*, Frederick Hartman, John Mills*, William Maxwell, Maguire* & Wolff*, Joseph Hogan*, Barnett & Murray*, Joseph Schuster*, Alexander Raffen, William Beaton, Bigden & Baggot, Rubel & Bro., Michael Greenebaum*, T. Garvey, William S. Verity*, Kostlery* & Brown. Of the pioneers of the trade those marked thus * were residents in 1885.

Prices for plumbing material have not changed since 1856, as much as one might suppose. Solder was then sold at forty-five cents; the price now is twenty-five. Pan and valve closets only were quoted then—the former at $10 and the latter at $15. While the prices of these remain about the same as now, there are dozens of other closets, of all sorts and styles, in use at the present time, ranging in price as high as $50 and $75, with the necessary fixtures. Then, lead-lined tanks were used, now, there are cast-iron and sheet-copper tanks, the iron being considerably cheaper, but not considered so good, from the fact that among other things, they rust and the water which flows from them discolors the watercloset bowl. Iron pipe is sold from fifteen to eighteen cents cheaper now than formerly. Sinks are twenty-five per cent. cheaper. Then, copper boilers only were in use, and cost from $32 to $60. These have largely given way to galvanized-iron boilers, which cost from $13 to $30. While many consider the copperboiler the ideal, the galvanized-iron is probably just as good, if the galvanizing is well done, and it is less liable to collapse, being made stronger.

The city directory of 1855–6 gives the names of nine plumbing firms, including four tinners. That of 1856–7 gave seventeen names of plumbers; but of the number there were five who should be classed with tinners, pumpmakers or stove dealers.

John J. Hamblin having served an apprenticeship to Joseph P. Quinn, of New York City, set out for Chicago September 1, 1856, and arrived here September 6. Robert McDougall, who was then a journeyman plumber in the employ of Michael Greenebaum, urged him to come to Chicago. His first work here was for James Brown, who was plumbing contractor for the Richmond Hotel, on the corner of South Water street and Michigan avenue. Next he worked on North's theater, and in November, 1857, became a boss plumber himself as a partner of James McDonald. This was the beginning of Hamblin's long and useful career in Chicago.

James McDonald came from Scotland in 1850, settled at Chicago in 1856, and in 1857 became an employer of labor, with his shop at 51 Desplaines street. In 1859 his partnership with J. J. Hamblin ended, and that with James McDonald, Jr., commenced. In 1861 the elder McDonald enlisted, served through the war, and, a short time after his return, died suddenly at the door of his house. James the younger continued business here until he enlisted in the United States Navy.

William Beaton came from Scotland in 1853 and settled at Chicago in 1855. In 1857 he became a partner of James Irons, established a shop at 83 Washington street, and took P. L. O'Hara as their first apprentice. From 1862 to the time of his death he carried on business alone at 79 Dearborn street.

MAP OF CHICAGO CITY EXTENSIONS.

John A. Hampson and George P. Ruggles, with Joseph Hogan as foreman, established a shop at 159 Lake street in 1857; but the depression of the period militated against their success, and failure waited on their venture.

Eliphalet W. Blatchford came in 1855 and established the lead works on Clinton street. Caleb F. Gates, who was a partner in the firm of Thomas George & Company, up to its failure in 1865, joined the Blatchford enterprise that year, and in 1869 the Shot Tower Company was organized with C. F. Gates secretary.

Richard T. Crane came also in 1855, when he was joined by his brother, Charles S., shortly after. A little brass foundry was established by the former in a corner of Martin Ryerson's lumber yard. In 1856 the brothers erected a building at 102 Lake street; in 1858 introduced the manufacture of steam-heating apparatus; in 1864 established their wrought-iron pipe mill, at the corner of Fulton and Desplaines streets, and in 1865 built their present works. In 1880 the pipe mill at the corner of Canal and Judd streets was built.

The principal plumbers in 1869 were Bassett* & Pattison*, James Bell, Harry Byrne*, James Irons*, George Key, James Patterson*, John C. Ryan* (296 Clark street), John Schuster*, Hugh Watt*, Woodruff & Raffen, John Hughes* & Son, and Phillip Meany*.

The following list of master plumbers, doing business here in 1891 is given, so that it may be compared with similar lists of earlier years and stand as a reference for the future:

Atkin, Andrew W., 144 West Lake street; Alles, George, 463 Division street; Alles, J. F., & Bro., 233 Lincoln avenue; Anderson, Matthew, 69 Thirty-fifth street; Anthauer, William, & Co., 538 Milwaukee avenue; Arnold, Robert J., 407 West Division street.

Baer, Adam J., 1710 North Clark street; Baggot, E., 171 Adams street; Baggot, E., & Son, 2134 Michigan avenue; Bain, D. & L., 633 West Madison street; Barr, James C., 320, Forty-third street; Barrett, Michael F., 468 West Chicago avenue; Barry, George D., 285 Center avenue; Basset, James S., 204 Dearborn street; Bauer, Henry, 232 North avenue; Bayha & Bachmann, 124 Clybourn avenue; Beam, John H. W., Ravenswood Park, near Wilson avenue; Beaver & Smith Co., 3111 State street, telephone 8664; Becker, Peter, 668 West Twenty-second street; Becker, Peter, & Co., 483 South Halsted; Becker & Schirra, 643 Sedgwick; Bell, James M., 80 Thirty-fifth street; Bensinger, Alfred W., 173, Thirty-first street; Birney, James, rear 4001 West Madison; Bischoff, Charles, 352, Ogden avenue; Black, Harry A., 40 Forty-third street; Boulton, William H., 240 Lake; Bowden & Co., 158 Fifth avenue; Bowman Bros., 750 West Chicago avenue; Boyd, Charles J., 805 Forty-seventh street; Boyd, Thomas C., 11, 40 Dearborn street; Boyle, Michael, 243 Ninety-second street; Bradley, Edward, Vincennes avenue near Tracy avenue; Bradley, James H., 8028 Vincennes avenue; Breen, Joseph B., 368 West Van Buren; Breyer, Charles C., 833 Milwaukee avenue; Breyer, Ernest, 72 West Randolph; Breyer, Henry, Jr., 1706 Milwaukee avenue; Brooks, C. J., Plumbing Co., 879 West Polk; Brooks, Marcellus G., 1111 West Harrison; Brosnan, Timothy J., 688 West Lake; Brown, J. W., & Co., 364 Lincoln avenue; Brown, William C., 370 West Lake; Browne, F W., & Co., 118 Eighteenth; Brunt Bros., 9115 Erie avenue; Bryson, T. B., &

* Here also in 1872-9.

Son, 6335 Wentworth avenue; Bufton & Lyon, 26 Customhouse place; Burg, Hans C., 46 South Morgan; Burkhardt, Edward, Jr., 942 North Clark; Burns, Daniel W., 25 Forty-third; Butler, James J., 521 West Taylor; Byrne, J. J., 2810 Archer avenue; Byrne & Ryan, 254 Forty-third.

Cameron, Alexander M., 135 West Van Buren; Campbell, Albert A., 842 West Madison; Campen, E., & Co., 1553 Wabash avenue; Cannon, John, south side One Hundred and Eleventh place West Michigan avenue; Canty, John, 3105 State street; Chappell, William, 66 Lake street; Chilvers, A. L., 1611 Forty-seventh; Christiansen & Becker, 1245 Milwaukee avenue; Clancy & Sons, 215 Ogden avenue; Clark, James J., 119 Twenty-second and 113 Fifty-third; Clark, Lacy, 6302 Yale; Coleman, Rupert, 855 North Clark; Coles, William G., 194 South Western avenue; Coller, Chris., 4538 Wentworth avenue; Collins, J. M. & Co., 356 Thirty-seventh street; Conant, Clarence M., 474 Ogden avenue; Conlin, Thomas, 3905 Cottage Grove avenue; Connell, John, 235 West Harrison; Connor, Edward D., 2465 Archer avenue; Conraths, Jacob, Jr., 411 Fifty-ninth; Conway, Thomas, 614 Sixty-third; Cook & Mangan, 1802 Wabash avenue; Cook & Shannon, 577 South Halsted; Coolidge, William M., & Co., 223 Lake; Corboy, M. J., 78 Dearborn; Cotter, William, & Son, 867 Thirty-first street; Cullinan, Thomas, 236 Thirty-first street; Cummings, William H., 1236 West Van Buren street; Curtin, Jeremiah J., Wallace northeast corner Forty-third.

Dalton, John F., 127 Indiana street; Daly, Le F., 97 Dearborn street; Danneil, William, 453 South Canal and 406 South Western avenue; Davey, Samuel F., 461 Lincoln avenue; Degnan, John, 3304 Cottage Grove avenue; Dempsey, John, 196 West Madison street; Denniston, John A., 148 North Clark street; Desmond, Patrick C., 906 West Lake street; Devlin, Edward J., 30 Rush street; Dewald Bros., 746 Southport avenue; Dewar, D. P., & Co., 6312 Wentworth avenue; Donoghoe, James, 497 West Huron; Dornbos Bros., 573 West Eighteenth street; Downs, William J., 59 Plymouth place; Doyle, James J., 6040 South Halsted street.

Ehrhardt, Richard, 2338 Wentworth avenue; Emblen, Joseph L., 256 Thirty-fifth street.

Falk, Frank, 717 Milwaukee avenue; Faulkner, Clayton R., 809 Seventy-ninth street; Fehr, Gustav A., 80 Canalport avenue; Feldcamp, George J., 333 Sixty-third street; Feltman, Peter, 1149 Lincoln avenue; Finn, Richard B., 136 Thirty-fifth street; Fischer, F. J., 7446 Cottage Grove avenue; Foley, Thomas, 646 Noble; Foskett & Brown, 217 Fifth avenue; Foster, Adolph H., 800 West Twelfth street; Franklin, George W., Ravenswood Park, south Leland avenue; Fransted, Edward L., 443½ West Randolph street.

Gannon, John, 5601 South Halsted street; Garner & Bahn, 1740 Milwaukee avenue; Garvey, Jeremiah, 478 South Leavitt street; Gay & Culloton, 52 North Clark street; Geary, Thomas F., 72 Thirty-first street; Geiss, Ignas J., 1199 Milwaukee avenue: Gilligan, Charles B., 237 Forty-third street; Goehst, Edward, 4309 Lake avenue; Good, Samuel, 2904 Cottage Grove avenue; Goodridge, George F., 461 West Indiana street; Gormley, James, 2580 Archer avenue; Graham, Richard, 78 North Clark street; Griffin, Lawrence G., 161 West Madison street; Griffith, Robert, 427 North Clark street; Griffith, Watson, 51 North Wells; Gruschow, Frank W., & Co., 84 Oak street; Gunderman Bros., 182 North avenue.

Hackett & Connell, 143 West Harrison; Hagedorn, Joseph, 306 Twenty-fourth street; Halfen, Martin J., 876 Sheffield avenue; Halpin, John J., 619 Blue Island avenue; Hamblin Plumbing Co., 348 South Robey; Hamich, Peter H., 172 North Clark; Hamilton, Alexander, 350 State; Hamilton, Henry, 759 Sedgwick street; Hans, George, & Co., 785 Blue Island avenue; Hans, Michael J., 311 West Twelfth street; Hardin, Daniel, 217 Thirty-first street; Hardin, John, 4539 Cottage Grove avenue; Hardin, Patrick K., 3521 State street; Harker, H. W., & Co., 550 Lincoln avenue; Harvey, Thomas, 509 Thirty-ninth; Hayes, John R., 427 State street; Hennessy, E., & Co., 3251 State street; Herbert, Charles J., 100 Randolph street; Herbst, William, 171 Milwaukee avenue; Herzog, Louis, 2230 Archer avenue; Hickey, Andrew C., 69 South Clinton; Hills, George W., 680 West Van Buren; Hoffmeyer, August, 607 North Wood; Hofmann, George W., & Co., 57 South Green; Hogan, Joseph, 275 Fifth avenue; Hogan, Walter J., 1063 North California avenue; Hois, Joseph, 609 West Twelfth street; Horne, Marshall, 5329 Lake avenue; Howard, Terrell & Co., 10 Center avenue.

Innes, T. & J., 1806 Wabash avenue; Irons, Alfred F., 467 Ogden avenue.

Jack, David T., 882 West Lake; Jaeshke, Paul, 759 Clybourn avenue; Johnston, William, 531 Sixty-fifth; Jordan, James F., 3129 Archer avenue; Juergens, Charles E., 1274 West Madison.

Kay, John B., 108 Twenty-third street; Keeney, John, 645 Blue Island avenue; Kelleher & Son, 3417 Union avenue; Kelley, Augustine, 25 Washington street; Kelly, Thomas, & Bros., 75 Jackson street; Kendrick, Fred. J., 3634 State street; Keppner, L. A., 57 Dearborn street; Killeen Bros., 3039 South Halsted; Kinney, Peter J., 87 Twenty-second; Kirk, C. T., Ravenswood Park near Sunnyside avenue; Klahre, Henry, 88 North Clark; Klein, Stephen, 666 Milwaukee avenue; Klentz, C. Frederick, 552 Elston avenue; Kostlevy, Charles, 218 West Eighteenth street; Kuhn, Frank N., 4111 State street; Kuhlnt, Adolph, 393 Gross Park avenue; Kurz & Kretschmer, 379 West Eighteenth street.

Larson, G. A., 272 Fifty-seventh street, Latto, Thomas, 3124 Archer avenue; Lawder, Alexander, 902 West Madison; Lavery, John F., 3643 Cottage Grove avenue; Lawrence, Charles S., 1315 West Madison; Leamy, James M., 21 West Madison; Lear, Richard H., 3723 Cottage Grove avenue; Lenz, John, 86 Howe street; Levi & Miller, 509 South Canal; Levy, Louis H., 4009 State; Livingston, S., & Son, 3213 State; Lothian, David, 75 North Wells; Love & Leibold, 535 South Halsted; Ludwig, John F., 497 Ogden avenue; Lyon & Lee, 6215 Wentworth avenue.

Mandable & DeVeney, 2306 Cottage Grove avenue; Markey, John, & Co., 2918 Cottage Grove avenue; Martin, J. T., 215 Twenty-second; Marmedal, Athos E., 445 North Clark; Mathews, John T., 3241 Cottage Grove avenue; Maypole, A. M., & Bro., 816 West Van Buren; McCabe, Patrick H., 763 Racine avenue; McCourt, John, 3450 Indiana avenue; McCulloch, Robert, 233 West Madison; McDermott & Kinsella, 5745 Wentworth avenue; Mc-

Donald, Michael C., 383 Ogden avenue; McGarry, Peter B., 187 Washington; McGinley, Charles, 164 Clark; McGinley, John J., 558 South Ashland avenue; McGinley, J. & Sons, 86 South Desplaines; McLaughlin, James J., 742 Forty-third; McMullen, Joseph J., 3441 South Halsted; Mertz, George J., 2208 Archer avenue; Metz, William, 342 Fifth avenue; Miller, Anthony, Forty-third, southwest corner Atlantic; Miller, George, & Co., 1138 West Lake; Miller, Robert C., 871 West North avenue; Miller, Robert M., 2518 Cottage Grove avenue; Milne, John A., 1353 West Lake; Minzesheimer, M. F., & Co., 512 North Clark; Mische, Adolph L., 127 Goethe; Mitchell Bros., 85 Forty-third; Molter & Kretschmer, 426 Division; Monahan, James, 1636 Thirty-seventh; Moran, John K., 1620 Wabash avenue; Morris Bros., 3442 South Halsted; Morrissey, Peter J., 417 South May; Morrow, William B., 750 Forty-third street; Mose, Andrew K., 665 West North avenue; Moylan, P., & Co., 2231 Cottage Grove avenue; Mozlan & Alcock, 101 Twenty-second; Muldoon, Edward J., 537 West Indiana; Muller, William J., 387 West Chicago avenue; Mund, Herman, 2 Ambrose; Murphy, James C., 21 Blue Island avenue; Murphy & Voight, 345 Forty-third; Murray, Alexander W., 811 West Madison.

Nacey, Patrick, 339 Wabash avenue; Nash & Hama, 2216 Wabash avenue; Nash & Rea, 494 West Indiana; Negley Plumbing & Gas Fitting Co., 474 North Clark; Nelson & Cederholm, 87 West Ohio; Newerburg & Reich, 874 North Halsted; Neustadt, Fred, 300 North avenue; Neybert & Euphrat, 2969 Archer avenue.

O'Brien, James P., 293 West Indiana; O'Brien & Luder, 451 West Chicago avenue; Oliphant, Thomas A., 4438 Cottage Grove avenue; Oliphant, Walter M., 5 Aberdeen; Oliphant & Liddell, 268 West Madison; Oliver, George, 313 Garfield boulevard; O'Malley, Joseph E., 215 North Wells; O'Malley, Thomas J., 317 North Wells; O'Neill, Benjamin F., 752 West Lake; Overend, George, 2618 Cottage Grove avenue.

Pagel, Albert C., 6746 Yale; Pattison, J. L. & Co., 297 Wabash avenue; Pedersen, Engelbrecht, 119 West Indiana; Perdisatt, Patrick F., 2900 State; Peters, John J., 211 North Clark; Peterson, Charles, Storms avenue, northwest corner Seventy-third; Pfeifer, George, Kensington avenue, near Front; Pickett, John, 341 Clark; Pietsch, Max R., 161 Southport avenue; Pinter, Philip, 817 North Clark; Plumstead, James W., 5101 Atlantic; Powers, Martin B., 3817 State; Powers, Richard J., 9, 90 La Salle; Probasco, R. P., Co., 26 Dearborn street.

Quinn, Joseph J., 2543 South Halsted.

Rankin, W. & J., 453 West Madison; Redieske, Charles, 99 Clybourn avenue; Reedy, John J., 3027 Cottage Grove avenue; Reilly Bros., 517 West Madison; Reinemann, E. J., North Clark, near South; Renn Bros., 142 North Clark; Riordan, Michael J., 527 West Twelfth; Robertson, Robert, 844 West Harrison; Robinson, Ralph, 173 South Halsted; Robinson, Thomas E., 566 South Halsted; Roche, James H., 210 Thirty-first; Rock, Thomas F., 204 Blue Island avenue; Roderwald, Hugo, 510 Belmont avenue; Roderwald, Otto, 200 Clybourn avenue; Roland, John, 952 North Halsted; Rothschild, Jacob, 24 South Green; Roughan, M. J., 25 Quincy; Rounds & McLogan, 527 State; Ruh, Frank J., 1204 Diversey;

Ruh, Valentine, 548 North Wells; Russell, Oliver F., 1111 West Lake; Rustman, William H., 238 West Fourteenth; Ryan, Bart, 290 Dearborn; Ryan, M., & Bro., 421 Milwaukee avenue; Ryan, William H., 18 Blue Island avenue.

Sanders, P., & Sons, 1314 Wabash avenue; Sanford, E. & T., 5238 State; Sattler, Joseph, 642 West Van Buren; Scheuer, Joseph, 924 Lincoln avenue; Schmidt, Ira T., 145 Michigan; Schmidt, William, 641 West Lake; Schmidt, Peter, 4928 State street; Schneider, A., 725 Sheffield avenue; Schram, H. B., 477 Garfield avenue; Schubot, Emil, 382 Clark and 561 South Canal; Schuster Bros., 234 North Clark; Schuster, Charles, 266 North Wells; Shannon, John H., 273 Blue Island avenue; Shannon, William P., 42 North State; Shay, Dennis F., 9 North Desplaines; Shea, John J., 149 Forty-third street; Sheahan & Conlin, 60 South Halsted; Sheehan, E., & Co., 220 Illinois; Sherman, Bennett & Co., 2515 South Halsted; Sherman, George W., 4509 State; Sheville, James B., 5032 State; Sims', William, Sons, 556 West Madison; Sloan, M. C., & Co., 8828 Commercial avenue; Somner, Alvin A., 80 Chicago avenue; Straub, Max, 423 North Wells; Steiner & McFarlane, 918 West Twenty-first; Stewart, Ceramic C., 7, 325 Dearborn; Stewart, James, 6438 Wentworth avenue; Stokes, George J., 232 West Randolph; Sullivan, John H., 328 Division; Swartz, John, 96 Plymouth place; Sweet, Oliver P., 29 Forty-third street.

Terrell, W. F., 10 North Center avenue; Teutsch, John, 2961 Wentworth avenue; Thielen & Pinter, 271 North Clark; Thompson, Albert L., 9138 Erie avenue; Thompson, Henry S., 201 Randolph; Thompson, William R., 85 Lake; Thomson, James P., 272 Fifty-fifth street; Tierney, Dennis J., 533 West Lake; Tipple, George, 689 Lincoln avenue; Tossell, Richard, 5942 South Halsted; Tumalty, John W., 2251 Cottage Grove avenue.

Uher, Charles, 524 West Eighteenth.

Verity, William S., 229 West Randolph.

Wade, J. J., & Son, 112 Dearborn; Waite, Frank, 25 Artesian avenue; Waldron & Baggot, 1072 West Twelfth; Walsh, David, 6754 South Chicago avenue; Walsh, James, 524 Ogden avenue; Walsh, N. S., 48 West Adams; Walter, Charles, 403 Blue Island avenue; Watson, Alexander H., 426 Milwaukee avenue; Watson & Davidson, 45 Van Buren; Watt, Archibald, 2523 State; Watt, Hugh, 300 Dearborn; Webber, Jacob G., 244 North Clark; Weber, Mathias, 477 Twenty-sixth; Webster, Crombie & Co., 9248 Commercial avenue; Weisbach, August, 141 Center; Welch, James, 292 Blue Island avenue; Welch, John, 475 South Halsted and 1169 West Van Buren; Weller, Edmund, 3108 State; Weppener, John, 1381 North Clark; Wetzel, Otto C., 31 Chicago avenue; Whelan, W., 2906 Archer avenue; Whiteford, David, 205 West Madison and 372 West Randolph; Wilkie, John, 262 Ogden avenue; Wilkie, William, 705 West Madison; Wilks, E., & Co., 54 State; Willems, Peter, 254 North Clark; Willson & Thompson, 173 Randolph; Wilson, William, 3907 Cottage Grove avenue; Wilson & Wilk, 1158 Milwaukee avenue; Winterburn, John H., 53 West Van Buren; Wittick, John N., 7056 Cottage Grove avenue; Wixted & Gibson, 110, Thirty-ninth; Wolf, Peter, 39 Evanston avenue; Woodley, William T., 366 Forty-fifth.

Young & Cavanah, 995 West Madison.

Henry W. Hamilton, who came here in 1856 or 1857, was a man not well remembered by the Chicago plumbers of the present day. He was from a well-to-do family in Ireland, and seemed out of place in the trade, at which he was a practical workman. He is remembered as a fine-looking, dashing fellow. He was in business but a few years here when he went south. At the outbreak of the war he entered the Southern army. In the vicissitudes of war he was captured by the Northern forces, brought to Chicago as a prisoner of war, and confined in Camp Douglas. After the misunderstanding had been settled, he went back to Ireland, where, in Dublin, he married a lady of rank and fortune.

The plumbers of 1859 were: Beaten, William, 83 Washington; Boone, D. L., & Brown, James; Bell & Irons (James Bell and James Irons), 143 South Wells; Dox, A. J.; Garvey, Thomas, 59½ North Clark; Greenebaum Sons (Michael, Jacob and Isaac Greenebaum), 240 Randolph; Hamilton, Henry W., 115 North Clark; Hughes, John, 51 Washington; Humphrey & Murray (Thomas Humphrey and Alexander Murray), 56 Washington; James, William, 215 North Clark; Lawson, George, 123 South Wells; Hale & Hamblin, 171 West Madison; Hamilton, Fuller & Co. (Edward Hamilton, Willard M. Fuller, John H. Kinney and Daniel Smith), 116 and 118 South Franklin; Hogan & Wylie, 85 West Randolph; Kenny, S. B.; McFarlane, R. D.; Lyons, Andrew J., 157 South Clark; Maguire & Wolff (Terence Maguire and Lewis Wolff), alley rear 75 Lake; McDonald & Hamblin (James McDonald and John J. Hamblin), 43 West Lake; Marks & Schuster (Nicholas Marks and Joseph Schuster), Cedar, near Green Bay; McGee, John; Mills, John, 82 West Lake; Raffen, Alexander, & Son, 261 Wells, near Jackson; Rubel & Brother (Abraham and Isaac), 241 Lake and 183 South Canal; Ryan, J. C.; Scanlan, Jeremiah; Meany, Philip, 528 State; Van Schaack, Henry C., Jr., 177 Michigan.

Brass founding may be considered a sister trade. The relation between the plumber and the brass founder is very close. It may be stated that about as much brass is used in the plumbing business as there is of lead, consequently the advent of the first brass founder in Chicago is of some importance. Owen Owens, when alive, related that when he came to Chicago, in 1848, he found no representative of his craft in the city save a German named H. W. Rincker, a bellmaker, and two brothers. Rincker had no shop, as his services were so seldom in demand that a fixed place of business would have been a luxury. He afterward had a foundry at 198 Randolph street.

Owen Owens, the pioneer of the plumbing-supply trade, was born in Wales in 1817. At the age of twelve, after acquiring a rudimentary education, he was apprenticed to a brass-founder in Liverpool. Upon the death of his father, he brought his mother and family to Chicago in 1848. With him, from Liverpool, came Michael Nugent, and together they began the manufacture of brass goods and anything else in a similar line. Among other things they made four of the celebrated hand fire-engines which were in use in the city until 1857, at which date Mayor John Wentworth introduced the first steam fire-engine. Their shop was located on a corner of Washington and Market streets, and was destroyed by fire in 1853, leaving both partners, practically, without funds. Owens went on a farm near Elgin, Ill., and Nugent resurrected the business. In 1857 Owens returned from his agricultural pursuits and purchased the brass foundry, which Michael Nugent had reëstablished on the lot adjoining the old site, from Mrs. Nugent, Mr. Nugent having died in the meantime. The style of the firm became T. C. Smith & Co., and so continued until 1865, when Owens purchased Smith's interest in the business. Soon after this he purchased a lot and a substantial building at 226 Washington street, the present location, in the rear of which he built a workshop and foundry. In the great fire of 1871 these were all destroyed, entailing a loss of $60,000. Owens was not to be discouraged, however, and immediately built a workshop and foundry on the rear of his lot. Two years later he built the present building, hauling from the river the water used in its erection himself. His business has been a very prosperous one, and, looking back over forty years' life in Chicago, his memory could span nearly every important event in the city's history, and his books would have shown dealings with almost every plumber who has ever started in business in Chicago. Mr. Owens died May 30, 1887 and the business is now conducted by his sons, Robert and Joseph.

A. W. Murray read a historical sketch relating to early Chicago plumbing and sewerage, prepared by President Young in November, 1883. Mr. Young said that twenty-nine years ago the waterworks of this city were located at the foot of Randolph street. The pipes extended south as far as Twelfth street, those on Edina and Buffalo streets, now Third and Fourth avenues, being of logs. The usual size of a pipe to supply the outdoor hydrant of a dwelling was half an inch, and that could be strong or light, as the owner preferred. On the west side of the river the pipes extended to Halsted street. At that time there was no sewerage system, each building sewers ,to suit himself. The usual method was to extend a wooden box sewer to the street, and terminate it in an empty hogshead under ground. The sanitary engineer and sewer gas had not yet made their appearance. The closet then in use was the pan closet with oval bowl and a good cistern. The soil pipe was made of honest lead, and as the contract system had not come into vogue the work was honestly done. The cock in use at that time was of the ground-in pattern. The boilers were of copper and made in the alley just south of the Tremont house, by Wolff & Maguire. The copper was of good quality; the steel boiler had not yet come into use. All manufactured articles for plumbers at that time were of good quality, and the work was well done. The plumbing shops were those of John Hughes, Alexander Raffen, Captain Lawson and R. D. McFarlane. As the ground on which Chicago stood was spongy, the entire force of a shop was turned out when a tap was to be made; the job done, the employer discharged the men for the day. The journeyman was trusted and treated like a gentleman. He was a first-rate workman, as well as an open-hearted man. His money and sympathy were freely tendered a brother out of work, or laid up by sickness. Their favorite resort at that time was at the corner of Clark and Madison streets, where they gathered evenings and Sundays, and, using the floor for a blackboard, laid out runs of soil pipe, showing how the work was done and how it should be done—"in fact," said Mr. Young, "more sanitary science was explained and argued than has been written upon from that day to this. These very discussions sharpened the interest taken in their calling. This is the reason that the journeyman of that time was master of his trade. The apprenticeship was five years, and there are quite a number among us who served that time. The boy was proud of his boss and of his shop, and was ready to maintain the honor of his shop, under any and all circumstances—by force of arms, if necessary. It was also a matter of pride with the bosses that their boys should turn out well, and when together they would do a little bragging themselves.

"A quarter century of plumbing in Chicago," was the title of a historical paper, prepared in 1888, by David Whiteford. Looking back to the days of Civil war, he relates that the plumber was a manufacturer, his workshop a factory, and every man a maker of articles from raw material that entered into the fitting up of buildings. The plumber made lead traps, he made the S-trap, half-S and three-fourth S-traps from sheet lead cut to the proper size and width, forming it into shape by beating the lead by a dresser, first making a drawing on the bench with chalk, or working to a trap already made; this is the method that was practiced by some in this city up to twenty-five years ago and even later. This is what was called the hand-made trap, and probably the oldest trap, unless it is the D-trap.

The trap made on the mold was cut in strips from sheet lead half the diameter of the size of the trap, formed to a semicircle and worked by the dresser in the neck of the trap some distance up, laid on the mold and carefully beaten so the lead would neither stretch nor buckle in the operation. When this was in shape it was cut to the mold, rasped, fitted, soiled and shaved, and then soldered with a copper hatchet or straight bit. To make a fine raised soldered seam on this trap was a fine piece of work. Workmen could always be found in the shop during the working hours, engaged in making articles, such as service boxes for water-closet tanks or cisterns, both names being synonymous, lining cisterns for the pan-closet, lining bath tubs from sheet lead and zinc, chiefly zinc; also making up fine, artistically designed "showers" for bath tubs. This shower was considered a masterpiece of work, and on it the older apprentices were selected to try their hands. Great pride was taken by the workmen to make the joints of solder look bright and clean. No bath tub was considered complete without one of these showers. Another source of employment for the workmen in the shop was the making of hydrants and street washers. The hydrant was made of wood, 8x4 inches, seven feet long; this was made by the carpenter and fitted by the plumber; almost every house had a hydrant either in the front or back yard. The street washers were eight inches square and four feet long, also made by the carpenter, sometimes by the plumber himself, and fitted up similarly to the hydrant.

In the year of the great fire (1871), when buildings began to rise where the old ones formerly stood, great changes in plumbing methods were made. In the spring of 1872 the firm of Culver, Page & Hoyne erected a building on Monroe street, between Clark and Dearborn streets. Verity & Whiteford were doing the plumbing. "This was the first time," says Mr. Whiteford, "I had seen cast-iron soil pipe used in this city, wrought-iron pipe not being thought of for that purpose. These pipes were put together in a manner that would be impossible to leak sewer gas. The method that was adopted I think a good one. We used oakum for packing, soaked in thick red lead and boiled oil. Three rounds of this oakum was driven into the joints, then one round of dry oakum forced well into the hub of the pipe, and molten lead was run and forced tightly in. This was the first soil pipe that I ever saw carried full sized through the roof of a building for ventilation. The sewer pipe had no fresh-air inlet; they had not come to its use in Chicago yet. I had put in the smaller pipes from the crown of water-closet traps a quarter of a century ago, in this city. The purpose was not for ventilation, or to prevent siphonage, but to keep the soil pipe from becoming air-bound; of course it was ventilation in a small way. I will say in this connection that since the great fire in the city, lead soil pipe has been gradually giving way to cast-iron soil pipe. Short pieces of lead soil pipe are used now, only for lateral branches. The dangers arising from lead soil pipe are too well known to require any remark. In an article published several years ago, I showed the danger consequent from its use. The cities of the old world did use, and do use it to-day, with great success. But, circumstances alter cases.

"The next reform or change in plumbing is the water-closet. The introduction of the first sanitary closet in Chicago was in the autumn of 1872. This closet is now a question among plumbers and our learned sanitary engineers, whether it is a sanitary closet or not. There is a phase in this closet that is good, namely, the quantity of water used in every discharge. This feature of its make-up scours the soil pipe, and drives the fecal matter into the main sewer before it loses its momentum. The weak phase of this system is very bad. The larger reservoir in connection with the closet bowl is a fouling place, as bad, or worse, than the pan-closet. This first water-closet, I speak of, is the Sanks plunger closet, of Scotland. Those closets were put in the Palmer house when it was built, in 1873. From this time onward we may reckon, began the changes in the plumbing system. I can name a few of the closets that were all the rage, but apparently have now run their race. The Jennings water-closet, the Zane water-closet, and the rest of this class of closets are survivors, only because they have improved the reservoir and made it a small size. The water-closets used and the methods of construction up to the time of the Chicago fire, were three in number, the pan-cistern water-closet, the pan-valve closet, the English and Philadelphia hopper closet. These three constituted the pioneers.

"The pan-closet of twenty-five years ago was identical with the pan-closet of to-day. The old pan cistern-closet was defective in structure in two particular things: First, the supply pipe to the closet bowl was far too small for a proper flush; one-half inch pipe was not sufficient. Second, the closet bowl, especially the French bowl, was defective in principle. The swinging of the water around the bowl in a whirlpool-like shape was not enough to cleanse the bowl nor remove the soil from the trap, or clean the trunk of the closet or wash out the soil pipe. The oval water-closet bowl, with the lead or copper fan, is preferable to the round French bowl. The force from the fan is greater, and washes all parts of the bowl. The cistern pan-closet is not used in this city any more, and the pan-closet is fast following it. The hopper water-closets are still in demand. They are used in basements of houses, under sidewalks and outdoors in yards. Some improvements have been made in fitting them up. The earthenware hopper is taking the place of iron-enameled hopper, and is more desirable. The water-closet trap, where there is no likelihood of its freezing, is located close up to the hopper. The water-closet seats are made from hardwood, open all around and supported on cast-iron legs. I have previously stated the introduction of the first so-called sanitary water-closet into Chicago was the Shanks plunger closet. The next water-closet that appeared in this market was the washout. This closet is of an entirely new principle to anything we have had heretofore; certainly, it is the hopper idea, but superior in many respects. I think Myers & Sniffen, of New York, were the first to send them here, about 1877 or 1878, and they were imported from either England or Scotland. From this time forward dates a new era in the annals of plumbing in Chicago, with the introduction of the flush-rim hopper, of the long and short pattern, of every shape and form; the siphon water-closet, so finely and scientifically adjusted to nature's laws; the pedestal washout closet, with its siphon cistern, polished-brass pipes and hardwood seats, marble and tile floors. With all the variety of water-closets, the arrangement of parts is similar in many respects.

" Traps are indispensable to sound plumbing, but especially the water-closet trap. The water-closet traps, as now made, are of cast and of pressed lead, of cast-iron and of earthenware. The lead traps are most commonly used. On all jobs where there is a pan-closet or long hopper the lead trap is used entirely. The first lead trap, other than the hand and mold-made traps from sheet lead, was the cast-lead trap. I think it must be about twenty years since I first saw the cast-lead trap. The plumber had much fault to find with this trap for two reasons: First, it was an innovation and violated the old accepted notion that it is well to let good enough alone. It would also deprive the plumber of his birthright to be the sole maker of traps. The plumber believed it was not only an intruder, but that it was not fit to be used, and he was right to a certain extent. These traps were brittle and hard, and a proper flange could not be turned over on them. There was also many a sand hole in these traps. I can not say who was the inventor of this trap. There is a similar trap made at the present time called the Lowe lead trap, a very good one. The next lead trap that appeared in Chicago, about fifteen years ago, was the Dubois trap. I understand that a man of the name of Cunningham had a prior invention, but I never knew what became of it. This trap is pressed from molten lead, is round, smooth and even in bore and is very ductile.

" The improvement in traps and their introduction into market has been of inestimable value to the public from a sanitary point of view. The dangers consequent upon the use of the old style hand and mold-made trap are reduced to a minimum now. In practice the plumber discovered the seam of the old-time hand and mold-made trap where the solder joined the two edges together would decay and break away and leave an open space. Iron soil pipe is used at the present in preference to lead. The method of joining the lead traps to the sanitary tees is by ferrule. There are several ferrules now in the market. One of these is a ring of iron forced or pressed inside of a lead pipe. The other is a ring of brass or iron forced or pressed on the outside of a lead pipe. The last is a ferrule of cast brass, soldered to the end of trap or lead pipe, and fastened into the soil pipe T or bend with oakum and melted lead.

"The fitting up of soil and revent pipes presents problems of the greatest importance to the plumber and the man who shall have to live near and use his work. The necessity for the ventilation of the soil pipe is an outgrowth of the introduction of the new style of water-closet, though it has always been a necessity to ventilate sewer and soil pipe. This is shown by facts gathered from experience, yet who will say he knew the necessity before the advent of sanitary fixtures? It has come to be an established fact that a water-closet set on a line of soil pipe without the pipe passing up and above the roof of the house and a revent pipe from the crown of the water-closet trap, is considered not a good job of plumbing. Be this as it may, it is a positive fact where there is more than one water-closet on a line of soil pipe it must have atmosphere from some source, and the purer the source the better. The quantity of water discharged, say six gallons, and it never ought to be less, to do the work effectually, forms a plug of water in its descent, creating a partial vacuum in the soil pipe and removing the water from the trap. The ventilating and reventilating of water-closet pipes prevents siphonage of traps, and has come to stay until some new method shall be discovered.

"The soil pipes that are put in buildings are cast iron. The revent pipes are sometimes connected with the soil pipe above the highest fixture, and, once in a while, into a chimney-flue. There is a system of wrought-iron soil pipe called the Durham system. The pipes are put together by thread. As to this particular system I can not say much. The best authorities on wrought-iron pipe say that the life of cast iron is much longer than wrought iron. The joints in cast-iron pipe can be made perfectly air and water-tight. If any change or alteration is to be made, it can be much easier done with cast-iron than with wrought-iron pipe.

"The washbasins in use for many years in this city were known as common overflow basins. The washbasins now are known as the patent rubber-plug and the patent metal-plug basin, the oval washbasin, and basins of various designs with center outlets and back outlets. All of those basins can be fitted up with valve fixtures and many of them are. Cast-iron washbasins and cast-iron enameled washbasins and portable stands and washbasins combined of different shapes and sizes were much used for a good many years, especially in stores and offices. This class of goods was never much in favor on account of the chipping of the enamel from the iron. There was also another class of goods much in vogue years ago, I refer to the combined earthenware slab and basin, which was very good, but never become popular because they were so easily broken and could not be made well to fit in bath-rooms and recesses. The present method of fitting up washbasins of the different patterns of earthenware is by setting a marble slab on the top of the basin. The marble slab is cut and fitted for the niche or place, where it is to be set, and, instead of setting the basin, as formerly, into a wood slab to support it in place, the basin is now fastened to the slab by brass clamps run in by lead. The common overflow basins previously had the lead overflow connections made by putty. Now they are joined together with a rubber sleeve or connection. The marble slabs are now sometimes set on brackets and no woodwork around or about them, and others are finished very beautifully with hardwood and drawers underneath.

"The waste-pipe traps for washbasins that are very much used at the present time are the Bowers' trap and Cudells' trap. The two traps are half traps made after the form of the old bottle-trap and common S and half S-traps. There are many other kinds of traps, but they are all verging on the prineiple of the common trap. Basin-traps are now ventilated through the roof of the building or into another line of pipe. The basin-eoeks are mueh improved in style. The Fuller patent cocks, although invented twenty-eight years sinee, it has only been within the past fifteen years that they have been used to any great extent. For a great many years after the invention of the Fuller eock, which is named after the inventor who lived in Brooklyn, and had a small workshop and one or two men working for him, it was next to an impossibility to get any of them in Chieago. I remember when working for John Hughes (a master plumber), in the year 1862, hearing him say when he wanted any Fuller work he had to order it six months ahead. I think it was in the year 1873, the L. Wolff Manufacturing Company purchased the right to make Fuller work in Chicago. It was then, as the advertisement had it, "no more leaky cocks." The plumbers commenced to use them by the thousands. To say that the Fuller cock is the best in the market, would be saying too much, they are not durable by any means, and leak abont as much as any of them. I remember taking out ground-key work with the name of S. C. Smith & Company, Owens being the company and sueeessor, fifteen years after they had been put in, if the owner of the building's word was good for anything. Ground-key brass-work is the most durable and the best work ever invented, if made of the right kind of brass. There is no water-hammer from their use and consequently not so hard on the pipes as Fuller work. Compression brass-work has been used in Chieago for a quarter of a century and some makers' work has given great satisfaction.

"The methods of fitting up urinals has changed somewhat of late years. The urinal used in Chieago extensively for many years in public buildings and saloons was a lead-lined trough four feet and longer, made triangler in shape, supplied with water through a perforated pipe running its whole length and operated by a self-aeting Hooper eoek with foot treadle. Sometimes urinals were washed out by a eommon stopcoek and water let run a little all the time. Cast-iron and enameled-iron troughs were also used and fitted up similar to the lead ones. The improvements in urinals are like the improvements in water-closets. The aim of sanitarians for the last deeade has been to reduce the dangers arising from foul places by substituting better material, non-porous vessels, and devising a better water washout. Earthenware has been in use for urinals for a long time, and nothing has been found to give more universal satisfaction. There are many different shaped urinals of earthenware. The flush rimmed lipped urinal and the others of the covered and flat-shaped pattern are supplied through compression and self-acting cock, and periodieal automatic flushing tanks of various devices. The more recent improvement are marble stalls, they are principally fitted up in hotels and public buildings. The water supply is kept constantly trickling through brass pipes over the faee of the marble baeks, emptying into a marble gulley in the floor which connects to the waste pipe. The waste pipes of urinals are vented in the best jobs.

"I will now note the changes in material and methods of fitting up bathtubs, as compared to that of twenty-five years ago. There were no manufacturing establishments for the making of bathtubs in Chicago until Louis Wolff commenced to make them years ago. Up to this time all our copper tubs were brought here from the east. The other bathtubs that were used in Chicago were made by the plumbers—zinc and lead tubs. There is not so much improvement in the shape of bathtubs as there is in the way of fitting them up, and the material that they are made from. Had I to follow my feelings instead of my better judgment I would say the lead-lined wood bathtub was the best ever used. It would last ages on ages where made out of the proper thickness of lead. The surface of the lead is a little too rough for a first-rate sanitary bathtub. There are now the Imperial porcelain bathtub and the cast-iron painted and the cast-iron porcelain. These tubs have been introduced into Chicago of late years by the J. L. Mott plumbers' supply house, and other houses of this kind. These bathtubs, especially the Imperial, are very costly, and put only in the very best residence houses and hospitals.

"The carpenter work done on these bathtubs consists of a hardwood cap on top of tub, and is left open all around and set up from the floor on cast-iron legs or on wood blocks. The water to the bath is supplied through combination silver or nickel-plated cocks, with rubber tube and shower attachment, and Foley & McFarland's patent waste and overflow. These patent wastes and overflows are only slight improvements on the bath waste and overflow the plumbers made thirty-three years ago from a piece of lead pipe, brass valve seat, and cap fitting made to rest on the wood cap of the bathtub. The present arrangement of fitting up these bathtubs, including the planished copper bathtubs, is much more healthful and ornamental than formerly. The old method of connecting the waste pipes from bathtub into the water-closet trap without a separate trap for the bathtub, is no longer considered by plumbers a good sanitary job. The plan now followed by the progressive plumber is to have a drum-trap for the bathtub alone, with the overflow of the bath and the waste from the bottom of the bath entering separately into this drum-trap to stop any circulation of foul air from the sides of waste or overflow pipes. The bath-tub trap has a separate vent pipe carried through the roof of the building or into a vent flue or other stand pipe to prevent siphonage when the water-closet is used, and also to ventilate the drum-trap itself.

"Galvanized iron kitchen boilers for hot water have taken the place of copper boilers. The first galvanized boiler I ever saw was in this city about twenty years ago. It was not, however, until about twelve years ago that they were used to any extent. Now they are put in altogether. There is one advantage the galvanized boiler has over the copper boiler, besides cheapness, namely, the thickness of the iron as compared to copper. The iron resists the atmospheric pressure and does not collapse if there should exist in it a partial vacuum, whereas the copper, as made, would collapse under the same conditions. Sink and laundry tubs have undergone some changes, yet there has been nothing particularly new to offer to the trade. Whatever was good in the shape of washtubs in the past was high-priced and was seldom used, even in fine residences, until the time sanitary plumbing and sound fixtures were called for and their necessity became well known.

"Since the great Chicago fire (I have dated the changes in plumbing methods almost entirely from that event) cast-iron sinks have taken the place of wood sinks in all classes of buildings. The steel sink, pressed into shape and enameled, is something new; it is also light, strong and clean. Galvanized and enameled cast-iron sinks are also much used now. Wood sinks, lined with sheet copper, lead and zinc, belong to the past. The soapstone sink can not be relied upon, as some of them, I have seen, after a few years' usage, get rough and uneven. There are other good sinks in the market—earthenware, concrete and composition. The present method of putting up water supply pipes in the kitchen is by fastening boards on the wall and screwing the pipes to the boards, which is much superior to running the pipes in under the floors."

Reminiscences of old time plumbers by E. Baggot, written in September, 1891, deals familiarly with ancient tradesmen and their methods. He says:

"Plumbing has become so closely identified with health, and the efforts to improve the public health have been so rapidly increasing in their effectiveness, that it is not strange that great advances should have been made in the art in response to demand of the people for healthful habitations. Added to the anxiety on the part of the owner that his residence should be free from sewer air, there has been and still exists a laudable desire on the part of the plumber that his work should be as perfect as possible. These two desires have joined to produce a great improvement in plumbing work and in sanitary fixtures. There has also been a growth of public opinion in Chicago which has permitted the city health department to maintain an inspection of plumbing which has been rigorous enough to accomplish great good, and all these causes combined have worked to produce a high grade of plumbing work.

"When one who is familiar with the early frontier days of Chicago, with the primitive methods then in use for disposing of human excrement, steps into one of the magnificently appointed buildings which now adorn its streets, and examines the complete and comparatively perfect systems of disposal of waste products, he can see at a glance the great improvements which have been made.

"Much of this great advance has been made, to be sure, in an artistic direction, and marble slabs and nickel-plated fixtures have superseded the uncomfortable and unhygienic inconveniences of that early time. But an advance quite as great, though not so readily recognized by the unpracticed eye, has been made in the appliances themselves.

"Of course these sanitary improvements have been made gradually. Those who have been familiar with the plumbing business will remember when the pan-closet represented the best water-closet obtainable, and when we were not aware of the danger which accompanied waste and soil pipes which were not run through the roof, or which were not trapped as fully as they might have been. But I will say for the plumbers that they have never been backward in making improvements in their work, and many of the improvements we now have are the products of the ingenious inventing plumber, who recognized danger in faulty work and sought to remove it by substituting an improved appliance.

"There have been very excellent and enterprising plumbers in Chicago, and the best work-

Ludwig Wolff,

men have come here and after working for a few years as journeymen, have gone into business for themselves and now stand as leaders in the trade. The pioneers in plumbing have nearly all passed away. In 1846 the first public water supply was put in, and, as was to be expected, the limited amount of plumbing done at first, was done by hardware men at that time in business. Thomas George, at 201 Lake street, did most of the early plumbing, and in 1849 among his apprentices was James S. Bassett, who is still in the plumbing business in Chicago. Michael Greenebaum & Bro. were also early tinners and did plumbing, but these feeble attempts ceased when the work increased, so that regular plumbers began to work in the city. The first plumber to enter business in Chicago was Alexander Raffen, father of John T. Raffen, who established himself at the corner of Canal and Lake streets in 1850. It was not until 1853 that Mr. Raffen had a competitor, when Henry L. Wilson went into busines at 161 Lake street, with John Hughes as his practical man, and in later years his partner. With Wilson also came Terence Maguire, who went into business for himself at 32 Lake street in 1853. It was in 1855 when Ludwig Wolff formed a partnership with Maguire, with a shop in the alley south of the Tremont House. Thus began the business career of a man who was founder of the well-known plumbing supply house of the L. Wolff Manufacturing Company. R. D. McFarlane was also one of the early plumbers of the city. In 1856 J. J. Hamblin (still in business), and James McDonald appeared in Chicago, and for them worked as journeymen many of the men who have since added honor to the trade in Chicago, including Daniel J. Rock and Edward Bufton. In those days the plumber was a manufacturer of lead-traps, tanks and other things, which are now much better and more cheaply made by machinery. It was in 1872 when cast-iron soil pipe was first used in Chicago, and since then cast-iron and wrought-iron soil pipe with screw joints have entirely displaced lead pipe. In water-closets the old pan-closet found itself improved upon by the pan-valve closet and the English and Philadelphia hopper-closets. Then followed the closets of the plunger type, then the wash-out patterns, followed by the siphon closets so scientifically adjusted that they seem nearly perfect in their action. Of the improvements made in ventilation of pipes and traps, and in trapping fixtures and pipes I have no space to go into detail. It is only necessary to say that the methods now in use are the results of the latest scientific investigations, and no improved method of plumbing is now devised without being immediately communicated to the entire trade of the country by the enterprising newspapers published in the interests of the trade.

"In the improvements of the sanitary conditions of Chicago, I would be remiss in my duty and omit the performance of a pleasure, should I fail to mention some of the men to whom I feel the building interests of Chicago are much indebted. Any city in the world might be proud of such craftsmen and business men as J. J. Wade, M. J. Corboy, Alexander Murray, David Whiteford, Thomas Conlin, William Bowden, D. and L. Bain, Oliphant & Liddell, T. C. Boyd, J. J. Hamblin, David J. Rock, Robert Griffith, Patrick Nacey, J. J. Clark, P. Sanders, Wandable & Davimey, Val. Ruh, A. Young, Hugh Watt, Peter Williams, P. Becker & Bro., R. Coleman and Foskett & Brown, not to mention many of the younger plumbers who are attracting favorable comment and attention by their excellent work."

The laundry tubs, like the sinks, were made from wood and are to-day much used in that shape, though fast giving way to the porcelain, earthenware and concrete washtubs. The sanitary arrangements of the waste pipes from washtubs are the same as all other classes of fixtures, ventilated, by the same method as sinks and water-closets, through the roof of the building or into some other pipe or flue. The traps of all fixtures are now located as close to the receptacle as possible.

The trap seal began only in 1883 to take its proper place in public estimation. Prior to that time the importance of the trap won attention from members of plumbing and sanitary associations; but the plebian outsiders knew little or nothing of it, some going so far as to style it a plumber's device for increasing the taxes of house owners. In those days the latest immigrant learns the uses of the trap; but the word seal is seldom or never heard. Even the plumbers permit the word trap to carry the whole onus of the apparatus. Without the seal the trap is worse than useless; with it, it is the protector of the household from sewer gasses. Architect Putnam, in 1888, contributed to the *Sanitary News* a paper "On water seals in vented traps," which goes to the bottom of the subject: "It is evident that the air current induced by the trap-vent pipe must produce a degree of evaporation on the water seal proportionate to the rapidity, dryness and temperature of the current. But whether or not the increased evaporation due thereto is sufficient to render the vent pipe a serious element of danger has been the subject of very considerable dispute, and the differences of opinion have, unfortunately, not always been expressed in the sober and impartial spirit its importance deserves. If it is found that vented traps are really liable to lose their seals in a few days or weeks, while unvented traps are practically secure in this respect, the question of the desirability of the trap vent becomes a very serious one, well worth investigating; for it often happens that plumbing fixtures must be left in temporary disuse, as when, for instance, in winter or summer hotels or residences, the rooms are, out of season, partially or wholly vacated, or in apartment houses or office buildings, when certain rooms are closed during change of lease; or in schoolhouses during the months of vacation; or, in short, in any building, in case of sickness, death or absence for travel or any cause. Under such circumstances it becomes necessary to appoint a special watchman to fill the traps at regular and suitable intervals. This practice has proved to be altogether unsatisfactory and unreliable. The vent pipe becomes a greater source of danger than the trap. Instead of the watchdog it should more properly be likened to the wolf quickly devouring the seal it was appointed to guard. How now should experiments be conducted to give the absolutely satisfactory answer we desire to this question? Only by using for our apparatus, plumbing pipes correctly laid under ordinary conditions and for regular use in house drainage, and by repeating one experiment under a sufficient variety of conditions to permit of the formulation of rules covering all. By measuring the rapidity, temperature and moisture of the air current in the vent pipes in each experiment, a very accurate estimate of the average rate of evaporation in buildings can be obtained, and the relative effects of warm and cold flues.

"For the present our problem is to discover, not whether the vent pipe always occasions a rapid destruction of the water-seal, but whether, under ordinary conditions, it is liable to do so and to do it frequently enough to render its use dangerous and undesirable. The experiments I am about to describe have been made exactly in the manner above recommended. The first series was made in winter on the plumbing pipes of a Boston office building four stories high above the basement. The main soil pipe was four inches in diameter and extended from the cellar ceiling up through the roof, where it remained open as a head vent. At the bottom the pipe ran horizontally fifty feet to the main house-trap, on the inner side of which was the foot vent. The traps tested were ordinary one-and-one-fourth or one-and-one-half inch cast-lead lavatory traps, vented at the crown, the vent pipes being carried through the roof. One series of experiments was made on a cold vent pipe two and four inches in diameter. Another upon a vent pipe which entered a heated flue ten feet beyond the trap tested. In both series the experiments were made on traps on the lower floor, so that the ventilating current was obliged to traverse over thirty-five feet (in the first series over fifty feet) of soil pipe before reaching the crowns of the traps on which the experiments were made. Twenty feet of this soil pipe was kept constantly wet by the discharge of four water-closets, two sinks and seven washbasins in daily use in the various occupied rooms connected with it. The remainder was wet at the beginning of each experiment.

"A Casella anemometer was used to measure the velocity of the ventilated current moving in the cold flue, a small portion of the flue being cut out and a glass chamber holding the anemometer being inserted to take its place. Thus in all our experiments the conditions were the usual ones met with in ordinary plumbing, except that, inasmuch as our soil pipe was kept constantly wet, the conditions were less favorable for evaporation than in houses which are temporarily closed. Since in these the entire inner surfaces of the waste pipe traversed by the ventilating current is at once dried by disuse, and all the energy of evaporation is turned upon the seals of the traps. Hence, it may be safely assumed that the average rate of evaporation shown in our experiments would be exceeded rather than unequaled in practice. The experiments were made both in winter and in summer, and extending over several months; they included a fair average of wet and dry weather.

"The experiments were as follows: (A) Experiments on evaporation produced by a cold ventilating flue. A one-and-one-quarter-inch scant S-trap having a seal of four and five-eighths inches deep attached to the end of the branch waste. A one-and-one-half-inch ventilating pipe was taken from the one-and-one-quarter-inch ventilating flue. This flue passed through two occupied offices (basement and first floor) whose temperature was maintained at about 68 degrees Fahrenheit, during the terms of the experiments, and through a chemical labratory (second floor) whose temperature was maintained at about 60 degrees Fahrenheit. For the remainder of its hight the flue passed through a cellar and stairways, whose temperature was maintained at about 45 degrees Fahrenheit. No artificial heat was applied to the flue.

"The velocity of the movement of the current of air was measured by the anemometer. The daily rate of loss of seal by evaporation, and the velocity of the current in feet per minute was obtained. The loss of seal averaged about an eighth of an inch per diem. It amounted to about a quarter of an inch the first day, and gradually diminished as the level of the water descended in the trap and the distance of its surface from the ventilating current increased, to a little less than an eighth of an inch per diem. Hence an ordinary S-trap having a one-and-one-half-inch or a one-and-three-quarter-inch seal, would loose its seal in from nine to eleven days under these very ordinary conditions. The experiment was repeated several times at different parts of the year, from the middle of December to the middle of May, with substantially the same results. The same trap was now vented two inches below the crown. The rate of evaporation was somewhat slower. This experiment was carried on only eleven days, inasmuch as by this time one and one-half inches of the seal had been destroyed, and the seal of ordinary machine-made S-traps does not exceed one and one-half or one and three-quarters inches.

"A number of experiments were then made on S-traps unventilated, but open at both ends as is the case in practice. The loss of water was almost inappreciable, not exceeding one-thirty-second or one-sixteenth of an inch in ten days. (B) Experiments on evaporation produced by a heated ventilating flue. (a) A one-and-one-half-inch trap having a seal three and one-fourth inches deep tested. A one-and-one-half-inch wrought-iron gas pipe six inches long connected the crown of the trap with a brick flue, 8x12, heated by a stove. The average loss per diem exceeded one-third of an inch or exactly four-elevenths of an inch. The smallest loss was one-eighth of an inch. The fixture side of the trap was closed during the tests. (b) A second series of experiments was made with an ordinary one-and-one-half-inch cast-lead trap having a seal one and one-half inches deep. The trap was connected with the heated flue at a point three inches beyond the crown. Four tests were made. The loss of seal was much slower than in former tests, because of the distance of the mouth of the vent pipe from the crown of the trap. The rate of evaporation, however, in these four tests averaged one-seventh of an inch a day; the greatest loss in any day being three-eighths of an inch. In all these experiments on evaporation it was found to make no material difference in the results whether the fixture end of the trap was open or closed, showing that evaporation at this point was inappreciable. In the experiments on evaporation with the cold ventilating flue, in the first experiment with the vent at crown, the anemometer recorded an average rate of movement of the ventilating current, of ninety-four feet per minute.

"In the second test, with vent at crown, the average was eighty-five feet per minute, with vent two inches from crown the average was one hundred and nine feet per minute. The velocity of the current during the cold months of the year was quite uniform. In the summer months, however, it was exceedingly variable, sometimes equalling that of the cold season, and sometimes ceasing entirely or even retrograding. In the cold months the relation between the rapidity of evaporation and the velocity and dampness of the air-current was not accurately determined, the rate of evaporation being quite uniform in spite of considerable barometric fluctuation and change of velocity. But in summer a change of the conditions of the atmosphere produced a very marked change in the rate of evaporation. On a few occasions of damp or rainy weather in the summer months, where the cold brick flue was used without a ventilating cap on top, the seal actually gained slightly in depth, from condensation on the cold flue of the damp air of the soil pipe, or from an actual fall of rain or moisture down the chimney. These accretions were, however, very rare, not occurring more than three times in the whole duration of the experiments."

The experiments demonstrate that an S-trap of ordinary depth of seal, if vented to the roof, will, when not used, lose its seal by evaporation in from nine to eleven days, and that a similar trap, unvented but open at both ends, as is the case in practice, will lose not exceeding one-thirty-second to one-sixteenth of an inch in ten days. Accepting these data to be correct, the conclusion is inevitable that venting to the roof is indeed a most untrustworthy practice. But these experiments equally demonstrate that if the conditions of an unvented trap as regards evaporation can be maintained, and at the same time the seal of the trap be protected against siphonage, then the simple S-trap of easy curves and uniform calibre is incomparably better than any other. Siphonage can only be prevented in this form of trap by the free admission of air on the sewer side of the seal whenever a partial vacuum is formed in the pipe. This is now sought to be secured by back vent pipes to the roof, but with disastrous results to the seal of the trap, by evaporation when not in use. But if the admission of air is limited by an automatic device, to the requisites to prevent siphonage, then, during periods of disuse the conditions would be identical with those of an unvented trap, so far as evaporation is concerned. Hence an ordinary S-trap vented by such a device, would not lose its seal by evaporation, when not used, in less than from eight to sixteen months, if Putnam's observations are founded on correct data. The want of such an appliance has long been recognized, and numerous attempts have been made to produce a device that would successfully meet this requirement. One of the first of these that came to public notice, operated by means of a hinged valve, with depending edges which dipped into a shallow channel of water, while others relied upon the accuracy of mechanical closures of various forms, but all alike failed of success until 1888, when one or more practical trap vents were brought to the notice of plumbers. The work of Chicago inventors, within the last three years, has presented to the public an opportunity to select one from many successful traps.

In June, 1888, the *Sanitary News* obtained from a few leading plumbers their views on trap seals in untenanted houses. Replies were received from David Whiteford, J. J. Wade, Martin Moylan, Tossell & Hendrick, P. K. Hardin, Kelly Bros., L. H. Levy, John F. Matthews and J. J. Coughlin. The first-named believed in the use of glycerine. It is itself an antiseptic, and would be washed out clean the first flushing the fixtures got. Then it would not evaporate if left a year, and frost would not interfere with it or the pipe in winter. The cost would be merely nominal, as glycerine is quoted in the list of chemicals at 20 @ 25 cents a pound. The second stated, "To prevent sewer gas from flowing through traps of fixtures when the building is unoccupied in summer or winter, the water should be removed from the trap, and salt, well packed, substituted. This forms a solid crust on the surface, thus preventing sewer air from entering the apartments, and is a safe and sure remedy.

When the building is occupied again, the water is let run and the salt melts away without any difficulty." The third answered, "The answers you will receive to your inquiry, 'what to do with traps while not in use, or while house is closed,' will, I have no doubt, thoroughly demonstrate the thoughtfulness and responsibility of the plumbing trade. I feel sure this simple every-day question has been presented for the first time in all its importance by the *News* to a great many readers. Your answers will show the necessity, I think, of keeping up the a, b, c problems of the trade. I have used glycerine or oil in my practice." The fourth was laconic, saying simply, "Turn off the supply pipes, and leave the traps full of water." The fifth said, "I would turn the water off from the house and leave the traps filled; then there would be no danger of siphonage, where the traps are well ventilated, as they are in all modern plumbing." The sixth, "I would dry the closet and fill the bowl with glycerine, or a similar fluid, which would not evaporate." The seventh, "I would remove the closet and solder a lead cap over the trap, in case no one was around to fill it. If the bathtub has a connection with the closet, I would do the same." The eighth, "I would have a man fill all the traps once a week with water. If the plumbing were properly done, there would be no danger of gas escaping," and the ninth, "For fear of rats gnawing the pipes when thirsty, or the pipes bursting, I would shut the water off, if the pipes were properly ventilated. If convenient, I would have some one turn the water on once a week." Thus the question rested and still rests, many believing that whether in use or out of use, the trap seal is unable to resist gas pressure in such a degree as to prevent ingress.

The plumbers of 1871–2, others than those named above, were Adams & Burke, 176 Indiana; George Alles*, 463 Division; E. Baggot*, 132 Fifth avenue; G. J. Baker, 6 South Jefferson; Biederman* & Bischoff, 320 Ohio; James Blow, 102 Harrison; H. W. Boettner, 471 South Halsted; William Bowden*, northwest corner Archer avenue and State street; Boyd* & Bufton, 146 State; Boyington & Edwards, 974 Wabash; Charles Breyer*, 87 North Halsted; M. C. Brooks, 279 West Randolph; James Brown, 180 North Halsted; William Brown*, 349 Division; Richard E. Burns, Cottage Grove and Twenty-third; John Byrne, 198 South Park; W. S. Carpenter, 605 West Lake; Clark & Lyons, 1055 State; M. J. Condon, 354 Blue Island; Connell & Goolden, 53 Cottage Grove; William Craggs*, 35 West Adams; Danniells* & Brown, 453 South Canal; James Ferguson, 9 South Halsted; Gair & Hadfield, 133 La Salle; Jerry Garvey*, 407 Twelfth street; Ginley & Co., 118 West Monroe; Watson, Griffith*, 51 North Wells; Harper & Skinner, 190 Twenty-second street; Harth & Weppner, southwest corner Chicago avenue and Wells; P. Harvey*, 449 State; G. Hauslein, 291 North avenue; Alexander Hendry, 154 Eighteenth street; C. J. Hickey, northwest corner Kinzie and Dunn; Henry Hoff, 190 North Wells; Joseph Hogan*, 132 West Madison; James Hussey, 305 North avenue; Innes Bros.*, 422 West Van Buren; Kelly & Cashill, 426 West Twelfth; Robert Kind, 265 Division; R. C. Kinney, 75 Dearborn; Lane* & Murphy, 143 Illinois; Thomas Lees, 931 North Clark; S. Livingstone*, 1473 State; Terence Maguire, 133 Michigan avenue; McCartney & Hamblin, 461 West Madison; Thomas McKenna, 1200 State; Joseph McMullen*, 808 South

* Here in 1879.

Halsted; John Mills*, 189 West Lake; Philip H. Murphy, 929 State; Murray & Son*, 318 West Randolph; P. Nacey*, 631 State; Oliphant & Liddell*, 268 West Madison; J. L. Pattison & Co.*, 132 Lake; N. E. Peterson, 177 Twenty-second street; John Pickett*, 351 Clark; George Powell, 103 Madison; John Powell*, 103 Randolph; Edmund Powers*, 388 Twenty-second street; Patrick Rafferty, 226 La Salle; James Reid, 1223 State; D. J. Rock* & Dorgan, 76 North Clark; Valentine Ruh*, 548 North Wells; M. Ryan*, 324 Milwaukee; Sanders & Bro.*, 564 State; Jerry Scanlan, 424 State; Bernard Schaefer, 391 North State; Thomas Shatwell, 143 West Harrison; Sheehan & Drinkwater, 147 North Wells; W. S. Shepherd, 483 Wabash; Sloan & Graham, 190 North Wells; Charles Spayers, 193 West Harrison; William Stell, 121 West Randolph; Stoneham & McCullough, 18 North Halsted; R. & J. Summers*, 375 Canal; W. S. Verity* & D. Whiteford*, 229 West Randolph: J. J. Wade*, 74 West Madison; John Ward, 421 South Canal; Weir & Craig, 149 Archer avenue; Willems Bros.*, 256 North Clark; Moses Williams, 707 Wabash.

The plumbers and gasfitters of 1879, whose names do not appear in the lists of 1872 were Matthew Anderson, D. & L. Bain, Peter Becker, A. Bergener, John Blake, Patrick Blake, Henry Boon, Breyer & Berney, C. J. Brooks & Co., Timothy Brosnan, W. C. Brown, Ernst Bryen, J. J. Bufton, Michael Burke, D. W. Burns, H. Byrne & Co., James Byrne, Ed. Campen, Ed. Carr, John A. Carroll, Chappell & Welber, William Coates, Coffey Bros., Michael Conway, Curtin & McDonough, Daly & Matthews, Patrick Desmond, B. J. Downey, Chester Drake, John W. Driscoll, John Dunn, Henry Fleming, John Gannon, William F. Gay, George Girney, Richard Graham, Robert Griffith, James Halleran, Halpin & Kelly, Dan A. Hanley, Hartman & Denniston, Thomas Havey, Edward Hennessy, M. E. Herbert & Bro., William Herpst, Andrew C. Hickey, T. P. Hughes, C. P. Hulbert, A. F. & J. Irons, J. B. Kay, Thomas Kelly & Bros., J. Ketter & Son, Louis Kopp, C. Kostlevy, Theodore Kraefft, Krakow & Son, Gus. Kreischmer, John Lavery, William Lazievre, Alexander Leuder, Louis Levy, William Lewis, W. F. Lothian, William Lutz, Matthews & Holt, T. J. McCarthy, Alexander McDonald, James McGinley, McGinley Sons, S. McGraw, J. B. McKay, James McLaughlin, R. M. Miller, James Monahan, M. W. Moran, Martin Moylan, Hiram Mund, James C. Murphy, A. W. Murray, John Nelson, F. Neustadt, Edward O'Brien, James O'Brien, Napoleon O'Brien, John P. Olson, Joseph O'Malley, Thomas O'Malley, Alfred Patterson, Matthew Pitts, W. Rankin, Rudolph J. Reetz, H. M. Reilly, Jr., Thomas Robinson, Joseph P. Roche, Roche & Hardin, John G. Roland, George S. Ross, J. H. Roth, Ruehlman Bros., John T. Ryan, John Scanlon, Martin Schell, Peter Schmidt, A. J. Sherman, Michael C. Sloan, George J. Stokes, P. J. Thielen, W. & E. Thompson, George Tipple, Joseph Urban, Charles Walter, A. H. Watson, Hugh Watt, John Watt, John Walsh, A. R. Wilson, John H. Winterbury and Andrew Young.

In 1884 a committee of the Plumbers' association reported on the use of iron pipe for house drainage. This committee could not recommend anything better than the usual salt-glazed sewer pipe, properly laid on a solid bottom and imbedded in Portland cement concrete of a thickness not less than two inches. If the sewer bed is filled ground it should be thoroughly

*Here in 1879.

rammed and made solid; this only applies to underground drainage. The committee further recommended that no iron pipe for soil or ventilation be used unless coated inside and outside with tar, and that all vent pipes be flushed out with water at least once every six months to prevent them filling with rust. The committee considered this necessary, especially where offsets or bends are in vent pipes; also, that vent pipes be left as short as possible above the roof, as that portion of the pipe generally freezes in winter and stops all ventilation. The objectors to the opinion of the committee were many, among them being P. Havey. He was not in favor of the use of sewer pipe, buried underground, but would use iron pipe, and have it laid in a brick box, or hung on its side, so that it might at all times be accessible. Original defects, or those which resulted from use, could then be discovered in ten minutes at any time. It was admitted that the joints of sewer pipe would crack, but no one could tell where these defects were without digging up the entire length of drain. These remarks applied to that part of the drainage within the house walls; outside, the laying must of course, conform to the rules and regulations of the department of public works. If iron pipe rusted, it could be seen, if laid as suggested, and could be replaced, but let such thickness of pipe be prescribed that it would not be likely to rust out. Messrs. Bowden, Roche, McGinley, Griffith and others participated in this debate, and expressed themselves in consonance with the report.

C. W. Durham, who originated the use of wrought-iron pipe with steam-fitting joints for house drainage, was formerly a resident of Chicago and a civil engineer of some reputation. He early gave his attention to sanitary engineering in all its branches, and, among other things, invented a hot-air furnace, the principal aim in the construction of which was to prevent the escape of gases into the house. He early noticed that house drains were likely to become broken or misplaced by the uneven settling of the walls of a building, and he conceived the idea of so constructing the system that it would be practically independent of the building, so far as settling was concerned. He therefore rested the entire system of pipes above ground upon an independent foundation, and, by using wrought-iron pipes with screw joints, made it impossible for the pipes to be pulled apart at the joints, and thus prevented the escape of gases. It is said that the patents cover this general method of construction, as well as the special fittings which have been devised, and which are manufactured by the company, or for the western states, by E. Baggot, of this city.

The discussion of traps is also receiving its share of attention. Modifications of existing traps, as well as new forms of traps, are being put upon the market. The trap is, in one sense, the base of all plumbing, and there is no one thing on which more ingenuity is being exercised in its perfecting. A large advance has already been made, but there is still room for improvement. Faucets and cocks of all kinds are being planned on new principles, and nowhere is there a greater opportunity for inventive genius to display itself. The repair bill, where many faucets are placed on the plumbing system, is no inconsiderable amount, and it should be the aim and design of manufacturers of this line to make their goods in the most lasting way possible.

Lead pipe and brass are the metals most prized by the plumbers, with iron pipe forcing its way toward popularity. Although lead, in many instances, has been found in a native state, it is more generally discovered as sulphuret of lead. This is known in commerce by the name of galena. Knight says lead was known in old times. "They sank as lead in the mighty waters," is a part of the triumphant song of Miriam, 1491 B. C. Job refers to its use for writing tablets, "An iron pen and lead." A work of Hesiod's was preserved for many centuries scratched on leaden tablets. Iron, tin, and lead were enumerated by Ezekiel as among the commercial objects of the Tyrian trips to Tarshish. The Romans used sheet lead largely in making water pipes. Lead was probably the first metal worked, because its ores are abundant in all countries, and it is frequently found at or near the surface of the ground, fusing at so low a temperature as six hundred and twelve degrees Fahrenheit. The discovery of melted lead must have attracted the attention of the ancients at an early day, while building fires in the mineral districts. Ewbank relates that the terraces of Nebuchadnezzar's hanging gardens were covered with sheets of lead, soldered together to retain moisture in the soil. Archimedes used lead pipes to distribute water by engines in the large ship built for Hiero. The plumbers of Pompeii used lead pipes, for the Neapolitan government sold large quantities of lead pipes as old metal. Plumbing is, therefore, no new art, but among the earliest of which there is any record. Rolling or milling lead was invented by Thomas Hale in 1670.

A table of weights and strengths of leaden pipe was prepared a number of years ago by B. B. French, civil engineer, of New York City. The figures in the table were determined by actual test, and the experiments on each pattern of pipe were made in duplicate. The second specimen was subjected for the space of ten minutes to one-quarter of the absolute or bursting pressure of the first, on the supposition that within that time the alteration of its structure, if any, would ensue. The pipe was then burst, and if its tenacity proved equal, or nearly so, to the first proof, it was assumed that its strength was unimpared by the pressure thus imposed and a safe working pressure was derived. As the gauge used in the experiments did not record below two hundred pounds pressure per square inch, pressure under that amount was assumed. The strength of the one-and-three-fourths-inch pipes were calculated, as no pipes of that size were available for test when the experiments were made. This table, we are informed, was never printed, though a limited number of lithograph copies were made at the time. Owing to the diversity in the markings of pipes of different manufacture, we would caution our readers not to make comparisons on the basis of the pipe-markings, but to compare according to weights and dimensions. It is to be regretted that lead pipes are not made to conform to a common standard, but on comparing the above table with the different current lists of the manufacturers, we find that it does not vary widely from any of them. Some of the sizes are heavier than one manufacturer's and lighter than another's. The list in the table, therefore, is as much entitled to be called a standard as any of the several lists of the present day.

The presence of impurities affects the ductility and malleability very much. Common impurities are oxide of lead, which is dissolved in small quantities while in a melted state, zinc, tin, antimony, etc. Lead has a very low tenacity. The tensile strength of lead is variously estimated at from one thousand four hundred pounds per square inch by Trautwine, and by authorities, as below: Cast, nineteen hundred and thirty pounds per square inch, by D. K. Clark; sheet, twenty hundred and forty; pipe, twenty-two hundred and forty; pipe, twenty-seven hundred and forty-five, by Box; pipe, thirty-three hundred, by Rankine; pipe, twenty-one hundred and ninety-nine, by Kirkaldy. Impurities, or small quantities of other metals reduce the specific gravity, and have the tendency to make the lead harder, while increasing the tensile strength generally, which, in pipes, is rather an advantage than otherwise, if not carried to excess.

Number of Experiment.	Caliber.	Mark.	Weight per foot.	Exterior Diameter.	Thickness.	Distention of proof.	Absolute bursting pressure.	Mean bursting pressure.	Safe working pressure.	Equivalent head in feet.	Theoretical value of P. by formula.
1	⅛	——	0.2	....	....	....	....	....	....	....	....
1′....	⅛	——	0.2	....	....	....	....	....	....	....	....
2	¼	E	0.5	....	....	....	....	....	....	....	....
2′....	⅜	E	0.5	....	....	....	....	....	....	....	....
3	⅜	AAA	1.12	0.75	0.18	0.03	1987.5	....	....	....	....
3′....	⅜	AAA	1.12	0.75	0.18	0.08	1950.	1968.75	492.18	10275.15	1967.84
4	⅜	AA	1.5	0.68	0.15	0.07	1610.	....	....	....	....
4′....	⅜	AA	1.5	0.68	0.15	0.05	1645.	1627.5	406.875	8494.25	....
5	⅜	A	1.2	0.64	0.13	0.05	1350.	....	....	....	....
5′....	⅜	A	1.2	0.64	0.13	0.07	1412.	1381.	347.75	7259.91	....
6	⅜	B	1.0	0.625	0.125	0.03	1330.	....	....	....	....
6′....	⅜	B	1.0	0.625	0.125	0.03	1355.	1342.5	335.625	7006.78	....
7	⅜	C	0.14	0.60	0.11	0.05	1162.5	....	....	....	....
7′....	⅜	C	0.14	0.60	0.11	0.06	1212.	1187.25	296.81	6196.45	....
8	⅜	——	0.10	0.55	0.087	0.07	1080.	....	....	....	....
8′....	⅜	——	0.10	0.55	0.087	0.05	1090.	1085.	271.25	5662.83	....
9	⅜	D	....	....	....	....	....	....	....	....	....
9′....	⅜	D	....	....	....	....	....	....	....	....	....
10	⅞	——	0.9½	0.5975	0.08	0.04	780.	....	....	....	....
10′....	⅞	——	0.9½	0.5975	0.08	0.05	770.	775.	193.75	2986.96	....
11	½	AAA	3.0	1.	0.25	....	1750.	....	....	....	....
11′....	½	AAA	3.0	1.	0.25	0.08	1825.	1787.5	446.875	5245.01	....
12	½	——	2.8	0.95	0.225	0.09	1620.	....	....	....	....
12′....	½	——	2.8	0.95	0.225	0.09	1690.	1655.	413.75	4856.22	....
13	½	AA	2.0	0.86	0.18	0.07	1425.	....	....	....	....
13′....	½	AA	2.0	0.86	0.18	0.12	1362.5	1393.75	348.43	4089.55	....
14	½	A	1.10	0.82	0.16	0.06	1230.	....	....	....	....
14′....	½	A	1.10	0.82	0.16	0.03	1340.	1285.	321.25	3770.53	....
15	½	B	1.3	0.75	1.25	0.05	930.	....	....	....	....
15′....	½	B	1.3	0.75	1.25	0.04	1030.	980.	245.	2875.58	....
16	½	C	1.0	0.70	0.10	0.09	790.	....	....	....	....
16′....	½	C	1.0	0.70	0.10	0.07	775.	782.5	195.625	2296.06	....
17	½	D	0.9	0.63	0.65	0.07	462.5	....	....	....	....
17′....	½	D	0.9	0.63	0.65	0.06	475.	468.75	117.18	1375.35	....
18	½	——	0.10	0.65	0.07	0.09	550.	....	....	....	....
18′....	½	——	0.10	0.65	0.07	0.09	562.5	356.25	139.0625	1632.18	....
19	½	——	0.12	0.68	0.09	0.08	637.5	....	....	....	....
19′....	½	——	0.12	0.68	0.09	0.05	613.	625.25	156.31	1834.62	....
20	⅝	AAA	3.8	1.10	0.23	0.14	1510.	....	....	....	....
20′....	⅝	AAA	3.8	1.10	0.23	0.13	1587.5	1548.75	387.18	2908.94	....
21	⅝	AA	2.12	1.06	0.21	0.10	1340.	....	....	....	....
21′....	⅝	AA	2.12	1.06	0.21	0.10	1420.	1380.	345.	2592.03	....
22	⅝	A	2.8	1.	0.18	0.09	1115.	....	....	....	....
22′....	⅝	A	2.8	1.	0.18	0.12	1190.	1152.5	288.125	2164.68	....
23	⅝	B	2.0	0.95	0.16	0.09	1000.	....	....	....	....
23′....	⅝	B	2.0	0.95	0.16	0.08	975.	987.5	246.875	1854.8	....

Number of Experiment.	Caliber.	Mark.	Weight per foot.	Exterior Diameter.	Thickness.	Distention of proof.	Absolute bursting pressure.	Mean bursting pressure.	Safe working pressure.	Equivalent head in feet.	Theoretical value of P. by formula.
24	⅝	C	1.7	0.86	1.17	0.11	785.	....	....	....	....
24′....	⅝	C	1.7	0.86	1.17	0.07	805.	795.	198.75	1493.29	....
25	⅝	D	1.4	0.84	0.10	0.09	680.	....	....	....	....
25′....	⅝	D	1.4	0.84	0.10	0.09	737.	708.5	177.125	1330.76	....
26	⅝	——	......	......	......	......	......	....	....	....	....
26′....	⅝	——	......	......	......	......	......	....	....	....	....
27	⅝	E	......	......	......	......	......	....	....	....	....
27′....	⅝	E	......	......	......	......	......	....	....	....	....
28	¾	AAA	4.14	1.33	0.29	0.12	1450.	....	....	....	....
28′....	¾	AAA	4.14	1.33	0.29	0.08	1475.	1462.5	365.625	1907.27	....
29	¾	AA	3.8	1.20	0.225	0.10	1200.	....	....	....	....
29′....	¾	AA	3.8	1.20	0.225	0.07	1250.	1225.	306.25	1597.54	....
30	¾	A	3.0	1.13	0.19	0.10	1145.	....	....	....	....
30′....	¾	A	3.0	1.13	0.19	0.12	1000.	1072.5	268.125	1398.66	....
31	¾	B	2.3	1.05	0.15	0.06	890.	....	....	....	....
31′....	¾	B	2.3	1.05	0.15	0.10	840.	865.	216.25	1128.06	....
32	¾	C	1.12	1.	0.125	0.12	790.	....	....	....	....
32′....	¾	C	1.12	1.	0.125	0.08	775.	782.5	195.625	1020.47	....
33	¾	D	1.3	0.93	0.09	0.12	505.	....	....	....	....
33′....	¾	D	1.3	0.93	0.09	0.12	505.	505.	126.25	658.58	....
34	¾	E	......	......	......	......	......	....	....	....	....
34′....	¾	E	......	......	......	......	......	....	....	....	....
35	1	AAA	6.0	1.60	0.30	0.09	1220.	....	....	....	....
35′....	1	AAA	6.0	1.60	0.30	0.07	1240.	1230.	307.5	902.28	....
36	1	AA	4.8	1.46	0.23	0.25	870.	....	....	....	....
36′....	1	AA	4.8	1.46	0.23	0.18	950.	910.	227.5	667.54	....
37	1	A	4.0	1.42	0.21	0.16	810.	....	....	....	....
37′....	1	A	4.0	1.42	0.21	0.08	905.	875.	214.375	629.03	....
38	1	B	3.4	1.34	0.17	0.11	790.	....	....	....	....
38′....	1	B	3.4	1.34	0.17	0.18	700.	745.	186.25	546.5	....
39	1	C	2.8	1.28	0.14	0.16	560.	....	....	....	....
39′....	1	C	2.8	1.28	0.14	0.15	565.	562.5	140.625	412.63	....
40 ...	1	D	2.4	1.25	0.125	0.14	525.	....	....	....	....
40′....	1	D	2.4	1.25	0.125	0.18	512.	518.5	129.625	380.35	....
41	1	E	2.0	1.20	0.10	0.17	475.	....	....	....	....
41′....	1	E	2.0	1.20	0.10	0.14	475.	475.	118.75	348.44	....
42	1	——	1.8	1.18	0.09	0.20	320.	....	....	....	....
42′....	1	——	1.8	1.18	0.09	0.19	330.	325.	81.25	238.40	....
43	1¼	AAA	6.12	1.80	0.275	0.20	937.5	....	....	....	....
43′....	1¼	AAA	6.12	1.80	0.275	0.18	987.5	962.5	240.625	451.87	....
44	1¼	AA	5.12	1.75	0.25	0.07	885.	....	....	....	....
44′....	1¼	AA	5.12	1.75	0.25	0.18	762.5	823.75	205.93	386.72	....
45	1¼	A	4.11	1.67	0.21	0.12	690.	....	....	....	....
45′....	1¼	A	4.11	1.67	0.21	0.09	680.	685.	171.25	321.59	....
46	1¾	B	3.11	1.59	0.17	0.12	505.	....	....	....	....
46′....	1¼	B	3.11	1.59	0.17	0.14	587.5	546.25	136.56	256.45	....
47	1¼	C	3.0	1.52	0.135	0.14	415.	....	....	....	....
47′....	1¼	C	3.0	1.52	0.135	0.15	425.	420.	105.	297.18	....
48	1¼	D	2.8	1.50	0.125	0.15	375.	....	....	....	....
48′....	1¼	D	2.8	1.50	0.125	0.19	325.	350.	87.5	164.37	....
49	1¼	E	2.4	......	......	......	......	....	....	....	....
49′....	1¼	E	2.4	......	......	......	......	....	....	....	....
50	1¼	——	2.0	1.44	0.095	......	325.	....	....	....	....
50′....	1¼	——	2.0	1.44	0.395	0.11	320.	322.5	80.625	151.48	....
51	1½	AAA	8.0	2.08	0.29	0.20	730.	....	....	....	....
51′....	1½	AAA	8.0	2.08	0.29	0.14	755.	742.5	185.625	242.04	....
52	1½	AA	7.0	2.	0.25	0.16	700.	....	....	....	....
52′....	1½	AA	7.0	2.	0.25	0.16	700.	700.	175.	228.19	....
53	1½	A	6.4	1.96	0.22	0.22	595.	....	....	....	....
53′....	1½	A	6.4	1.96	0.22	0.15	662.5	628.75	157.18	204.96	....
54	1½	B	5.0	1.86	0.18	0.20	500.	....	....	....	....

Number of Experiment.	Caliber.	Mark.	Weight per foot.	Exterior Diameter.	Thickness.	Distention of proof.	Absolute bursting pressure.	Mean bursting pressure.	Safe working pressure.	Equivalent head in feet.	Theoretical value of P. by formula.
54′....	1½	B	5.0	1.86	0.18	0.19	512.5	506.25	126.56	165.02	....
55	1½	C	4.4	1.80	0.15	0.24	445.	....	....	....	....
55′....	1½	C	4.4	1.80	0.15	0.20	415.	430.	107.5	140.17	....
56	1½	D	3.8	1.78	0.14	0.21	....	....	....	....	....
56′....	1½	D	3.8	1.78	0.14	0.23	320.	315.	78.75	102.68	....
57	1½	——	3.0	1.74	0.12	0.34	260.	....	....	....	....
57′....	1½	——	3.0	1.74	0.12	0.28	230.	245.	61.25	79.86	....
58	1½	E	2.0	....	....	....	....	....	....	....	....
58′....	1½	E	2.0	Waste.							
59	1¾	AA	8.8	....	....	....	....	....	....	....	....
59′....	1¾	AA	8.8	....	....	....	....	....	....	....	....
60	1¾	A	6.7	....	....	....	....	....	....	....	....
60′....	1¾	A	6.7	....	....	....	....	....	....	....	....
61	1¾	B	5.0	2.12	....	....	....	....	....	....	....
61′....	1¾	B	5.0	2.12	....	....	....	....	116.24	111.36	464.97
62	1¾	C	4.0	2.04	....	....	....	....	....	....	....
62′....	1¾	C	4.0	2.04	....	....	....	....	93.35	89.43	373.40
63	1¾	D	3.10	2.	0.125	0.23	325.	....	....	....	....
63′....	1¾	D	3.10	2.	0.125	0.14	312.	318.5	79.625	76.28	325.77
64	2	AAA	10.11	2.60	0.30	0.15	610.	....	....	....	....
64′....	2	AAA	10.11	2.60	0.30	0.13	612.5	611.25	152.81	112.07	629.70
65	2	AA	8.14	2.50	0.25	0.25	512.	....	....	....	....
65′....	2	AA	8.14	2.50	0.25	0.25	510.	511.	127.75	93.69	....
66	2	A	7.0	2.42	0.21	0.14	405.	....	....	....	....
66′....	2	A	7.0	2.42	0.21	0.26	405.	405.	101.25	74.25	....
67	2	B	6.0	2.38	0.19	0.27	330.	....	....	....	....
67′....	2	B	6.0	2.38	0.19	0.16	340.	360.	90.	66.006	....
68	2	C	5.0	2.32	0.16	0.13	275.	....	....	....	....
68′....	2	C	5.0	2.32	0.16	0.08	245.	260.	65.	47.57	....
69	2	D	4.0	2.18	0.09	0.22	200.	....	....	....	....
69′....	2	D	4.0	2.18	0.09	....	200.	200.	50.	36.67	....
70	2	——	3.0	Waste.							
70′....	2	——	3.0	....	....	....	....	....	....	....	....

Latter days have developed a wide difference of opinion on the values of lead and iron pipe for soil supply and waste purposes. Not only have their qualities of durability been discussed, but also the relations of each to the true sanitary condition of buildings. Hugh Watt, in June, 1890, maintained that should you ask the question of an old-time plumber, he would say at once: "Lead; there is nothing like lead." In his practical experience of nearly half a century (there were no sanitary engineers in those days to make out the plumber's specifications), the plumber was allowed to use his own judgment in the weight of lead that he thought was necessary for the particular job he had in hand. He would take the raw material (pig lead), cast it into sheets, and then make the pipe for four-inch soil pipe, and never thought of using anything lighter than eight or ten-pound lead; such pipe, when properly put up, was good for thirty years at least. If they had known enough to have had ventilation through the roof, it might have lasted much longer. Sewer gas was unknown in those days, consequently ventilation was not thought of. As the wheels of progress rolled along hydraulic pressure came into use, and deprived the plumber of his crack job of casting sheet lead. Although very hard, laborious work, he did not like to give it up to be beaten by that machine, but he soon had to acknowledge that the drawn pipe was much superior to the hand-made pipe. If the manufacturers had kept up the proper weight it might have been generally used to this day, but they tried to see how light they could make it, and destroyed their trade. In 1873 he had a block of buildings on the north side, and sent a load of soil pipe to them. When he arrived at the buildings the plumber was trying to make an offset on one of the lengths. The workman asked what kind of pipe this was which had been sent him. Watt said he had ordered six-pound pipe as usual. When examined, it was found to be impossible to make an offset of twelve inches on that pipe, so a foot was cut off, and it only weighed four and one-half pounds. Ordering the pipe sent back to the factory, he went to inquire what they meant by making such rubbish of pipe as that was. They said they had a demand for it, and some of the plumbers wanted them to make it still lighter. He told them they were taking a good way to ruin their trade, as the plumbers would be forced against their will to adopt the cast-iron soil pipe. Cast iron had been introduced quite a number of years before that, but the plumbers were slow to take hold of it. They did not like the brittle stuff; the lead was so nice and smooth and pliable, they could bend it and twist it to any shape they wanted, and thought there was nothing like lead. They did not have so many nice iron fittings in those days, and the plumbers had to do a great deal of planning and scheming with the few fittings they had at hand. The iron-pipe manufacturers were very apt to catch on and make any kind of fitting the plumber wanted, from a quarter bend to a ninety-degree curve, offsets from two-inch to sixteen-inch, Y's, half Y's, sanitary T's of every description, so that any mechanic with very little head work can select such fittings as he may need for the most difficult job he comes in contact with. The iron pipe makers took a different course from the lead pipe men. Instead of making their pipe lighter they doubled it in weight, and, making all the necessary fittings to correspond, have now a standard quality of pipe, which, if properly put up by a good, competent man, will stand a water pressure of twenty-five or thirty pounds to the square inch. There is still one thing more they ought to do, and some manufacturers are now doing it, that is, test the pipe by hydraulic pressure before it leaves the foundry. It may cost a few cents a foot more for the pipe, but the plumber, and the public at large, will be benefited by having an article which, when properly put up by a skillful mechanic, is good for at least half a century.

One change that was inaugurated comparatively recently was the system of exposed pipes. While a few years ago it was the exception to leave the soil, supply pipes, taps and other parts of the system exposed, this arrangement is now generally followed in new work of the better class. It is a very encouraging sign, too, this growing popularity of exposed plumbing work, for it indicates a desire on the part of the public to have their work done in an honest and substantial manner. There is no doubt that this improved style of plumbing has come to stay, although it may undergo modifications, but people will never return to the abandoned method of covering this part of the house equipment. Another noticeable fact in connection with this general line of business is the increasing adoption of plumbing systems. It was not so long ago that only the best city residences were plumbed, in the country districts the primitive system of sanitation being adhered to. Now, however, every year sees plumbing systems introduced into smaller and more inexpensive classes of houses. All the new low-cost cottages springing up around every city in the country are being supplied with some simple plumbing system, while even the old houses are being renovated and equipped with boilers, bathtubs, closet and basins. Along with this growth of public interest in sanitary conveniences there has also come a demand for a higher class of goods. The old-fashioned pan-closet went out of favor some years ago, and the number of new closets that are being put upon the market show that perfection has not yet been reached, though many of the minor objections to the early washout and siphon goods have been overcome. There is also a demand for complicated bathing apparatus and baths, the luxury of which would have tickled the fancy of a Roman emperor, are now found in many private dwelling houses of wealthy people. The habit of cleanliness is increasing among all classes, and bathtubs, either portable or stationary, are being more and more generally introduced. The portable tub is almost a novelty here, but it is meeting with a considerable demand in new parts of the country where town water service has not been introduced.

The contract for the plumbing of the Calumet building was awarded to Foskett & Brown, in April, 1884. The water-closets and urinals are on the top floor and in the basement only, but these floors are easy of access by the two elevators which are kept constantly running. Double-flush, trapped closets are used, their outlets all leading to a single soil pipe, six inches in diameter, extending to and above the roof. At present, the upper end of the soil pipe is surmounted by a cowl; but it has been suggested that this cowl be removed and the soil pipe left open to secure more certain ventilation and prevent the closing of the pipe by freezing of vapor. The soil pipe is placed in a perpendicular shaft about 3x12 feet in size, extending from the basement to the roof; in this shaft are placed, also, the gas, steam and water pipes. This shaft not only serves as a ventilator for the basement, carrying off the hot and impure air, but, being warmed by the steam pipes, it tends to create a movement in the soil pipe, thus helping to ventilate it. The waste pipes from the sinks and washbasins are trapped with Bower's traps, and ventilated by a pipe ranging in size from one and a quarter to two inches in diameter, and the pipes which ventilate them are carried up above the highest fixtures, where they enter the soil pipe. Similar wastes are provided in all the washbasins and the sinks, and are made of four-pound lead, so shaped as to secure ready outflow. The very best material is used in everything. The soil pipe is of cast iron with securely packed lead joints. While the flush of the water-closets are automatic, that of the urinals are left entirely to the control of the janitor. The main drain connects with the street sewer without an intervening trap, but it is also connected with the huge smokestack of the building. The chimney thus becomes not only a ventilator for the drain, but for the street sewer as well. As the fires in the furnaces of this building are expected never to cease burning, the experiment may be as safe as it is certainly successful, while there is heat in the chimney. Horizontal pipes are laid in gutters, made of four-pound lead, which are readily accessible through the floors. The gas is supplied to the rooms on each floor, through separate meters, the meters for each room being arranged in the halls. The heating is done by steam, direct radiation coils being placed in each room.

The plumbing of the Rialto building was awarded to E. Baggot in August, 1885, at $26,500. It was the largest contract for plumbing made here up to that date, and one of the first calling for exposed pipes.

The contract for plumbing work in the new Board of Trade building was awarded to Hugh Watt, in June 1884, for $19,000. Its essential requirements were:

The contractor is required to take a main supply pipe, of extra heavy cast iron, four-inch, regular standard, such as the city of Chicago uses in its city mains. This pipe will be taken from the meter in front just through the curb wall, and extended through the whole length of the building, or to such places as are required to take out branches for the supply to the receiving tank for the boilers, with a shutoff Fuller brass cock, one and one-quarter inches, attached to a one-and-one-half-inch strong lead pipe. There will also be a one-inch lead pipe leading to the cistern in the building and for the elevators. This will also have a three-fourths-inch shutoff Fuller brass cock. From this main pipe there will be a two-inch strong lead pipe for the supply of the basement, first and second stories; also, a one-inch pipe will extend from the second to the third story, with a one-inch branch of strong lead pipe in the basement, first and second stories; also a one-and-one-half-inch supply for the supplies of the different closets shown on these floors. The water-supply for the fourth, fifth, sixth, seventh, eighth and ninth stories will be taken from the tank over the pavilion on the west or Sherman street side of the office building, in a two-inch strong lead pipe, and quarter-inch strong lead branches on the fifth, seventh and ninth floors, leading to the several places for water-closets and basins where shown on the plans. The fifth-floor branch will supply the fourth and fifth floors, the seventh-floor branch will supply the sixth and seventh floors, and the ninth-floor branch will supply the eighth and ninth floors. All branch supply pipes to basins must be one-half inch strong to each basin; and for the nests of water-closets, three-quarters inches strong to each nest, with one-half-inch branches to each separate cistern for the closets, and each closet must have a separate cistern. All the horizontal pipes must be safe-lined with three-pound sheet lead covered with a sheet-zinc cap. All these safe-linings must have an outlet of one-inch light lead pipe to the basement, without connection with the sewer, or soil pipe, or open waste. The basins and water-closets above the first floor will be underlined with three-pound sheet lead, and the basin safe-waste may be connected with the pipe safe-waste on the same floors. The waste from the water-closet safe-lining will have an independent two-inch iron waste pipe to the basement, not connected with any soil pipe or sewer. The connection may be made on each floor to a two-inch pipe water-closet safe-waste, as one set of the closets is located directly over another in the office portion of the building. In putting in the supply pipes from the mains on each floor, each set of water-closets must have a shutoff cock, so that if the nests, or water-closets, are out of order, the supply can be shut off without affecting either those above or below. The supply for the basins must have a shutoff for each basin, separate, so that the other basins on the same floor may not be interfered with in case of repairs being required for any of them.

The washbasins are to be fourteen-inch, plain, heavy English ware. Those for the general lavatory, in connection with the Board of Trade hall, will have Italian, counter-sunk, marble tops, one-and-one-half-inches thick with molded edge, and one inch thick molded edge Italian marble, twenty-four inches wide for the backs. The top of the bowls, and the bottom of the marble, must be ground together and thoroughly set with three brass clamps to each bowl. This will be required for all other bowls in the building. Each and every bowl will have Washburn & Moore's patent waste valve and trap connection, and vent above the trap, connected with a pipe leading to the top of the building, except for the gents' lavatory on the main hall floor, especially for the Board of Trade department, which will be conducted into the main vent flue across the corrider by a four-inch cast-iron pipe. The vent and waste pipes for the basins will be two-inch cast iron. The basin cocks will be self-acting and nickle plated.

All the waste and soil pipes will be extra heavy cast iron, thoroughly coated with two coats of liquid asphaltum, and all the joints thoroughly calked with oakum, and then run with lead and tamped positively tight. All the waste and soil pipes leading from the first floor into the sub-basement will be suspended from the first floor beams, where they run horizontally. The soil pipe leading from the main nest of closets, especially for the Board of Trade, will be six inches, with branches cast on for connecting each separate closet; also, the same size soil pipe from the series of water-closets on the east side of the office building up to the fifth floor, and four inches from the fifth floor to the top and to the roof. The vent from the soil pipe from the Board of Trade's closet proper will have a vent flue six inches direct into the main ventilating shaft across the corridor. The vent from the bowl and from above the trap must be four-inch iron each, and each carried into the main ventilating shaft across the corridor. The vents from the flue, and from the top of the traps to all the water-closets in the several floors, must be carried separately through the roof, and there terminate with a half bend about two feet above the roof.

The urinals for the main Board of Trade department will be made with three-quarter-inch hammered-glass backs, two feet and four inches wide, and five feet high, screwed into the backs, and the divisions will be one-and-one-fourth-inches Italian marble in the thick projection. The outer ends will be one-and-one-half-inch thick marble. All these divisions will be grooved one-fourth of an inch deep, eighteen inches back from the front edge, to receive the three-fourths-inch glass backs, and must have at least one inch of marble back on the groove. There are to be one-half-inch thick Italian marble bottoms set on and attached, to drip to the lead trough; these bottoms will have the same width as the divisions, to rest in. All these joints will be set in the finest English Portland cement. The lead-lined trough will be eight-pound sheet lead. The outlets of all these urinal troughs must have a four-inch lead and iron trap at one end. The trap must have a screw cap on it for opening, as the case may require, and each of the traps must be ventilated at the top into the secretary's private closet soil pipe. There are to be seven-eighths of an inch (inside measure) perforated brass pipes extending the whole length of the urinal backs for a constant spray of water. These perforated pipes will be carried by a three-fourths-inch brass burr cock at one end. All exposed pipes in this room must be of brass. The urinals on the first floor will be made in the same way throughout as the last described. The urinals for all the other floors will have Bedfordshire earthen urinals 15½x18½ inches, full backs, with projecting lip twelve inches; these will all be attached to marble backs, seven-eighths inches thick, and the same hight as the glass backs already mentioned, and capped with marble, and marble divisions, ends and bottoms, as already specified, only differing by having the bottoms counter-sunk one-half inch deep, and catching the drip. There will be no waste from these bottoms. The earthen urinals will be mounted with one-half inch brass supply pipes, and burnished-brass cocks, self-acting. The waste from these urinals will be connected with the water-closet soil pipes, and trapped with a two-inch iron or lead trap, and screw cap as before mentioned, and ventilated above the trap. The waterclosets throughout the building will be the Inodora, all earthen closets, with separate cistern for each, which will be protected by a fancy pole and brass chain worked by opening and closing the door. The flushing pipe between the cistern and flushing rim of the bowl will be one-and-one-fourth-inch brass and brass-burnished couplings, every part made in the most thorough manner, and the seats will rest on fancy brass legs in front. The basement water-closets will be self-acting enamel closets.

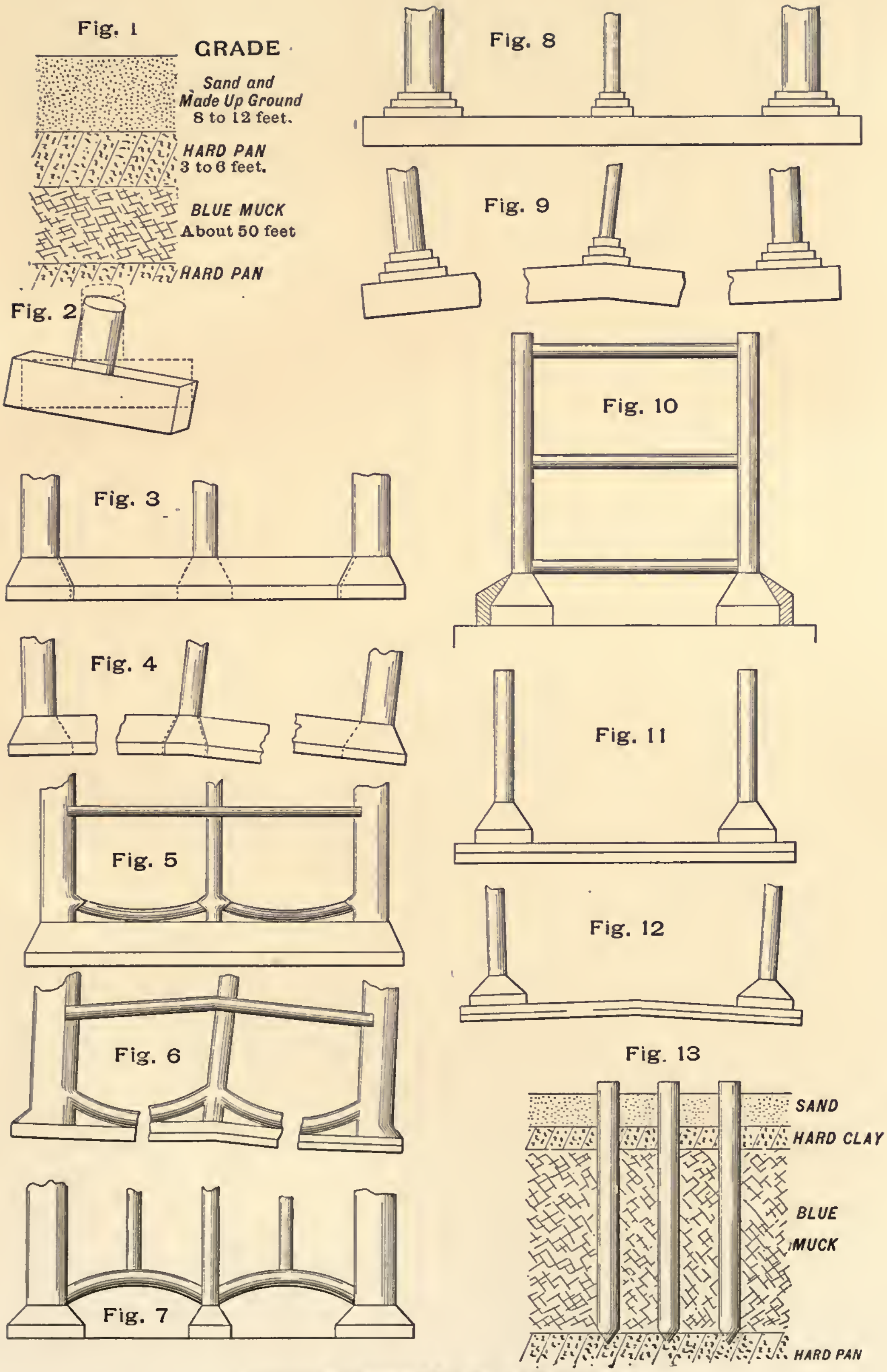
The plumbing system of the Taeoma consists of supplies, waste and ventilation pipes, arranged generally on the Durham system of house drainage. All soil, waste and ventilation pipes are of wrought iron, heavily coated with asphaltum inside and out, and all joints screwed up. This is a general guarantee against sewer gas from leaky joints. The rain-water on the roof of building is earried down inside in wrought-iron pipes, which are connected with the sewerage system. Under the roof, at each down spout, is placed a gravel basin which is readily accessible to the janitor of building. These gravel basins are of wrought iron. The sewerage system of the building is also of iron, and wherever the sewer is connected with the street sewer, a back water trap is inserted to guard against possible backing up of the city sewers. The under side of asphaltum floor of basement is thoroughly subdrained with open joint tile sewers which carry water to a large basin in the engineroom, from which it is raised by means of a siphon pump to the level of the first-story floor and then allowed to flow into the sewer. Thus every precaution has been taken against flooding from city sewers and surface water, rendering the basement absolutely dry and perfect. The water-closets for the entire building, except stores, are located in the eleventh and twelfth stories, the ladies' toiletroom being on the eleventh floor and the gentlemen's toiletroom on the twelfth floor. There is also a toiletroom in the basement for the use of the basement and first-story stores. Thus all the difficult plumbing is massed and easily cared for. Each store and office has a washbowl, supplied with hot and cold water throughout the year. All the plumbing is open and accessible. Closets for the building are J. L. Mott's "Inodoro," supplied with tanks. The toiletrooms are finished in Italian marble, with closet divisions, tank screens and floors of marble. The seats and doors, being the only woodwork in the rooms, are of oak.

The plumbing of the Auditorium was awarded to Potts & Esch for $94,000, in August, 1888, and the same month commenced the work of piping for steam, illuminating gas, fuel gas, hot and cold water, soil, waste and ventilation. There were five bidders, the highest being $104,000. The specifications for this work are instructive in every particular. Nothing appears to be overlooked, and in the ensemble everything connected with first-class plumbing is noticed. The specifications are as follows: "The contractor shall furnish all labor and material and complete and construct in good, firm, substantial and workmanlike manner, the sewers, drains, catch-basins and their appurtenances, and all the piping for cold and hot-water supplies, waste and ventilation of waste, and the plumbing fixtures, and all appurtenances, making the system of water supply, use and waste, complete and ready for use, and all piping and appurtenances for the gas supply in the manner shown upon the plan, and set forth in the following specifications:

Material.—All material used in this work shall be the best of its kind. All pipe shall be of the inside diameter shown. Cast-iron pipe shall be light gas pipe, cast on end in lengths of twelve (12) feet, and smooth inside with inner and outer surfaces concentric, sound and free from defects. The average weight per foot for each pipe, including bell, shall not be less than the following: Eight-inch pipe, thirty-seven pounds per foot; six-inch, twenty-five; five-inch, twenty-one; four-inch, seventeen; three-inch, twelve and one-half; two-inch, nine and one-half.

The pipe shall be of iron which will cut well, and any pipe cracked in cutting or otherwise, shall be at once removed from the building and shall not be used in any part of this work. Fittings for cast-iron pipe shall be specially made for drainage purposes of the same internal diameter as the pipe with which they are used and of equal quality; these include curves or bends, elbows, traps, Y-branches, etc., and where shown shall have handholes with cast-iron covers packed and bolted, or screw plugs as may be directed, and those receiving risers shall have a proper shoe cast on them. Fittings for junction of wrought and cast-iron pipe shall be cut at one end with a full thread to receive the wrought-iron pipe. All cast-iron pipe fittings shall be thoroughly coated inside and outside while hot, with coal-tar varnish. Clay pipe shall be hard burned or vitrified salt-glazed pipe with sockets, and equal in quality to the Standard Akron Ohio pipe, straight and sound with smooth internal surface and circular concentric section. Drain tile shall be hard burned unglazed straight tile. Brick shall be hard burned sewer brick free from lime, and shall be thoroughly wet before being used.

Natural cement shall be Utica, Blackball, or one equal in quality, satisfactory to the architects. Portland cement shall be best English or German Portland. Sand shall be clean, sharp sand. Lead shall be pig lead of good quality for calking. Gaskin shall be made of old rope yarn. Mortar for pipelaying shall be made of one part natural cement and one part sand. Mortar for bricklaying shall be made of one part natural cement and two parts sand. Portland land cement mortar shall be made of one part Portland cement and three parts sand. Portland cement concrete shall be made of one part Portland cement mortar and three parts broken stone, thoroughly mixed. The parts of cement and sand shall be by measure. The cement and sand shall be mixed dry, and only sufficient water shall be added



BUILDING FOUNDATIONS OF THE PAST.

to make an easy working mortar when thoroughly worked. Mortar shall be mixed fresh for the work in hand, and any mortar which shall have set or become hard in the box shall be thrown out and shall not be used in the work. Broken stone shall be clean, and broken to pass through a one-and-one-half inch ring. Gravel shall be fine, free from sand or dirt. Boards shall be common pine.

Street connections.—The stubs are laid into the curb-line, and this contractor shall excavate for them, clean and examine them, and, upon order of the architects, shall connect with the same.

System.—The sewers shall be of iron, in part laid in the ground below the basement floor, and in part suspended to the floor beams of the first story as near the ceiling as practicable.

Excavations.—This contractor shall excavate for the sewers to be laid in the ground, open trenches not less than two feet wide in the bottom, and for the surface drains not less than four inches wider than the boxes, and truly to line and grade. A line shall be used to mark out the trenches, and there shall be no variation from the plan except on order of the architect. After refilling the trenches the surplus earth, if any remain, shall be removed from the building by this contractor.

All sewers laid in the ground shall be of cast-iron pipe. The cast-iron sewer shall be connected to the street connections by inserting it at least eighteen inches into the sewer pipe and filling the space between the iron and vitrified pipe with Portland cement mortar. In case the iron pipe will not enter the clay pipe, the joint shall be made at least eighteen inches in the curb wall; the entire hole in the wall shall then be filled under and over both pipes with Portland cement concrete rammed in place. From this point the sewer shall be laid true to line and grade, rising one-fourth inch in one-foot length, or, as ordered by the architects, using fittings indicated and shown. Where risers are shown to connect, the top of the fitting shall be set at the level of the basement floor, and the fitting shall be seated upon or firmly clamped to the adjacent foundation wall or stone. Each pipe or fitting shall be laid on a solid bed of dry earth or sand under its entire length, and with a proper bell hole at each joint. Any deflection in line shall be with a proper curved fitting, and all branches shall be joined with a Y-branch. The sewer shall be kept truly in line and grade. The joints shall be tightly calked with hemp gaskin, leaving not less than one and one-half inches depth of lead room. The inside of the joint shall be examined, and if not smooth shall be made so. A clay roll shall be used to make the joints, and it shall be so put on as to allow a sufficient excess of lead that the joint when calked shall finish flush with the end of the bell. No asbestos roll shall be used. The joint shall then be run full of molten lead at one pouring, if it does not fill perfectly it shall be cut out and repoured. The joint shall be examined and if any lead has run through it shall be removed and the inside of the pipe left smooth. The joint shall be thoroughly calked with a proper calking tool and a two and one-half pound hammer. No lead shall be cut off until the calking has been carried all around the pipe, the lead shall then be trimmed and finished smooth and flush with the end of the bell. All openings for risers or connections shall be closed with iron plugs or flanges until used, and all handholes shall be closed at once and the sewer kept clean. Any dirt which may get in shall be removed by this contractor.

Backfilling.—As fast as the pipe is laid, dry earth or sand shall be rammed in place at the sides of the pipe, leaving the joints and top of the pipe exposed until tested as hereinafter specified. After testing the trenches shall be filled, in layers not more than nine inches thick with sand or dry earth. Each layer shall be thoroughly rammed with an iron rammer.

Catch-basins shall be built in the boilerrooms where shown, four feet inside diameter and four feet deep in the clear below top of finished floor. They shall be built with three flat courses of brick in the bottom and three rings of brick in the wall, each ring laid from bottom to top with a sweep from a center pin. The sweep shall be cut to allow one-half inch plaster and one-half inch collar joint between the rings. Portland cement mortar shall be used. A flat course shall be first laid in mortar in the bottom with full joints, and upon this the outer ring of brick shall be started and carried up seven courses. The joints shall be kept full and the back of the wall shall be plastered and filled in with sand lightly tamped. The bottom and wall shall then be plastered inside with one-half inch of mortar and the second flat course of brick shall then be laid in mortar with full joints, and the second ring of brick shall be started and carried up four courses, keeping the collar joint full. This bottom and wall shall then be plastered as before, and the third flat course in the bottom be laid in as before, and the inner ring of wall be started. The rings shall then be carried up in the order started, with not less than two courses difference in the hight, and each of the outer rings plastered as before, and the joints kept full. Plaster and filling at the back to be kept up with the outer ring, as before specified. No headers shall be used in the wall except in the top three courses. Half brick shall be used in building the rings in the wall. Bottom boards shall be used to stand on while building the basin. The basin shall be cleaned out, the center pin drawn and the hole carefully filled with mortar rammed in, and the joints in the bottom and wall shall be scraped out and pointed up with mortar struck smooth. The basin shall be covered with a flag-stone five feet square and four inches thick set in mortar at the level of the finished floor, and with a counter-sunk iron ring and lid eighteen inches clear diameter.

Manholes.—Rectangular manholes shall be built where shown with eight-inch walls laid in natural cement mortar, inside measurement two feet six inches by three feet, with two flat courses of brick in the bottom. The inside joints shall be pointed and struck as before specified. These manholes shall be finished at the level of finished floor with cast-iron frame and lid thirty inches square inside, bolted to the brick work with six counter-sunk bolts in each.

Flanged pipe.—Where ejectors are shown the pipe shall finish with a cast-iron flange of twelve inches in diameter.

Suspended sewers.—The suspended sewers in the basement shall be of wrought-iron pipe hung to the beams of the first floor. The points of suspension shall be not more than twelve feet apart. As regards line, grade and the use of fittings they shall be built as specified for cast-iron pipe sewer. The joints and fittings shall be as hereinafter specified for risers and branches in the waste-water system.

Testing.—When the sewers are completed this contractor shall set up a stand pipe on one of the openings for risers on each section, and shall close all other openings and stop the sewer at the trap, and fill the same with water to the level of the second floor. If any leak shall show in the pipe or joints, he shall make the same tight and repeat the test. He shall not be entitled to demand or receive payment for this work, nor shall the final certificate issue until the same shall be made tight as contemplated herein. If so ordered by the architect the sections shall be subdivided and tested. After this test the back filling shall be completed as hereinbefore specified.

Surface drains.—Surface drains shall be laid of the size and on the lines shown in plan. They shall be set in boxes in the trenches and the boxes and trenches shall be filled to the bottom of the concrete floor with gravel or broken stone. The boxes shall be made of sixteen-foot pine boards; the bottom nailed to the sides projecting eight inches at one end. The corners of the boxes shall be notched through. The boxes shall be not less than one inch wider inside in the clear and one inch higher than the outside diameter of the pipe with which they are used. Each box shall be set in the trench as directed, on a solid bed for its entire length, and with the projecting sides of one box resting upon the projecting bottom of the preceding. The drain tile shall be strung upon a straight pole with stop near one end and ten feet four inches long beyond the stop. The pipe shall be turned to make as close joints as possible, and each joint shall be wrapped around with a piece of tarred roofing felt, lapping by and securely tied on each side of the joint in a square knot with linen twine. The pipe shall then be set in a box with the projecting end of the pole inserted into the preceding pipe, and that joint shall be covered with roofing felt and the pipe shall be held closely up in place centrally in the box and filled around and to the top of the box with fine gravel; the pole shall then be withdrawn and the trench at the sides of the box and to the top, as before specified, shall be filled with broken stone. All drain tile shall be laid in this manner: Where shown surface basins shall be built four inches thick of brick standing on end, and with one flat course in the bottom, they shall finish nineteen inches inside diameter and sixteen inches deep and shall be covered at the level of the finished floor with a cast-iron ring and lid eighteen inches inside diameter. The main drain shall be laid at such grade as directed, in the same manner as the foregoing, and the connecting basins shown shall be three feet inside diameter with two flat courses in the bottom laid with the top six inches below the bottom of the drain. The walls shall be eight inches thick drawn in to nineteen inches inside diameter at the top. Corbeling to be done in the top six courses, which shall be headers. These basins shall be finished at the floor level, with iron ring and lid, as before. The brickwork in the surface and connecting basins shall be laid in natural cement mortar. At the connecting basin where junction is made with the iron pipe to ejectors the connecting drains shall each be fitted with a back-water flap valve firmly secured in place. The broken stone filling shall be finished evenly at the specified level, and shall be covered by this contractor with inch boards secured to stakes driven on each side of the trench, and he shall maintain this protection until the laying of the concrete floor, and shall make good any damage which shall arise from his neglect so to do.

General description.—There will be two independent systems of water-supply, one for the hotel and one for the office building and auditorium, each to furnish both hot and cold water. City pressure shall be used to supply the basement, first and second floors with cold water, except in dressingrooms of stage. The cold-water supply for all other floors, including the tower, shall be taken from tanks located as shown. The hot-water supply for all floors, except the basement, shall be taken from the house tanks.

Tanks.—The surge tanks in the basement and the house tanks in the roof spaces and on the fourteenth floor will be furnished and set by owner, and will be provided with proper flanged openings ready to receive the plumber's connections.

Street connections.—The connection to the water main in the street will be laid in by the owner to the curb line. The owner will also set the meters and make the connection from the curb line to the surge tanks. The owner will also furnish and set the connections from the surge tanks to the house tanks.

Material.—All material used in this work shall be the best of its kind. Wrought-iron pipe shall be standard, except in connections from tower to basement for water supply, it shall be extra strong; and in all sizes above one-and-one-fourth-inch diameter, shall be lap-welded. When used for water supply it shall be galvanized pipe. For waste and ventilating pipes it shall be black pipe coated inside and outside while hot with coal-tar varnish.

All this pipe shall be cut with full threads, and when used for waste or ventilating pipes shall be cut to a gauge. Fittings for waste pipes shall be specially made for this purpose of cast-iron of the same inside diameter as the pipe with which they are used, with full threads cut in a lathe to the same gauge as the pipe. Graded fittings shall have the grade cast in them. Fittings for ventilating pipe shall be of cast iron, cut with full threads, and all of greater diameter than two inches cut to a gauge. All fittings for waste and ventilating pipes shall be thoroughly coated inside and outside, while hot, with coal-tar varnish. Fittings for wrought-iron pipe used in water supply shall be of malleable iron, cut with full threads. Brass pipe and fittings for same where exposed shall be nickel plated. Lead pipe used in the basement, first, second, eighth, ninth, tenth, thirteenth, fourteenth, fifteenth, sixteenth and seventeenth stories, for water connections, shall be strong pipe, weighing for one-half-inch pipe, one pound twelve ounces per lineal foot; five-eighths-inch pipe, two pounds eight ounces per lineal foot; three-fourths-inch pipe, three pounds per lineal foot. And in the remaining stories it shall be extra strong pipe, weighing for one-half-inch pipe, two pounds eight ounces per lineal foot; five-eighths-inch pipe, three pounds per lineal foot; three-fourths-inch pipe, three pounds eight ounces per lineal foot. For waste and ventilating connections light lead pipe shall be used, weighing for one-and-one-fourth-inch pipe, three pounds per foot; one-and-one-half-inch pipe, four pounds per foot; two-inch pipe, five pounds per foot;

All pipe and fittings shall be of the inside diameter specified or marked on the plans.

Sheet lead for safing and for flashing shall weigh four pounds to the square foot. All brackets, clamps or hangers shall be of wrought iron and constructed to the satisfaction of the architects.

Joints.—Joints in and to wrought-iron pipe and fittings shall be made with threads fully coated with red lead and oil or tar varnish as will at the proper time be ordered by the architects, and screwed home with proper tongs or wrenches. Joints in lead pipe, or of lead pipe to brass fittings, shall be made of solder, neatly wiped. All joints shall be finished smooth inside.

Carpenter work.—All carpenter work for the troughs, gutters and safes, hereinafter specified, and all necessary for grounds, supports, etc., in setting the fixtures and marble included in this specification shall be done by this contractor, and he shall employ skilled workmen to do the same.

Risers and branches.—All risers and branches for soil, waste or ventilation shall be of wrought-iron pipe, and shall be connected as shown to the sewerage system in the basement. All connections through which water is to run shall be made with Y's, and these Y's, or the elbows used to change from vertical to horizontal runs, or to receive water-closets or slop sinks, shall be cut to the proper grade of the horizontal pipe. Safe-waste risers shall be of wrought-iron pipe located as shown, with lower end closed with safe-waste valve, loosely hung. All safe wastes to fixtures in the ninth, tenth and sixteenth stories shall be carried to and connected with the trough in the floor or roof space above, containing the main supplies. All risers shall be of the size marked on the riser diagram, and shall be located and follow the lines shown on plan. They shall be clamped at every third floor securely to the beams or wall with wrought-iron clamps, and where they cross the building, or at any deflection from the vertical, a secure support shall be given the riser in its new position, and such intermediate support as shall be directed. . Branches to water-closets shall be securely hung or clamped to beams where necessary. All branches for water-closets or sinks shall finish at the floor level with a flange proper to receive each fixture, set level and true. Branches for the ventilation of traps shall be run as shown, and all openings shall be left above outlet of fixture at such hight as to give a continuous rise to the connection from the crown of trap; and in the case of bathtubs this shall be above the top of overflow. Where a branch crosses a room, corridor or doorway, on any floor, it shall be run in the floor above and dropped to the fixture. In all cases, whether of waste or ventilating pipes, the iron shall come through the floor or plaster, leaving the opening at the finished floor or plaster line, ready for the connection. All openings shall be closed at once, securely, with iron plugs or flanges until connected.

Handholes.—Handholes shall be left where shown and closed with a brass plug.

Traps.—The traps used under fixtures shall, except where trap is in combination with the fixture, be the common lead S-trap, of the same diameter as the pipe with which it is used, furnished with trap-screw at bottom, and with a soldering union connection at crown for ventilation, as shown in detail. Each fixture shall have its own trap set in every instance as close as possible to the waste opening in the fixture.

Connections.—All connections between lead pipe and wrought-iron pipe, or fittings, shall be made with a soldering nipple or union of the same internal diameter as the pipe.

Tank connections.—This contractor shall furnish and set a cross-head at each surge tank and shall connect the house tanks in the roof space by a main supply running in the roof space, or near ceiling of ninth floor, continuing this beyond each tank, all as shown; or shall set a cross-head, as the case may be. At the tanks the connecting pipes shall be provided with valves for shut-off; in the case of pipe three inches in diameter or larger, these valves shall be iron body, double-faced brass gate valves.

From these cross-heads or the main supply, branches of wrought-iron pipe for cold water shall be taken off, as shown, and each branch shall be provided with a shut-off cock at the point of connection.

House boilers.—This contractor shall furnish and set in basement, where shown, eight hot-water boilers for the house service. They shall be of the inside diameter and length shown, built of Otis steel or its equal, not less than one-fourth of an inch thick, properly braced and tested to an internal strain of two hundred and fifty pounds to the square inch. Each boiler shall be fitted with an internal copper steam coil brought through the shell and with coupling ready for steam connection and tested for one hundred pounds of steam, and shall furnish their entire contents per hour continuously at two hundred degrees temperature with steam at five pounds pressure. Each boiler shall be provided with a pressure gauge and approved safety valve, and three-fourths inch sediment pipe and connected to nearest drain.

House boiler connections.—This contractor shall connect the house tanks of each system to their respective boilers in the basement, and shall furnish and set a cross-head at the top of each boiler to which he shall connect branches to the hot-water supply, all as shown. The connecting pipes from tanks to boilers shall be provided with a valve at each point of connection and a drain cock where directed; the cross-head and each branch from it shall be provided with shut-off cocks.

Pipe in basement.—All pipe in the basement shall be hung to the beams of first floor as closely as is practicable.

Risers.—Risers shall be of wrought-iron pipe of sizes shown on riser diagram, located as shown, and shall be securely fastened to the walls or corridors at every third floor. Each riser for hot or cold water in the basement shall be provided with lever handle stop and waste. Each cold-water riser which is supplied from above shall be provided at its lowest point with a lever-handle stop and connected into the nearest safe waste.

Branches.—All branches shall be of wrought-iron pipe and shall, at the fixtures, show through the floor, or through the plaster, as the case may be. All pipe shall be laid to drain.

Connections.—At all connections to fixtures the iron pipe shall be brought through the floor or plaster, and the connections shall be made of lead pipe wholly outside finished floor or plaster line. Each connection to cock or bibb shall be provided with an air hammer sixteen inches long and a stopcock with a square head, which can only be moved with a wrench, all as shown in detail. Every connection to iron pipe or fitting shall be made with a soldering nipple of the same internal diameter as the pipes.

Pipe covering.—All suspended pipes in the basement, except returns to boilers, and all hot-water risers and the horizontal runs to descending risers, shall be closely covered with a non-conducting pipe covering, approved by the architects and thoroughly secured to the pipes.

Safing.—All horizontal pipes along girders, on walls or in floors or roof spaces, and all fixtures except in bathrooms and water-closet rooms, shall be safed. Molded spaces will be left where necessary in the terra cotta floors for such safes as run in the floor; and this contractor shall form the bottom to the proper drip and shall line the sides with dressed boards with the upper edge rounded and level with top of beams. For the lead safing along girders he shall furnish and secure firmly in place the necessary troughs dressed with rounded top edges, and under the fixtures he shall build the necessary grounds. The grounds under fixtures against the base shall be of clear white pine, and where exposed of cherry three inches high, smooth, with rounded upper edges closely fitted and finished on the exposed sides as hereinafter specified. For washbowls they shall include the entire space under slab, and for other fixtures the space under fixtures.

Gutters shall be lined with sheet lead turned neatly over the edges and closely nailed with flat-headed nails. The gutters shall be connected to safe wastes with one-and-one-half-inch lead pipe. Gutters shall be fitted with covers of No. 26 galvanized iron soldered at the joints and turned down over the edges at the sides one inch. The trough for main supply of cold and hot water in the roof space and in the ninth floor shall be built of two-inch lumber and shall finish at least eight inches deep. The sides shall be nailed to the bottom and the inside shall be dressed with rounded top edges, and it shall be lined with lead, as before specified. The upper edges shall be tied together every three feet with one-inch by one-quarter-inch iron straps bent over the top and screwed to each side with one-and-one-quarter-inch screws. All safe wastes which rise to the floor below main trough shall be carried up and connected to this trough with funnel-shaped opening. The top of the trough shall be set level all around and it shall be covered like gutters. After the galvanized-iron covers are in place all gutters shall be temporarily covered with boards nailed in place for protection; and this contractor shall have charge of and maintain the same until the finished floor is laid, and shall make good at his own cost and expense any damage resulting from his negligence in so doing. All troughs and pipes in roof space shall be hung from the roof beams.

The safes under the fixtures shall be of sheet lead turned over the grounds and nailed as before. The lead shall be formed to drip to the center and shall be connected to the safe waste with one-and-one-half-inch lead waste pipe. The opening shall be covered with a brass two-and-one-half-inch convex strainer, soldered in place.

Safe waste from tile floors.—This contractor shall set in base of all rooms with tile floors where fixtures are located at floor level, as directed, and connect safe waste with two-inch lead pipe, a brass overflow grate with nickel-plated face, made as shown in detail. This shall be closed temporarily with a thin piece of metal, and after tiling is laid this shall be removed and the overflow made operative.

Testing.—All gutters, troughs and safes shall be tested with water. All supply pipes shall be filled with cold water at normal pressure and carefully examined while exposed to view. After completion of the whole work the architect shall select three risers for soil and waste, including their ventilators on each system with a separate outlet, making nine risers in all, and these shall be stopped off at the bottom and at all openings and filled with cold water to the roof and be carefully examined. If any of the above be found to leak they shall be made tight and the test repeated; if, in the case of the waste and soil risers it is, in the judgment of the architect necessary, more or all of the risers including their ventilators, shall be tested and corrected in the same manner. These tests shall be made at the cost and expense of this contractor, and he shall not be entitled to demand or receive payment, nor shall the final certificate issue until all this work be made tight as contemplated herein.

Flashing.—The waste or ventilating pipes continued through the roof shall be flashed with sheet lead not less than eight inches in every direction from the pipe on the roof, with a piece of lead soil pipe not less than one-eighth inch thick, fitting close and running to the top and turned over on the inside of the iron pipe. The joint between the sheet lead and lead pipe shall be a wiped joint.

Setting.—All fixtures except where otherwise specified, will be set without casing, and all pipe, safing, etc., done by this contractor, exposed to view, shall be done in a neat, clean and finished manner to the satisfaction of the architects.

Cutting and fitting.—The contractor shall do all cutting and fitting and shall furnish and set all grounds in floor or walls necessary in setting or securing the fixtures, marble slabs, etc.

Water-closets.—All water-closets used in the general and helps' closet rooms in basement on east front shall be the Kelly Self-acting Washout closet. In all other public water-closet rooms the closets shall be all porcelain back outlet washout closets. Selection will be made by the architect from the "Inodora," "Knickerbocker" and "Delta." The tank used with the closets shall be of wood lined with copper, operated automatically by the seat action, and shall give a certain strong flush of about three gallons; with the "Inodora" Mott's No. 11; with the "Knickerbocker," Meyer-Sniffen copper lined; with the "Delta," No. 55, shall be the tank used. The tanks shall be of plain flush paneled cherry set on bronzed iron bracket. In the bathrooms attached to private rooms the water-closets shall be "Geyser," with eighteen-inch copper-lined wood cistern, or the "Sanitas," with nickel-plated chain and pull. Where shown in plan, water-closets shall be set on the iron flange or fitting before specified, packed with a solid rubber ring, and shall be bolted to the iron flange with proper brass bolts with hexagon nuts; nuts set uppermost and the bolts secured so they can not drop out when nut is removed. A lead washer shall be used under the nut. The flush pipe between tank and closet shall be one-and-one-fourth-inch wrought-iron pipe. In public water-closet rooms the flush shall be brass pipe of the same diameter.

This contractor shall set for the closets cherry seats of proper dimensions with enameled iron drip tray and bronzed iron legs, substantially as shown in Wolff's catalogue of water-closets, with automatic seat attachment, where such is used, pertaining to the closet and tank selected. From the crown of the water-closet trap to the ventilating pipe before specified a connection of two-inch lead pipe shall be used.

Bathtubs.—Where shown on plan bathtubs shall be set and connected. The tub used shall be Mott's porcelain-lined French bath, with a nickel-plated plug, stopper and chain. Five-and-a-half-foot tubs shall be used, except where otherwise ordered, and they shall be set in a cast-iron base, shown on details. Each bidder shall note in proposal price per half foot to be added or deducted for variation in length of tubs used. The portion of the rough floor necessary to set the cast-iron frame for tubs shall be brought up to the proper level with cement mortar. When this mortar is set, the frame shall be placed in position, and the floor inside and three inches outside all around the frame shall be poured with melted Trinidad asphalt, one-quarter inch deep, over the entire surface, making a tight joint with the iron frame and with the tile partition. The tub shall then be set in the frame, and the joint between them shall be filled with putty well worked up with red lead and oil. The waste connection shall be run through this frame and connected outside with the overflow, all to be of brass pipe with trap, as shown in detail.

All baths shall be finished on top with a rim of cherry. The hot-and-cold-water connections shall be of lead pipe and connected to Peck Bros.' improved nickel-plated combination bath cock No. 8.

Washbasins.—The washbasins shall be white porcelain, oval or round, with visible standard waste and overflow. One-half the basins shall be 15x19 inch oval, and one-half sixteen-inch round basins, with nickel-plated fittings. Selection will be made from the "Sanitas," "Nonpareil" and "Universal." Each basin shall be ground to fit slab and clamped in place with three Peck Bros.' No. 2 basin clamps. Each basin shall be fitted with two nickel-plated Boston self-closing cocks connected to hot and cold water with half-inch lead pipe. The waste connection for each basin shall be one-and-one-quarter-inch lead pipe, and the crown of each trap shall be connected to the ventilating opening before specified, with one-and-one-fourth-inch lead pipe rising continuously, the connection to the iron pipe to be made with a soldering union. Basins of the shape directed shall be set where shown in plan with marble slab and back. The slab shall be supported on cherry frame with cherry legs, as shown in detail.

Slop sinks.—Slop sinks in the water-closet and sinkrooms where shown, shall be Demarest's combination trap, standard No. 1, enameled iron, set on the specified flange fitting, packed and bolted like the water-closets and finished on top with hardwood rim. Marble shall be set as hereinafter specified, and each sink shall be fitted with two half-inch plain nickle-plated Fuller iron-pipe bibbs with loose flange and lock nut, and connected to hot and cold water. In each boilerroom, where shown, shall be set a square galvanized cast-iron sink 42x20x6 inches. Each sink shall be fitted with one three-quarter-inch Fuller finished hose bibb connected to cold water, and one half-inch Fuller finished plain bibb connected to hot water. The waste pipe to each sink shall be one-and-one-half-inch lead waste, with combination trap, not ventilated. All sinks, except as otherwise specified, shall be connected from crown of trap to ventilating opening hereinafter specified, with one-and-one-half-inch lead pipe rising continuously, connected as specified for basins

Urinals.—Urinals shall be set where shown in marble stalls as hereinafter specified. They shall be flushing-rim lipped urinals, flat back or corner as the case may be, and shall be ground to fit slab and held in place by nickel-plated urinal clamps. They shall be connected as shown in detail, and except in general water-closet room in basement, shall be flushed automatically with Demarest's patent automatic flushing cistern of copper-lined wood; with one or two urinals, cistern No. 1 shall be used; with three or more urinals the size shall be No. 2; the cisterns shall be fitted with a square-headed compression urinal cock and single or double coupling as required. In the general water-closet in the basement the flushing tank shall be Williams' two-inch automatic flushing siphon, set in lead-lined wood tank, throwing ten gallons at a flush. Selection will be made between No. 1 standard blind cap, nickel plated, and Bedfordshire No. 1, with nickel-plated top and bottom connections, shown in detail.

Kitchen and pantry sinks.—This contractor shall set and connect in kitchen where shown a set of four wooden sinks each forty-two inches square outside and eight inches deep, of one-and-one-half-inch clear pine with galvanized iron legs, and shall line the same with galvanized twenty ounces bright copper, and shall cover the back eighteen inches high with fourteen ounces bright copper, all neatly turned over the edges and closely nailed with copper nails. The sinks shall be finished on edges with a hardwood rim four inches wide. Each sink shall be furnished with two-inch metal plug and stopper, safety chain and chain-stay and overflow grate, and connected as shown to cast-iron grease traps with two-inch lead pipe. Each sink shall be fitted with two one-half-inch plain Fuller flanged iron pipe bibbs connected to hot and cold water. Six square copper pantry sinks, 16x30 inches, with one-and-one-half-inch metal plug and stopper, safety chain, chain-stay and overflow, shall be set where shown and connected to grease traps as before with one-and-one-half-inch lead pipe. The backs shall be covered eighteen inches high with fourteen ounces bright copper, as before specified, and each sink shall be fitted with two one-half-inch plain Fuller bracket flanged iron pipe bibbs connected to cold and hot water.

This contractor shall also set proper fitting for the connection of the dish-washing machine, where directed, and also in the laundry shall set fittings for connection of washing machines and ringers.

Laundry tubs.—This contractor shall set and connect in the laundry where shown, sixteen "Yorkshire" brown glazed earthen washtubs with bronzed iron standard and hardwood tops, complete, as shown in Plate 263-D Mott's catalogue 1887, each tub to be fitted with metal plug, stopper, safety chain and stay, and two one-half-inch plain Fuller bibbs with flanges, connected to hot and cold water and connected to waste to grease traps with one and one-half-inch lead pipe.

Grease traps.—This contractor shall set and connect as shown, for the kitchen and laundry fixtures, cast-iron grease traps partly in the floor and supported securely on the floor beams. These shall be made as shown in detail with waste and ventilating connections as desired.

Drinking fountains.—This contractor shall set and connect where shown, drinking fountains with marble slab and back, one-half-inch lead coil sufficient to cool the water to proper degree, one-and-one-half-inch lead waste connection and an approved self-closing fountain cock coming through the back with loose flange and lock nut.

Shampoo cocks.—The shampoo cocks in barber shop will be furnished by the owner, and this contractor shall set and connect the same.

Street washers.—Brass three-quarter-inch street washers shall be set where shown, as close to the building as is possible and calked into the sidewalk. They shall be operated by a key and a key shall be furnished with each street washer. The connecting pipe shall be provided with an iron pipe lever handle stop and waste at such point as may be directed.

Cocks and bibbs.—Cocks and bibbs shall be equal in all respects to samples in architect's office and shall be approved by them.

Boiler connection, etc.—Pipe for boiler connections and other points which may be required shall be run as shown in plan.

Woodwork.—All exposed woodwork which is to be furnished by this contractor shall be dry selected cherry of uniform color, and shall be worked and set by skilled mechanics. It shall be close jointed, and all exposed surfaces shall be brought to a good surface. This surface shall be filled with one coat of shellac rubbed down, and three coats of hard oil, each coat rubbed down, the last with pumice stone to an eggshell finish.

Marble.—The marble used for plumbers' work in this building shall be pure white Georgia marble. All exposed surfaces, both faces and edges, shall be polished as highly as sample in architect's office, except foot-pieces in urinals.

This contractor shall furnish and set the basin slabs and backs, slop sink backs, foot pieces, backs and sides of urinal stalls, and partitions and backs of water-closet stalls, with polished brass frames or supports as shown. The marble for basin slabs shall be not less than twenty-four inches wide and for single basin one-and-one-quarter-inches thick; for more than one basin, one-and-one-half-inches thick. Basin slabs shall be counter-sunk one-quarter inch, and shall measure this in all cases. In counter-sinking and cutting holes, provide for proper basin cocks and wastes. Backs for basin slabs shall be not less than sixteen inches high of seven-eighths stock. The backs shall be set in plaster and each piece shall be also secured by two or more hold-fast screws, which shall project from the wall into holes cut properly in the back of the slab; said holes to be filled with plaster and the slab pushed into position and held until the plaster has set. No screws will be allowed in the face of the marble. Detailed drawings will be furnished showing the finish of edges of all basin slabs and backs, and these shall be strictly followed. Marble for slop sinks shall be seven-eighths stock, and where there is no adjacent side wall shall be a slab at back four feet high by two feet six inches wide, with proper holes cut for bibbs, and the edge finished as in detail drawing. Where pipes show in the sink room this slab shall be set in front of the pipe and shall be finished on top with a strip of seven-eighths marble and returned to the wall at the sides with the same. This back shall be set in plaster with its lower edge on the floor and shall be fastened back near the top with two nickel-plated, square headed, brass log screws with nickle-plated rosettes, as shown in detail drawings. Where the slop sink is near a side wall, a similar slab four feet high by two feet two inches wide, secured in same manner, shall be set.

Marble for urinal stalls shall be seven-eighths stock with foot piece, except in general water-closet room in basement, not less than two inches thick, counter-sunk half-inch. In the general water-closet room in basement, foot pieces shall be not less than three inches thick, counter-sunk as before. The partitions and backs for urinal stalls and closets shall be constructed as shown in detail drawings. Clamps and bolts shall be of polished brass. Backs and sides where they come against walls shall be set in plaster with concealed fastenings. All marble shall be set with fine joints closely fitted, level, plumb and square. Detail drawings will be furnished showing sizes and sections of edges, brass work, etc., of this marble work, and these drawings shall be strictly followed.

Guarantee.—This contractor shall be responsible for this work and for the operation of the fixtures, and shall make good, and repair or replace, as may be necessary, any defective work or fixture which may show itself within one year from the date of final certificate, provided said defect is due to imperfections in material or workmanship, as specified.

The plumbing of the modern Chicago apartment houses displays artistic points as well as useful ones. A system of doing plumbing work well and neatly was introduced by Moylan & Alcock, in 1888, in fitting up the Morton apartment house. The building itself is a handsome structure, five stories high, containing twenty-four apartments, each appointed in the most convenient and approved manner. The kitchens are supplied with gas ranges and refrigerators. The bathrooms present an unusually clean and handsome appearance. The closets are the "Marna," the baths porcelain lined, while the washbowls are richly decorated and supported by brackets. The arrangement of fixtures is superb. The hot-water is supplied from a boiler in the basement and is carried through galvanized-iron pipes. The laterals are of lead. Drum-traps are placed immediately under the basin and connected with the bathtub. The traps are beneath, but have a handhole on a level with the floor. The object in using this kind of a trap is that in flats it has been the experience of many that the bathtub has not been used sufficiently often to keep the water in the trap from fouling or evaporating, but in this instance, with the wastes of the bathtub and the washbowl connected with the same trap, the continued use of the latter precludes the possibility of fouling or evaporating. The arrangement of pipes presents a handsome appearance, as is the case with all exposed work where the work has to be necessarily of a superior order. In the case of repairs, the cost is reduced to almost nothing, it being estimated that work of this character will not foot up to one-twentieth part of what is ordinarily expended for repairs in flat buildings. Another good feature of the system is that when each tenant has easy control of the water in his apartments, there is no possibility of interfering with the operation of fixtures in the other parts of the house when it is necessary to make repairs. The old system of stopcock rods, which are always found deficient when needed, is done away with. The distribution of water is so nearly perfect that there is always a full supply at any faucet in the house, and water can be drawn from any faucet in the twenty-four apartments at the same time. There are separate stopcocks in the kitchens and bathrooms, so that when anything is wrong with one group of fixtures it can be repaired without interfering with the others. A large laundry, with six sets of granatine tubs, is located in the basement.

The style applies, even in a higher degree, to the more modern flats, such as the Ozark, the hotel Hyde Park, the Virginia and other great apartment houses, many of which are equipped with the most perfect types of the system.

The laws regulating plumbing are of slow growth, owing to the opposition of councils and of people. Years were devoted to the question in Chicago before satisfactory rules were adopted, and even in the end, opposition, based on the want of knowledge of plumbing work and material was offered. There are laws governing the practice of medicine, of law, of teaching, pharmacy and other pursuits, but when the subject of further regulating plumbing by law is mentioned, the keen edge of opposition is felt. If this is not the result of dense ignorance regarding its importance, it is difficult to conceive to what this opposition must be ascribed. Those ignorant of the nature of plumbing and its relation to health, consider it as one of the mere mechanical arts and class it with blacksmithing. They do not know any better, and are a full lifetime behind the age in which they live. Blacksmithing does not need any special legal regulation, and they can see no more in plumbing requiring it to be done under legal restrictions. If plumbing were nothing more than a mechanical trick, or the result of mechanical training, then such reasoning would apply. But plumbing is more. It is all the mechanics of it imply and all that the scientific knowledge of it demands. A plumbing job may be made mechanically perfect and yet be wholly defective in its relation to the proper sanitation of a building. Its nature is such that the health of the home depends on the character of the plumbing. If the refuse of a family were left in the house for a short time, it would soon become not only offensive but sickening. Defective plumbing does not remove the ill effects of this refuse from the house. It may be able to get it out of sight, but it provides avenues through which will enter all the foul and poisonous gases that arise from it. It will do more than this. It will open up to one household all the poisons that arise from many. Defective plumbing may be put in a house and that house left vacant, clean and new, and yet in a short time every corner of it will become infected with the foul gases in the sewer rising from the wastes of the surrounding houses.

Another danger is presented by defective plumbing. A house may be plumbed in accordance with the very best practices, and every part be perfect, and yet that dwelling may not escape the evils arising from the defective plumbing of surrounding houses. A city may have its full share of honest, reputable plumbers, who do their work properly, and yet through the fraudulent and incompetent work of a few irresponsible plumbers the whole city is endangered. Cases are of record where fatal epidemics have resulted from defective drainage of a single house. One poorly plumbed dwelling may be the means of spreading throughout the city a contagious disease. It has been the case and may be again. The protection from such dangers lies in the proper regulation of all plumbing work.

Human nature is said to be human nature the world over. Bad and incompetent men can be found in all trades and walks of life and the plumbing profession is not an exception to the general rule. There are so-called plumbers doing plumbing work who need the compulsory effects of legal enactments to compel them either to do good work or quit. This is all that is required. Some standard for plumbing must be set up, care being taken that it meets the requirements of sanitary science, and then laws must be passed compelling all plumbing to be done in accordance with the rules and regulations established. It is not legislation for a few or a class, but legislation for the public. Experience has long since taught us that this is a public necessity, relating as it does to the highest public good. It seems that a subject so well settled and so widely accepted would not need further discussion, but some officials do not understand because they will not. In many cities there are political rings and cliques, who seem to think that public offices were created especially for them, and that city governments were established to aid them in working out some selfish end or ambitious scheme. They give little heed to the best interests of the people so long as that interest is not necessary for their own gain. Cities have grown so bad in this regard that the people have risen in force to cast out the offending officials.

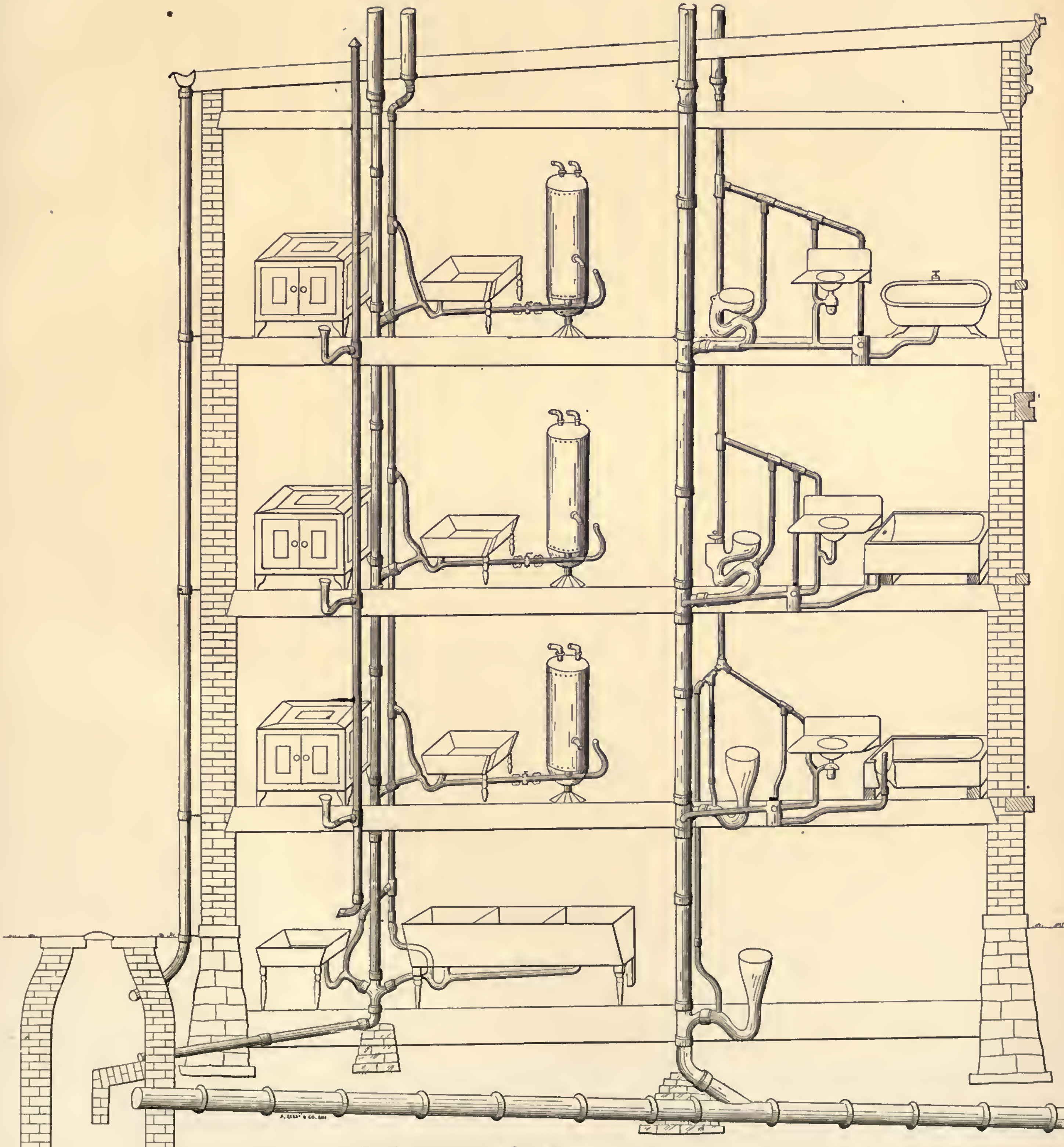
The views of Chicago plumbers on the prevailing desire for a higher standard of plumbing, and on the rules of the Chicago health department, were clearly set forth in a paper, read by David Whiteford, before the Master Plumbers' association of this city, in October, 1889. From that paper the following paragraphs are taken:

"Since, and before the organization of master plumbers' associations in this country, individual effort has been directed toward a higher standard of plumbing work. The observing, experimenting and practical plumber has for years been unconsciously educating himself. He has been impressed, while actively engaged in his daily pursuits after money for bread, with new thoughts and other ways of doing his work.. He has foreseen that there would come a time when a radical change in plumbing material and labor would take place. That time has arrived. The transition has been quietly and almost unconsciously going on, and now we find ourselves face to face with the change, scarcely knowing whether to accept the new order of things or cling with an irresistible fondness to the ways of the past. The old path we have traveled for years has served its day and generation. To the beater and former of lead, we bid adieu, a final farewell, forever. The advanced thinkers and sanitary cranks, of which we form a part, are responsible, in no small degree, to the high state of sanitary perfection which has thus far been attained. It is rumored, and we hear the mutterings of the people, that the plumbers are making new rules and getting city and state officials to adopt them. What will the plumber do next, if he takes it into his head!

"Sanitary science knows no bounds. Our organization, through its efficient members and skillful leaders, has made itself felt in many ways. Manufacturers and material men, through its instrumentality, have joined hands with the plumber, in placing before the public the best ware that can be found in the market. It is to be regretted that so many master plumbers stand aloof from our society, for which they can give no valid reason. If sanitary science and other matters depended upon their efforts for support, it would still be where it was years ago. These men are reaping a benefit of every hour you pass in these meetings. If the men engaged in the plumbing business, and who are not in harmony with the association, could but realize what their condition would be were this association to disband and go to pieces, they would come to its support. So long as other men are ready and willing to spend time and money for their good, they are quite willing to let them do it. The changes recently inaugurated by the board of health, and approved by this body, are now in force, and you are expected to adhere to them, and if you don't, the language of Shakespeare, with all its force, will fall on your head. 'Lay on Macduff, and cursed be he who says hold, enough.' The plumbing inspector has a duty to perform, and we may feel keenly at times that our liberties are taken from us; that our pet theories and practices can no longer be indulged in. That there is a right way of doing everything, is agreed upon, but whether the certificate of instruction, as handed to you for your guidance, is all that is desired, time alone will tell. The laws of the Medes and Persians were unalterable, but the laws that govern the plumbers of Chicago can be amended. If the system of plumbing, as laid down to us, be found faulty in theory and construction, and can be so demonstrated by this assembly of practical men, then I think it would be the duty of the powers that be to hearken to the voice of the people through the proper channel—the master plumbers. I do not propose to enter into a discussion of the merits of the rules and regulations governing the trade, but pass hurriedly over some of them.

"The first on the list is the duty of the architect. I take it that the architect shall use the certificate of instruction as a whole, taking it as a text to evolve a specification therefrom, and then present it, with the plans for the same, to the commissioner of health, so that they can pass upon them, and if a working design could be first prepared, showing a finished structure, it would greatly enable the contractor to complete his work. The power of the health commissioner and the duty of the plumber are one and inseparable. The health of the people is paramount to all other considerations. Should the plumber do his work well, and in accordance with the law, the commissioner is satisfied, but should the certificate of instruction, as offered to the plumbers, be at variance with good practice and common sense, I consider that we are under no obligation to follow them, but this is rarely likely to occur, as long as a good, thorough, practical plumber is at its head. The first article of the rules and regulations I will pass over, allowing the commissioner, in approving the plans, to see that there is a proper place left for pipes.

"In the second article, the foot connection, I am emphatic in the belief that it ought to be a bend, as described, with a broad flange on the socket end for resting the weight of a stack of soil pipe. The makeshifts of the past have not proved satisfactory. Third. The size of pipe. This is a supply pipe, and it ought to be considered by itself in a sketch, illustrating the various apartments. Fourth. The pan-closet. We may bid it good-bye. It occupied the same position on the one end of the soil pipe that the catch-basin does on the other. Fifth. I remember when scientific sewerage got its first impulse. It was in the discovery that the kitchen flue at the side of the stovepipe was the proper terminus, only to blow back in the stove the awful sewer gas. Sixth. Six years ago, in a paper, read before this association, I advocated strongly the use of heavy cast-iron soil pipe, and gave my reasons, lead being too light and too costly when heavy. The enlargement and hight of soil pipe through the roof is all right, provided the rule means two feet above the portion that it passes through. The cap or cowl on the top end of soil pipe is of no value, unless it should be in a place where there is a blow-down. Seventh. Horizontal waste and soil pipes can not well be prevented in store and flat buildings, but when they can, it is preferable. Eighth. This is all right, though two inches are plenty large enough, well back-vented. Ninth. This is all right. Tenth. I accept this as probably the best practice. I am persuaded that where a heated flue can be had and the pipe carried to the top of the house, a trap may safely be placed at the foot of the soil pipe, with a four-inch air pipe, carried from the roof of the building down to near the foot of the soil pipe above the trap. Eleventh and twelfth I pass, taking it for granted that all pipes, before being tarred, have been inspected. Thirteenth. Wherever there is any doubt in the mind of an inspector that the work is not what it ought to be, and wherever called for, it ought to be tested, using the smoke or water test. Sixteenth. The brass ferrule I concur in. Seventeenth. Where there is more than two parts to the laundry-tub, I would use a drum-trap, four inches in diameter, dipping the several branches separately in the water and a good drum or S-trap for sinks. Eighteenth I pass. Nineteenth. The holes in sink strainers are entirely too small. If it were not for the liability to get stopped up, I would have no strainer; it does not get the proper flush it requires. Twentieth. In a great many cases, I prefer to have connections from bathtubs and basins directly into the dip of the trap; for instance, a trap is located in the direct line of a free passage of air constantly going on between the revent pipe and soil pipe, day and night, and a bathtub, the junction of which is on the outlet side of the trap, or on a bend, is in great danger of being emptied by evaporation; in such a condition as this, sewer gas would find an easy access into the house through the basin or bathtub. The bathtub may not be used very often, whereas, if it were connected to the water-closet trap, it would have the advantage of a frequent flush of water, keeping the closet trap full of water. Two traps reventilated between, is sometimes done to good advantage. Twenty-first. To prevent traps from siphoning. Atmosphere must be brought by some means and connected to the long leg of the siphon near the top of outlet side. If the air should be taken from the inside of a house, so long as the vacuum exists the house is perfectly safe, but when the vacuum is filled and not perfectly sealed, the generated



PLUMBING IN A FLAT

air passes through the trap back into the house. Mechanical methods have been invented, to be operated automatically, and by the opening and closing of a shut-off. The water seal is the most practical and the best known method. Ventilation and reventilation of discharge waste-water pipes is the safeguard so long as the pipes are good and the air passage is free. The sizes of pipes, as laid down in the rules, are satisfactory. In regard to the kind of pipe to be used for reventilation, I am satisfied that wrought iron, as now put in, is not the thing. In four years, a two-inch pipe, to my own knowledge, has filled up and choked with scales for the distance of two feet above the crown of the trap. Whether lead of a certain thickness, galvanized wrought iron or cast iron is the best, I am not positive. The method of reventing is one which requires great care. Bye passes are unintentionally and so easily made for the return of sewer gas, that unless the plumber is well up in scientific construction he will get into trouble.

"I pass to the thirty-third article. Tanks for drinking purposes. What is the matter with a lead-lined tank for drinking purposes? I presume it is lead poisoning. If such is the fact, I reckon it must be because the water is not drawn off but once a week. When I was a boy and learning my trade, they would not have anything else. Understand me, I don't take the ground, that because it was the right thing then, it is the right thing now. I want to be on the right side of every question. If the authority for the disuse of lead tanks is a settled fact, and based upon undisputed evidence, I am with you. Article thirty-nine says, 'the privy accommodation in a tenement or lodging house should not be in the basement, unless it be in a hotel, and that in a part of the building well lighted and ventilated and set apart for the purpose.' This article I do not understand to forbid the use of water-closet in basement in private dwellings, but wherever used, must in all circumstances be a tank water-closet. The last article. The wooden wash trays and sink are the source of a great deal of local offensive smell, and some of the composition wash trays are not much better; at least some of them are very porous and absorb water rapidly. In summing up this review of the plumbing and drainage ordinance, I have only to say that it is the duty of every master plumber, as far as it lies in his power, to assist the board of health in its enforcement."

The present sanitary ordinances of the city are as follows:

1347. That no person shall hereafter erect, or cause to be erected, or converted to a new purpose by alteration, any building or structure which, or any part of which, shall be inadequate or defective in respect to ventilation, light, sewerage or any of the usual, proper or necessary provisions or precautions for the preservation of health, nor shall the builder, lessee, tenant or occupant of any such or of any other building or structure (having the right or ability to remedy or prevent the same), cause or allow any matter or things to be or to be done in or about any such building or structure dangerous or prejudicial to health.

1348. That no owner, agent or lessee of any building or any part thereof, shall lease or let or hire out the same or any portion thereof, to be occupied by any person, or allow the same to be occupied by any person, or allow the same to be occupied as a place in which any one may dwell or lodge, except when said buildings or such parts thereof are sufficiently lighted, ventilated, provided and accommodated, and in all respects in that condition of cleanliness and wholesomeness for which this article or any law of this state provides, or in which they or either of them reqnire any such premises to be kept.

1349. That no person, being the owner, proprietor, lessee, manager or superintendent of any store, factory, workshop or other structure or place of employment where workmen and workwomen are

F

employed for wages, shall cause, permit or allow the same or any portion or apartment of or any room in said store, factory, workshop or other structure or place of employment, to be overcrowded or inadequate, faulty or insufficient in respect to ventilation and cleanliness; and in every such building or apartment, or room in any such building, where one or more persons are employed as aforesaid, at least five hundred cubic feet of air space shall be allowed to each and every person employed therein, and the air changed or renewed by ventilation at least once in every twenty minutes during the hours of employment.

1350. All such places of employment or service shall be kept in a cleanly condition, free from the effluvia of a sewer, drain, privy, stable or other nuisance; also, as far as practicable, from all gases, vapors, dust or other impurities generated by manufacturing processes or otherwise, and injurious to health. Sufficient and separate privies and urinals shall be provided for male and female employes, and such privies shall be ventilated.

1355. That every owner, lessee and tenant, and manager of any boardinghouse or manufactory, shall cause every part thereof and its appurtenances to be put, and shall thereafter cause the same to be kept in a clean and wholesome condition, and shall speedily cause every apartment thereof in which any person may sleep, dwell or work, to be adequately lighted and ventilated; and if the same be a manufactory, shall cause every part thereof in which any person may work to be maintained at such temperature, and be provided with such accommodations and safeguards as not, by any reason of the want thereof, or of anything about the condition of any such manufactory or its appurtenances, to cause unnecessary danger or detriment to the health of any person being properly therein or thereat.

1359. The roof of every house shall be kept in good repair and so as not to leak, and all rainwater shall be so drained or conveyed therefrom as to prevent its dripping on the ground, or causing dampness in the walls, yard or area.

1360. Every such building shall be provided with good and sufficient water-closets or privies, and shall have proper doors, traps, soil pans and other suitable works and arrangements, so far as may be necessary to insure the efficient operation thereof.

1361. Such water-closets or privies shall not be less in number than one to every twenty occupants of said house; but water-closets or privies may be used in common by the occupants of any two or more houses, provided the access is convenient and direct, and provided the number of occupants in the houses for which they are provided shall not exceed the proportion above required for every privy or water-closet.

1362. Every house situated upon a lot or street in which there is a sewer, shall have the water-closets or privies furnished with a proper connection with the sewer, which connection shall be in all parts adequate for the purpose, as to permit entirely and freely to pass whatever enters the same.

1363. All such water-closets and vaults shall be provided with the proper traps, and connected with the house sewer by a proper tight pipe, and shall be provided with sufficient water and other proper means for flushing the same; and every owner, lessee and occupant shall take adequate measures to prevent improper substances from entering such water-closets or privies or their connections, and to secure the prompt removal of any improper substances that may enter them, so that no accumulation shall take place, and so as to prevent any exhalation therefrom, offensive, dangerous or prejudicial to health, and so as to prevent the same from being or becoming obstructed.

1364. Where no sewer exists in the street, the yard or area shall be so graded that all water from the roof or otherwise, and all filth shall flow freely from it and all parts of it into the street gutter, by a passage beneath the sidewalk, which shall be covered by a permanent cover, but so arranged as to admit access to remove obstructions or impurities.

1371. In every such house hereafter erected or converted, every habitable room, except rooms in the attic, shall be in every part not less than eight feet in hight from the floor to the ceiling; and every habitable room in the attic of any such building shall be at least eight feet in hight from the floor to the ceiling, throughout not less than one-half the area of such room. Every such room shall have at least one window connected with the external air, or over the door a ventilator of perfect construction, connecting it with a room or hall which has a connection with the external air, and so arranged as to produce a cross current of air. The total area of window or windows in every room communicating with the external air, shall be at least one-tenth of the superficial area of every such room: and the top of one at least of such windows shall not be less than seven feet and six inches above the floor, and the upper half at least shall be made so as to open the full width. Every habitable room of a less area than one hundred superficial feet, if it does not communicate directly with the external air, and is without an open fireplace, shall be provided with special means of ventilation by a separate air shaft extending to the roof, or otherwise as the commissioner of buildings may prescribe.

1372. Every such house hereafter erected or converted shall have adequate chimneys running through every floor, with an open fireplace or grate, or place for stove, properly connected with one of said chimneys, for every family and set of apartments; it shall have proper conveniences and receptacles for ashes and rubbish: it shall have water furnished at one or more places in such house or in the yard thereof, so that the same may be adequate and reasonably convenient for the use of the occupants thereof; it shall have the floor of the cellar properly cemented so as to be water-tight, the halls of each floor shall open directly to the external air, with suitable windows, and shall have no room or other obstruction at the end, unless sufficient light or ventilation is otherwise provided for said hall in a manner approved by the commissioner of buildings.

1389. That it shall be the duty of every person using, making or having any drain, soil pipe or passage to connect with any sewer from any ground, building, erection, or place of business, and in like manner the duty of the owner and tenant of all grounds, buildings and erections, and of the parties interested in such place of business or the business thereat, and in like manner the duty of all departments, officers and persons (to the extent of the right and authority of each) to cause and require that such drain, soil pipe, passage and connection shall at all times be adequate for its purpose, and such as shall convey and allow freely and entirely to pass whatever enters or should enter the same, and that all connections between metal pipes and house drains shall be made by a plumber as the commissioner of health may direct.

The plumbing and sewerage ordinances are embraced in Sections 1735 to 1758 and sundry higher numbered sections.

1735. Any person desiring to do business in connection with the waterworks of the city of Chicago as a plumber, shall first obtain a license as such plumber from the department of public works, and shall pay a fee of $1 therefor, which fee shall be paid to the cashier of the water office of said city, who shall account for the same as all other receipts which come into his hands belonging to the water fund of the city, and no person shall receive such license who shall not have attained the age of twenty-one years and have an established place of business within the limits of said city, and who shall not furnish the commissioner of public works with satisfactory evidence of his responsibility and skill to ply his trade in accordance with the rules and regulations of the department of public works and the ordinances of the city.

1736. Every person desiring such license shall file with the commissioner of public works a petition in writing, giving the name of the firm, if he shall be one of the firm, and each member thereof, and place of business, asking to become a licensed plumber, and said petition shall be accompanied by a bond signed by two or more sureties, to be approved by the commissioner of public works, in the sum of $3,000 conditioned that he, or they will indemnify and save harmless the city of Chicago from all accidents and damages caused by any negligence in either the execution or protection of his work, or for any unfaithful or inadequate work done under and by virtue of his license; and that said licensee as such will also conform to all the conditions and requirements of the city for his government, or in default thereof will submit to such penalties as are or may be prescribed by the city council for the government of licensed plumbers.

1737. Any change of the firm name or location of business must be promptly located to the commissioner of public works, and the license shall be kept in a conspicuous place at the place of business.

1738. When two or more persons are co-partners, licenses shall issue in the name of the firm or co-partnership, and no license shall be transferable.

1739. Any plumber who shall be guilty of a violation of any of the provisions of this article shall forfeit his license and shall be subject to a fine upon conviction of not less than $10 nor more than $100.

1740. All licensed plumbers shall be held responsible for all acts of their agents or employes done by virtue of his or their said license. No license shall be granted for a greater period than one year, or the unexpired portion thereof; all licenses shall expire on the last day of December of each year unless sooner revoked.

1741. All applications for permits for the introduction or use of water shall be made in writing upon the printed forms furnished by the department of public works, the blanks to be specifically and properly filled in and signed by the owner or duly authorized agent of the owner, and no work whatever shall be done in the street, or outside a building, by any plumber or other person until after the issuance of such permit. This restriction shall not prevent licensed plumbers or other persons from rendering assistance in case of accident to service water pipes occurring at night, or at any time requiring immediate action; provided, however, prompt report shall be made at the department of public works and a permit for the occasion secured.

1742. No person except the tappers employed by the department of public works will be permitted under any circumstances to tap the street main, or insert stopcocks or ferrules therein; all service cocks or ferrules must be inserted at or near the top of the street main, and not in any case nearer than six inches from the bell of the pipe; the size of the cock to be inserted shall be that specified in the permit.

1743. In making excavations in streets, alleys or highways for the laying of service pipes or making repairs or for any other purpose, the paving material and earth removed must be kept separate and deposited in a manner that will occasion the least inconvenience to the public with provision for the passage of water along the gutter and a safe passage way for foot travel.

1744. No lead pipe shall be used in any work done under the authority of a license issued by the city of Chicago, except such as is known to the trade as "strong," and must weigh as follows:

	Pounds per linear foot.		Pounds per linear foot.
Half-inch internal diameter	1¾	One and one-fourth inch internal diameter	4¾
Five-eighths inch internal diameter	2½	One and one-half inch internal diameter	6
Three-fourths inch internal diameter	3	One and three-fourths inch internal diameter	6½
One inch internal diameter	4	Two inches internal diameter	8

No pipe shall be used for the purpose of street service of a different material or size than herein specified except by special permit.

1745. All service pipes leading from the street mains to the building line, shall, as far as practicable, be laid in the ground to a depth of not less than five feet, and said pipe shall be laid in such a manner and be of such surplus length as to prevent breakage or rupture by settlement, and all joints in said pipes must be of the kind termed "plumber or wiped joints." The connections of pipe by the so-called "cup-joint" is prohibited.

1746. Every service pipe must be provided with a stop and wastecock for each consumer, easily accessible, placed beyond damage by frost and so situated that the water can be conveniently shut off and drained from the pipes.

1747. Said stopcocks, unless otherwise specially permitted, shall be connected to service pipes within the sidewalk at or near the curb line of the same, and be inclosed in and protected by a cast-iron box with a cover having the letter "W" of suitable size cast thereon; said iron box must be of form and dimensions satisfactory to the commissioner of public works, and must extend from service pipe to surface of sidewalk, and be of proper size to admit a stopkey for operating the stopcock.

1748. Whenever two or more distinct buildings or premises are to be supplied by means of branch or subservice pipes supplied by a single tap in the street main, each branch must be independently arranged with stopcock and box on the curb line in the manner above prescribed. All cocks used at the sidewalks by licensed plumbers shall be of the kind known as "round water way."

1749. Before filling the trench the service cock in the street main must be covered with a suitable cast-iron box furnished by the city, the earth must be well rammed under the main, to a level with the top thereof; from thence the trench must be filled in layers of not more than twelve inches in depth, and each layer thoroughly rammed or puddled to prevent settlement. This work, together with the replacing of sidewalks, ballast and paving, shall be done in all cases by the city. A sufficient amount must be deposited with the city before issuing the permit for opening the street to cover this expense. In all cases where the street to be opened has been recently paved with blocks, sufficient of the paving must be removed so that the foundation boards or planks (if any) can be taken up without cutting. No permit shall be granted for the opening of any paved street for the tapping of mains or laying of service pipes when the ground is frozen to a depth of twelve inches or more, except when in the opinion of the commissioner of public works there is a sufficient emergency to justify it.

1750. Plumbers are prohibited from connecting pipes whereby steam boilers may be supplied with the water direct from city pressure. All such boilers shall be provided with a tank or other receptacle of sufficient capacity to hold at least six hours' supply in case of a pipe district being shut off to repair mains or make connections or extensions. In such cases the city of Chicago will not be responsible for a lack of water for steam boilers or for any other purpose.

1751. No alteration or addition whatever, in or about any water meter, conduit pipe or watercock in connection with the water supply to any building or premises shall be made or cause to be made by any plumber or any person whosoever, without first obtaining a written permit so to do from the commissioner of public works.

1752. No water meter shall be connected with the water-supply pipes of any building or premises, until such meter shall be tested and approved by the commissioner of public works, and a special permit granted therefor.

1753. Whenever any material change is to be made in the plumbing work, beyond that specified in the permit therefor, the plumber is hereby required to give previous notice to the commissioner of public works, presenting the original permit for correction and record.

1754. Any plumber or other person who shall turn on the supply of water to any building or premises from which the supply has been shut off by the commissioner of public works on account of non-payment of water rate or for any other cause, or shall cause the same to be done without having first obtained a written permit for so doing, shall be subject to a penalty of not less than $10 or more than $100 for each offense.

1755. No water-closet or apparatus of any kind shall be connected with the water supply, through which the water will pass, when such water-closet or apparatus are not in use, unless such water-closet or apparatus are controlled by a water meter.

1756. All work done by licensed plumbers shall be subject to the inspection, supervision and approval of the commissioner of public works, and all faulty or defective work which may at any time be discovered, shall be made satisfactory to the commissioner of public works, and no further permit will be issued to the party in default until this section shall have been fully complied with.

1757. All permits issued for any work to be done under the authority of this article shall be returned to the commissioner of public works within twenty-four hours after the work shall be completed, and such permit shall contain a written statement of the facts and the time the water was turned on for use, which shall be signed by such plumber.

1758. Any plumber whose license shall be declared forfeited by the commissioner of public works for a violation of any provision of this article, shall not again be entitled to do work under this article unless said declaration of forfeiture shall be revoked by said commissioner.

1911. No connection with or opening into any sewer or drain shall be used for the conveyance or discharge into said sewer or drain of steam from any steam boiler or engine, or from any manufactory or building in which steam is either generated or used, under the penalty of $50 for each and every day during any part of which such connection or opening may have been used for that purpose. This penalty shall be imposed upon and recovered from the owner and occupants, severally and respectively, of such manufactory or building.

1912. All connection with sewers or drains used for the purpose of carrying off animal refuse from water-closets or otherwise, and slop of kitchens, shall have fixtures for a sufficiency of water to be so applied as to properly carry off such matters, under the penalty of $5 for each day the same are permitted to remain without such fixtures for supplying said water.

1913. No butcher's offal or garbage, dead animals or obstructions of any kind whatsoever, shall be placed, thrown or deposited in any receiving-basin or sewer; and any person so offending or causing any such obstruction or substance to be placed so as to be carried into such basin or sewer shall be subject to a penalty of $10 for each offense, and any person injuring, breaking or removing any portion of any receiving-basin, covering-flag, manhole, vent or any part of any sewer or drain, or obstructing the mouth of any sewer or drain, shall be subject to a penalty of $20 for each offense; nor shall any quantity of marble or other stone, iron, lead, timber or any other substance, exceeding one ton in weight, be placed or deposited upon any wharf or bulkhead through which any sewer or drain may run; nor upon or over any sewer or drain where the same shall be within three feet of the surface of the street, under the penalty of $50 for each offense, to be recovered of the person or persons causing or permitting the same.

1914. It shall be the duty of every person having charge of the sweeping and cleaning of the streets in the city to see that the gutters are properly scraped out before the water is suffered to flow from any hydrant for the purpose of washing the same, in order that no substance or obstruction be carried into any of the receiving-basins; every person violating this section to be subject to a penalty of $5 for each offense.

1915. It shall be the duty of the policeman to be vigilant in the enforcement of the provisions of this article, and report any violations thereof to the commissioner of public works. The captains of the several police districts shall, on observing or being informed of the opening or of excavating in any street or avenue, require the person making such opening or excavation to exhibit to him the authority or permission for such opening; and, if none has been given by the proper officer, or if the exhibition thereof be refused, said captain of police shall, without delay, report the same to the commissioner of public works.

1916. Any person who shall uncover or excavate under or around the brick or pipe sewers in this city, for any purpose whatever, without the written consent of said commissioner, shall be subject to a fine of not less than $10 and not exceeding $50: the person or persons by whom the work is done, and their employers shall be deemed guilty of a violation of this section.

1917. Any person who shall lay, alter and disturb any part of the house drain or drains, catch-basin or strainer of said drain or drains, cesspool or water-closet, connected with any brick or pipe sewer belonging to said city, without being duly licensed to perform the same by said commissioner, shall be subject to a fine of not less than $10 and not exceeding $50 for each offense, which shall be recoverable against the person or persons performing the work, or their employers.

1918. It shall be the duty of any person or persons constructing or using any private drain, sewer, cesspool, water-closet pipe or other pipe connecting with or emptying into any brick or pipe drain or sewer belonging to said city, to construct and use the same strictly in conformity with the orders and directions of the commissioner of public works, which orders and directions shall be given in writing for such purpose: and any person who shall construct or use, or cause to be constructed or used, any such drain, sewer, cesspool or water-closet pipe in a different manner from that so ordered and directed by said commissioner, or in violation of the orders of said commissioner, shall be subject to a fine not exceeding $50, which shall be recoverable against the person or persons so constructing or using said sewer, drain or pipe, or their employers, and the owner of the lot or lots or premises in which said work is constructed or used, shall be deemed and considered as authorizing such construction or use and liable to such penalty.

2053. It shall be unlawful for any person to construct, have, or permit to remain in any building in the city of Chicago, any tank for water, of a larger capacity than ten barrels, unless the said tank shall rest upon a foundation of solid brick or stone masonry, or upon iron girders which rest upon solid brick or stone masonry, unless said tank shall remain uncovered, when located above the main floor of the building, under the penalty of not less than $25, and a like penalty for every day he shall refuse or neglect to comply with the requirements of this section. Provided, no such tank shall be constructed without first obtaining a permit therefor from the commissioner of buildings.

Any person, firm or corporation, who shall construct, or cause to be constructed, any such tank, without first obtaining such permit, shall be fined not less than $5 nor more than $25 for constructing without permit.

2056. Any person who shall lay any water-service pipes, or introduce into or about any building or on any grounds, any water pipes, or do any plumbing work in any building or on any grounds, for the purpose of connecting such pipes or plumbing work with the pipes of the Chicago waterworks, or of preparing them for such connections, with the view of having such premises supplied with water by the Chicago waterworks, or who shall make any additions to or alterations of any water pipe, bath, water-closet, stopcock or other fixture or apparatus for the supplying of any premises with water without being duly licensed to perform such work by the commissioner of public works of the city of Chicago, and without having first obtained a permit for doing such work from said commissioner, shall be subject to a fine of not less than $10 and not exceeding $50.

The following certificate of instructions, relating to plumbling, drainage, etc., is approved by the commissioner of health:

When the work is completed, and before it is covered from view, the department of health shall be notified that it may send its inspector, upon whose report the commissioner of health will act upon its final approval. All materials shall be of good quality and free from defects; the work shall be executed in a thorough and proper manner. All plumbing in the house shall be so placed as to be readily inspected. Every soil pipe and waste pipe of iron or lead shall extend through and at least four feet above the roof, of undiminished size, and provided with suitable top or cap. All house drains shall be provided with a proper trap near the street, and be provided with an inlet for fresh air, just inside the trap. The house drain, if of iron, shall have a fall of at least half an inch to the foot. It should run along the cellar wall and never be hidden under ground. These iron pipes shall be sound, free from holes, and of a uniform thickness of not less than one-eighth of an inch for a diameter of two, three or four inches, or five-thirty-seconds of an inch for a diameter of five or six inches. Before they are connected, they should be thoroughly coated inside and outside with coal-tar pitch, applied hot, or with some other equivalent substance. All joints in soil pipes and waste pipes shall be so calked with lead, or with a cement made of iron filings and sal ammoniac, so as to make them impermeable to gases. House drains, other than iron, should have twice the internal diameter and half the grade, except by special permission. When a lead pipe or trap is connected with an iron pipe, the joint shall be made through a metallic sleeve or ferrule, and calked with lead. Every sink or basin, every water-closet and every tub or set of tubs shall be separately and properly trapped. All traps should be ventilated by a special pipe extending above the roof. Every "safe" under a basin, refrigerator or other fixture shall be drained by a special pipe not directly connected with any waste pipe, drain or sewer. Every water-closet should be supplied with water from a special cistern, and not by direct connection with the city water supply. No overflow pipe from a cistern shall be directly connected with any soil pipe, waste pipe or drain. When the pressure of the city pumping works is not sufficient to supply the cistern, a pump should be provided. No cistern for drinking water should be lined with lead. Wrought-iron, steam fitted, glazed pipes are the best for house drains.

Thus it is evident that the municipality has the power to enforce sanitary laws. Whether this power be exercised judiciously or not is a question that has been agitated from time to time. Severe critics fail to see where they are exercised, but the citizen who is able to distinguish between extremes knows full well that the plumbers of Chicago aim to observe the ordinances and succeed in this aim generally. They realize the importance of their work and bend their energies to do it well. Notwithstanding the progress of plumbing, the tendency of the trade is toward simplicity in the arrangement of pipes and the use of durable material; but some plumbers go to excess, like other men, and hence the law of the city should be present to check this excess. Plumbing ordinances are only severe on the bad plumber in the same degree that the state laws are only severe on the bad citizen.

CHAPTER III.

PLUMBERS' ASSOCIATIONS.

ORGANIZATION of the members of the plumbing trade in the United States has raised that branch of business almost to the rank of a profession, and, with this social elevation, has conferred upon the members an unquestionable title to intellectual superiority above many of the trades connected with the building arts. Through organization the working plumber of the past has developed into a student of the scientific school of plumbing and a director of labor. Progression and success go hand in hand, and one cannot be successful without being in some manner progressive. Search the world over, and the fact will come back, if not with added force, at least with striking realization, that the most successful merchants, manufacturers, professional men and mechanics are those in whom the most prominent trait is progression. This assertion, more than ever, holds good of plumbing in its true sense, and if, as some assert, plumbers are successful, in a pecuniary point of view, it must be confidently said that they are at the present time as progressive, probably more so, than the average mechanic. Plumbing is, indeed, a progressive science; few realize the rapid strides which have been made during the present generation, few, indeed, understand the prerequisites, essentials and training which combine to make the competent and successful plumber. Knowledge acquired from long training and study, experience gained after continuous and patient research, honest desire for success, a susceptible disposition to accept the results of the investigations of others, have contributed in the makeup of the plumber of the present time. The plumber of the past was a workman, plain and simple, versed, almost to perfection in the use of tools and the performance of his work. Beyond this the demands of his business never led him. Every job was done alike, varied by a regard for decorations, and a dexterous manipulation of lead pipe; the demands of his calling made him a plodder, honest and industrious, but as regards new methods, new ideas, obstinate, as a rule. To-day the science of plumbing demands that the plumber shall be not only a workman, but that he shall be a skilled mechanic, and beyond that he shall be familiar, if not from actual study, at least from experience, in certain laws of physical science, with laws which govern hydraulics and ventilation. The modern science of plumbing abounds with examples which call for the most thorough and complete knowledge of these laws. The plumber of the past had but to provide the necessary supply and waste pipes, to hide them from view, if such were a possible thing, and to set his fixtures neatly to accord with the construction of the building in which they were placed. The plumber of to-day must thoroughly ventilate, not only the traps and the system of soil and waste pipes which he puts in, but he also must ventilate the building itself in the most approved manner, insuring beyond the possibility of a doubt, security against those poisonous gases which recently-acquired science teaches must be faithfully guarded against. He must know the laws of hydraulics, that he can understand the capabilities and capacities of supply pipes, the flow in them under varying heads, the loss due to friction, that allowances may be made for the same. He must understand and know the principle of circulation of hot water, that the best results attainable may follow his work. He must combine with these a knowledge of sewerage and drain laying, as applied to buildings, that he may take a commanding part in all that has to do with sewage disposal, and to them all he must add a trained knowledge of legitimate business for his own protection. The associations help to make him capable of being all this and more. They bring him in contact with the strongest minds of the craft: they inoculate him with a sense of independent manhood, dependent only upon intelligence.

The National Association of Master Plumbers dates back to June 27, 1883, when the first convention was held in New York City. It appears that an organization of plumbers existed there as early as 1880, and on December 1, 1882, this association met to consider measures for protecting the trade. A committee was appointed to report at a future meeting on this subject, and the chairman, Thomas J. Byrne, invited the plumbers' association of Brooklyn to send one or more delegates. The meeting was held at the Astor House, January 10, 1883. It was apparent to the delegates that to make the plans suggested in the report effective, a union of master plumbers was necessary, and to this end a confidential letter was mailed to members of the trade in the great commercial centers. This letter suggested the organization of local associations and was a success in having the suggestion carried out extensively. On March 7, 1883, a meeting of delegates from the eastern cities was held in New York, and a call for a meeting on June 27, 1883, to organize a National association was issued. Twenty-one associations answered the call by sending one hundred and twenty-five delegates. Mayor W. E. Foster was made permanent chairman and the same secretaries were retained. A committee of twenty-one was appointed to formulate a plan of organization. This was done and adopted and Col. George D. Scott was elected president of the newly organized National association. Edward Murphy, of New York, was elected secretary. While papers were read on the apprenticeship question and on protection, no action was taken by the first National convention save to appoint committees to report on those subjects at the next convention.

The second convention assembled at Baltimore, Md., June 26, 1884. Five towns represented in the first were not represented in this; yet twenty-seven associations sent one hundred and forty-six delegates. Messrs. Boyd, Griffith and Hamblin, of Chicago, the committee on by-laws, reported, the reports of the executive committee and other committees were received, and the paper on "Trade protection," by J. J. Wade was read. This paper set forth the resolutions, known as the "Baltimore resolutions," which became the bible or koran of the trade. The officers elected were Andrew Young, Chicago, president; James Allison, Cincinnati, vice president; J. J. Wade, Chicago, recorder; J. J. Hamblin, Chicago, correspondent; W. H. Graham, St. Louis, treasurer; Enoch Remick, Philadelphia, financial secretary; D. H. Collins, St. Louis, sergeant-at-arms; John Sanders, Martin Moylan, A. W. Murray and Thomas Havey, of Chicago, and Jeremiah Sheehan, of St. Louis, members of executive committee. The resolutions as adopted are as follows:

Whereas, the manufacturing and wholesale firms in plumbing materials persist in selling to consumers, to our injury and detriment, placing us toward our customers in the light of extortionists, causing endless trouble; and whereas, the system of protecting us from this wrong, which draws in its wake other wrongs, is ineffective, it is absolutely necessary to perfect such a system by united action, which will remove these evils from which we have suffered for years; therefore, be it

Resolved, that any firm manufacturing plumbing materials selling to others than master plumbers, that we withdraw our patronage from such firm; that manufacturers of gas fixtures selling to consumers shall not receive the patronage of any master plumber; that the master plumbers shall demand of the manufacturers and wholesale dealers in plumbing materials to sell goods to none but master plumbers; that this association keep a record of all journeymen and plumbers who place in buildings plumbing material bought by consumers of manufacturers or dealers; that any manufacturing or wholesale dealers, dealing in wrought-iron pipe, who sell to consumers shall not receive our patronage; that a committee be appointed by this association in every state and county for the purpose of reporting to the proper officer at its head in the state any violation of these resolutions; that these measures are just and necessary to our welfare, and a rigid enforcement is demanded; that this convention endorse the above, and urge upon the National association to perfect and adopt a uniform system of protection for the trade over their entire jurisdiction.

The names of manufacturers who signed the "Baltimore resolutions," without reserve, prior to October 17, 1884, are given as follows: Peck Bros. & Co., New Haven and Chicago; Cooper, Jones & Cadbury, Philadelphia; William McShane & Co., New York; R. B. Swain & Co., Philadelphia; M. M. Murphy & Co., Cleveland; Washburn & Moore Manufacturing Co., Yonkers, N. Y.; Ward & Curley, Boston; Thomas H. Hussey, New York; Colwell Lead Co., New York; Fieldhouse, Dutcher & Belden, Chicago; J. N. Raymond, Chicago; Goulds & Austin, Chicago; Thomas Maddock & Sons, New York; Thomas Hanson, New York; L. M. Rumsey Manufacturing Co., St. Louis, Mo.; N. O. Nelson Manufacturing Co., St. Louis, Mo.; T. P. Tuite & Co., Detroit, Mich.; E. Stebbins Manufacturing Co., Springfield, Mass.; Charles Harrison & Co., New York; B. P. Bower & Co., Cleveland, Ohio; Thomas Kelly & Bros., Chicago; Henry McShane & Co., New York; Peter Becker, Chicago; Henry Huber & Co., New York; The Standard Lighting Co., Cleveland, Ohio; Renton Bros., New York; Western Brass Manufacturing Co., St. Louis, Mo.; Cassidy & Adler, New York; E. G. Schafer & Co., Washington, D. C.; Northwestern Lead & Oil Co., Chicago; Schoenberg Metal Manufacturing Co., New York; C. T. Bride, Washington, D. C.; H. McCollum & Co., Cincinnati, Ohio; David Morrison, New York; James Bulger, Jr., New York; the Thomas Gibson Co., Cincinnati, Ohio; Jamer, Jacobs & Co., Brooklyn and New York; Bailey, Farrell & Co., Pittsburgh, Penn.; Miller & Coates, New York; J. T. Cammeyer & Co., New York; Lowe & Brother, New York; Le Roy Shot & Lead Manufacturing Co., New York; Joseph C. Bryan, New York; the Bradley White Lead Co., New York; Myers' Sanitary Depot, New York; L. Wolff Manufacturing Co., Chicago; Crane Bros. Manufacturing Co., Chicago; James F. McNulty, Brooklyn, N. Y.; Trageser Steam Copper Works, New York; Robert Leitch & Sons, Washington, D. C.; William H. Douglas, Washington, D. C.; James B. Clow & Son, Chicago; Ahrens & Ott, Louisville, Ky.; E. W. Blatchford & Co., Chicago; L. P. Clark & Sons, Baltimore. Md.; Lowe & Brother, New York; Peter Kries & Co., W. I. Clark & Bro., Crook, Horner & Co., J. Regester & Sons, all of Baltimore, Md.

The third annual convention was held at St. Louis, Mo., June 23, 1885, there being thirty towns represented by one hundred and fifty-three delegates. The most important action was the adoption of a resolution placing the interpretation of the Baltimore resolutions in the hands of the executive committee. This was taken because of a demand from the eastern cities that the Baltimore resolutions be so modified as to permit dealers to sell to each other. James Allison, of Cincinnati, was elected president, and Thomas McNeil, also of Cincinnati, was elected secretary.

The fourth annual convention was held at Deer Park, Md., June 22, 1886, twenty-five towns being represented by one hundred and thirty-nine delegates, a falling off from the previous sessions. The executive committee reported its interpretation of the Baltimore resolutions, modifying them as desired by the eastern delegates at the St. Louis meeting. The committee recommended that the plumber should cease acting as an agent, and endeavor to purchase goods by the quantity—in other words become a merchant—that, in localities where the Baltimore resolutions could not be lived up to, discretionary power be granted to local associations in accord with the spirit of the resolutions. This last recommendation was hotly contested by certain delegations, but was finally carried by one hundred to thirty-two. The election of officers resulted in the choice of James Allison, Cincinnati, president; John Trainor, Baltimore, vice president; Thomas McNeil, Cincinnati, recording secretary; M. J. Lyons, Brooklyn, treasurer; James Semple, Cincinnati, corresponding secretary; Enoch Remick, Philadelphia, financial secretary; David J. Collins, St. Louis, sergeant-at-arms. Executive committee—President, Allison; vice president, Trainor; recording secretary, McNeil; treasurer, Lyons, and Messrs. George R. Phillips, Providence, R. I.; James W. Birkett, Brooklyn; Thomas C. Boyd, Chicago; J. A. McDonald, New York, and James J. Weaver, Philadelphia.

In June, 1886, the late Martin Moylan prepared a paper on "Extras in plumbing work," which was read before the convention at Deer Park, Md. He pointed out that within the nine preceding years, buildings valued at $112,000,000 were erected at Chicago; that the cost of plumbing therein was about $2,500,000. Extra work valued at $625,000 was also performed, of which only seventy-five per centum returned to the pockets of the plumbers, the balance—$156,000—standing against the house owners of the city. In explaining this question of extra work he stated that plans and specifications could not be so drawn as to avoid extra work. The architect in planning a house is governed by the wants, tastes, whims, prejudices and finances of his client, and, being a stranger to all these with the exception of the latter, he, indeed. must needs be a judge of human nature who could, upon such short acquaintance, as he is usually afforded, meet every want. His client wishes to have every conceivable ornament and accommodation in that prospective home, be it ever so modest, that months of thinking and planning can suggest, together with all the recommendations of his friends, and not being able to judge intelligently from plans how this or that arrangement will suit his peculiar ideas, it is only as the work progresses and he sees it as it will be, that he can say with any degree of certainty what shall be. The speculative builder does not annoy his head with the idea of extras. He understands how "to make the punishment fit the crime," and while appearances tell of contracts being observed, it takes only a little time to show the owner that the lowest bidder for plumbing work was not necessarily the cheapest one. The man who builds a great business block or an elegant residence for himself must have changes from the original plans and accompanying extras. Otherwise he is dissatisfied with one or more parts of the building.

The fifth convention was held at Chicago in June, 1887. The city delegates were Robert Griffith, president; delegates, A. W. Murray, Martin Moylan, William Sims, T. C. Boyd, Hugh Watt, Michael Ryan, D. J. Rock, David Whiteford, William Bowden, E. Baggot, Rupert Coleman, Patrick Sanders, Joseph R. Alcock, Michael J. Corboy, William Wilson, Andrew Young and J. J. Wade; alternates, Thomas O'Malley, John J. Hamblin, Patrick Nacey, James H. Roche, Fred. Neustadt, Thomas Conlin, P. L. O'Hara, J. W. Weber, Michael Reilley, James J. Clark, A. C. Hickey, Peter Willems, G. J. Stokes, J. H. Norton, Joseph De War, C. J. Brooks and T. W. Potts.

John Byrnes, of New York, was chosen president; John Trainor, of Baltimore, vice president; H. G. Gabay, of New York, recorder; W. T. Hudson, of Brooklyn, N. Y., correspondent; M. J. Lyons, of Brooklyn, N. Y., treasurer, and Enoch Remick, of Philadelphia, financial secretary. The one hundred and seventy-three delegates represented one thousand three hundred and fifty-nine members.

The convention of 1887 was prolific of good to the master plumbers of the country. A brief abstract of the actual work of national importance accomplished by that convention shows that the association committed itself to the following points: First. The establishment of trade schools. Second. A uniform series of regulations concerning apprentices. Third. The recognition, by the manufacturers of all plumbers' materials, of plumbers as dealers. Fourth. The appointment of a grand secretary. Fifth. That contracts for plumbing work should be made direct with the owner or architect. Sixth. Endorsing the "Battle for the boys," by the New York association. Seventh. Endorsing the declaration of principles of the National association of builders. Eighth. Requiring state vice presidents to keep a record of violations of the Baltimore resolutions. Ninth. The allegiance of the Manufacturers' association of metalworkers to the Baltimore resolutions.

The endorsement of the New York trade schools was brought about by the reading of an essay, carefully prepared by the New York association. It detailed the influence for good which their trade school had had upon the plumbing apprentices, and, by motion of A. Young, of Chicago, the present administration was charged with the duty of carrying out the idea of manual training, so far as possible, in every city. The new rules adopted for the government of apprentices, while not, and could not be binding on any plumber, still the adoption of a national idea might assist in the return to some kind of an apprenticeship system which this country needs so badly. The Baltimore resolutions were endorsed in two instances. The denomination of all plumbers as dealers was a declaration of position which manufacturers need to be apprised of. But the chief victory of the adherents to the Baltimore idea was in securing the adherence of the National association of manufacturers of metalworkers to the resolutions. Though the manufacturers' committee asked to be allowed certain concessions, the plumbers' committee was firm, and absolutely refused to break the intent or spirit of the resolutions. The provision of a grand secretary with a salary, such as would allow the appointee to devote his entire time to the work, was a step rendered necessary by the demands of the National organization. The growth of the association was feeble. The first convention had one hundred and twenty-five delegates. Five years later, there were but one hundred and sixty-five, an increase entirely too small. Several organizations faded out after a brief existence, because they were unable to see any good in continuing. Other associations maintained a very slight affiliation with the National association, because they did not receive the aid from it which they were led to expect. In other towns of good size, no organizations existed. The convention, in committing itself against the practice of subcontracting, put itself on record in a direction where other bodies took the initiative. Architects' associations recognized the injustice done to the plumbing trade in not permitting it to be dealt with at first hands. The association, in endorsing the well-known code of principles adopted by the National association of builders, and by many local organizations, set their face in a common direction with other employers. The personal independence of the man to work or not to work, to employ or not to employ, won recognition from all employers.

The system of apprenticeship was treated very ably in the *Sanitary News* of May, 1887. The writer considered the relations of the employer, the apprentice and the journeyman to each other and of all of them to the public: "It is no more than justice that the interests of the employer should be considered first and paramount to the interests of the other three classes in this quartet. It is the brain of the master which has enabled him to gather about him an institution which will yield to him an income and furnish a means of support for his laborers. It is his ability as a manager which keeps him in the field against his competitors, and commands a fair return on the money which he has invested. If his interests are disastrously interfered with, not only he, as the head of the business, will suffer, but in a like degree will every man suffer, to whom he has been able to give employment. What are the considerations influencing him on the apprenticeship question, taking him as a business man, and irrespective of any philanthropic views individual employers may maintain? Perhaps the greatest desire he has is that apprentices shall be sufficient to keep the demand for men supplied, even if not over supplied. In the first case, with the demand for labor continually met, wages will probably not go any higher. In the second case, with an over supply of labor, the tendency of wages will be downward, and that is, to the employer, a gratifying tendency. At the same time he is anxious to see the price of labor go down, he is also anxious to see the skill and dexterity of the workmen go up, so that he can produce a greater quantity of goods at a price no greater than before. Between these two desires, skilled labor has always been able to maintain a pretty uniform price. It is also to the employer's advantage to see the quality of the product increase with a decrease of labor expended upon it. Taking all these considerations together, it should be the desire of the employer to see the number of apprentices increase. As to his relation to the apprentice, it is evident that he should, for his own good and for the apprentice's welfare, be something more than an employer to him. He is theoretically responsible for the boy's advancement in the art. It is to his interest that the boy's labor be made profitable as soon as possible. He is also interested in keeping up the standard of labor in order to guarantee the quality of his productions in the future. All these considerations point to the master, or employer, as the proper person to control the apprentices, and to decide how many he shall have in his employment. As to the fear that such a cause would lead to the substitution of boy labor for adult labor, it is not a well-grounded one. In trades where boys can perform labor equally as well as men, it is unjust to boys not to permit them to perform it, and in skilled labor it is impossible for a boy to compete with a man. It would not be a fair representation of the case, however, were we to leave out of consideration the dishonest employer, who, in order to cut under his competitor, will "scamp" his work and employ botch laborers. It would be idle to say that there are not slop-builders and skin-plumbers, who have no moral responsibility at all, and who do not care whether there is an apprenticeship system or not, if they only be allowed the means to continue their miserable existence. But these do not influence the question much, and they will be obliged by trades unions to pay adequate wages generally.

"The interests of the apprentice are all bound up in the few years he shall work as such. His whole career as a workman depends on his acquitting himself ably while he is a learner. The circumstances of apprenticeship have changed greatly since the early days of skilled labor. No longer does the apprentice have to leave home and friends and become an inmate of a strange family. No longer do his parents have to pay a premium as a compensation for the knowledge he shall gain. He can live at home and can at any time draw wages commensurate with his usefulness to his employer. His lot is a hard one, as, under existing conditions, he has to work hard to obtain an adequate knowledge of the trade, because he has to work at a disadvantage. He is often no more than a helper to a journeyman and an almost unknown quantity to the master. If he learns his trade well, under existing circumstances, he is, indeed, a bright boy. An apprentice is entitled to some kind of an agreement with the master who employs him. The old indenture has long ago dropped out of use, but something should take its place. The term of apprenticeship should be fixed and enforced; it is a question though, if this term should be invariably applied to all alike. A bright and intelligent lad can easily accomplish in three years what it would take another five years to do, and it is unjust to require the three-year lad to toil out the remaining two years on the same basis as the duller boy. As the primary object of apprenticeship is to keep up the supply of skilled workmen, it is due the apprentices that they should receive all the instruction from master and journeymen which can be imparted to them.

"Here we have struck a class of men whose interests are mainly centered in the questions of wages and hours of labor. The journeyman desires the demand for his labor to be always good, and that wages shall always be high because of a scarcity of skilled workmen. To accomplish this he would restrict the number of apprentices, in order that boy-labor may not supplant him or prevent his own advancement. As regards the teaching of apprentices, it is manifestly unjust to expect journeymen to teach their trades to boys, knowing that the only compensation they will receive will be the knowledge that the boys may cheapen their own labor. If masters will not become responsible for the teaching of the boys, the journeymen should be paid for it. The journeyman has always jealously guarded his right to the control of the apprentices. In New York, the plumbing trade has just witnessed an unprecedently long strike on this very point. Yet the moment the journeyman takes such a stand he becomes a monopolizer of labor and becomes a source of danger to the community and the cause of injustice to the boys who must learn skilled trades. It may be unfair for capitalists to ask for an unlimited number of apprentices, but it is just as unfair for journeymen to demand fewer than would adequately fill the demand for the labor of their hands.

"The public is only interested in seeing the quality of products kept up and the price kept down, and is therefore in sympathy with the apprentices. It is also interested in seeing that no trade is so overstocked as to keep skilled men out of employment. The great question is to provide a remedy for the alarming condition of affairs as we find it to-day. It is believed that the decline of the apprenticeship system caused, as it was, by the changed conditions of labor and the substitution of nothing to take its place, is responsible to a great degree for the demoralized condition of our labor to-day. Our goods are poor. Wages have a downward tendency. Strikes and lockouts unsettle business, and all of these complications could have been avoided by a better understanding of the conditions existing between the employer and the employed. What can be provided for an apprenticeship system? Let each trade, through its organizations of masters and journeymen, come together and formulate a plan of apprenticeship which will prove satisfactory to both sides. One system can not be applied to all trades. Each specific trade has its own specific conditions which will influence any plan of apprenticeship which may be brought forward."

The sixth convention was held at Boston in June, 1888, when several papers were read and the following named officers elected: John Trainor, of Baltimore, president; E. J. Hannan, of Washington, vice president; John J. Carey, of Baltimore, secretary; Enoch Remick, of Philadelphia, financial secretary; John J. Hamblin, of Chicago, treasurer; David J. Collins, of St. Louis, sergeant-at-arms. The state vice presidents were T. J. White, of Denver, Colo.: George S. Arnold, of Hartford, Conn.; John Mitchell, of Washington, D. C.; Robert Griffith, of Chicago, Ill.; George Kendall, of Clinton, Iowa; James Foley, of Leavenworth, Kas.; Simon Shulhafer, of Louisville, Ky.; J. C. Mitchell, of Baltimore, Md.; Thomas J. Tute, of Boston, Mass.: J. J. Dunnigan, of St. Paul, Minn.; Henry Goss, of Kansas City, Mo.; M. B. Hussey, of Omaha, Neb.; D. W. Littell, of Jersey City, N. J.; W. G. Reid, of Rochester, N. Y.; Mr. Snyder, of Cleveland, Ohio: William M. Wright, of Philadelphia, Penn.: William L. Whipple, of Providence, R. I.; T. J. Mooney, of Nashville, Tenn.; W. E. Foster, of Norfolk, Va., and George S. Lyon, of Milwaukee, Wis.

In November, 1888, the association issued a circular letter giving the Baltimore resolutions and amendments thereto, up to July 1, 1888, and pointing out the conditions under which material men and master plumbers should do business. The additions to the original resolutions:

> Resolved, that it is not the intention of the said resolutions to prevent the interchange of patented or any other plumbing material between manufacturers and wholesale dealers in such goods, or for the export trade, and that the interpretation of the Baltimore resolutions be left in the hands of the executive committee with power; and that it is our fixed intention to adhere to the line of action already pursued in regard to "protection of the trade," and that we relax no honorable effort to relieve our business from unjust and discreditable competition on the part of manufacturing and supply houses.

The paper by J. J. Wade, entitled "How to promote the unity of the associations; what benefits are derived from the National association and upon what does the security of the Local and National associations depend," was delivered before the Boston convention in 1888. The reader says: "In starting out on this my chosen theme, I would presume to invite you, gentlemen of this association, to take with me a journey through the past. We must trace the furrows left on the sands of time and mark each succeeding step as it advances toward its goal, if we would become thoroughly familiar with the benefits derived from national organization. History attests that even from the earliest stages of civilization, the principle of unity was commensurate with progression, and hence we read of national synods held in the first eras of the world's history. In fact, the ancients considered the foremost step to be taken toward securing the unity of the people, was the consolidation of power, and so we have the grand tribunals of these remote periods coming down to us through the centuries as models of perfect government. Ever since the time of the Cæsars, wise soothsayers have employed their wits in recommending requisite modes of government for the different nations; new ideas have been promulgated, old ones stricken out, so that at present, only the most approved methods are in existence. Take our own grand republic and its glorious founder, before whom the crowned heads of Europe were forced to bow, and on examination you will find that prominent among the causes that led to his rapid progression was the centralization of power, and even the minor organizations that from time to time spring up among men are regulated by this system, and with what success you are well aware. Unity, then, is the base of all associations that have as their aim the good of their fellow creatures, as well as the elevation of its members in their particular sphere of life. May I state as an example of our own organization—the Master Plumbers' association of the United States—to prove to you that 'in union there is strength?' My pride exults at the prosperity of our brilliant, though short career, where no stain of dissention has sullied the pages of a history of incessant activity.

"Six years ago what was this organization? A myth you may say, but it was hardly that, for the dream of such an organization was harbored in the minds of many of our present members. In the hearts of our founders there was nurtured a hope that was destined to burst forth into a flame of determination that spread throughout the union and enkindled in

THE MONTAUK BLOCK.

COMMERCIAL ARCHITECTURE. ROMANESQUE ORNAMENT.

the hearts of the master plumbers of this country a desire to be up and doing, a desire to free themselves from the bonds of slavery, and the indignities that were heaped upon them through a series of impositions which seemed to threaten our very existence except as members of an inferior trade. At this crisis a call was made at the instigation of a noble few, who felt that by promoting kindly relations among the master plumbers they would combine their efforts to protect the trade against injustice and encroachments upon their common rights and interests. That their efforts have not been made in vain you can clearly see. With our worthy men from the great metropolis, surrounded by an army of 'fighters' from all larger cities, could we do aught but succeed? To the New York men, however, belong the honor of having established this association, which has spread throughout the United States. At the first convention learned legislators were found who applied to our new organization the collected wisdom of experience, and framed a constitution in which unity was the predominant feature. Too much praise can not be given those men who fought so earnestly in the interests of the trade we represent. Permit me to conjecture, however, that they are rewarded with the gratitude of every master plumber in this country, and posterity will reciprocate in the sentiments which, for want of eloquence, must now remain untold. Since their retirement from office others have risen up to aid the impetus given by them, and hence follow the names of Scott, Young, Allison and Byrne, who have all proved themselves men equally upright, honorable and sincere. Five years ago we 'little knew' of the intelligence that was centered in the followers of our trade; we were so unfriendly that we 'cared less,' and hence it was that two-thirds of our fellow-tradesmen residents in our own city were unknown to us. Among those with whom we were acquainted there prevailed a sentiment of jealousy, envy and narrow-mindedness. So far from enlarging our acquaintance to encourage friendly feelings among the plumbers of other cities, our selfishness was such that it would not permit us to entertain for a moment such odious connections and so we moved along in the same groove of antagonism.

"On June 28, 1883, indeed marked a grand epoch in the history of the plumbing fraternity of this country. In responding to that national call we became alive to the fact that we had a mission to perform, an end to attain, and it immediately became our object to make friends of those whom we regarded with scorn, and associates of those whom we considered our enemies, so as to work together in a common cause. Who among us have regretted this movement? Not one, I can safely say. Through organization we have accomplished work that would be utterly impossible for individual or even local effort to perform. We have grappled with the enemies of our trade and they now lie slain by their pet desires. Think of our victory over the manufacturers; think of the victories gained by the Baltimore resolutions; think of how public opinion has become elevated and then you will know what benefits are derived from national organization. Local organization has played its part, and has worked wonders for the home interests, but through national, concerted influence alone, we have raised up an impregnable wall which commands admiration and defies attack. Since all this has been accomplished satisfactorily and well, may we not anticipate great successes for the future?

"We have a number of questions on hand that require the concurrence of the national organization to make firm and binding. These questions should be agitated at our convention, and then, by becoming familiar with the views of all the members, our deeds may be sanctioned by the voices of all speaking through our president. Agitation on the subjects that affect the prosperity of our trade is essential to stimulate the interest now taken by our members, for it is this alone that will build up a foundation for our society on which its security must depend. A code of laws regulating the kind of material and how it is to be used in a building, would not be amiss as a topic for the National organization. This is a subject that receives much attention from the public, and as one of our principal aims is to educate the public at large, why not debate on this one, that possesses special interest for them. If it is not practicable, why is it not so? And if it is, establish it among the members of our association. Then, oftentimes, labor questions arise in our midst that need the conjoined effort of the National organization for their suppression or settlement. By this, however, I do not wish you to infer that all the little difficulties that the local associations encounter should be referred to the National organization. We must understand that our executive officers are all business men, who, should they be ever so willing, could not justifiably sacrifice their precious time and leave their business to attend to these matters. Not being salaried officers it would be unreasonable to expect them to leave all their callings to gratify the whims of any local society. But in questions of weight that effect all local organizations, we think it but right and proper to lay the grievances at the feet of our National organization to receive its advice and be guided by its dictates. Our apprentice system is a question of national importance. Alas, it seems as if it were doomed to be talked and written about without ever coming to any definite settlement. The subject of trade schools, I am afraid, seems 'too far beyond' for comment now, so we will pass to another question of national importance, and that is the best mode 'for providing wholesome plumbing and sewerage systems for the people of our realm.' We must so master our work as to make it impossible to be held accountable for any of the dire maladies that afflict our populace, for we wish to become 'masters' worthy of the title and all that it signifies. We must, through our National organization, encourage state legislation and insist on sanitary laws."

At the convention of February, 1889, Andrew Young reviewed the work accomplished by the association. His paper was statistical as well as historical. It is well worth study.

He said: "In the brief time before us we may only glean of the harvest of good results arising from the organization of the National Association of Master Plumbers of the United States. Previous to 1883 the plumber was looked upon as a necessary evil, and a fit subject for the cheap wit of every scribbler; nor were the lashings we received undeserved, for our actions toward one another was but the natural result of the promptings of jealousy and envy. A literature of plumbing we had none, while our business relations with our manufacturers and dealers were as dishonorable as degrading. Such was the condition of the trade at that time—aimless, purposeless and apathetic. A meeting was held in the city of New York in June, 1883, when the National association was organized, and the following adopted as the aim and purpose of the association: 'The association is organized for sanitary, commercial and social purposes, and has for its special objects the advancement of the trade in all the latest discoveries of science appertaining to sanitary laws; to promote and combine the intelligence and influence of members for the protection of the trade against imposition, injustice, or enroachment upon our common rights and interests, encouraging inventions and improvements in sanitary appliances, fostering an interchange of thought, and eliciting and communicating for the benefit of each member, the last talent and the result of the experience and ability of all; to promote amicable relations with employes on the basis of mutual interest and equitable justice to both journeyman and master plumber; to encourage national and state legislation for the furtherance of the interests of sanitary laws; to secure for the members of the trade equitable treatment in their dealings with manufacturers and dealers in supplies; to regulate the system of apprenticeship and employment, so as to prevent, so far as practicable, the evils growing out of deficient training in the responsible duties of selecting, arranging, and the fitting up of materials relating to the hydraulic and sanitary conditions of dwellings, public and private institutions; to create and maintain a sanitary code at as high a standard as the progress of science, chemical, philosophical and mechanical knowledge teaches, and we are to carry forward, with tireless zeal, the great work to which the above language relates.' At this meeting a work was begun that has placed the plumbing trade of to-day foremost among the industrial arts. Committees were appointed on apprenticeship, sanitary matters and legislation, and an essay committee assigned subjects to the different associations for presentation and discussion at the following meetings.

"The second convention was held in the city of Baltimore, June, 1884, twenty-seven cities being represented, a gain of six over the previous year. At this meeting a term of apprenticeship was presented and since adopted; legislation was asked for the District of Columbia, and during the session our members of congress were asked to further such legislation, and their prompt response to our requests filled us with encouragement. At the meeting Philadelphia stepped forward with the first manual training school in operation under the care of the association. The essays read at this meeting were meritorious in the thorough and practical manner in which the different subjects were handled, and, after an harmonious session, the convention adjourned to meet in your city in June, 1885. This was a meeting memorable in our history for the princely hospitalities showered upon us by the local association and your citizens. At this convention thirty cities were represented. Succeeding conventions have been held at Chicago, Deer Park, and Boston. These meetings have stimulated us to renewed effort, nor have our efforts failed. Many of the states have enacted laws framed by us in the interest of the public health, and to-day there are but few cities without ordinances governing the manner in which our work shall be done, and requiring special qualifications by the persons doing such work.

"In other directions our labors have met with pronounced success. Manual-training schools have been established, libraries collected, to which our men and apprentices have access, while journals devoted to sanitary science have been established and maintained in many of our cities. But let us look for a moment at the duty of the citizen and the duty of the state. Experience proves that disease is a costly burden upon a community. The neglect of the municipality to provide efficient sanitary regulations is murder by the municipality. Had intelligent quarantine precautions been rigidly enforced, New Orleans would have been saved from the yellow-fever epidemic of 1878. There might have been lost $1,500,000 of trade; their omission entailed a needless waste of $11,500,000, enough money to have given them a sewerage and water system adapted to their needs.

"The smallpox epidemic in Philadelphia, in 1870 and 1872, during which there were twenty thousand cases and over four thousand deaths, entailed a loss upon the community of over $21,000,000. As eighty-five of every hundred of these twenty thousand cases and ninety-five per centum of these deaths, representing four thousand sacrificed lives, were preventable, we may thus sum up the account that an expenditure of $20,000 for purposes of prevention would have resulted in a saving to the city of Philadelphia of millions of dollars. It is within a very few years that the state has seemed to realize the fact that it pays to protect the health and lives of the producer. Sir James Paget says that the value of a child's life in England is, in money, £200; that is costs an average of £500 to raise a child to the age when it becomes a producer. Its death at the beginning of the production age is, therefore, so much lost. Dr. Farr, the eminent British sanitarian, estimates the value of an adult's life to the state at £750, and its annual productive value to the state as £95.

"In the United States, the number of deaths, annually, of the productive age, is four hundred thousand. Further, every death represents two years of sickness throughout the community. Therefore, there are in the United States one million, five hundred thousand persons sick constantly. In England and Wales it has been found that the average of sickness among the working class is a week and a half per year for each individual. The same supervision of sanitary matters which reduce the mortality rate will reduce the death rate. The recognition of these facts by nations and by individuals has created a new science-preventive medicine, and it clothes with a new and peculiar dignity the laborer in every department of social and professional life, who intelligently strives in whatever he does to elevate the physical development aud well being of the community.

"The future great city of our continent is yet unknown. I see in the near future such a city; its streets models of cleanliness, its sewerage system up to every need, a plenteous supply of unpolluted water to every inhabitant, its garbage removed, its streets and alleys cleaned, its sewers flushed during the midnight hours, its avenues shaded and cooled in summer by trees, whose properties are health-giving; its parks and driveways made pleasing and beautiful by the hand of man; the face of nature changed to meet the wants and needs of its inhabitants, its public buildings under vigilant supervision—models for the world. Such a city would be the magnet to draw to its bosom the wealth and culture of the nations. Its highways graced by iustitutions dedicated to the arts and sciences, on its fair brow the learning of a continent would find a fitting home. What of the picture? This is no ignis-fatuus, no illusive shadow; it is a prize within your grasp. Ask yourselves the question, are you equal to the occasion? And if you answer aright, your names will be honored by posterity, as benefactors of the human race."

The seventh annual convention was held at Pittsburgh, Penn., in June, 1889. The Chicago delegates were A. W. Murray, Patrick Sanders, Hugh Watt, Michael Ryan, William Bowden, Andrew Young, David Bain, Robert Griffith, Matthew Mandable, Michael Riley, C. J. Brooks, Charles Bryer, P. J. Laughlin, G. A. Larsen, P. L. O'Hara and D. J. Rock. There were present one hundred and ninety-five delegates, representing fifty-three cities and towns and twenty-eight states. A lengthy report on the apprenticeship question; a paper on "Pure water for country houses," and one on "Motors for raising water," were presented. The following officers were then elected for the ensuing year: Edward J. Hannan, president, Washington; Robert Griffith, vice president, Chicago, Ill.; George A. Green, corresponding and recording secretary, Washington, D. C.; Jeremiah Sheehan, treasurer, St. Louis; Enoch Remick, financial secretary, Philadelphia; Messrs. Scott, New York; Lewis, Brooklyn; Murphy, Milwaukee; Geiger, Buffalo, and Finnerty, Boston, executive committee. The state vice presidents were L. E. Furman, California; T. J. Morgan, Colorado; L. H. Mills, Connecticut; Edward Caverly, District of Columbia; William Clark, Florida; William Rothrock, Maryland; Michael H. Riley, Illinois; James Madden, Indiana; Alfred Gothrock, Delaware; Hugh F. Hogan, Iowa; G. J. Bransfield, Kansas; Simon Shulhafer, Kentucky; G. M. Werner, Maine; Daniel Shannon, Massachusetts; Edward Sterner, Michigan; J. T. Holmes, Minnesota; F. J. Busley, Missouri; L. E. Littell, New Jersey; N. B. Hussey, Nebraska; T. W. Desnoyers, Ohio; John A. Kramer, Pennsylvania; W. J. Reid, New York; W. M. Whipple, Rhode Island; R. S. Long, South Carolina; G. J. Mooney, Tennessee; William E. Foster, Virginia; P. L. Lyons, Vermont; William E. Goodman, Wisconsin, and John S. Trimble, West Virginia.

Among the important reports presented to the convention (1889) was the following: "Your apprenticeship committee respectfully report that, at the request of the apprenticeship committee of the International Association of Journeymen Plumbers, on April 16, they held a conference with the above-named committee, which was pleasant and harmonious, the result being an expressed desire on the part of the Journeymen's association to aid the National Association of Master Plumbers in seeing that the boys so get their trades that when they become journeymen they will be creditable not only to themselves but their instructors. The apprenticeship committee (which is the legislative committee, a standing committee to whom the subject was referred) of the National Association of Builders, taking as a groundwork the system as reported by a former apprentice committee of this national body, have formulated a plan which will apply to apprentices in all trades, and believing that such a uniform system is desirable, we submit it as part of our report, and recommend it for approval by this body. The legislative committee have thoroughly reviewed the method approved at the last convention, to take the place of the old system of apprenticeship, and recommend a slight change of wording in the second clause, and an important change in the third clause. They herewith present the whole method as they recommend its modification, the changes proposed being inclosed in brackets. Method approved by the National Association of Builders to establish the right of any person to be known as a regular journeyman in the building trades:

"The serving of a regular course of instruction in a mechanical trade school, and graduating therefrom with a certificate of proficiency granted by the same, under rules and regulations approved by a committee of master mechanics, who may unite in the management of said school. [The preliminary training in the trade school to be followed by] a term of practice with an employer on actual work, this term to be at least one year less than the usual term of apprenticeship by virtue of the holding of a certificate of proficiency granted by a mechanical trade school; during this term of service the young man to be known as 'junior.' [Finally], completion of the education of the mechanic to be acknowledged [after a proper examination has been passed before a board of examiners appointed for the purpose by the association of builders to which the employer may belong, or to whom the junior may apply for examination], by the issuance of a certificate by the said association, which shall state that the holder has passed through the prescribed course at the trade school, and the term of practice with an employer (name and location given) with satisfaction and credit, and is entitled to be received by all builders as a journeyman. [Any young man who has received the 'certificate of proficiency' from the trade school may apply for the second examination before the board of examiners, and, if adjudged by them to be old enough, strong enough, and competent, may receive a special certificate, which shall state the facts in the case.]

"The committee also recommend that this method of the National association be persistently agitated, and that a special committee be appointed to have the matter in charge." This was signed by Marc Eidlitz, William Harkness, Jr., and E. L. Bartlett, committee.

"In conjunction with the above, we submit as part of our report the admirable paper on trade schools, which was prepared and read by Col. R. T. Auchmuty, at the last convention of National Builders, for the reason that it deals directly with and seems to solve the great problem of 'What shall we do with our boys?' To which were appended the names of John J. Weaver, William Harkness, Jr., William H. Doyle, apprenticeship committee."

The eighth annual convention assembled at Denver, Colo., in June 1890. The delegates from Chicago were Hugh Watt, Robert Griffith, David Whiteford, J. H. De Veney, William H. Rielly, C. J. Herbert, William Bowden, J. D. Roche, J. R. Alcock, James J. Byrnes, C. C. Boyer, D. J. Rock, Andrew Young, W. F. Gray, J. J. Hamblin, J. G. Webber, J. P. Kalleen. Robert Griffith, of Chicago, was elected president; Joseph A. Macdonald, of New York, vice president; Joseph R. Alcock, secretary; M. J. Lyons, treasurer; J. J. Hamblin, financial secretary, and David Whiteford, vice president for Illinois. The question of the exhibit of plumbing materials and work at the World's Fair was considered, and Cincinnati named as the convention city of 1891.

On June 12, 1890, James A. Lynch, William H. Graham and Thomas Cantwell, members of the apprenticeship committee of the National association, presented the following report: "The apprenticeship question of to-day is one of the most important that we have to discuss at our annual conventions. What the foundation is to the building, what seed grain is to the farmer, the apprentice is to the plumbing profession. The trade has in the past employed boys to learn the business without regard to their mechanical ability or tastes. The result has been that fifty per cent. of them quit or were laid off in one or two years, being entirely unfit for the trade, and only twenty-five per cent. of the total number of boys became first-class plumbers. We must put better material into our shops in the future if we expect to make perfect plumbers. A few years ago apprentices in England and other European countries were required to serve seven years, and then often had to pay for the privilege. When they got through they were finished mechanics, if not artists. Many of them coming to this country could shape anything out of lead. The average time for an apprentice in this country has been five years. Very often boys break through their obligations and quit work, and proclaim to those who employed them that they are journeymen. It does not take long to prove their assertion false, and the result is provoking and expensive, as it frequently happens that they are put on first-class work which has to be done over. And the trade unions allow these men to select the task or grade of work for themselves, without any regard for their experience or ability, which is a great imposition and outrage on the business. We all have this experience sooner or later. Boys become restless as the end of their apprenticeship approaches and often demand wages they are not entitled to. They become filled with a sense of their own importance and give a great deal of trouble, often acquiring expensive habits which their limited wages will not keep up.

"A case of this kind came up in St. Louis. A boy quit work, and after several weeks' wandering found a man who wanted a plumber. He hired as a journeyman, but after a short time his employer told him he was not a journeyman. The young man acknowledged he was not, and admitted the deception. His employer then made arrangements to employ him a year under instructions at a small advance over his former wages, and the boy went to work for him. His former employer had some circulars printed informing the members of the organization that this boy had not finished his apprenticeship as agreed, and also referring to an article in the by-laws which prohibited any member from employing an apprentice who worked with another member without his consent. The young man was laid off, and could not get work in any first-class shop in the city. He could go back and finish his apprenticeship, but he got stubborn and refused to do so. He tried to get work under an assumed name, and did get some work in a few small shops, but finally had to leave the city. He brought suit for $5,000 damage, which was demurred to and the demurrer sustained. Then he amended his petition and sued for $2,500, and his employer set up a demurrer to that also, and it was sustained. The boy's attorney then took it to the Court of Appeals, where they ordered the case to go to trial. In the meantime the judge who sustained the demurrer on the two occasions failed to be re-elected, and a new judge tried the case. Both parties fought the case zealously, but there was a good common jury trying the case, and they gave a verdict against the apprentice and in favor of the employer. Then the Knights of Labor and other labor organizations raised a howl, claiming to have elected the judge, and that he had made pledges and promises to them. They were furious because the boy lost the case, and were going to have a special law passed in Jefferson City protecting workingmen, etc. The boy's attorney applied for a new trial, and after two months' waiting the judge granted it on the sole ground that the verdict was not in accordance with the evidence. The employer then took a change of venue, declaring he could not get justice in that court; that he had fairly won the case, and it should have gone up to the higher court on its merits. It was assigned to an associate judge of the one before whom it had been tried, who was elected on the same ticket and indorsed by the labor party. This time ten of the twelve jurors were young men, employes, and when they were sworn in we knew the case was lost. The case was discussed by them for two days, and they finally brought in a verdict for the boy for a portion of the amount claimed.

"The case was appealed. The Court of Appeals confirmed the verdict on the ground that the boy was not indentured according to the law of the state of Missouri, which says that an apprentice must be taken before the Probate court, accompanied by his parents or guardian, and two witnesses, and have a notary certify the papers. It was proved that five years was the customary time for a boy to serve at the business learning the trade. The court ruled that when there was a written law governing the case custom could not prevail. The boy had been well treated, was paid his wages promptly and had no other ground for complaint, but that he was not legally apprenticed. An effort was made to take the case to the Supreme court on constitutional grounds, but the amount sued for limited it to the Court of Appeals. This was the first case of the kind ever tried in the state of Missouri, and it was commented on by the daily press as a case of great interest to employer and employe. The lesson learned is to take no apprentice unless properly protected by papers. No employer wants to educate a boy, and then when he is able to do anything have him quit work, often when he needs his service most.

"What our trade wants as apprentices are young men about sixteen years of age, strong and sound, physically and mentally; boys who are not afraid of work. Reading, writing and arithmetic is all the education they need, with a decided taste for mechanics. If they have not this taste or talent, all the education in the universe will not make mechanics of them. Too much education unfits a boy for a trade. It makes him feel that work is degrading, and he wants some work that will not soil his hands. The trade schools are very popular in New York and Philadelphia. In about three months a boy gets his diploma, and can make a joint, bend a pipe in all sorts of shape and solder ends of lead together, all of which does not make a finished workman by a great deal. If a boy does not work in a shop in addition to the trade-school lessons, the result is only superficial and is only a veneering. The promiscuous education of boys without regard to their talents or tastes for mechanical pursuits is pernicious, and often ruinous to the boy's future. A boy whom nature intended for a minister or a merchant can never be made a mechanic. We are not in favor of short methods of education. They are not durable. Nature takes the usual time to perform her work, and it is done well. The earth takes the same time to perform its revolutions. The sun, the stars and the various planets revolve in their endless orbits, and have done so for thousands and thousands of years; they have no short route over which to travel; they go over the same old beaten path. What would the public think if Yale, Harvard or Princeton colleges were to announce that instead of four years' study as of old you could get all the degrees in three months under the direction and care of old experienced teachers! The people would be astonished, and would think it impossible. Does our trade-school enthusiast think to overcome the laws of nature by cramming into a boy's brain in three months what it usually takes as many years to accomplish? We admit that as preliminary training for a boy before going to learn his trade it is splendid, but of itself alone it will do much harm. 'A little learning is a dangerous thing.' Euclid, the world-renowned mathematician, was asked by the king to reveal his knowledge to his son, without the drudgery of the labor of years' studying to acquire it. The king offered him a large sum of money if he would comply with his request. Euclid said, 'Sire, I would do so with pleasure were it not impossible. There is no royal road to knowledge. Your son must study and learn like all the other boys in your dominion.'

"The same great truth holds good to-day. Look at our successful men in their various pursuits. They were poor boys, who, by untiring exertions, won fame and fortune. Ericsson, Edison, Morse, Carnegie, Fulton and Stephenson—we want a few boys like these in the plumbing business to elevate it and ennoble it. Andrew Carnegie says he began in an office using a broom. All boys should begin low and aim high, avoid gambling, drink and other bad habits, and an industrious, persevering boy with good habits can and does work his way to the head of his profession. Your committee recommends the trade-schools in connection with actual work as an apprentice in a plumbing shop; experience in the shop and technical instruction in the training school, combined, will make a first-class mechanic of a boy; but trade-school instruction alone will fail to make a finished mechanic. We request every city and town where there is a plumbers' association to establish and maintain a trade school in connection with their shops, where their apprentices can be instructed in the science of the trade, one or two evenings a week, by a committee appointed for that purpose, and to establish a readingroom in the same building, if possible. In this way the trade will be kept in its proper channel, and diplomas given by veterans in the business to finished plumbers only."

The ninth National convention of plumbers assembled at Cincinnati, Ohio, in June, 1891, when the following-named officers were elected: Joseph A. Macdonald, of New York, president; Jeremiah Sheehan, of St. Louis, vice president; M. J. McDermott, of New York, recording secretary; W. E. Goodman, of Milwaukee, treasurer; Thomas J. Tute, of Boston, financial secretary. Executive committee—John Trainor, Baltimore; William McCoach, Philadelphia; C. J. Prescott, Topeka; W. J. Freaney, St. Paul; J. A. Harris, Sioux City, Iowa. Legislative committee—James Madden, Ft. Wayne, Ind.: Alexander Crawford, Evansville, Ind.; Charles Anaeshensell, Indianapolis, Ind.; Peter J. Gall, Indianapolis, Ind.; James Healey, Indianapolis, Ind. State vice presidents—Colorado, Joseph P. Ratican, Denver; District of Columbia, Donald S. Williamson, Washington; California, E. L. Burgoin, Los Angeles; Rhode Island, George R. Phillips, Providence; Illinois, William Bowden, Chicago: Indiana, James H. Healey, Indianapolis; Iowa, J. H. Harris, Sioux City; Kansas, James Foley, Leavenworth; Maryland, D. N. Sullivan, Baltimore; Missouri, John F. Reardon, Baltimore: Massachusetts, Dennis A. Horgan, Boston; Nebraska, J. H. O'Neil; New

York, J. A. Creelman, Rochester; Ohio, D. M. Kelly, Columbus; Oregon, William Muirhead, Portland; Pennsylvania, B. F. Call, Pittsburgh; Tennessee, J. L. Park, Nashville; Texas, D. L. Sullivan, Dallas; Wisconsin, E. T. Doyan, Milwaukee; Utah, J. J. Farrell, Salt Lake City; West Virginia, C. H. Turner, Parkersburg; Virginia, W. E. Foster, Norfolk.

Secretary Alcock's report, a statistical review of the conventions since the first held at New York, was presented, and from it the following paragraphs are taken:

"Permit me to quote the record for the year preceding the one about to close. At our first convention held in New York the association throughout the United States was represented by one hundred and twenty-five delegates; and the enthusiasm enkindled by some of our stalwarts at that time has been kept up from time to time by accessions to our ranks. The second year of our meeting one hundred and fifty-four delegates were called together at Baltimore, and while perhaps some new faces appeared, they were always a credit to our association; some new ideas were brought out and acted upon. Our association had come to stay. Our fame traveled abroad; our proceedings were published throughout this broad land, and were copied and spread before the eyes of our brothers across the deep Atlantic. Our third year at St. Louis was one of no small consequence. We numbered in our convention some one hundred and fifty-one delegates, and although not so well represented as the year prior, still we were working on the same old line—protection. Then it was we saw the importance of our work and the power necessary to control it. The famous B. R. had been planted, and signs of growth began to appear; carefully were they guarded and watched lest some weed or thistle should appear, and to-day they stand forth like the gold dug from the mountain stream, pure and untarnished. At our fourth convention, held at Deer Park, we mustered to the number of one hundred and thirty-nine; no increase over former years, but still a good healthy showing. Our fifth convention was held in Chicago, and we find on our record delegates to the number of one hundred and sixty-six. Here we find an increase again. Fresh material, renewed and concentrated efforts, brought the abundant harvest. Our sixth convention, held in Boston, was largely attended, two hundred and twelve representatives being at that convention as delegates.

"At our seventh convention, held at Pittsburgh, we lost two in number, two hundred and ten delegates answering the roll call. Our eighth, although held at a point at the extreme western boundary of our circle, and consequently difficult for many to be present, was well attended, there being one hundred and eighty delegates present, and a right royal welcome did they receive. Our ninth and present convention, with the strenuous efforts of your officers and state vice presidents, we are able to count two hundred and two delegates, and an increase of twenty-one over last year, and more than at any other preceding convention during our existence with the exception of the Boston convention. The following is a list of the new associations formed during the past year: Butte City, Montana, certificate issued January 3, 1891, membership ten; president, Louis Eschle, 38 Broadway; secretary, J. Kreeger, West Granite street; members, H. T. Van Buskirk, R. B. Gould, Thomas A. Arthur, Charles W. Gould, John R. Colson, William J. Miller, Frank S. Davey, J. A. Hasley. Chattanooga, Tennessee, certificate issued February 4, 1891, membership six; president N. A. McQuade; secretary, Julius Tschapik; members, Fred Fox, R. Whigan, D. Carlin, J. J. Mack, W. W. Johnson. Evansville, Indiana, certificate issued February 25, 1891, membership six; president, Alexander Crawford; secretary, Charles Wahnseifler; members, Lambert and Grant, S. A. Bate, Paul Musmussime, Crawford Bros. Worcester, Massachusetts, certificate issued March 7, 1891, membership twenty-five; president, J. W. Jordean; secretary, George W. Knapp; other names not given. Odgen City, Utah, certificate of membership for nine issued March 12, 1891; president, M. Patten; secretary, George Halverson, box 202; members, Doyle & Halverson, A. W. Meek, W. W. Funge, James Macbeth, Lee Fitzman, Baltimore & Co., Thompson & Co., P. H. Bolfert & Co., other names not given. Madison, Wisconsin, certificate issued April 1, 1891, membership six; president, William Owen; secretary, Edwin Mason; other names not given. Los Angeles, California, certificate issued in 1891, membership nineteen; president, S. M. Perry, 519 Broadway; secretary, E. L. Burgoin; members, H. E. Dascont, A. A. Burnett; other names not given. Texas State association, certificate issued November 5, 1891, membership forty; president, F. J. Madden, Sherman, Sherman County; secretary, George Mummert, Dallas; members, David Kirkwood, Sanataronia; W. W. Otter, Houston, Texas. Seattle, Washington, certificate issued June 16, 1891, membership twenty-eight; president, D. B. Spillman; secretary, J. S. McClellan. Altoona, Pennsylvania, certificate issued April 1, 1891, membership twelve; president, George W. Stewart, 1000½ Eleventh avenue; secretary, George R. Stone, 1009 Fifteenth street. Helena, Montana, certificate issued September 25, 1891, membership six; president, John Sturrock, 22 Main street; secretary, B. L. Smith. Louisville, Kentucky, reorganized, membership twenty-one; president, M. J. Duffy; secretary, W. H. Matlack. Haverhill, Massachusetts, certificate issued October 30, 1891, membership eleven; president, Charles Le Bosquet; secretary, A. F. Sanders; members, A. W. Crawim, Harry Blake, Mark S. Holmer, George E. Smith, John Duncan, Jr., Harry Le Bosserse, Dennis X. Xoakley, W. F. Sawyer, N. W. Wilkinson. Charleston, South Carolina, certificate issued April 13, 1891, membership ten; president, W. F. Paddon; secretary, A. B. Riddick; members, A. J. Reilly, Oscar J. Miscally, J. S. Hyer, J. F. Tobin, J. J. Carey, C. W. Blake, J. S. Barton, J. J. Finnegan, John Hallis, William Welsh. San Francisco, California, certificate issued February 8, 1891, membership thirty; president, John Shephard; secretary, W. T. Bush, 34 Geary street. Oil City and vicinity, Pennsylvania, certificate issued May 21, 1891, membership twelve; president, H. S. Mark, Franklin; secretary, T. N. Chambers, Oil City. Mansfield, Ohio, certificate issued May 12, 1891, membership four; president, J. J. Tait; secretary, George H. Harris. Covington, Kentucky, certificate issued May 15, 1891, membership six; president, J. T. Underhill, 410 Scott street; secretary, F. J. Maser, 817 Madison avenue.

"Individual members—August 25, 1890, Barton A. Whitsett, Florence, Alabama; September 16, 1890, William Sofeliss, Woodbury, New Jersey; March 7, 1891, S. H. Bishop, Wahpeton, North Dakota; April 1, 1891, J. A. Monogan, Eureka Springs, Arkansas; June 8, 1891, J. H. Bradish, Batavia, New York; June 8, 1891, Edward O. Donoyhue, Ogdensburg, New York; J. C. Sullivan, Oswego, New York; M. B. Crawford, Oswego, New York; June 13, 1891, Cranlon & Gault, 130 California avenue, Oklahoma, Oklahoma Territory; Toledo, Ohio, certificate issued June 15, 1891; membership seven; president, John A. Wait, 419 Madison street; secretary, James P. Lock, 430 Summit street. Brocton, Massachusetts, certificate issued June 15, 1891, membership nine; president, Thomas J. Kinney, 24 East Elm street; secretary, Daniel Synah, 7 Perkons avenue.

"Besides the above new associations some have been reorganized and others strengthened and encouraged through personal efforts, so that at this convention we have a total addition to our National association of two hundred and sixty-eight members, making a great total in our organization at the present time of one thousand nine hundred and sixty-eight members. This record differs somewhat when compared with the financial secretary's books, where they show a per capita tax, paid for one thousand five hundred and sixty-four members for last year, while for this year we find that the per capita tax has been paid for one thousand nine hundred and eleven members, showing an increase over last year of three hundred and forty-seven members. During the past year nine hundred and eleven letters were written, eight hundred and thirty-two copies of letters sent out, making a total correspondence of one thousand seven hundred and forty-three letters."

The Ladies Auxiliary associations were represented by the following named members: Chicago—Mrs. J. Hamblin, Mrs. P. Sanders, Miss J. Sanders, Mrs. M. L. Mandable, Mrs. Andrew Young, Mrs. R. Griffith, Mrs. Alcock, Mrs. Charles Cavanah. St. Louis—Mrs. Morris, Mrs. M. Ward, Mrs. Moran, Mrs. Reardon, Mrs. Gerhart, Miss B. Norris. Pittsburgh—Mrs. B. F. Coll, Mrs. J. Rickets, Mrs. Bradshaw, Mrs. J. W. Tate, Miss E. Weldon, Mrs. James Hay, Miss Hay. Boston—Mrs. Lute, Mrs. Mitchell, Mrs. J. W. French. New York—Mrs. Miller, Mrs. Knight, Miss Knight. Baltimore—Mrs. J. Trainor. Bloomington—Miss Loudon. Louisville, Ky.—Mrs. Matlock, Mrs. Simon Shulhafer, Miss Ramsey. St. Joseph—Mrs. J. W. Powers. Rochester—Mrs. W. G. Reid, Mrs. J. A. Creelman. Pueblo—Mrs. W. J. Morgan.

The delegates, whose credentials were approved, represented twenty-four states and the District of Columbia. They are named in the following list: Altoona, Penn.—G. M. Stewart, president; David Wylie, Charles Wylie. Baltimore, Md.—Joseph Mitchell, president; John Trainor, W. H. Rothrock, George Knipp, D. J. Barry, V. H. Dunnett, D. N. Sullivan. Buffalo, N. Y.—Charles Geiger, president; L. P. Beyer, J. S. Stygall, Jr. Brooklyn, N. Y.—William J. Fitzpatrick, president; W. J. Gault, M. J. Lyons, George Cummings, Thomas H. Radcliffe, George B. Lewis, Martin Fallon, H. M. Noble, Thomas H. McWhiney, John Danaher, George Alfred Smith, Gos. Zoll, Thomas Donivan, John J. Keenan, W. E. Morgan, Patrick Dunn, Paul Gateson, O. O. Sawkins, W. Keegan, J. W. Kelly, J. M. McConnell, W. J. McCaw, W. J. Roche, R. J. Knox, E. McDonald, O. Marrin, M. J. Farrell. Burlington, Iowa—H. Ewinger. Bloomington, Ill.—Robert Loudon. Boston and vicinity—Thomas J. Tute, president; Daniel J. Shannon, W. H. Mitchell, W. U. McKenna, H. W. Tombs, J. W. French, C. W. Bromwich, D. A. Horgan, D. J. Finnerty, J. P. Conlon, George C. Forbes. Cincinnati, Ohio—Thomas Gibson, president; C. W. Murray, Thomas McNeil, J. R. Gibson, E. J. Nolan, W. J. Gibson, Fred Lampkin. Chicago, Ill.—J. J. Wade, chairman; D. J. Rock, T. C. Boyd, T. P. Culloton, M. L. Mandbale, A. Young, Paul Redske, W. Bowden, J. Weber, P. Sanders, J. Matthews, C. Byrnes, Thomas Kelly, J. J. Clark. Chattanooga, Tenn.—J. J. Mack, president; Fred Fox, Jr., R. Whigham. Cleveland, Ohio—Adam Schneider, president; W. H. Henderson, W. A. Kelly. Duluth, Minn.—W. W. Hooper. Davenport, Iowa—James Cameron. Dayton, Ohio—Charles Ware, F. J. McCormick. Evansville, Ind.—Alexander Crawford, president; Charles Wamsdell. Fort Wayne, Ind.—James Madden. Indianapolis, Ind.—Charles Aneshensell, president; P. J. Gaul, James Healey. Kansas City, Mo.—L. B. Cross, president; H. B. Farley, W. G. Ashdown, Alexander Gray. Kansas State.—C. J. Prescott, president; A. T. Buckridge, John Sheehan, James Foley, Robert Mood. Milwaukee, Wis.—P. H. Murphy, president; L. H. Plum, W. E. Goodman, L. Eggert, Charles Polachek. Nashville, Tenn.—David Glemar, president; J. L. Park. New Haven, Conn.—S. E. Dibble, president; A. J. Clerkin. Nebraska—J. H. O'Neill, president; N. B. Hussey. Seattle, Wash.—D. B. Spellman, president; W. B. French, Thomas Kearns, J. S. McLellan. Oil City, Penn.—Ray S. Clarke, president; William Moran. New York City, N. Y.—H. G. Gabay, president; George D. Scott, John Byrns, Joseph A. Macdonald, J. N. Knight, Frank Reynolds, William H. Quick, T. J. Toumey, T. J. Cummins, J. S. Dunn, C. H. Kranichfelt, T. Sullivan, M. J. McDermott, E. J. Brady, Joseph O'Brien, J. Gileroy, T. J. McCormack, Philip Smith, D. W. Littell, John Miller, O. McGinness, E. J. Connor, John M. Carron, J. A. Rossman, Charles Tucker, William Young. Rochester, N. Y.—W. G. Reid, president; George Hennegan, John A. Creelman, James J. Connor, James A. Tanner. Parkersburg, W. Va.—Charles H. Turner, president; William S. Caswell. Hamilton, Ohio.—J. L. Walker. Pueblo, Colo.—J. I. Morgan, president; J. H. Bennett. Portland, Ore.—Alexander Muirhead, president; A. Donnersberg, Robert Brady. Philadelphia, Penn.—William Harkness, William M. Coach, E. Remick, Frank P. Brown, John J. Weaver, George F. Uber, John E. Evanson. St. Joseph, Mo.—J. W. Powers, president; R. T. Connell. St. Louis, Mo.—Joseph P. Gallagher, president; James Lancaster, J. M. Lipe, Joseph Tumulty, P. H. Callahan, D. J. Collins, J. F. Reardon, M. J. Ward, William Morris, Jeremiah Sheehan, John McMahon, O. J. Gerhardt, Patrick Madden, E. P. Reardon, William Schwehr. St. Paul, Minn.—W. J. Freaney, J. T. Holmes. Sioux City, Iowa—J. A. Harris, president. Springfield, Mass.—J. W. Kennealy, president. Texas—F. J. Madden, president; A. H. Shafer, George Mummert, D. J. May, D. F. Sullivan. Washington, D. C.—James Ragan, president; E. J. Hannan, D. S. Williamson, J. I. Atchison, E. F. Brooks. Worcester, Mass.—John J. Jordan, president; J. F. Deedy. Salt Lake City, Utah—J. J. Farrell, president; H. S. James, B. M. Ellenbeck. Columbus, Ohio—D. H. Kelly, president; E. A. Futerer. Syracuse, N. Y.—W. N. Tobin, president; Charles G. Hanchett, M. J. Kennedy. Los Angeles, Cal.—S. M. Perry, president; H. A. Bennett, W. C. Furry, J. C. McMenomy. Pittsburgh, Penn.—Allen McFadden, president; F. P. Blythe, John M. Tate, James G. Weldon, I. R. Becker, James

Hay, John Cowley, B. F. Coll, S. W. Hare, J. J. Kennedy, R. J. Bradshaw, George Addy. Vincennes, Ind.—C. F. Munroe. Madison, Ind.—A. Anger. Louisville, Ky.—M. J. Duffy, president; Simon Shulhafer, John Stickler, W. H. Matlack. Covington, Ky.—W. S. Nock, J. T. Underhill. Denver, Colo.—Joseph P. Ratican, William McKelvey, M. McIntyre, T. J. Delaney, Archie Davis, John R. Parry. Bridgeport, Conn.—Gerhardt Drouve, Thomas E. Logan. Charleston, S. C.—W. P. Padden, president; J. A. Reilly, O. S. Miscally.

The receipt of a letter from Dr. O. C. De Wolf, of this city, conveyed to the delegates the estimation in which their trade is held by sanitarians. He said: "If I may judge from my own observation during the past fifteen years, I am justified in saying that no feature of sanitary science, or the application of scientific thought to the sanitary necessities of civilized communities, has passed along to so remarkable a development as that branch of the sanitary tree which your organization represents. By intelligent and logical methods you have advanced from the mere mechanic to a commanding position in sanitary science, and the scientific world recognizes and acknowledges your claim. No curriculum of medical study is now complete which does not take note of your work, and for the past three years I have sought to supplement my course of lectures on public hygiene at the Chicago Medical college by several lectures on plumbing and plumbing appliances, given by a distinguished ex-president of the National Master Plumbers' association. In view of my interest in this subject, you will not regard it as improper, I trust, if I suggest the propriety of your appointing a committee to wait upon the director general of the Columbian exposition to present the name of some fellow of your organization as chief of the bureau of plumbing exposition. This exposition should be made—as it can be made—of world-wide interest, and will be a subdivision of the general division of 'the liberal arts.' A place is provided for you—and you should fill it."

The address by Thomas Gibson, of the Cincinnati Plumbers' association; the welcome by Mayor Mosby, of that city, and the reply of President Griffith, point out as well as words may, the social disposition of the plumbers in beginning the serious work of a trade convention. A paragraph from Gibson's address is historical and comparative. He said: "In 1839, when I first came to Cincinnati from St. Louis to enter upon my apprenticeship, very few people knew what a plumber was, but since that time, even if not personally acquainted with a plumber, every one, by means of the alleged newspaper humorists, knows them by the size of their bills. There was a country church in Scotland whose minister was absent. The promised supply failed to put in his appearance, and as many of the members came from quite a distance, one of the elders undertook to conduct the service. He did very well in giving out the Psalms, in prayer, and in reading the chapter of Scripture, which was in the book of Job, when he said: 'My freens, I dinna ken what you think about this subject, but it's my candid opinion that atwixt God and the devil Job was a very ill-used mon.' I sometimes think that plumbers resemble Job in more ways than one. Every branch of the building trades is important; and preëminent among them all stands plumbing, contributing as it does to the comfort and health of the people at large. Physicians from all over the land hold their conventions and discuss matters pertaining to the advancement of their profession—the cure of diseases which have taken hold of man—and we commend them for it. Our business is to prevent these diseases the physicians cure, and certainly our deliberations must be of more importance and moment than theirs. For 'an ounce of prevention is worth a pound of cure.' The plumbers' business is becoming of more importance to the people at large every day. As property rises in value the owners are enabled to occupy the whole of their lots with buildings, owing to the great improvements in sanitary plumbing. It is in consequence of the advancement in our trade more than the progress made by other trades, that the erection of large and lofty buildings in our great cities is possible. Old London was but two stories high. You all have witnessed the wonders of our modern times."

The mayor of the city was facetious in his warm greeting. "It is a duty I owe to the master plumbers of this city and to the citizens to give you welcome," he said. "We are proud of our city and proud of our plumbers and their bills. The master plumbers will extend to you our city's hospitality, and I extend to you the freedom of our city. You will be taken care of in a manner due the important interests you represent. I am not a plumber, and do not know anything about your 'take-ins' and your 'wash-outs.' That is not my trade, but I suppose your 'take-in' is the man whom you do plumbing for, and your 'wash-out' represents the condition of his pocketbook after he has paid the bill. A few years ago plumbing was a mere trade and uncertain in its service, but now it is advanced to a science, requiring not only mechanical skill, but scientific knowledge. As I said, I am not a plumber, and do not want to get into your domain or I will get lost. I recognize the importance of your high calling and its relation to public comfort and health. I want you to see our city. You will be taken to our places of interest, and don't fail to see our suburbs, for we have the finest on God's green earth. Gentlemen, I give you the freedom of our city."

Great applause and three cheers followed the conclusion of the mayor's address. President Griffith, referring to the address, said he could assure the honorable mayor that he would not be taken in by the plumbers present, and that he would not find his pocketbook washed out. He also hoped that as the mayor had extended to them the freedom of the city, none of the plumbers would get pulled in. "This gavel," said the president, "will bear interpretation. The handle is made of a piece of wood, taken from the South Fork dam, which caused the disaster at Johnstown. It signifies caution, wisdom and prudence; that force is often destructive where gentler measures would be the means of accomplishing much good. There are subjects coming up for our consideration in which we must use wisdom and prudence, and not the destructive element of force. The flood at Johnstown did no good, but a vast amount of harm. It destroyed and nearly depopulated a city, and flowed on out into the sea, and was lost and forgotten, except in the sad remembrances it left behind. Let us be not like the flood, that sweeps everything in its path to destruction, but like the gentler tide, that flows through our plains and villages, giving health and strength to all about it. The head of the gavel came from the top of Pike's Peak, indicating that our aims should be high and our motives and purposes lofty. We are engaged in a high calling, and our motto should be onward and upward to the summit of our profession. There is also a signification in the source whence the gavel came. I want to use it with caution, prudence, wisdom and gentleness, on account of the source from which it came, for it was presented to me by the Ladies' Auxiliary association at Chicago."

The Chicago Master Plumbers' association dates back to 1884. From the beginning it was a success and replete with benefits to the municipality. The *Sanitary News* noticing its relation to the public and the National association, speaks enthusiastically of the local organization: "It is said that great questions of state, great enterprises, and great achievements have their origin at the family fireside. It is probably true that from the quiet of the home many great achievements have received their beginning which carried them through. The local association in its relation to the National association is the fireside, the hearthstone where there is the quiet and time necessary for the full contemplation of the best interests of the entire membership. Here is the opportunity for considerate discussion and thorough investigation of all questions that may arise. Regular meetings afford the best opportunities for a thorough consideration of all matters possible. Should a mistake be made at one meeting, another shortly held gives the opportunity for correcting it, and thus the question that come up affecting the general national interest, has the advantage of being well considered before it is carried up to the National convention or executive committee. It is the local association that is nearest the people, and in this regard it becomes the best teacher we can have. It is the association's duty to remove whatever prejudice may exist on the part of the public against the association of plumbers. There is a sentiment against them, and, however small, it would be better to remove it. Many do not understand the purpose of the Plumber's association, and look upon it as an effort to form a kind of combine to advance the prices of plumbing work to the injury of the people. There is no reason to doubt that if the objects of this association were fully known all opposition and prejudice would be removed. These have been measurably lessened in the past few years, and through the efforts of the master plumbers themselves. In nearly every case where their work has been made subject to regulations secured by ordinances, they have themselves been instrumental in securing such regulations. No one can deny that these regulations has been of direct benefit to the public. The plumbers have placed their work on a high plane in a business sense, and in a professional way have made it a strong agency in the promotion of health. All this has been to a large degree due to the efforts of local associations. It does not seem to need argument that every plumber belonging to an organization should be a member of the National association. It is through local associations largely that the National association is recruited. They stand between the National association and the outsiders, are nearer them, and have the first opportunity of showing to others the advantages of the association. These local associations should not depend alone on the state vice president as the recruiting officer, but should consider each member a committee to solicit membership. Building up local associations is the first step in adding to the National association. Harmony and good fellow-feeling in these associations will attract others to them.

THE ROOKERY.

The report of the committee on incorporation was made January 16, 1884, by Messrs. Sims, Clark and Tipple, and President Young, with Messrs. Boyd, Wade and Murray, the incorporators, reported receipt of the charter. The meeting of April 16, 1884, was occupied principally in discussing the plan for the erection of a new plumbers' hall. J. J. Wade reported that he had received the following subscriptions to stock: Abraham Mead, New York, $100; J. W. Birkett, Brooklyn, $100; E. Baggot, Chicago, $1,000; A. W. Murray, Chicago, $100; T. C. Boyd, Chicago, $100; Andrew Young, Chicago, $100; Peter Willems, Chicago, $100; D. & J. Hardin, Chicago, $50; J. H. Roche, Chicago, $100; M. Moylan, Chicago, $100; Foskett & Brown, Chicago, $100; S. J. McGraw, Chicago, $100; Patrick Harvey, Chicago, $200; V. Ruh, Chicago, $100; J. J. Wade, Chicago, $100; George Cummings, Brooklyn, $500; J. J. Hamblin, Chicago, $100; George D. Scott, New York, $100; M. Ryan & Bro., Chicago, $100; A. C. Hickey, Chicago, $500. J. J. Wade, in behalf of the committee, outlined a plan for the incorporation of the Chicago Master Plumbers' association, in order that they might have proper authority for the issuing of stock. The plan was adopted, and the following committee was authorized to proceed with the incorporation: J. J. Wade, E. Baggot, John Sanders, E. E. Brown, Martin Moylan, J. L. Pattison, Hugh Watt, Andrew Young, D. J. Rock and J. S. Bassett.

The committee on library reported that work was progressing in making the room ready, and that it was probable that it would be thrown open at the time of the next meeting. President Young announced that he had received a check of $250 from E. W. Blatchford, and one of $100 from J. N. Raymond, for the library fund. He stated that these gifts were accompanied by the best wishes of the donors for the prosperity of the association.

In June, 1884, the Chicago association elected the following named officers: Andrew Young, re-elected president; T. C. Boyd, D. Whiteford, Peter Willems, P. Havey and Martin Moylan, vice presidents; W. B. Oliphant, recorder; Frank Ruh, correspondent; J. J. Hamblin, financial secretary; A. W. Murray, assistant financial secretary; John Sanders, treasurer, and George Tipple, sergeant-at-arms. A presentation of a gold watch and chain was made to Andrew Young, and badges to Messrs. Stokes, Moylan and McGinley, retiring secretaries. The receipt of four bound volumes of the *Plumber's Trade Journal*, the first journal published in the United States in the exclusive interest of plumbers, was acknowledged.

In August, 1884, blank forms were issued to master plumbers, asking for particulars relating to apprentices. The system outlined is as follows: "The object is to put into practical working shape the system of apprenticeship which has been adopted by our association, and has been favorably regarded by the National Plumbers' association. The system, in brief, is: Each employer returns to the association a list of apprentices, or those working for him as such, with date of beginning as such with him, age of such apprentice, and place of residence. This is recorded in a separate book, apprentices' record, which is kept by the proper officer of the association, who issues a card back to the employer, to be retained by him so long as the apprentice is in his employ. When the apprentice ceases to work for him, he is to fill out such card with the date of his quitting and residence of apprentice, and return the same to the proper officer to be recorded. The apprentice receives a card from the association to which he is an apprentice, which card he retains as a voucher of his good standing. When the apprentice takes service with another boss, the blank or certificate is given to his new employer, to be filled in with the date of beginning with him, and so on, till the certificate shows that the proper time has been served." In September, 1884, the license committee reported that it had secured the adoption and enforcement of a new rule at the department of public works relative to the granting of plumber's licenses to applicants. Commissioner Cregier now required that any plumber who recommends another for a license must himself make affidavit that he knows the applicant to be a capable plumber.

In June, 1885, T. C. Boyd was elected president (vice Baggot, who refused renomination); Robert Griffith, Thomas Havey, Peter Willems, R. Coleman and William Bowden, vice presidents; James E. Beaver, recorder; J. J. Clark, correspondent; J. J. Hamblin, treasurer, and George Tipple, sergeant-at-arms.

In June, 1886, the president was re-elected; Martin Moylan, D. Bain and M. H. Reilly, took the places of Messrs. Havey, Willems and Coleman, as vice presidents; Joseph Alcock was elected secretary; George Tipple, correspondent; J. J. Hamblin, treasurer, and Patrick O'Hara, sergeant-at-arms. The deaths of M. M. Powers and W. H. Milne were reported, and the celebrated resolutions of May 25 approved. The preamble to the resolutions set forth that the Master Plumbers' association and the Journeymen Plumbers' and Gasfitters' unions have always been able to adjust all matters between themselves to the satisfaction and mutual benefit of each; that the Master Plumbers' association is steadfastly opposed to the introduction of other tradesmen or mechanics to exercise any control or business over the plunbing or gasfitting business. It was resolved that no member of said association will employ any plumber or gasfitter after Saturday, May 29, who recognizes his right to leave his employer at the dictation of steamfitters or other mechanics not part or parcel of the plumbing and gasfitting business.

In January, 1887, the following named officers were elected: Robert Griffith, president; J. J. Wade, William Sims, M. J. Reilly, Frank Ruh and William Wilson, vice presidents; J. R. Alcock, recording secretary; C. S. Wallace, corresponding secretary; J. J. Hamblin, treasurer; William Sims, financial secretary; P. L. O'Hara, sergeant-at-arms. For chairmen of committees: C. J. Brooks, sanitary committee; William Wilson, arbitration; Rupert Coleman, auditing committee; D. J. Rock, license committee; M. Ryan, legislative; David Whiteford, apprenticeship; J. S. Bassett, conference committee; George J. Stokes, library; Hugh Watt, warehouse committee; T. C. Boyd, exhibit. The report of progress shows one hundred and sixty-one members on January 1, 1887, against one hundred and forty members in June, 1886. Ex-president Boyd, in his address, stated that there were two hundred and fifty master plumbers then doing business in Chicago employing about twenty men each or five thousand men. He pointed out the power which five thousand voters could exercise not alone on the council but also on the legislature. The sanitary bill, as adopted by the Western Architects' association in 1885, was considered in its bearings on the construction and alteration of buildings and on the ventilation and sewerage rules. In January, 1888, the association elected Andrew Young, president; Peter Willems, Martin Moylan, P. Sanders, Daniel Rock, Michael Ryan and Frank E. Ruh, vice presidents; Joseph R. Alcock, recording and corresponding secretary; P. L. O'Hara, financial secretary; Hugh Watt, treasurer; George Webber, sergeant-at-arms; James H. Roche, P. Nacey, E. Baggot and J. J. Wade, board of directors. The report of the committee on apprenticeship was presented by D. Whiteford and the financial report by William Sims. This latter document showed that $10,166.79 were received in 1887, and $4,895.55 expended.

The election of January, 1889, resulted in the choice of A. W. Murray for president; Martin Moylan, Richard Graham, J. H. Roche, C. J. Brooks and M. L. Mandable, vice presidents; J. R. Alcock, secretary; Patrick Sanders, treasurer; J. J. Hamblin, financial secretary, and William Wilkie, sergeant-at-arms. The number of members in good standing was one hundred and fifty-five, the total revenue including balance $7,388.99, and total expenditure, $3,805.96.

In March, 1887, a paper by Richard Wood, on the relation of plumbing to the modern house, was read before the Architectural Sketch club. He states that "the absolute necessity of good plumbing in both dwelling houses and public buildings is second only in importance to the stability of the structure itself. Until very recently," he says, "it was customary to conceal so much of the plumbing work in wooden boxes in the plaster and flooring that its defects were not discovered or sought after until the result made its appearance in the shape of fevers and other sickness among the inmates, when the physician or other interested persons advised an inspection to be made. It has been complained of by plumbers that architects are too often induced to specify new fixtures, with which the market is continually flooded, and their numerous good qualities thoroughly demonstrated through the medium of innumerable testimonials and the plausible but not over truthful tongue of a drummer, and that they are frequently called upon to rectify and repair such of those that are defective in themselves, and for which the plumbing done in connection with them is in no way responsible. That such requests are unreasonable can not be denied, and it may be suggested that architects in specifying some newly advertised fixture should first of all ascertain its suitability for the purpose intended by consulting with a plumber, or some other person who can speak of its repute. The sewers from mains, which are of vitrified pipe, should never go beyond two feet outside of the building line, where the work of the sewer-builder should cease. Then extra heavy cast-iron pipe should be used, suspended to the joists, where there be no objection to its being seen; if there be, and it must be laid beneath the cellar floor, it should be laid in a trench made of brick and covered with stone or wood covers, so as to be very easy of access, and have handholes at each branch for cleaning purposes.

"Much danger might be averted if housekeepers of all classes could be led to believe that it is sometimes necessary to pay attention to the cleanliness of the plumbing fixtures in their houses, as they are invariably neglected until reminded of their presence in a not altogether desirable way. I refer more especially to the cleaning of sink traps and the flushing of water-closets, which fixtures ought to receive periodical attention. A trap under a sink, which could be readily cleaned, might be made of a shape which would make a cheap grease trap. The ordinary S-trap is an excellent one, and should always be placed as near the fixture as possible, and back vented from the crown; a brass union coupling, to connect it, is desirable, as it can be easily disconnected in case of stoppage of the vent, which often occurs. All back vents should be of lead, and it is a question open to discussion whether cast-iron pipes are preferable to wrought-iron for all purposes of plumbing. It is doubtful whether lead will become generally used for soil and waste pipes. The chief objection seems to be its cost and liability to be easily punctured, its difficulty of hanging and its expansion. A good but not very common practice is for architects to indicate on their plans the various runs of pipe, which should be so arranged as to be most direct, with as few bends and elbows as possible, to be well protected from injury and easy of access in case of accident, without having to tear down other work in the building.

"Soil, waste, and vent pipes should not continue more than one foot above the roof, and should increase in size at the top and be surrounded with wood casting as a protection, as the heads of these pipes are often to be seen covered with hoar frost in winter, which must prevent them from fulfilling their intended purposes. The soil and waste pipes should always have handholes with brass traps, screws at the bottom for cleaning, and safe-wastes which deliver over sinks, to have valves for the prevention of any disagreeable smell being conveyed to the upper floors. Where it is necessary to run lead pipe along the floor the cutting of the joists is often done, and the strips upon which the pipe is laid let into the joist their full length. A better, although a little more expensive way, is to let the board in between the joists, screwing them to strips nailed to their sides, thus preventing the cutting of joists deeper than is really necessary. These troughs are sometimes covered with lead and connected with waste pipes, but in case of a pipe bursting it would be difficult to avoid damage being done by the water; so if they are covered with abestus, or well packed with sawdust, the danger of being frozen is considerably lessened."

In January, 1888, Robert Griffith, the president for 1887, made his annual report. It was replete in facts, but its most noticeable section was that devoted to the treatment of the plumber. In concluding his reference to the value of organization he said: "It is now necessary that we should keep what we have fought for and gained, stand together and 'hold the fort,' that the enemy may not again take possession of it. But they say: 'Well, the people slander the plumber just as much as they ever did.' Yes, this is true, to some extent. They will point to all the diamonds in the jeweler's safe, and to all the prominent buildings in the city, and tell you that the plumber either owns them, or has a mortgage on them; and the funny newspaper man will show your picture in his paper on a cold morning, and tell his readers that this is the plumbers' harvest. Yes, and he will do this while sitting in his comfortable office, with his legs crossed, enjoying a highly-flavored cigar, while the plumber is going shivering along the street, to attend to some frozen pipe. When he arrives at the house to which his order calls him, he is met at the door with the common courtesy that his profession deserves: 'O! We couldn't wait for you, we had to get another plumber.' When you come to inquire into the matter, you find that the same order was left at two or three different plumbing shops, and the one who got there first had the honor of thawing out the frozen pipe. The other plumbers lose their men's time. But 'that don't count much, as you can always hire good men without giving them any wages, and you can keep a standing army of plumbers to attend to parties who do not intend to pay for anything that they can beat their way out of!' But what about the plumber who got there first and did the job? Well, in due time, he sent in his bill and was politely told he should take it to the landlord. It is of no use to say anything to the contrary, so the bill is taken to the landlord, who looks at it and reads: 'Thawing out water pipe, seventy-five cents.' He then asks: 'Who ordered you to do this work?' To which you reply: 'Why Mr. Stylishman, up at your house.' Then he tells you to take it back to Mr. Stylishman, saying: 'I don't know anything about it.' The bill is taken back, and Mr. Stylishman tells you that he will call and pay it himself in a few days; but he forgets all about it until you call again, and then he makes some other excuse, and puts you off a while longer. Of course the time of collecting this bill don't cost anything, so you call again but, alas! only to find that Mr. Stylishman has moved away from that house and has gone to parts unknown. This is the kind of people who talk most about the plumber, and this is often the kind of a harvest the plumber reaps in cold weather. But let the funny newspaper man and the professional beat talk and make fun for themselves to laugh at, for all fools must laugh at their own folly. It is not the honest, good-paying customer who ridicules the mechanic.

"Again, some of our members say that the master plumber is not treated as other professional men are. Well that is so in many cases; the master plumber seems to be more of a common servant for the public to call upon, than is the case with other professions. Take the doctor, for instance. He is called to visit a family, goes there, and is met at the door with: 'Good morning, doctor! I'm glad to see you. Step right into the parlor; let me take your hat,' and he is invited to the best chair that adorns the room. Now we don't object to this kind of treatment to a doctor; it is just what he deserves. But the master plumber is called to the same house, and is met with the familiar greeting to which he is accustomed: 'O! it's the plumber. Mary, show this man where the laundry is;' or, perhaps, to some other fixture that may chance to be out of order and is dealing out poison in large quantities, pure and unadulterated, for general use in the family.

"What is the difference in these two men? Are they not both men of importance? The one cures sickness, the other prevents sickness. Which is the more important of the two? But it is an old saying, 'Rome was not built in a day,' and you can not educate all the people in a day, but we expect to get there some time. You ask: 'How are you going to do it?' Why, by assuring your customer when you have an opportunity, that his interest is your interest, and that you are interested in the health of his family, and by being careful to practice just what you preach, and, by and by, you will see that the master plumber will stand upon the same level with other business men, and will receive the treatment that his profession deserves.

"And now, in conclusion, allow me to make a few suggestions that may be for our benefit. Be careful how you listen to reports you may hear about your brother members, and do not believe every foul-mouthed slander that some one may tell you about your fellow-craftsman; but have respect and esteem for one another. Bear no enmity against each other. If a member has wronged you in any way go and see him, talk the matter over with him, convince him of the wrong, and I will venture to say that you will heal the wound quicker by pouring on a little oil in this way than otherwise."

In March, 1888, J. J. Wade read a paper on the subject of "Problems before Chicago plumbers," from which the following is adopted:

"One of the principal objects of the Chicago Master Plumbers' association is to promote health and devise methods to furnish the populace with good plumbing, drainage and water supply. This feature of the work is consequently of great importance to the public, since with the freedom of a perfect constitution come happiness, peace and prosperity. A contrary effect, however, is produced where sanitary disorders exist, good health being dependent almost entirely on the sanitary condition of the city. Therefore, more clearly to demonstrate the truth of this assertion, take a survey of the sewerage system now used in Chicago and the work it is expected to perform daily in order to effect prompt and efficient removal of the sewage-waste of household and manufacturing establishments, the sweepings of streets, rain-water, etc. The founders of the sewerage system did not suppose, nor had they the remotest idea, that from the Indian village of half a century ago, Chicago would become in so short a time one of the greatest business centers in the commercial nations of the globe. Had they any presentiment that such a growth would be possible, Lake Michigan, from which is received the water supply, would never have been selected for the sewage repository, nor would the Chicago river, a navigable stream over which thousands of people pass every day, have been chosen as an outlet to carry off the immense quantities of refuse matter of so vast a population. Have you ever considered what an enormous quantity there is of the sewage matter? In order that you may have an idea of its magnitude, make an estimate. Every man, woman, and child has an allowance of ninety-seven gallons of water daily, at which rate a complete system of sewerage for a population of eight hundred thousand people would require provision for the discharge of three hundred and ten thousand, four hundred tons daily, or one hundred and thirteen million, two hundred and ninety-six thousand tons yearly. In this calculation storm water is omitted. Considerably more than three hundred thousand tons of sewage, therefore, pass through the sewers every day, mingling at certain periods of the year with the water of the lake, thereby breaking up the harmony of even iron constitutions, which, together with the nauseating odors rising from the stagnant river, leave the victim gloomy and unhappy. Nor are these the only sources of the water citizens are compelled to drink. Recent investigations prove how much attention is paid to so important a factor in the public health as drinking water. The main sewers are very imperfect. The low grade at which they are constructed prevents the essential instantaneous outflow, and hence the solids remain stagnant in the pipes, generating the most unwholesome gases, When northeast storms are raging, or high winds prevail from that direction, these gases are driven back from the mouths of the main sewers into the house drains, and through the water in the traps of waste and soil pipes. If the house drains, soil, or waste pipes are in any way defective, these gases must necessarily find some outlet, and invariably escape and force themselves into the dwelling. Necessity, therefore, demands the most perfect house drains, soil and waste pipes possible. As the safest remedy against all such imperfections in pipes, rigid testing by air or water pressure is recommended, this duty being assigned to expert sanitary inspectors appointed by the authorities. That ventilation by the most approved methods must be adopted, with the use of all the latest improvements in sanitary fixtures in order to eradicate, by protecting health, some of the 'ills that flesh is heir to,' are also recommended.

"The story about the system of house drainage now in vogue being defective, is somewhat old, but is nevertheless true. But how can it be otherwise, when it is regulated by no stringent measures? The work is done haphazard, by the lowest bidder, pipes simply thrown together, with no safeguards whatever. The only object to be attained is cheapness and profit at the same time, rather than durability and perfection. Men meet every day the laborer of a year ago, the licensed sewer builder of to-day; the crude apprentice of a year ago, the licensed plumber of to-day; and the makers of the cheap and imperfect work that is seen around. Under these conditions, is it any wonder that scarlet fever, diphtheria and other pestilential plagues rage violently every day? The mission of the plumbers' society, therefore, is for a high and noble purpose, not that which plumbers are daily charged with as being their highest ambition:

> "To welcome to our hearts the fierce howling blizzards,
> Which come from the north like a wolf from the fold,
> Rejoiced in by plumbers—the high-charging wizards—
> The demons of pipe-bursts, and lovers of cold.

"Their highest ambition is that a study of plumbing and sewerage system be entered into by the wisest and best citizens. Even though millions of dollars be necessary to effect a change, such expense should be readily undertaken in finding a different receptable for sewerage than the place whence the water supply comes. The present pumping capacity (1888) of the Chicago waterworks is ninety million gallons daily, which gives, in a population of eight hundred thousand, one hundred and fifteen gallons to each person. Therefore, it would seem that the sewage amounts to three hundred and sixty thousand tons every day, but, of course, it must be taken into consideration that a great quantity of this is simply waste water from elevators, etc., and has no real sewage substance. Therefore, it is computed that the real sewage substance is seven hundred and seventy-six pounds to each individual daily, in place of nine hundred and twenty pounds."

In May, 1888, Martin Moylan read a paper before the Architectural Sketch club, on "Practical plumbing," which is valuable for its comparisons:

"The architect may expect and will be forgiven for mistakes and lack of harmony in the exterior finish, and for incovenience and discomforts in the interior layout of the house.

but I have grave doubts of his forgiveness, here or hereafter, for the misery and discomfort of an unhealthy home," said Mr. Moylan. "The plumber, while often responsible for bad plumbing, is, I believe, in the majority of cases, willing and anxious to do right, but is hampered by considerations and circumstances over which he has no control. Therefore, I repeat, that to the Chicago Architectural Sketch club—the future architects of Chicago—practical plumbing is the most serious and important subject that can engage your attention. It is a subject of so much importance, and contains within itself so many interests, that I undertake its consideration with diffidence. But encouraged by twenty odd years of practical experience, the only safe guide in plumbing, I hope, with your kind indulgence (not so much for what I say, as how I say it), to throw some light on the subject. You know Chicago contractors, and especially plumbers, have not much time to devote to cultivating anything but the practical; that after devoting fifteen hours daily trying to come out even with the architect and owner, there is not much time left to prepare for such an undertaking as I have presumed upon this evening. I have thought best to devote my attention to the most important feature of our subject—sewer, waste, soil and ventilation pipes. That I may make myself clear and intelligible," he said, "let us suppose that I am getting built a home. If the house occupy the entire lot, my sewer would, of necessity, have to be inside, in which case I would run the sewer, as is the custom now, to within a few feet of the house, where I would have a manhole, large enough to allow a man room to work in. There I would have the sewer-builder's labors cease, and the plumber's commence. From this manhole I would continue, in a trench built of brick for this purpose, a six-inch lead soil pipe to catch-basin in rear (unfortunately, we are compelled to have such nuisances in Chicago), with four-inch branches for closets, and one-and-one-half-inch for basins, with handhole openings, properly arranged, all in trenches, or such way that they could be got at without destroying floors and casing and creating such general havoc as is now necessary to make the slightest repair.

"Our groundwork now in, we proceed with our soil pipe, for which I have had the architect provide eight-inch partitions over each other, so as to give me a clean straight run from basement to roof. In this partition I would have a recess, large enough to accommodate all my pipes running to and from basement. In this way the plumber would not have to be coaxing the carpenter to take out a header here and put one in there. I would increase my soil pipe through roof one or two sizes. The soil pipes I would carry right in the center of the recess resting on brass lugs, soldered on the pipe and supported by regular pipe rests. There should be none of the old-fashioned flanges on floors or straps on pipe; pipes at floors should be clear, and all supports should be so placed as to give the utmost freedom in examinations. Plumbers given this opportunity and requested to put in extra heavy lead soil pipe, would send their best men; no others would be of use.

"The practice of to-day would be reversed, the expert, skillful workman would be sent to do the 'roughing in' while your young neat workmen would get the finishing, where they would be least liable to make mistakes and where such would be easily remedied if made. We have now our soil pipe complete from manhole to roof, and proceed to test it by plugging it in the manhole and filling with water to the roof. What a pleasurable job this would be to the plumber in comparison with his task of to-day! Let us compare, for a moment, this job of lead soil pipe run in a nice recess large enough to carry all pipes to and from the bathroom, with a nice paneled board cover set on with round-head screws, or hinged so that there will be no defacement or trouble in removing it, and the universal practice of to-day of having everything iron. In the first place all iron pipe for plumber's use is of a very inferior quality, the purposes for which it is used and the habit of burying it out of sight, and above all the desire for a cheap article gets the manufacturer to where he is compelled to turn out a very worthless article. Besides this, with the habit of tarring it or covering over the sand-holes and cracks, by the time the plumber gets through with it trying to fix up a sand-hole or defective caulking here, and a split pipe or fitting there, it forms a very poor and dangerous job, liable at any moment to give way at some of its many weak points. But if there is such danger with the iron pipe that has been put up carefully and tested, what can we say of the miles of it put up by careless, inferior labor without any test?

"Gentlemen, there is only one way of forming any conception of this great danger, and that is to examine a load of soil pipe and fittings as they are delivered at a job or at the plumber's shop. The knowledge you would there get would be entirely sufficient to settle for all time any doubt there might be on your mind about the fitness of this stuff for soil and ventilation pipes. The only objections that I have ever heard offered to the use of lead are that rats gnaw it, carpenters drive nails through it, and it costs a little more. Now, properly run, the first two are entirely avoided, and as for the last, it is only in keeping with the man's idea of things who told me some time ago, when I recommended replacing an old pan-closet that was within ten feet of his bed with something modern, 'No, fix it up, these new arrangements cost too much. Put in a new pan and we will take another year out of it.' At the same time there were painters and decorators in the parlors trying their utmost to give the neighbors and friends of this house an idea that this poor foolish old fellow was a man of fine susceptibilities, fine feelings, etc. Well, he was not; notwithstanding that, looking at the parlors you would not have thought that the old pan-closet was good enough so long as it could not be exhibited and give the owner a reputation for wealth and good taste. Cost, I think, should not be considered in such an important matter. If the plumbing is not right in a house, certainly nothing else is. If the house is unhealthy, the doctor's and undertaker's bills very soon reach what the perfect job would have cost.

"In the bathrooms, I would place immediately under water-closet a large lead-lined box sufficient to accommodate the nest of pipes and bathtrap usually located here, and drain bathroom safing too. Over this box I would place a marble slab in such a way as to be easily removed to admit of inspection. If the closet is to be closed in, which, I think, is preferable for private houses, I would only have sufficient covering over this box to bolt my closet to. In this way the entire network of pipes would be visible by opening the riser of the closet, which ought always to be hung on hinges from the top with only a button on the bottom to keep it closed. The fixtures in the bathroom ought to be so arranged that the entire piping will be in clear view. The waste from the bath ought not to be more than one and one-half inch, and from the basins one-and-one-fourth-inch. Bath and basin plugs, as they are made at present, are very faulty in having such small openings. They should be enlarged so as to fill their waste pipes and thoroughly flush them. The present practice of running kitchen and laundry wastes is simply abominable. It is hard to conceive why any man in his senses will run a six-inch earthen pipe from a sink or set of laundry tubs when the openings in these fixtures are not sufficient to thoroughly flush a one-and-one-fourth-inch one. These wastes should not exceed one-and-one-half-inch. They are usually in such a position that they can have a good grade, and whatever their grade they will keep clean longer than a larger filthy six-inch pipe will.

"But the great danger with this large earthen pipe is that it will clog up and, the joint below the floor being cement, or, as the health department now insist, elastic cement or asbestus, a very small head of water or pressure from within will force this asbestus or elastic cement joint and allow the entire waste from the kitchen and laundry to run under the house until the odor from the accumulating filth gives warning of something being wrong. Gentlemen, if you would see a couple of hundred houses every year for twenty years the entire area underneath of which was covered with a few inches of seething, rotting sewage, the result of broken soil pipe and sink-waste connections with the sewer, you would never permit in your practice, you would never allow in the house that you were to be responsible for and to whose owner you promised to give a healthy home, a cement joint, an asbestos joint or an elastic joint. You would have the joint that common sense recommends, that experience, the only guide and safeguard, in mechanical as in all other matters, tells us is right. You would have a lead wastepipe from fixture to outside of house. In that you would have the metal, the elasticity, the durability, in fact, everything but your asbestos and that you would have supplanted with common sense, which is a most useful and valuable thing to have in the performance of practical plumbing.

"Our next consideration is ventilation and reventing, on which there are as many theories as there are sanitary engineers, and I very much fear as many grievous mistakes made as there are both. In ventilation, all seem to agree that the soil pipe should be continued above the roof, increased as it goes. To this general practice I have no objections to make, except in the material used, which I insist should always be lead above the highest fixture. It is folly, it is madness, it is criminal to put into any man's house a pipe to carry off deadly poisons, which, from the nature of things, cannot last long. Yet what can the individual plumber do in such cases? What can the plumbers do without the aid and coöperation of architects? I have taken out enough of defective cast-iron pipe to convince any man, not naturally a crank, that iron is no material to use for such purposes. Those pipes that I have removed (some of which were on exhibition in the Chicago Master Plumbers' association) were so thoroughly eaten away that it was almost impossible to save enough out of twenty feet of them for a relic of the iron age in plumbing. None of them were in use more than fifteen years. I have in my office several four-inch lead bends which once formed the connecting link between soil and cast-iron ventilation pipes.

"In testing houses to find the cause of the odor complained of, I found in two that, with the peppermint test, we could not locate the trouble, and, seeing that there was an offset from soil to ventilation pipe, experience lead me to believe that the bend was filled up. To make sure before cutting it out, we tried the water test, filling from roof, and found that the bend was solid. In the other cases, the bends, becoming defective, were removed, in doing which they were found to be almost completely filled up with rust, the ravelings of the iron pipe as it gave way to the effects of the sewer air. These pipes were four-inch, and the ventilation pipe in a couple of cases was not more than ten feet long, and had not been in use more than five years. If such is the case with four-inch cast-iron, what can we say or think of the practice of putting in one-inch, one-and-one-fourth-inch and one-and-one-half-inch soft wrought-iron for reventing.

"The plumber is not to blame always, for I have fitted up houses where there were porcelain baths and decorated bowls, the cost of one of which would have more than paid for lead for all the ventilation and reventing there was in the house, but the owner felt too poor to stand the additional cost of lead, or probably he might have thought that it was only a device of the plumbers to get in a bill for extras, and he did not feel inclined to sacrifice a decorated bowl for something he could not see when plastered up, so the cast-iron ventilation and wrought-iron had to go in. I believe there is more than enough of wrought-iron pipe used for this purpose in Chicago every year to reach from New York to San Francisco, and to what purpose? The cure in this case is surely worse than the disease. A wrought-iron pipe will fill up so solid at the first turn or bend it gets in a couple of years that there is no ventilation, and when it dosen't fill up it will be eaten away so quickly that the more venting and reventing there is, the more danger. The owner or occupant feels secure, believing that every precaution has been taken to make his house safe, when he would be ten-fold better and safer if there had never been a foot of such ventilation in his house.

"There is also a practice now-a-days of reventing every trap in the house, whether it needs it or not, which I think is very unwise for many reasons, as in this indiscriminate venting and reventing many very serious errors or mistakes are made in what plumbers call 'by-passes,' by which an otherwise fine job of plumbing is made a death trap. Therefore, while claiming that plumbing has kept in advance of all other departments of the building trade, especially in fixtures and workmanship, I am sorry to have to admit that the benefits derived from this important advancement are only temporary, and I feel no hesitation in saying that the house gets no better security from foul air than it enjoyed without ventilation, and with the old pan-closet, the filthiest of all plumbing fixtures. Consequently, I would urge upon the architectural profession to eliminate iron pipe from their plumbing specifications. If you cannot agree with me as to its unfitness for sewer and soil pipe (it may take a few years more to thoroughly demonstrate it), discard at least for ventilation purposes. I should have probably said something in the beginning about earthen-pipe sewer, which I regard as just a very little improvement on the old wooden-box sewer. Why, gentlemen, there is not a week passes by that I am not grieved and shocked to see the upper surface of new-laid earthen-pipe sewer made the passageway for all the laborers and mechanics in new buildings. Look at the way it is put into place. At least in half the houses in Chicago the trenches prepared for earthen-pipe sewer would remind you very strongly of a farmyard where hogs were let loose for a picnic, a hole here and a couple of feet of trench there, and then another hole and so through the house. Where there is any depth to go, every shovelful of dirt that can be avoided is left undisturbed. Work cannot be done in such a manner properly, and it is not done. There is no necessity at this late day to use such stuff. There is no reason why the health of families should be subjected to the risk of any material so easily misplaced or injured.

"Our next consideration is 'Plumbing fixtures,' on which I am pleased to state there is very little to be said except in praise. Everything from the sink to the bathtub and their fixings and connections is on the steady advance to perfection. The new-style closets seem to me to possess all the necessary requirements for cleanliness and durability. No closet should be used that a closet-brush will not reach to water seal. The servants' closet, which sometimes receives too little attention, ought always to be automatic in its workings. Baths and basins ought always to have the removable overflow attachments which allow of the cleansing of those fouling places, with which the porcelain, enameled or copper bath is all that can be desired for health and comfort. Wooden laundry tubs and sinks are fast disappearing, but hardly as quickly as they ought. The new styles, with a one-and-one-half-inch lead waste from fixture to catch-basin, will never give any trouble or headaches. I would also recommend the placing of a large tank in attic, so arranged that it could be used for a supply tank in case of need, but whose chief purpose would be for flushing soil, waste and ventilating pipes. This would be of very great benefit, and, in my opinion, would prevent in great measure what we may call the 'dry rot' in those pipes. With such an arrangement flushing the entire system once or twice a week, there would not be so much foul air generated in house pipes, and householders would be taught the necessity and importance of its liberal use. I have never seen such an arrangement. I don't think there is one in Chicago, but I believe you can not have a perfect job of plumbing without them. No house can possibly be clean and healthy without frequent inspection and cleaning of its plumbing fixtures. No plumbing fixture should be used that can not be easily cleaned in all its parts. This ought to be the chief consideration in their selection. No house is safely plumbed for any length of time where wrought iron is used for soil or waste, and is absolutely dangerous where used for ventilation purposes. I believe that every remedy, so far, for coating iron pipe for preserving for plumbing purposes, is merely a makeshift, a blind, and does more harm than good in hiding and covering a multitude of defects.

"Let us suppose that the National Association of Architects should submit to the National Association of Master Plumbers the following proposition at their meeting next June: 'That hereafter all plumbing must be guaranteed for a term of ten years, during which period said plumbing must annually be tested by filling with water from manhole in front to roof, and if any defects are found, to right them free of expense to owner.' What think you, gentlemen, would be the answer of the National Association of Master Plumbers? I feel very safe in anticipating their answer. It would read something like this:

"'Yes, gentlemen, we will do just as you say on the following conditions: That you specify no iron pipe for sewer, waste, ventilation or reventing pipes; that you specify lead instead, and that you require a bond with every guarantee.' This proposition I most respectfully submit to the consideration of the National Associations of Architects and Plumbers, believing and feeling that as each has the one grand object in view, healthy homes for their clients, it is the shortest, surest and safest road to honest, practical plumbing."

On January 8, 1889, David Whiteford of the committee on apprentices, presented the following report to the Chicago association:

"The past year has been one of inactivity, especially on the part of its chairman. No new plan of effort has been suggested to you for your consideration and action. The usual course of lectures or addresses has been omitted. Toward the end of the year our amiable brother and fellow-craftsman, J. J. Hamblin, did kindly volunteer to talk to the apprentices, for which he has always had a great interest. I deemed it of little use, however, as the expiration of my term of service would soon close, to try to awaken in you a new interest in your apprentices. Before much good can be accomplished in this direction, you must move with one accord. Two-thirds of the members of our association pay little attention to the requests of your committee in sending in the names of their apprentices, etc. We sent out the yearly circular letter to every member. Thirty-two answers were received out of a possible one hundred and fifty. These replies to our circular letter does not indicate, however, that we were not in possession of a list of apprentices of master plumbers, as many had sent in their list of apprentices the previous year. Eight boys out of every ten who have called on me for a job have known nothing about our apprentice system. After asking their names and looking over our registry for their record, their names did not appear. This very likely can be accounted for, to some extent, that so many boys go simply as helpers, with no fixed design in their mind to learn the trade. We would suggest when a boy is hired he be made acquainted by his employer that he has to serve a stated time at the trade, either with his present employer or some other. This of course could be best accomplished by the chairman visiting every shop, take a list of names, and hand them a certificate of apprenticeship. The apprentice scheme is all right, and I believe it would be difficult to amend it. I think there has been an apathy all along the line. None of us have shown the interest at heart that we might have done. We need a Chicago millionaire to leave some money to the Master Plumbers' association, or, probably, better still, to the manual training school for the purpose of fitting up and equipping a class for plumbing instruction. Until this time comes—which is sure to come someway or another—let us not cease in our endeavor to teach the boys what we know. In the past we have raised up good workmen, as thoroughly trained as our opportunities could command. We must keep pace with our sister cities of the east with their schools of science. The giant city of the west cannot lag behind. Ours is now a city of schools and colleges, and from her halls of learning step forth some of the brightest orators of the pulpit and bar, and of the ablest of men in surgery and medicine that can be found in the land.

"We have now on our registry the names of five hundred and forty-five apprentices. Out of this number only eight have received their journeyship certificates. There also appear the names of one hundred and five master plumbers on the record. Twenty-five per cent. of the names that appear have sent no record of their apprentices, but are shown on the record through others as having had certain boys in their employ. Nothing of a serious nature has arisen between master and apprentice during the past year that has needed your committee's mediatorial services. Everything seems to have moved along smoothly. In closing this third year of my services as chairman of your apprentice committee I do so not with a feeling of pride or satisfaction. The results could have been greater. Appoint out of your number a capable man as chairman to take charge of such an important branch of your work. It is in youth that the mind is molded and fitted for future development. Choose from your ranks, then, a good leader—a man of magnetism. Such men will surmount any drawback that may appear in their way."

The officers chosen in January, 1890, were Hugh Watt, president, to succeed A. W. Murray; David Whiteford, first vice president; James J. Clark, second vice president; Jacob Weber, third vice president; David L. Bain, fourth vice president; Charles C. Breyer, fifth vice president, John J. Hamblin, treasurer; Matthew L. Mandable, financial secretary; Alexander Irons, recording secretary; Charles J. Herbert, sergeant-at-arms. The deaths of George Bigden, Joseph Dewald, L. H. Hartman and Martin J. Ryan were noticed, and the progress made by the Ladies' Auxiliary association commended. The roster of members on January 1, 1890, contained one hundred and forty-eight names; the receipts for 1889 amounted to $6,218.34, and the disbursements to $2,635.42. In May, 1890, the prize essay on methods of exhibiting plumbers' materials and workmanship at the World's Fair, was read by J. J. Wade.

The plumbers' strike of April, 1890, was settled by arbitrators representing the journeymen and employers. The committees on arbitration comprised James Boyle, Joseph Alcock, Bernard Shields, James Buchan and Patrick Burke, representing the journeymen, and J. J. Hamblin, Patrick Nacey, Martin Moylan, E. Baggot and M. J. Carboy, representing the employers. The settlement turned mainly upon the question of what to do with the juniors, but an agreement was signed embodying the terms of settlement. It is that the minimum rate of wages shall be $3.50 a day for all journeymen plumbers, above which no employer is bound to go; all future differences are to be settled by arbitration. The juniors receive an advance of twenty-five cents a day. They had demanded fifty cents. This advance benefits only a minority of the juniors, as most of them work under a previous agreement that their wages shall be advanced annually. Those working under this agreement are excepted from the advance of twenty-five cents. The classification system of wages was abandoned by the employers, while the men gave up their demand for a uniform rate of wages for all workmen. The middle ground between the two is agreed upon. A minimum rate of wages is fixed, below which no employer can go, and to which a vast majority of the men will be raised or reduced, but there is nothing to prevent an employer from paying more to such men as he thinks particularly valuable. Under the old system one class of workmen got $3.60 a day, and another, by far the larger, $3.15. The men demanded an advance to $3.75, which was to extend to all workmen alike. The bosses did not oppose this advance so much as the idea that all men should be paid alike without regard to their capacity.

In May, 1890, David Whiteford read a paper proving the conditions under which the city authorities should grant a license to carry on the plumbing business. He said: "When the pioneer plumbers landed in Chicago from eastern cities and from across the seas, they obeyed the law which is ever present in the hopeful mind—never to rest satisfied in their present condition, so long as they have before them a prospect of bettering themselves in life, or until they have reached the hight of their ambitions, and lifted themselves beyond the reach of poverty, and placed themselves and their families in comfortable circumstances. To that end did the first plumbers of our city, following the pent-up desires of their mind, launch out upon the world in business for themselves. In those early days when the plumber established himself in business, there was no law higher than himself, and no legislation had yet been thought of for the regulation of his business. The plumber was left to do as he pleased, as no one knew more of his trade than he did himself. He was trained in the old school, and under the direction of the old masters. Time had handed down to him the heritage of the fathers, hoary with age. He followed the instructions with great faithfulness, not daring to venture outside of the old beaten path lest his conscience would charge him with going astray, and violating the fundamental principles of his trade. Revolution upon revolution has been going on. The past methods of the tradesmen of all classes are dissimilar in character to what they were thirty-five years ago. The head has immeasurably lessened the work of the hand, and made it subservient to its wishes. The ingenuity brought to bear on all trades is co-extensive, and the needs of the times must be carefully studied and rightly comprehended to be of any value to the best interests of the citizens of the world.

"Edward Bellamy says in his book, 'Looking backward:' 'We are living in the close of the twentieth century, enjoying the blessings of a social order, at once so simple and logical that it seems but the triumph of common sense.' Edward Bellamy is presenting the social condition of things one hundred years ahead of time. We do not predict what conditions the master plumber will be in a hundred years from now, but if the government takes our business from us, and puts each master plumber in a good, fat office, we will, no doubt, be as well off as we are to-day. This is not our object, however, as we desire to review the past and present conditions of licensing men to carry on the plumbing business, and perchance, by some comparison of facts, be able to show who are not the fit persons to grant a license to carry on the plumbing business, and by this means be able to show who are the proper persons to grant a license to.

"The conditions which exist at the present time are to some extent similar in character to those which existed twenty-eight years ago. This was about the time the city authorities established an ordinance requiring the plumber to take out a license to conduct the plumbing business. At that time the applicant for a license did not need to qualify by taking oath that he was a practical plumber, nor did he have to satisfy a board of commissioners that he was able financially, physically, practically or theoretically to carry on the plumbing business.

"In 1862 there were engaged in the plumbing business in Chicago twenty-six master plumbers. Two-thirds of them were men who had learned the trade. There were about one hundred and fifty thousand inhabitants, or one master plumber for about six thousand inhabitants. To-day there are engaged in the business of plumbing over three hundred and fifty master plumbers, three-fourths of them, or more, having learned the trade. This is one master plumber for less than three thousand inhabitants. The increase of master plumbers in proportion to population is due, perhaps, to the difference in the quality and quantity of work done in each house, as the ratio of plumbing fixtures and accompauying pipes has increased to satisfy the sanitary demands of growing cities. So it appears that the master plumbers increase in proportion.

"Taking into consideration the growth of the city of Chicago in twenty-eight years from one hundred and fifty thousand inhabitants to over one million, it is astonishing that the city authorities have not required a more stringent law for the licensing of master plumbers. The object of the common council, in passing an ordinance requiring a plumber to take out a license for the conduct of his business, did not comprehend anything beyond protecting the city against paying damages which might arise in consequence of persons being injured by falling into excavatious made in public highways by plumbers for the purpose of laying water pipes. The greatest consideration of the authorities was the protection of life and limb from accident.

"Now the greatest desideratum of the city fathers and state legislators should not only be the protection of life by accident, but from the more serious and insidious death-dealing sewer gas, which has conclusively been found to be a hundred-fold more dangerous to human life than any other cause of human ills. The giving of a bond is not a sufficient guarantee nor is the statement of two practical plumbers upon oath enough on which to grant a license to carry on the plumbing business. Can we say with all the light of the past thrown on the present, that we have not known, as the result of our ignorance of sanitary laws in constructing plumbing, many a fair face and lovely form to have fallen a victim to the defects of the plumber's work?

"Is there to be any change made in the methods of dealing out licenses to men to carry on the business, or are we to continue in the same old rut, and not have a law passed which will be in keeping with the present advances of sanitary science? The warning of the past and the light of the present should convince the most conservative person in authority that the plumbing trade is no ordinary one. Let the combined experiences of the enlightened master plumbers assert at this time that they would much rather, for the benefit of all concerned, not be allied with the man who has not learned the plumbing trade nor perfected himself in the art. You have long enough been held responsible for the imperfect work of men who have licenses to carry on the business, but not sufficient knowledge. Can there be a remedy found? Shall the plumber be able to start a new epoch? Will you pause and

BOARD OF TRADE BUILDING, 1882-5.

suggest to the city authorities those whom you think should be granted a license? Has the time come with us in Chicago as it has in other cities in this and other countries, that we can ask the watchman upon the wall what are the signs of the times, and what of the night? And the echo comes back, 'All is not well!' The walls must be rebuilt and the battlements made strong. We may not need a sword in the one hand and a trowel in the other, but we need the strong arm of the law and the help of lawmakers to protect us and the people of our land against any further encroachments upon ours and their rights.

"It will be asked what are the rights of the people, and what more do they want that they have not already? For twenty-eight years the master plumbers in this city have been living and laboring under the same conditions so far as the licensing of plumbers is concerned. There have been laws enacted for the government of plumbers for several years under the directions of the board of health. There has been little effort put forward heretofore for their enforcement. It is a noticeable fact, however, since a master plumber has been put to work as chief inspector of plumbing, with an able body of practical plumbers as assistants, that the work is changing for the better. We concede that there has been a point gained, and the right of the people better conserved by the inspection of the plumbers' work. However, if it has been found necessary to have stronger and more durable and reliable material, better sanitary fixtures and all that, what of it, if, on the other hand, workmen and master plumbers are not asked for higher skill and a more perfect knowledge of their business? If there has been a need of a radical change in the method of plumbing, there still exists a greater need of guarding the trade from a class of soulless and incapable masters. It has no doubt appeared to you all by observation that there are too many apprentice-boy master plumbers. The granting of licenses to young men is overdone, and a great wrong is forced upon the community and on the young men themselves. Scarcely has the boy left off carrying the bag of tools for the plumber before he applies for a license to carry on the business. The young man has put in his best efforts to be able to make a joint, and has succeeded fairly well, and because he can do this and solder on a pair of tacks, he considers himself a crack workman. He must be a master plumber, and his nearest kinsman prevail on some good-hearted master plumber to vouch for his ability and business qualifications, and that he is entitled to a license.

"Gentlemen of the fraternity, this is one of the greatest evils that you have to contend with to-day. This class is undermining and sapping the very life of the plumbing business, and lowering the once-honored guild of master plumbers in the estimation of the people. These facts we offer for your consideration and action. The people in their ignorance tell you of the cheap ware they can buy from them, and they tell others to buy, but the purchase is like the most of cheap bargains—it is not worth the money paid. It is the old story over again of 'penny wise and pound foolish.' You will remember seeing a sign somewhere in a window that read: 'Plumbing done at half price.' Of course this sign attracted the attention of the people who were looking for a cheap plumber. No one can do cheap plumbing and do it good. These are not the men who should be recommended to the commissioner of public work for a license, for by so doing it is putting into their hands a weapon of great mischief. The men can not fulfill the conditions which the trade demand, and should not be granted a license.

"The great majority of master plumbers rise from the ranks of journeymen, yet there are a great many who have not, but who have learned what they know about the trade by being associated with others who are practical. The time was in Chicago when the gasfitting trade was not considered a part of the master plumber's work, and contracts for plumbing and gasfitting were let separately; but gradually the plumber contracted for gasfitting, and the gasfitter, in turn, contracted for plumbing, and so we find this state of things existing to-day. The gasfitting and plumbing trades are very closely connected, but a gasfitter can learn his trade in two years, while it takes five to learn plumbing. What we think ought to be done before a license is granted to gasfitters hereafter is, that they should be associated in the plumbing business with a plumber a time equal to that an apprentice spends at the trade, so he could learn, at least, the theory, if not the practice, before he is granted a license.

"There are still other trades, as the tinsmith and steamfitter, who keep constantly rapping at the door for admittance to carry on the business, and the trade papers and books of the various classes are called upon as a library of information to furnish the missing link between the man who has served his time at the trade and the man who has not. By this means a tradesman can equip himself fairly well, and in time become an adept and expert at the trade, a prosperous and honest business man.

"If there is a standard to be reached and any reliance to be placed in the ability of a person to manage the business of a plumber, a certificate of proficiency must be laid down. The main question that presents itself to every person when he wants a job of plumbing work done is: 'Is the man I hire a plumber; does he know the beginning and does he know the end of his work in all its details?' The engineer at the locomotive must be known by the railroad company who hires him to be a capable engineer, and one in whom they can place implicit confidence. He is a man of steady nerve, whose eye is always on the lookout, and whose hand is ever on the trottle. Would you, if you knew it, embark on a ship for some distant shore, and place your life in the hands of a man who was not a captain and never sailed the seas nor learned to navigate a ship? You would want the captain to be a sailor with all the knowledge possible, and hold a certificate granted to him by a board of examiners. On the same ground and by the same immutable principles, you ask that the plumbers should hold a certificate of ability.

"Let us pass from this and review a class of men who receive a license to carry on the plumbing business, who never ought, as they have never learned a trade of any kind, but who have push and daring enough to force themselves before the public as plumbers. They are prompted to rush into the business for the money they believe there is in it. This class reminds us of men whom we have known who were not contented with the particular business in which they have been engaged and doing well. In the moment of excitement, on hearing of gold being found in yonder hill and plenty of it, they start in search of it. Footsore and weary they arrive at the mountain only to face the adamantine rock with no tools, no experience in handling the tools like the old and well-tried miner; they return to the home they left, wiser and better men. This class of men entering the plumbing business with no experience, neither practical nor theoretical, looking for a bonanza and not finding it, drive on fearlessly and regardlessly, with only one idea, to make a spoon or spoil a horn; and this they do by hiring cheap labor and doing poor work, thus endangering the lives of thousands of persons by faulty plumbing construction.

"What will be done with such men? Will the city authorities conscientiously grant a license to these innovators and quacks who know nothing of the trade they engage in? Public sentiment, if it only knew, would cry out against it. The newly filled graves of the innocents loudly speak against it. Guardians of the public weal must be asked to raise their hand against it and stop granting licenses to such men. It is said of Diogenes, the philosopher, that he went about with a lantern in his hand looking for an honest man. The master plumbers of Chicago must light the lamp and let the full glare of the light be focused on the city and state authorities so they may see the necessity of passing a law to regulate the granting of licenses to men to carry on the plumbing business. Let the authorities be like Xeniades of Corinth. When he asked his slave, Diogenes, after he had purchased him, what business he was proficient in, he answered: 'To command.' At one time in the British army there was a rule to take commissioned officers from the sons of the 'nobility,' as it was called. Now they rise from the rank and file. Strictly speaking plumbers, and only plumbers who have been fitted by education and merit, should conduct the business. In the cities of Baltimore and St. Paul they have passed laws for the examination of the plumber. In Glasgow, Scotland, the journeymen are registered. All this goes to show that the trade is considered equal in the eyes of thinking persons to be put on the same level with the physician and druggist, and of paramount importance to any of the professions.

"In the foregoing thoughts we have principally dwelt in a general way, asserting that the plumbers' work improperly done is a dangerous commodity to have around, but have not so far shown wherein the trade of the plumber differs materially from that of the gasfitter's steamfitter's and tinsmith's. The gasfitting trade is the fitting in of iron pipes in buildings for conveying illuminating gas for lighting and heating purposes. The technicalities of the trade consist mainly in mensuration, as the rules and sizes of pipe are laid down for their guidance. The threading of pipes and putting them in is a question of strength and agility, and the testing to make them tight, a matter of patience. As for the work of the steamfitter it is the repetition of the gasfitter almost in every detail. If the pipes leak the escape of steam will make itself known and point to the place. The tinsmith's trade, and that part of it which is akin to the plumbing trade, is the solder and the soldering bolt. We admit that any of the three trades has in it those principles of workmanship which the plumbing trade contains, but no man of any of the trades could possibly do the work of a plumber without a good deal of practice. The distinguishing features of the plumber's trade, from almost any other, lies in the scientific points that it embraces; the methods of pipe construction, material and receptacles for the immediate removal of organic matter, and the prevention of foul air becoming injurious to life and health, and by understanding the surrounding condition of things. Take for instance the very able paper presented on catch-basins, by J. J. Hamblin, and you can comprehend the relation that the size of one pipe holds to another. It has been shown that a two-and-a-half-inch pipe can not be washed clean internally and made inoffensive by joining an inch and a quarter to it. Neither can a soil pipe be kept clean by the quantity of water used at each discharge. Science has taught us the necessity of flushing all waste pipes with a plug of water equal to the size of the pipe. To this end the plumber should have some knowledge of the laws which nature has laid down for him as to the correct sizes and angles of pipes for the flow of liquid wastes and gases in a horizontal and vertical position. Take the very best constructed forms of angles and grades of discharge pipes and let a quantity of water pass through filling the entire diameter of the pipes and you have the very best conditions possible for the thorough cleansing of the waste pipes. And yet you have the very worst conditions for preventing the emptying of the waste-pipe traps of their water seals. Many illustrations could be made to show that the greatest care is needed in designing and executing plumbing work.

"In reviewing the thoughts which have been presented, there grow out of them several essential points for training men to carry on the business of a plumber. The first is, that the apprentice to the trade must needs be required to attend one year in the day time, or its equivalent at night, during the term of the apprentice, at a manual training school where a special branch can be given covering the knotty points of the trade. Second, the registration and examination of the journeymen plumbers under state law would correct two existing evils: First, no apprentice at the trade should be examined and registered for a journeyman until he has served his stated time. Second, the journeyman should not apply for a license to carry on the plumbing business until he is a registered journeyman in good standing. Third, state legislation and the unity of the craft protecting and upholding the board of health in the enforcement of good plumbing, will go far toward weeding out and furnishing to the trade a class of competent master plumbers. Competition is said to be the life of trade. That might be true if there were a standard for all men and all men worked to the standard."

At a meeting of the local association, held July 24, 1890, Matthew L. Mandable read his paper on "In what relation should the intelligent and trustworthy plumber stand toward his customers in the selection of sanitary appliances?" "The plumber of to-day," he said, "should stand in the same relation to his customer as the family doctor does to his patient—that is, as an adviser. He should first inquire, when consulted about undertaking the plumbing of a house, what kind of a structure his customer is going to erect, about the amount of money he proposes to expend in building a house for himself and family. After the information has been obtained, it is the duty of the plumber to advise his customer what he considers it best for him to do, and what he thinks best for him to use in the line of sanitary appliances. This may prove a very difficult task and require considerable experience. The plumber of to-day is not what he was twenty years ago. His surroundings are changed and the mode has changed. At that time they all had the same idea as to which was the best closet; now they have at least fifty or more to select from, and they all seem to do the work for which they are intended. Therefore, I think the plumber should use great care in advising what goods to select. He should not let his prejudice against any firm, which for some reason or other may have fastened itself in his mind, enter into the transaction at all. He should, by all means, advise the customer to buy the best that money can get, as it is the cheapest by far, in the end. And now I come to a feature of the business which some of you may be inclined to slight, and think of no real value to the business. Every master plumber should have his own showroom, with a complete line of his favorite fixtures set up all complete, and supplied with water, so that he will be able to show his customers the advantages claimed for the various designs. As it is to-day, the plumber is null and void three times out of five, as the manufacturer is standing in the plumber's place. The manufacturer goes to great expense in fitting up a grand showroom, pays big rent and employs expensive clerks, who, by the way, deserve great credit for the able manner in which they display them themselves when your customer happens to fall into their hands. Seldom do they lose their sale, for they have got just what the plumbers should have—their own specialties to show to the public. I do not wish to be considered as expressing myself maliciously toward any of our manufacturers while on this subject, but I do feel as though the plumber of to-day should endeavor to follow the good example which the manufacturer and jobber have placed before us. We can readily see how easy it is to make a sale when we have the goods to show. The plumber should have his goods to exhibit, just the same as any other retail merchant, and I feel that we are coming more and more to this feature of the business every year. We have good examples in a dozen or more of our members, who are awaking to the fact that it is a good thing to have a showroom fitted up with a nice line of sanitary goods. It is highly necessary at the present time for the plumber to stop and consider what position he occupies with his patrons and the public. A great many times he is ignored altogether, and often he is not considered the proper person to consult concerning the class of fixtures to be used. This should not be the case. The plumber should call attention to the fact that the plumbing is the most important work that is put into a building, and he should endeavor to influence his customer in selecting the best material. He should not be afraid to tell his customer that certain goods which he is about to put in are not what he ought to have; that they are not the best fixtures, and try and have him get nothing but the best, so far as lies in his power. The curse of the plumber to-day is the cheap, shoddy goods, with a big discount as their only recommendation, which supply dealers endeavor to foist upon the trade, the use of which should not be permitted; but as long as they can find buyers, the dealers will live and get rich at the cost of the plumber. But he is himself to blame for this, as he well knows that a good article cannot be bought at the ridiculously low prices which some manufacturers make. It is the sale of to-day which they are after, and not the plumbers' benefit, and as long as you buy their goods, they will continue to live. It would be a blessing to the public, as well as the plumber, should the cheap man be wiped out of existence, and buried forever, to return no more.

Once upon a time goods were sold on their merits, but now the cry is, 'How cheap can I sell them?'"

The feature of the meeting of December 11, 1890, was the nomination of officers for the ensuing year. The nominations were as follows: Patrick Nacey, David Whiteford* and William Bowden, president; M. L. Mandable, William F. Gay, T. P. Culloton and M. J. Carboy*, first vice presidents; William Bowden, C. J. Herbert*, second vice presidents; Frank Ruh, Joseph R. Alcock, C. A. Cavanah*, third vice presidents; Joseph O'Malley, Charles Lawrence and A. C. Hickey*, fourth vice presidents; George J. Stokes*, fifth vice president; Patrick Sanders*, treasurer; Harry A. Black*, recorder; M. L. Mandable, John J. Hamblin, J. H. Kilian, James De Veney*, financial secretaries; Henry Negley, Paul Rediske*, sergeants-at-arms. The election took place in January, 1891, when the officers whose names are marked thus, * in the record of nominations, were chosen. The report of the committee on apprenticeship was presented by A. W. Murray; six hundred and thirty names of apprentices appear on the record up to date, and of this number three hundred and nineteen were entitled to certificates of journeymanship. The ordinance prepared by Alderman Ryan, increasing the plumbers' license to $100, was approved, and the work of Andrew Young in connection with the health department complimented. Mr. Young stated that few of the members of the association had any idea of the number of defective closets and traps that were ordered to be replaced by new ones by the inspectors, and as a result thousands of dollars' worth of work was given to the Chicago plumbers.

The first state convention of master plumbers assembled at 15 Washington street, Chicago, June 15, 1885, for the purpose of forming an association. William McGraw, then vice president of the National association, issued the call and was elected temporary president. The delegates present were E. C. Barrett, Joliet; S. A. Jones, Rockford; Charles Stetson, Freeport; P. Mueller, Decatur; P. J. Kane, Alton; Samuel Good, George Stokes, John Swarts, E. E. Campin, Joseph Dewald, William Bowden, Martin Moylan, J. J. Clark, David Whiteford, Hugh Watt, Daniel Rock, Alexander W. Murray, P. C. Desmond, Charles Breyer, J. H. Roche, William Gay, J. J. Hamblin, William Wilson, Andrew Young, T. C. Boyd, William McGraw and James E. Beaver, Chicago. The officers elected were P. J. Kane, president; William McGraw and Martin Moylan, vice presidents; P. Mueller, recorder; C. S. Stetson, correspondent, and S. A. Jones, treasurer. The per capita tax was placed at $2.

The Chicago Sanitary association was organized in 1886 with Peter Willems, president. Among the earliest members were John F. Alles, A. W. Murray, J. J. Wade, D. J. Rock, Rupert Coleman, George Tipple, Fred Neustadt, George Alles, Robert Griffith, J. J. Hamblin, Jacob Weber, David Whiteford, John E. MacDonald, W. F. Gay, Richard Graham, Martin Moylan, J. Reilly and E. Breyer. Its purpose is distinct from that of the Master Plumbers' association, with which it has no connection, as it aims solely to promote a friendly feeling between members of the plumbers' trade.

The International Brassmolders' union was organized at Chicago in March, 1891. The brassmolders' trade, so intimately connected with plumbling, is one of the most important in the United States, but it was without organization until 1891. This city, being the greatest center of the trade in America, led in local organization, for, in June, 1890, a local union was established, with J. W. Morgan, president, and A. R. Healy, secretary. Within less than nine months this local union held in membership two hundred and twenty-five of the two hundred and fifty brassmolders in the city last June.

The ramifications of the trade are as numerous as its followers. Every branch of the building trade is interesting to the plumber; for what is weak and poor in a building, as well as what is substantial and rich, relates to his trade and in a measure controls his calculations. Agaiu the promise of a good sanitary condition for a new building has to be made by the plumber, and in his conclusions he must have before him the whole house plan as well as the plans of the water, sewer and gas systems of the locality in which his work is to be done. The promptings of the trade lead still farther into the consideratiou of material, and every metal and manufactured clay must expose its mysteries to him. Hence all the instructive papers read before local and national associations come from the plumber as poetry from the poet. There are, of course, grubs in the trade, who neither think nor write nor speak. They plod along, day after day, like the cabbage worm; but, fortunately, for one of such, the trade can boast of a dozen thinking men, who leave no stone unturned to arrive at the acme of trade knowledge and turn it to the improvement of material and apparatus. The result of this study and thought may be seen to-day in Chicago. Old-time methods have been revolutionized and the iron and lead pipes, which were hidden away only a few years ago, are now presented to the occupants of home or office or store as part and parcel of the furniture.

To the associations of plumbers this remarkable advance is, in a great measure, due. As a body they declared themselves in favor of improvement, and fostered taste and invention wherever and whenever they were made reconcilable with utility. To the associated plumbers the cities owe much, for their health depends on their sanitation, and in making this fact public and in enforcing their ideas, they have brought blessings to the millions whose lives are passed amid the smoke and dust and debris of great cities.

CHAPTER IV.

SANITARY DRAINAGE AND SEWERAGE.

NOTHING is more conducive to the health of a great city than a system of house drainage and sewerage based on true principles; yet nothing of so much importance receives such little attention from the municipality. Years ago the villagers of Chicago knew nothing of the value of general cleanliness. Perhaps the few cabins scattered over the marsh did not warrant the effort to attain such knowledge. Later, when cabins multiplied, and death was beyond all proportion to the sparse population, a thought may have been given to the insalubrious marsh, but not one to its improvement. The locality was only fitted for man in a wild or semi-civilized state, and then only as a temporary fishing or hunting ground; but its white pioneers, living in a semi-civilized state, brought hither iron constitutions—proof alike against malarial poison and the rigorous climate—to build the foundation of a great community. They appear on the prairie like great aluminum columns, resisting the corroding influences of time and bearing up the first floors of civilization without regard to nature or art.

A time arrived when they received a rude awakening. The shadow of Asiatic cholera fell upon the prairie, and the prairie seemed fitted to receive the reality. The bodies of a hundred soldiers were buried within a few days.

The true beginnings of sanitary sewerage and drainage must be credited to ancient Rome. In digging trenches for the purpose of laying the foundations of new forts in that city a few years ago, it is recorded that the workmen came upon the remains of ancient drainage works. The most perfect example was found below the surface of a hill on which a villa once stood. A system of tunnels four feet high and two feet wide were cut through the porous rock, the roof supported by pairs of large tiles meeting in the center. The galleries of this tier converge to a common outfall which leads to a second tier a few feet lower. The outfall of this tier is narrow and closed by a sheet of lead eighteen inches square, pierced with numerous holes and serving as a strainer, through which the water passes to the third tier forty feet from the surface. The floor of this tier is level, has no outfall for the water, and is six feet high and nearly three feet wide. This serves as a place of storage for the water conducted to it by the upper drains, and is connected with the surface, as were the others also, by a perpendicular shaft up which the water could be raised. Steps were placed in the shaft for convenience of access when they were cleaned. When the drains had been cleared, though it was a dry summer season, the water began to flow, and the drains to discharge their double duty of sanitating the soil and providing water for the villa above as when built centuries ago. An authority on this subject repeats that sanitary science in general is not a new thing in the world's history. Much pertaining thereto was well understood in ancient times, and the remains of elaborate drainage works have been brought to light by recent excavations of the sites of other former centers of civilization as well as at Rome. Perhaps the earliest written formulation of elementary principles of this science is the code of sanitary laws laid down by Moses in the Old Testament. Thus in Leviticus, chapter xiv, verse 33, where a plague-infected dwelling is described, we can not fail to recognize in the expression: "The wall of the house with hollow strakes, greenish or reddish, which in sight are lower than the wall," a description of a wet subsoil polluted with filth. The ancient remedy prescribed for such a condition was the entire removal of the infected portion, its reconstruction with clean, new material, and the thorough cleansing of the remainder in all particulars. At the present time little more than this would be done by city health officers in a similar case, and the additional work would consist of an examination of the water used by the inmates and the removal of all accumulations of decaying organic matter from the premises; special stress would also be laid upon the necessity of efficient underdrainage and sewerage, in order to prevent dampness and any further pollution of the soil. Other principles of sanitation were likewise enunciated by Moses, which are still regarded as standards, and form the basis of certain recent systems for rendering harmless various offensive wastes.

The rules, however, which were of easy observance by a nomadic people who could quickly leave a tainted locality, required considerable amendment after the migratory habits were abandoned in favor of permanent abodes in a single spot. For social and defensive reasons, large numbers of persons gathered together more or less compactly in communities or cities, and it was soon found that almost as much was to be feared from the diseases which developed in dense population, as from the attacks of external foes. Great care, accordingly, became necessary in the choice of locations for new towns, both with regard to the preservation of the public health and to successful defense in times of war. These important principles were keenly appreciated by the ancient Romans, whose conquest of the world was distinguished by the foundation of a vast number of cities, connected together by great roads and provided with extensive sanitary works for the welfare of the inhabitants. In fact, the Roman civilization in Europe was characterized by the concentration of the population in cities and the almost entire absence of country dwellings. Latin authors state that much attention was paid to the selection of sites for their towns, particularly with the view of securing freedom from noxious exhalations and obtaining efficient drainage. The extensive sacrifice of domestic animals, kept for a long period of time in a locality previous to deciding upon the foundation of a city, possessed in reality a scientific significance, for when the livers and certain other organs of such animals were found in a healthy condition, it was regarded as evidence that the soil of that locality was safe for the occupation of human beings and that its waters were fit for their consumption. Examinations of the subsoil were also made to ascertain whether it was capable of sustaining the weight of the contemplated structures, and whether it contained an undue amount of ground-water. If all of these conditions were found favorable, work on the new site was generally commenced by systematically draining it, as well as the adjacent lands; and as soon as a sufficient population was attained to warrant the expense, other improvements specially designed for the health and comfort of the inhabitants were carried out. The sanitary work done by the ancient Romans is thus seen to give evidence of much commendable wisdom and of remarkable municipal enterprise.

With the fall of the Roman empire, however, the development of practical sanitary science ceased for many centuries, and nearly all of the important public works that had been constructed for the maintenance of health in populous cities were allowed to decay, and even to become utterly forgotten. As a consequence of this neglect, the condition of densely inhabited towns became deplorable, and relief was sought by the formation of smaller communities in the agricultural districts. A number of large cities, however, which were distinguished by an unusually favorable sanitary and commercial location, continued their existence, but their growth was very slow, and serious epidemics were of frequent occurrence. In spite of such repeated warnings, few efforts for improvement appear to have been attempted, and these only when an exceedingly large mortality threatened the ultimate extinction of the inhabitants. Owing to the undeveloped condition of the physical sciences which are the handmaids of hygiene, the measures adopted at such times were rarely of permanent value; and it was not until civilization had sufficiently advanced to lead again to the formation of large towns, that considerations of the general health and comfort of the population gradually compelled earnest attention to be given to the subject of the systematic removal of the dangerous organic wastes. Especially slow appears to have been the progress of the art of the sanitary drainage of dwellings and cities; and, in fact, so recent is the formulation of the principles of scientific sewerage, that many of the pioneers of the art are among the living.

The relation between architecture and the sewerage of cities will doubtless appear very remote at the first glance; but, upon reflection, a strong mutual dependence of these arts can easily be discovered. The development of a large city involves an accumulation of wealth by many inhabitants and the creation of desires for personal comfort and luxury. To satisfy this desire, the architect's skill is first called into requisition, and hence large towns become the special field of important architectural operation. Particularly is such the case in the United States, where the physical and intellectual activity of the people is much more concentrated in cities than in the Old World, and, in consequence of this fact, the best specimens of American architecture are generally found in populous towns and their immediate vicinity. The increased value of land in large cities, as well as the effort to provide shelter for great multitudes upon relatively small areas of ground, has also resulted in the development of an entirely new type of buildings, which is characterized by an unusual hight of walls and a large number of stories, and has been adapted to a variety of purposes. Structures of this kind are necessarily more or less monumental in character, and require the utmost stability of their foundations, in addition to a pleasing appearance and a convenient arrangement; they must, moreover, be made perfectly healthy in all their parts, otherwise the large outlay involved in their erection will not meet with adequate returns. Now both of these essential features are dependent in high degree upon the local sewerage system, and hence it follows that architectural progress is always impeded where facilities for drainage and the removal of organic wastes are absent.

The powerful impulse which the remarkable development of science and industrial art during the past few decades has imparted to modern civilization, has had the effect of inducing an astonishingly rapid growth in the population of nearly every large city. Among the reasons that may be assigned for this growth, the principal ones are doubtless the general increase of wealth resulting from more skillful management of business enterprises and the payment of higher wages to employes, the consequent desire for the comforts, recreations and luxuries obtainable only in large communities, and the attraction which the possibility of securing profitable employment exerts upon the population of agricultural districts. A study of the census reports of our own and other lands shows that the concentration of population in large cities still continues, and, in fact, that the rate of increase is steadily growing. The introduction of so many new inhabitants, however, occasions periodical insufficiency of accommodation in these places, and thus requires commensurate improvement in both public and private work, not only in order that proper care may be taken of the new arrivals, but also that no serious danger to health shall result from the aggregation of large numbers of people upon a limited area of territory. Experience has proved that, sooner or later, the site of such aggregations will become pestilential, unless early provision is made for the safe removal or destruction of the putrescible organic wastes produced by the occupants, and as the study of the precise relation of these wastes to the diseases prevalent in dense communities has latterly become very extensive, the expansion of knowledge has led to the development of a special department of applied science, called sanitary engineering, which deals with the promotion of the health, comfort and longevity of mankind. Now, since one of the provinces of architecture is the accomplishment of the same purpose, there is accordingly a common ground upon which the architect and the sanitary engineer can meet.

The idea of a municipal guardianship of public health is well set forth in Superintendent Young's report, published in 1890. The preservation of the health of every class in a community is equally important to the rich and the poor. It is important to the wealthy that the working people should be kept in good health; for the influence of infectious diseases once introduced into the dwellings of the working classes often spreads far and wide, and is no respecter of persons; it is much more important to the poor man, as his health is his capital and wealth, that when taken from him leaves him a burden upon the community. How much the nation loses annually by preventable diseases can not be estimated; physical ability forms the basis of the working capacity of the laborer, and full work can not be obtained from a sickly and enfeebled population. Therefore, those communities who persistently neglect proper sanitary measures are squandering the wealth of their citizens. It is true economy to make sufficient appropriations for sanitary inspection and the general enforcement of the sanitary rules and regulations. Health is the capital of the laboring man and working woman; it is better to preserve health than to give alms. Unsanitary conditions cause sickness, disease and death, followed by pauperism, demoralization and crime. To preserve health is a moral and religious duty, for health is the basis of all social virtues. We make ourselves useful only when we are in good health. Municipal neglect of the public health is murder by the municipality. With a sufficient number of practical plumbing inspectors to cover the one hundred and seventy square miles of territory, the ordinances could be enforced and the rate of mortality reduced and much sickness prevented. The enforcement of the rules is a boon to the poor man, whether purchasing or building a home; for he could not himself superintend the plumbing and drainage of a house in course of construction, and would be at the mercy of any dishonest contractor. After the arrival of the troops in 1832, under date of July 19, General Scott wrote to military headquarters at Washington: "Major Whisler reports to-day sixty-three bayonets for duty; the battalion of artillery in the fort, or hospital, eighty-one. Colonel Eustis hands me this paragraph: 'The health of the battalion of artillery is evidently improving, and the progress of the cholera is checked. In the last four days there have occurred eleven new cases and ten deaths. The sick report is reduced from seventy to fifty, of whom twenty-eight are decidedly convalescent. The new cases are more mild than those of previous occurrence. The four companies, on leaving Detroit, counted one hundred and ninety enlisted men; fifty-nine have died, four were left sick at Mackinac, fifty remain sick and eighty-six enlisted men are on duty.'" On August 1, the disease was reported subsiding. No deaths had occurred in the last sixty hours, and there were very few cases. The prevalence of the disease among the troops caused great anxiety to General Scott, who did all he could to avert it, and to check it in its spread throughout the country. He left Chicago for Rock Island on July 29, and from the latter place he wrote, under date of September 1: "The great calamity of the times has come upon the troops on this island." His views as to the manner of the introduction of the disease are interesting. "I cannot doubt," he says, "from much personal observation that spasmodic cholera is partly epidemic and partly contagious. The atmosphere prepares the human system for its reception, and then it is readily degenerated by intemperance or extraordinary exposure; and when once generated, readily propagates from individual to individual, whose systems are more or less prepared for its reception. From all that I can learn, the population below, as well as the troops in this quarter, were many weeks since so prepared. To the systems so prepared, premature and fatal activity has been given, I believe, by importation from Chicago."

While at Chicago and on his way westward, General Scott filled the whole country, south and east, through newspapers, by innumerable letters, through discharged volunteers on the Illinois and Rock Island rivers, and other means, with admonitions to rangers not to approach Chicago. He sent his letters unsealed, endorsed with his name and rank, to excite curiosity, and to induce postmasters and others to read them and give publicity to his admonitions.

In short, he erected a paper barrier around Chicago, through which no company of rangers, though ordered to report to him, could ignorantly pass. The first case taken west of Chicago was that of a man named Johnson, who was with a company of fourteen men under Captain Ford, who came up from the Ohio river for provisions. The latter heard of General Scott's solicitude, and received his warning; nevertheless he moved forward and suffered himself with some of his men to be coaxed into Fort Dearborn. This was about August 10. Twelve days later the company reached the Mississippi, and on the night of the 25th Johnson was taken sick with the cholera. The second case, which appeared on the following day, proved fatal. General Scott closes his dispatch to his superior officers, in which he gives the painful details of the epidemic, as follows: "I am fully aware of the heavy responsibility that rests upon me for the spread of a dreadful malady among the troops under my orders, and through them prematurely among the population of this immense valley. I have never regarded myself as having been born to be a curse to my country. On the contrary, it has always been the first wish of my heart to serve her gloriously, but my care and foresight, amidst recent events, have been signally defeated. I have, without getting into battle myself, brought disease and death upon those who vanquished the public enemy. To the new danger I have freely and fearlessly exposed myself without utility. My heart is deeply humbled and afflicted. But, if I can not show that I have employed extraordinary care, and exercised even more than common sagacity to prevent the evils which I lament, I ask to be subjected to universal execration."

The beginning of sanitary laws in Chicago dates back to November 7, 1833, when the trustees ordered that persons casting refuse into the river should be fined $3. On June 6 of the following year positive instructions were given to the street commissioner to have debris and refuse of every character removed from the streets. This was followed in August, 1834, by laws providing against the obstruction of ditches, and a committee of citizens was appointed to see that those sanitary regulations were carried out. The fear of Asiatic cholera prompted the action of the village trustees, and drew several leading residents into the circle of sanitary works. Such men as Dr. W. B. Egan, Mark Beaubien, Dr. Goodhue, C. Taylor, G. Kercheval, A. Steele, J. Miller, N. R. Norton, Dr. Kimberly, John Davis, J. K. Palmer, H. Hugunin, J. Bates, John Kinzie and Dr. Clark, were appointed by the trustees to guard the village against all attacks of the disease. In February, 1835, a board of health was created, but on the demand of $2,000 by this body, made June 19, that year, to carry out necessary improvements, the villagers stamped the board as the very essence of extravagance and withdrew all countenance from the members as an organization. At this time sewers were undreamed of and the system too common even now in little country villages throughout the Union, then obtained. It was continued in various forms until the close of the fifth decade of the century, when the danger became too great to tolerate longer and the people called on the council to exercise their powers under the act of February 16, 1847.

The sanitary doings of the council and of the citizens in 1834–5 are thus set forth in detail: On June 6, 1834, the fear of cholera impelled the trustees to direct the supervisor "to remove and abate all nuisances within the corporate limits." Ordinances were passed providing that no "straw, shavings, or other substance" should be thrown into any "sewer, drain or ditch" within the town limits, under the penalty of a $2 fine and the expense of removing the nuisance; and that no person should deposit any "dung, dead animal, or carrion, putrid meat or fish, entrails, or decayed vegetables, or any other offensive substance," in the streets, river or elsewhere, under a penalty of a fine of $3; it also prohibited any owner of a lot from allowing such deposits to be made on the lot, or in the streets or alleys adjoining.

Two months after the passage of the first of the above ordinances, the town trustees were called to make suitable arrangements to prevent the introduction of the dreadful and fatal disease into the town, and at a meeting the condition of the town was taken into consideration and a full discussion of the impending danger followed, resulting in the adoption of measures intended to be preventive. The street commissioner, or supervisor, was directed to make arrangements for cleansing the streets and removing the filth half a mile outside of the limits of the corporation, and the inhabitants were warned not to throw anything of an offensive nature into the river. Committees of vigilance were appointed, whose duty it was to inspect all houses and yards of individuals of the town, and, if not found in proper condition, to direct the owners or occupants to cleanse them and put them in order within twenty-four hours of the notice given.

The first board of health was established at this time, though its functions were special, and its existence short. A committee was appointed to procure a suitable house, without the limits, for a hospital, to prescribe for all persons attacked with cholera, and to give such instructions to the supervisors as to promote the health of the town. Arbitrary authority was given the supervisor to order every male person in the town, over the age of twenty-one years, to work upon the streets and alleys within the corporation, for the purpose of cleaning them, and failure to work or furnish a substitute was punished by a fine of $5 for each offense. The cholera scare began to pass away, when the ordinances, already loose enough, were modified. On September 1 it was ordained that any person not wishing to work on the streets could compromise the matter by paying $1, instead of $5, as before.

There are no means of knowing, even approximately, the mortality, if any, from cholera during the year, and neither can it be judged of the efficiency of the measures taken to keep the plague out of the city and to stay its progress, if it were introduced, though there is no evidence that it appeared at all. No record of the deaths was kept, and all the regulations were primitive, however effective they may have been at the time. One good was accomplished by the cholera fright, and by the agitation and discussion which it caused. The propriety, if not the necessity, of making some permanent provision for preserving the general health of the town, and for meeting future contingencies in the shape of cholera or other epidemics, forced itself upon the trustees; and, accordingly they organized a board of health, and prescribed its duties and powers.

At a special meeting of the president and trustees of the town of Chicago, on June 19, 1835, a new board of health was established, consisting of seven persons, whose duty it should be to examine all streets, alleys and other highways within the limits of the town, and direct and aid the supervisor in the discharge of his duties. They were also required to examine the condition of every lot, dwelling house, cellar, outhouse, or other building, of whatever description, and require the owners, or occupants, to remove "all the predisposing causes of disease"—an extensive undertaking, it would seem—and abate all nuisances. The board of health, or the supervisor, were given authority to remove the nuisance, or fulfill the other requirements, if the owner or occupant should refuse or neglect to do his duty, at his expense, and, additionally, a fine of $5. Another important result of the agitation of sanitary matters was an order issued on August 13 of that year, directing the town surveyor to lay out sixteen acres of some suitable canal lot south of the Chicago river, and ten acres north of the river, for cemetery purposes. When the grounds had been surveyed and fenced, an order was issued forbidding further interments within the town limits. The north-side cemetery was located on what is now Chicago avenue, close to the lake shore, and the south-side cemetery, near the present intersection of Twenty-third street and Wabash avenue. The rapid extension of the town soon compelled the evacuation of these burying places. The first Chicago cholera scourge came to an end in 1835, having continued through the four years, 1832, 1833, 1834 and 1835, with greater or less severity.

In 1833 the first pier along the river was built, and early in 1834 the great sand bar was removed, opening the river to the commerce of the lakes. During the twelve succeeding years attempts to straighten the river's course were made; the line of docks was extended, and citizens began to dream that this "great and shining stream" would form at once the highway for commerce and the great channel for sewerage. The dreamers were summarily aroused in 1845, when that "shining stream" became so terribly offensive that the drowsy councilmen, driven to a sense of danger, adopted an ordinance providing penalties for those detected in casting refuse into the river and otherwise protecting it from pollution. This ordinance, while aimed at the owners of the slaughter houses, who were, in fact, primarily responsible for the pollution, did not or could not affect the equally noxious feeders or open street drains which meandered toward the river in all directions. Hence, even if it were observed by the plutocratic butchers, it could be only semi-effective in abating the dangerous nuisance.

As early as 1835 Anson Sweet constructed a large plank sewer on the west side of Dearborn street, from the river to Lake street, and was censured for the expense incurred. This was the first attempt at public sewerage. Sundry efforts to drain the streets were made during the following decade. The council in 1846 conceived the project of surface draining the town by cutting down the streets so that the surface water of adjacent blocks might be carried to the river. This unwise movement was effected to the extent of excavating in front of several blocks on Lake and Randolph streets, but was stopped by injunction of the property owners. The streets were refilled, and in a very few years it was difficult to find out who was responsible for the suggestion of making a second Venice of Chicago. About 1847 the owner of a brick block on the southwest corner of Lake and State streets, determining to have a cellar under his store, made the five-foot excavations and planked the bottom and sides with three-inch plank, the joints of which were caulked. Upright posts were placed between bottom and ceiling to resist the tendency of this box-like cellar to rise; but all was done without avail, as the force of the water was more than equal to the weight of the building, and the whole structure entered on an upward movement. This led to the abolition of the cellar project.

In 1849 a crude system of drainage was introduced, one which cost the town, ultimately, a large sum of money. Madison and State streets were selected as drainage divides, and Randolph, Lake and South Water streets were lowered according to a scale or grade established with the object of carrying off the water. The New Orleans system was adopted without its perfections, so that it is not to be wondered at that the people cried out against the remedy and demanded a practical sewerage system. In 1850 heavy box sewers were placed in the centers of Fifth avenue, La Salle, Clark and State streets, draining the territory between Randolph street and the river; branch sewers were also introduced, and the total cost, $2,871.90, was raised by special assessment. This attempt proved futile, for the box sewers failed to carry off the waters, and the planked streets became wood-covered, disease-breeding sinkholes. So unbearable did the streets become that the application of quicklime to the planking had to be resorted to. The second system of drainage was a failure. The legislative act of June 23, 1852, provided for the creation of a board of drainage commissioners. Charles V. Dyer, Isaac Cook, Henry Smith, George W. Snow, James H. Rees, George Steele and H. L. Stewart were appointed with plenary powers of taxation and construction. It was a step in the right direction. Just as the summary levee laws in the South proved immensely beneficial, so also did this radical act of 1852 inure to the sanitary and financial good of the village. By the close of 1854 there were four and a half miles of sewers, from five to eight feet below the leading streets, and the use of cellars became a possibility for the first time. In the north, south and west divisions ditches or dykes were excavated, and the marshy appearance of the neighborhood was partially lost in the improvement. Such were the beginnings of the sewerage system of this city. Humble, unsatisfactory, expensive for the time, useless for the future, they appear to have been necessary in the economy of city building and municipal education.

The appearance of the cholera in 1854, and the death rate of five-and-five-tenths per cent. of inhabitants, or one thousand four hundred and twenty-four persons, suggested the act of February 14, 1855, providing for the creation of a board of sewerage commissioners with ample powers. W. B. Ogden, J. D. Webster and Sylvester Lind were at once elected commissioners, and they appointed E. S. Chesbrough, then city engineer, superintending engineer of the work. Grades were adopted for the new system, the following inclinations being given, so as to produce a velocity of about two feet per second, when running half full: Six to four feet, one in two thousand five hundred; three and a half feet, one in two thousand; three feet, one in one thousand six hundred and sixty-six; two and a half feet, one in one thousand two hundred and fifty; two feet, one in one thousand; one and one quarter foot and

TELEPHONE BUILDING.

FLORENTINE-ROMANESQUE STYLE. ITALIAN ORNAMENT.

one foot, one in five hundred, with the provision that where more decided inclinations could be had they would be given. Under this system fifty-three and a quarter miles of sewers, or two hundred and eighty-three thousand five hundred and eight-six feet, were built prior to April, 1861, when the powers of the sewerage commissioners and their system were transferred to the board of public works. The effect on the health of the people was made evident in 1855, when the death rate decreased to two and forty-six hundredths per cent., and in 1860, when one and eighty-eight hundredths per cent. was recorded.

Five years after the construction of the sewers was commenced, or, in the spring of 1861, fifty-three and three-fourths miles of sewers had been built, which, with the catch-basins and manholes, cost $686,277.30. This included items which were not figured on in the original estimate, to the amount of $82,213.40. The average cost of sewers in 1856 and 1860 is shown by the following tabular statement:

	In 1856.	In 1860.
6-foot sewer, per linear foot	$5.76	$2.88
5-foot sewer, per linear foot	5.39	2.44
4-foot sewer, per linear foot	5.75	2.20
3-foot sewer, per linear foot	3.19	1.45
2-foot sewer, per linear foot	1.66	92
1-foot sewer, per linear foot	1.20	70

These differences in cost were owing to lower prices of labor and material; to greater competition among contractors, and to greater experience among the contractors and workmen. The cleansing of the sewers had cost up to January 1, 1861, $7,735.78. It was the custom to examine, and, if needed, to cleanse every sewer at least once a year. Some were found to require it twice or three times a year. The very slight inclination of the sewers led to unusual precaution in their construction; the result was that up to 1861 it had not been necessary to break open any sewers to remove substances that had found their way into the sewers and caused obstruction, except in two instances. One of these sewers had not been accepted from the contractors on account of known defects in the work, and the other had a defect not discovered until after the work had been accepted. In both cases the sewers were filled with quicksand which found its way through the defective work. An important modification of the original plan consisted in omitting the arrangement for flushing the sewers. It was found that the interest alone on the estimated cost of that arrangement would be more than the existing expense of cleansing the sewers.

The original plans of 1855 had in view the opening of a sewerage channel to the Mississippi, and thus avoid the contamination of the lake water. The sewerage commissioners, in their half-yearly report, made on June 30, 1860, thought that it was "expedient to delay, for the present, the construction of the canal from the lake to the South Branch," and it has not yet been built. The estimate for that work, with the necessary wheel and engine for pumping was $60,000. This expenditure, it was argued, would be rendered in a large degree useless, so soon as the deep cut in the Illinois and Michigan canal, which was then contemplated, should be made. It was thought that if the condition of the river seemed to demand some extra means of purification, some arrangement might be made with the canal company

J

to pump from the river so much as might be necessary to change the water. Should the deep cut be indefinitely postponed, it was felt that it would be necessary to revert to the original plan. The board said that no subject seemed to them to be of so great importance to the material interests of the city, and they recommended that the matter be brought before the next legislature. Mr. Chesbrough had been directed to make some investigations with reference to the practicability of lowering the canal so that it could be fed by the river, without the aid of pumpingworks. Two projects were then talked of, one to give the canal a channel two hundred feet wide and six feet deep, and the other with a channel of the same width, but twelve and a half feet deep. The probable cost of the former was estimated to be $10,000,000, and the latter $20,000,000. Mr. Chesbrough came to the conclusion that economy should decide the question, and the canal company be hired to keep their pumpingworks in operation during about ninety days a year. Thus, in connection with what the canal company would have to do, for their own benefit, pumping operations might be carried on during three-fourths of the time. It was considered that it was only from May 1 to November 1 that serious inconvenience could arise from the effect of the sewage in the river. Sometimes, in the coldest weather of winter, the water of the river, when covered with ice a foot or more in thickness, became offensive to the smell; at least offensive gases were generated somewhere, and they made themselves very sensibly felt wherever they found openings in the ice.

At the close of the spring of 1866 there were four hundred and forty-four thousand seven hundred and eighty-nine linear feet of sewers in existence, built at a cost of $1,345,798.60, all flowing into the river. The population was two hundred thousand four hundred and eighteen, including twenty-four thousand eight hundred and fifty-one children of legal school age. There were about thirty-five miles of streets improved. These figures show little over two feet of sewerage and less than a half foot of improved street for each inhabitant at the close of 1866. The lake-water was highly impregnated with sewage; sloughs were still as common as open drains; the packing interests were as extensive as their methods of removing large quantities of refuse were bad, aud, all in all, the city was prepared to respond promptly to the call of any epidemic which might present itself.

The sewer builders of 1869 were William M. Dee*, 106 Monroe; Dickey & O'Brien*, 134 La Salle, and Woodruff & Raffen*, 78 Madison. Charles Gladding* was the principal dealer in sewer pipe. In 1872 many additions were made to this list; John Brown, Coffey & Jackson, Ed. Flannedy, G. Gladding, M. Hartnedy, P. McCarthy, J. McNulty, P. R. and R. R. Williams were all enrolled. W. M. Dee, Hill & Williams, Hyde Park Cement Pipe Works Company, and Joliet Mound Company, were dealers iu and manufacturers of sewer pipe.

The *Sanitary News*, in its issue of August, 1885, refers to the epidemic of 1866, which carried off nine hundred and ninety citizens. "The first case of cholera in Chicago occurred July 21, 1866. To what extent the disease spread during the remainder of that month is not known, as the city authorities, from the desire not to alarm the public, reported all such cases as cholera morbus. On August 10, S. C. Blake, city physician, reported to the board of police, acting as a board of health, as follows: 'There have, doubtless, a few cases of sporadic cholera occurred in the city, but there is no evidence that cholera is prevailing in any epidemic form in our city. In view of the fact that cholera morbus is prevailing to a considerable extent, it is the duty of all citizens to purify and thoroughly cleanse and disinfect their premises.' Three days later the board of police ordered the health officers to purchase disinfectants and to cause the assistant health officers to examine all unhealthy localities, and especially those in which disease was reported; they were also required to have such localities thoroughly cleansed and disinfected. On the 16th three cases of cholera were reported, and the health officers were instructed to purchase material for the erection of a temporary hospital for the reception of cholera patients in the south division of the city. The health officers were also instructed to employ such nurses as were necessary at the cholera hospital. Two days later the chairman of the hospital committee of the board of supervisors of Cook county was requested to meet the board of police for consultation. As cholera was prevailing in Cincinnati and St. Louis, the city physician was authorized to employ two competent physicians to visit and meet the morning and evening trains from those cities at a distance not less than ten miles from the city, to ascertain if there were any cases of cholera on board. The health officer was also to employ a competent physician to take charge of the cholera hospital. Assistant health officers were directed to be at the depots upon the arrival of each train, to take charge of persons suffering from cholera reported by the physicians. The city had become so much alarmed by the 24th of September that an ordinance was passed making an additional appropriation of $10,000 with which to fight cholera. The disease continued to rage with more or less violence throughout the year, two fatal cases being reported on the last day of December. The highest mortality was marked on the 10th of October, when there were eighty-two deaths. Dr. John H. Rauch, while sanitary superintendent of the city, and during the months of July to December, inclusive, 1866, prepared tables showing the mean of the thermometer, the amount of rainfall, the direction of the wind, the mortality by cholera, and the number of cases reported."

In the early part of the year 1866 the council made appropriations, and the board of police in conjunction with the board of public works, went vigorously to work removing, so far as in their power, the exciting causes of disease, filth, etc., the results of former years of neglect. Owing to favorable climatic influences, and no doubt to the precautionary measures adopted, the first six months of 1866 were comparatively healthy, but, owing to meteorological changes, the mortality from all diseases was very much increased in July, and in this month there were indications that the dreaded pestilence was again in the city, although it had been reported as cholera morbus. In August there was a decided increase in the number of deaths, and on the fourteenth of that month the authorities announced the presence of cholera. From this time to the end of the month the fatality from this disease increased with daily fluctuations until the end of the month. Not much change occurred in the month of September, deaths occurring daily without exciting any unusual alarm, and for a time it was hoped that the scourge had done its work; but this hope was dispelled on October 8, when it became epidemic, causing the most intense alarm and excitement, and continued so until the twentieth, when it gradually diminished, the last fatal case occurring on December 31, 1866.

The great fatality by cholera in October, stimulated the friends of sanitary reform to action, and it was found that there was a general feeling among them that, although every effort had been made by the authorities to prevent the cholera, there was a want of intelligent action upon the part of those who had been entrusted with the execution of the preventive measures that had been adopted. Then, again, there was a well-founded feeling that sufficient prominence was not given to health affairs by law, as they were necessarily a secondary consideration with the board of police, which was encumbered and embarrassed by a multiplicity of other cares and duties, and could not give to the public health the time and attention it required. Custom sanctioned for a number of years the appointment of a health officer who was not a medical man, to whom was entrusted the general management of the health department, although the acts passed in 1865 made it the duty of the city physician to keep the board of police advised of the sanitary condition of the city, but beyond this his authority did not extend. Owing to the great increase of population, to the varied and numerous duties devolving upon the officer, to the inadequate remuneration given him, and to the want of means and authority to carry out his suggestions, but very little could be expected from him in his official capacity. The registration of deaths was notoriously imperfect, and gave only an approximate idea of the mortality.

To this defective registration, attention has been frequently called, and many unsuccessful efforts were made to improve it. This important duty was entrusted to those who were wholly incompetent to perform it, and even to them, comparatively speaking, no compensation was allowed. It is simply nonsense, suggests Dr. Rauch, to suppose that any but a medical man can properly prepare or supervise such records. It will also be seen that, generally speaking, the common council did not appreciate the importance and necessity of providing the means to enforce the existing regulations, or passing new ones, the object of which should be to promote the health of the city. Experience had also taught those who were interested in this subject that it was absolutely necessary, for the successful execution of the laws in this respect, to remove those who were entrusted with their administration, so far as possible, from local political influences, and that frequent changing of those who were placed in charge of the health affairs of the city was generally productive of much harm. Impressed with these views, a friend of sanitary reform visited Philadelphia, New York and Boston, and after carefully investigating their respective systems, he returned to this city, with the conviction that the plan adopted in New York, in the establishment of the metropolitan board of health, was the best and most efficient. The success attending the efforts of this board in preventing the increase of cholera was so striking that it attracted universal attention; and had it not been for this fact, the ravages of the pestilence would, undoubtedly, have been much greater throughout the entire country, as New York is the entrepôt and distributing point of nearly all the emigrants that arrive in this country. A meeting of citizens interested in this subject was called, and at that meeting a committee, consisting of Elliott Anthony, A. C. Coventry, Dr. J. V. Z. Blaney and Dr. John H. Rauch, was appointed to prepare a bill, to be sent to the legislature at the ensuing session, embodying the main features of the metropolitan health bill of New York, and at the same time to adapt it to the existing laws and altered circumstances here. The press heartily coöperated with the movement, and so did the board of trade and the mercantile association. The board of police acquiesced in the proposed change, being anxious to be relieved from the charge, which, from the organization of the board, naturally took precedence of the health department, and because they could not give this subject the attention it required, as the duties in many respects were of a character entirely different from those which generally occupied their attention. A copy of the bill was sent to the common council, accompanied by a request asking their coöperation in securing the passage of it by the legislature. The council, however, opposed it, and in addition to the proposed charter amendments that had been prepared, added others for the reorganization of the health system then in force. A spirited contest occurred before the legislature, upon the part of the friends of the bill first prepared and the common council, which finally resulted on March 9, 1867, in the passage of the act creating the health board.

On April 3, 1867, the board of police formerly transferred to the board of health everything coming within the province of the latter's authority. Among the first acts of the board was the adoption of a report made by the sanitary committee, which was prepared with special reference to warding off cholera. It is interesting to note the plan of action proposed in the first organized sanitary effort of the city authorities. The committee believed it to be of the first importance to have a thorough sanitary inspection of the city made "for the purpose of ascertaining what is necessary to be done to promote its sanitary conditions." The committee also recommended the appointment of a sanitary superintendent, who should be the chief executive officer of the board. He was to be charged with the execution of the orders of the board, and to exercise a practical supervision over its officers, agents, and employes. He was to make weekly reports concerning the public health of the city, and any causes endangering life or health that had come to his knowledge. It was recommended that the city be subdivided into sixteen sanitary districts, in each of which should be a sanitary inspector, who should be a physician of respectable character and standing. These inspectors were to be required to make written reports to the sanitary superintendent once a week, or oftener, as required, stating what duties they had performed, and such facts connected with the sanitary affairs of the city as might be worthy the attention of the board. A conference was to be held with the board of public works to ascertain where the duties of the board of public works ceased, so far as related to the streets and alleys, and where the duties of the board of health commenced. It was also recommended that the removal of the dead from any cemetery within the limits of the city be forbidden, and that no privies be allowed to be emptied, unless they, with the night-soil. were thoroughly disinfected.

Dr. Rauch was appointed sanitary superintendent, and sixteen medical gentlemen were appointed sanitary inspectors. Among these may be noticed the names of several who are now among the prominent physicians of Chicago, such as Drs. H. W. Jones, H. M. Lyman, Walter Hay, W. C. Lyman, E. O. F. Roler, Philip Adolphus and others. Among the first specific recommendations of the committee was one that the use of any organic matter in filling up streets, alleys or lots, or made ground within the city, a very common custom, be prohibited. The committee also recommended that some system be adopted for the disposal of night-soil, manure, kitchen-offal, and refuse matter, that might be detrimental to the health and cleanliness of the city, and that the laws and ordinances relating to the health and sanitary affairs of the city be "published in all the papers of the city, and that extra copies be obtained for distribution." It was only a short time before the number of sanitary districts was increased to twenty-two, and six more inspectors were appointed. The assistance of the board of police commissioners was requested and given, to the extent of having a sergeant of the force detailed as sergeant of the sanitary police. As early as the 11th of April the public expressed their alarm in a memorial signed by a large number of citizens, which was presented to the board of health. In this document were important suggestions with regard to cholera. As a result of a conference with the board of public works, the latter agreed to clean the streets and coöperate cheerfully with the board of health in all work tending to sanitary reform. In accordance with suggestions from the sanitary committee, a notice was published in all the city papers informing the public that a sanitary inspection of the city was about to be made, and requesting the coöperation of all citizens. A circular of instructions for the use of the sanitary inspectors, known as "Circular No. 1," was adopted and placed in the hands of the inspectors. It is of sufficient interest to warrant its reproduction, and was as follows: "The sanitary inspectors will keep constantly in mind the great good to society, and the scientific value of the knowledge expected to be gained by the system of health police that has just been inaugurated in this city. It is therefore desirable that they should take special interest in all sanitary questions, and keep themselves informed of what is being done, at home and abroad, relative to the causes which affect health or disease; thus they will contribute their share to the accumulation of knowledge which is destined to promote human life and establish sanitary science on the most permanent foundations. The value of these inspections depends entirely upon the conscientiousness, intelligence and industry of the inspectors, which the board trust will be appreciated, particularly when it is borne in mind that they involve life, health and prosperity.

"Inspectors will be under the immediate control of the superintendent, and will obey orders with promptness. They shall present themselves at the office of the sanitary superintendent as often as required by him, to receive orders and to make reports; nor are they to consider that their duties are limited to the district to which they may be assigned. They are to watch over all cases of small-pox, malignant fevers, or any contagious or infectious diseases, and if the patients are removed, to follow them with their supervision. It is a matter of great importance that they should familiarize themselves without delay with the sanitary conditions of their respectives districts, commencing their inspections where sanitary reform is most needed, and devoting especial attention to the localities in which cholera prevailed during the past summer, diligently searching for all local causes, especially overcrowding, the lack of ventilation, drainage and water, the influence of manure, garbage, etc. (in such common use for filling up lots in the city), and, if possible, to indicate in their reports the remedy for such deficiencies when found. The inspectors shall, every Saturday, make a written report to the superintendent, stating what duties they have performed during the past week, and also such facts as may have come to their knowledge connected with the sanitary affairs of their district, or the city, worthy the attention of the board, or as its regulations may require. All the forms for making reports must be filled up legibly and minutely, and any information added that will throw light on the subject under investigation. Reports should contain the name and position of the person making them, the date when any matter was inspected, the streets, avenues and alleys, how many lots the same is upon, and the names of the several owners, tenants and occupants of each, so far as can be ascertained. Reports should specify what part of the thing reported is on each lot, and (except in case of the regular general reports of the inspectors, upon which no order of the board is to be found), there must be a separate report, on a separate blank for each thing and lot reported upon, except that, when one building or business owned, tenanted, or occupied by the same person covers several lots, when only one report need be made. In cases where it will facilitate the understanding of the thing complained of, a simple diagram of the premises should be sketched with the pen on the margin of the report. Care must be taken to secure accuracy in reporting owners, tenants or occupants. In regard to each and every nuisance reported upon, the officer making the report should state his opinion that it is dangerous to life and detrimental to health. In addition to the duties already imposed upon the inspectors, they will promptly investigate and report upon any special complaints which may be referred to them by the superintendent, and pay particular attention to the character of meats and other articles of food offered for sale in their respective districts. They shall wear their badges prominently displayed when engaged in their official duties. On entering any house or premises, they must announce their authority and the object of their visit, and while endeavoring to avoid giving offense, must make their investigations minute. If resistance be offered them in the performance of their duty, they are to report the fact to the superintendent. They will, likewise, promptly report all who violate the health laws, in order that the offender may be summarily dealt with. All questions of doubtful authority must be referred to the superintendent for decision."

Look over the reports made by the health officers in April, 1867, and be grateful that the dread disease did not carry off nine thousand nine hundred and ninety inhabitants, in 1866, instead of the nine hundred and ninety-nine who died. Dr. Hay, sanitary inspector of the second district, reported the streets generally in bad condition, and the alleys, without exception, filthy, being used as a common receptacle for manure and garbage of all sorts. The sewerage was bad and the gutters and catch-basins obstructed. He wrote: "It seems inconceivable that people can exist; and that they do live in comparative health in the midst of such filth is only another illustration of the wonderful adaptability of man to his surroundings." In twelve days he reported: "Two hundred and thirty-four nuisances have been examined and complained of to the sanitary superintendent. An improvement is already perceptible in the district, although the work yet before us appears to be inexhaustible." Dr. John M. Woodworth, of the fourth district, represented the western portion of his district as being in a "deplorable sanitary condition—neglected stables and privies; filthy, oozy yards, and garbage scattered everywhere; obstructed sewers, and some of the streets impassable to teams with empty wagons." Dr. R. M. Lackey, inspector of the sixth district, reported imperfect drainage; bad streets, in many places impassable, and labelled "No bottom," "Keep out," etc.; the slaughter houses in a passable condition, and the scavenger work imperfectly done. Dr. Philip Adolphus, of the eighth district, reported his district in a bad sanitary condition; lots overflowed with water, gutters clogged up and filthy, great accumulation of manure, etc., and no pure water in the district. Dr. H. Webster Jones, of the ninth district, reported imperfect drainage, clogged gutters, and the use of surface water for drinking purposes. Dr. W. C. Lyman, inspector of the eleventh district, stated that the sanitary condition of his district suffered from (1) accumulation of manure; (2) accumulation of night-soil; (3) lack of drainage and connection with sewers. Dr. H. M. Lyman, inspector of the twelfth district, reported impaired drainage, defective water supply of a majority of the inhabitants, and the use of surface water. Dr. George Schloetzer, inspector of the fourteenth district, reported imperfect drainage, clogged gutters, and an accumulation of garbage, etc. Dr. John Reid, sanitary inspector of the fifteenth district, reported many of the streets and alleys in an impassable condition, with large quantities of manure in the latter. Dr. D. B. Trimble, inspector of the sixteenth district, reported the streets in a fair condition, the alleys in bad condition, and the drainage imperfect. The river was in a worse condition than ever, as citizens who stopped to consider the influence of such filth, shuddered to think of its results.

On April 20, 1867, a petition was received from about four thousand citizens of Chicago, requesting the board to exercise its full powers to prevent the reappearance of cholera during the coming season. The people seemed to have good reason for anxiety, from the fact that the night-scavengers frequently deposited nightsoil in the streets. The only action which seems to have been taken with reference to this matter was that the night-scavenger work was to be let by contract.

The conditions of the city when the inspectors began the work cannot better be shown than by their reports. The condition of the streets and alleys was found to be such that it was reported early in May as one of the greatest obstacles in the way of sanitary improvement, and a special committee on streets and alleys was appointed. By this time the work was carefully systematized and much good work was being done. At one meeting, one of the inspectors presented a communication on cholera, calling attention to the ground-water, theory of Pettenkofer, and recommended that observations be made in Chicago with regard to the effects of ground-water on the disease. There is no record showing that this recommendation was carried out. The sanitary committee presented an elaborate report on disinfectants, which was substantially like the recommendations of the present. Considerable attention was given to the subject of water-supply, as many people were using water from wells.

It was recommended that, when the lake-water was not supplied, it was a matter of vital importance that rain-water, or water-boiled, should be used for drinking. The recommendations have so useful an application at the present time that they may be reproduced in part: "Boiled water must be allowed to cool, also to absorb air which has been driven off by boiling, before it is drank. It should also be filtered. A flannel bag also answers for this purpose. The use of well water in this city is detrimental to health, as it is nothing but the drainings of the surface, containing large quantities of organic impurities. These can, to some extent, be removed by using a chemically pure solution of permanganate of potassa, eight grains to an ounce of distilled or boiled water. Into a half-pint of the suspected water, in a goblet or tumbler, put one drop of the red solution. If the red tint disappears from the glassful in half an hour, add more of the solution. For every drop that loses its color in the half-pint there will be from one-half to two grains of putrid organic matter in a gallon of that water. To purify such water, if it must be used, drop in the permanganate until the red tint remains in the water. A barrel of water may be prepared, using the same proportions, for culinary purposes. The addition of the solution to the water will not render it in any way injurious, nor give it an unpleasant taste."

The benefits of cleaning the city were plainly seen in delaying the appearance of cholera this year. It was not until July that the disease appeared, although, under ordinary circumstances, it might have been expected early in the season. During the entire month of July there were only three fatal cases; in August, five; in September, one, and in October one—a total of ten cases for the year. The conditions for cholera were certainly prevalent before the systematic cleaning-up began, and the effects were shown in an increase in the number of deaths, particularly among children. Cholera morbus was reported as having frequently occurred in July, "generally the result of excesses and of living in filthy places." On the 29th of the month the board of health recommended all householders to disinfect their outhouses, sinks and cesspools generally. The board also appealed to all citizens to aid the health authorities in carrying out sanitary measures. Early in August, the sanitary superintendent called attention to the necessity of increased vigilance upon the part of the board, owing to the increase of deaths from bowel affections. The vigilance of the authorities is shown in steps taken on the 12th of August to supply the small-pox hospital with lake-water and bathing facilities, and in providing that the better clothing be disinfected by boiling, hot air, and the vapors of sulphur or bromine, under the immediate direction of the city physician. By this time it had become apparent that cholera would not prevail to any serious extent during the year, and special attention was given to small-pox. Cholera did not reappear in Chicago until the year 1872, when the fourth and last epidemic came, and caused much suffering and great mortality.

The history of sanitary transactions in 1871–4 is taken from the report of the department of public works, issued in June, 1891: "The result of the almost total neglect of sanitary laws for a number of years, in addition to the fact that the construction of sewers did not keep pace with the increase of population, was apparent from the increased mortality of the year 1864. There was a great increase by cholera morbus and cholera infantum. Erysipelas and the lower grades of fever nearly doubled and small-pox almost trebled. There were nearly five times as many deaths by measles, and a great many more by pneumonia. Scarlet fever had almost disappeared. There were one thousand two hundred and thirty-three cases of small-pox reported, and two hundred and eighty-three deaths occurred. The report of the sanitary superintendent for the years 1870, 1871, 1872 and 1873—the period immediately preceding and following the great fire, contain much of interest, although the records of 1871 are incomplete, having been destroyed. Immediately after the fire, the placing of so many people in barracks, the crowding incident thereto, with the favorable conditions for local epidemics, called forth the utmost vigilance of the department, which was heartily seconded by the medical staff of the Relief and Aid society. Steps were taken immediately for the erection of a small-pox hospital, and a temporary structure was provided on the site of the old building. The month following the fire was one of a high rate of mortality, twenty per cent. of which was estimated to have been caused by exposure during and after the fire. With the approach of winter and the crowded condition of the barracks; with the heavy influx of strangers, and an increasing number of cases of small-pox with their points of infection, danger was apprehended from a general epidemic of this disease. Steps were taken to ensure a general vaccination by the inspectors of this department; orders were also issued by the Relief and Aid society that all persons receiving aid from the fund consigned to their care, be vaccinated. In this way some sixty-three thousand were vaccinated, and so to this action was due, no doubt, the escape from a general epidemic.

Since the great fire an unusual number of cases of small-pox has occurred in the city. The usual course was taken, simply vaccinating the infected houses, until winter, when an attempt was made to eradicate the disease by a general house-to-house vaccination. Authority was given by the board, and nine assistant sanitary inspectors appointed, to report to the regular inspector of each division. The work of visiting and vaccinating was begun about December 20, 1873. It was faithfully done, both by the inspectors and assistants. At the time this work was commenced the number of infected houses reported each week was thirty-one. After persistent work the number of infected points commenced to diminish, and at the time of issuing this report (April 1, 1874), the number of infected houses for the week was five, showing a decrease of twenty-six points compared with the week that the work was commenced, and a decrease of thirty-one points compared with the corresponding week of the previous year. The winter was one in which the most favorable conditions existed for a general epidemic of small-pox, as the disease was prevalent in many of the small towns surrounding Chicago, and from these towns persons from infected houses were in daily communication with the city, and many of the patients, when aware of the nature of their disease, would come to the city to gain admission to the small-pox hospital. With this constant exposure to the disease, confidence that the great care taken, with the efficient mode of inspection and vaccination, was the only means by which a general epidemic was prevented. In addition to the work done by this department, by request of the sanitary superintendent, all persons receiving aid at the office of the agent of Cook county were compelled to be vaccinated and to have their families vaccinated, or to present certificate or satisfactory evidence of recent vaccination from the proper medical officer. In this way about three thousand families were examined and vaccinated. The same rule was adopted by the Chicago Relief and Aid society, and by other charitable societies. The number vaccinated by the department was in ratio to the examinations, about one to seven; the number of persons actually vaccinated was seven thousand one hundred and sixty-two, while the number examined was fifty thousand one hundred and thirty-four. During the winter the new small-pox hospital, located on the grounds of the House of Correction, was completed and occupied. New furniture was placed in the rooms, and every effort made to make it comfortable and home-like, so that the objections urged against going to the old Lake hospital would not be urged against this one. Rooms were provided for doubtful cases, not connected with the wards, where inmates could remain without danger of infection until all doubt was removed. Rooms were also provided for private patients, where any one could go and have all the conveniences of home. The experience of the previous winter clearly demonstrated that the only way by which small-pox could be kept down is by thorough inspection of infected houses and neighborhoods, and the early isolation of cases, with power to vacate all boarding and tenement houses where a number of cases have occurred. This policy, followed up for a time, rid the city almost entirely of the disease.

The force of sanitary policemen was wholly inadequate to the performance of the duties required by the department. It was an area of thirty-five square miles, with a population of at least four hundred thousand. This was divided into twenty wards, with an average area of one and two-thirds square miles for each ward. The appropriation of 1873 provided for eighteen men; this did not give a man for each ward; in fact it gave but sixteen, two on special duty—one at the office and one as meat inspector. The inspector of meats did what he could toward discharging his duty, but the work was necessarily done very imperfectly, the number of markets and slaughter-houses in the city to be looked after being so situated that no one man could do it justice. Nothing is more important to a city or people than the food they eat. A strict surveillance should be kept over all slaughter-houses and markets, and everything not sound condemned. In the summer of 1873 Chicago was visited, in common with many places in the west and south, by cholera. It is true that sanitary science and care has rid this, the most terrible of diseases, of many of its terrors. It is a well-known fact that good water, perfect drainage, and personal attention to cleanliness and diet, with proper care, has rendered the disease, to a certain extent, controllable. During the epidemic of the summer of 1869 the disease struck hardest where sanitary laws were not observed. When the first cases occurred here, the department went to work quietly and did what could be done. The cases of cholera occurring in and about Chicago, during the summer of 1873, were principally in the Fifth ward, south of Thirty-fifth street and west of State street, and in the adjoining town of Lake, which was a continuation of this district, being separated from the city at that time by Thirty-ninth street. The district was densely populated, principally by foreigners, consisting of Germans, Swedes and Poles, the families living in small rooms, poorly ventilated, and subjected at all times to the ill effects of overcrowding. The district was low, with sandy soil and poor surface drainage. The water used, at the time of the first case, was procured from shallow wells, supplied with surface water, ordinarily from five to sixteen feet in depth, and walled up with pine boards, the water rising to within two feet of the surface of the ground. Many cases occurring in the beginning and, in fact, throughout the continuance of the disease, were reported as cholera morbus, as many physicians were loath to acknowledge the disease as cholera. Many cases so reported were identical with the cases reported as cholera. There were, outside of this district, thirteen cases reported as deaths from cholera in different parts of the city, the most of them from two to four miles from the district in which the first cases occurred, and with one exception in locations where overcrowding and filth were prevalent. There were six cases in the Fifteenth ward, two in the Third ward, one in the Eighth, one in the Thirteenth, and one in the Twelfth ward. After the disease broke out in the Fifth ward, many persons fled to other parts of the city; however, no connection could be traced between the cases in the Fifth ward and the cases in the wards mentioned above. The first case occurred at No. 444 Arnold street, in the person of John McFec, a bridge-builder, who had been working near Memphis, and left on account of the cholera. When he arrived in Chicago he had diarrhœa, which remained unchecked, and after a week or ten days developed choleraic symptoms and proved fatal. The second case was at No. 945 Butterfield street, two miles from the first case, in a tenement house occupied by several Danish families.

From the beginning, active measures were taken by the officers of the board of health—Drs. Rauch and Reid. Thorough disinfection was prosecuted, and the people warned not to use the water from surface wells. The board of health recommended that water pipes be laid, so that the district could be supplied with pure lake water, and ordered the wells to be fouled with carbolic acid so that the water could not be used for drinking or culinary purposes. The board of public works supplied the district with water as far south as Thirty-ninth street, where public hydrants were placed by the board for the benefit of the people in the town of Lake. Butterfield street was supplied June 24; Burnside street July 13, and Arnold street June 10 to 21. The effect of cleanliness on families and individual cases was marked. Those who observed sanitary laws, attended to the disinfection of stools, and who were prompt in calling a physician, with few exceptions, recovered, and the occurrence of a second case in such families was rare. On the other hand, when the stools were not cared for, and the vomit permitted to remain on the floor, and the bedding (principally feather-beds) used without having been properly cleaned, and where no attention was paid to ventilation or personal cleanliness, several cases would generally occur, and as a rule prove fatal. As but few cases were reported to the board until they had proved fatal, there were no data aside from the cholera hospital, by which to form an estimate of the value of any plan of treatment.

During the fall and winter of 1872 there appeared the epizootic or horse disease. After traversing the eastern states it made its appearance in Chicago October 11. The disease spread rapidly, until almost every horse in the city was afflicted. During the prevalence of this disease cattle were substituted for horses, and the business of the city done in that way. The number of horses dying during the epidemic was eleven hundred and fifty. The mortality of 1870 was not characterized by any general epidemic, although the number of deaths was greater than in 1869, the deaths for that year being sixty-four hundred and eighty-eight, or eight hundred and thirty-five less than for the year 1870. The increase of deaths was accounted for by the increase in population during that year, the ratio remaining about the same for each year. The largest mortality from any disease was from cholera infantum, nine hundred and sixteen having died from that disease. The mortality statistics for 1871 were very imperfect, the records of the office, as before stated, being destroyed on October 9. The mortality for the year was some three hundred and forty-seven less than for 1870, notwithstanding the deaths caused by the great fire. The mortality that week was: By burns, ninety-six; by falling walls, five; and some ten or twelve others were found, upon whom the coroner held inquests, some of whom died of shock, some of suffocation. The total number of inquests held was one hundred and seventeen, the result of the fire. The total mortality for the year 1872 was ten thousand one hundred and fifty-six, being thirty-one hundred and eighty more than in 1871. The cause of this is apparent when we consider the great number of people brought together in barracks during the winter, the crowding in the tenement houses that remained, and the great influx of workmen engaged in the work of rebuilding the city, who were congregated in cheap boarding houses without reference to comfort or ventilation. This overcrowding brought its legitimate result—an increased death rate—although during the year no epidemic existed. The highest death rate was from cholera infantum, being fourteen hundred and sixty-nine. The mortality for 1873 was ninety-five hundred and fifty-seven, a decrease of five hundred and ninety-nine compared with 1872. The decrease in the death rate was very noticeable during the latter part of the year. The removal of so many people in the barracks and the less crowded condition of the tenements, the better ventilation of the new buildings that replaced the old ones had its effect on the mortality. During the summer, although cholera was present, the cases of cholera infantum were less than the year before, there being twelve hundred and sixty cases this year against fourteen hundred and sixty-nine last year. During the year many miles of sewers were laid, and a large area of our city drained. The board enforced the law compelling persons to connect dwellings with sewers. Much good was thereby done, and the sanitary condition of the city much improved. In 1874 the ordinance regulating packing and rendering-houses was adopted. The council learned that the old system of condensers had to be superseded by one which would rob the gases of their odor or destroy them.

Returning to the subject of sewer building, attention must be redirected to the act of the legislature approved February 14, 1855, under which a board of sewerage commissioners was appointed by the city council, consisting of one member from each of the three divisions of the city. It was the duty of this board to consider all questions relating to the thorough and systematic drainage of the city, to submit a plan and an estimate of the cost to the common council, and to issue bonds from time to time, as they should deem expedient, not exceeding the sum of $500,000, pledging the faith and credit of the city for the payment of the principal and interest thereof. The first commission consisted of William B. Ogden, J. D. Webster and Sylvester Lind. E. S. Chesbrough was appointed chief engineer and William H. Clark principal assistant engineer. During the season of 1855 surveys were made and plans drawn and adopted by the commissioners and submitted to the common council and their fellow-citizens for a general approval, December 31, 1855. The plans submitted were bound on the north by Division street, on the west by (Reuben street) Ashland avenue, on the south by (North street) Sixteenth street, and on the east by Lake Michigan. The plan as adopted and since carried out provided for main sewers in the north division, in Rush, Clark and Franklin streets discharging into the main river, and Chicago avenue emptying into the north branch. The west division mains were located on Fulton, Randolph, Madison, Adams and Van Buren streets, emptying into the South Branch. The south division, east of State street, was drained by a main sewer in Michigan avenue, from the river to Sixteenth street, the summit being at Van Buren street; that part south of Van Buren street discharging into the lake at Twelfth street, the part north to empty into the main river; the portion lying south of Washington street, west of State street, to be discharged into the South Branch at various streets; the part west of State street and north of Washington street to be drained by two-foot sewers in each north and south street emptying into the main river. From the outset Mr. Chesbrough insisted upon constructing sewers to discharge by gravity; this necessitated raising all the streets from one to three feet above the natural surface of the ground in order to have sufficient cover over the top of the sewers to protect them from frosts and heavy traffic. The first sewerage bonds to the amount of $100,000 were sold March 19, 1856. The first contract for constructing public sewers was awarded and work commenced in 1856. State street, from Randolph street to the river, was built by Ives & Lonergan, contractors. North Clark street, from North Water street to Erie street, was built by S. S. Wiltsee & Co. West Randolph street, from the river to Desplaines street, was built by S. S. Wiltsee & Co. These were the first sewers built.

There were built during the year 1856, six and two-hundredths miles; during 1857, four and eighty-six-hundredths miles; during 1858, nineteen and twenty-nine-hundredths miles; during 1859, ten and forty-five-hundredths miles, and during 1860, thirteen and nine-hundredths miles; total built by sewerage commissioners, fifty-three and seventy-one-hundredths miles.

On December 19, 1856, Mr. Chesbrough received instructions from the board of sewerage commissioners to proceed to Great Britain and the continent of Europe for the purpose of examining the various methods of sewerage adopted there, and to collect such information as in his judgment would aid in the further prosecution and perfection of the sewerage of the city of Chicago. He visited Liverpool, Manchester, London, Glasgow, Amsterdam, Hamburg, Berlin, Paris and other cities, and made a lengthy report to the board of commissioners March 25, 1858, recommending that the system planned by himself and adopted by the board in 1855 be carried forward. By an act of legislation, approved March 20, 1861, the board of sewerage commissioners was abolished and a board of public works was created. At an election held the third Tuesday in April, 1861, Benjamin Carpenter, Frederick Letz and John G. Gindele were elected commissioners. The board was organized and assumed full control of all public works, including sewerage, on May 6, 1861. The board of public works continued in power, with several changes in its members, until September 19, 1876. Total number of miles of sewers in place December 31, 1876, two hundred and sixty-five and eight-tenths miles. On September 18, 1876, an ordinance was passed abolishing the board of public works, and on September 18, 1876, the department of public works was organized, with the Hon. Monroe Heath, mayor and acting commissioner. No commissioner of public works was appointed until after the Hon. Carter H. Harrison was inaugurated mayor, on May 19, 1879. Charles S. Waller was appointed and qualified commissioner.

The total cost for the construction of sewers and catch-basins and maintaining same since the establishment of the sewerage system in 1855, to January 1, 1891, is shown in the following table taken from the official report:

YEAR.	Linear ft. of sewers built.	No. of catch-basins built.	No. of man-holes built.	No. of house drains put in.	Cost of cleaning sewers and catch-basins.	Street intersections and repairs of sewers.	Cost of construction.
Previous to 1861	283,586	1,174	2,102	2,194	$ 5,619 48	No amts. found on reports.	$ 665,188 46
1861	2,826	18	33	243	1,715 60	$ 2,951 76	3,617 31
1862	15,676	72	66	365	4,897 24	3,024 07	57,036 42
1863	39,605	192	204	536	5,065 40	2,058 11	169,527 38
1864	25,021	189	183	512	9,417 81	4,597 63	87,221 48
1865	29,948	223	168	1,288	13,818 07	7,493 56	137,643 02
1866	48,127	327	271	3,732	28,445 16	7,773 65	225,564 53
1867	89,681	418	555	3,703	26,540 81	9,581 42	416,730 51
1868	47,841	480	293	3,261	26,954 06	11,287 08	197,152 92
1869	139,705	771	928	3,979	26,015 68	7,527 16	654,141 26
1870	78,166	626	468	5,187	21,464 30	10,954 74	258,664 70
1871	50,716	277	357	3,093	17,415 46	42,557 72	153,295 36
1872	47,342	245	341	1,435	21,484 16	16,975 40	173,255 76
1873	146,702	897	1,015	4,691	31,229 27	29,781 97	450,222 90
1874	222,322	1,054	1,474	6,292	36,884 57	21,996 72	587,507 38
1875	120,971	958	789	3,365	32,098 23	28,107 40	342,932 89
1876	15,248	155	75	1,172	29,345 41	19,803 29	79,545 28
1877	64,666	363	431	1,822	35,763 33	16,959 44	291,829 63
1878	88,031	492	603	1,544	25,704 37	19,259 49	37,264 97
1879	145,381	820	1,043	2,953	29,283 67	10,649 69	130,840 50
1880	79,128	271	554	4,196	25,561 48	25,068 11	92,544 08
1881	132,076	548	917	4,810	34,512 15	30,967 89	452,310 06
1882	98,515	792	725	5,677	33,969 35	26,618 05	224,450 16
1883	75,364	835	497	5,963	34,749 74	25,140 81	232,084 33
1884[1]	101,547	751	654	5,957	43,678 03	37,893 29	258,020 91
1885	118,647	796	854	6,325	46,532 18	45,333 02	203,188 03
1886	103,193	734	723	7,441	51,110 46	50,707 64	177,647 24
1887	90,584	756	605	8,100	50,264 65	43,789 60	186,496 98
1888	104,903	816	674	8,152	52,422 41	53,782 97	228,567 57
1889**	171,023	1,351	1,190	4,303	61,503 01	63,459 25	350,234 54
Annexed Districts previous to 1890,	993,573	6,102	8,620	Estima Cost of	ted cost of co st maintenance not	ruction. known.	2,614,224 75
1890	379,203	2,986	2,604	9,279	107,873 34	83,388 08	826,718 67
Totals	†4,149,317	26,489	*30,016	121.570	$971.338 88	$759,489 01	$10,965,669 98

[1] At the close of the fall of 1884 (September), the whole village of Hyde Park could boast of only sixteen miles of sewers, placed without much regard to grade.

**At the close of 1889 only three sewers in the old city emptied directly into the lake.

†Of this amount, 5,897 feet have been taken up and replaced by sewers of larger size, leaving in place January 1, 1891, 1,143,420 feet, or 784,737 miles.

Of the above 784,737 miles, 360,694 miles are constructed of brick, and 424,043 miles are of vitrified clay pipe.

*Of this amount twenty-six manholes have been abandoned, leaving in place January 1, 1891, 29,990.

The cost of sewer building and house drainage has been a serious drawback to the extension of the sewerage system of Chicago. The large sums required to line the pockets of officials made the question of sewer building, within the old limits, a serious one for the council; while the plan of special assessment or direct taxation for street improvement, made it a serious one for the settlers in the old suburbs, now part of the city. The knowledge that too large a percentage of the total cost would be required by the contractor and boodlers proved a poor incentive to prepare the taxpaying mind for expenditure in this direction, and thus the great centers of population throughout the world, except Paris, tolerated the barbarous, dangerous cesspool and wooden pipe, until necessity drove them to accept the expensive remedies prescribed by the sewer-builder and the plumber. Municipal law, competition and the law of demand and supply, were generally ignored in works of this character; for the solidarity of interests in the trades prevented competition to a degree, and left the taxpayer to pay a fixed price or do without the improvement. The old town boards were stockholders, so to speak, in the trusts, and the taxpayer was too often compelled to pay the highest price for the least value. The ordinance, the commissioners, the judgment and the collection, were all summary institutions, wasteful and untrustworthy in the extreme. Sewers were constructed at great expense and out of all proportion to even prospective demands. An inquirer into the methods of the past finds out the needless expense and the ignorance of design manifested. He distinguishes between the combined and separate systems thus: In the combined system—that is, sewers designed to carry the storm-water as well as the sewage—the size is determined by the amount of storm-water to be provided for, the amount of sewage being so small that it is not necessary to take it into consideration. The ordinary amount of sewage is very small in comparison to the size of the sewer, and the stream is shallow and sluggish. The sand and rubbish carried into the sewer during storms form small dams, holding the sewage in pools. The sewage decomposes, and the sewer becomes a manufactory of sewer gas on an extended scale, and the gas pours out of the manholes and street-basins into the streets and through empty traps and leaky pipes into the houses. In the separate system of sewers, i. e., from which the water is excluded, the size of the sewer is determined by the amount of sewage to be provided for where rapid and efficient disposal of sewage is desired. By thus limiting the size of the sewer to what is necessary for the service required, there is not only given an efficient working, but the cost is decreased considerably.

To illustrate the carrying capacity of sewer pipes, let it be supposed that the lots on a street are forty feet wide; there is a house on every lot, and each house contains an average of five people. Allow two barrels of sewage per day for each person. An eight-inch sewer, laid on a grade of one foot in a hundred, will carry more sewage than would be discharged from a row of houses two miles long under the same conditions. A sewer small enough to secure a proper depth of flow is much less liable to stoppage and clogging than one in which the flow is shallow and sluggish. The matters of ventilation and flushing can also be much better attended to in a small sewer than in a large one. In some cases storm-water

TACOMA BUILDING.

conduits may be necessary on the principal streets, and may empty into the nearest water-course. The Chicago sewerage system, outside the old business center of the city, perfect as it now may be, is at fault in its expense and scope, so much so that a sufficient sum has been expended on eighty square miles to complete the system over the entire area of the present city, or about one hundred and eighty square miles.

The compound sewerage system was introduced since 1889 at Auburn Park. It is called the double sewerage system, and necessitates the laying of twice the amount of pipe that the ordinary style needs. Therein lies the cause of the extra cost. One pipe is laid from five to seven feet deep, and is used for the regular sewage. At the head of each of these sewers is a reservoir, eight feet deep and five feet in circumference, which is fitted with valves, etc., so as to automatically flush the sewer as often as desired. The outlet of this flow is into the Chicago river. Above this lower pipe is one for rainfalls or storm-water. This pipe is but from three to four feet deep, and leads its contents, by gravity, in an almost opposite direction to the Auburn lakes, and thence to the Calumet river.

Pullman, the home of water fowl and muskrat at the close of the eighth decade of this century, is to-day an object lesson in communal life. In the matter of city sewerage, it demonstrates, in a small way, the economical system of Paris, France. Dr. De Wolf deduces from this accomplished fact five important points: "First, that the sewage of a town, if separated from the surface water and used on a farm in the vicinity of a market, can be profitably made into manure; second, that capitalists can find a profitable investment in the erection of towns built on sanitary principles for the occupation of their workmen; third, that the erection of such towns as Pullman and Saltaire has a very valuable and decided sanitary educational influence on the general population; fourth, that such towns, by improving the social surroundings of the working classes, tend to diminish the unrest, which is one great factor in capital and labor conflicts; fifth, that this field is one which especially deserves the attention of philanthropists, since it increases the power of the person aided to help himself, does not take from him self-respect, and therefore has no pauperizing tendencies, like the greater number of other philanthropic schemes."

The sewage farm of Pullman is situated about two and one-half miles south of the village. About one hundred and forty acres of land have been thoroughly drained and piped for the reception of sewage, with which these acres are irrigated by means of hose. Hydrants are placed at proper intervals, so that the distribution can be easily effected. There is nothing offensive about this work, nor can any one detect noxious odors at the pumping station, or at the farm. All organic matter in the sewage is at once taken up by the soil and the growing vegetation, and the water, making from one hundred to five hundred parts of the sewage, runs off through the under-drains to ditches which carry the filtered waters into Lake Calumet. Where the sewage-water leaves the drains it is as clear and sparkling as spring-water, and laborers often drink it. One acre of land will take up the sewage of one hundred persons. There is land enough already prepared to receive the sewage made by a population of fifteen thousand. The pumps now at the pumping-station can handle five million gallons a day, if necessary, and the main to the farm could carry the sewage for a population of fifty thousand. These pumps are now required to handle about a million gallons a day, coming from shops, homes and public buildings. All waste products at Pullman are thus carefully utilized, being transformed by vital chemistry into luxuriant vegetable forms. The sewers of the town are kept clean by the flow and by ample flushings. Provision is made for rodding them out when they become obstructed. Every portion of the town is perfectly sewered, and every sewer is well ventilated by perforated manhole covers. The whole system is built after a scientific method, the same plan being adapted to every house and lot. The drains are trapped only outside the buildings, where an S-trap is used. Traps are also placed under the water-closets. House drainage is of course compulsory, as everything is owned by one man, but the tenants have nothing to do with this themselves, everything being provided for them. No odors have been detected even at the ventilating manholes, as the sewers are kept as clean and well flushed as possible, and the sewage is almost immediately pumped out of the town.

The ordinary street in Pullman has the regulation width of sixty-six feet. When finished there is a sidewalk on either side, eight feet in width, then plats of grass eight feet wide, on which shade trees are planted, and then cobblestone gutters two feet in width. Thirty feet of the central portion of the street is paved for a roadway. At the outside of the sidewalk line, or what is termed the block line, there is usually a terrace, from one to three feet higher than the street center, and from eighteen to twenty feet wide, which makes the distance between opposite house lines a little more than one hundred feet. The sidewalk has a lateral pitch of two inches, the side nearest the roadway being two inches lower than the side on the block line. The long grass plots, too, have a further slope of two inches from the sidewalk to the gutter-line. These gutters are usually about three inches deep, with summits so placed as to lead surface-water to the catch-basins, which are placed in the center of gutters, at intervals of about one hundred and sixty-five feet. The pavement is crowning, the street center being as high as the sidewalk line nearest the building line and sloping each way to the gutters. There are six miles of paved streets, and two kinds of pavement, or macadam have been used. The first kind consists of nine inches of furnace slag spread over the street, and this slag covered with four inches of Joliet gravel. The second kind consists of a similar substratum of slag or broken stone, with a top-dressing of four inches of crushed limestone. The top-dressing in both cases is well rolled with heavy rollers, and, with moisture and use, becomes a sort of artificial stone. The furnace slag used is a porous vitreous compound, which readily absorbs water and has a tendency to keep the surface of a street dry. The material known as Joliet gravel is composed almost wholly of limestone pebbles. Experience and observation have shown that crushed limestone is preferred as a top dressing for streets.

The streets are swept and cleaned every day and sprinkled when there is any dust. The results are believed to be perfectly satisfactory, and it is claimed that such clean streets and alleys can not be found in any other city on the earth. The dust argument against the crushed stone applies with equal force against the gravel, as the dust in both cases is merely pulverized limestone. In the construction of sidewalks no particular material has been prescribed. Most of the walks are now of two-inch plank. Here and there we find a stretch of gravel walk. Some brick sidewalk was laid during the summer of 1884. Although the town is still in its infancy, there are already thirty thousand shade trees and shrubs in its streets and parks. The regulations provide that garbage and ashes shall not be deposited in streets or alleys, but shall be placed in receptacles at the back ends of the lots; thus the alleys and streets are kept clear and clean. The contents of these receptacles are carted away daily.

The mean velocity of flow in sewers has been determined through a knowledge of the relation of the mean velocity to the cross section and slope of the water. Some years ago Kutter's formula was published, while D'Arcy and Bazin also wrote on the subject. The former considers the character of saturated surfaces. Though his work is complicated, a realization of his terms and his diagrams will render it comparatively simple. Engineer Hering points out how its simplification may be accomplished for general sewer work without even the use of the diagram, thus:

The original formula reads:

(1)

$$v = \frac{41.6 + \frac{1.811}{n} + \frac{0.00281}{s}}{1 + \left(41.6 + \frac{0.00281}{s}\right)\frac{n}{\sqrt{r}}}\sqrt{rs}$$

in which v = velocity per second. n = coefficient of roughness of wetted perimeter. r = hydraulic radius. s = slope of water surface.

The term $\frac{0.00281}{s}$, which occurs twice, can be readily eliminated by substituting for the value s the least grade that we are likely to have in sewers—namely, 1:2500. Then we obtain the constant value: $\frac{0.00281}{0.0004} = 7.0$, which reduces the formula to:

(2)

$$v = \frac{48.6 + \frac{1.811}{n}}{1 + 48.6\frac{n}{\sqrt{r}}}\sqrt{rs}$$

This substitution influences the result but little. It tends to make the smaller sewers slightly larger than the original formula. There would be in fact no difference at all for a sewer about thirteen feet in diameter, whatever its grade, and the difference would increase, as the size diminishes and the grade increases, up to an excess of about five per cent. for a sewer of one-foot diameter, at a grade of four feet for one hundred. This excess of about five per cent. is practically the maximum error for sewer application, and it is always on the safe side. We can, therefore, safely let it stand. But the formula can still further be simplified by substituting a numerical value for n. According to Kutter, for glazed pipe we would have to put $n = .010$. But owing to the frequency of joints and the imperfect shape due to the process of burning, which causes projection in the sewer at nearly every joint, it is not safe to assume so low a coefficient. Besides, the flow of sewage is slower than that of clear water, because the suspended matter drags at the perimeter and tends to hold the water back. Allowing for these causes, we generally get nearer the truth, if for pipe-sewers we put $n = .013$. For brick sewers, on the other hand, Kutter gives $n = .013$.

It has been found, however, that if well built n can often be reduced to .012. Still, for sewage flow, the resistance is again greater, and it is found that by adopting the value of $n = .013$ also for brick sewers we are about as nearly correct as it is necessary to be in the majority of cases, and err slightly on the safe side, if we err at all. By substituting this value in formula two we get:

(3)
$$v = \frac{188}{1 + \frac{0.64\sqrt{rs}}{\sqrt{r}}}$$

or,

(4)
$$v = \frac{188\, r \sqrt{s}}{0.64 + \sqrt{r}},$$

which is, therefore, not only a sufficiently accurate, but also a sufficiently simple formula for general use in sewer work, for which purpose it has been used since 1879. Stated in general terms, the formula reads:

(5)
$$v = \frac{A\, r \sqrt{s}}{B + \sqrt{r}}$$

By substituting the following values for the coefficients A and B, we can use it for any other degree of roughness than $n = .013$, as we may think proper in some cases.

Different Degrees of Roughness.	A	B
For = n 0.011 very smooth with even joints	213	0.54
For = n 0.012, very smooth with even joints	200	0.59
For = n 0.013, average, with even joints	188	0.64
For = n 0.014, average, with even joints	178	0.69
For = n 0.015, poorly built brick work with washed-out joints	169	0.73

For *very* smooth and regularly-shaped sewers we might say:

$$v = \frac{200\, r \sqrt{s}}{0.6 + \sqrt{r}},$$

which formula is easily remembered and easily solved.

Wooden manhole covers were in general use prior to the year 1879. For the eighteen years preceding that date the average cost of maintaining these covers was thirty-eight cents each. In his annual report for the year 1878, Benezette Williams, principal assistant engineer, urged the adoption and use of iron covers. A standing objection to any municipal improvement then, as well as at the present time, was the cost. Williams sought to show that it would be economical to use iron covers rather than wood, and presented the fact that the cost of each wooden cover, thirty-eight cents, was equal to the interest on $5.40 at seven per cent. per annum, hence that, if $5.40 were added to the cost of wooden covers, a permanent cover needing no repairs or renewals could have been obtained and would have been equally economical. Wooden covers were then costing a little more than $5; if permanent covers could be obtained at any price less than $10.40 it would be wise to adopt them, to say nothing of the greater satisfaction and safety attending their use. But covers of a good quality of cast iron could be had at a cost not exceeding $10. In accordance with Williams' recommendation the use of iron covers was inaugurated in the following year, and nine hundred and ninety-eight were substituted for wooden covers, at an expense of $7,332.46, not including one thousand one hundred and thirty-six open iron covers on manholes and catch-basins for ventilating purposes, costing $3,568.71. The question of ventilating the sewers through grated manhole covers was first suggested by Mr. Williams, and a small appropriation was made by the city council in the year 1878 for this purpose. Nothing was done, however, until the following year.

In 1883 an elaborate system of plumbing, sewerage and sanitary ventilation was introduced by J. J. Wade, as the embodiment of improvements suggested by twenty-five years of practical work. Other members of the craft in Chicago also introduced admirable sanitary apparatus, and it may be stated that no body of plumbers in the world has at all approached that of Chicago in the number and usefulness of health guarders for sewers and drains.

The system of sewer building adopted in Washington, D. C., and common in Chicago, is peculiar in its perfection and highly sanitary in its effects. The runners, under twenty-four inches in diameter, are composed of round, vitrified, terra cotta pipes, placed in concrete, with bands set in hydraulic cement. One of the prime objects of this substantial setting is to present an obstacle to tree roots entering the pipes. The sewers over twenty-four inches in diameter are constructed of brick, springing in egg-shape form from a base of vitrified pipe known as the half-pipe invert. This system is so planned that a rainfall of two inches per hour and a house drainage of five cubical feet per second to every one hundred thousand superficial feet may be carried off immediately. The system of manholes show one in every one hundred and fifty linear feet, with ventilated covers in the street and close covers in the parkways.

In the case of large cities, the drainage of the surface and the subsoil, as well as the removal of organic wastes by water-carriage, is commonly effected by a single subterranean conduit; but when circumstances demand that the conduit containing such objectionable wastes shall be absolutely impervious, a separate pipe, laid under or alongside of the former and simultaneously with it, is sometimes provided for the interception of the subsoil water. Drainage and sewerage are thus performed by a single operation; and even where sewers have been constructed as water-tight as possible, with the direct view of excluding sub-soil water, a marked reduction in the level of the latter always follows from the simple act of cutting a trench on a true grade to some outfall, and the provision of a relatively smooth and continuous surface along which this water may flow in a thin sheet. The principal function of a sewer, however, is the quick removal of putrescible surface matter from human habitations, and the delivery of such matter to some distant point.

In 1890 Chicago led in the movement to master the air currents in sewers. Instead of having the branch to connect with house drainage opposite the lot, it is inserted from five to ten feet beyond a continuation of the lot line in the direction of flow in the main sewer. The object of this system is on its face simple. The possibility of the sewer current, even in case of flood, is reduced to a minimum, while the chances of air currents being diverted from the larger main are lessened. Common sense, rather than science, suggested the change from the old system, and beyond the extra expense which it entails on the house owner in making connection with the main, it is every way preferable. The movement of sewer air is an important question connected with ventilation of sewers. Engineer Santa Crimp, in his paper read before the Institute of Civil Engineers, says:

"With regard to the question of temperature as causing movements of sewer air, it has generally been supposed that the movements were principally due to that cause. If the assumption were a correct one, the sewer air would pass upward in winter, and downward in summer, that is speaking generally. The movements would be most rapid when the difference between the temperature of the air and that of the sewer air was greatest. Now, in the author's experiments, the greatest difference was found to be in October, when it averaged eighty and four-tenths degrees, yet during that month the up hill currents were too feeble to affect the anemometer except upon three days. During the same month down-hill currents were registered on twelve days. In the exceedingly calm and foggy December, the difference was seventy and eighty-five-hundredths degrees, yet the results as regards up-hill currents were altogether of a negative character, while down-hill currents were registered on nine days. February again shows a difference of seventy and fifty-five-hundredths degrees, and while up-hill currents were registered on nineteen days, down-hill currents were found to prevail on every day; moreover, the movements were exceedingly active, compared with those of the other months referred to.

"The results obtained during February and March are in striking contrast, and it is obvious that the effects of temperature are weak compared with those of some other agent. The drag of the sewage, if of any appreciable degree, would have made itself apparent during the calms of December and in other months. The author would at once say that the experiments had not long been in operation before he found that the wind was practically the only agent capable of producing movements that could be registered by an anemometer. Numberless cases could be quoted from the mass of detail accumulated in making these experiments, but a few must suffice. During the entire series of experiments the actual volume of air recorded as passing down-hill exceeded that recorded as passing up-hill by very nearly one-third, while down-hill currents were recorded on two hundred and seventy-three days as against up-hill currents on ninety-seven days. The cases given could be multiplied if desirable, but throughout the whole series of experiments the same effects of the wind were observable; the direction of the sewer-air currents was determined by that of the wind, while the currents were either strong or weak or imperceptible, according as the wind was fresh or light, or calms prevailed."

The value of the Fullerton avenue conduit, in connection with the pumping works at Bridgeport, was so manifest as to attract the attention of many, who never before gave a thought to the influence of surroundings on health. Others, practical men, were not slow in recognizing the improvements. Such practical plumbers as J. J. Wade wrote on the subject repeatedly from 1881 to 1887. In 1881 the population of Chicago was five hundred and forty thousand. The total deaths in that year were thirteen thousand eight hundred and seventy-four, which makes a death rate of twenty-five and sixty-nine-hundredths per one thousand persons living. In 1882 the population was five hundred and sixty thousand, six hundred and ninety-three, and in that year thirteen thousand two hundred and thirty-four persons died, making a death rate of twenty-three and sixty-hundredths per one thousand population. Here is where the work of the health department of the city of Chicago under the administration of Dr. De Wolf begins to show its value. In comparing the deaths in 1882 with those of 1881, we discover that if the same death-rate had prevailed in 1882 as did prevail in 1881, the total number of deaths in 1882 would have been fourteen thousand four hundred and eleven, instead of thirteen thousand two hundred and thirty-four. In other words, stating it more forcibly, one thousand one hundred and seventy-seven persons were alive at the close of the year 1882, who would have been dead had it not been for the sanitary work of the health department. Carrying this comparison a little farther, it is seen that in 1883 the saving in lives over the death rate of 1881 was three thousand three hundred and forty-five; in 1884 it was three thousand seven hundred and twelve; in 1885 it was four thousand five hundred and ninety-nine, and in 1886 it was four thousand three hundred and eighty-one. These figures mean that in the past five years the work of the Chicago health department has saved the lives of seventeen thousand two hundred and fourteen persons who would have been dead had the death rate of 1881 and the conditions which caused it been allowed to continue. This great work has been accomplished in the face of a great increase in population, the city numbering seven hundred and three thousand eight hundred and seventeen, in May, 1887, and in spite of a very large immigration of uneducated people, not accustomed to the restraints of sanitary regulations. The following table shows very clearly this great sanitary work:

YEAR.	Population.	Death rate.	Total deaths.	What deaths would be at 25.69.	Saving in lives.
1881	540,000	25.69	13,874	......	....
1882	560,693	23.60	13,234	14,411	1,177
1883	580,000	19.92	11,555	14,900	3,345
1884	630,000	19.80	12,471	16,183	3,712
1885	664,634	18.76	12,474	17,073	4,599
1886	703,817	19.46	13,699	18,080	4,381
Total lives saved in five years					17,214

During the last half decade the percentage of deaths has been comparatively low.

The conduit was completed January 9, 1880. This is a brick circular tunnel, eleven thousand eight hundred and ninety-eight feet long, with an internal diameter of twelve feet. From the river to Racine avenue, four thousand two hundred and seventy feet, it is carried on a level, thirteen feet below city datum. East of Racine avenue is a vertical reversed curve connecting the lower grade, which is twenty-seven and two-thirds feet below datum. From this point to the lake shore shaft a descent of fifty-four and one-half feet marks the tunnel, while, from the shore shaft to the lake shaft, one thousand feet in length, it is level. The cause of the gradual descent east of Racine avenue must be attributed to structural reasons, as from that point east the tunnel work had to be carried on in working clay, and the line of working clay had to be followed. At each street intersection there are shafts with branch pipes to receive sewage. The machinery is powerful, showing a capacity of twenty-four thousand cubical feet per minute in response to one hundred revolutions of the screw. One of the objects of this conduit was to force such a quantity of water into the North branch as would not only create a strong current in the branch, but would also force it past its natural confluence into the South branch. It was part and parcel of the plan to abolish the divide between the Mississippi and St. Lawrence, and turn the surplus waters of Lake Michigan and the sewage of Chicago into the first-named river.

Sanitary house drainage is a most important branch of this subject. Where intelligence rules the individual, there is health. Under its genial influence whole city squares have been raised out of the ancient mire, and many of the cesspools of later days removed; but the unpleasant truth remains to be told, that, in thousands of places may yet be found hot-beds of disease beneath the homes and often in the very living rooms of the people. The earnest inquirer may begin in the basements of the city and county buildings in his search for a vicious system of house drainage. Having examined that unhealthy place, let him enter forty thousand other buildings and report. The document would prove a grim satire on the pretensions of the many and the conscientious beliefs of the few who claim perfection for the present sanitary condition of this great city.

Where ignorance is there is filth. The latter is the index to the former, and its removal the first sign of the dawn of intelligence. Filth degrades as it impoverishes. It is evil company in an inanimate form, generally destroying that with which it comes in contact. The poisons it distills into the human system have to be counteracted by other poisons in the form of alcoholic drinks, until the disease and accepted remedy reduce man to the lowest grade, and leave him fit subject for the poorhouse or for the prison. Uncleanliness of surroundings leads generally to corporal and mental uncleanliness, destroying families, and, sometimes, whole communities.

The subject of cleanliness, must, therefore, possess a rare fascination for the citizen, whether he be the owner of a cottage or a palace, the renter of a room or of a great apartment house, while to the architect, builder and plumber it should be a never-ending study.

On the dwelling, the store or the office building of Chicago, much of the welfare and happiness of citizens depend. The damp, ill-lighted building exerts a terribly evil influence on its inhabitants. An inadequate supply of pure water is absolutely impoverishing. A defective system of house drainage is absolutely poisonous, and defective ventilation means a living death. Therefore, the citizen, to be useful, must be healthy, and to be healthy, in a great city, requires the use of light, air, good water and general cleanliness.

The rapid growth of the United States militated against the application of true sanitary principles to city life, as they were understood and acted upon at Paris years ago, and are to-day observed there. Wealth was the first object sought after, but as the cities grew in population, the law of self protection cried out for remedies. Only in very recent times have such remedies been prescribed. Still later the prescription was "filled," and many patients were relieved, but not until the present time has Chicago made a determined effort to correct the mistakes of the sanitation of the past, mistakes so serious and numerous as may take years to rectify.

The house drain and trap of a former day must be attacked first. It is difficult to distinguish between the evil qualities of each. Some few years ago the *Sanitary News* reviewed, at some length, the system on which such drainage was constructed, giving, in addition, a plan of the system. Carelessness or incompetence carried this system so far as to introduce it into one of the large buildings on Madison street, where an examination revealed the facts that not only was there a leakage, but also that the sewage had saturated the earth, under the basement, to its limit, and then formed a cesspool on the surface. How many such cases as this an examination would reveal to-day? Is it necessary to have a subterranean examination? Scarcely. Its existence is denoted on the faces of the habitants.

These serious house-drainage blunders caused, very naturally, a revolution. The sewer builder and plumber were themselves the leaders in this revolt. They were joined by the architect and contractor, and, strange to relate, by the house-owner afterward. What benefits were conferred by this revolution of the trades against the mistaken ideas of the past are being now realized. The modern system of house drainage combined with the plans for heating and ventilation insures health, and the house-owner, the last to receive such ideas, is the greatest beneficiary. In March, 1890, the question of house drainage was discussed before the Plumbers' association, Mr. Nacey's paper being the basis of the discussion. The system then in vogue was perfection itself compared with that which it displaced. The ordinary house drain as adopted in Chicago and other cities may be described as a series of clay pipes joined together with cement and carried from a junction in the street through the dwelling to a catch-basin. At various points along the line of this system apertures are provided for the reception of tributary branches, which serve for soil and waste pipes throughout the building. The receptacle known as a catch-basin is placed in the yard in the rear of a structure. It is built cylindrical in form, three feet in diameter to a depth of about two feet six inches below the outlet, surrounded by a wall, whose thickness is composed of a single brick laid in common cement mortar. In the interior of this cesspool a similar wall is constructed, being carried down below the mouth of the outlet to prevent grease from entering the house drain; it also serves as a trap, for, although in these basins the drains find an outlet, they are, however, made for the express purpose of receiving the refuse of sinks, laundry tubs and down spouts. The pipes carrying these substances are almost always laid at the same grade as house drains, which is one-fourth inch per lineal foot. In short, the drainage system may be merely defined to be a number of ordinary clay pipes, two feet in length with a hub of about the depth of one and one-half inch on one end, laid piece by piece, one being slipped into the hub of another until the terminal point is reached. The recognized system of the present time is set forth in the following laws and ordinances.

The act of the Illinois legislature for the regulation and inspection of buildings is as specific in its definitions of the duties of architect, plumber and health commissioner as it is in the matter of penalty for infraction of the law. Its provisions are as follows:

That it shall be the duty of any architect or architects, builder or builders of, or other person or persons interested in any projected tenement, lodging house or other places of habitation in any incorporated city of fifty thousand (50,000) inhabitants, to submit plans and specifications of any such building or buildings to the health commissioner or commissioners of such incorporated city, that the said health commissioner or commissioners may examine the said plans and specifications, for his or their approval or rejection as to the proposed plans for the ventilation of rooms, light and air shafts, windows, ventilation of water-closets, drainage and plumbing.

Architects, penalty.—If any architect or architects, builder or builders, violate the provisions of this act, he or they shall be fined in a sum of not less than one hundred (100) dollars nor more than two hundred (200) dollars for each offense.

It shall be the duty of any plumber or other person or persons interested in the contract for the plumbing work of such building or buildings, to receive a written certificate of instruction from the health commissioner or commissioners before commencing work on the said building or buildings, and to proceed according to the plans, specifications and instructions, as approved by the health commissioner or commissioners of said city.

Penalty.—If any plumber, or other person or persons interested in the plumbing work, violate any of the provisions of this act, he or they shall be fined in the sum of not less than one hundred (100) nor more than two hundred (200) dollars for the first offense, and the further penalty of ten (10) dollars for each and every day such plumber or other interested person or persons shall, after first conviction, neglect or refuse to comply with any provisions of this act, or the written instructions of the health commissioner or commissioners, and for the second offense, a like penalty and a forfeiture of his or their license to do business in said city for one (1) year after conviction.

Notice.—It shall be the duty of any plumber or other person or persons interested in the plumbing work, after the completion of said plumbing work, and before any of the said plumbing work is covered up in any building or buildings, or on the premises connected with said building or buildings, to notify in writing the health commissioner or commissioners, that said building or buildings, or other premises are now ready for inspection, and it shall be unlawful for any plumber or other person or persons, to cover up, or in any way conceal such plumbing work in or about such building or buildings, until the health commissioner or commissioners approve of the same.

Emergency.—Inasmuch as the health of the people is endangered, an emergency exists requiring this act to take effect immediately; therefore, this act shall take effect and be in force from and after its passage.

The rules and regulations of this city, governing the drainage and plumbing of new buildings, are substantially as follows:

The drain, soil and waste pipes, and the traps must, if practicable, be exposed to view for ready inspection at all times, and for convenience in repairing. When necessarily placed within partitions or in recesses of walls, soil and waste pipes must be covered with woodwork so fastened with screws as to be readily removed. In no case shall they be absolutely inaccessible, unless so placed in accordance with a permit issued by the board of health. Foot connection of soil or waste pipes shall be carried to the level of the sewer, and a one-quarter or one-eighth-inch long iron bend used. A metallic cap, such as is in general use, may be used to complete the construction. The size of supply pipe must in every case be ample for the purpose. Water-closets.—The use of pan-closets is prohibited. No brick, sheet metal, earthenware, or chimney flue shall be used as a sewer ventilator, nor to ventilate any trap, drain, soil or waste pipe.

Every vertical soil and main waste pipe must be of iron, and where it receives the discharge of fixtures on two or more floors, it must extend at least two feet above the highest part of the roof or coping or light shaft louvres, and have a diameter above the roof at least one inch greater than that of the pipe proper; but in no case shall it be less than four inches in diameter above the roof. No cap or cowl shall be affixed to the top of such ventilation pipe, but in tenement houses, a strong wire basket shall be provided and securely fastened thereto in every case, to cover the mouth of it. Soil, waste and vent pipes in an extension must be extended above the roof of the main building, when otherwise they would open within twenty feet of the windows of the main house or the adjoining house. Horizontal soil and waste pipes are prohibited. The least diameter of soil pipe permitted is four inches. A vertical waste pipe into which a line of kitchen sinks discharges must be at least three inches in diameter if receiving the waste of five or more sinks, and shall have two-inch branches. Where lead pipe is used to connect fixtures with vertical soil or waste pipes, or to connect traps with vertical vent pipes, it must not be lighter than extra light pipe. There shall be no traps on main vertical soil or waste pipes. All iron pipes must be sound, free from holes or cracks, and of the grade known in commerce as extra heavy. The following weights per linear foot will be accepted as standards: Two inches, five and one-half pounds per linear foot; three inches, nine and one-half pounds per linear foot; four inches, thirteen pounds per linear foot; five inches, seventeen pounds per linear foot; six inches, twenty pounds per linear foot; seven inches, twenty-seven pounds per linear foot; eight inches, thirty-three and one-half pounds per linear foot; ten inches, forty-five pounds per linear foot; twelve inches, fifty-four pounds per linear foot.

All fittings used in connection with such pipe shall correspond with it in weight and quality. Tar-coated cast-iron pipe shall be used. When required by an inspector from the board of health, plumbing work must be tested with the peppermint test, or by other approved methods, such test to be made by the plumber in the presence of the inspector. Defective pipes discovered must be removed and replaced by sound pipes, and all defective joints made tight, and every part of the work in which defects are found be made to conform to these rules and regulations. All joints in iron drain pipes, soil pipes and waste pipes must be so filled with oakum and lead and hand caulked as to make them gas-tight. The amount of lead used to a caulked joint shall be not less than twelve ounces to each inch diameter of the pipe so connected. All connections of lead with iron pipes must be made with a brass sleeve or ferrule of the same size as the lead pipe, put in the hub of the branch of the iron pipe and caulked with lead. The lead pipe must be attached to the ferrule by a wiped or overcast joint. All connections of lead waste and vent pipes shall be made by means of wiped joints. Every water-closet, urinal, sink, basin, wash-tray, bath, and every tub or set of tubs and hydrant waste pipe, must be separately and effectively trapped, except where a sink and wash tubs immediately adjoin each other, in which case the waste pipe from the tubs may be connected with the inlet side of the sink trap. In such a case the tub waste pipe is not required to be separately trapped. Urinal platforms, if connected to drain pipes, must also be properly trapped.

Traps must be placed as near the fixtures as practicable, and in no case shall a trap be more than two feet from the fixture. All waste pipes from fixtures other than water-closets must be provided at the outlet of such fixtures with strong metallic strainers to exclude from such waste pipes all substances likely to obstruct them. In no case shall the waste from a bathtub or other fixture be connected with a water-closet trap. Traps must be protected from siphonage, and the waste pipe leading from them ventilated by a special air pipe, in no case less than two inches in diameter for water-closet traps, and one inch and a half for other traps. Except in private dwellings, the vertical vent pipes for traps of water-closets in buildings more than four stories in hight, must be at least three inches in diameter, with two-inch branches to each trap, and for traps of other fixtures not less than two inches in diameter, with branches one and a half inches in diameter, unless the trap is smaller, in which case the diameter of the branch vent pipe must be at least equal to the diameter of the trap. In all cases main vertical vent pipes must be of cast or wrought iron.

Vent pipes must extend two feet above the highest part of the roof or coping, or light shaft louvres, the extension to be not less than four inches in diameter, to avoid obstruction from frost, except in cases where the use of smaller pipes is permitted by the board of health. They may be combined by branching together those which serve several traps. These vent pipes must always have a continuous slope to avoid collecting water by condensation. No trap vent pipe shall be used as a waste or soil pipe. Overflow pipes from fixtures must, in each case, be connected on the inlet side of the trap. Every safe under a washbasin, bath, urinal, water-closet or other fixture must be drained by a special pipe not directly connected with any soil pipe, waste pipe, drain or sewer, but discharging into an open sink, upon the cellar floor or outside the house. The outlets of such pipes should be covered by flap valves.

The drain pipe from refrigerators shall not be directly connected with the soil and waste pipe, or with the drain or sewer, or discharge upon the ground; it must discharge into an open and water-supplied sink. Such waste pipes must be so arranged as to admit of frequent flushing, and must be as short as possible, and disconnected from the refrigerator. In tenement houses it must be ventilated above the roof. Covering the outlet by means of a flap valve is recommended. The sediment pipe from the kitchen boilers must be connected on the inlet side of the sink trap.

Water-closets must never be placed in an unventilated room or compartment. In every case the compartment must open to the outer air or be ventilated by means of a shaft or air duct. All water-closets within the house must be supplied with water from special tanks or cisterns, the water of which is not used for any other purpose. Interior water-closets must never be supplied directly from the city supply pipes. Except in tenement houses, a group of closets may be supplied from one tank, but water-closets on different floors are not permitted to be flushed from one tank. In tenement houses there must be a separate cistern for each water-closet and one water-closet must be provided for each two families. The overflow pipes from water-closet cisterns may discharge into an open sink, or where its discharge will attract attention and indicate that waste of water is occurring, but not into the soil or waste pipe, nor into the drain or sewer. When the pressure of the city is not sufficient to supply these cisterns, adequate pumps must be provided. The valves of cisterns must be so fitted and adjusted as to prevent wasting of water, especially where cisterns are supplied from a tank on the roof. Water-closets, when placed in the yard, must be separately trapped, and so arranged as to be conveniently and adequately flushed, and their water supply pipes and traps must be protected from freezing. The compartments from such water-closets must be ventilated by means of slatted openings in the doors and roofs.

Tanks for drinking water are objectionable, but if indispensable they must never be lined with lead, galvanized iron or zinc. They should be constructed of iron or wood, lined with tinned and planished copper, or wood alone. The overflow should discharge upon the roof, or be trapped and discharge into an open sink, but never into any soil or waste pipe or water-closet trap, nor into the drain or sewer. Discharge pipes from such tanks must not deliver into any sewer connected with soil or waste pipe. Rain-water leaders must never be used as soil, waste or vent pipes; nor shall any soil, waste or vent pipe be used as a leader.

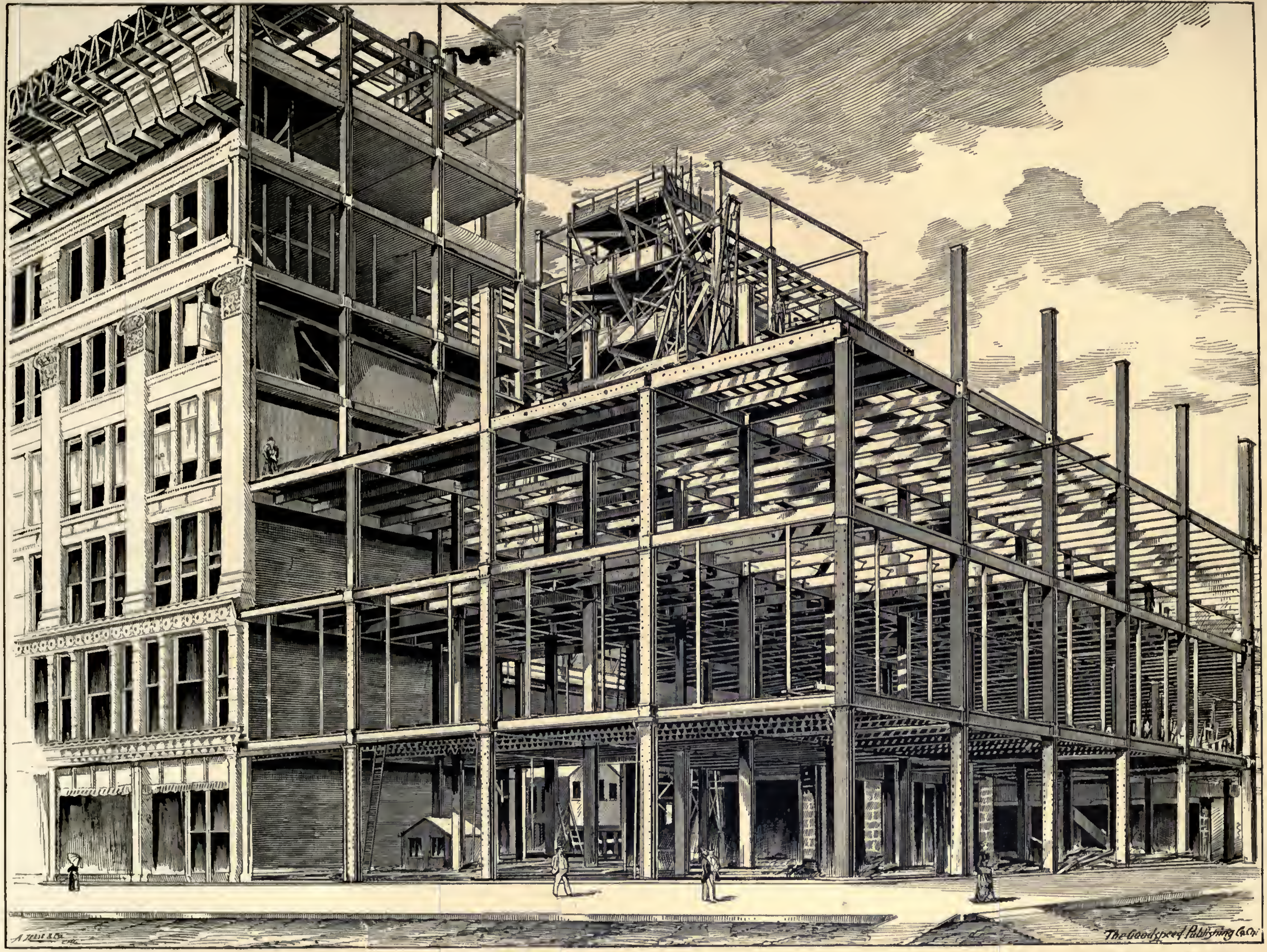
When within the house, the leader must be of cast iron, with leaded joints, or of copper with soldered joints. When outside of the house and connected with the house drain, it must, if of sheet metal with slip joints, be trapped beneath the ground or just inside of the wall, the trap being arranged so as to prevent freezing. In every case where a leader opens near a window or light shaft, it must be properly trapped at the base. The joint between a cast-iron leader and the roof must be made gas and water-tight by means of a brass ferrule and lead or copper pipe, properly connected. No steam exhaust, blow-off or drip pipe, shall connect with the sewer, or with any house-drain, soil pipe or waste pipe. Such pipes must discharge into a tank or condenser, from which a suitable outlet to the house sewer may be provided. Yards and areas, and open light courts must always be properly graded, cemented, flagged or well paved, and properly drained; when the drain is connected with the house drain it must be effectually trapped. Front area drains must, where practicable, be connected with the house drain inside of the running trap, if one be used. Cellar and foundation walls must, where possible, be rendered impervious to dampness, and the use of asphaltum or coal-tar pitch, in addition to hydraulic cement, is recommended for that purpose. In no case will the general privy accommodation of a tenement or lodging-house be allowed in the cellar or basement. Wooden washtrays or sinks are prohibited inside of buildings; they shall be of non-absorbent material.

The system of elevating the sewage of the Tacoma to the level of main sewer varies from that of the Rookery, the Ryerson and the Auditorium. It is accomplished by means of a steam siphon, connecting the catch-basin in the boilerroom, to which the surface water drains with the overflow pipe from the elevator discharge tank, and from that point running below the basement floor to the main sewer. The sewage is carried off by means of iron pipe suspended from the ceiling of the first floor. In the Rookery building the water-closets and other fixtures in the basement only are connected with the scheme by which the sewage is mechanically discharged into the main sewer. The sewage is carried to a catch-basin. By means of a float in the catch-basin which operates on auxiliary valves shown in the accompanying illustration, a stream of water under an hydraulic head of one hundred and seventy feet passes through a main-balanced valve into the ejector, where its velocity is transferred to the sewage, which, with the incoming water, is discharged into the sewer. In the construction of these ejectors it is necessary to proportion them to the relative heads under which they are to be operated. This one is operated under a head of fifty volumes of sewage to one volume of water. The operation of the main-balanced valve is similar to that of the piston of an engine. It is governed by the auxiliary valve, and as the float raises with the water, an arm of the float rod engages with stops fastened to the stem of the auxiliary valve. By this means the position of the auxiliary valve is changed, thus the high-pressure water is allowed to act first upon one side and then on the other of the main-balanced valve. The pressure of the water causes this valve to shift from side to side, thereby allowing the stream of water from the tank in the attic to enter the ejector, with the results as described above. The velocity of the water is very great, and will empty a catch-basin at the rate of about eight hundred gallons in thirty-five seconds, being clean and effective in its sweep, and, when the action ceases, leaving behind it no possibility of an escape of odors or gases from the sewer or catch-basin.

The fact that a high basement was desired by the projectors of the Auditorium led to having the drain below the level of the main sewer in the street. An idea of how extensive the system of drainage required in this building is may be gained when it is learned that part of the building is used for a hotel. The hotel contains about four hundred rooms, many of which are supplied with private baths. In addition to this there are about one hundred and fifty offices, besides many stores and a large entertainment hall. The necessity for an almost perfect sanitary system of drainage will be observed at once. To elevate the sewage to the main sewer, or to discharge the house drain into the main sewer, a patented device is used in this instance. The sewage from the building runs into an hermetically sealed cast-iron receiver. This is known as Shone's hydropneumatic ejector. It is placed at such a level that all the sewers will have a grade at which they will be self-cleansing. Connected with the receiver is an air-tight pipe from an air compressor, located in the engineroom. When the receiver or ejector is full (in this case two ejectors, each with a capacity of fifty gallons per minute, will be used) a float is raised, whereby an air-valve is opened, and the contents are drawn out by the pressure. The ejector is absolutely automatic and takes care of all the drainage, water-closets, and all the sanitary appliances, and is regulated to the flow of the sewage. If the receiver fills once an hour it discharges once an hour, or if it fills oftener the receiver discharges more frequently. The steam from the engine is allowed to be turned on all day, very little steam, however, being required. It is estimated that an amount of steam, sufficient to fulfill the requirements of the ejector goes to waste every day where high-pressure engines are in operation. In every branch of sanitary work Chicago men have made most remarkable progress, until the question: Have the sanitary plumbing and drainage ideas of Chicago tradesmen reached the acme? may be seriously asked. Another system of disposing of the solids in sewage is incineration.

The garbage crematory on Seymour street and Grand avenue was completed in March, 1888, at a cost of $7,000. It is interesting simply on account of its capacity for accomplishing good, because what is reduced to ashes therein, would otherwise be allowed to decay and aid in spreading malaria if not pestilence. The building, or shed, covering the furnace, is fifty-two feet and eight inches wide, ninety-one feet long, and twenty-eight feet and six inches high. The foundation must be built in accordance with local requirements, but need not be excessively heavy. On the foundation, sills, 8x10 inches, are laid. At each corner is an upright, 10x10 inches, there being two similar uprights on the ends, each seventeen feet and ten inches from the corner. On each side there are five uprights, each 10x10, the two next the corners being sixteen feet from the corner, the others fourteen feet and nine inches apart. These are framed into a 10x12 floor plate and supported each side by 8x10 diagonal bracings. In one end there are two doors, 4x6 feet, and in the sides are twelve windows, in two rows. The sides are framed up with ordinary studdings and sheathed over with one-inch pine boards. The flat roof is built by laying 3x12 joists on the 10x12 plates, and laying first a floor of three-inch white pine, and then a floor on that of two-inch oak, laid in this case with a grade of one in thirty-six. The roof, on which wagons loaded with garbage are driven for unloading, is protected by a substantial railing built of 6x6 posts, 2x6 laterals, and a top rail of 3x8 white pine stuff. The chimney is in the center of the rectangular shed. At its base it is twelve feet square, tapering in its hight of ninety feet about one inch in forty inches. The inside of the shaft is four feet square. The shaft is of brick on a stone foundation. The furnaces are located one to the north and one to the south of the chimney. But one furnace will be described, as they are identical. The garbage furnace and the coal furnace are separate, but connected. The garbage furnace is twenty-four feet and nine inches long by thirty-five feet and nine inches wide, external measurements. The interior of the garbage-burning chamber is twenty feet and one inch long by fourteen feet wide, and ten feet and ten inches high at the side walls. This chamber is divided into two independent chambers by a seventeen-inch brick wall, extending from the bottom of the ash pit to the center of the main arch, from which the arched tops of the two chambers spring. At the front of the garbage furnace are three coal furnaces, four feet deep with an ash pit three feet high, and a fire-box twenty inches high. The grate bars for the garbage furnace have one and one quarter inch slots, are six inches deep, and are supported by cast-iron beams, 2x8 inches by seven feet long set into the masonry. The coal furnace is separated from the garbage furnace by a thirteen-inch bridge wall, leaving an opening at the back of the fire-box where the flame from the coal rolls into the garbage chamber and over and through the garbage. The flame from the middle fire-box divides and goes equally into each chamber. The fronts of the coal furnaces are pierced with eighteen-inch fire and ash doors. In these a good coal fire is started, which furnishes the combustion which, when added to the combustible material in the garbage, consumes the whole. The garbage furnaces are built of brick, two eight-and-a-half-inch walls, with an air space of two inches between being built on both sides and ends. Inside of the inner wall, and forming the fire-box, is a nine-inch wall of fire-brick laid in fire-clay. The arches are of common brick. Up to a level with the grate bars, the side and end walls are built solid, twenty-eight inches thick, and above that level the air space is put in to prevent radiation of heat. The bottom of the ash pit of the garbage furnace is made of two layers of common brick laid on end in cement. The walls of the furnaces are held together by twenty cast-iron binders, sixteen feet and two inches long, arranged so that the greatest support comes opposite the thrust of the arches. These are tied by one-inch rods nineteen feet and nine inches long with square nuts on both ends. The garbage grate bars are of castiron, one inch wide, with a space of one and one-quarter inches between, so as to give great draught, and are three feet and five and one-half inches long, made double. The grate bars are set on 1x6-inch cast-iron lateral beams, resting on six 2x8-inch cast-iron cross-beams, seven feet long. The grate bars are so arranged that at the front end their top surface is three feet above the floor of the ash pit, and at the rear end, next the chimney, it is four feet and eight inches. This gives a rising inclination from the front to the rear. In the side of the furnace are three series of doors. There are four doors to the ash pit, for the removal of garbage ash. There are four doors, 18x22 inches, immediately above the ash doors, each being level with the grate bars opposite its position. These are used to throw in fine garbage and to punch up the burning garbage, and to rake ashes of that already burned down into the ash pit. Still farther up, at a level with a floor to be hereafter described, are two larger openings, twenty-five inches by three feet, into which large garbage is fed.

As stated before, the roof of the shed is of such construction as to permit wagons loaded with garbage to be driven on it. Apertures in the roof at ten points will permit the descent of garbage and coal. Two of these are for coal, located where the chutes will deposit the coal immediately in front of the coal furnaces on the ground floor. Eight are for garbage, and have chutes which deposit the garbage on an iron floor built on both sides of the furnaces, and eight feet from the lower floor. These apertures are provided with trapdoors so that horses can not fall into them. The garbage falls upon an iron floor eight feet above the ground level, and even with the feeding doors in the side of the furnace. Near by the end of each of these eight chutes is wooden grating with bars one and one-half inches wide with one-inch space between. These gratings are 4x4¼ feet square. Over these the garbage is to be raked as it falls from the chute. The coarser garbage which does not pass through the bars is fed into the upper doors of the furnace. The ashes and fine



COMMERCIAL ARCHITECTURE. THE FAIR BUILDING. ERECTED IN SECTIONS.

garbage which pass through the grating fall upon an oscillating sieve geared just beneath each grating. This sieve is eight feet long, four feet wide, and fourteen inches deep. Five inches from the bottom is a wire netting with one-half-inch mesh made from No. 10 wire. The upper portion of the sieve will retain the smaller garbage, while the lower portion will receive the ashes. The sieve, by its throw, will deposit the small garbage on one side of a partition, to be fed into the furnace doors on a level with the grate bars, while the ashes will fall on the other side of the partition and be taken away. The eccentric which operates this sieve has an eight-inch throw, and has one hundred and twenty revolutions a minute. It is geared to a shaft which is operated by a small steam engine located in one corner of the building.

In connection with sewer construction the drain tile or drain pipe plays a most important part. Only the main sewers of this city are set in brick, so that the tile pipe holds an immense constructional as well as economical position. Drain tile absorbs at present a large amount of labor and capital, especially in the western states. It had its origin most marked in the first century of the Christian era. Calumella, a Roman contemporary with the philosopher Seneca, in the reign of Nero, treats at length and with fullness, not inelegantly, of the cultivation of all kinds of grain, garden vegetables, trees, the vine, olive and other fruits. He gives directions for selecting farms, the management of servants and slaves. He himself lived in Rome most of the time, but owned a small villa and farm in the country. He advanced the idea of loosening the soil in various ways—by cultivation, and to quote his words, he says, "For to cultivate is no other thing but to loosen and ferment the earth; therefore the same land which is both fat and loose and crumbling yields the greatest profit, because at the time it yields the most it requires the least." He speaks of the different kinds of soil, whether it be woody, stony or marshy land covered with rushes, fern plants or shrubs. He says if it be wet let the abundance of moisture be first drained or dried up by ditches—of these we have known two kinds—blind and open. Then he describes the manner in which the blind ditches were made with stone and clean gravel, but if these were not obtainable to make bundles of brush tied together, on which were laid boughs, over which the earth was thrown, leaving the ends open for the free passage of water both in and out. Thus it can be seen that they had some knowledge of the benefit of under-drainage as far back as the beginning of the Christian era. There is no record of the Romans using drain tile for draining land, but the same author speaks of the use of earthen pipe to convey water to cisterns, as follows: "But if these also fail you and the small hopes of spring-water force you, let large cisterns be built for men, and ponds for cattle, for gathering and keeping rain-water, which is most proper and suitable for the health of the body, and this you may have exceedingly good if you convey it in earthen pipes into a covered cistern."

The manufacture of drain pipes is in itself an interesting study. The material of which the pipes are made is composed of three ingredients—two kinds of clay and a sand and clay mixed. The first is a very strong clay obtained from brickyards. It underlies the clay of which bricks are made. The second is a strong clay containing a red coloring matter. The third ingredient is a material composed of fire-clay and sand. These ingredients are mixed in the proportion by measurement of two parts of the strong clay first mentioned, one part of the clay containing the red coloring matter, and one part of the fire-clay and sand. Made in these proportions, the mixture is placed in the wet-pan, where water is added. The wet-pan is a shallow, circular iron pan, in which the clays are crushed and mixed by two iron wheels, following each other on edge around the pan, driven by a horizontal axle attached to a vertical shaft. This pan is placed on the ground floor. After the materials are properly mixed this clay is turned by a suspended shovel into the buckets of the elevator, which are attached to an endless band, in which it is raised to the third floor of the building. Projecting from the third floor toward the second is the casting which contains the iron mold for the pipe. Into this the clay from the wet-pan is thrown, and an iron plunger, moved by the piston of a steam cylinder, which piston is attached to the upper end of the plunger rods, descends vertically, compressing the clay in the mold below.

After the clay is thoroughly compressed in the mold, an iron table under the mold, attached to the upper end of a piston passing below the second floor, and forming, as it were, the bottom for the mold, descends with the pipe standing upon it. The alternate upward and downward motions of the piston which moves the plunger, and the piston which moves the table, are controlled by the operator on the second floor, where the pipes are removed from the mold. Pipes under five inches in diameter are, when taken from the mold, immediately removed to another part of the second floor, where they have placed in them a wooden frame of the proper length, to which their ends are trimmed off and then smoothed with leather. As those over five inches in diameter come from the mold, they immediately have their spigot ends trimmed off, and are then taken by an elevator to the first floor, where their ends are finished up. These, with the smaller pipes from the second floor, are placed on end on the drying floor of the first story of the building, where they remain from three to six days, when they are ready for burning. Branches are made by placing the branch piece, while damp, upon the main pipe, and then trimming and shaping them. Traps are formed by hand in plaster of Paris molds, which are made in halves, dividing lengthwise. The walls of the kilns are of brick, and are thirteen inches in thickness. The kilns are circular, the largest being, inside, twenty-two feet in diameter, and eight feet high to the square, surrounded by a dome. The kiln is filled with pipes from the drying floor, placed on end. It is fired from eight fire-places at equal distances round the kiln. Gas coal is used. Inside the products of combustion pass through short vertical stacks toward the top of the kiln, whence they are beaten back among the pipes, and finally escape through a flue built around the kiln, near the bottom, and pass in an underground flue to the stack. At the proper stage of burning, which is ascertained by small test pieces of clay, which may be drawn and examined, the attendant passes three times around the kiln, and each time throws into each fireplace a shovelful of common salt. By this means the pipes are glazed. After the sealing of the kiln, three days are required in which to fire up and burn, and three more in which to cool off and remove the pipes, which are inspected and are then ready for market.

CHAPTER V.

GENERAL SANITARY DRAINAGE.

PROGRESS in the systems of city and house drainage has been described and statistics have been given. The ultimate disposal of this sewage will now be considered. As has been already shown, Chicago river and its branches formed the main receptacle or reservoir of Chicago sewage up to 1859. In 1848 the canal was completed and the pumping establishment at Bridgeport established. The water level of the lake was eight feet below the old summit level of the canal, and to provide a cheap feeder two engines, with a capacity of seven thousand cubical feet per minute, were placed at its head to pump feed water from the Chicago river. The idea of draining this city southward was not entertained, and there is no record of the effect which the removal of seven thousand cubical feet per minute had on the current of the South branch or of the main river. Even in 1855 the architect of the sewerage system did not look beyond the lake and river for an outlet, for he suggested that water from the canal or the Desplaines should be pumped into the South branch and thus create a current which would carry with it, into the lake, the accumulating refuse in the river. The freshet of 1856 accomplished this without machinery, and eighty-four thousand of the total number of inhabitants—eighty-four thousand one hundred and thirteen—were satisfied with themselves, the river and the new sewers. During the ensuing few years the increase in population was very marked, even as the growing offensiveness of the river was. This led to an arrangement with the canal trustees to increase the capacity of their pumps and to become, in fact, the great scavengers of the time. Chicago paid for this service from 1859 to 1871.

Meantime great expectations were harbored by the people, for the act of 1865, authorizing the deepening of the summit level of the canal, was in force, and the workmen busy on a work which many believed to be full of promise. In 1865 Chicago appropriated $2,500,000 to be applied toward deepening the Illinois and Michigan canal, one of the objects being to reverse the flow of sewage. The work of deepening was completed in July, 1871, and for a season a clear river and prospect of health were placed before the citizens. As days grew apace such signs became feeble indeed, the growls of the inhabitants of the Desplaines valley, in Cook and Will counties, louder, and the calls for a ship canal more fervent and emphatic. The great fire settled temporarily everything connected with sewage, but in July, 1872, a population of three hundred and sixty-seven thousand three hundred and ninety-six revived the old cry for a clean river and pure water. A few years later the Fullerton avenue conduit was brought into existence, with the object of cutting off the sewage of that section of the city and driving it into the lake, far above the point where it might pollute the water in the vicinity of the crib. In 1881 the legislature authorized the city to construct pumps, at the head of the canal, with a capacity of sixty thousand cubical feet per minute. This was accomplished in 1883–4, and a modus vivendi between the river and the citizens established. The plan was further improved in 1885, when the pumps at Fullerton avenue were reversed, so as to drive thirteen thousand and forty-eight cubical feet of lake-water into the North branch and create such a current as would send the water and refuse past the confluence with the main river, into the South branch and thence to the pumps at Bridgeport.

The *Tribune*, in a very able editorial refuting the false statements made regarding the cost and prospective benefits of the proposed general drainage plan, deals with the deep cut of 1865 historically:

"In 1865 the city was authorized to deepen the Illinois and Michigan canal, so that the sewage which had been flowing into the lake and poisoning the drinking water might flow off southwestwardly by gravity. The cost of that work was $3,500,000. The money was raised by selling seven per cent. bonds a little below par. The yearly interest charge on those bonds was $245,000. The population at that time was a little under two hundred thousand. The interest charge per capita, therefore, at the time when the city began on what seemed then a big undertaking was about $1.25. Rates of interest have dropped since 1865. The city or the drainage district can get what it needs now for four per cent. Suppose that the latter should issue $25,000,000 in bonds, sold at par or above, to raise the money to cut the big channel. The yearly interest charge would be $1,000,000. But the population is one milion two hundred thousand, so the annual interest bill per head would be but a shadow over eighty cents. For while the gross interest charge of 1891 would be four times that of 1865, the population is six times as great. If the little city of a quarter of a century ago could enter boldly on a work which required each of its citizens to pay $1.25 a year shall the metropolis of to-day, the second city in the country, shrink back from an enterprise which will call on each of its citizens for only eighty cents a year?

"It was fortunate that the city had the courage to make the deep cut of 1865. But for that it would have been smothered long ago in its own filth. Capital and labor would have shunned it, and it would not have grown to be larger than Milwaukee. That three-and-a-half-million investment—it seemed a huge sum then—was a wise one. Down the shallow cut made with that money a steady though small stream of diluted sewage has gone to the Illinois, and the water supply of the city has been saved from pollution except on rare occasions. Had a little more money been spent, the relief would have been even greater. The engineers who planned the deep cut gave it a fall of only an inch and a tenth a mile, equal to a current of two-thirds of a mile an hour. They said that if the current were made stronger an extra mule would be needed for every canal boat coming this way—and that of course would not do. They were told that tugs would supplant mules speedily—as was the case—but they knew too much to believe that and hence gave the canal a fall of only thirty-three inches to Joliet, whereas, had they given it one of thirty-six inches more, or sixty-nine inches, the greater force of the current would have carried off most of the lighter material, which, owing to the more languid flow, was deposited in the bed of the canal. The trustees never dredged it out, and about two feet of the bed of the ditch has been filled up, thus depriving Chicago of so much water space which it had paid for. From the great good which this little, faultily-constructed ditch did, it is easy to form an idea of the immense good which will be wrought by the great channel it is proposed to cut, which will settle the sewage-disposal question for all time, let the population increase as it may, and will give the city pure water through the unending years. And it will be a less formidable job to tackle than the one which the city began so pluckily in 1865."

This is the system of general drainage which obtains here now and will obtain until the new system, described hereafter, is in operation. On the present plan vast sums of money have been expended. The best pumping machinery known, and the highest engineering ideas have been requisitioned; but still dissatisfaction exists. Under certain circumstances, which arise too often, dangers of a most startling character threaten the city. The health of the citizen is placed at the mercy of every adverse wind, every Desplaines flood, or every mysterious recession of the lake waters. When the direction of the wind current is otherwise than due west, i. e., blowing from the lake, the vacuum created by the pumps at Bridgeport is not sufficient to exert such influence on the waters of the main river and branches as to check the natural flow into the lake. In the event of a freshet in the Desplaines valley the pumps are valueless; for, as stated in the Culloton paper, it is invariably the case that the country on the line of the Desplaines river, from the city line, all along the river valley from twelve to twenty miles distant, is entirely submerged, the water often covering an area of twenty or thirty square miles. In the vicinity of Twenty-second street, during a heavy freshet, the water in the South branch not infrequently rises six or eight feet, while in the basin of the main river, north of Van Buren street, the rise is generally from eighteen inches to two feet. During the prevalence of a freshet continuing two or three days, not less than one hundred and fifty thousand cubic feet of water a minute empty from the Desplaines into the South branch of the Chicago river. The flow of water from the Desplaines river is much greater now than in former years, primarily because of the clearing up and ditching of swampy land. To guard against these overflows the city constructed a dam, but, notwithstanding the existence of this dam, it was found, at one of the above freshets that the Desplaines river was so swollen that one hundred and twenty-five thousand cubic feet of water a minute found its way over the top of the dam into the Chicago river, while the volume of water coming down the North branch was twenty-seven thousand cubic feet a minute, causing a rise in the main river of nearly two feet. Yet this fall of water was only about one-half the quantity which usually enters the city during the hight of flood season. At such times every effort of engineering skill and mechanical invention has thus far proved inadequate to cope with the action of the refractory elements, and the entire body of water in the main branches and tributaries is swept into the lake. A lowering of the lake level under its mysterious law brings about the same result, so it may be stated that the sewage of a great city flows into the lake during the greater part of each year.

The effect of the winds and of rainfall on the level of the lake and river is statistically treated in the first chapter of this volume. The lowering of barriers at Fort Gratiot, the St. Clair flats, or at Niagara, would, of course, cause the lowering of the lakes. A report quoted by the *Morning Press*, Grand Rapids, Mich., in August, 1891, that the level of Lakes Michigan and Huron is now several feet lower than it used to be, and claiming that this low level has come with the deepening of the channel through the St. Clair flats was noticed, editorially by the Chicago *Tribune* on August 24, 1891. It asks if it be true that the rainfall upon the watershed of the great lakes has been less for the last five years than formerly, and hints that if not, the cause must be found in the deepening of the water on the St. Clair flats. The report says: "It is hard for the public to understand why a deepening of the drain between Lake Huron and Lake Erie should not have the effect of lowering the level of Lakes Huron and Michigan. It is folly for the government to be spending millions of dollars deepening harbors from Chicago to Port Huron while the water of the lakes is being drawn off by dredging the St. Clair flats." This is a matter of great importance, not only of itself, but in its bearings upon the proposed Chicago drainage channel. It is asserted by General Poe that the operations of the government at the flats are not of sufficient magnitude to affect the level of the lakes, which he attributes to a lessened rainfall. His view of the case is fully borne out by the fact that it averaged nearly one inch per month less than that for the next preceding group of five years. If the same be true at all other points in the region tributary to the two lakes named, and it may be so assumed in the absence of knowledge to the contrary, the striking fact is amply sufficient to account for the difference in lake level, and there is no occasion to drag in the dredging work on the St. Clair flats or elsewhere to explain it. In this connection it may be stated that expert computation gives about four inches as the maximum depression in the surface level of Lake Michigan that can occur from the cutting of the drainage channel to the extreme depth named in the law.

When the revival of 1881–2 brought thousands to Chicago, and suburban towns sprung into existence, the general drainage question assumed an importance never hitherto attached to it. In November, 1884, the Citizens' association offered a $500 prize for the best practical essay on the main drainage, sewerage and water-supply system of the city. In 1885 the association considered the effects of the flood waters of the Desplaines and North branch on the lake water, and presented a plan not only for diverting such water from the lake, but for leading them to the Illinois river. On January 27, 1886, the council authorized the mayor to appoint a drainage and water-supply commission. This commission organized in March, that year, and in January, 1887, submitted a formal report which was followed on July 1, 1887, by the more elaborate report of the engineers on providing temporary relief.

The report to the old city drainage commission, made July 1, 1887, by Rudolph Hering on the Okokie cut-off suggested the expenditure of $3,348,617. The report is interesting in many ways, not the least being the wide difference of opinion on the usefulness of such a channel:

"As a part of the final project to dispose of the Chicago sewage into the Illinois river, it was recommended that hereafter no more flood-water should pass into the lake through the Chicago river, and thus periodically endanger the water supply. This flood-water, which comes partly from the North branch and partly from the Desplaines river through the Ogden-Wentworth ditch, can be otherwise disposed of. Sufficient capacity can be provided for it in the proposed channel to the Illinois river, or it can be diverted into Lake Michigan before it becomes polluted by its passage through the city. The latter disposition is advised for the following reasons:

"It is less expensive. To conduct the flood-waters southward without danger of backing out into Lake Michigan will add not less than $5,000,000 to the cost of the main channel. A discharge of the entire Desplaines flood-water down the proposed main waterway below Summit will, at times, greatly diminish the amount of water which it will draw from the Chicago river. In extreme cases the flow from the latter river would cease entirely or be reversed, and a stagnation of its polluted waters or even their discharge into the lake would occur. During a flood, such as took place in 1881, this condition would have held for more than a week, and one-half the capacity of the channel would have been useless during two weeks more. In 1885 only fifty to eighty per cent. would have been available for a period of three to four weeks. The diversion of the flood-waters into Lake Michigan will secure a reduction of the fluctuations of the water-level in this channel and in the river below, and thereby cause less damage in flood times. By thus giving it a more constant flow, the channel will be made more suitable for purposes of navigation, an advantage of some moment, when considering its future prominence as a waterway connecting the Mississippi river with the lakes.

"The diversion project provides a new inlet for vessels to the North branch docks. Incidentally, it furnishes an opportunity for maintaining fixed bridges across a portion of the river. By a similar channel from the Stock Yards eastwardly to Lake Michigan or southerly to Lake Calumet the bridges can be closed throughout the central part of the city, thus providing a satisfactory solution of this important question. It will reduce the low water level of the North branch at Bowmanville some three feet, and high water about ten feet, and thereby cause a material benefit in providing better drainage facilities for the territory lying south of this point, and, also, for the flat and low area extending toward Evanston. It will furnish a channel from which the lake water may be drawn to flush the North branch much more thoroughly than is possible by means of the Fullerton avenue conduit, the capacity of which is at present insufficient to secure adequate cleansing, although the amount of sewage discharged into the river has not yet reached one-half its ultimate amount; the extension of dockage above Fullerton avenue toward Bowmanville and the probable construction of sewers will demand a circulation which this conduit can not provide. The Fullerton avenue conduit may then be used as a water-supply tunnel for pumping works, furnishing the northern and northwestern parts of the city, Lake View and Jefferson with water, and, as such, will be worth fully fifty per cent. of its original cost.

"During the year that must necessarily elapse before the completion of the main waterway, the diversion of the Desplaines river and North branch as proposed will be beneficial for the following reasons: It will permit the building of a dam across the Desplaines valley at Summit, and thus render it possible to control the flood waters to the extent of their entire exclusion from the Chicago river. To build this dam without first building a diversion channel is not practicable. After the diversion channel is built, the floods of the Desplaines and the North branch will no longer wash the sewage through the Chicago river into the lake. The intakes for the water supply can then be safely placed at a much less distance from shore than is otherwise admissible, and will, therefore, cause a reduction in the cost of the tunnels. When capacity and head remain constant, the cost increases in a much greater ratio than the length, on account of the necessity of increasing the size, and the greater difficulties and risks in construction. The sanitary condition of the Chicago river will be improved, because canal pumps can draw through it a greater quantity of water from the lake for diluting the sewage than under present conditions, as the Desplaines river occasionally supplies the pumps by way of the Ogden-Wentworth ditch and West forks. Before it is practicable to excavate the proposed waterway to Joliet, in an expeditious manner, the flood-water will have to be controlled and excluded as much as possible. The diversion channel north of the city and sluices placed in the proposed dam at Summit will accomplish this, and their construction should, therefore, be completed before the other work is done.

"The proposed disposition of the flood-waters will not cause an injury to any vested rights along the stream. The Desplaines diversion, as proposed, does not imply that hereafter there will be an entire cessation in the flow below the point where it is diverted. The ordinary flow, such as obtains at least eight months in the year, will not be changed at any point. During floods the quantity of water passing between the point of diversion and Riverside will be materially reduced to the benefit of this portion of the river. As the bill authorizing the Desplaines and North branch diversion has now become a law, it is deemed important to proceed with the execution of the work at the earliest possible moment, because the territory through which the proposed channel is carried is rapidly building up, and property is increasing in value.

" As a result of the investigation, it has been concluded that the channel from the Desplaines to the North branch should be given a capacity of ten hundred thousand cubic feet per second, with a mean velocity of five feet, or a section of two thousand square feet, and the channel from Norwood Park to Lake Michigan a capacity of twelve thousand cubic feet per second, the section from Bowmanville to the lake to be two hundred and ten feet in width and eighteen feet in depth below city datum. The distance from the Desplaines to the lake is eleven and three-quarters miles. Norwood channel, the channel of diversion, will start at the Desplaines river, three and three-fourths miles, by the course of the river, below the village of Desplaines, and at the first easterly bend above the south line of the town of Maine, in section thirty-four. The center line of the channel will continue the course of the river above this bend by an easy curve to a line parallel to and two hundred feet north of the township line between Maine and Niles on the north and Leyden and Norwood Park on the south, until the valley of the North branch be reached, at a distance of nineteen thousand four hundred feet, or three and seven-tenths miles. A strip, four hundred feet wide, and bounded by the township line on the south, will be required for right of way. The proposed channel of diversion is designed to carry ten thousand cubic feet per second from the Desplaines without sensibly altering the hight due to a flood of that volume. This channel will conduct floods of any other hight without materially changing their level. Ordinary floods are less than that of 1887, and do not reach a damaging hight.

"The velocity in great, and unusual floods will be five feet per second, giving a cross-section of two thousand square feet. An economical section for this channel will have a depth of sixteen feet, a bottom width of one hundred feet, and side slopes of three horizontal to two vertical. The width at the flood line will be one hundred and forty-eight feet. The maximum depth of cut at the summit will be fifty-seven feet, or forty feet above the flow line, and the greatest width will be two hundred and seventy-one feet. The flow line will lie sufficiently below the general level of the prairie and the bluff level of the Desplaines at the west end. It will lie above the prairie level for about two thousand feet at the east end, where it will be retained by broad levees of from one to seven feet in hight. This will not interfere with the natural drainage of the prairies. The valleys of the North branch and Desplaines will furnish ample facilities for spoil banks, which banks will be an improvement, rather than otherwise, in raising the large areas to the general level of the surrounding country. The Desplaines river dam will be simply an embankment raised to an elevation of fifty-five feet above datum, or five feet above high water of 1881. About one-half mile from the head of the diversion channel a low weir or ground sill will be placed with its crest about five feet above the bed, or at such elevation as will cover the head of an iron pipe four feet in diameter leading down stream through the solid ground to the open channel of the Desplaines river. This pipe may be set so as to carry about eighty cubic feet per second before water passes down the channel of diversion, or, practically, as much water as flowed down the river nine months of the year ending June 30, 1887. The low water in the fall of 1886 was four feet per second at Riverside and was still less in the winter. In high water the capacity of the pipe will be nearly twice that at low water. The drop or weir near the North branch is to be set at an elevation of thirty-four feet above city datum and have a width of one hundred feet. The depth thereon for the assumed flood will be nine feet. The total fall to high-water level in the North branch will be approximately fifteen feet. Below the weir a tumbling bay will be provided of sufficient depth to cushion the great mass of falling water.

"The length of the first reach from the weir west of Milwaukee avenue to the proposed location of the first weir in the North branch will be seven thousand one hundred feet, or one and one-third miles. It is proposed to excavate a section with a bottom width one hundred and fifty feet to a depth of twelve feet below the flow line and on a grade parallel thereto.

The route for this excavation is the center line of a belt four hundred feet wide, which belt represents fairly the available width of the valley. Generally, the cut will be shallow. It will be necessary to clear and grub the full belt of four hundred feet, which is now timbered, and reduce projecting bluff spurs. This portion of the valley is exceedingly irregular, and furnishes large areas for the deposit of spoil. No bridging is required, or is proposed, for this reach. The second reach extends from the east line of section 5 to a point one-fourth mile west of Western avenue at Bowmanville, a distance of twenty-three thousand one hundred and fifty feet, or four and three-eights miles. The route follows the bed of the stream to the Bowmanville bridge, thence easterly one-fourth mile north of Lawrence avenue. The low-water line is twelve feet above datum at the upper end, descending to eight feet at the east line of section 9, to seven feet at Crawford avenue, and to five feet at Bowmanville bridge. The latter elevation is known to be affected by ice gorges. No weirs are proposed in this reach. For four miles in the valley of North branch the same treatment is proposed as described for the first reach. The bottom grade will be ten feet above datum at the weir and descend at the rate of three feet per mile, or be two feet below datum at the Bowmanville bridge; thence the descent will be six feet to the end of this reach. An enlargement of this channel accompanied by a reduction in flood hight will probably occur. If anything is to be inferred from the Ogden-Wentworth ditch, the changes will occur slowly and not be of an erratic character. In time it will be feasable to extend dockage throughout this reach.

"The section from Bowmanville to Lake Michigan begins one-fourth mile west of Western avenue, and continues in a straight line one-fourth mile north of Lawrence avenue to five hundred feet beyond the shore line of the lake. The right of way will extend from the south line of Webster avenue on the north to the north line of Tuttle street on the south, and be, generally, five hundred feet wide south from the east-and-west line of Webster avenue. Subdivisions and street lines may vary the right of way somewhat without affecting the location of the channel. For instance, Argyle street, from Evanston road to the lake, will give a less width on the north.

"It is proposed to dock and dredge a channel two hundred and ten feet wide and eighteen feet below city datum. The cutting for about one-third of the distance will be less than ten feet above datum, for another third, from fourteen to eighteen feet, and at the highest point, on the Green Bay road, twenty-five feet. The cut will require side slopes and a berme at dock level. A considerable portion of the material above datum will be sand or soil. The balance of the cutting will probably be in clay. At the lake end, a pier will extend five hundred feet on the north side, and to three or four feet depth of water on the south. These piers are not intended to reach a navigable depth. To entirely prevent the water of the Desplaines from entering the Chicago river by the Ogden-Wentworth ditch will require a dam and levee nearly one mile long across the head of Mud lake valley near Summit. The estimated cost of this work in Norwood Cut, three-sevenths mile is:

Excavation, 3,543,123 yards at 25 cents	$885,781	
Structures, bridging, wire and pipe	102,700	
Right of way and damages	76,000	
		$1,064,481

" North branch improvement, five and three-quarters miles:

Excavation, 1,578,180 yards at 20 cents	$315,636	
Clearing and grubbing	10,500	
Structures, bridging and wire	84,000	
Right of way and damages	41,000	
		451,136

" Bowmanville cut, two and one-third miles:

Excavation, 3,716,575 yards at 15 cents	$557,500	
Docking and piers	205,000	
Bridging	67,500	
Right of way and damages	250,000	
		1,080,000
Preliminary cut, Bowmanville to Belmont avenue		50,000
Dam and levee near Summit		50,000
Total		$2,695,617

" The project of drainage via the Desplaines river, recommended in the preliminary report, involves the extension of the western end of the South fork in a westerly and northerly direction to the Ogden-Wentworth ditch, and thence to the Summit. For the immediate amelioration of the condition of the South fork until the final completion of the main canal, it was also recommended that the western arm of the South fork be extended along its proposed permanent line to the Illinois and Michigan canal, where a new pumping station was to be built.

"The canal pumping-works were built in 1882 by direction of the legislature, which, by a joint resolution passed in 1881, instructed the city of Chicago to build pumping works to discharge sixty thousand cubic feet of water per minute into the canal, or so much thereof as the commissioner should find the canal capable of carrying. The pumps, as built, are fully able to discharge that amount of water when they are all running, but, as one of the four separate machines is necessarily off duty a part of the time, it is customary to run but three, which pump about forty-five thousand cubic feet of water per minute. The canal by a nominal expenditure can be made to carry seventy-five thousand cubic feet per minute, or thirty thousand cubic feet more than the usual amount. It is believed to be to the sanitary interest of every one living along the canal and the Illinois river, as well as to the commercial interests of navigation and manufacturing, to have more water supplied to it, in accordance with the frequent demands of the state board of health.

" To build a channel from the Stock Yards to the canal, as recommended in the preliminary report, will involve no new exercise of authority, as the city, with the concurrence of the canal commissioners, possesses full power in the premises. As there is nothing temporary in this plan except the pumping-works, and as further consideration of the question confirms the commission in its previous conclusion, the recommendation is repeated that the western arm of the South fork be extended along the most practicable route to a point on the canal north of Thirty-ninth street and west of the Chicago & Grand Trunk railroad, and that pumping-works be built near the canal with a total capacity of forty-five thousand cubic feet per minute. There are no improvements on the proposed line. The channel will be ten thousand five hundred and sixty feet, or two miles in length, and should be excavated to an average depth of twelve feet below datum, and sixteen feet wide on the bottom, with side slopes one and one-half horizontal to one vertical. Such a channel will carry thirty thousand cubic feet of water per minute with no greater velocity than that existing in the Illinois and Michigan canal. By selling permits to brickmakers, this channel can be widened and deepened in a few years to any desired extent, and a revenue derived therefrom in the meantime. To keep the eastern arm of the South fork in a sanitary condition it will be necessary to build an intercepting sewer along its south side from Halsted street to a point on the west arm, so that all sewage will be discharged into the current established by the pumps. Heretofore, various other plans have been proposed for the purification of the South fork, the salient ones of which are as follows:

"To build a conduit from the end of the slip at Halsted and Thirty-ninth streets diagonally across the city to Lake Michigan at about Thirty-third street, and to pump lake water to the head of the slip or to pump river water therefrom to the lake, as occasion might require. To build a conduit from the same point in the slip to the canal entrance at Bridgeport and pump into the canal from the slip. To build a conduit from the west end of the South fork to the canal and pump into the canal.

"The plan recommended is the third one, modified to conform to the complete plan of drainage via the Desplaines river. The cost of improving the South fork, as herein recommended, is estimated as follows:

Right of way	$300,000
3,700 feet of intercepting sewer	23,000
460,000 cubic yards of excavation	115,000
Five highway bridges	25,000
Four railway bridges	20,000
Engine house, foundations and flumes	30,000
Pumps, boilers and connection complete	120,000
Improving canal	20,000
Total	$653,000"

This report was signed by Rudolph Hering, chief, and Benezette Williams and S. G. Artingstall, consulting engineers. Subsequently the commission recommended the discharge of sewage into the Desplaines near Lockport, through a wide, deep channel of six hundred thousand cubic feet per minute, and the diversion of the flood water of the North branch, Desplaines and Calumet into Lake Michigan. The old act to organize the city into a drainage district was approved June 6, 1887, but under it little was done and the act of May 29, 1889, was suggested.

The drainage act, approved May 29, 1889, and in force July 4, 1889, is necessarily general in form, because the state constitution prohibits special legislation. It is, however, specially applicable to the great Chicago project of opening an outlet for the waters of Lake Michigan to the Desplaines and Illinois rivers, and through them to the Mississippi, for the purpose of drainage and navigation. A synopsis of its provisions with particular reference to this project is here presented. The title of the act is "An act to create sanitary districts and to remove obstructions in the Desplaines and Illinois rivers, and the dams at Henry and Copperas creek." The territory of any sanitary district must be contiguous, must lie within the limits of a single county, and contain two or more incorporated cities, towns or villages. Any five thousand legal voters resident within the limits of the proposed district may petition the county judge to submit to the voters of the district the question of organizing the same as a sanitary district under the act. The petition must contain a definite description of the territory intended to be included, and the proposed name of the district.

It is made the duty of the county judge, upon the filing of this petition in the office of the county clerk, to call to his assistance two judges of the Circuit court, these three, "to constitute a board of commissioners, which shall have power and authority to consider the boundaries," of the district, "whether the same shall be described in such petition or otherwise." At the meeting of this board, of which at least twenty days' notice must be given, all persons in the proposed district shall have an opportunity to be heard touching the location and boundaries of the same, and after the hearing the board shall determine the boundaries thereof. This done, the county judge shall submit the question of organization to the voters of the proposed district at an election to be held on the first Tuesday after the first Monday in November next ensuing, provided that twenty days' public notice of the election and its purpose must be given. If a majority of the votes cast on that question shall be found in favor of the proposal, "such proposed district shall thenceforth be deemed an organized sanitary district under this act."

Next, it is made the duty of the county judge, upon such organization of the district, to call an election to elect officers, giving due public notice thereof. These officers are to be nine trustees, "who shall hold their offices five years and until their successors are elected and qualified, except the term of office of the first trustees shall be until five years after the first Monday in December after their election. The election of trustees, after the first, shall be on the first Tuesday after the first Monday in November in every fifth year. In all elections for trustees each qualified voter may vote for as many candidates as there are trustees to be elected, or he may distribute his votes among not less than five-ninths of the candidates to be elected, giving to each of the candidates among whom he distributes the same the same number of votes or fractional parts of votes;" which seems to mean that the elector may divide his nine votes equally among not less than five nor more than nine candidates. The trustees are to choose a president from their own number, and may elect a clerk, treasurer and chief engineer, to hold office during the pleasure of the board, and to give such bond as the board may require. The board is to prescribe the duties and fix the compensation of all officers and employes, provided that the president shall not receive more than $4,000, nor any other member more than $3,000, nor any attorney more than $5,000 per annum. The board as a body corporate is clothed with ample powers, which need not be described in detail, for the purpose for which it is created. It will suffice for the present to say that besides providing for the drainage of the district, the board may establish, lease and control docks adjacent to any navigable channel made under its direction and control and dispose of any water power which may be incidentally created in the construction and use of such channel or outlet, and such channel or outlet may extend beyond the limits of the sanitary district. Among the corporate powers is that of acquiring by purchase, condemnation or otherwise, all real and personal property, either within or without the corporate limits, that may be required (printed "acquired" in the bill) for its corporate purposes.

The corporation may borrow money or issue bonds therefor, but may not incur indebtedness in any manner or for any purpose in excess of five per cent. on the valuation of taxable property therein, according to the last general assessment for state and county purposes previous to incurring the indebtedness, nor in excess of $15,000,000 in the aggregate. Upon incurring any indebtedness, the board must provide for the collection of a direct annual tax sufficient to pay the interest as it falls due, and also to pay the principal as it falls due, which must be within twenty years from the time of contracting the indebtedness; but this annual tax may be remitted to the extent that net earnings from water power and docks may suffice to meet payments on account of interest or principal. The board may levy and collect taxes for corporate puposes upon property within the limits of the district, but not to an amount in any year exceeding one-half of one per cent. of the value of the taxable property within the district as assessed and equalized for state and county taxes in the same year.

The board may also defray the expenses of any improvement which it is authorized to make wholly or in part by special assessment, but no special assessment may be made upon property outside of the district, "and in no case shall any property be assessed more than it will be benefited by the improvement for which the assessment is levied. Any assessment may be divided into not more than twenty equal annual installments, and deferred installments shall bear interest at a rate not exceeding six per cent. per annum. Any one or all of the installments may be paid at any time after the assessment is confirmed, with accrued interest, if any, to the date of payment." The board may issue bonds or certificates to an amount not exceeding eighty per cent. of deferred installments of any assessment, payable only out of such assessment, and bearing interest at a rate not exceeding that upon such installments, and the board may call in and pay these bonds or certificates as fast as money is received into the treasury, which is applicable to that purpose.

Provision is made for payment for private property taken for the use of the corporation, and for damages to real estate, by overflow or otherwise, within or without the district. Provision is also made for entering upon public property to the extent necessary for the purposes of the corporation, and for the use of the Illinois and Michigan canal within the limits of Cook county. The interests of private owners are guarded by a provision that "all damage to property, whether determined by agreement or final judgment of court, shall be paid out of the annual district tax, prior to the payment of any other debt or obligation."

The act provides that the channel to conduct the waters of Lake Michigan into the Desplaines or Illinois river shall be of sufficient capacity to maintain a continuous flow "of not less than three hundred thousand cubic feet of water per minute, and to be of a depth of not less than fourteen feet, and a current not exceeding three miles per hour, and if any portion of such channel shall be cut through a territory with a rocky stratum where such rocky stratum is above a grade of sufficient capacity to produce a depth of water from Lake Michigan of not less that eighteen feet, such portion of said channel shall have double the flowing capacity above provided for" (that is, six hundred thousand cubic feet per minute), "and with a width of not less than one hundred and sixty feet at the bottom capable of producing a depth of not less than eighteen feet of water." Further, if the population of the district, together with that of tributary drainage territory, if any, shall at any time exceed one million five hundred thousand, the channel must be made and kept up to a capacity of not less than twenty thousand cubic feet of water per minute for each one hundred thousand of population at a current of not more than three miles per hour. And in case the general government shall improve the Desplaines or Illinois river to a capacity of six hundred thousand cubic feet flow per minute, the drainage district must enlarge the entire channel so as to give it the same capacity at the same rate of flow. It must also remove the dams at Henry and Copperas creeks, and may correct, modify and remove obstructions in the Desplaines and Illinois rivers whenever it shall be necessary to prevent overflow or damage along said rivers, but may not injure or destroy existing water power.

Before the water of Lake Michigan can be turned into the main channel, the work must be inspected and approved as fulfilling the conditions and requirements of the act, by a board of three commissioners to be appointed by the governor, all of whom shall be residents of different sections on the Desplaines and Illinois rivers; their approval, however, to be subject to the action of a court of competent jurisdiction. The commissioners can only apply for an injunction to restrain the district board from turning the waters of the lake into the channel, which the court may or may not grant. The act was approved by the people in November, 1889; the trustees were elected December 12 that year, and on February 1, 1890, completed organization. The legality of the whole business was questioned, but the Supreme court was adverse to the questioners.

Opposition and uncertainty followed the new organization. The thoughtful citizen viewed with alarm the summary powers of taxation bestowed upon the drainage trustees. Others thought only of the general drainage system in connection with a great waterway connecting Chicago with the Mississippi, while the other men of the community were content to mimic the Parisian system or the Pullman system and thus save millions for the city, as well as avoid poisoning the waters of the Desplaines and Illinois rivers with the sewage of Chicago. Within the tax-eating circle itself other troubles came up, and the servant of servants urged his own plans without regard to their utility or expense. The United States engineers reported adversely, one or two of the trustees held aloof from the meetings of the board and left the cool-headed president to hold the fragmentary elements together as best he could. After the decision of the Supreme court the commission took on a new life, and work was carried on in comparative harmony until the beginning of the winter of 1890–91 when the chief engineer was dismissed.

The dismissal of Engineer Cooley was followed, on December 11, 1890, by the dismissal of W. M. Rees, T. T. Johnston, William T. Blunt, J. C. Des Granges and Henry A. Wilson, chiefs of the various divisions or bureaus, and the appointment of the following named to fill their places: G. R. Shnable vice Rees, John H. Spengler vice Johnston, August E. Gaus vice Blunt, J. B. Nixon vice Des Granges and H. C. Clifton vice Wilson. The failure of Engineer Cooley to present the report on "Federal relations" at a stated time was the given cause for his dismissal, while sympathy for the chief engineer and refusal to obey the orders of the trustees led to the dismissal of the department chiefs. The important report was ordered to be made in the spring of 1890, the work being assigned to Cooley. The report he was asked to prepare was one to be presented to congress, showing why it should appropriate the necessary money for the carrying out of the scheme—a detailed statement showing the relation of the government to the scheme of connecting, by a navigable waterway, the great lakes and the Mississippi river. Up to December 11, 1890, this report was not presented by the engineer, who claimed that professional usage urged him to hold the report until he considered it perfect in detail.

The engineer's report (Worthen's) of January 10, 1891, was in favor of the following described route: "Beginning at the Bridgeport locks the line diverges in a northwesterly direction to Mud lake. Thence it follows the line of the Ogden avenue ditch, sometimes crossing it until Summit is reached. Then it bends toward the south, following the west line of the Desplaines river to a point a little this side of the Sag. There it cuts through the bed of the river and comes out about a mile this side of Lemont. From that point until it terminates at Lake Joliet it runs along the west side of the river and parallel to its general line, without, of course, following the curve. It crosses the bed of the river at two points only—a mile this side of Sag bridge and at Summit, where it cuts through the northern branch." This is the true course of a channel to connect Lake Michigan with the Illinois river; it is the old choice of the United States engineers, and the same as pointed out years ago by John Doolin, of Lemont, a man thoroughly acquainted with the country and its conformation.

The alternative route commences at the end of the South branch of the South fork at Ashland avenue, or thereabouts, and proceeds as the crow flies to the Desplaines river at a point a few rods this side of the crossing of the river and what is known as the Chicago terminal line. This route travels over a considerable length of rocky formation and bowlder, and the cutting would be quite expensive. Along the first proposed route there need be no rock-cutting until a little below Willow Springs. Then the rock-cutting will not extend over half a mile, until Romeo is reached. There the limestone uplift commences and continues. Until Willow Springs is reached the cutting is through mud, bowlders, gravel, then again bowlders, then again gravel. It will not be half as expensive as estimated. A connection

THE GREAT NORTHERN HOTEL.

between the southern line of the South fork and the main channel at a point between Brighton Park and the crossing of the same channel by the railroad tracks is also proposed. This branch will cleanse the South fork and furnish the water necessary to make the volume of three hundred thousand cubic feet. He said further that the work would cost $24,500,000, and that, too, on the assumption that the cut through the clay this side of Summit is made eighteen feet deep at once, instead of making it fourteen, as the law allows, and then deepening it to eighteen at some later period. In order to comply with the law he favors a surface section for the cutting nine hundred and eighty-three feet wide and eighteen feet of water. The sides of the canal he would line with dry rubble stone.

Other reports followed; but the tenor of all was that the construction of a channel would amount to over $20,000,000, and perhaps exceed $30,000,000.

Opposition to the drainage law was manifested immediately after the act was approved, but did not take practical shape until January 17, 1891, when one hundred and fifty members of the Hamilton club agreed to a report tendered by their committee on political action. After recapitulating the "Act to create sanitary districts and remove obstructions in the Desplaines and Illinois rivers," the report says it was understood by the voters of the district and the people throughout the state that the channel with its connections should form a continuous navigable waterway from Lake Michigan to the Mississippi river. Apparently this idea has been abandoned. The character of the drainage canal was predicated on the idea of a navigable waterway, and it was assumed that the Federal government would assist, but no greater assurances than a hope have been given, and the Federal engineers have reported adversely. Even if the proposed improvements be made they would not be available for general navigation, for the Mississippi at the mouth of the Illinois can not carry vessels drawing more than five or six feet. As to the drainage feature the report says it is difficult to see how a channel whose surface level is the same as the lake and the river is going to help the condition of Chicago sewers. There would be no greater fall than now. The drainage law provides that "all garbage, dead animals, and all solids shall be taken from sewage discharged into the channel." If the sewage is purified before going into the channel what is the use of the drainage channel? Why should not the purified sewage flow into the lake, especially when the water supply is drawn through the new tunnel? But the water supply is contaminated by sewers which empty into the lake. But these sewers follow the natural drainage and can not be tapped in the rear. Neither is there any such provision in Engineer Worthen's report to divert the sewage. The report alleges that no one can estimate the cost of the waterway, and submits resolutions denouncing the drainage law as providing neither for a waterway nor purer water supply; as creating an engine of taxation menacing property interests and vesting in a special municipal body unwarranted and irresponsible powers, and asks for the unconditional and total repeal of the law. After the reading of the report a general discussion followed. The resolutions condemning the law wholly inadequate to its purposes and calling for its unconditional and total repeal were stricken out.

George P. Engelhard delivered an address before the Hamilton club at that meeting, entitled "Chicago and the national waterway." This address was founded on data containing an exhaustive report to congress by Captain Marshall, of the United States corps of engineers to the valuable treatise on the "Lakes and gulf waterways," by L. E. Cooley, C. E.; to Gordon H. Nott, C. E.; George W. Waite, C. E., and others.

"The site of present Chicago and the tributary territory was the field of one of the most terrific and decisive combats ever waged by Nature's forces. In the pre-glacial period, the lakes of Huron, Superior and Michigan found their outlet, not through the dreary wastes of a northern clime to the Atlantic, but by the inviting shores of the present western metropolis through the valleys of the Desplaines and the Illinois, where it joined forces with the Mississippi and swept majestically onward to the Gulf of Mexico. Then indeed did the Chicago river divide honors with the St. Lawrence. No Canadian had then the hardihood to assert undivided possession of the outlet waters of our inland seas, and sneer at the wretched river poverty of the ancient denizen of Chicago. Assuming the presence of population and civilization, we may picture a vast imperial city, the 'Constantinople of the continent,' the ancestor of great Chicago, powerful in her wealth drawn from the fertile surrounding valleys and renowned in her commerce which plowed not only the seas to the north and east, but the imposing river which brought the treasures of the west and south. But this greatness was destined to an interruption which already has spanned a long vista of centuries. The portentous day arrived with the relentless advance of those Goths of the ice period, huge glaciers, which crushed all animal and vegetable life, exterminated lakes and rivers, and even put to torture and finally death the noble range of mountains which reared their crests from Lake Superior to northern Indiana. Buried deep in this continental sepulchre of ice, the fiery spirit of Chicago was for once subdued. For many years, good authorities place it as high as forty thousand, she lay thus bound and nearly congealed. It was an ordeal which put to a severer test her faith and recuperative powers than the cyclone of flame which swept over her in later years. But the day of deliverance came at last; the elements relented; warmer breezes began to hold sway, and the ice monster was driven slowly but surely backward. But when the resurrected Chicago came forth, what a transformation had the glacial hordes wrought! Hardly a vestige of the old landscape remained. The high-soaring Wabash arch had vanished; ridges had become peaceful valleys; meadows rose into frowning hills; rivulets thundered as appalling Niagaras; lakes had become dry land and land had become water. But to Chicago the most startling revelation was the divide which pierced the valley of the Desplaines, arrested the waters of the imposing outlet of the great lakes to the Mississippi, and forced them back through the Mackinac and Detroit straits to swell the majesty of the St. Lawrence. The great river to the Mississippi had disappeared. The Desplaines and Illinois rivers, and a deserted, though clearly-outlined river bed across the divide, were the mute, sad remnants of a once mighty waterway. Chicago now found herself on a level with the lake, surrounded by bayous and lagoons, with here and there a mound of solid ground. The divide was found to be an average of only six feet above the lake level, reaching its highest point about fourteen miles from the lake, declining to lake level in thirty miles, near Lockport; and then descending precipitously seventy-seven feet in ten miles to Joliet; ten feet more in two miles beyond, and continuing the descent to a total of nearly one hundred and fifty feet to La Salle, the head of river navigation, in a distance one hundred miles from Lake Michigan.

"The destruction of this pre-glacial waterway to the Mississippi, with its attendant continental transformations, has been the subject of fascinating study by geologists, engineers, statesmen and others, for many years. The waters of the Atlantic meet those of Lake Michigan by intervening lakes, rivers and canals. Restore the ancient outlet of Lake Michigan; give back to the Mississippi its lost heritage, and the circuit of navigation between the seaboard, the lakes, the Mississippi and the Gulf will be complete. This is the daring and startling challenge which modern enterprise hurls at the helmeted forces of glacial triumph. Can it be possible that the mighty benefits to accrue to the nation and to the American people from such restoration shall be much longer deferred? The commerce of a continent flows unimpeded from the Atlantic to the foot of Lake Michigan, where it is rudely stopped and turned back by a paltry hundred miles which defy its rightful progress to the Father of Waters. Shall this defiance silence the demands for a waterway, indispensable alike to the proper defense of the nation in times of war, and to its highest prosperity in times of peace? Shall the greatest and wealthiest nation of modern times, with the genius of modern engineering at its command, longer refuse to inaugurate a work destined to eclipse in the sublimity of its results all former achievements of this or of other countries? As was asked in the course of an address by Governor Oglesby, at the waterway convention, 'does not the national government know that it ought to own at least one through line of transportation? Will not the national government come to feel that it would be a most expedient and judicious thing for it to have unobstructed control of one waterway for commerce in this country that might become the criterion for charges by other modes of transportation? Can not the people of New England and the East, as well as the people of the South and West, feel the importance of spending a few millions of dollars to open this waterway, so that commerce can go by its own easy steps, and, when necessary, war vessels also?' The voice of patriotism as well as of the gigantic agricultural and mercantile interests of the Mississippi valley cries out against further delay, and demands that a broad-minded, generous and intelligent policy shall prevail, unencumbered by petty local interests, and controlled by no government save that of the nation itself.

"The project is no new creation. Albert Gallatin, in 1804, directed attention to the importance of uniting the waters of Lake Michigan and the Mississippi. Clinton and Morris, in 1824, eloquently set forth its advantages, two years before the United States granted the right of way for the Illinois and Michigan canal. The work was promptly undertaken by the state of Illinois and the canal opened to navigation in 1849. It is nearly one hundred miles long, six feet deep, sixty feet wide at surface, thirty-six feet wide at bottom and for a distance of twenty-six miles has a summit level eight feet above the lake. As a national waterway it has been a signal failure, owing to the shallowness of the Illinois river, which it was expected the general government would improve adequately for general navigation. In the hope that Congress would complete and enlarge the waterway, the state of Illinois, in 1882, tendered the canal to the United States, but Congress, on the advice of a Federal board of engineers, declined to accept it, preferring, if it did anything, to utilize the Illinois river for a waterway, rather than the canal between Joliet and La Salle. Complications with Chicago's drainage problem were also feared, as the canal was the receptacle of a large portion of the city's sewage.

"The Illinois and Michigan canal having proved so wofully inadequate to its purposes, and having so grievously disappointed the hopes of its projectors, the old problem again pressed forward, 'How shall the great national waterway become a fixed fact?' While rival sectional interests were debating the question, Congress, on August 11, 1888, authorized the secretary of war, 'for the purpose of securing a continuous, navigable waterway between Lake Michigan and the Mississippi river, to make the proper surveys, plans and estimates for a channel improvement of the Illinois and Desplaines rivers from La Salle to Lockport, so as to provide a navigable waterway not less than one hundred and sixty feet wide and not less than fourteen feet deep.' The duty imposed by these plans and estimates was assigned by General Casey, United States chief of engineers, to Capt. W. L. Marshall, the officer in charge of the improvement of the Illinois river, whose report, dated February 28, 1890, is, beyond question, the most exhaustive in its details of routes, surveys and estimates, and the most complete in its information and all facts bearing upon the drainage subject, of all related literature.

"In making provision for the surveys, Congress was, no doubt, influenced by petitions from certain circles in Chicago, contemplating Federal coöperation in an ingenious scheme for solving Chicago's sewage problem by floating the sewage on the national waterway. Captain Marshall's report does not take kindly to the suggestion. The logic of its surveys, plans and estimates, is a scathing arraignment of the proposed sewage highway, demonstrating not only its impracticability and its utter absurdity, but also its ruinous consequences if persisted in.

"'As the Illinois state law stands,' Captain Marshall declares, 'demanding a constant discharge and unnecessarily great and expensive channels not demanded nor suitable for the commerce to be subserved, a compliance with its terms does not seem advisable for the United States. We find this proposed route,' he further remarks, significantly, 'instead of being urged upon a purely national basis, encumbered with conditions that have no relation whatever to national ends or objects, but purely dependent upon local necessities for sewerage and water supply as the real governing basis, while a great waterway is urged as a national necessity to secure United States aid.' Engineer L. L. Wheeler, who was in immediate charge of the surveys, is no less emphatic in his conclusions. Referring to the disadvantages to navigation by the proposed sewer waterway through the Chicago river from the lakes he says: 'The river is spanned by twenty-four bridges, all of the largest and costliest type. The traffic over the bridges in the central portion of the city is enormous and the opening of one of them interrupts street traffic for blocks away. The river is thronged with lake crafts of all kinds both day and night, and the bridges require to be constantly on the swing to permit their passage. At certain hours of the day, however, the pressure of street traffic becomes so great that the bridges are not opened at all, and vessels must wait at their docks or in the harbor until the bridges can be opened. In order to make a waterway one hundred and sixty feet wide through the Chicago river to Bridgeport suitable for Mississippi river steamboats it would be necessary to reconstruct twenty bridges, at an estimated cost of $2,250,000, and to acquire three hundred and twenty-five thousand square feet of ground, the estimated value of which is $450,000 and to construct eleven thousand five hundred linear feet of new dock, at an estimated cost of $172,500. To these amounts would have to be added $165,000 for excavation and a large amount for land damages, which it would be impossible to estimate.' These facts, Mr. Wheeler concludes, would, 'forbid this route as an outlet to the lake,' and all other proposed routes within the old city limits are 'no less objectionable.' Even with a width of one hundred and sixty feet, however, navigation in a current of three miles per hour and a stream but one hundred and sixty feet wide would be fraught with extremely hazardous consequences to the numerous river vessels of a length double the width of the channel. The rapid current required by the drainage act for purposes of drainage is, moreover, as Captain Mashall points out, irreconcilably hostile to the conditions of safe and efficient river navigation. Following the demonstrated facts and disinterested arguments in this, as in all former reports to Congress on the subject, and guided by the investigations and judgment of scores of other engineering experts for the state and city, the nation will unquestionably (unless balked by the Chicago drainage absurdity) soon stand committed to the project of a pure and independent national waterway, but never to a scheme which would degrade the majestic enterprise to a mere sewer outlet for Chicago, in violation of every law of decency, of sanitary science and of sound economics.

"Let us review briefly the development of the Chicago sanitary district, and the colossal folly which prompted its formation. Finding the general government indisposed to take immediate action, but disposed rather to avoid the Chicago river route altogether, the projectors bethought themselves of a plan whereby the city of Chicago, single-handed and alone, should undertake, at her own expense, the construction of a waterway for the state and nation. The idea was fascinating. Long had learned sanitarians wrestled with the perplexing problem of the disposal of the city's sewage; long had certain enthusiasts dreamed of Chicago sitting enthroned at the head of a mighty river which linked the destinies of a continent. Could not the problem of the dream be happily combined and the drainage and the waterway project be pushed forward to joint completion? As the thought progressed, the estimates of cost gradually contracted, while the advantages rapidly expanded. A committee was finally appointed which reported in favor of a waterway one hundred and sixty feet wide and eighteen feet deep from Lake Michigan through the Chicago river to Joliet. Into this Danube of the West, Chicago could turn all her sewers, thus promoting, it was urged, the health of all her inhabitants and those of the farms, towns and cities located along the banks of the stream. Such an undertaking would cost, at the modest estimate of its promoters, not less than $20,000,000. The indebtedness of Chicago was already $13,000,000—$5,000,000 in excess of the constitutional limit of five per cent. How then was the money to be raised? None could be borrowed, and the current municipal expenses consumed all the annual taxes of the full constitutional limit.

"It was at this critical point a fertile brain evolved the idea of a separate and independent drainage municipality for Chicago, with separate and independent taxing powers whereby the bonded indebtedness of the territory comprised in the limits of the city might be doubled. This was in plain violation of the spirit of the constitution, but, once seized by the ship-canal fascination, considerations of fact, law and equity lost all force. The next step was to embody the ideas in a draft of a bill, which was duly presented to the last Illinois legislature, backed by a lobby of unprecedented size and of all degrees of persuasiveness, plasticity and unscrupulousness. The towns along the route of the proposed canal, and in the tributary valleys, made the most of their opportunity. They demanded everything as the price of their support. Amendments were fired at the bill from all quarters of both legislative branches. Chicago yielded point after point. Several city representatives were disposed to protest, but the lashings of the city press and the curses of the ravenous spoilsmen who swarmed about the capital, preserved an unbroken front for the Chicago contingent. There was great rejoicing when the bill finally passed. Then began the process of suburban annexation, to fortify the conspiracy against independent municipal action by any portion of the proposed district. Annexation accomplished, the next step was to make sure that opposition to the creation of the district was disarmed in advance. A joint session of the central committees of both the great political parties was called; arrangements for the election were perfected, and an agreement entered into to print on the ballots only the affirmative proposition. The proposition, as a matter of course, carried quite unanimously. Thus far the drainage coterie had won an uninterrupted series of triumphs. They had successfully duped the legislature, the people of Chicago and the party representatives; but, strange to relate, in the nominating conventions for drainage trustees, they found themselves unable to dictate the nominees. The republican convention named republicans, and the democratic convention named democrats, utterly ignoring the demands of the now arrogant drainage leaders. In their dilemma, they deserted their dupes, called themselves together, patched up a so-called 'citizens' ticket,' and on election day again came forth triumphant. It was a brilliant fight and a famous victory; but in their subsequent calculating moments the people of Chicago began to investigate the real meaning of the drainage act, the actual powers vested in the drainage board, and the probable consequences of the affair to themselves as citizens and taxpayers.

"The avowed purposes of the drainage act were: First, to enable Chicago to maintain a pure water-supply by diverting all sewage from the lake; second, to provide a means for the most rapid and effective disposal of all the city's sewage, and, third, to authorize the construction of a channel adapted to the demands both of an adequate sewage outlet, and of a great navigable waterway to the Mississippi. If the facts shall justify the conclusions that the vast undertaking bears no necessary relation to the problem of pure water; that for purposes of drainage it would prove utterly useless, or, at best, but a half-way and temporary expedient, and that, finally, if, instead of providing a great waterway to the Mississippi, it would tend to obstruct, jeopardize and defeat the successful prosecution of this sublime project, would it not be patriotic and wise to call a halt without further delay?

"The importance of a thorough system of sewerage to every community, and particularly to large cities, is impossible of exaggeration. It is more closely related to the health and the lives of the people than any other department of the government service. Pure water and perfect sewerage are the vital factors in the physical life of a city. Impure water, or imperfect sewerage, is certain to result in extreme prevalence of disease and a high death-rate at all times, with periodical ravages of frightful epidemics. The question of a pure-water supply has therefore engaged the earnest attention of all well-governed cities, and, to the credit of Chicago be it said, no other city has given the subject more conscientious thought. Lake Michigan furnishes, practically, the entire water supply of Chicago. The supply for the recently annexed portion of the city on the north is to be from a point located nearly two miles out in the lake; that for the towns of Lake and Hyde Park is from the Hyde Park crib, located one mile from shore, and that for central Chicago from a point two miles from shore. A new water tunnel is now being constructed, which will supply the city from a point four miles from shore. The low death rate of Chicago, as compared with cities against the purity of whose water supply no suspicion can exist, proves that the reports alleging serious contamination of our drinking water by sewage, are either gross exaggerations or pure fabrications. The new four-mile tunnel inlet was located after an exhaustive series of observations by the city engineering department, with especial reference to the direction of the lake currents, and thus to the avoidance of contaminated lake water. With this precaution, and with the vast diluting and oxidizing forces of the lake, it may be safely asserted that the new service will supply the city with as nearly pure water as the lake affords anywhere; but even should this be denied, the fact still remains that purity of water is simply a question of distance of the supply from shore, and that this question is one merely of thousands of dollars, where that of a drainage channel is millions. And here we note, in passing, the strange contradiction involved in the construction of a channel at a cost of millions, designed to keep the lake perfectly free from sewage, and in the location of a tunnel four miles out at a cost of hundreds of thousands, when a half mile from shore under such conditions would do as well.

"But, retort the drainage advocates, even though it be possible to obtain pure water without the drainage channel, is not the channel the most effective and at the same time the cheapest solution of the sewerage problem? Here is a vast city of already over a million inhabitants, and growing at a rate which promises a population of over two millions in ten years. Evanston and a part of Lake View, together with a portion of the south side from Twelfth street, and all of Hyde Park, drain into the lake; all the remaining portion of the drainage district drains into the various forks of the river—by far the greater part into the

South fork, which discharges into the Illinois and Michigan canal. The site of Chicago is everywhere low, so low that, adjacent to the river, it was necessary to elevate it fourteen feet above low water in order to secure proper sewerage. Much of the territory of the district is below lake and river level. Its waters are frequently undecided whether to seek the lake or the Desplaines. During the spring freshets the lake is given the preference, but when the Desplaines runs low the preference is kindly reversed. Under such conditions we should expect to find the serpentine Chicago river the stagnant, noisome thing it usually is. Its slimy deposits and persistent sluggishness clog the sewers and drive back their contents freighted with deadly gases. In view of these conditions, shall the great city of Chicago, already the second metropolis of the New World, and destined soon to become the first, ignore this frightful menace to the health and happiness of its people? Shall it permit the evil to grow and flourish until an appalling epidemic shall teach it the neglected lesson of humanity and common sense? Is any price too high to pay for immunity from the sanitary perils which threaten us under existing conditions? These are the considerations which appeared to justify, to the minds of tens of thousands of Chicago's conservative people, the gigantic measure of relief represented in the proposed drainage channel and the tremendous taxation which it involves.

"The question, however, recurs, Will the channel afford the desired relief? The efficacy of a medicine is surely not always proportioned to the immensity of the dose. It is proposed, in fact the drainage act practically requires, that the channel shall be one hundred and sixty feet wide and eighteen feet deep, with a flow of not less than three hundred thousand cubic feet per minute, and a current not exceeding three miles per hour. It is asserted that this volume and velocity will insure a sufficient dilution and oxidation of the sewage to render the stream practically pure, and therefore a blessing to the people of the tributary valleys. The truth of this assertion is challenged by the ablest sanitarians of Europe and America, whose testimony is unanimous against the contamination of rivers by metropolitan sewage. The water may appear pure, but the disease germs of sewage are not thus easily destroyed. High authorities go further and deny that even under the most favorable circumstances, would a stream of such limited volume and uniform current, without rapids or cataracts to expose its impurities to the oxidizing forces of the air, be able to free itself from the physical offensiveness of the fearful mass of sewage from so vast a city. If this be true under favorable season conditions, what shall be said of the condition of the stream during the winter months, when the filthy, disease-laden mass is sealed in ice and thus free to pursue its satanic way to the population of the river valleys, undisturbed by the atmospheric angels which are supposed to hover over it and cast out the devils of filth, disease and death. It is, of course, magnanimous in Chicago to endeavor to dump its garbage into its neighbor's front yard, with the assurance that the garbage will, in due season, become oxidized and innocent and sweet; but we marvel at the good nature or the imbecility of the neighbor who not only submits to the outrage, but even lends a helping hand to its perpetration. This phase of the question is, however, one which concerns chiefly the people of the

Desplaines and Illinois valleys, though to Chicago it may serve to suggest the important constitutional question, set forth in the brief of Judge Sanford, before the Supreme court, as to the right of a municipal corporation 'to go outside its own territory to construct a channel for the deposit of its own filth into territory outside its own limits, and not in its own natural basin.' This alleged right is contrary to established precedent, is opposed by the most eminent legal authorities, and is in direct violation of the criminal code of Illinois (chapter 38, paragraph 277.) The Supreme court in its decision failed to pass on this question. It is held in reserve by citizens of the valleys who may enjoin sewage discharge into the channel even after Chicago shall have expended millions for its completion. This is a contingent liability which the district can not afford to ignore. The threatened pollution of navigable rivers adds another to the many reasons why the United States government refuses to enter into the proposed Chicago drainage partnership.

"But will the proposed drainage scheme actually drain? This is the question of vital interest to Chicago. Let the conditions be clearly seen. Since the channel is to be an outlet of Lake Michigan, its surface level must be the same as that of the lake and of the present Chicago river. How, then, will the situation be materially improved, save in respect to the greater attractiveness of the river itself? The land will be just as low, and the river outlet just as high as at present. The chief evil to be overcome—the clogging and damming up of the sewers, due to their necessarily slight decline—will remain precisely as at present. A face blemish has been removed, but the constitutional disease remains. We have improved the condition of the Chicago river, but the sluggish sewers are as sluggish and menacing as ever. The surface of the stream, not its depth, determines the level of its tributaries at their junction. The sewers must be higher than the surface lever of the channel, or drainage will be impossible. Did time and your patience permit, it might also be of interest to inquire how the drainage scheme projectors propose to reverse the laws of gravitation and make the vast territory which now drains into the lake divert its sewage into a foreign watershed.

"Let us assume, however, for argument's sake, that everything claimed in behalf of the channel is logical and true. Its supporters are then confronted with the following section (No. 208) of the drainage act: 'If the population of the district draining into such channel shall, at any time, exceed fifteen hundred thousand, such channel shall be made and kept of such size and in such condition that it will produce and maintain at all times a continuous flow of not less than twenty thousand cubic feet of water per minute for each one hundred thousand of the population of such district, at a current of not more than three miles per hour.' Twenty thousand cubic feet volume for every one hundred thousand population is equivalent to one cubic foot for every five of population. The drainage board has announced its intention to begin with a volume of three hundred thousand cubic feet. This would answer, according to the ratio required by law, for a population not exceeding fifteen hundred thousand, a limit which Chicago will reach, under the stimulus of the World's Fair, certainly within five years, or several years before the channel could possibly be completed. Should the board start with the maximum volume of six hundred thousand cubic feet per minute, it would suffice for a population not exceeding three millions, a limit which the city, following its past rate of increase, will reach in from twenty to twenty-five years. Allowing ten years for completing the work, if prosecuted with vigor, we should then have (conceding everything which has ever been or ever can be claimed for it), as the net result of a stupendous scheme of perpetual taxation, a solution of the drainage problem for a period of only ten or fifteen years! This clause in the drainage act is obviously alone sufficient to condemn it in every part as a rational sanitary measure. Nothing short of shameless duplicity or a frightfully distorted sense of official duty can account for the apparent determination of the drainage board to proceed with its surveys in the face of the law's explicit condemnation of the entire scheme to early and certain fatality. Just when the exigencies of a vast population shall have become greatest, the city's drainage system, constructed at frightful expense, will have become useless! It is this startling mathematical fact in the drainage act which imparts a hideous grin to the legislative absurdity under which nine men of alleged sanity are now expending $20,000 a month for a corps of engineers and clerks and their own inevitable salaries, and under which they have already levied $2,000,000 of taxes, and are authorized to mortgage the district for $15,000,000, to say nothing of levies for annual taxes and millions by special assessments!

"'But,' again retort the drainage dreamers, 'we deny the sufficiency of your conclusions. You may strike from the list of advantages purer water and better drainage, but have we not remaining the superlative beneficence of a grand ship canal, which must crown Chicago the autocrat of all mercantile America?' The construction of such a channel is, as has been shown, of the utmost importance to the metropolitan future of Chicago, but will the channel proposed by the drainage board, under the conditions of the drainage act, fulfill the requirements of a proper navigable waterway to the Mississippi? The law makes no provision for a waterway beyond Joliet. It is urged that the general government will improve the Desplaines and Illinois rivers to La Salle, the head of river navigation, thus completing the waterway to the Mississippi, but what reason exists for this hope it is difficult even to surmise, in view of the rejection of the gratuitous offer by the state to the United States of the Illinois and Michigan canal, and the uniformly adverse reports by the government engineers against any sort of Chicago drainage ship-canal project.

"The objection of the Federal government to the proposed coöperation is primarily that the drainage idea is fundamentally opposed to the requirements of a national waterway. By the government improvements now in progress in the Mississippi and Illinois rivers it is hoped to secure a minimum depth of seven feet in the Illinois river from La Salle south; six feet on the upper Mississippi; eight feet from St. Louis to Cairo and ten feet from Cairo to the Gulf. The present depths are from eighteen inches to three feet less than the foregoing. Why, then, the tremendous scheme for a channel eighteen feet deep to Joliet—nearly treble the present depth of the Mississippi? If it be to meet the demands of lake craft—requiring a fourteen-foot depth—the terminus of the Chicago channel would of necessity be Joliet; the depth of the rivers beyond, even with the increase consequent upon the augmented volume from the proposed new channel being wholly inadequate to the demands of the lake craft. The waterway should obviously be a consistent whole. It should be either a lake waterway throughout or a river waterway. A channel for lake craft to Joliet, and for river craft beyond, would be a magnificent absurdity. Yet this is precisely what the drainage act requires Chicago, for its part, to do, and at an extra cost, compared with an eight-foot depth, of not less than $10,000,000. But what logic can justify the exigency which forces this discussion at this time? The drainage party does not and dare not deny that the ultimate success of everything it has done and everything it proposes to do is predicted upon the general government completing the waterway from Joliet to La Salle. For Chicago to attempt this enormously costly extension at its own expense would be criminal madness. Under the circumstances, prudence would suggest postponement of active operations until the general government had at least evinced some slight inclination to entertain a thought of such coöperation, but with an insane zeal and insolent arrogance which rules for to-day if it must die to-morrow, the drainage board rushes blindly forward to its own doom, defiantly attempting meanwhile to extort millions in useless taxation for its brainless project. The plain fact is, that the general government wants not a lake but a river channel, conforming to the rest of the waterway system, and for reasons of economy starting from the Calumet river. Chicago, on the other hand, seeks for purposes of drainage a channel of lake depth, starting from the Chicago river. These views are fundamentally antagonistic, and the Chicago drainage district, therefore, finds itself in the attitude of an heroic engineer who begins work on a huge bridge with no means of completing it beyond mid-stream, and with no hope of assistance from the other side.

"And what is this useless ship-canal luxury to cost? The board engineer has given several opinions, and an army of assistant engineers is now making surveys preparatory to a report of estimates. In the meantime, we have these estimates reported to Congress by Captain Marshall for a fourteen-foot channel:

LAKE MICHIGAN TO SAG BRIDGE.

Dredging Chicago river	$ 69,200
Widening Chicago river	96,000
Docking Chicago river	172,500
Excavation, Bridgeport to Sag bridge (earth, $2,497,250; hardpan, $816,000; rock, $796,480)	4,109,730
Docking, Bridgeport to Sag bridge	840,000
Bridges (to replace those over the Chicago river when widened to 160 feet)	2,865,000
Right of way	1,167,250
Guard lock at Summit	398,130
Contingencies, 10 per cent	971,781
Total cost to Sag bridge	$ 10,689,591

SAG BRIDGE TO JOLIET.

Excavation—earth, $168,000; rock, $7,585,120	$ 7,753,120
Waste gates at Lockport	72,955
Locks	1,667,547
Excavations in basins at Joliet	6,000

Retaining walls above Joliet	$ 717,700
Retaining walls at Joliet	140,550
Bridges	410,000
Right of way	142,440
Movable dam	52,908
Contingencies, 10 per cent	1,096,322
Total, Sag bridge to Joliet	$ 12,059,542
Chicago to Sag bridge	$ 10,689,591
Sag bridge to Joliet	12,059,542
Total, Chicago to Joliet	$ 22,749,133

"The above estimate of over $20,000,000 is, as has been said, for a fourteen-foot depth of channel. The Chicago drainage act requires an eighteen-foot channel, with a grade of four inches to the mile, which would increase the cost by about $10,000,000. Here the question again recurs, what possible advantage for navigation to the Gulf of Mexico would be a channel stopping at Joliet? In the absence of coöperation from the United States, to make the channel worth anything, it would need to be extended by the Chicago district to La Salle at an additional cost, according to the estimate of the government engineer, of $25,533,630. There remains also to be considered the possible damages from overflow, for which the district is made liable as set forth in the following clause of the drainage act: Every sanitary district shall be liable for all damages to real estate within or without such district which shall be overflowed or otherwise damaged by reason of the construction, enlargement or use of any channel, ditch, drain, outlet or other improvement under the provision of this act. And actions to recover may be brought in the county where such real estate is situated, or in the county where such sanitary district is located, at the option of the party claiming to be injured, and in case judgment is rendered against such district, the plaintiff shall also recover his reasonable attorney fees to be taxed as costs of the suit. These 'reasonable attorney fees' of successful claimants against the district might reach into the hundreds of thousands annually. As to the extent of lands in the Illinois valley subject to overflow, the following quotation is from Captain Marshall's report to congress:

"Now, at any little summer freshet, producing a discharge exceeding eight thousand cubic feet per second at La Salle, damage by overflow would begin at that point, the artificial discharge being ten thousand cubic feet per second, and with greater natural discharge become more and more widespread as we progress down stream, at times when such overflows would not otherwise occur. Upon all rises of the river producing anywhere near bank-full stages, this artificial discharge would cause flowage damages that would not otherwise occur. The lands would become submerged at high water earlier and the water remain upon them longer than it otherwise would. From one hundred thousand to three hundred thousand acres of lands in the Illinois river valley will be subject to such conditions. Estimating the possible overflow at only two hundred thousand acres, with the damage in any one year at $10 per acre, and we have a possible annual liability of $2,000,000. Estimating the land at $50 per acre value, and protection from such annual liability would cost $10,000,000. It is admitted that the Chicago river can not be made to carry over three hundred thousand cubic feet per minute. It has been shown that a minimum of six hundred thousand cubic feet will be necessary. An auxiliary channel in the vicinity of Thirty-ninth street will therefore be required, not only to secure a sufficient water supply, but to make the drainage of any part of the southern portion of the district at all possible. The cost of this feeder is estimated at $12,000,000. Captain Marshall places the figure at $14,000,000. A channel to divert the flood waters of the Desplaines, known as the 'Bowmanville cut-off,' is also a universally conceded necessity. Its cost will be not less than $4,000,000. The flushing of the North branch of the river will cost $3,000,000. The intercepting sewers from the north line of the city to Eighty-seventh street, to convey the sewage now discharging into the lake into the proposed new channel, will involve a cost of $5,000,000 more. We have then a grand total for the sewage and canal systems to Joliet the following:

"Cost of level channel from Lake Michigan to Joliet (fourteen feet depth)....	$ 22,749,133
Additional cost for eighteen-foot depth channel, as required by drainage act, four inches grade to the mile..........	10,000,000
Possible damages from overflow..........	10,000,000
Thirty-ninth street or Hyde Park channel..........	12,000,000
Bowmanville cut-off to divert the flood-waters of the Desplaines..........	4,000,000
System for flushing North branch..........	3,000,000
Intercepting sewers for north line of city to Eighty-seventh street..........	5,000,000
Total (not including salaries, attorney fees, interest on bonds, etc.).....	$ 66,749,133

"This total of over $66,000,000 represents the cost of the system, exclusive of the item for the improvement of the Illinois river to La Salle, computed by Captain Marshall at $25,533,530, which must be regarded as at least a contingent liability against the district. This would swell the aggregate to over $90,000,000, all of which indebtedness would be payable, under the terms of the drainage act, ' within twenty years from the time of contracting the same.' The assessed valuation of the district, with the recent increase by the state board of equalization, will be about $225,000,000. The cost of the ship-canal job will therefore represent a mortgage of forty per cent. on all Chicago property. Such a tax would be equivalent to confiscation; it would make Chicago the most desirable place for capital to avoid in the world; it would mean a revolution with no uncertain penalties for the schemers, theorists, speculators and political spoilsmen responsible for the calamity. True, the drainage act limits the total bonded indebtedness to five per cent. of the valuation of the property in the district, with a proviso that five per cent. shall not exceed the sum of $15,000,000; but, upon the most moderate estimates of the drainage engineers and statesmen, this limitation will place the district in the foolish position of attempting a job which it knows it can hardly commence with the funds at its command, or in the fraudulent position of beginning the work with the determination of browbeating the people and the legislature into repealing the indebtedness limitation. No estimate by the drainage mathematicians themselves places the cost of the channel to Joliet, with the drainage accessories at Chicago, at less than $30,000,000. The $15,000,000 indebtedness limitation is, therefore, by their own admission, either a gross absurdity or a transparent fraud.

"The objections to the ship-canal drainage project and its taxation conspiracy may therefore be summarized as follows: It bears no necessary relation to a purer water supply for the city. It would, at the best, prove but a partial solution of the sewage problem, and that for a period of less than twenty years, when, under the terms of the drainage act, the system would be wholly useless. It contemplates a noisome sewage canal to Joliet, harmonizing with no other portion of the waterway system of which it is proposed to make it a part. It would intensify the bridge nuisance in Chicago to an intolerable degree. The welfare of the entire city demands the diversion of the present river traffic to the lake harbors and the Calumet, and not its further concentration in the river, as proposed. It threatens Chicago with a financial burden of such colossal and crushing magnitude as to jeopardize investments, alarm and divert capital, retard the general prosperity, and cause great pecuniary hardship and suffering among the poorer classes of the people. It means a project which must inevitably delay for many years the construction by the general government of a grand national waterway, consistent and harmonious in all its parts, and destined to prove of incalculable value to the nation, to the entire Mississippi valley, and to the commerce and trade of Chicago. It means a perpetual menace to the health and comfort of the people of the river valleys. It is opposed to the experience of London, Paris, Berlin and every other large city on the globe, and must inevitably delay the proper and permanent solution of the sewage problem of the city. It creates a powerful political oligarchy, fraught with untold possibilities of profligacy and corruption.

"It has been my endeavor to set forth clearly the grave defects in the vast undertaking into which the city has launched, and the grave perils which surround it. It is not the part of this discussion to present the numerous other plans for a solution of the great drainage problem. It is sufficient for our present purpose to indicate that the present one is as fundamentally defective as it is certainly destructive of its every alleged purpose. An appeal to the legislature at its next session to stay the further progress of the ruinous project appears to promise the most effective and early means of relief. Section 207 of the drainage law provides: 'Nothing in this act contained shall be so construed as to constitute a contract or grant between the state of Illinois and any sanitary district * * or to prevent, debar or deprive the state of Illinois from, at any time in the future, altering, amending or repealing this act.' It is under this clause that the drainage coterie hopes to secure the supplementary legislation essential to its designs, but under it the people may also take the initiative in chaining and throttling the monstrous taxation iniquity. A through waterway from Lake Michigan to the Gulf along the line of the recommendations of the United States engineers is among the early probabilities, if Chicago will but come to its assistance in the broad-minded, chivalrous spirit which the nation has the right to expect. But if the state and city permit the present bigoted, narrow-minded, absurd and ruinous policy of the drainage party to continue, the result can not but prove disastrous to all the vast national, state and municipal interests involved."

The club and its resolutions were unmercifully criticised, and the literature of sewerage systems increased in volumes and vehemence, but the work of the trustees went on, as if the act creating the commission and empowering it to construct a great ditch were perfection itself.

One of the peculiarities of a chief engineer of public works is to dream extravagant dreams, and achieve comparatively little. From March, 1886, to July 1, 1887, the drainage and water-supply commission tried to solve the drainage problem. Engineer Hering suggested the Skokie cut-off as an auxiliary to his deep-channel plan for carrying the city's sewage to the Mississippi, and recommended that the small sum, scarcely amounting to $3,000,000, or over $3 per capita, be expended in excavating a ditch to carry the flood waters of the upper Desplaines into the North branch and thence to the lake. The late chief engineer of the present drainage commission also desired this ditch and the $3,000,000 appropriation, but his desire was impracticable and had to give way. In February, 1891, the newly appointed engineer, Worthen, and consulting engineer, Newton, reported as follows to the drainage commission on that worn-out subject: "The large cross-section that the law demands for the western portion of the drainage channel, which is in rock, made it expedient to adopt the recommended route, which would likewise serve for the diversion of the Upper Desplaines. Since that report we have more fully considered the plans of Mr. Hering for the diversion of the Upper Desplaines, first into the North branch and then into the lake by a channel at Bowmanville, and we have made a personal examination of the locality. In Mr. Hering's report of July 1, 1887, to the mayor and common council upon his project for the diversion of the Upper Desplaines, he states: 'At Summit the drainage area, including that of Salt creek, will be one hundred and ninety-four square miles, and the quantity of water will not differ much from that which now flows during floods toward Joliet,' and he estimates that even after the completion of his scheme for the diversion from four thousand to five thousand cubic feet per second during floods will not be intercepted, but as before will flow through the Desplaines. The conclusion is in confirmation of our previous recommendations on this subject submitted to the board, viz.: That the portion of the drainage channel beyond the Summit be used as the diversion of the Upper Desplaines. In this connection it will be seen by the records of the flood which culminated February 9, 1887, with a volume of ten thousand three hundred and twenty-four cubic feet per second, that it fell the tenth to eight thousand cubic feet, the eleventh to seven thousand, and the sixteenth to two thousand, rising again the nineteenth to five thousand one hundred and seventy-four cubic feet. The effect of the outflow from this flood through the Chicago river into the lake is shown by the sketch of Mr. Hering. It does not appear to have reached the crib and to have contaminated the water supply, except at the period of maximum flood of ten thousand three hundred and twenty-four cubic feet per second. After the construction of the proposed new drainage channel comparatively little water from such a flood would find its way into the river, even for a brief period, if the gates, which it is proposed to place in the new drainage channel, were left open. Ten thousand cubic feet per second is to be provided for in the new channel when the system contemplated by the present law is completed, and the floods in the Upper Desplaines exceeding this quantity are exceedingly rare."

This report did not mollify the objectors, and the question of amending the act was suggested.

The *Herald*, in noticing the introduction of a bill to amend the drainage act, says, under date February 28, 1891: "A new plan of carrying and using the sewage of Chicago will be introduced in a bill at Springfield amending the drainage act. Dissatisfaction with the present law is undeniably general. The people see no light whatever upon the project. The factious and assumptive majority of the board appear to think that they need not trouble themselves giving the taxpayers clear or complete information; that they may proceed when they are ready to assess from $20,000,000 to $90,000,000 in taxes, and that it is the business of nobody to inquire what benefits the district is to gain or in what manner and under whose responsibility this colossal sum is to be laid out. Any scheme which will be within general comprehension, which will receive the sanction of engineers of known capacity having property and family interests in the district, will commend itself in lieu of the mysterious and baffling plan, if they have a plan, supposed to be contemplated by the majority of the drainage board. The scheme now proposed excludes absolutely the idea of a navigable waterway. This will induce opposition to it. On the other hand, it is claimed that the scheme in contemplation by the majority of the board of trustees is a waterway in no proper sense, and will never add a dollar to the shipping interests of the district. If being unnavigable for ships be an objection to the project, it is also an objection to the only other project under consideration. Experts differ in opinion over the theories of the trustees, no one of whom has a scientific education; all of whom are as incapable as any other layman to tell whether the proposed ditch will float a ship or sink a canoe. The scheme is at least simple, clear, and rejectable on its merits, if it be rejected. It is a tunnel to catch the sewage, when carried by lowering levels beyond Joliet, to be settled in basins in the Desplaines valley, the effluent water to be harmless and the solids to be chemically purified and used for enriching the soil. This is really the Paris plan, with slight mechanical modification, and a brief history of that plan and the effects it has produced cannot fail to be of interest."

The newly appointed engineers continued their investigations, as if there were no opposition, and on March 3 the morning papers announced that the pet scheme known as the Skokie cut-off, was ignored by them in the report made a day or so before to the trustees.

One of such announcements hailed the news in the following words: "It appears from these statements of engineers of unquestioned ability that the cut which has to be made through the rock beyond Summit will be so deep and so wide as to accommodate all the flood waters of the Desplaines. That deep channel through the rock will carry off six hundred thousand cubic feet a minute, moving with a velocity of less than three miles an hour. Its capacity for discharging the flood waters of the Desplaines having a much greater head than those of Lake Michigan would, of course, be far greater. It appears also that if the flood of February, 1887, when a little over six hundred thousand cubic feet per minute flowed past Riverside, contaminated the water supply at the crib for a short time only, that even a larger flood, happening after the limestone barrier which now holds back the waters of the Des-

THE GERMAN THEATER BUILDING.

COMMERCIAL ARCHITECTURE. ROMANESQUE DRESS.

plaines has been cut through, will have no effect at all on the purity of the Chicago water supply. All it would do would be to check for a few hours the flow of the diluted sewage toward the Illinois. None of that sewage, however, would be forced into the lake. The moment the Desplaines began falling, the flow through the Chicago river westward would recommence. Another fact brought out by the above extract is that the Skokie cut-off would not have accomplished one of the chief objects Mr. Hering hoped to secure by it. It was his idea to follow the present bed of the Desplaines with his deep cut, and thus utilize whatever excavating had been done by the water of the stream in the slow course of time. It was in order that he might have dry working that he was so anxious to get rid of the waters of the Desplaines, which would have interfered so seriously with the contractors. It appears, however, that even after spending about three millions on his Skokie cut-off he would have had the drainage of one hundred and ninety-four square miles to plague him. Had he begun digging in the bed of the Desplaines, every now and then floods about as violent as those which occur now would have swept down suddenly, drowning out his workmen, carrying away their machinery and tools, and delaying the progress of the work for days or weeks. It is not the intention of the present engineers to be guilty of such folly. They will leave the channel of the Desplaines to carry off its waters, and will cut a straight ditch across country from Joliet to the point where the rock-cutting begins. As they go along they will use a part of the excavated material to build a small embankment to protect the cut from the high waters of the spring, when the Desplaines abandons its banks and overflows the whole valley. In this way the men will work all the time in the dry and can go ahead uninterruptedly, by day as well as by night. The only moisture which will bother them will be the rain which will fall into the ditch and which can be pumped out with the greatest ease. So it will be seen that here are three millions saved by rejecting one Hering fad, which was not needed to preserve the purity of the water supply, and which would not have made the work on the rock cutting any easier."

On April 30, 1891, the drainage trustees, through President Prendergast, formulated the following address to the citizens on defects in the law and their ammendment: "The decision of the Supreme court upholding the sanitary district act was announced June 12, 1890. A petition for rehearing was filed by the opponents of that act, which remained pending until October, 1890, when it was denied. Notwithstanding the pendency of this petition, the board of trustees conceived it to be their duty to do what they could to put the law in course of execution. They could not be expected to know what would be its cost until the trial should be made, and the application of the law to existing physical conditions ascertained. General Newton, consulting engineer, and Mr. Worthen, chief engineer, have, since December 17, 1890, been actively engaged upon the problem of laying out a route under and in accordance with the law for a main channel and preparing plans for the adjuncts and additions necessary to accomplish the purposes of the law. January 10, 1891, they submitted a preliminary report, and February 21, 1891 a further report. These reports show careful study and thorough consideration of the entire problem. These reports demonstrate further: The cost of construction of the smallest main channel permitted by the law, which is fourteen feet in depth through earth and eighteen feet in depth by one hundred and sixty feet in width on the bottom through rock, would be $22,700,000; the cost of deepening the present canal for a gravity flow to care for the sewage in that section of the city and Stock Yards, $3,200,000; the conduit from the lake to the north branch at Bowmanville, for flushing the North branch, $900,000; or a total of $26,800,000.

"In this carefully prepared estimate the following items are not provided for: Right of way, dumping ground, and transportation of the waste material to a place of deposit. Further charges for straightening the south branch of the Chicago river; changing bridges, etc., to produce a larger flow, to be done by the city; the cost of the same, being variously estimated from $750,000 to $1,500,000, must be borne almost wholly by the same taxpayers, and will make the entire cost over $30,000,000. There is not provision under the law for raising any such sum, and it was not contemplated that it would cost so much. Requiring a cut of eighteen feet through rock involves a cost that is wholly unnecessary. The law provides for an annual tax of one-half per cent. upon the assessed value of the property of the district. The assessed value is about $204,000,000. The tax will therefore produce about $1,000,000 per annum. The law also authorizes the issue of bonds not exceeding $15,000,000, and not above five per cent. of the assessed valuation of property within the district. Assuming that before the work can be completed the assessed value will authorize the issue of the total amount, $15,000,000 can be counted upon from this source. The bonds with interest must be paid within twenty years, and taxes levied for such purposes.

"The law also provides for a special assessment upon real property within the district specially benefited; that is benefited in contradistinction from the general benefit. A special assessment is indefinite and depends upon: First, the judgment of special commissioners to be appointed by the court; second, the opinion of a jury, both of which must be at present wholly unknown and largely incapable of estimate. A special assessment is collectable only after proceedings of this nature have been carried through. The unnecessary cost arises from the excessive size of the channel through the earth and through the rock, particularly through the rock. As said before, a channel through the rock is required one hundred and sixty feet broad on the bottom and deep enough to flow eighteen feet of water. At the maximum current allowed by the law through such a channel it would give a flow of over seven hundred and fifty thousand cubic feet per minute, when the law only requires three hundred thousand cubic feet per minute through the earth, and that flow of three hundred thousand cubic feet per minute is not required to be increased until the United States government makes a channel in the Desplaines or Illinois river of a capacity to receive six hundred thousand cubic feet. As the general government has not yet taken definite action toward doing this, and as the government engineers and commissioners have not suggested or recommended a channel of such capacity, it does not seem proper to us to proceed to plan and execute such an extensive work without advising our principal, the people, of what we have ascertained. But if in the future the rivers should be so deepened that this large channel should be required, let that time enlarge and pay for the same. The theory of the law is that a flow of three hundred thousand cubic feet per minute is ample for all purposes of sanitation and dilution, and will afford a channel for navigation which will probably not be met at its southern terminus—at or near Joliet—by a similar channel during this generation, and possibly never, that is, as long as the present conditions continue; therefore we say that a channel can be constructed of ample width and depth to flow three hundred thousand cubic feet per minute where a saving in the rock cut alone will be from $7,000,000 to $10,000,000, and therewith a corresponding saving in the earth cut. This recommendation in nowise trenches upon the policy of a commercial waterway through the Illinois river valley; on the contrary, its adoption will do two things: First, immediately there will result a channel to Joliet much greater for purposes of a commercial waterway than its lower connection, i. e., the Illinois river. Second, the construction of this will promote the project so far as it depends on Federal legislation. We deem it our duty to submit these views to the citizens of this district, and suggest that they have the law amended in such particulars as will enable us to execute it in the most practical and economical way."

At this meeting the chief engineer was asked the direct question, whether the channel could be constructed for less than $30,000,000. His answer was that the sum stated would be required to carry out the provisions of the law. This immense sum and strong opposition from within and without the sanitary district led many to believe that the act, the commission, the channel and all the hopes of good water and perfect drainage had lapsed, but a greater effort was made.

On May 1, 1891, the question was discussed in the local papers. The *Tribune* said: " Judge Prendergast stated in his remarks before the legislative committee: The fall of the river from La Salle to Grafton is about twenty-seven feet, from Joliet to La Salle eighty feet, and from Chicago to Joliet fifty feet. So little is known about the Illinois river, and so few will understand without explanation the full significance of Judge Prendergast's observation, that it is worth while to dwell a little on this point. The following table shows the hight in feet during low water of the surface of Lake Michigan above the various places mentioned, Utica being a few miles this side of La Salle:

	Distance apart.	Below the lake level.	Fall between places.
" Lake Michigan	....	....	....
Lockport	33.5	7.5	7.5
Dam No. 1, Joliet	38.8	41.5	34.0
Dam No. 2, Joliet	39.4	51.5	10.0
Lake Joliet	41.9	76.3	25.0
Kankakee river	54.2	93.0	16.5
Marseilles dam	79.7	101.5	8.5
Foot of Marseilles rapids	81.1	118.7	17.2
Utica	97.0	141.0	22.3

" These figures show that while it is an easy matter to make the Illinois navigable between La Salle and Grafton, to do so between La Salle and the mouth of the Kankakee or La Salle and Joliet is something calling for engineering ability of a higher order, and the expenditure of a great deal of money. The general government ordered that surveys and estimates of cost be made for fourteen-foot and eight-foot waterways from Chicago to La Salle in the beds of the Desplaines and Illinois rivers. The total estimate of cost from Chicago to La Salle was for the fourteen-foot project $48,282,000, and for the eight-foot one $26,883,000. The estimates from Joliet to La Salle were: Fourteen-foot, $25,533,000; eight-foot, $9,757,000. From the mouth of the Kankakee to La Salle in the Illinois river the estimates were: Fourteen-foot, $20,488,000; eight-foot, $6,938,000.

"The government engineer's estimate for a fourteen-foot channel from Chicago to Joliet is $22,748,000. These are the careful figures of an expert who had to deal with a fourteen instead of an eighteen-foot cut, and with a canal, not a flowing stream. The proposition is that this district shall not only give four feet more water than the government project, but make a stream which shall have a current of over two miles an hour. In other words, while the bottom of the proposed canal would be all the time at the same level below the surface of the lake, the bottom of the Chicago deep channel would be sinking lower and lower all the time, to give the necessary fall. This would necessitate going many feet deeper into the rock, and would add enormously to the expense. It would be at least half as much again.

"Would any but a delirious man expect the government to spend $20,000,000 to make a fourteen-foot channel for twenty miles in the Illinois when the depth of water in the Mississippi, from the mouth of the Illinois to St. Louis, is but six feet, and that from St. Louis to Cairo not over eight? Is the government to spend $20,000,000 in making the navigation between the mouth of the Kankakee and Utica better than between St. Louis and Cairo? And if it cost the government $20,000,000 to carry fourteen feet from the mouth of the Kankakee to La Salle, what will it cost to carry eighteen feet from Joliet to below Cairo? Has it the countless millions? Until it gets them and will spend them why should Chicago make an eighteen-foot channel to Joliet, especially when the government engineers say that such a channel, with its proposed discharge of six hundred thousand cubic feet a minute, will interfere with their plans for the improvement of the upper Illinois? Captain Marshall says: 'As the state law stands, demanding unnecessarily great and expensive channels not demanded or suitable for the commerce to be subserved, a compliance with its terms does not seem advisable for the United States.'

"An insistence on the law as it is, therefore, will lessen the likelihood of the general government doing anything in Illinois. Will it spend $25,500,000 between Joliet and La Salle when its engineers tell it the work will be interfered with seriously by the eighteen-foot Chicago channel with its immense discharge? Unless that part of the Illinois and Desplaines which has a fall of eighty feet in about sixty miles is made navigable by locks and dams, no Mississippi steamers can reach this city. The state will improve that section of the stream. This city can not be forced to do it. And the Federal government will not touch it with the Chicago sanitary drainage law as it stands, rendering the Federal government liable to damages from annual overflows from an excessive discharge of lake water. The main point made by Judge Prendergast before the legislative committees was one which has not been given the prominence it deserves. That is that the 'waterway' for which Means and other Peruvians, Senecans, Ottawans and Peorians are clamoring is not the waterway of the drainage act, but the impracticable creation of their fevered imaginations, the result of an attack of too much water on the brain. It never was intended by Chicago to dig a channel deep enough to float the great lake propellers down to Joliet, Marseilles, Peoria, Grafton, Alton, St. Louis and New Orleans, for the one sufficient reason, out of many, that the Illinois river can not be given or made to contain a depth of water such as is needed for lake navigation without flooding and destroying the whole valley. If lake propellers are to go down the Illinois it will be necessary to pour into that stream a summer flood which will cover as much land as the high spring freshets do. But while the high waters of February and March soon subside and do not interfere with the use of the land for farming purposes, summer floods would make it impossible to raise any crop, except of catfish, on $100,-000,000 worth of fine farm lands.

"Is the Federal government ready to foot those damages, and if not, who will? And is it ready, also, to pour out the millions which will be necessary to maintain lake navigation in the Mississippi from Grafton to St. Louis, Cairo, Memphis, Vicksburg and New Orleans? Its total revenues could not do it. But of what use would eighteen feet of water in the Illinois be if there were but six in the Mississippi from Grafton to St. Louis or Keokuk? This idea of lake navigation in the Illinois is the wild chimera of a disordered mind. All that was ever conceived to be practicable was, as Judge Prendergast showed, so to improve the navigation of the Illinois as to allow Mississippi river barges and steamers with a draft of from six to seven feet to ascend the stream as far as La Salle, and above there to Joliet whenever the Federal government furnished the money to overcome the fall of eighty feet, and from Joliet to Lake Michigan, using a channel cut with Chicago money for sewage dilution, but one of the incidents of which would be improved navigation.

"That is the utmost limit of the ship-canal scheme which ever entered the head of any sensible man. It never occurred to any but a valley dreamer that the head of navigation of the lakes and the St. Lawrence should be carried to Grafton, or that lake propellers should try their luck in a rock-bound channel with a swift current from here to Joliet. All that people who have their wits about them wanted was that Lake Michigan should be made the head of navigation of the Mississippi, so that the stern-wheelers drawing five, six or seven feet which ply on that river and its tributaries could unload at the wharves of Chicago. If the valley people say they do not want the kind of waterway which permits that to be done, but must have one which will allow great lake steamers to sail past their doors, then, like the dog in the fable, they are dropping the substance and grabbing at the shadow. As Judge Prendergast says: 'It is beyond the agency of human power to send lake vessels down the Illinois river below Joliet.' Chicago can do a great many things, but it can not work miracles. It can not furnish eighteen feet of water in the Illinois. And by insisting that it shall do so, and by forbidding it to construct any other kind of a channel than that specified in the law, the people in the valley towns are cutting their own throats."

In May, 1891, S. G. Artingstall was appointed chief engineer vice Worthen. His first report to the trustees was made May 22, 1891: "I have the honor to submit the following report, with map and estimates showing four feasible routes for the main drainage channel between Bridgeport and Summit, with comparative estimates of the cost of the same. As the routes shown are wholly in earth excavation, the channels have been taken of sufficient size and capacity to maintain at all times a continuous flow of not less than three hundred thousand cubic feet of water and a depth of not less than fourteen feet. In making estimates wherever practicable, the right of way is sufficient to provide for the deposit and storage of spoil during the construction of the work. Four routes are considered: No. 1—Commencing in the West branch of the South branch at Western avenue and following the line of the Ogden ditch to Summit. No. 2—Commencing at the junction of the Illinois and Michigan canal and the South branch of the Chicago river and following the line of the canal to Summit. No. 3—Commencing at the end of the west arm of the South branch near Western avenue, thence westward along Thirty-ninth street to the Illinois and Michigan canal, thence westerly along the canal to Summit. No. 4 follows the preceding route to the canal, where it crosses and continues in a northwesterly direction to the Ogden ditch and along this ditch to Summit.

"As it is imperative that the great pollution in the South branch, caused mainly by the drainage of the Stock Yards and packinghouses, should be provided for, and as this can not be reached directly by routes Nos. 1 and 2, a smaller channel to provide for a flow of sixty thousand cubic feet per minute, commencing at the west end of the West branch and discharging into the main channel, has been included in the estimates for these two routes. Routes Nos. 3 and 4 I would respectfully recommend to your favorable consideration for the reason that the total volume of three hundred thousand cubic feet per minute will pass through the whole length of the South branch and the West branch of the South branch and will insure a regular and constant circulation and change of water in the most polluted part of the stream; and this without any additional channels or pumping stations, with the attendant expense of maintenance and operating. As the east arm of the South branch is private property and not a natural channel, it seems to me that the parties owning and using it should be at the expense of abating a nuisance. The use of the Illinois and Michigan canal, or any part of it, involves the removal of the present pumping station and locks at Bridgeport to a point west of the main channel, where it occupies the line of the canal. In my opinion no serious interruption to navigation or permanent injury will be done to the canal by the use of any portion of it as a part of the main channel. I estimate the total cost as follows:

"Channel No. 1. From Western avenue to Summit, by way of Ogden ditch, at	$2,108,791.
Channel No. 2. From the river to Summit, by way of Illinois & Michigan canal, at	$3,367,313.
Channel No. 3. From the end of west arm of South branch along Thirty-ninth street to canal, then by canal route to Summit, at	$2,689,872.
Channel No. 4. Following the same route to canal which it crosses, then in a northwest direction to Ogden ditch, then along the Ogden ditch to Summit, at	$2,227,392.

"On account of the proximity of railroad tracks for a long distance on both banks of the canal, considerable of the excavating material when the canal is enlarged to a suitable size will have to be removed by rail or vessel, and for this proper allowance has been made in the estimates. It is not to be understood from the foregoing that there is recommended a prosecution of the work from Chicago to Summit only. On the contrary, so far as the means of the district would permit, there should be a line of operation on the entire route simultaneously and a beginning of the work at the lower end of the route at Joliet and working northward.

"The cost of the right of way has not been made, as this department has not been directed to estimate this subject. This department is now investigating in further detail the route for the continuation of the main channel from Summit to Joliet, and will give the results at the earliest possible time. As soon as the board can, after due deliberation, fix the route for a portion or the whole of the length of the main channel, I wish to commence and prepare working drawings, specifications, etc., so as to be ready to commence operations by the time you have acquired the right of way. I am able to state that I find in full possession of the board very valuable and reliable information and data in the shape of contour maps and borings for the whole length of the route between Chicago and Joliet, also maps of the watersheds tributary to the Desplaines and Chicago rivers, measurements of the flow of the streams and analysis of the Chicago river-water at various points, which are the results of the investigations carried on by the board up to date. The data obtained are now nearly all tabulated and in available form for immediate use. The collection of this information has of necessity been a work of much time, care and labor, and was needed to arrive at an intelligent conclusion of the most economical and available route and sections of channel for this important work."

On June 20, 1891, the new chief engineer submitted the following report: "I have the honor to submit the following report, with estimate, being the result of investigations for the continuation of the main channel from Summit to Joliet. Much care and consideration has been given to locate the line so that it can be constructed at the least cost, and at the same time comply with all the requirements of the law in regard to dimensions, capacity and velocity of water. The section from Summit to Willow Springs is located so as to avoid all expensive rock excavation. From Wilton Springs to Lockport the route is laid out so that it occupies the lowest ground, and generally follows the bed of the Desplaines river. This is a material advantage in the portion between Lemont and Lockport, where the whole depth of the channel is in hard limestone rock. From Lockport it is proposed to build the channel down the slope to the upper basin in Joliet of sufficient width and depth to carry off the water the channel shall bring down from above. At the upper end of this slope is to be a movable dam to control and regulate the amount of water flowing in the channel above, and to guard against damage which is liable to occur in flood seasons to Joliet and below unless means are taken to hold the water in check at such times. There are also to be a series of basins, wiers and races in this section, which incidentally can be utilized for power and in time be a source of revenue to the district. To avoid as much as possible expensive limestone excavation, it is proposed to construct the channel below Lockport partly by removing obstructions, and partly by embankments of rubble masonry walls, backed by the waste materials. Dykes will also have to be constructed to protect some of the low grounds from being flooded.

"The proposed channel is almost entirely artificial, although in some parts it occupies the present bed of the Desplaines river, and is subject to its floods, which will be under control by the movable dam at Lockport. As that part of the route above Lockport for a length of ten miles is almost wholly in rock, and the work of excavating any channel through it will be, of necessity, slow and tedious, work in this section can be commenced both at Lockport and at (or near) Willow Springs, and prosecuted as fast as the means at the disposal of the district will permit, while the less difficult stretches between Summit and Willow Springs and between Lockport and Joliet can proceed in a more leisurely manner, and allow ample time to consider and carefully design suitable adjuncts necessary for the proper control of the waters when the channel is completed. Between Summit and Joliet, a distance of twenty-four and one-half miles, there will be twenty-one million one hundred and sixty-two thousand cubic yards of waste material, of which eight million three hundred and three thousand three hundred and eighty-five cubic yards will be rock excavation, and twelve million eight hundred and fifty-eight thousand six hundred and seventeen cubic yards earth or glacial deposit. This great quantity of spall I consider of no marketable value at this time, and it is impracticable to dispose of it, except by depositing it on each side of the channel. A sufficient width of right of way will be necessary for this purpose. I estimate the cost of constructing the channel as follows:

"From Summit to west end of fourteen-foot channel near Willow Springs..	$ 3,907,582 00
From west end of fourteen-foot channel to Lockport....................	9,031,973 00
From Lockport to Joliet..	1,605,910 00
Total	$14,545,465 00

"The cost of the right of way is not included in the foregoing estimates. The soil is to be deposited on each side of the channel, excepting a small portion of the rock, which can be used in building walls, dams, etc., below Lockport."

The first ordinance establishing a route for the drainage channel was adopted August 4, 1891, President Prendergast, with Trustees Hotz, Gilmore, Russell and Wentner, voting for it. This ordinance is substantially as follows:

Section 1. That there be and is hereby laid out and established a route for a main channel to be hereafter constructed and maintained, together with the necessary additions thereto, over and upon the lands lying between the following described lines: All the land between the east line of the northwest quarter of section 6, township 38 north, range 14, east of third principal meridian, and the center of the Summit and Riverside road, included between the following boundaries on the north and south lines, respectively.

The north boundary is described as follows: Beginning at a point three hundred and one and forty-four-hundredths feet south of the northeast corner of the northwest quarter of section 6, township 38 north, range 14, east of third principal meridian; thence running north eighty-seven degrees, fourteen minutes, west six hundred and sixty-six and seventy-two-hundredths feet; thence north eighty-six degrees, forty-one minutes, west three hundred and four and fifty-five-hundredths feet; thence north eighty-two degrees, forty-eight minutes, west four hundred and two and eighty-hundredths feet; thence north two hundred and eight and three-tenths feet to the north line of said section 6; thence north eighty-nine degrees, forty-two minutes, west one thousand two hundred and ninety-four feet to the north west corner of said section 6; thence west five thousand three hundred and seventy-six and four-tenths feet on north line of section 1, township 38 north, range 13, east of third principal meridian to the northwest corner of said section 1; thence west six hundred and twenty-six and seventy-five-hundredths feet on the north line of section 2, township 38 north, range 13, east to the center of Spaulding avenue; thence north along said center three hundred and thirty feet; thence west six hundred and seventy-two and two-tenths feet to the center of Homan avenue; thence north on said center three hundred and thirty feet to the center of Thirty-eighth street; thence west on said center of Thirty-eighth street one thousand three hundred and thirty-five feet to the east line of the southwest quarter of section 35, township 39 north, range 13 east; thence west eleven feet to the center line of Atchison, Topeka & Santa Fe railway in Chicago; thence northwesterly four hundred and twenty-five feet along the center of said railway to the south line of the Chicago, Alton & St. Louis railroad; thence south sixty-nine degrees twenty-six minutes, west fifty feet; thence north sixty-six degrees five minutes, west two thousand seven hundred and two and five-tenths feet to a point on west line of said section 35, said point being five hundred and thirty-six and twenty-two-hundredths feet south of the northwest corner of the southwest quarter of said section 35; thence north one thousand six hundred and thirty-six and twenty-two-hundredths feet; thence south sixty-seven degrees twenty-seven minutes, west two thousand eight hundred and sixty-seven and five-tenths feet to the center of section 34, township 39 north, range 13, east of the third principal meridian; thence south two hundred and one feet; thence south seventy-nine degrees two minutes, west one thousand three hundred and forty-nine and four-tenths feet; thence south seventy-five degrees thirteen minutes, west one thousand three hundred and seventy-four feet to a point on west line of said section 34, said point being eight hundred and thirty-one feet south of the northwest corner of the southwest quarter of said section 34; thence south seventy-five degrees thirteen minutes, west two thousand seven hundred and seventy-two and nine-tenths feet to a point one thousand one hundred and one feet north of the southwest corner of the southeast quarter of section 33, township 39 north, range 13 east; thence south seventy-five degrees forty-two minutes, west one thousand three hundred and eighty-six and thirty-two-hundredths feet; thence south sixty-seven degrees forty-three minutes, west one thousand four hundred and forty-three feet; thence south one hundred and ninety-six and six-hundredths feet to the southwest corner of said section 33; thence west three hundred and thirty feet on the north line of section 5, township 38 north, range 13 east; thence south fifty-nine degrees forty-two minutes, west two thousand seven hundred and eighteen and seven-tenths feet to a point one thousand two hundred and twenty-eight feet north of the southwest corner of the northeast quarter of said section 5; thence south fifty-nine degrees, forty-two minutes, west two thousand four hundred and twenty-four and four-tenths feet; thence west five hundred and eighty-four and two-tenths feet to the west line of said section 5; thence south three hundred and forty feet; thence south fifty-nine degrees, forty-two minutes, west three thousand and eighty-four and eight-tenths feet to a point seven hundred and forty-nine feet north of the southeast corner of the southwest quarter of section 6, township 38 north, range 13, east of third principal meridian; thence south fifty-nine degrees forty-two minutes, west one thousand four hundred and seventy-one and four-tenths feet to the south line of said section 6; thence south fifty-nine degrees forty-two minutes, west one thousand six hundred and eighty-nine and five-tenths feet to the range line between ranges 12 and 13 east; thence north eight hundred and fifty-four and five-tenths feet to the northeast corner of section 12, township 38 north, range 12, east of third principal meridian; thence west to the northwest corner of the northeast quarter of said section 12; thence south to the south line of Chicago, Santa Fe & California railroad; then southwesterly along said south line to the west line of the east half of the northwest quarter of said section 12; thence south to the south line of said northwest quarter; thence east to the center line of the Desplaines river; thence down the center of the Desplaines river to the west line of the east half of the southwest quarter of said section 12; thence south along said west line to the center of the Summit and Riverside road; thence southeasterly along the center line of said Summit and Riverside road to the Illinois and Michigan canal.

The south boundary is described as follows: Beginning at a point nine hundred and two and one-tenth feet south of the northeast corner of the northwest quarter of section 6, township 38 north, range 14, east of the third principal meridian; thence north eighty-seven degrees fourteen minutes, west six hundred and sixty-six and sixty-two-hundredths feet; thence north eighty-six degrees forty-three minutes, west three hundred and four and six-hundredths feet; thence north eighty-three degrees thirty-six minutes, west four hundred and two and three-tenths feet; thence south ninety-nine and eight-tenths feet to the Union Stock Yards Transfer Company's railroad north right-of-way line; thence northwesterly along said right-of-way line seven hundred and eight feet; thence west six hundred and fifty-eight feet to west line of said section 6; thence south twenty-seven and fifty-six-hundredths feet; thence west six hundred and seventy-six feet along the south line of lots 5 and 6 of block 1, and lots 5 and 6 of block 2, of Paul F. Knefel & Co.'s subdivision of lot 3 of Kerfoot's subdivision of the north half of the northeast quarter of section 1, township 38 north, range 13, east of third principal meridian to center of Hart avenue; thence west six hundred and ninety-eight feet along the center of Fortieth street to the west line of Blanchard avenue; thence north to a line six hundred and thirty-three feet south of the north line of said section 1; thence west nine hundred and twelve feet to the north line of Archer avenue; thence southwest along said north line of Archer avenue to the southwest corner of lot 15 of Graves' subdivision of lot 1 of the Superior court partition of the south twenty-five acres of the north half, and the north fifteen acres of the south half of the west half of the northeast quarter of said section 1; thence northwest on west line of said lot 15, to the northwest corner thereof; thence in a direct line to the southeast corner of lot 26 of said Graves' subdivision; thence west along the south line of said lot 26 to the southwest corner thereof; thence north along the west line of said Graves' subdivision to the center line of Fortieth street produced; thence west on center of Fortieth street twenty-seven hundred and twenty-three and two-tenths feet to the west line of said section 1; thence south fifty-nine and eight-tenths feet to a point seven hundred and fourteen feet south of the northwest corner of said section 1; thence north seventy-eight degrees thirty-one minutes, west thirteen hundred and sixty-six and three-tenths feet; thence north sixty-seven degrees fifty-nine minutes, west eleven hundred and seventy-nine and one-tenth feet to the south line of section 35, township 39 north, range 13, east of the third principal meridian; thence west two hundred and forty-six feet to the southeast corner of the southwest quarter of said section 35; thence north ninety-seven and eight-tenths feet; thence north sixty-six degrees five minutes, west eighteen hundred and forty feet to the south line of lot 3 of the Superior court partition of the west half of the southwest quarter of said section 35; thence southwest ten hundred and sixty-two feet on south line of lots 3 and 4 of said Superior court partition to the west line of said section 35; thence north two hundred and forty-two and five-tenths feet on west line of said lot 4; thence north sixty-eight degrees fifty-eight minutes, east seven hundred and forty-eight feet on north line of said lot 4; thence north sixty-six degrees five minutes, west seven hundred and sixty-five feet to a point on the west line of said section 35, said point being fourteen hundred and ten feet south of the northwest corner of the southwest quarter of said section 35; thence north seventy-four degrees thirty-four minutes, west thirteen hundred and seventy-six and eight-tenths feet; thence north eighty-eight degrees forty-six minutes, west thirteen hundred and twenty-four and nine-tenths feet to a point ten hundred and four and three-tenths feet south of the center of section 34, township 39 north, range 13, east of third principal meridian; thence south seventy-seven degrees forty-six minutes, west thirteen hundred and fifty-five and twenty-five-hundredths feet to the center of the Western Indiana Belt railroad; thence south seventy-five degrees thirteen minutes, west thirteen hundred and seventy-three and five-tenths feet to a point sixteen hundred and sixty and four-tenths feet south of the northwest corner of the southwest quarter of said section 34; thence south seventy-five degrees thirteen minutes, west twenty-seven hundred and sixty-nine and five-tenths feet to the east line of the southwest quarter of section 33, township 39 north, range 13, east of third principal meridian; thence south two hundred and seventy-one and six-tenths feet to south line of said section 33; thence west thirteen hundred and thirty-four and twenty-six-hundredths feet; thence south one hundred feet; thence south sixty-eight degrees six minutes, west seven hundred and sixteen feet; thence south sixty degrees fifty-seven minutes, west seven hundred and fifty-eight feet to a point seven hundred and thirty-five feet south of the northeast corner of section 5, township 38 north, range 13, east of third principal meridian; thence south fifty-nine degrees forty-two minutes, west thirty-one hundred and one and five-tenths feet; thence south two hundred and ninety-eight feet to center of said section 5; thence west five hundred and five feet; thence south fifty-nine degrees forty-two minutes, west twenty-five hundred and fourteen and two-tenths feet to a point twelve hundred and seventy feet south to the northwest corner of the southwest quarter of said section 5; thence south fifty-nine degrees forty-two minutes, west twenty-seven hundred and twenty-three and eight-tenths feet to north line of section 7, township 38 north, range 13, east of third principal meridian; thence south fifty-nine degrees forty-two minutes, west thirty-four hundred and ninety-six and six-tenths feet to a point seventeen hundred and eighty feet south of the northwest corner of said section 7; thence south to the southeast corner of the northeast quarter of section 12, township 38 north, range 12 east; thence west on south line of northeast quarter of said section 12 to the east line of block 2 of the county clerk's division of the west half of the southeast quarter of said section 12; thence south one hundred and thirty-seven feet; thence west two hundred and thirty-three feet; thence south one hundred and sixty-five feet; thence west two hundred and sixty-six feet; thence south two hundred and thirty-three feet; thence west two hundred and sixty-six feet; thence south two hundred and thirty-three feet; thence west three hundred and thirteen feet to the west line of said county clerk's division; thence south to the Illinois and Michigan canal; thence southwesterly along said canal to the center of the Summit and Riverside road.

Said main channel to begin at the west arm of the South fork of the South branch of the Chicago river and to extend to the center of the Summit and Riverside road, all in Cook county and State of Illinois. Said land includes the route of the main channel and such additional lands as are necessary for the corporate purposes of said sanitary district of Chicago.

Sec. 2. The line or route of said main channel and the width of the same, together with the necessary additions thereto; shall be as shown by the lines in red upon the said map hereto annexed and made a part of this ordinance.

Sec. 3. The route of the main channel herein described and located is a part of the route, or main channel, to be laid out and established by said sanitary district of Chicago, the remainder of the route or main channel, and necessary additions thereto, to be hereafter laid out and established; and the said board of trustees of the sanitary district of Chicago reserve the right to lay out and establish the remainder of said route or main channel and such necessary additions thereto.

Sec. 4. That for the purpose of making said improvement the said sanitary district of Chicago shall appropriate and acquire the lands hereinbefore described, and the cost of said improvement shall be paid for in part by general taxation, and in part by special assessment.

Sec. 5. As to any of said lands that can not be acquired as aforesaid, by purchase or cession from the owners, the attorney of the sanitary district of Chicago shall be and is hereby directed to file petitions in the Circuit or County courts of the county in which the same is situated, in the name of the sanitary district of Chicago, praying that the just compensation to be made for private property to be taken or damaged for said improvement or purpose as specified in this ordinance, shall be ascertained by a jury.

Sec. 6. That an ordinance establishing a route or main channel, adopted by the board of trustees of the sanitary district of Chicago, April 4, 1891, be and the same is hereby repealed.

Sec. 7. This ordinance shall be in force from and after its passage.

This welcome ordinance proved that the progressive party within the board of trustees conquered all opposition, and that a great and useful work, once undertaken by Chicago, must always be pushed forward to competition, regardless of the quibbles of the law and the opposition of the minority.

It is not from the city sewers opening directly into the lake that the dangers of water pollution arise, but from the fact, hitherto explained, that the river empties into the lake oftener than into the valley of the Illinois. The only sewage emptied into the lake along the front of the old city, from Fullerton avenue to Thirty-ninth street, is that of a strip averaging perhaps a quarter of a mile wide, in some places a little wider, accommodating a few thousand people. But whenever the dip is toward the main river or any of its branches or forks all the sewage goes into them. Thus all the sewage made west of the North and South branches discharges into them or the West fork. All the sewage of the Twenty-ninth and Thirtieth wards of the Town of Lake, covering the Stock Yards territory, discharges into the South branch, because the natural drainage is that way. The south ward of Lake tends to slope in part toward the Calumet basin, but the inclination is so slight that the sewage will go whichever way it is directed by the sewers. The natural grade of the west half of Hyde Park is toward the western outlet of the Chicago river. All of Jefferson and seventy-five per cent. of the area of Lake View drain into the North branch, as all of Cicero does into the West fork of the South branch. Thus of that part of the city which is within the drainage district, from ninety to ninety-five per cent. drains naturally into the Chicago river and into the canal, and hence when the great channel is cut the flow will be into the Desplaines, for the dip will be in that direction, and, obedient to the law of gravity, the amply diluted sewage will run off into the Illinois and Mississippi to the Gulf. Again, when the drainage channel is drawing three hundred thousand cubical feet of water a minute from the lake, its suction will draw into the Chicago river, and discharge into the Desplaines nearly all the shore water which has been fouled by sewers emptying into the lake from Lake View on the north, as far south as Kenwood or perhaps Jackson Park on the south. Thus this dreaded sewage will be disposed of without further artificial means; but to make assurance doubly sure it is the intention to reverse all these shore sewers which now discharge into the lake, so that they will drain westward, and as the great channel will make the outlet in that direction considerably lower than that into the lake, not one drop of sewage will mingle with the drinking water.

So late as the year 1855 the water of the Chicago river and its branches was comparatively free from pollution, perhaps as much so as the Calumet river was in the year 1880. The establishment of a sewerage system and the increase in industrial houses changed this condition, and for the last thirty-six years the same stream which induced settlement in the eighteenth century has threatened the physical life of the citizens, if it has not actually exerted an evil influence on the moral life; for, in the neighborhood of filth the moral life, which is superior to the physical, must suffer, since uncleanliness and morality can not dwell together. The conversion of the river into a strait, connecting the upper lakes with the Gulf of Mexico, is the only means of restoring the river to a condition beneficial to the city.

The system of main drainage now commenced, will place Chicago on the sanitary plane of Paris, and permit the young city of the prairies to grow up in health and beauty like the fair city on the Seine.

CHAPTER VI.

HOUSE HEATING AND VENTILATION.

HOUSE HEATING, like housebuilding, has been subjected by time to change. Within the memory of men now living, the open fireplace and elaborate mantel formed the highest idea of house heating; the grate was slowly received as an improvement, and the box-stove introduction was still more slowly made, and so with the soft coal, coke and charcoal burners of early days. Between 1822 and 1830, one Dr. Nott, of Albany, N. Y., brought the baseburner into existence, with a view to its use as an anthracite burner. This was an illuminated magazine stove, without an internal fuel chamber made separate from the outer case, which was an oblong square. D. G. Littlefield, a resident of Albany, N. Y., speaking in 1890, of Nott's invention, says:

"At this time the mining of anthracite coal was in its infancy. It had not been used for making steam, nor in smelting furnaces, and there were but few persons having confidence in it as a domestic fuel. Some, however, desired to test it, but there were no proper means of doing so. It fell to the lot of Dr. Nott, however, to show, so far as he could under the circumstances, people how to use this fuel for every purpose for which it is now employed. Coal miners did not have coal breakers in those days. They had nothing but the pickax and crowbar with which to prepare it for market; and the mine owners looked upon it as a loss when the coal became broken into small pieces. Thousands of tons now found most valuable for many purposes were then regarded as only fit to make into roads leading from the mines. Dr. Nott, when writing on the subject, made no suggestions as to the size of coal best adapted for different purposes. He so constructed his stove that it could serve as a coal breaker. He overestimated the temperature required for a complete combustion of anthracite coal, and in his anxiety to generate intensity of heat within his stove he lined with fire brick its whole interior portions, except the flues and ash pit. The intention was to so heat the coal that it would crumble into smaller pieces on rolling his Saracenic grate backward and forward by means of a lever attached."

The Doctor had to import fire brick for his stove, and was forced to construct it to fit such brick. Again he made no provision for the escape of gases generated within the stove, nor for regulating draft. All his attempts to construct a working stove up to 1853 failed.

The Littlefield baseburner, as invented in 1853, had all the useful points overlooked in the Nott stoves, and in 1855 the Pioneer constructed by him was a succes. The Morning Glory was another of his practical baseburners and the beginning of that long line of artistic stove-work which is observed to-day in the great stove works of this country.

In the New England states, including everything east of New York, there are two thousand two hundred and eighty-nine stove dealers. This number, large as it appears, is exceeded by each of three individual states, for the Empire state has two thousand eight hundred and ninety-five, Pennsylvania is credited with two thousand four hundred and eighty-nine, and Illinois with two thousand two hundred and ninety. Taking the next block of states, working westward, comprising New York, Pennsylvania and New Jersey, Delaware and Maryland, we find that the total is nearly three times that of the New England states, in other words, six thousand six hundred and twenty-three. Going still farther west, and for lack of a better name calling the next division the central block, comprising everything east of the Mississippi and north of the Ohio rivers, and in addition including Tennessee, Kentucky and West Virginia, there are eight thousand seven hundred and fifty-five dealers. The southern seaboard states show dealers handling stoves to the number of one thousand six hundred and seventy-one, while Alabama, Mississippi and Louisiana add one thousand and thirty-seven to the number, making for the South a total of a little more than the New England states, namely, two thousand seven hundred and eight. Texas alone is an empire when area is considered, and is credited with seven hundred and eighty-one dealers, while Arkansas, much smaller territorially, is only a little behind it, having seven hundred and eleven stove dealers. Missouri is a little ahead of Ohio, having one thousand six hundred and twenty-seven, while Ohio has one thousand five hundred and seventy-one. Kansas has nine hundred and seventy-nine, while Nebraska is credited with six hundred and ninety-one. North and South Dakota, respectively, have one hundred and forty-four and two hundred and ninety-eight. Minnesota and Wisconsin rank close together, having eight hundred and forty-five and eight hundred and ninety, respectively. The Pacific coast figures up as follows: California, three hundred and fifty-four; Oregon, one hundred and fifty-one, and Washington one hundred and two, a total of six hundred and seven. Referring to the large cities, New York has four hundred and forty-two merchants carrying stoves in stock; Brooklyn, two hundred and seventy-nine; Boston, one hundred and eighty-five; Philadelphia, two hundred and twenty-nine, and Chicago, five hundred and twenty-seven. Some very interesting deductions might be made, taking these figures into consideration in connection with the population of the several cities. For instance, Chicago, with a population not very far removed from the figures of Philadelphia and Brooklyn, has more than twice as many dealers as either of these cities. Again, with a population of about one-half of that of New York, Chicago has more than fifteen per cent. more retail dealers than the metropolis. This is no doubt to be accounted for in part by the wider distribution of the trade in Chicago and to the fact that there are more mixed stores proportionately in this city than in any other city in the Union. The statistics relate to 1879, and, in considering population, to the census of 1880. Since the report was made, the population of Chicago has been found to exceed one million two hundred thousand, and the increase in stove dealers has been correspondingly marked.

Reminiscences of ancient stove days are not without value. They recall the times, not a hundred years ago, when house heating was effected by the cooking stove, and when that stove was the central attraction of the family circle during the cold winter days. That great authority, the *Metal Worker*, published recently the memories of an old settler, who wrote as follows: "I have a vague memory picture of a primitive cooking stove with a central fire-box, flanked by boiling places which overhung the space like a vessel's taffrail. I think it was called a saddle-back stove. Do any of my readers remember them more clearly? Soon after, although not directly following, came the Rotary, which was thought a great innovation in its time. It was originally without an oven, except as hereafter shown, and the whole top of various sizes of boiler-holes was made to revolve at will around a common center. Thus the cook could rotate from pots to kettles, bringing them successively over the direct blaze of the wood fire, to be later 'moved on' to more temperate regions. The covers were, as intimated, of differing diameters, having wire bails for convenience in handling. The oven was simply a cover made of tin for the whole top of the stove, usually provided with an aperture at the apex like that of a cistern through which access was had to the edibles below. Of course baking and boiling could not be done in conjunction, but that was not accounted a serious objection; for this tin cover was simply an auxiliary to the more primitive brick oven and did not compete with that old reliable. Later on came the elevated oven, which at first was a double cylinder of sheet iron with cast heads, to which doors were hinged. Query: Who first discovered that an oven really needed more than one door? This oven was supported at an altitude above the stove-pipe sufficient to allow the procession of utensils to pass under, like water craft below a suspension bridge, by two pipes or smoke flues, one from the center or hub of the stove and the other from the rear collar outside of the rotating top. The exit-collar, from which the pipe led to the chimney, was placed on top of the oven, and thus the smoke and heat were compelled to pass around the oven between its inner and outer walls. This oven stood at a right angle to the front or hearth of the stove, but about the time when the rotary idea came out it was placed parallel with the hearth, on a center-supporting pipe over the rear of the stove. It seems to me that about this time the Rotary had a cast-iron oven located under the stove, but am not clear on this point.

"There was a stove with a cast oven on the elevated principle supported on a lower rectangular frame upon which as a truck ran wheels, carrying the stove body. By this means the stove, being a plain top, could be trundled under the oven, exposing two or more boiling places for use as the cook might desire. The maker's name has passed from my memory, but I think we called it a 'railroad' stove. Another modification of the upper or elevated oven door of cast iron was largely sold to the country trade by peddlers who carried wagon loads of them to the farmers. It was said by competitors that unless a purchaser owned a wood lot he could not afford to run one of them. Desired economy of fuel produced the 'airtights,' of which I have no time, nor will the editor give me space, to speak in detail. The story which I received cum grano salis regarding a 'wager stove,' to the effect that a barrel of flour was once baked into bread therein with only the wood of the barrel for fuel, I used to tell to customers with a mental reservation to ease conscience as to the capacity and number of cord feet of wood in that barrel. Another and like unto it was that which said Mr. P. P. Stewart made a final inspection of his stove with sledge hammer in hand, when the slightest imperfection was a good reason for the destruction of the stove by the merciless inventor's hammer."

Some time before the anthracite subheater was invented numerous wood and coalburners were placed on the market, adaptations of which are offered to-day to consumers of soft coal and wood as in days of long ago.

The house furnace is peculiarly an American institution. Its succession to the throne of the stove was slow indeed, so much so that in 1880 one of the present furnace factories could produce such heaters in sufficient number to supply the demand in the United States. Since that period the furnace has shared the popular favor, and to-day thousands of homes are heated by hot-air where a decade ago not more than one-twentieth of the number could boast of this modern heating system. The number of furnace manufacturers now carrying on business enter into lively competition, leaving the house owner in that happy condition where he can have his whole house heated at a cost a little below that of heating three parlors with the ancient or modern stoves.

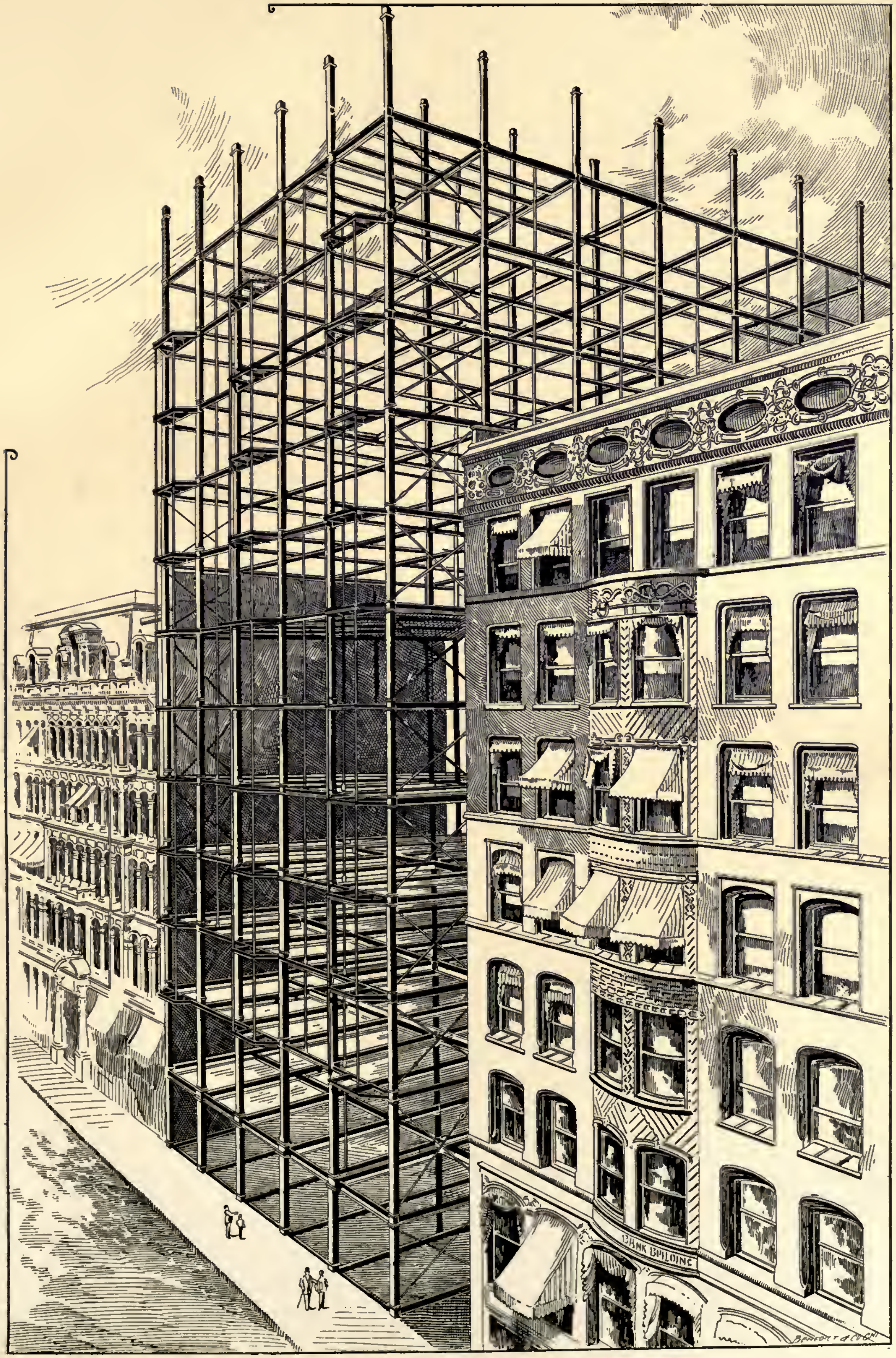
Lester's furnace was advertised by M. W. Lester & Son, of 54 State street, in 1869; A. E. Leavenworth, of 176 Lake; N. M. Simonds & Co., 218 Washington; H. C. Van Schaack, Jr.*, 82 State; Bliss & Brown, 158 State; John H. Keyser & Co., 178 State; Pratt, Wentworth & Co., 198 Lake; M. A. Thayer & Boomer, 829 State; Wilson, Davis & Co., 31 North State, and Rubel Bro.*, 193 Lake street, were named in 1872 with Bliss & Brown, Chevill & Lennox and M. A. Thayer.

The manufacturers of hot-air furnaces in 1879 were William Boomer, 951 Wabash; Servoss, Northen & Co., 56 North Clark street; Hatch & Breeze, 50 State; A. E. Leavenworth, 171 Randolph; Franklin Lester, 57 Lake; Richardson, Boynton & Co., 84 Lake; Ruttan Manufacturing Company, 68 Lake, and Younghum & Rickert, 74 Adams. Others engaged in manufacturing or selling heating apparatuses were John D. Bangs & Co., Cruver & Jones, W. T. Powell, A. Rubel, Isaac Rubel, A. A. Spear, P. J. Stanton, F. R. Taylor and J. M. Taylor.

John McWade, 245 Madison; Prickett & Drysdale*, 80 Monroe; J. C. & J. J. Young, 88 Michigan avenue, were manufacturers or dealers in grates, fenders and grate fronts in 1869. Dewey & Jones, 167 Dearborn, were manufacturers of mantels, grates and cornices. H. Gammerdinger*, 370 State; E. L. Gowen*, 146 to 152 North Water, and Sherman, Cole & Co.*, 221 to 223 State, were manufacturers of marble and stone mantels.

In the construction of a furnace and hot-air pipes, the location, the size of hot and cold-air pipes, the arrangement of flues and the system of ventilation have all to be considered.

*Were here in 1872 with the Hackett Manufacturing Company and the Scheurman & Hand Mantel Company.



THE UNITY BUILDING IRONWORK.

A central location, a point northwest of the apartments to be warmed, is necessary. An excavation, fourteen inches deep, below the level of the cellar floor, should be filled in solidly for foundation purposes, and the apparatus raised upon it. A galvanized-iron smoke pipe eight inches in diameter, with ventilator and damper; bright tin warm-air flues, encased by outside tin covering, one-quarter inch from flue, when carried through or in partitions, and four inches from woodwork when single, should be used. The furnace flues should be eighty square inches sectional area, and be close from ashpit (or place for tightly fitting ashpan) to top, as openings in flue interfere with necessary draft. The cold-air box, 16x36 inches inside, may be carried from the northwestern exterior of the house along the cellar ceiling, and thence to the base of furnace. A tight-fitting door at the top of the vertical cold-air duct may permit the taking of air from the top of basement in connection with that from rooms and halls at night or on cold days during the existence of a south wind. A further provision for obtaining air from the interior may be made by placing a 20x26-inch register in hall, connected with a 16x24-inch air-tight wooden duct leading to a point under the furnace. Cold-air ducts may be carried in the same manner from parlor, dining-room and library to the furnace. When the exterior air is extremely cold the economy of taking the supply of air for the furnace from the interior is manifest. Air-tight dampers should, however, be used on the interior air ducts, so as to close them off from the furnace when exterior air is in use.

Regarding the sizes of registers and pipes for different sized rooms, the following is taken from the catalogue of a leading furnace company: In public halls or buildings where but a single register is required, take the hot-air pipes from the top of the furnace and use register without valves. The size of pipes and registers requisite for the successful operation of any furnace is a matter requiring the best judgment, and should be determined by the size, position and distance from the furnace of the spaces to be heated, and can not be governed by any fixed rule. We usually recommend for rooms of ordinary hight as follows:

Room on first floor, 12x14 feet, should have eight-inch pipe, with 8x12 register. Room on first floor, 12x18 feet, should have nine-inch pipe, with 9x12 register. Room on first floor, 16x20 feet, should have ten-inch pipe, with 10x14 register. Room on second floor, 8x12 feet, should have seven-inch pipe, with 8x10 register. Room on second floor, 10x16 feet, should have eight-inch pipe, with 9x12 register. Room on second floor, 12x16 feet, should have nine-inch pipe, with 10x14 register. Medium sized halls should have ten-inch pipe, with 10x14 register. Large sized halls should have twelve-inch pipe, with 12x15 register. When oval or flat pipes are built in the walls of an ordinary three or four-story city house, the basement rooms and parlors should have independent pipes; second, third and fourth-story rooms can be warmed by a single line of pipe, reduced in size over each register, viz.: A house, 18 or 20x45 or 50, should have a separate pipe, 4x16, to each parlor. A house, 18 or 20x45 or 50, should have one line, 4x18 to second story, reduced to 4x14 for third story, reduced to 4x8 for fourth story. A house, three stories, 20x45 or 50, should have one line, 4x16, to second story, reduced to 4x9 for third story. The above sizes to be varied according to the size of house and general division of the interior space; 4x24 pipe in the wall should have twelve-inch pipe connected with furnace; 4x20 pipe in the wall should have ten-inch pipe connected with furnace; 4x18 pipe in the wall should have ten-inch pipe connected with furnace; 4x16 pipe in the wall should have eight-inch pipe connected with furnace; 4x14 pipe in the wall should have eight-inch pipe connected with furnace; 4x12 pipe in the wall should have eight-inch pipe connected with furnace; 4x9 pipe in the wall should have seven-inch pipe connected with furnace; 4x7 pipe in the wall should have six-inch pipe connected with furnace.

Heating rooms on furnace level from the furnace is a question that has been somewhat of a puzzle since the day the furnace was introduced. The searcher for heat on the furnace level is generally content with that radiating from the apparatus, but men are found who desire that the furnace must now be made equally useful as a heat distributor in the basement as it is on the second and third floors. To heat four or five rooms on the level, as is sometimes done by a large baseburner stove, is a precarious means of obtaining heat in winter. In the day-time all doors must be left open and at night all transoms and a few of the doors must be open; but much depends on the location of the furnace, in such a plan. A second method is to convey a part of the heat from the top of the furnace by round tin pipes carried through the partition walls and under the ceilings of adjoining rooms. A third method is to pipe the cold air from the floor outside the furnace room to a cold box or safety bottom under the furnace and thence into it, thus giving the warm-air pipes, first described, more play. Carrying the smoke pipe through a room or two to the main flue pertains to this method. Piping the smoke from the furnace room into a combination drum, in an adjoining room, where it sweeps along to a smoke pipe to be carried to the flue, is a method by which the circulation of air as well as of heat may be provided for.

The underground fresh-air duct or air-supply pipe may be more than a heater auxiliary. Unless it be made a way for the entrance of fresh air, it becomes a vehicle for the conveyance of poisons to the household. It is customary where houses are built on narrow lots and the lower or basment story is used for kitchen and diningrooms, to construct the conduit to supply fresh air to the furnace, of glazed sewer pipe underground, leading from the furnace pit to the rear of the house, where it is brought to the surface by a little well built against the rear wall. The disadvantages of such an underground air conduit in this soil are numerous, so numerous, in fact, that the health department frequently receives complaints about them. In order to avoid this unsanitary condition, the health department secured the insertion in a proposed bill governing the sanitary construction of buildings, of a section forbidding the use of underground fresh-air conduits. In deference to some architects who believed that method of constructing fresh-air flues as the least objectionable of any, provided it was properly done, the section has been modified and now reads:

> No duct or flue for admitting air to an apparatus intended for warming shall be concealed below the concrete under the lowest floor of any building, except that the same be laid in dry sand or soil, and be made of impervious and imperishable material, hermetically sealed at the joints.

It is altogether probable that architects would provide the underground air duct if they chose, without reference to the quality of the soil, about which they are not supposed to know anything. If the plan called for an underground air duct, the contractor would put it in without reference to the soil. Then, to, the level of the ground-water rises and falls in this city very greatly at two seasons of the year. The ground upon which a proposed house is to be built might be perfectly dry at one time and saturated at another.

The only reason why they should be built, other than a desire on the part of the architect to preserve the symmetry of his rooms, which would be spoiled by a galvanized-iron pipe passing through the kitchen or servant's bedroom, is one given by Walter Bernan, C. E., in his "History and art of warming and ventilating," in which he says: "Where practicable, cold air should be drawn from a large underground tunnel. By this means, when the external air is at the freezing point, the tunnel will furnish air at nearly the mean temperature, by which a considerable portion of heat may be saved." He also advises the tunnel to be square, so as to present a large surface to the air, and to be made of some good conducting material, so as readily to conduct the heat of the earth to it.

An account of a practice once common here, but now prevented by the health department whenever it is discovered, will show a forcible objection against it. A row of three houses on Ontario street, some years ago, were designed by a firm of Chicago architects. These houses were provided with furnace pits and underground fresh-air ducts. The latter were so poorly constructed that, before the houses were finished the architects discovered water in the furnace pit and ordered the sewerbuilder to drain it by a direct connection with the sewer. What the result would have been had the health department not discovered the condition of affairs is well-known now to the merest tyro in sanitary construction, and it would be supposed that such foolish and criminal arrangements would be abandoned in the light of the knowledge of to-day. Yet, within a year, the Chicago health department has been compelled to reject house plans because of this very provision. If the duct is not supposed to fill with water why was the connection made to carry it off? This connection with the sewer is not the chief objection, as it is not often made. The joints of the duct are seldom made tight, or, if so originally, are soon loosened by the percolation of water from the soil. Open joints permit water to accumulate and become foul, and permit ground air to mix with the fresh air, especially, as is often the case, the fresh-air flue is tightly closed at its outer end during cold weather. The surface of the earth is filled with decomposable substances, and whenever air is confined in any spot in contact with the ground, or any changeable organic matter, it becomes saturated with various exhalations which are detrimental to health. The noxious air generated in cellars, basements, and under floor spaces reaches the inhabitants of the upper apartments in so small quantities, that, instead of producing any marked and sudden process of disease, it operates rather as a steady tax on their income of health, so uniform in its depressing effects as not to be appreciated.

The hot-blast system of heating buildings is an improvement on the old furnace methods. This system is simply the supply of cold air to a chamber above coils of steam or hot-water pipe and its diffusion thence through the building by means of hot-air flues. Used in combination with steam or hot water, this system is recommended for its economy even as the combination steam and hot-water system is recommended. The prompt response of hot-air flues to the condition of the furnace or steam and water pipes is one of the leading points in its favor.

The system of heating by hot water must be credited to M. Bonnemain, who, in 1777 brought it near perfection at Paris, France. Almost a century passed away before Americans realized the simplicity and utilty of the system, and to-day, only, has Chicago extended to it any general patronage, although known here in its simplest form as early as 1859. During the years 1889 and 1890, a number of hot-water heaters were introduced, and each one, the ideal of the manufacturer, was shown to have so many good points that it was difficult to decide which of the heaters offered was the best. Many of them were tried and found wanting, a few of that many proved successes in some houses while showing failure to heat in others. Some of them were so intricate in make-up that it was a marvel how the water circulated; others were so simple in construction that one wonders where the heating surface is; some are made to gather round the pipes every particle of dust and soot; others to repel such particles; yet for each is claimed perfection, and to sustain the claim nothing less than the heater in actual practice is requisite. With heater radiators and flue arranged properly, great things come from this system. It is pleasant, healthy and economical.

Many are curious to know why, in hot-water heating system, the water circulates; what is it that secures the movement known as circulation? Water consists of an innumerable quantity of extremely minute particles, called molecules. These particles have the property of being able to glide over, under, and to and from each other almost without resistance or friction. When water is heated in a boiler, the action that takes place is this: As the heat is applied the particles nearest the heated surface becomes expanded or swollen, and are so rendered lighter (bulk for bulk) than the colder particles, they are therefore compelled to rise to the highest point in the boiler; finding an opening in the flow pipe, they travel up this, also, until the highest point in the system is reached. It will be understood that immediately the expanded particles left the heating surface, other cold particles immediately took their place; these become heated in turn, and rise, following the particles that preceded them, and this goes on continuously. The circulation can be described as a stream of heated particles flowing up one pipe from the boiler, and a stream of cooler particles flowing down another pipe into the boiler; or it might be described as a means of automatically transporting heated water from the lower to the upper parts of a building, and providing a down-flow of cold water to the boiler to be heated in turn. From this it will be seen that the flow pipe should never start from the boiler in a horizontal direction, as this will cause delay and trouble in the circulation. This pipe should always start in a vertical direction, even if it has to proceed horizontally within a short distance from the boiler. Reflection will show that the perfect apparatus is one that carries the flow pipe in a direct vertical line to the cylinder or tank; this is never, or but rarely possible, but skill and ingenuity should be exercised to carry the pipes as nearly as possible in this direction. Many or most of the failures in hot-water heating can be attributed to a neglect of the simplest laws which govern the movement of water in pipes, and those having in charge the erection of hot-water systems, for heating buildings, will do well to remember that the circulation they expect depends entirely upon the expansion of particles when heated, and that they must avoid, as much as possible, friction, exposure of flow pipes to a very low temperature, and frequent or numerous short bends. To sum up, let your flow pipe be protected from external temperature, go direct, vertically, without bends or short turns to the cylinder or tank.

The editor of the *Sanitary News* explains the laws governing the circulation of hot water in the following paper:

"The circulation of the water is caused by unequal pressure on some portion of the system. The most common system of heating water for circulation is that required in connection with the kitchen range by every modern city house. The reason that the water circulates when heat is applied to the water in the chamber about the firebox, a dilation of the volume of the water takes place, and it becomes lighter. The heated water rises in the chamber, and finds its outlet through the short pipe leading to the boiler. The moment heat is received by the water and it becomes lighter, a change in the pressure occurs, and the cold water, being heavier, begins to flow through the return pipe into the bottom of the water-chamber in the heater, and this movement continues. Suppose, for the time, that the circulating system includes nothing but the heater and the water reservoir, and that the two pipes attached to the top of the water reservoir are removed, it will be seen that the hot water will flow into the reservoir and collect at the top, and the cooler and heavier water will gather at the bottom and flow down the return pipe to replace the water moving out at the top. There is nothing more simple than this movement. Persons not familiar with the laws of hydrostatics, might not see at a glance that the pressure would be even in this system before heat was applied, when they consider the great difference in size between the columns of water maintained in the water chamber in the heater and in the one-inch return pipe. The pressure of fluids depends on the hight of the column only, and is entirely irrespective of the bulk. Therefore, the one-inch pipe exerts as much pressure as the much larger heating chamber.

"If the pipes referred to were entirely disconnected, and the reservoir and return pipe allowed no heat to escape from the water, the circulation would take place until the water was of a uniform temperature, which would occur only when no more heat could be received from the fire, when the circulation would stop. This, however, would never occur in practical work, for the water is continually losing its heat by conduction and radiation, and a uniform degree of heat can never occur. The quicker the water loses its heat the heavier it becomes, and the more rapid the circulation becomes. Now to the point where circulation of hot water throughout the house to different fixtures is desired. For this purpose the pipes are carried from the crown of the reservoir, the hot-water pipe always leading from the top of the reservoir, where the hottest water always is. The cold-water supply pipe empties down in the lower part of the reservoir, where the cool water is, to avoid reducing the temperature of the hot water by mixing cold with it.

"It is evident, after the explanation of the pressure-law of fluids, if the hot-water pipe and the return pipe are carried to the same hight in a building and there connected, that circulation will always result, as the pipes are a simple elongation of the two original columns of water. In practical plumbing it is necessary to supply fixtures on different floors, and at different levels, and the question of securing a circulation becomes an important one. The main-flow pipe, after leaving the crown of the boiler, is carried horizontally to a point over the sink. Here a branch is dropped down to the level of the sinkcock. The main-flow pipe is then carried to the next floor, on which there are fixtures, by as direct and straight a route as possible. The pipe is lead as near to the fixture as possible and a branch taken off to the cock. The main flow pipe then continues to the next floor, on which is the bathroom, probably. The pipe is connected to the bathcock by as short a branch as possible, and is then carried around the side of the bathtub to the washbasin. These generally complete the fixtures to which hot water is conducted; to complete the circulation the main-flow pipe is continued directly back, without any branches, to a point underneath the boiler, where it connects with the return pipe leading from the boiler to the fireback. This system, if properly constructed, will form a circulating system which will work satisfactorily. For convenience the cold-water pipe is constructed parallel with the hot-water pipe, but it has no return pipe and comes to a dead end at the highest fixture.

"It is frequently noticed that upon opening the hot-water faucet a large amount of cold water is expelled before the hot water begins to flow. This need not necessarily be so, and if it occurs, can be remedied. It is caused by leading a long branch from the circulating system, instead of so placing the circulating pipes that a very short branch would be necessary to reach the hot-water faucet. Another annoying feature in some hot-water systems is the belching of air from the hot-water fixtures on the upper floor. This is because the plumber has neglected to supply an air-vent at the highest point on the system. Vapor is always present in water. As it becomes heated, the air is expelled from the water and collects at the highest part of the system. Here a cock is usually placed to allow its escape. In case the water-pressure in the house is from a tank, the air-vent may be left permanently open, if it extends above the level of the cistern.

"The pressure exerted in the hot-water system of a house is principally exerted on the boiler. If the pipe leading from it is thirty-four and one-half feet long from the bottom of the boiler, and is full of water, the bursting pressure on every square inch of the inner surface of the boiler will be fifteen pounds. The requirement for boilers of a good tested strength is very apparent. In this apparatus where hot water is continually being drawn off and is replaced by cold, there will be a greater or less deposit of mineral matter, according to the degree of the hardness of the water. This is provided for to some extent by the sediment cock at the bottom of the boiler, yet the pipe which runs through the fireback is often stopped up with lime. In some localities this deposit is very extensive, constantly requiring the substitution of new connections.

"Another source of trouble with firebacks is in their freezing in severe weather. It is impossible to prevent it in houses which will not withstand the inroads of cold, except by keeping fire in the stove all night. Drawing off the water at night is futile, because it necessitates looking out for air binds, and if there is a dip, even of slight extent, in any portion of the system, it is impossible to empty the system of water, and it is liable to freeze and to require the whole plumbing to be torn out to find the stoppage. If there is a suspicion that the waterback is frozen, it is best to burn a newspaper or two under the connecting pipes. If water exposed about the room is frozen, it would be desirable to do this anyway. If the lead pipe is slightly bent, the cracking of the ice inside will determine if it be frozen. If, after the fire has been burning a few minutes, the upper pipe does not feel warmer than the lower, the supposition that the pipes are frozen will be always correct.

"There is one cause for the non-circulation of water in pipes which plumbers should be constantly alive to. It is that the most trivial obstruction, such as a lead shaving, lodged in the pipe, in a tank system where the pressure is not aided by the pressure from the mains, may entirely prevent the circulation. This is because the motive power of the heat upon the water is so small. It is so small that an ounce or even a fraction of an ounce often expresses it. This small amount of motive power is easily overcome. The velocity of the circulation is another point in which plumbers are interested. As the movement of the water is dependent upon the difference in temperature of the water in the rising pipe and in the return pipe, it is evident that any measure to maintain the temperature in the hot-water pipe, such as packing, etc., and to reduce the temperature in the return pipe, such as doubling it back and forth horizontally, thus increasing its length, and increasing the amount of heat lost by radiation, will increase the velocity of the circulation, and deliver the water to distant fixtures at a higher temperature than otherwise would be the case."

A practical illustration of hot-water heating may be based on a boiler showing twenty-five and eighty-three-hundredths square feet of plain and three and ninety-five hundredths square feet of extended surface, or a total surface of twenty-nine and seventy-eight-hundredths square feet with grate area equal to three and four-hundred-and-eight-thousandths square feet. This supplied nine hundred and forty-three and five-tenths square feet of radiating surface, including forty square feet of cast-iron pipe, used in the conservatory. It shows one square foot of grate surface to eight and seventy-four-hundredths square feet of boiler-heating surface and two hundred and seventy-six square feet of radiating surface. The work performed by such a heater is shown in the following table:

FLOOR.	Total contents of all apartments, in cubic feet.	Contents of apartments heated, in cubic feet.	Total square feet of surface in radiators.	Cubic feet of total contents to 1 square foot of surface in radiators.	Cubic feet of contents of apartments heated to 1 square foot of surface in radiators.	Square feet of glass or its equivalent to 1 square foot of surface in radiators.	Square feet of surface in radiators to 1 square foot of glass or its equivalent.	Square feet of surface in radiators to 1 linear foot of exposed wall.
Basement	8,248	5,308	126	65	42	0.76	1.3	3.1
First floor	13,810	13,810	422	32	32	0.58	1.6	6.0
Second floor	10,332	7,491	199.5	51	37	0.96	1.03	4.5
Third floor	9,348	6,251	156	59	40	0.90	1.00	4.2
Total	41,738	32,860	903.5	46	36	0.77	1.28	4.5

Such a system of course does not provide for waste. While the quantity of heat produced is out of all proportion to the requirements of such space, except on the few extremely cold days experienced in Chicago, it is safe to make provision for such extremes of cold without forcing the fire.

A simple method of calculation was presented a few years ago by Charles A. Smith, of Dubuque, Iowa, who made practical test of the relation between radiating surface and cubical contents, taking steam heat as a basis.

CLASS OF BUILDING.	When heaters are in same rooms (direct system), cubic feet per square foot.	When heaters are in basements (indirect system), cubic feet per square foot.
Dwellings	50	40
Stores, wholesale	125	100
Stores, retail	100	80
Banks, Offices, Drug stores	70	60
Dry goods	80	70
Large hotels	125	100
Churches	200	150

For determining the cross-sectional area of pipes (in square inches) for steam mains and returns, it will be ample to allow a constant of three-hundred-and-seventy-five-thousandths of a square inch, plus, for each one hundred square feet of heating surface in coils and radiators, three-hundred-and-seventy-five-thousandths of a square inch when exhaust steam is used, nineteen-hundredths of a square inch when live steam is used, and nine-hundredths of a square inch for the return. If the cross-sectional areas thus obtained are each multiplied by one and three-elevenths, and the square root extracted from each product, the respective figures obtained will represent the proper diameters, in inches, of the several steam pipes referred to.

Years ago the tank or boiler was located at an elevation high enough to supply all fixtures; long pipes connected it with the waterback, circulating the water when heated. The first change from this open-head boiler or tank was the construction of what was called the flue boiler, located in the chimney; the heat from the range fire was carried around the body of the boiler, the flue being so constructed that all the hot gases would be applied directly to it; this boiler was close-head, with feed, circulation, and return pipes, connected at the top, which was exposed. The next was the close-head boiler, located near the range, connected to a waterback or coil, and supplied direct, or from a tank, placed at an elevation above all hot-water fixtures. This is in existence to-day, but used generally as a hot-water supplier rather than a house heater. The conduction of heat is its transmission through the substance of bodies without a mechanical motion being manifested in such bodies. The laws governing it are illustrated in the metallic bar heated at one end, which receives heat at the fire and conveys it promptly to the hand which holds it. A piece of wood of similar dimensions may be held until it burns near to the end without transmitting heat to the hand. Asbestus, mineral wool, lime and some chlorides are nonconductors like wood, and some compositions, as well as asbestus, are slow to receive heat in any degree. Against them are the metals, marbles and burnt-clays which are high conductors. To render this rating of conductivity clearer, let the following table showing the conducting and radiating power of substances be given:

CONDUCTING POWER OF VARIOUS SUBSTANCES—Despritz.		RADIATING POWER OF VARIOUS SUBSTANCES—Leslie.	
Material.	Conductivity.	Material.	Radiating Power.
Gold	100	Lampblack	100
Silver	97	Water	100
Copper	89	Writing paper	98
Brass	75	Glass	90
Cast iron	56	Tissue paper	88
Wrought iron	37	Ice	85
Zinc	36	Rough lead	45
Tin	30	Mercury	20
Lead	18	Polished lead	19
Marble	2.4	Polished iron	15
Fire clay	1.1	Gold, silver	12
Water	0.9	Copper, tin	12

Specific heat is the quantity of heat necessary to raise the temperature of solids and liquids so many degrees. Thus, to raise one pound of water 1 degree will require the same heat as the raising of one pound of mercury to about 30 degrees, or one pound of lead to about 32 degrees.

TABLE OF SPECIFIC HEAT OF EQUAL WEIGHTS OF VARIOUS SUBSTANCES.

	Specific Heat.		Specific Heat.
Solid bodies.		Liquids.	
Wood (fir and pine)	0.650	Water	1.000
Wood (oak)	0.570	Alcohol	0.598
Ice	0.504	Acid (pyroligneous)	0.590
Coal	0.280	Ether	0.520
Charcoal (animal)	0.260	Acid (acetic)	0.509
Charcoal (vegetable)	0.241	Oil (olive)	0.309
Iron (cast)	0.241	Mercury	0.033
Coke	0.201		
Limestone	0.200		
Glass	0.195	Gases.	
Steel (hard)	0.117	Hydrogen	3.409
Steel (soft)	0.116	Vapor of alcohol	0.547
Iron (wrought)	0.111	Steam	0.480
Zinc	0.095	Carbolic oxide	0.245
Copper (annealed)	0.094	Nitrogen	0.243
Copper (cold-hammered)	0.093	Oxygen	0.217
Tin	0.056	Atmospheric air	0.237
Lead	0.031	Carbonic acid	0.202

Convection is the transfer of heated substances such as water by change of temperature creating currents. The law of convection may be explained by taking a tube full of water. In an attempt to heat it from the top by bringing a heated ball of metal into contact with the surface of the water several times, the surface-water may be warmed by its contact, but the water in the lower portion of the tube may be shown not to have changed temperature, by a piece of ice in the bottom or by an immersed thermometer. Now, if heat be applied with an alcohol lamp at the bottom of the tube, the heat will be rapidly diffused throughout the water. If bran, or other substance which sinks but little, be added to the water, its movement with the currents will show how the water is set in motion by the heat. These currents of water are termed "convection currents," as by them heat is conveyed throughout the house. It is by bringing this law of the transmission of heat into operation, that hot-water circulating systems are brought into successful operation, and that hot water is made to circulate through a hot-water heating system. These convection currents are also applied in systems of ventilation, and in heating by hot air. In furnace heating the tin pipes form columns of air which are supplied with heat at their lower ends. The warmer air rises and the cold, fresh air from the cold-air duct takes its place, maintaining a constant current so long as the heat is maintained. To convection currents is also due the draught of a stove, which is simply a rising of a column of warm air in the chimney and a rushing in of colder air from the room through the stove to replace it. If the chimney is so large that the fire is not able to heat the whole of its air contents, convection currents result in smoky chimneys. If the air is too heavy, as on damp, foggy days, for the heat to raise it, back-draughts result. Plumbers are familiar with the action of currents of convection, because when they extend soil pipes to the roof, and furnish vent pipes to all traps, one of the objects is to secure ventilation of the drainage system. If the soil pipe has a fresh-air inlet at its bottom, the warmer air in the pipe will pass up the pipe and out at the top, to be replaced by the colder fresh air at the bottom.

Radiation, direct and indirect, is the evidence of the life of heat, the evidence of the effort made by water or air to reach an equal temperature. The moment a body becomes warmer than its surroundings, radiation begins, and heat shoots forth in all directions equally, as a ray of light, lessening as the area increases. The extent of radiation is governed by the conveyancer, it being understood that a bright or smooth-surfaced conveyancer will not permit so much radiation as a dull-colored or rough one. This idea of dull colors and rough iron work was the ruling one for years. Only a little while ago, it would seem, ideas were used in discussing stove ornamentation and stove decoration. At the outset the idea was altogether new that a stove might be made beautiful, or at least attractive, as well as useful as a heater. But finally art stoves were produced, and that manufacturer would be considered crazy to-day who would talk about putting a stove upon the market which is based entirely upon its heating capacity, and which has no claim whatever to beauty and art excellence. A little while ago, the steam and hot-water men were entirely content to put their apparatus on the market without respect to any æsthetic considerations. Coils of pipe were considered quite good enough for use as radiators, and in many respects it was a machine-shop job which was introduced into the finest parlors for heating purposes. Just at present art is in possession. One or two enterprising and courageous firms, a few years ago, put out radiators with efforts at ornamentation. They were well received, and one step followed another, until at the present time, decorated patterns are found in all directions. The general trend is in the right, and it will not be long before parlors and sittingrooms, libraries and diningrooms can be fitted with steam or hot-water heating, and have the necessary radiators quite as artistic and attractive as anything else that is put in the rooms, without interference with their powers of radiation. What effect art will exert on the indirect radiator is immaterial, for at best it is only an air heater, being composed of hot water, steam or electric coils, gathered in one plenum to receive the cold air, heat it by direct radiation, and supply it to the rooms by convection, as heat from a furnace is transmitted.

The principle of steam and hot-water heating by radiation is comparatively new, being first defined by the Frenchmen Péclet and Regnault. They determined the standard unit of heat to be the amount of warmth necessary to raise the temperature of one pound of water from the freezing point, 32 to 33 degrees.

The specific heat is the number or fraction of standard units required to raise one pound weight, 1 degree of Fahrenheit, or two-hundred-and-thirty-eight-thousandths of a unit. Thus one cubical foot of air at 32 degrees weighs eight-hundred-and-seven-ten-thousandths of a pound, and twelve thousand three hundred and eighty-seven cubical feet will be heated to 33 degrees by the application of two-hundred-and-thirty-eight-thousandths of a standard unit of heat, while at zero a cubical foot of air weighs eight-hundred-and-sixty-four-ten-thousandths of a pound, and only eleven thousand five hundred and seventy-four cubical feet, or one pound may be raised 1 degree by the same fraction of a unit of heat.

One square foot of glass will cool one and one-quarter cubical feet of air in a room 1 degree per minute for every degree it varies from the external temperature. Thus if it be 10 degrees outside and 80 degrees inside, one square foot of glass will render eighty-seven and five-tenths cubical feet of air within 1 degree cooler in one minute, or 70 degrees, the difference between the interior and exterior air multiplied by one and one-quarter, the cubical measure of air cooled by one square foot of exposed glass. Where storm windows are used the cooling capacity of a square foot of glass is three-quarters of a cubical foot of interior air per minute.

Exposed walls exert a strong influence on interior heat. It is ascertained that ten square feet of an exposed wall, eight to twelve inches thick, will equal one square foot of single window glass in its cooling capacity, or, one and one-quarter cubical feet of air per minute; or, eighty-seven and five-tenths cubical feet of interior air will be lowered 1 degree, when the exterior temperature is 10 degrees, and the interior 80 degrees.

A one-foot length of pipe, four inches interior diameter and fourteen inches exterior circumference, shows a radiating surface of one and one-hundred-and-sixty-seven-thousandths square feet. The estimated heating capacity of this piece of pipe is two hundred and twenty-two cubical feet of air to 1 degree per one minute, when a difference of 125 degrees between the acquired heat of the pipe and the natural heat of the surrounding air exists. Thus it requires one thousand four hundred and thirty-nine standard units of heat for each square foot of radiating surface to bring one cubical foot of air from the exterior temperature zero, to the interior temperature 70 degrees.

The emission and absorption of radiated heat is a question of importance in calculating the capacity of a heater. Radiators carrying water 160 degrees will emit one hundred and twenty-six and thirteen-hundredths units of heat per square foot per hour, all of which the air absorbs. That amount is exceeded by sixty-four units in the heat given off by the human body in one hour, and by four hundred and seventy-three units by that emitted from a gas jet which burns one cubical foot of gas per hour.

In March, 1890, the *Metal Worker* published a valuable summary of views on the relative value of heating boilers, in steam and hot-water heating apparatus. The specifications for furnace heating were easily compared, for the possible variations were, comparatively speaking, few. With steam and hot-water heating, however, there is a large range of choice as to methods and wide differences of opinion as to details. Though the work of comparison in the latter case is much more difficult, the value of the resulting tables and data is more than enough to warrant the trouble. It is not to be supposed that the averages and deductions given necessarily represent the best practice, for in such work as steam and hot-water heating there are no absolute standards formulated as yet. The tables and text are, however, both interesting and valuable, for they present in a concise form the practice of many different experts engaged in the practical work of steam and hot-water heating in various parts of this country and Canada.

Table I gives the general information necessary in order to draw up a specification and estimate for heating, by steam or water, the house described in the prospectus of the *Metal Worker* competition. Tables II and IV give various methods of proportioning and ascertaining the quantity of radiating surface, and its distribution on the different floors; while Table III presents a summary of the estimates. For convenience in comparison the competitors who agree on the several points according to percentages of the whole number are classified.

In the steam heating competition the methods of heating used were direct radiation only, eleven per cent.; direct-indirect radiation, twenty-two per cent.; direct and indirect radiation, fifty-five per cent.; indirect radiation only, eleven per cent. The number of apartments and halls heated were as follows: Fourteen apartments were heated by twenty-two per cent.; fifteen apartments were heated by thirty-three per cent.; sixteen apartments were heated by twenty-two per cent.; eighteen apartments were heated by twenty-two per cent; the hall on third floor was heated by eleven per cent., while the hall on second floor was heated by forty-four per cent., and the vestibule on first floor was heated by twenty-two per cent. The hall on first floor was heated by direct radiation only by thirty-three per cent., by indirect radiation only by fifty-five per cent., and by direct-indirect by eleven per cent. Twenty-two per cent. heated the butler's pantry, half of the number using indirect and the others direct radiation. The kitchen was heated by direct radiation by forty-four per cent. From Table II the average distribution of radiating surface to each floor is fifty-three and seven-tenths

TABLE I.—SUMMARY OF SPACE, SURFACES, ETC.

FLOORS.	Number of apartments halls, etc., on each floor.	Space on each floor in cubic feet.	Aspect.	Square feet of glass.	Total square feet of glass on each floor.	Square feet of exposed wall.	Total square feet of exposed wall on each floor.	Total equivalent of wall to glass at 10 to 1 inch square feet.	Total square feet equivalent to glass.	Exposed wall in linear feet.	Total linear feet of exposed wall on each floor.	Percentage of cubic space on each floor.	Percentage of equivalent to glass on each floor.	Percentage of linear feet of exposed wall on each floor.
Third ..	4	6189	North.	10.5	......	91.5	......	......	......	15.5	......	......	......	......
			South..	5.0	......	116.0	......	......	......	25.0	......	......	......	......
			East ..	14.5	......	89.0	......	......	......	22.0	......	......	......	......
			West .	8.0	38.0	80.5	377.0	77.7	75.7	10.0	72.5	17	9	20
Second .	8	14082	North.	42.5	......	391.5	......	......	......	41.5	......	......	......	......
			South..	45.5	......	296.5	......	......	......	31.0	......	......	......	......
			East ..	65.0	......	361.0	......	......	......	38.0	......	......	......	......
			West .	25.5	178.5	322.0	1371.0	137.1	315.6	34.0	144.5	38	35	38
First....	10	15909	North.	66.5	......	451.5	......	......	......	43.0	......	......	......	......
			South..	62.0	......	388.5	......	......	......	37.0	......	......	......	......
			East ..	147.0	......	433.0	......	......	......	41.0	......	......	......	......
			West .	48.0	323.5	370.0	1643.0	164.3	487.8	35.0	156.0	45	56	42
Totals	22	36180	....	......	540.0	......	3391.0	339.1	879.1	......	373.0	.....	......	......

TABLE II.—STEAM RADIATING SURFACES.

METHODS OF HEATING.	Number of square feet of surface in radiators to			Number of cubic feet of space to 1 square foot of surface in radiators.	Distribution of surface n radiators on floors.		
	1 square foot of glass, or its equivalent.	1 linear foot of exposed wall.	100 cubic feet of space.		Floors.	Percentage of direct radiating surface.	Percentage of indirect radiating surface.
Direct radiation only..................	.469	1.10	1.136	88	1st	65	..
					2d	24	..
					3d	11	..
Direct-indirect radiation only..........	.600	1.41	1.470	68	1st	59.5	..
					2d	81.5	..
					3d	9	..
Direct-indirect and direct radiation, 75 per cent. of the surface being direct-indirect..........................	.627	1.48	1.538	65	1st	52	..
					2d	35.5	..
					3d	12.5	..
Indirect and direct radiation, 87½ per cent. being direct radiation........	.670	1.58	1.666	60	1st	35.6	13.5
					2d	31.2	..
					3d	19.7	..
Indirect and direct radiation, 45½ per cent. being direct radiation........	.855	2.02	2.083	48	1st	3.75	56.5
					2d	28.25	..
					3d	13.5	..
Indirect and direct radiation, 55 per cent. being direct radiation........	.921	2.17	2.222	45	1st	14.37	31.45
					2d	29.87	9.27
					3d	10.76	4.28
Indirect radiation only................	.771	1.85	1.923	52	Not capable of averaging.		

per cent. to the first floor, thirty-two and fifty-nine-hundredths per cent. to the second floor, and thirteen and seventy-one-hundredths per cent. to the third floor, the largest proportion of surface on the first floor being sixty-five per cent., and the least or lowest proportion being forty-three and thirty-hundredths per cent.; to the second floor forty-one and fifteen-hundredths per cent. being the highest and twenty-four per cent. the lowest, and to the third floor the greatest proportion given is nineteen and seventy-hundredths per cent., and the least nine per cent.

In all the specifications fresh-air inlets were provided. While seventy-eight per cent. provided exits for foul air, twenty-two per cent. omitted any mention of these exits. The areas in square inches of the fresh-air inlets may be thus given: Eleven per cent. provided an average area of from nineteen hundred to twenty-one hundred square inches; eleven per cent. provided an average area of from twelve hundred to fourteen hundred square inches; forty-four per cent. provided an average area of from six hundred to eight hundred square inches; eleven per cent. provided an average area of from four hundred to five hundred square inches; twenty-two per cent. provided an average area of from thirty to two hundred square inches; the areas of the foul-air exits may also be summarized: Twenty-two per cent. provided an average area of from eight hundred to one hundred square inches; thirty three per cent. provided an average area of from four hundred to six hundred square inches; twenty-two per cent. provided an average area of from one hundred and fifty to three hundred square inches.

TABLE III.—COMPARISON OF ESTIMATES.

Cost of pipes and fittings..........	$180 to $185	$120 to $125	$60 to $80	$50 to $55	....	....
Percentage......	11	22	55	11	....	....
Cost of bronzing and decorating radiators and pipes	$18 to $20	$12 to $13	$5 to $7	....	....	....
Percentage......	22	11	22	....	....	....
Cost of covering pipes in cellar.	$110 to $115	$50 to $55	$20 to $30	$10 to $15	....	....
Percentage......	11	11	44	11	....	....
Cost of labor, pipe-fitting..........	$310 to $320	$130 to $140	$100 to $110	$90 to $99	$80 to $89	$50 to $55
Percentage......	11	11	22	33	11	11
Total estimates.....	$1,600 to $1,800	$1,300 to $1,400	$900 to $1,000	$800 to $899	$700 to $789	$600 to $699
Percentage......	22	11	33	11	11	11

In the fresh-air inlets forty-four per cent. averaged about fifty cubic feet of space to one square inch in the foul-air exits to about seventy cubic feet of space in the average of thirty-three per cent. of all the proposals, or about forty-three per cent. of those who gave sizes of foul-air exits. Cast-iron radiators are apparently more generally used than wrought-iron radiators, as sixty-six per cent. used the former, while only twenty-two per cent. adopted the latter, and eleven per cent. offered pipe coils. Forty-four per cent. used one and one-fourth-inch steam and one-inch return valves on all radiators direct or indirect, while twenty-two per cent. used one-inch valves on steam and three-fourths-inch valves on return on direct radiators having less than fifty square feet of surface. Forty-four per cent. gave no sign of steam or return valves on radiators. The system of piping most generally adopted was that known as the double pipe, that is, steam and return pipes from all radiators; fifty-five per cent. used this method, thirty-three per cent. used the same method to the first and the single-pipe system to the second and third floors, that is, one pipe instead of two to each radiator; and eleven per cent. used the single-pipe system throughout to all radiators, with main steam and return pipes in the cellar; eleven per cent. used one and one-fourth-inch pipes to the radiators in the single-pipe system, and the same percentage offered two-inch pipes in the same system. The main steam pipes were of various sizes, twenty-two per cent. used one three-inch main, the same percentage had two mains each of two and one-half inch pipe; eleven per cent. used one three and one-half-inch pipe and the same proportions had respectively two mains, one three-inch pipe and one two and one-half, and the other one two and one-fourth-inch pipe and two-inch pipe. The remaining thirty-three gave no definite information relative to the main steam pipes.

A two-inch main return was used by fifty-five per cent. of the competitors, one or two others used two and one-half inch return main, and the others gave no definite information about the sizes of return mains. Eighty-eight per cent. placed the main return below the water line in boiler. Check-valves on return pipes were used by twenty-two per cent., while only one provided any means to prevent water backing up in radiators. The position and style of finishing connections were only referred to in a casual way. Twenty-two per cent. mentioned the use of flange or other unions on main pipes, and only eleven per cent. specified ground unions or radiator-valves.

Boilers may be enumerated as follows: Wrought-iron boilers were used by fifty-five per cent., cast-iron boilers were used by thirty-three per cent., and eleven per cent. did not state of what material the boilers were to be made. Forty-four per cent. had brick-set boilers, while fifty-five per cent. used those of the portable type. Magazine coal feeders were provided with forty-four per cent. of the boilers. The following proportions are of interest.

Grate surface provided.	
6 and above 5 square feet by	22 per cent.
5 and above 4 square feet by	44 per cent.
4 and above 3 square feet by	33 per cent.

Boiler heating surface.	
200 to 210 square feet, by	11 per cent.
160 to 170 square feet	11 per cent.
140 to 150 square feet	33 per cent.
110 to 120 square feet	22 per cent.
90 to 100 square feet	22 per cent.

Square feet of boiler surface to one of grate surface.	
40 to 50	11 per cent.
30 to 39	22 per cent.
20 to 29	66 per cent.

Square feet of radiating surface to one of boiler surface.	
6 and above 5	44 per cent.
5 and above 4	44 per cent.
4 and above 3	11 per cent.

The use of automatic water-feeders was disapproved of by twenty-two per cent., and the same proportion of competitors did not mention them, while fifty-five per cent. specified and used them; sixty-six per cent. used automatic damper regulators and the others did not refer to them. Electrical thermostatic regulators were specified and used in addition to the common regulator by fifty-five per cent. Hardwood boards or marble slabs under radiators were only specified by eleven per cent. of the competitors, and automatic air valves with drip pipes were specified by fifty-five per cent., the others using hand air-valves or not definitely explaining what they did propose to use or making no reference whatever to them. The remaining items in these specifications which attract attention are the varieties of the estimated costs and the differences in the total estimates. The value of the pipes and fittings is variously estimated, the lowest being $50 and the highest about $185. The cost of decorating and bronzing radiators and pipes is mentioned as from $5 to $20, a proportion of forty-four per cent. giving no price. The lowest sum put down for pipe covering is $10 and the highest $115, and twenty-two per cent. give no estimate on this item. The cost of the labor connected with the pipefitting varies from about $50 to $320, and the total estimated value of the job goes from about $600 to $1,800. In Table III the estimates are compared in more detail.

The hot-water heating competition shows the following methods of heating used: Direct radiation only twenty per cent.; direct and direct-indirect and indirect radiation, ten per cent.; direct and indirect radiation, seventy per cent. The number of apartments and halls heated is thus given: Eleven apartments were heated by twenty per cent.; fourteen apartments were heated by ten per cent.; sixteen apartments were heated by twenty per cent.; seventeen apartments were heated by ten per cent.; eighteen apartments were heated by ten per cent.; nineteen apartments were heated by ten per cent.; twenty-one apartments were heated by twenty per cent.; hall on third floor was heated by direct radiation by forty per cent.; hall on second floor was heated by direct radiation by seventy per cent.; vestibule was heated by indirect radiation by twenty per cent.; main hall, first floor, by direct radiation only, fifty per cent.; main hall, first floor, by indirect radiation only, twenty per cent; main hall, first floor, by direct and by indirect radiation, twenty per cent. The back hall, first floor, was heated by direct radiation by thirty per cent. and by indirect radiation by ten per cent.; forty per cent. heated butler's pantry by direct radiation, and ten per cent. by indirect radiation. The kitchen is heated by direct radiation by thirty per cent., and by indirect by ten per cent.

From Table IV it will be ascertained that when direct radiation is used, forty-five per cent. of the surface is placed on the first floor, thirty-five per cent. on the second and twenty per cent. on the third floor, whereas, where indirect and direct radiation is used, the surface is proportioned to the floors, respectively fifty-three, thirty-one and sixteen per cent. Fresh-air inlets were provided by eighty per cent. of the competitors, and they gave the number of square inches in these openings; fifty per cent. had a total area of five hundred and twenty square inches, and thirty per cent. for the same had one hundred and sixty-three square inches, making an average of three hundred and forty-one square inches. Only thirty per cent. gave the areas of the fresh-air. openings to each floor, and these average one hundred and ninety-two square inches to the first floor, ninety-seven to the second floor, and forty-four to the third floor. Foul-air exits were specified by fifty per cent., some of the others referred to chimney flues as sufficient, while others made no mention of them. The average of the total areas of these exits is five hundred square inches. Cast-iron radiators were specified

CALUMET CLUB BUILDING.

ITALIAN ARCHITECTURE. ITALIAN-ROMANESQUE DETAILS.

by ninety per cent. of the contestants, ten per cent. using one-inch pipe coils; twenty per cent. used indirect pin radiators; sixty per cent. provided coils of one inch pipe for the indirect radiators; twenty per cent. gave no sizes of the flow and return connections to radiators; thirty per cent. used one and one-half and one and one-quarter to indirect and first-floor radiators, and one-inch to second and third-floor radiators; twenty per cent. had one and one-quarter, one and three-quarter-inch flow and return on first, second and third floors; ten per cent. had one-inch connections on all floors, and about the same number had one-inch connections to first floor, and three-quarters-inch to third floor. The materials used in the construction of the boilers or heaters were not in all cases described, and some omitted the size of grate. Forty per cent. specified cast iron, and twenty per cent. wrought-iron tubes in the boilers.

Grate surface provided.

6 sq. ft. and above 5 sq. ft., by	10 per cent.
4 square feet	40 per cent.
3 sq. ft. and under 4 sq. ft	30 per cent.

Boiler heating surface.

110 square feet to 120 square feet,	20 per cent.
80 square feet	40 per cent.
60 sq. ft. and under 80 sq. ft	10 per cent.

Boiler heating surface to 1 square foot of grate.

20 to 1	40 per cent.
15 and under 20 to 1	10 per cent.
30 and under 40 to 1	30 per cent.

Square feet of surface in radiators to 1 square foot of boiler heating surface.

7 to 1 and under 10 to 1	10 per cent.
10 to 1 and under 12 to 1	10 per cent.
13 to 1 and under 15 to 1	20 per cent.
15 to 1 and under 17 to 1	10 per cent.
17 to 1	10 per cent.

The main-flow pipes can only be compared by the number and a general reference to the sizes of pipes. Seven-flow pipes were specified in ten per cent. of the specifications, the largest and smallest of these pipes being respectively two and one-half and two inches; forty per cent. recommended six-flow pipes, the largest being two and one-half-inch pipe, and the smallest one and one-quarter-inch pipe; twenty per cent. proposed five-flow pipes, from two and one-half to one and one-half inches being the sizes, and twenty per cent. had four-flow pipes with three and one-half to two-inch pipes as the largest and smallest pipes used. Some used single mains, but the information is not sufficient to make a comparison of any value.

Marble slabs under radiators were specified by some twenty per cent. of the competitors, while thermostatic and automatic regulators were used by about the same number. The covering of the main pipes was specified by ninety per cent., while sixty per cent. connected the expansion tank to bottom of return pipe near boiler, forty per cent. connected to the return pipe of a radiator.

In comparing the estimated costs, it will not be possible to make detailed comparisons in all or the principal items, several having omitted detail prices and included different articles. From the separate prices given for the expansion tank, it is estimated as worth from $5 to $15.

The smoke pipe cost is placed as low as $2 by one, and as high as $10 by others. The estimates of the cost of radiation vary by those who give details from $227 to $570, while an average of all the prices given makes its value about $380. Pipes and fittings range from

$43 to $415, but it is possible something else is included in the highest one, because without it the average cost is $121. The estimated time required to do the pipe fitting is placed at from five to forty-eight days; an average of all the times proposed gives twenty-one days, while the cost is stated to be from $21 to $280, and when all the costs are taken an average of $121 is the result. An item in estimating which was very generally omitted was the cost of freight; only a few mentioned it, and it may be averaged at about $35. The total estimates varied from $775 to $1,725, and the average was $995, which is probably a fair sum at which to place the cost of heating such a residence by hot water.

TABLE IV.—HOT-WATER RADIATING SURFACES.

METHODS OF HEATING.	Number of methods compared.	Number of square feet of surface in radiators to			Number of cubic feet of space to 1 square foot of surface in radiators.	Distribution of surface in radiators on floors.				
		1 square foot of glass, or its equivalent.	1 linear foot of exposed wall.	100 cubic feet of space.		Floors.	Percentage of direct radiating surface.	Percentage of indirect radiating surface.	Percentage of direct-indirect radiating surface.	Total percentage.
1.—Direct radiation	20 %	0.986	2.333	2.453	41	1	45	......	......	......
						2	35	......	......	......
						3	20	......	......	.....
2.—Direct, direct-indirect and indirect radiation	10 %	1.351	3.190	3.256	30	1	31.5	2.35	......	55
						2	9.5	......	22	31.5
						3	7.5	......	6	13.5
Total	......	......	......	......	......	.....	48.5	23.5	28	......
3.—Direct and indirect radiation	70 %	1.243	2.938	3.030	33	1	23.3	29.7	......	53
						2	26.8	4.2	......	31
						3	13.7	2.3	......	16
Total	......	......	......	......	......	.....	63.8	36.2	......	......
4.—Subdivision of No. 3 comparison of direct and indirect radiation.	49 %	1.121	2.650	2.732	36	1	39	9	......	48
						2	35.5	......	......	35.5
						3	16.5	......	......	16.5
							91	9	......	......
	17 %	1.113	2.631	2.702	37	1	......	60.8	......	60.8
						2	24	......	......	24
						3	15.2	......	......	15.2
							39.2	60.8	......	......
	34 %	1.483	3.505	3.570	28	1	28.5	22.5	......	51
						2	22	10.5	......	32.5
						3	10.7	5.8	......	16.5
							61.2	38.8	......	......

The local manufacturers of steam and hot-water apparatus in 1869 were: A. L. Winne & Co., 114 Dearborn street, advertised their steam and hot-water heating apparatus, giving E. B. McCagg, Perry H. Smith, the Sisters of Mercy (Wabash avenue), William Bross, E. G. Hall, Alfred Cowles, Fred Tuttle, S. J. Surdam and N. S. Bouton as references. Each had the heaters in use.

Haythorn & Company's steam-heating works were here in 1872. O'Keefe & Clarke, S. I. Pope & Co., and Wells, Whitmore & Co. were also steamfitters with Baker, Smith & Co., Heron, Smith & Moocrs, A. L. Winne & Co. and A. A. Clark.

The manufacturers represented here in 1891 are named as follows: Backus Portable Steam Heater Company, Baker & Smith Co., E. P. Bates, A. M. Butz & Co., Caloric Ventilating Heater Company, the John Davis Company, Eclipse Manufacturing Company, Eureka Steam Heating Company, Exhaust Steam Purifying Company, Gorton & Lidgerwood Manufacturing Company, Albert Galloway Company, A. A. Griffing Iron Company, Gurney Hot Water Heating Company, William Haythorn, Sooy & Co., George D. Hoffman, Holbrook & Kane Company, Home Comfort Steam Heating Company, Instantaneous Water Heating Company, Theo. Jacobs Company, Kroeschell Bros., F. W. Lamb & Co., Michigan Radiator and Iron Manufacturing Company, D. F. Morgan Boiler Company, National Hot Water Heater Company, W. D. O'Brien, Gust. Olson, Ordway Heating and Ventilating Company, W. S. Patterson & Co., Pierce, Butler & Pierce Manufacturing Company, Pierce Steam Heating Company, Samuel I. Pope & Co., William P. Powers, L. H. Prentice & Co., Rice & Whitacre Manufacturing Company, Ruttan Manufacturing Company, Ruttan Warming and Ventilation Company, Safety Car Heating and Lighting Company, Smead Warming and Ventilating, Henry G. Sohn, B. F. Sturtevant Company, and E. J. Woodman.

The Master Steam and Hot-water Fitters of the United States is the name of an association chartered by the state of Illinois, April 12, 1889. On April 17 a preamble to the constitution was adopted in the form of a resolution, showing that the association is organized for protective, commercial and social purposes, and has for its special object the advancement of the trade in all the latest discoveries and science pertaining to the circulation of steam and hot water. The officers named in the charter were: John Davis, president; S. I. Pope, vice president at large; P. S. Hudson, corresponding secretary; George H. Reynolds, financial secretary; H. A. Kroeschell, treasurer; John Davis, S. I. Pope, P. S. Hudson, A. Galloway, F. W. Lamb, L. H. Prentice, C. H. Simmons, George H. Reynolds, H. A. Kroeschell, directors; L. H. Prentice, chairman; C. H. Simmons, F. W. Lamb, John Davis, C. H. Patton, executive committee; L. H. Prentice, Thomas Kavanagh, H. J. Ahern, James Murray, William Haythorn, legislative committee.

On September 10, 1889, the organization was effected at Chicago and the following-named officers elected: Charles J. Gillis, New York, president; Samuel I. Pope, Chicago, first vice president; A. B. Franklin, Boston, second vice president; H. D. Crane, Cincinnati, third vice president; George H. Reynolds, Chicago, secretary; H. A. Kroeschell, treasurer; D. F. Morgan, sergeant-at-arms; John Woodman, W. H. Cork, John D. Hibbard, W. D. O'Brien, G. D. Hoffman, J. L. Cook, Robert Gordon, George B. Cobb, Chicago, and J. O. Barrett, Joliet, were present with the Illinois members named above. In May, 1890, the association claimed two hundred and twenty-five members and sent delegates to the New York convention. The election resulted as follows: Samuel I. Pope, Chicago, president; Albert B. Franklin, Boston, first vice president; H. D. Crane, Cincinnati, second vice president; E.

Rutzler, New York, third vice president; George H. Reynolds, Chicago, secretary; Hermau A. Kroeschell, Chicago, treasurer; L. H. Prentice, Chicago; C. H. Simmons, Chicago; F. W. Lamb, Chicago; John Davis, Chicago; P. H. Hudson, Chicago, executive committee.

The Steam and Hot-water Radiator Manufacturers' association is a recent addition to trade organization. In May, 1890, its membership roll contained the following names: Michigan Radiator and Iron Manufacturing Company, Detroit, Mich.; Bartlett, Hayward & Co., Baltimore; Broomell, Schmidt & Co., (limited) York, Penn.; A. A. Griffing Iron Works, Jersey City, N. J.; Detroit Radiator Company, Detroit, Mich.; T. C. Joy, Titusville, Penn.; Crane Brothers, Chicago; Haxtum Steam Heater Compauy, Kewanee, Ill.; Exeter Machine Company, Exeter, Mass.; Gurney Hot Water Heater Company, Boston, Mass.; A. Harvey & Son, Detroit, Mich.; Hopson & Chapin Manufacturing Company, New London, Conu.; Haverhill Iron Works, Haverhill, Mass.; Mount Penn Stove Works, Reading, Penn.; Nason Manufacturing Company, New York; George K. Paul, Boston, Mass.; Pierce Steam Heating Company, Buffalo, N. Y.; H. B. Smith & Co., Westfield, Mass.; Walworth Manufacturing Company, Boston, Mass. The officers of the association are as follows: John R. Reed, of H. B. Smith & Co., president; Thomas W. Williams, of A. A. Griffing Iron Works, first vice president; George T. Coppin, second vice president; E. A. Sumner, of Detroit Radiator Company, third vice president; George L. Forman, of Crane Brothers, treasurer, and W. H. Oakes, of National Hot Water Heating Company, secretary. The executive committee consists of the president and the three vice presidents, together with Joseph Bond, of Pierce Steam Heating Company; John B. Dyar, of Michigan Radiator and Iron Manufacturing Company, and George Bartlett, of Bartlett, Hayward & Co.; Edward Gurney, of the Gurney Hot Water Heater Company, is couuselor.

The possibilities of the house furnace have been increased by the wizard of Menlo Park. In 1887 he presented to the American Association for the Advancemeut of Science his ideas of taking electricity directly from the fuel in the furnace and furnishing it for light to each room in the house. The machine, named the Pyromagnetic Generator, he completed in the fall of 1887, and changed what was prospective into that which is historical. It is true, as Edison stated, that the simple production of a potential difference by means of heat, is as old as Seebeck and Melloni. The science of thermo electricity thus origiuated has been developed by Becquerel, by Peltier, by Thomson and by Tait, and the thermo-batteries of Clamond and of Noe have found many important practical uses. The results already attained in these generators have stimulated research marvelously, and many investigators have believed that in this direction lay the philosopher's stone. His fellow-member, Moses G. Farmer, worked long and assiduously in this field, producing, it is believed, the most satisfactory results, as regards economy, which have ever been obtained. But even these results were not very encouraging. He never succeeded in converting one per cent. of the energy of the coal into electric energy. Quite recently, Rayleigh discussed the law of efficiency of the thermo-battery, from the standpoint of the second law of thermo-dynamics, and he concludes that for a copper-iron couple, working between the extreme limits of temperature possible for these metals, a conversion of not more than one three-hundredths part of the coal energy can be hoped for. While, therefore, as a heat engine, the thermo cell appears to follow precisely the law of Carnot, and hence may have a theoretical maximum efficiency equal to that of the reversible engine of this eminent philosopher, yet, in practice, its efficiency falls very far below this theoretical maximum.

The effect of heat on the magnetic metals, such as iron, nickel and cobalt, has been demonstrated by M. Becquerel. The metals named lose the power of being magnetized at various heats, iron losing it at a deep red heat, cobalt at a white heat and nickel at 400 degrees. Thus, if within a magnetic circuit an iron core be placed, and the magnetic capacity of that core varied by lowering or raising its temperature, an electric current may be generated through the wire encircling the iron core. The utilization of the variation in this magnetic capacity by heat is the problem which Edison solved by use of electro-magnets, in lieu of permanent magnets in the motor machine.

The new machine consists of eight distinct elements, each consisting of the two legs of an electro-magnet somewhat far apart (twelve inches actually), having at one end the ordinary yoke, and at the other a roll of corrugated sheet iron five-thousandths of an inch thick, called an interstitial armature, this armature having a coil of wire wound upon it and separated from direct contact by means of asbestus paper. The eight elements are arranged radially about a common center, and are equidistant, the eight interstitial armatures passing, in fact, through the iron discs, which constitute the common pole piece of all the electro-magnets. The coils wound upon the interstitial armatures are connected directly in series, the whole forming a closed circuit. Through the center of these discs a hollow vertical shaft passes, carrying at its lower end a semicircular plate of fireclay called a guard plate, which, when the shaft is turned, revolves close to the lower ends of the sheet-iron armatures and screens off half of them from the access of heat from below. The shaft carries a cylinder of insulating material having metallic contact pieces let into it on opposite sides, the line joining them being parallel to the straight edge of the guard plate. Upon this cylinder eight springs press, each of these springs being connected to the wire of the closed circuit above mentioned midway between the coils. The length of the metallic segment is so proportioned that the following spring touches it just as the preceding one leaves it. The springs themselves are so adjusted that each of them comes into contact with its metallic segment just as the preceding coil of the pair to which it is connected is uncovered by the rotation of the guard plate. Upon the same shaft, and above the cylinder just mentioned, a pair of metallic rings are placed, insulated from the shaft, to each of which one of the metallic segments is connected. Brushes pressing upon these rings take off the current produced by the generator.

The entire machinery now described is placed upon the top of any suitable furnace, fed by a blast, so that the products or combustion are forced up through those interstitial armatures which are not covered by the guard plate, and raise them to a high temperature. The field magnets, when charged, magnetize, of course, only those interstitial armatures which are cold, i. e., those beneath the guard plate. On rotating this plate, the interstitial armatures are successively uncovered on the one side and covered on the other, so that continually during the motion four of the eight armatures are losing heat, and the other four are gaining heat. But those which are losing heat are gaining magnetism, and vice versa. Hence, while currents are generated in all the armature coils, since in all the magnetism is varying, the current in the coils beneath the guard plate will be in one direction, while that in the coil exposed to the fire will be in the other. Moreover, whenever an armature passes out from under the guard plate, its condition at once changes; from losing heat and gaining magnetism it begins to gain heat and lose magnetism. Hence, at this instant the current in its coil is reversed, and, consequently, the line connecting this coil with the one opposite to it constitutes the neutral line, or line of commutation, precisely as in the ordinary dynamo. Indeed, the action of the interstitial armature coils of the pyromagnetic dynamo resemble strongly that of the ordinary armature coils of the Gramme ring, not only in the manner of connecting them together, but also in their functions, the change of direction in the current as the magnetism of the field changes sign in the latter case, corresponding closely to the change of current in the former case due to the direction of the temperature change. But it will be observed that while in the Gramme ring the loops between the armature coils are connected to commutators segments equal in number to that of the coils, upon which commutator two brushes press, in the pyromagnetic dynamo the loops between the armature coils are connected to an equal number of brushes (in this case eight), while the commutator segment are only two in number, so that the functions of the commutator and the brushes in this generator are, in a certain sense, reversed as compared with the ordinary dynamo.

The potential difference developed by this dynamo will obviously depend (1) upon the number of turns of wire on the armature coils; (2) upon the temperature difference in working; (3) upon the rate of temperature variation, and (4) upon the proximity of the maximum point of effect. No advantage will be gained, of course, by raising the temperature of the interstitial armature above the point at which its magnetizability is practically zero; nor will it be advantageous on the other hand to cool it below the point where its magnetism is practically a maximum. The points of temperature, therefore, between which for any given magnetic metal it is most desirable to work, can be easily determined by an inspection of the curve showing the relations between heat and magnetism for this particular metal. Thus, the points of temperature at which the magnetizability is practically zero, as above stated, are a white heat for cobalt, a bright red for iron, and 400 degrees for nickel. On the other hand, while at ordinary temperatures iron has a maximum intensity of magnetization represented by thirteen hundred and ninety, its intensity at 220 degrees is thirteen hundred and sixty; and, hence, no commercial advantage is gained by cooling the iron below this temperature. Nickel, however, whose maximum intensity of magnetization at ordinary temperature is eight hundred, has an intensity of only three hundred and eighty at 220 degrees. Hence, while this metal requires a lower maximum temperature it also requires a lower minimum one; but it may be worked with much less heat. The rate of the temperature variation is determined by the rapidity with which the guard plate revolves; and this in its turn is dependent upon the rapidity with which the interstitial armature can be cooled and heated. That it may take up and lose heat readily, the sheet iron of which it is made is very thin (only five-thousandths inch thick even when its durability is increased by enameling or nickeling); it is corrugated and rolled up so as to expose a large surface (about sixty square feet for the eight armatures), and hot and cold air are alternately forced through the armature. Experiments already made show that the guard plate can probably be made to revolve one hundred and twenty times a minute. Since the potential difference is proportional to the number of lines of force cut per second, it is evident that by doubling the speed of rotation, twice as many lines of force would flow across the generating coils per second, and the output of energy would be quadrupled. Exactly what thickness of metal is the most suitable for the purpose, what the relative volume occupied by metal and by air space in the interstitial armature should be, what is the best diameter for this armature, or even the best metal, what the best limits of temperature and what the best speed of rotation to produce the maximum potential difference, all these are questions which must be decided by experiments made upon the generator itself.

The results thus far obtained lead to the conclusion that the economy of production of electric energy from fuel by the pyromagnetic dynamo will be at least equal to and probably greater than that of any of the methods in present use. But the actual output of the dynamo will be less than that of an ordinary dynamo of the same weight. To furnish thirty sixteen-candle lights in a dwelling house would probably require a pyromagnetic generator weighing two or three tons. Since, however, the new dynamo will not interfere with using the excess of energy of the coal for warming the house itself, and since there is no attendance required to keep it running, there would seem to be already a large field of usefulness for it. Moreover, by using the regenerative principle in connection with it, great improvement may be made in its capacity, and its practical utility may very probably equal the interesting scientific principles which it embodies.

In his work on warming buildings, Hood gives a fair duty for hot-air furnaces, three hundred and twenty-two thousand feet of air heated 1 degree Fahrenheit, with a pound of coal. This represents a utilization of about six thousand eight hundred heat units per pound, or an efficiency of fifty per cent. He also mentions a practical case where five hundred and thirty-six thousand feet of gas were heated 10 degrees Fahrenheit, with two hundred and twenty-five feet of coal gas without a flue. The quantity of coal required to do the same work was sixteen pounds. Without the flue the gas did about half the above work, or two hundred and twenty-five feet represented eight pounds coal.

The air in a room can be warmed with an incredibly small consumption of gas, particularly if the required quantity is burned rapidly and the products of combustion are not permitted to escape: whereas, in order to warm the whole building and provide for heat lost by radiation and ventilation, the consumption of gas would be so great that only a nominal price could be afforded.

Investigations in regard to radiation of heat at high temperatures have shown that the rate increases enormously with increase of temperature. By applying a formula that has been found rigidly correct up to temperatures of about 600 degrees, Box estimated that while the radiation at 1,680 degrees was represented by three hundred, the loss of heat at 2,580 degrees was forty-six hundred. Now, since the flame temperature of water gas is considerably higher than that of coal gas, it is not unreasonable to expect it to develop a higher rate of practical efficiency.

One-quarter of a foot of common coal gas contains energy enough to boil a pound of water. The work can be done in practice with half a foot; while to start a fire and do it with coal, probably not less than a pound of it will be required. The heat energy of the coal is fifty times that of the gas, and the gas would be cheap at the cost of a corresponding quantity of coal.

On the other hand, if a ton of water were to be boiled with gas, it would be difficult to increase the rate of efficiency above seventy-five per cent., or to use less than seven hundred and fifty feet, whereas fifty pounds of coal, costing seven and a half cents, would be sufficient.

In generating steam with natural gas as fuel, the evaporative duty, under favorable conditions, has been as high as a pound of water for one and thirty-five-hundredths feet of gas; or an efficiency of eighty per cent. of the energy of the fuel. With coal an evaporative duty of twelve pounds of water per pound is not at all uncommon, and eight to ten ought reasonably to be expected.

An average of twelve different trials with common boilers, mentioned in Box's treatise, gives seven pounds as the quantity of water evaporated to steam at working pressure per pound of coal consumed. This represents an efficiency of about fifty per cent.

What the future has in store for househeating can not be determined. Electricity may prove its capabilities in this matter. The inventor who succeeds in making such a practical application will not be at a loss to find abundant employment for his device. Although nearly all the inventors along this line have sought to make an electric heater which would primarily be suitable for the heating of railroad cars, there is no reason why a successful heater of this kind should not have a much wider application, and come into general use. When the time comes, and it surely is coming, when electric heat can be developed for heating buildings at a cost comparable with other methods of heating now employed, the commercial distribution of electric heat will become an industry second only to that of electric light and power. When offices, parlors and drawingrooms can be warmed with no other effort on the part of occupants than the turning of a switch, when meals may be prepared on an electric cooking stove men shall have reached a point of maximum utility, convenience and cleanliness in heating as they already have in arrangements for lighting. The abolition from dwelling houses of the ordinary bulky stove with its attendant coalbin and ashheap is as much to be desired as is the absence of the kerosene lamp. Just as the introduction of the electric light has made the danger from fire much less than with other methods of lighting, so the replacement of fire in stoves by the electric heater would reduce still further and indeed almost abolish the danger from within of destructive fires.

The question of transforming all fuel into gas and supplying this gas to the home, store and factory is now settled. The system is in force in a few factories, and its extension awaits enterprise.

The nature of fire is a question which bears on the subject of heating. Few persons could answer the question off-hand, although the phenomenon of combustion is perfectly familiar to every one. The ancients considered fire to be one of the primitive elements, like earth, air and water—all of which last we know to be compound and not elementary substances—and this idea of an elementary fiery principle survived under the name of phlogiston, caloric, etc., down to the time of Lavoisier, and was not entirely overthrown until after the beginning of the present century. Fire is a phenomenon. It is not a substance; it is not even an immaterial force, like light or heat, but, as generally understood, is simply the sensible phenomena of light and heat resulting from an intense reaction, generally, but not always, a process of oxidation. You may dissolve a piece of zinc in sulphuric acid by itself, or do the same when it forms the pole of a galvanic battery, or, you may heat it until it bursts into flame. In all these cases the process is a similar one, that of oxidation, but fire accompanies the process only in the last. There the oxidation takes place so rapidly that the heat set free is only sufficient to be detected by the nerves of sensation, but the resulting particles of zinc oxide are heated to such a degree that they become luminous. So, if finely divided metallic iron is exposed to the air, it gradually absorbs oxygen and is converted into rust. But if the same iron is ignited with a match it takes fire, becomes luminous, smoulders away like a glowing coal and is soon converted into a similar oxide or rust. Just as much heat is set free in one case as in the other, the only difference being in the rapidity of its development, which determines whether or not it shall become evident to our senses. When hydrogen and oxygen gases are burned together, as in the oxyhydrogen blow pipe, the resulting flame, although one of the hottest known to us, is almost invisible, and to the eye alone there is no appearance of fire; but introduce a piece of metal or a lump of lime, or other refractory substance, and the brilliant, luminous phenomenon at once indicates the intensity of chemical combination which is taking place.

Fire is not always dependent upon a process of oxidation. A mixture of iron filings and flowers of sulphur is readily ignited, forming ferrous sulphide, and sodium, potassium, copper and some other metals readily burn in the vapor of boiling sulphur, giving rise to the same ingenious manifestations as when they combine with oxygen. Nitrous oxygen or laughing gas also supports combustion, although the reaction is one of true oxidation, the same as with pure oxygen or air.

A very important distinction must be drawn between fire and flame. The latter is merely an incidental manifestation of the former. Burning charcoal simply glows and wastes away; there are no combustible gases formed, and chemical reaction takes place only on the surface of the coals. With wood, oil, wax, tallow, etc., the heat produced from the oxidation sets free from the unconsumed portion a large quantity of hydrocarbon gases, which take fire and burn at a distance from the original burning body, exactly as the gas which we burn in our houses is driven off by heating the coal at a distant gas works. If we burn a piece of magnesium, flame is apparently present, but it is only the incandescent particles of oxide as they fly off into the air at a white heat. A similar artificial heat may be made from charcoal itself, by finely pulverizing it, throwing the dust into the air and igniting it. Serious explosions have occurred by dust igniting in this manner, but such phenomena are not, strictly speaking, true flames, which are only produced by the combustion of gases.

A word should be said in reference to electric lights, which are simply masses of carbon heated to an excessively high temperature. There is no true fire or oxidation about them, but a transformation of electric energy into heat and light. There is an oxidating process at the foundation however, and the heat of the oxidizing carbon in the furnaces under the steam boilers which furnish the power to drive the dynamo machines is just as truly transferred through the wires to the distant electric lights as the water from the pond or stream is transferred through the pipes to the dwellings of the city. In one case it is the transference of energy, in the other that of matter.

The knowledge of fire is a distinct attribute of mankind. No ape, however intelligent, has been found but what regards it with terror, and no race of men—with, perhaps, one or two doubtful exceptions—but what enjoys its numerous benefits. It is hard to say how it was first brought to the knowledge of mankind. The Greeks considered it a direct gift from the gods, but, disregarding that belief, the lightning stroke, the volcano, an accidental spark from the striking of a stone falling upon dry leaves, or even, as has been suggested, by a drop of gum exuding from a tree acting as a natural burning glass, any or all of these causes may have introduced this useful but dangerous servant to mankind. Once discovered, the knowledge seems to have been carefully preserved, and the art of producing fire has advanced through the fire sticks and drills of the savage to the flint and steel and friction matches of latter times, until, in this modern age of electricity, a touch of the finger is sufficient to produce an electric spark which will instantly ignite the fire and gas lights of the largest building, or, if desired, those of an entire city.

In houses where gas is not wholly used, it may be made an efficient aid to coal fires. In the present competition between gas and electric lighting laudable efforts are being made to extend the use of gas for heating purposes, and among these its application to the domestic fireplace has been attempted on a somewhat extended scale. The usual plan is to abolish the ordinary firegrate and to substitute a special apparatus in which jets of coal-gas mixed with air are allowed to play on pieces of asbestus or pumice stone, which, after a time become heated, and so radiate off heat into the room. About 1880 the late Sir William Siemens, whose name is so eminent from his wonderful heat inventions, took up the subject as one of great public interest. It was first described by him in an article in *Nature*, November 18, 1880, having the title of "A new cure for smoke." In his later years he was constantly urging the use of gaseous fuel, and after describing the advantages he had realized with it in manufactures, he said: "There seems no a priori reason why analogous results should not attend its application on a smaller scale, even down to the means of heating our apartments, which, although a small application in each individual instance, amounts in the aggregate to the largest of all the uses of mineral fuel." He had, of course, studied the gas fires above alluded to, but he remarked that they were very expensive, both in construction and in gas consumption, gave insufficient warmth, were cheerless in appearance, produced heat of an unpleasant character, and often gave out disagreeable smells. His thoroughly practical mind and great experience led him to go upon a different tack. He saw that a far more likely plan to succeed was to retain the general plan of the ordinary fireplace and fuel, but to bring in gas as an adjunct to it, and he accordingly devised a plan for this purpose. It should be explained that at that time the smoke abatement movement was active, and as the title of his paper showed, he made his invention conform to that object. He proposed to construct a grate in which jets of ordinary coal-gas should play among coke, the combustion of the two going on together, and being supplied by a peculiar contrivance with heated air. Thus was formed a smokeless fire of great heating power. Many were made under the inventor's directions which answered perfectly, and it is strange that enterprising manufacturers have not thought it worth while to promote their sale more generally.

The hot-air provision requires an entire reconstruction of the lower part of the fire-grate. This is rather expensive, and good housewives object to the mess and trouble of such changes. Moreover, the arrangement offers some obstruction to the free removal of the incombustible residue of ash, which, with ordinary gas-coke, is sometimes very considerable, and the retention of which impedes combustion and spoils the brightness of the fire. The simplified plan leaves the grate exactly in its original state, just as made for an ordinary fire. Then all that is to be done is to put at the front of the grate, between the two bottom bars, a piece of iron gas-tubing pierced with a few holes pointing obliquely upward, so as to throw, when supplied with gas, jets of flame into the body of the fire. This is an exceedingly simple thing, and, if gas be already laid in the room, a gasfitter may do it in a few hours and for a few dollars, without giving any trouble whatever. The holes may be about the size of a knitting-needle, and one and a half inches apart. And there must, of course, be a cock placed in an accessible position to turn the gas on or off or to regulate it at pleasure. This is Siemens' gas-aided domestic fire, for it is really in every respect an ordinary fire, only with the power of aiding it when desired by Siemens' gas flames. Now, let it be seen what this aid is worth.

In the first place, it enables coke to be used. This is a better fuel in many respects than raw coal; it makes a steadier, more compact and more enduring fire, and gives out no smoke or soot. It is difficult to keep coke alive in an ordinary grate, unless the burning mass is large and the draft powerful, but with the addition of the gas it burns perfectly in any quantity, and in fact, as is well known, the gas resupplies to the coke the hydro-carbons which had been abstracted in the gas-works and so restores the original elements of the fuel, but in an improved and refined form. It is found, however, that it is advantageous to have a small supply of coal to use in addition to the coke, by which the use of the gas may be much lessened, and, indeed, often stopped altogether, as the mixed fuel will make an excellent, pleasant and economical fire without it. A little experience will soon give instruction on this point. It is worthy of notice that the coal when burnt in combination with the coke and the gas makes much less smoke than when alone. This is easily accounted for. The cause of the production of so much smoke from the coal in an ordinary grate is the low temperature at which its decomposition is effected; here the particles of coal are enveloped in hotter surroundings, and the combustion is more complete.

The reduction of smoke from the fire is not only a contribution to the general smoke abatement movement, but it is an advantage to the householder himself. It diminishes the spread of dirt in the room (for it is seldom that all the products of the fire go perfectly up the chimney), and it either abolishes, or at least much lessens, the frequency of the great nuisance of chimney-sweeping.

The gas gives the facility of lighting the fire at any moment without the usual laying of wood and paper. This laying is ordinarily an enormous domestic trouble, involving the previous emptying and cleaning of the grate, and it is often most annoying, when a fire is unexpectedly wanted, to have to wait while the operation is being performed. It is often a chance, too, whether the fire will ignite or not, and if it does not, it has to be laid over again. But with the gas, nothing need be done but to put fuel in the grate and turn on the gas, when the lighting of the fire is speedy and certain. A very common case, when this power proves of great advantage, is when a little fire is desired in a bedroom on going to bed at night, and again on getting up in the morning. After the night's use, the ordinary fire must be laid again before it can be lighted the next day, which is so great a trouble as usually to forbid the practicability of the arrangement. But with the gas addition, nothing can be easier.

With this plan a fire never need go out; a little of the gas aid will suffice to check this proverbial natural tendency, and the fuel will go on burning until exhausted, and even then the gas will keep the grate warm. Hence stirring or poking the fire becomes a work of supererogation, or, at least, is only wanted at long intervals to help the exit of the dead ashes through the bottom grating.

With this arrangement, the grate need never be emptied, except occasionally for housewifely cleaning. With the ordinary fire, it is customary to empty the grate before every new laying, when a great deal of valuable fuel, in the shape of cinders, goes to the dusthole. With the gas arrangement, all that is necessary is to rake out the incombustible white ash, leaving the carbonaceous cinders behind to be burnt with the new fuel. This is a great source of economy.

The gas gives altogether a new power over the fire, namely, that of its regulation according to what is wanted. This with an ordinary fire is impossible, except in a very imperfect and extravagant way, but only experience can give an idea what an admirable and delicate power of adjustment is given by the little gas-tap. It is not so much the gas itself that is regulated as the influence of the gas upon the fuel. It acts as a sort of blow pipe; when full on, the combustion is highly active, but the stimulus can be lowered to any extent or entirely withdrawn. The combined use of coal and coke greatly facilitates this power of regulation. If this fire is required to be steady for a considerable time, a judicious mixture of the two fuels, with just a soupcon of the gas to prevent any tendency to go out, will give a far steadier and more durable fire that the ordinary one; but if it is wanted only for a short time, and then to be lowered, it should be chiefly coke and gas, which will be more sensitive. Suppose, for example, the case where a room has to be left for some hours, the fire not being wanted, the gas can be turned so low that the fuel will scarcely consume at all, but still will remain so hot that on coming to the room again and simply turning on the tap, in a few minutes the fire will be fully restored. For bedrooms, in cold nights and most especially in cases of sickness, such a convenience is invaluable. A low fire burning steadily all night, with a kettle of water on the trivet, would often be found a great blessing. And there are numberless other cases where a small fire, which will burn for a long time without attention and without danger of extinction, would be most desirable. This can not be obtained at all under the ordinary regime, but with the Siemens' and similar arrangements it is the simplest thing possible.

The gas arrangement may be made of great use even without the fire. In winter, when several fires are burning and doors and windows are closed, the whole atmosphere of the house becomes subjected by the action of the fires to a slight exhaustion, and every chimney where there is no fire is liable to have a down-draft into its room, bringing with it dirt, foul air and smells from adjoining chimneys. The usual remedy is to shut the register, if there be one, but this is only an imperfect provision, as it is never anywhere near tight. In this case a slight use of the gas alone will keep a proper current up its own chimney and give a gentle warmth in the room at very little cost and no trouble to anybody.

Then, even in summer, the gas is still useful. Everybody knows that a chimney is the ordinary and often the only ventilator for rooms; but in summer when there is no fire, the chimney having no motive power to give it a current, does not act. In this case, as in the last mentioned, the gas may be used to give a current up the chimney, a screen being provided and hung on the front of the grate, like a fire-guard, to prevent the heat radiating into the room. This arrangement accompanied by a window open an inch or two at the top will insure a gentle but most healthy change of air being constantly kept up in the apartment night and day. Moreover, the gas is then at hand, always ready for any accidental heating purpose that may be required.

It seems to me that a fire which has all these capabilities becomes an object more worthy of intelligent care and attention than formerly. An ordinary fire is considered a rough, coarse thing, only fit to be left to the clumsy treatment of housemaids, except when the authorities may choose to amuse themselves by poking it, either from the bottom or the top, as the sex may determine. But in this contrivance there is really something interesting to observe, and something intellectual to do, which will well repay a little thought and skill; while at the same time there is no compulsion in the matter, and if it be not done the house is no worse off than before.

It will naturally be asked at what cost all these advantages can be gained. As already stated, the outlay for the construction is exceedingly small. There is only a word or two to be added about the current expenditure. In the first place, this must naturally be much less than for the asbestus or pumice-stone gas fire, in which the whole heat must be furnished by the gas, seeing that in the plan here recommended the coal and coke form the efficient fuel, to which the gas is only a subsidiary aid. In a grate of moderate size the six jets when blazing fully on will consume about twenty cubic feet of gas per hour; but this is only exceptionally necessary, to light or quickly to strengthen the fire. The gas is often shut off entirely, and it may be estimated that ten feet make an ample average. This will cost about one and one-third cents per hour.

This would not be a very high price to pay for the advantages named, but it must be recollected that there is a large set-off to be made for savings. In the first place, there is the use to a large extent of coke, which is more economical than coal, and then there is much economy in the saving of the cinders, in the easy regulation of the fire, according to demands, particularly in keeping it low, and still more in the power of extinguishing it when not wanted, with the option of lighting it again at a minute's notice. These savings can not be put in definite money value, but they will certainly reduce materially, if not cancel entirely, the cost of the gas. Some people have thought that the small holes would soon be stopped up by fine ash. Experience negatives this fear, and it would seem that generally the current of gas through them suffices to keep them fairly open. It is, however, desirable to have a bent pick at hand, by which they can be cleared in a moment, and the tube itself should be connected by a screw so that it may be removed occasionally to be cleaned, or may be replaced when burnt or worn away. To sum up, the addition of the gas aid to the fire has many great advantages for cleanliness, convenience and usefulness in domestic economy. It is no patent, no monopoly; it requires no new grate, but only a small addition to the ordinary one which any good gasfitter can fix quickly and at small expense. It does not interfere with the use of the grate in the ordinary way. The increased expenditure for gas is very small and is largely compensated for by increased economy of fuel in many ways.

House ventilation is as necessary to health as house heating is to comfort and convenience. The ventilation of buildings antedates civilization, for the barbarians of the earliest ages understood its value as they did that of light and heat. It is true that they did not distinguish to a nicety between ventilation and air currents, they simply appreciated fresh air and obtained it without regard to science or art, just as the Massachusetts man does. He says the way to ventilate is, to ventilate, and all fine theories and elaborate scientific mechanism for bringing within reach of the lungs the fresh air that heaven bestows in such measureless quantities are of little value without ventilation, until people let the outside air come in and the inside air go out, a change that will take place fast enough whenever there is a chance for it. A broken window pane is not the worst kind of a ventilator if it happen to be at the farther side of the room, and of all sleeping apartments for moderate weather none are better than the attic chamber, where you can not only listen to the patter of the soft rain on the roof, but through the chinks of which you can see the stars shining when the human shadows have dispersed. Doubtless, there is a choice of methods, but the thing to be done is so simple and plain that it need never be misunderstood. The science of ventilation, as applied to inhabited interiors, belongs to the moderns, and was little understood or practiced until comparatively recent times.

Although several cities in Greece were preserved during a pestilence by Hippocrates, and great cures were effected by Varro, by ventilating the houses through opposite apertures—and the ancient Romans were adepts in regulating the temperature of the Laconicum, or sweating stove, of their baths, by placing an opening at the highest point of the ceiling, and regulating the exit of air from this opening by means of valves, they were far from the idea which now obtains in the great centers of the United States, or even in Rome at the close of the fourth century of the present era. In 1800 the Normans introduced a system of ventilation into England. This system resembled an inverted funnel in the roof of churches and halls, and six hundred years after Christopher Wrenn introduced a similar contrivance in the public buildings designed by him after the great fire of London.

So far as appears, the sole motive power depended upon for inducing velocity of upward discharge in these short truncated cones was the warmth contained in the products of respiration and combustion, as they rose to the ceiling of the house, and no means seem to have been provided in the outlet apparatus for insulation and prevention of condensation. It is not surprising, therefore, that the action of the pyramidal funnels, when their valves were opened, was found to be frequently the reverse of what was intended, and that the current, instead of moving in an upward direction, and thus carrying off the used and vitiated air, turned downward, causing showers of cold air, mixed with refrigerated impure air, to descend, to the discomfort and danger of those who sat beneath. No special provision appears to have been made for introducing the fresh air, which was left to be supplied on the system, or absence of system, still widely prevalent, by open or imperfectly fitting doors and windows. This and similar expedients, then and subsequently brought into extensive use, were crude and far from satisfactory means for renewing the atmosphere of inhabited interiors, but they were a great improvement on the previous total absence of ventilation; while the advantages we possess in advanced knowledge of chemical analysis, quantitative and qualitative, and of the science of atmospheric law and kindred subjects were not at the service of the authors of these crude methods, nor of those following them for a long period.

The growth of ideas of ventilation has been rapid within the last decade. A hundred devices for the introduction of live air and the expulsion of foul air have been brought into notice, and the work still goes forward.

The *Courier of Medicine*, St. Louis, in noticing a new system of treating and ventilating, describes it thus: "There are placed in the basement of the building large heaters, or, more properly, air warmers, varying in number according to the size of the building. These are built of heavy iron, so as to be durable, and are patterned after the locomotive boiler, tubular, so as to furnish a large radiating surface and retain the heat of the burning fuel as long as possible. To them the outside air is fully admitted. It is heated to a temperature of about 125 degrees, and rises through brick flues to the schoolrooms above, entering through ample registers. These are so arranged that the teacher can, by simply moving a hand upon a dial, regulate its admission to this extent. She can admit the hot air as it comes from the heater, or can partially or wholly shut off the hot air and admit an equivalent amount of cold air, but she cannot lessen the influx of air into the room. The fresh warm air rises to the ceiling, gradually forcing downward the air contained in the rooms, and out through ventilators placed under the windows. This position is chosen for the ventilators because there is always more or less downward movement of air there, as the windows are never completely air-tight, and the air in contact with them is cooled from the outside. This air, now contaminated, but still at a temperature of 60 to 65 degrees, passes directly under the floor, which is laid on furring strips on purpose to afford space for this. This keeps the floor always dry and warm. In the basement there are foul-air gatheringrooms, from which the air passes to the ventilating flue built in the smokestack. Another feature of the arrangement for this school is the disposal of the closets. These are placed between the foul-air gatheringrooms and the ventilating shafts, and are so arranged that the warm, dry air passes through the closets over the deposits on its way to the ventilating shaft, and as it sweeps up the big chimney, carries with it all the moisture and bad odor of the excreta, leaving behind it only a small quantity of inodorous material, which may readily be thrown upon the fire in the furnace and burned, without causing any bad odor or characteristic smell at all. During the summer months a free circulation of air is secured by small furnaces built in the base of the smokestack."

Gas jets may be made important auxiliaries to ventilation. Inserted in the bottom of air shafts, they establish active currents which withdraw the vitiated air, and may be made especially useful on occasions when apartments are unusually crowded. It has been proven by experiment that one cubic foot of illuminating gas can be utilized so as to cause the discharge of one thousand cubic feet of air, and as a common gasburner will consume nearly three feet of gas an hour, it would extract from an apartment three thousand cubic feet of contaminated air during that period. By suitable contrivances also, the gas lights, which usually are such active causes of deterioration, may not only be made self-ventilating, and carry off their own impurities, but also aid materially in keeping pure the air of inhabited apartments. Inventors have made successful contrivances for ventilating the burners of chandeliers, but they have hitherto not received the attention they merit.

From the "Annals of hygiene" supported by other authority it is learned that in each respiration an adult inhales one pint of air. A man respires sixteen to twenty times a minute, or twenty thousand times a day; a child twenty-five to thirty-five times a minute; while standing, the adult respiration is twenty-two, while lying, thirteen. The superficial surface of the lungs, i. e., of their alveolar or cell space is two hundred square yards. The amount of air inspired in twenty-four hours is ten thousand litres (about ten thousand quarts). The amount of oxygen absorbed in twenty-four hours is five hundred litres (seven hundred and forty-four

BLAIR APARTMENT HOUSE.

COLONIAL ARCHITECTURE. QUEEN ANNE ORNAMENT.

grams), and the amount of carbonic acid gas expired in the same time, four hundred litres (nine hundred and eleven and five-tenths grams). Two-thirds of the oxygen absorbed in twenty-four hours is absorbed during the night hours from 6 P. M. to 6 A. M. Three-fifths of the total carbonic acid is thrown off in the day time. The pulmonary surface gives off one hundred and fifty grams of water daily in the state of vapor. An adult must have at least three hundred and sixty litres of air an hour. The heart sends through the lungs eight hundred litres of blood hourly, and twenty thousand litres, or five thousand gallons daily. The duration of inspiration is five-twelfths, of expiration seven-twelfths, of the whole respiratory act; but during sleep inspiration occupies ten-twelfths of the respiratory period.

The report of Drs. Sequard and d'Arsonval to the Academie des Sciences, at Paris, on their discovery of poisonous principles in water condensed from respired air proves the value of thorough ventilation. They have shown that this poison, be it simple or multiple, which accompanies expired air, is able, in small quantities, to kill even without being directly injected into the blood. This toxicity is not due to the presence of microbes in the pulmonary liquid, for the same effects are produced by it after having been subjected to a temperature of 100 degrees Centigrade in a closed vessel. Many experiments have been made to determine the action of the pulmonary poison as it exists in respired air mixed with pure air, the results of which have completely confirmed what has been learned respecting this poison by other methods. An apparatus has been used for this purpose, which, while showing the poisonous property of respired air, has also permitted it to be demonstrated that the carbonic acid of this air has nothing to do with its toxicity.

The apparatus consists of a series of metallic boxes connected with each other, but shut off from the outer air by sealed joints. An aspirator connected with a gas meter draws a measured current of air through the series of boxes one after another. It consequently follows that an animal shut up in the first box breathes pure air, while others inclosed in successive boxes must breathe air more and more vitiated. Every care is taken to provide for the drainage of the boxes. It was found that animals shut up in these boxes died sooner or later, according to their distance from the fresh-air box, although the proportion of carbonic acid never became more than two or three per cent. of the air which proved most deadly. Pure carbonic acid in the proportion of twenty per cent. of the air was breathed by the same animals with impunity. Also when the pulmonary poison was arrested by passing the air containing it through a washing chamber charged with concentrated sulphuric acid, which would not have any effect upon its carbonic acid, the toxic quality disappeared. Hence, it may be deduced that the atmosphere of all badly ventilated rooms occupied by men or warm-blooded animals, is charged with an unknown active poison which would kill all the inmates if they remained long enough under its influence, and even in a short time affects their health.

The smokestack and fuel-consuming system of Chicago were designed for the benefit of laundry owners, druggists, physicians and painters. It is a system of indirect robbery, disguised under its own clouds, an insinuating enemy of cleanliness and health, which even the

Q

law can only master after its most severe application. Andrew Young, writing in July, 1891, says: "I observe that the smoke inspectors of this and other cities are proceeding legally against those who continue the smoke nuisance. This is right, and should be sustained by the citizens in every way possible. If there were no means of abating the smoke, or if such means were costly or of such nature as to work a hardship, then it might be indefensible to proceed hastily against the offender. But happily this is not the case. It has been demonstrated to the satisfaction of intelligent men that smoke can be prevented by processes at hand and economy practiced at the same time. There can be enough smokeless furnaces, smoke-preventive and smoke-consuming devices, etc., provided right here in Chicago, to render every city in the United States free from this easily avoidable nuisance. So when such devices are right at hand, and when their use is of direct benefit to the users, it is just and right that legal means should be employed to compel producers of smoke to comply with the strict letter of the law. A natural gas expert in an article on the decrease of that fuel states that its use has established the fact that the future fuel will be gas. I do not see that this is necessarily the case. The use of some such gas would solve the smoke problem at once, but at what cost none can yet say. If such a fuel is to take the place of the natural product lying in plenty in our mines, it must be cheaper and more desirable with a constant and limitless supply. But at present the cheapest fuel nature produces is soft coal, and the present genius of invention is turned toward its consumption in an economic and cleanly way. The near future may and may not produce a fuel undreamed of to-day, but nature has so bountifully supplied us that present thought and enterprise are largely turned toward improved methods of combustion in its use. Invention and mechanical skill have met the necessities of the times, and the problem has been solved. Improvements will go on, and new devices will be produced in the development of the principle of perfect combustion.

"The enterprise of conducting natural gas from the fields in Indiana to Chicago is again on foot. To what extent this gas will be used as fuel is at present unknown, but it would not seem reasonable that men would go to the expense of providing the means of obtaining and using a fuel of so uncertain a quality. It has stopped at many places; Pittsburgh is preparing to relieve that city of smoke consequent on the return to coal, and in Indianapolis the supply has been limited and shut off from certain consumers. It is still a question whether gas can be pumped such a distance, but if it can, this will not solve the other greater problem of its continued and reliable supply. The cost of this gas has not been made known, but it is believed devices are now at hand which will prove satisfactory in an economic sense and a sanitary point of view, which will render the use of a fuel of uncertain supply unnecessary. It has been stated by superficial observers that the virtue of smoke preventing devices was largely found in the careful firing which attended the tests, and that stokers would probably be more careful with such new devices. In the first place the observation is not correct. These tests are given under ordinary circumstances, and the object is to test the device and not the skill in firing. But supposing the remark to be true, does it matter greatly by what means the end is accomplished? One great virtue in tooth powders is the inducement they afford for the use of the brush. If smoke-consuming devices induce sufficient carefulness in the firemen to prevent smoke and secure perfect combustión, is the end not well enough accomplished, and does not the virtue lie in the device after all? The truth, however, is, that careless firing and its consequent waste and evils called into existence these devices, in order that these evils and waste might be remedied, and that they serve this purpose is excuse enough for their being. The enforcement of the law to the extent of securing the use of these devices will prevent the smoke nuisance despite careless stoking, for the stoker will have to become competent to do his work just the same as any mechanic or professional man."

The municipal laws, hitherto given, make provision for the ventilation of city houses, the disposition of smoke, the admission of cold air, and, in fact, the regulation of everything, connected with house building, conducive to public health and safety. All this is necessary in a great city. Other ordinances, such as one èstablishing building lines in the suburbs and otherwise regulating the limits to which ignorant neighbors may go, are wanting. The relation of the municipality to the individual, and of the latter to the municipality, is not so well understood here as in older and less cosmopolitan cities. Liberty is license in too many instances, and the ordinances are necessary in such cases. The loyal citizens—they who desire to obey the statutes of the state and city—have nothing to fear from the laws. They are formed to control the vicious citizen, and without them chaos would prevail where order is now enforced. Education occupies too many years in helping the ignorant and vicious to a knowledge of their duties, so that the application of the law is the only remedy. But one of the most noticeable drawbacks to the enforcement of law in great cities is the determination of some to avoid or disobey it, and the willingness of friends not only to condone the offense, but also to assist in the violation. There is scarcely a city ordinance that is not thus either avoided or violated. So long as laws made for the general good are thus openly or covertly disregarded, so long will civilization appear to be more or less of a failure. It is the enforcement of law that makes it beneficial and sacred, or reveals its faults, and thus leads to its repeal. Kindness or friendship should not stand in the way of a good law, or hesitate an instant in securing the repeal of an odious one.

CHAPTER VII.

GAS AND ELECTRIC LIGHTING.

GAS as a lighting medium in Chicago dates back to September 4, 1850, when the gas was turned into the Lake street pipes and thence flowed into the unlanterned lamp posts on each side of that street, as well as into the gasoliers of private consumers. The Chicago Gas Light and Coke Company was incorporated February 12, 1849. H. L. Stewart, Francis C. Sherman, W. S. Bennett, P. Page and P. L. Updike, corporators, who had the privilege of being sole suppliers for ten years. In October, 1849, George F. Lee, a Philadelphian contractor, entered on the work of placing mains and connecting pipes. This contract was completed in August, 1850, and simultaneously the houses and reservoirs on the south side of Monroe street near Market street were reported complete. On September 4, above written, the officials, President H. T. Dickey, Directors Dyer, Keen, Lee, George Smith, Skinner, Blair and Williams, Secretary Jerome Beecher and Treasurer J. K. Burtis, inaugurated the works and thus laid the foundation of the great gas interests of the city. Fires were started the last of August, preparatory to the grand initial illumination. On September 4 the gas was first lighted. From the *Gem of the Prairie*, dated September 7, the following account of the illumination is taken:

"Wednesday marked an era in Chicago. At about 2 o'clock P. M. the gas pipes were filled, and the humming noise made by the escaping gas at the top of the lamp posts indicated that everything was all right. Shortly afterward the fire was applied, and brilliant torches flamed on both sides of Lake street as far as the eye could see, and wherever posts were set. The lanterns not having been affixed to the posts, the bright, gaseous flame eddied and flickered in the wind, sometimes apparently disappearing, but anon shooting up as brightly as ever. The burners in Reed & Co.'s (drugs) and in Keen's (books) were lighted about the same time, presenting a steady golden flame. We believe these establishments had the honor of first lighting up with gas. In the evening the lamps were again lighted."

Of this notable event the *Journal* said: "Some of the stores on Lake street, particularly those devoted to California ware, made a brilliant appearance, and the gas lent an additional glory to refined gold. But the City hall, with its thirty-six burners, is the brightest of all, night being transformed into day."

There were about six miles of mains laid, about fifty laborers being employed in the work. The works had a capacity of sixty thousand cubic feet each twenty-four hours. There were six benches of three retorts each. The gasometer held sixty-five thousand cubic feet. The price charged the city was $2.50 per one thousand feet, and private consumers, $3.50 per one thousand feet. The works cost $149,000, only $90,000 in stock being issued. Of this stock, residents of Chicago held about $30,450. The remaining sum of $59,000 was paid in bonds, Lee taking all at seven per cent.

The gasfitter is not a plumber, but the plumber may be a gasfitter. When the necessity for gasfitters first arose in Chicago, the tinners or plumbers accomplished the work; but as the town grew into a city, so did the tinner's trade branch out into three divisions, which are to-day distinct in lines of labor, remuneration and organization. That the tinner was not a gasfitter, at least in 1850, is illustrated in the story told of the wreck of Burches' bank, 125 Lake street. Let it be understood that this financial concern was not financially wrecked. The gas inspector came around with a lighted candle to locate a reported leak, and did locate it so effectually that nothing of the inspector, leak or bank office remained, except its site at the corner of Clark and Lake streets.

The first master gasfitter of Chicago was Matthew Newman, a Philadelphian, who placed the gas fixtures in the Tremont house and completed his contract October 1, 1850. He returned to Philadelphia that year. E. L. Comly, with his brother-in-law, Baker, established themselves here in 1850, in a shop within the Tremont house building, fronting on Dearborn street and the alley. Their journeymen were Henry Lamparter, of 205 Dearborn avenue, William Street, of 232 North Franklin street, old residents of the city, with David Brainard, J. A. Carroll, J. Dodge, James Mooney, William Pitney, A. Rook, L. Scougall and Henry Seuthleben. Thomas P. Bryne became a partner of Comly, in 1855, and at 170 Lake street carried on business until the new partner established a crockery and glasshouse in 1858. In 1869 E. L. Comly retired.

In 1851 S. Lockwood Brown, a settler of 1835, and N. P. Wilder, were lamp and crockery dealers, and in 1855, gasfitters. James McGinley had charge of their gasfitting department and shops at 45–47 Wells street, (Fifth avenue) until 1860, when they retired.

Henry Lamparter established his gasfitting shop at 47 North Clark street, in November, 1853. In 1859 he sold to Rose & Bassett, but in 1860 resumed ownership, and carried on business at the northwest corner of Clark and Michigan streets until October 9, 1871. After the fire he built a three-story block on that corner, and in 1883 sold his business interests to Best & Dunn. The Chicago Steam and Gas Pipe Works were in existence as early as 1854, with William C. Hubbard, manager. In the advertisement which this firm had placed in the directory for 1854 the agent states that they are manufacturers of welded-iron pipes, boiler flues, brass valves, cocks and gauges, and every description of steam and gasfittings. They also called the attention of the public to the fact that their firm in Boston (formerly Walworth & Nason) were the originators of the plan of warming buildings by steam through the means of small wrought-iron pipes. They also did hot-water fitting. They did not do plumbing, but carried a line of fittings for plumbers' use. In 1855 the office was moved to 233 Lake street. Joseph P. Hayes came to Chicago this year and went into the office. In 1857 Messrs. Hubbard & Hayes had been admitted into the firm as resident partners, the name being changed to Walworth, Hubbard & Co. In 1861 the firm had moved to 181 Lake street. In 1864 they had moved to 225 Lake street, on the corner of Franklin. In 1865–6 the firm was changed by the death of Mr. Hubbard, and the entrance of Gustav E. Buschick. Augustus F. Buschick became superintendent of the work. The factory was at the corner of Michigan and Franklin streets. In 1867 Buschick had gone out, and the firm was changed to Walworth, Twohig & Furse, W. J. Twohig and John Furse having been admitted. This partnership continued until 1871, when Twohig dropped out of the firm, leaving it Walworth, Furse & Co. In 1872, after the great fire, Furse retired also, leaving James J. Walworth alone at 243–245 Lake street. In 1872 Frederick Brooks was admitted to the firm, and the name became Walworth, Brooks & Co. This firm remained intact two years, when, in 1875, the business was incorporated, being called the Redfield, Bowen & Walworth Co., the salesrooms being at 112–116 Lake street, and the works on Kinzie, Michigan and St. Clair streets. James J. Walworth, of Boston, was president; George Snowden Redfield, of Chicago, vice president; Frank A. Bowen, treasurer, and J. M. Colbath, superintendent. In 1878 this company was succeeded by the National Tube Works, and, with this metamorphosis, the character of the business, which had been gradually growing away from the steam-heating and fixtures trade, grew more into the manufacture of tubes for gas, water and steam supply. In 1879 a removal was made to 159–171 Lake street, and in 1884 another move was made to the commodious building at the corner of Clinton and Fulton streets, where they still remain.

Gerould Bros. established a gasfitting shop at 78½ Wells street, in 1856. In 1858 they moved to 75 South Clark street, and on the death of J. H. Gerould, in 1859, Henry M. Wetmarth, the firm's book-keeper, in 1856–9, continued the business. B. Munson was also a gasfitter, at 233 Lake street, in 1856, but did not continue in business here more than one year. Henry M. Wilmarth established his gasfitting house in 1859, and continued in business until his death in 1885. The fire of 1871 destroyed his store at 167–169 Lake street, but, immediately transforming his parlors at 222 Michigan avenue into a storeroom, business was carried forward until he purchased the building, known as the Church of the Messiah, on the corner of Hubbard court and Wabash avanue, and converted it into a gasfitting establishment. In 1874 he moved to 191–193 State, and that year purchased the lots 225–227 State, and erected a building thereon.

The leading gasfitters of 1869 were Harry Byrne*, J. S. Bassett* & Pattison, H. M. Wilmarth*, E. W. Foster & Co., James McGinley*, The Peoples' Gas Company*, Central avenue, near Twenty-second street, and the Chicago Gas Light and Coke Company*, were here in 1872, with I. P. Brown & Co., G. P. Costigan & Co., Behncke & Co., William H. Hacket, Lane & Murphy, J. L. Pattison & Co., Jeremiah Scanlan, W. S. Shepherd and J. Wingrave, Jr., David Humphrey and Perkins Bros., were gas and gasoline fitters; Bennett & Mackey, J. T. Duff and Henry Lampartner, gas and steamfitters.

The gasfitters of 1879 included J. L. Pattison & Co.*, H. M. Wilmarth, Edward Baggot*, J. S. Bassett*, Phillips & Phillips, Crane Bros. Manufacturing Company, A. J. McDonald, H. T. Lally & Co., S. I. Pope & Co., D. Humphreys and M. B. Derrick & Co.

The individuals and firms marked thus * in the list of 1879 were here in 1891, together with the Wilmarths. In the list of plumbers for 1891 the great majority of gasfitters find mention.

From the humble beginnings of 1850 the gas interests grew prodigiously, and in 1887 the Chicago Gas Trust Company was organized for the purpose of receiving the titles of and holding shares of stock in several separate gas companies then occupying the streets of the city with their mains and supplying gas to the municipality as well as to private consumers. These separate gas companies were the Chicago Gas Light and Coke Company, the Peoples' Gas Light and Coke Company, the Consumers' Gas, Fuel and Light Company, and the Equitable Gas Light and Fuel Company. After making arrangements to acquire a majority of the controlling interest and wielding, in fact, the entire stock in these four companies, the syndicate which had bought up the stock placed upon the property, franchise and plant of each separate company mortgages running into the millions. These mortgages were ostensibly for the purpose of securing bonds of the separate gas companies, which bonds sold at a high figure. The four gas companies had original shares and nominal capital as follows: Chicago Company, one hundred and ninety-nine thousand three hundred and sixty-eight shares, amounting to $4,964,200; Peoples' Company, forty thousand shares, amounting to $4,000,000; Consumers' Company, fifty thousand shares, amounting to $5,000,000; Equitable Company, thirty thousand shares, amounting to $3,000,000, or a total of $16,964,200. Of these holdings the syndicate purchased of the Chicago Company one hundred and eighty-nine thousand three hundred and eighty-three shares, amounting to $4,734,575; Peoples' Company, thirty-four thousand six hundred shares, amounting to $3,460,000; Consumers' Company, twenty-nine thousand eight hundred and eighty-one shares, amounting to $2,988,100; Equitable Company, twenty-nine thousand seven hundred and forty-seven shares, amounting to $2,974,700, or a total of $14,157,375.

These were the outside figures. Stock brokers and their clients know full well that of the nominal shares and capital stock of the several companies, on an average sixty per cent. were really paid up, and a similar ratio was accordingly purchased by the syndicate, involving an actual transaction of $8,494,525. The syndicate then turned over its holdings to the Chicago Gas Trust Company, of which C. K. G. Billings, Charles Counselman, E. C. Benedict, E. J. Jerzmanowski, Henry J. Davidson, W. L. Elkins, C. R. Cummings, S. A. Kent, Henry Fitzhugh, C. F. Dieterich, P. A. Widener, John Sloane and William H. Gebhard were the directors and officers—and are yet, to all practical intent and purpose. Billings, Counselman, Cummings and Kent are Chicago capitalists; the balance represent Philadelphia capital. The gas trust immediately proceeded to issue capital stock to the amount of $25,000,000, divided in two hundred and fifty thousand shares at $100 each. While the Chicago Gas Trust Company had been incorporated under the laws of the state, private citizens as well as semi-public organizations became at once convinced that such incorporation was fraught with the greatest public danger, and litigation was begun by both factions. The Citizens' association retained Ex-attorney-general J. K. Edsall to test the validity of a monopoly formed under the state laws. A bill was filed in the Circuit court, to which the gas trust filed pleas claiming the lawful right of consolidation as a trust. The case came to a hearing before Judge Baker, who overruled the demurrer of the Citizens' association to the pleas of the trust, and practically held that the Chicago Gas Trust Company was a legal corporation. The Citizens' association appealed to the Supreme court, and this appeal resulted in the complete overthrow of the Gas Trust Company and a reversal of Judge Baker's decision. The Supreme court decision, written by Justice Magruder, holds, briefly stating, that under the general incorporation act, no corporation can be organized for the purpose of holding stock in any other corporation, and especially can this not be done if such holding creates a monopoly nefarious in character and against public policy. The case was consequently remanded for further proceedings in the Circuit court. Judge McConnell presided, and his rulings during the earlier stages of the rehearing were favorable to the trust. The latter claimed that it had dispossessed itself of the greater portion of the shares of stock in the various individual gas companies by a transfer of these shares to the Fidelity Insurance Trust and Safe Deposit Company of Philadelphia, and that the trust then held only a certain number of shares, far less than a majority. To this plea the Citizens' association demurred so effectively that Judge McConnell finally held, in pursuance of the Supreme court opinion, that the Chicago Gas Trust Company had no right whatever to hold any shares in any gas company or in any other corporation, and he entered final judgment of ouster against the gas trust. The latter was ousted from the right to hold any shares of stock in any corporation, and a nominal fine was imposed to give effect to this judgment. From the latter the trust again appealed, in November, 1890, to the Supreme court, who dismissed it, leaving the trust without legal recognition.

The Mutual Fuel Gas Company of Hyde Park inaugurated their plant in September, 1890, supplying illuminating and fuel gas to residences of that division of the city at fifty cents per one thousand cubical feet. This was done under authority of the village of Hyde Park. The officers of the company here are George M. Bogue, president; J. B. Robertson, vice president; C. H. Randle, secretary, and J. J. Mitchell, treasurer. Among the fifty or more stockholders are L. Z. Leiter, Edson G. Keith, A. E. Smyth, S. W. Allerton, T. E. Wells, H. N. Higinbotham, Clarence Buckingham, A. A. Sprague, A. C. Bartlett, C. J. Blair, Eugene Cary, W. H. Mitchell, Ferd W. Peck, N. B. Ream, Joseph Sears, Jesse Spalding. When the Mutual company found itself ready to commence operations, it purchased a site at Fortieth street and Langley avenue, but the residents in the neighborhood protested so strongly that a gas plant there would be a nuisance, the company surrendered. It next found a proper location in the Town of Lake, at Forty-sixth street and Stewart avenue, and applied to the Chicago council for permission to lay a main from that point to the center of State and Forty-sixth streets, there to connect with the system of mains in Hyde Park. The council refused the permission. Later an ordinance was introduced in the city council, giving the company the right to lay pipes in the city, conditioned that it should supply fuel gas at forty cents and illuminating gas for seventy cents per one thousand feet. Subsequently that gas company offered to light the street lamps of the old village at $2 per lamp less than the city was paying; but the Chicago council is not a prompt actor when such a public boon is offered. As a fuel this gas seems to be unsurpassed, and its advocates claim it will heat the stoves and furnaces of the future. As a heating agent it is without smoke, and a piece of porcelain can be held in or over the flame without being blackened. The amount and character of heat the gas creates is so intense that it will burn a hole through a thin sheet of platinum. A piece of steel or iron held in the burning jet of ordinary gas soon becomes covered with soot; if then transferred to the flame of the new gas the soot is rapidly consumed and the iron becomes clean again and white with heat. When used as fuel the gas emits no light, but when used as an illuminant, in connection with an incandescent attachment called a comb, it becomes all light and presents not a particle of dark surface.

The Hyde Park Gas Company is a much older institution than the Mutual Gas Company, and observes the older schedule of charges, or $1.25 per thousand cubical feet. Hall's gas plant was inaugurated July 22, 1891, in the buildings of the Kelly Barbed Wire Company in rear of Deering depot.

The other companies in the field are the Calumet Gas Company, the Indiana Natural Gas and Oil Company, the Lake Gas Company, the Suburban Gas Company, the Chicago Smokeless Fuel Gas Company and the Chicago Economic Fuel Gas Company. The Fahnejelm Incandescent Gas Light Company, Globe Light and Heat Company, Pintsch Compressing Company, the International Gas and Fuel Company, the Hutchinson Water Gas Furnace Company, and the Backus Gas Fire Place and Mantel Company are all connected more or less with the gas manufacturing industry of this city.

The Welsbach incandescent gas lamp dates back to 1887. The invention is that of Carl Auer, a pupil of Professor Bunsen, of the Breslau university, and the light from the lamp is produced by the heating to an incandescence, or white heat, of a filament made from refractory earths or oxides, which it is not necessary to use in a vacuum, as the carbon filaments are used in making the incandescent electric lights. The necessity for using the vacuum is an expensive one, and Carl Auer a few years ago began a series of experiments to produce a filament which could be used in the open air. The result was the discovery of the Welsbach burner, which he named after the patent of nobility granted to him for his scientific discoveries as Von Welsbach. The light is successful because the oxides are produced in an extremely thin or attenuated form, whereby the minimum of heat will produce the maximum of light. There are three principal elements used in the manufacture of the solution in which the cotton cylinder or mantel is dipped—the oxides of lanthanum, zirconium and yttrium. These are produced respectively from the minerals cerite, zircon and samarskite, which are found in large quantities in Norway, Sweden, Ceylon, the Ural mountains, and in North Carolina and elsewhere.

The presence of water in gas has a most important bearing on that illuminator, where certain conditions do not render it objectionable. Water or water vapor is one of the products of the combustion of coal gas. This product is brought about by the combination, at the point of consumption, of the oxygen in the air and the hydrogen in the gas.

In large eotton spinning and weaving mills this characteristic of the gas flame is of the utmost utility. While not deleterious to the health or eomfort of the workpeople, it improves the quality of the work, by enabling the yarn to be spun and woven with fewer breakages than is possible in a dry, hask atmosphere. In short, this method of illumination, because of its moisture-producing quality, will always commend itself as being the most suitable and natural under such circumstanees.

The first useful part water fulfills in the proeess of gas manufacture is the work whieh it does in the ashpans and under the retort furnaces. Raised to a boiling point by the glowing coke, it gives off steam in a eonsiderable volume, and this rising underneath and between the furnace bars contributes to the durability of these by keeping them in a state of eomparitive coolness. At the same time it tends to prevent or mitigate the soldering together of the fused portions of the fuel. In its passage through the hot coke, the steam is decomposed into its constituent gases; the hydrogen adding to the furnace fuel, and the oxygen promoting combustion. A tidy fire about, with the ashpans charged with water and reflecting the bright fire between the bars, is one of the characteristies of good stoking. In the absenee of this, though the settings were composed of gold and diamonds, the best results would not be obtained. Dirt and disorder are indicative of general bad working.

In the slaking or quenching of hot coke, water is a necessity. It is true that if the coke be drawn from the retorts into iron barrows, and a close cover placed over it, the confined gases in the absence of atmospheric oxygen will smother and gradually arrest combustion in the mass; and some managers resort to this method of dealing with the coke with a view to abating the nuisance of the escape of steam, charged with sulphurous vapors, from the retort house, and to preserve the coke for sale in a dry and bright condition. Where the production of coke is great, however, as in the case of large works, this is an inconvenient, if not an impossible method of dealing with the material. It is to be noted further that the quantity of water absorbed by the coke when it is slaked in the ordinary way is comparatively small, not exceeding on the average fourteen per cent. of the weight of the coke in the first instance, and the bulk of this evaporates when the coke is deposited outside the retort house in the open air, about three per eent. being permanently retained.

The water which is found in the hydraulic main is due to the eondensation of the vapor or steam which, coming from the retorts, is carried up the ascension pipes along with the permanent gases and the heavy hydroearbons, the latter being deposited as tar. The presence of this water is accounted for by its previous existenee in the interstices of the apparently dry coal. It is also produeed synthetically by the eombination, brought about by the heat of the retorts, of a portion of the oxygen and hydrogen, two constituents of the solid coal. The quantity of water thus yielded varies with different coals, but the average yield may be set down at sixteen gallons per ton. A portion of the steam from wet coal is decomposed in the hot retorts, being resolved into its constituent gases. It will be seen, therefore, assuming the correctness of this hypothesis, that two opposite processes are being carried on simultaneously in the retorts, the analytical and the synthetical, and this apparent inconsistency may be explained by the original character of the substances acted upon, the steam in the one instance and the gases, oxygen and hydrogen in the other, and their proximity to, and period of contact with the hot surface traversed by them. It is, in fact, another case of blowing hot and cold with the same breath.

The strong affinity which exists between this water and the ammonia impurity in the crude gas causes the absorption of much of the latter by the former; and hence the ammoniacal liquor, which is, roughly speaking, a solution of ammonia. This, again, by reason of its affinity for sulphureted hydrogen and carbonic acid, absorbs a proportion of the gases named, reducing the amount of these impurities in the gas; and thus is produced the complex liquid designated ammoniacal liquor. In all well-regulated works, the ends of the dip pipes in the hydraulic main are sealed with this liquor in preference to tar, which not only offers greater resistance to the passage of the gas, but robs it to some extent of its richest illuminating substances, the volatile hydro-carbons, which would otherwise be retained in the gaseous condition. This liquor performs similar functions in the washers and scrubbers, where, in the finely-divided state, its quality of absorbing ammonia, sulphureted hydrogen, and carbonic acid is still further utilized.

In hot climates the crude gas can best be reduced to the temperature necessary to admit of satisfactory purification, by causing water to trickle down the exposed surface of the condenser. In the slaking of the oxide of iron and the lime with which the purifying vessels are charged, water again is indispensable, giving porosity to the materials, and largely contributing to their power of absorbing the carbonic acid, sulphureted hydrogen, and other sulphur impurities. The value of the water seal for the lids of the purifying vessels, in the hydraulic valve, in the station governor, in the gasholder tank, in the cups of telescopic holders, in the wet gas meter and in the water side pendant is evident. The simplicity and efficiency, as well as the indispensability of its application in these different directions is obvious.

The shop rules governing gasfitting are of recent origin. In 1890 a written code appeared to be necessary, and the work was undertaken by E. Baggot, with a view of facilitating business in his own shop. As originally prepared, they are here presented:

First. Gasfitters, when beginning the work of fitting up a building, should read the rules of the gas company, and see how many outlets are allowed on each size of pipe.

Second. When running extra pipe or making alterations in new buildings after the original work is completed, the fitter should put on the guage and test before, and also after, the alterations are made.

Third. Fitters must put in drops with bends instead of elbows, according to the gas company's rules.

Fourth. Be careful in locating the meter. Risers should not be run on the outside wall, for if they are, the gas will condense in winter and cause the light to flicker.

Fifth. When running service pipe, be sure not to trap the pipe. Always put alcohol cock when it can be got at conveniently, in case of freezing in winter. When the service is completed, test it by blowing into the alcohol cock; then close it and allow the pressure to stand five or ten minutes; then open the key, and if there is sufficient back-pressure, the piping is tight, if not, it leaks, and must be remedied.

Sixth. In making alterations in old buildings, before making any extensions, the fitter should disconnect the meter and cap the riser, put on his gauge and see whether the work is tight. Also prove it when the work is completed.

Seventh. Drops should be fastened properly by putting in cleats between joists.

Eighth. In parlors, one-half-inch drops should be put in. When running pipe for bracket light, fitters should be careful when there are two or three in one room, to put them the same hight from the floor, and see that they extend just the same length through the plaster, so as to make an even finish for back plates.

Ninth. In leaving openings for fire logs, they should be one-half inch in fireplaces, and for gas stoves they should not be less than one-half inch, and for large ones, three-quarters of an inch.

The following is a table of diameters of house drainage with various grades and for sizes of different lots capable of discharging two inches of rain per hour, when running three-fourths full.

SIZE OF LOT IN FEET.	Fall per 100.						
	1.0	1.5	2.0	2.5	3.0	4.0	5.0
	Diameters in inches.						
20x150	3½	3⅛	3	2⅞	2¾	2⅝	2½
25x150	3¾	3½	3¼	3⅛	3	2⅞	2¾
30x150	4	3¾	3½	3⅜	3¼	3	3
35x150	4¼	4	3¾	3⅝	3½	3¼	3⅛
40x150	4½	4¼	3⅞	3¾	3⅝	3½	3¼
45x150	4¾	4⅜	4⅛	4	3⅞	3⅝	3½
50x150	5	4½	4¼	4⅛	4	3¾	3⅝
60x150	5⅜	4⅞	4⅝	4⅜	4¼	4	3⅞
70x150	5⅝	5¼	4⅞	4¾	4½	4¼	4⅛
80x150	6	5½	5¼	5	4⅞	4½	4⅜
90x150	6¼	5¾	5½	5¼	5	4¾	4½
100x150	6½	6	5¾	5½	5¼	5	4¾

The *Economist*, in reviewing this table says: "By an inspection of the table, we see that a four-inch main drain is ample for any ordinary condition of service, even if roof-water be admitted, the discharge of house sewage proper being only a very small percentage of the total volume. A smaller size than four inches is not to be recommended, however, for the reason that although it may be ample so far as estimated carrying capacity is concerned, it is more liable to obstruction. Under some circumstances, it may be advisable to increase the size of the main drain to five or even six inches diameter; this limit should not be exceeded, however. If one drain of this size be not ample, it is better to increase the number."

Tenth. Fitters should not run risers across the floor under the tile of the vestibule in the main hall.

Eleventh. In placing one or more fixtures in a house, fitters should always smell of the joints and see if there be a leak; after turning on the gas they should watch the meter and see whether the hands on the dial move; if so, there is a leak. These are matters which are ignored by fitters altogether and cause a great loss of time.

Twelfth. Fitters should examine the brackets of fixtures after the gas is burning, for very often the nozzles have sand holes in them, and the fitter does not screw his burners up tight and does not put them on properly. He thinks that because it is tight to the key that is sufficient.

Thirteenth. In all new work, such as houses, offices or stores, the fitter should put on his pump before he puts the fixtures on, and if there be a leak and he cannot find it in the caps, he should report it to the foreman, and the parties who first put in the work will be notified and they will have to find it; but should the fitter put on the fixtures without testing, and if there should be a leak afterward, we would be held responsible for it, and would have to make it tight. After the fixtures are all up and tested, we should report to the gas office in the district where the work is completed.

The pump and gauge should be brought back to the shop, and also all caps that have been taken off.

Fourteenth. Relates to cutting pipe.

Fifteenth. For some reason or other the average amount of pipe put in by fitters in my shop is below the average of any other shop in Chicago. A strict account will be kept on each man on new work, and if he can not make a fair average he will be discharged. No excuse will be taken from the hangers or fitters that they were not able to get all the goods from the salesman, or that he is behind in his account, unless he reports to me promptly.

Sixteenth. Fitters should notify the timekeeper in the back part of the store when he will be ready to go out with his goods, and also when he wants a wagon, that he may not be asking for it when he knows he can not get it.

Seventeenth. Fitters will not let fittings lie around on the floor, but put them back in the bins. Each fitter must have a separate cup and brush, and also a bottle of ether, properly corked, and not use a piece of paper or wood as some do. Fitters should also keep their tools in good repair and in the proper place, so that they will not be compelled to look for them every time they go out on a job, as this causes much delay and annoyance to the foreman.

Always see that the gauge is in good order before taking it out of the shop, so that it will not be necessary to come back to the shop to get a new glass or fix the key. All step-ladders taken from the shop must be returned, and ladders borrowed while on the job must be returned before leaving the job, or they will be charged to the persons who disregard this rule. Foreman will report any fitter or boy who does not understand these rules, or who does not comply with them.

These rules convey a fair idea of what is required from the working gasfitter, but the details of fitting are numerous and serious. In W. B. Gray's "Practical gasfitting" such details are given, and from his papers the following is taken: "When the different lots of pipe have been carried to their respective floors the fitter should, if he has not already done so, blow through each piece to prove that it is not clogged with cuttings, dirt, or an imperfect weld, and test them by extracting the air with the lungs, in the same fashion that the tongue can be sucked into a bottle. If the tongue stick firm for five seconds on short and small pieces, they may be considered tight. Large and long pieces will require more time to extract the air, and a proportionately longer time for the test, because the larger the space that is void the longer it will take a small hole to restore the internal pressure. Pipes that are too large to be filled with the tongue may be covered with the lips. New pipe can be exhausted very quickly by drawing the air into the lungs instead of drawing a mouthful at a time, but it is bad policy to test old pipe containing rust or gas deposits in that manner. Any pieces that seem defective should be tried a second time to be sure that the helper was holding the end firm. Leaks discovered in this manner may usually be traced to a defective weld or a weld strained by cutting. Any bend or offset that is required should be made before the pipe is screwed in, that it may be tested to avoid cutting it out should scales clog it or the weld split. There is some difference in the opinions advanced relative to the position that ought to be given to the weld when making a cold bend. The writer believes that if there be any choice of positions it is the neck of a bend. For offsets the weld should stand half way between the neck and side of the first curve. In cases like the following, we would not venture to say that one particular place was better than another for the weld. We once had a boss who invariably commenced the day by drinking several 'eye openers' and telling us that we should obey orders if it broke the master's. One morning we informed him that we could not make a certain 'coil' because the mandrel was loaned. He ordered us to bend it around the telephone post. It is there yet, because the company will not remove the cross arms that we may lift it off.

"When the fitter is sure that every piece of pipe is clear and sound, the next step is to take the plan of the floor he happens to be on and call off the sizes and lengths of the pieces, while the helper, by the aid of the rule and measuring stick, finds the pieces and places them where the fitter directs. When the pieces are all placed the fitter may screw several pieces together loosely and hold them in the exact position they are to occupy, while the helper marks the joists to be sawed. It is better to mark the joist by the pipe itself, for then there is no recutting to make fittings match, etc. All drops for center lights must be screwed up in cement to prevent them from unscrewing when caps or fixtures are removed. Lines of pipe between joists should be well supported to prevent sagging. Any pipe that can not be given a fall to the riser should have a fall to the fixture. All pipes should be low enough to allow the floor to go in place without bearing on the fittings. Pipes for lights showing on partitions not yet in place give more trouble than anything else in a new house. If they are left standing the carpenter usually breaks them off while placing his studding. Probably the best way is to put in stubs that will stick above the floor and lengthen them after the partition is in place. Time can be saved by running the newel light after the post is up. Assuming now that all the pipes are put together, we will give our attention to fastening the drops and bracket pipes. Some wedges that will not split easily (white pine), and of the proper shape, are the first things needed. They should be about two inches wide by three and one-half inches long, and from one-fourth inch to five-eighths inch in thickness. The tapering part or point of the wedge should be only about an inch long, and if the grain of the wood converges at all the point should be at the converging end. Wedges should never be placed in the upright seam on a chimney jamb near the corner, because the corner brick will push out and allow the pipe to get loose. Wedging into flue walls should be done very carefully. Nails driven across the grain (screws are better) do not split the wedges so easily, and the pipe can not become loose unless the wedge pulls out. Bracket pipes ought not to be pulled in with hooks, because the pipe will crack the plastering if the hooks get a little loose, By fastening the fitting very firm there need be no fear that the pipe will crack the plastering.

"Fastening drops is so simple that it is hardly worth time to speak of it. Where they come between joists cleats can be nailed on the joists one inch more than the depth of the running pipe from the tip. A strip one inch thick can then be placed under the pipe near the drop and rest on the cleats. When the drop is beside a joist it can be secured by rabbeting a block and nailing it to the joist. Practically there are but two things to be remembered when fastening drops, viz.: Make them hang perpendicularly and fasten them firmly.

"The last and most interesting part of a gasfitting job is testing the pipe. The test should be just as rigid whether an inspector's certificate be required or not. There are two kinds of test pumps, the spring gauge and mercury gauge. The reader can see a cut of them by turning to any catalogue of gasfitter's tools. The mercury gauge is the more suitable, because it is more sensitive than the other. The glass may be placed nearly at the bottom of the cup, in order to use as little mercury as will give the required pressure; then should an accident occur there will not be much lost. A column of mercury two inches high is equal to about one pound pressure. Eight inches is ample hight for the mercury column when testing illuminating gas pipe, as there is at most only a few ounces' pressure on the mains at any time. The pump for testing may be placed at any convenient opening, and after allowing a moment for the mercury to settle, it should stand fifteen minutes without even getting flat on the top of the column. Very small houses may be passed with a ten-minute test, as the leaks will show sooner. If the mercury fall gradually the leaks are either considerable or very near the pump. If it stand for several minutes and then drop suddenly, the leak is very small and usually very remote from the pump. If the pump prove that the pipes leak, the pressure may be let off and a little sulphuric ether poured into the opening for the purpose, or into the barrel of the pump. Then pump up the pressure again. A large leak may be smelled and heard too, as soon as you get near it, but the nose will have to be placed close to a small leak to detect the smell of ether; a little soapy water can be used to advantage in hunting gas leaks. If the suspected place be painted with it, the air will make a bubble, showing exactly where the leak is. Split pipe and fittings should in all cases be removed. If the fitter have any time to spare when the job is finished, he can employ himself by loosening the caps while the pressure is on, to see that no pipe is clogged.

"The preceding paper described the work of piping an ordinary dwelling house at the time of its construction. This points out the method of piping a house already constructed. In every city and suburban district there are many of the better class of dwellings that are without gas, and in which the lighting does not meet the requirements of tenants or owners. This state of affairs causes constant changing, extending and fitting of gas pipe in houses already built. To fit a finished house with gas, some ability and aptitude is required on the fitter's part other than that necessary for ordinary fitting. He may have to remove the furniture, take up and replace the carpets and floors, as neatly as a carpenter and carpet-layer could, in order to give satisfaction. The fitting should be very carefully done, especially in cases where the family occupy the house while the work is being carried on, as each room should be completely finished, except the hanging of gasaliers, before another is commenced. This method of working makes it less inconvenient for the household, but gives double trouble in locating and remedying defects. In houses not occupied, where carpets, furniture and floors may be left in disorder until the pipe work is completed, all over rigid precaution may be economically dispensed with, because the time consumed in trying to avoid possible leaks is usually greater than that required to stop the leaks, which may be avoided by extra precaution, when the pipes are all accessible at the time of testing.

"The following is a list of the indispensable tools for such work: One ratchet brace; one twisted-point gimlet, three feet long; one twisted-point gimlet, short; one one-inch auger bit; one gouge, preferably of three-quarter octagon steel (hand made); one framing chisel, two inches wide; one floor chisel, with blade shaped like a hatchet blade; one hand saw, one very thin blade compass saw, one plumb bob, one tape line, one pocket rule, one cold chisel, one hammer, one oil can, one reversible vise, one chisel and one stone drill. The fitter may use his judgment as to what dies, taps, wrenches, etc., he may need. All chisels used to force up flooring boards should have round edges, causing them to mash rather than cut into the edges of the adjoining board.

"The first thing to be done is to center the rooms. A stick ten feet long marked in feet and fourths of feet is better than a line to measure with, as no help is needed, and the helper may set the vise while you center, first the floors, then the ceilings by means of the plumb. Rooms having plaster or fancy paper centers need no center marks, because the drop must come exactly through the center of the piece. Many rooms have neither paper nor plaster center pieces; such may have the drop exactly in the center, unless a joist is in the way, and in that case one inch either way to avoid the joist will not look bad. The posi-

THE AUDITORIUM BUILDING.

ROMANESQUE-COMMERCIAL ARCHITECTURE.

ROMANESQUE ORNAMENT.

tion of joists above paper or plaster surface ceilings may be known by the light stripes directly under them. The stripes are caused by the ceiling being drier under the joists than at any other place, consequently soot and dust does not adhere as readily. The fitter should be very particular about centering rooms with bay windows. Such rooms, when without center pieces to govern the location of the lights, can be more uniformly lighted from the center of the space if the window is large in proportion to the room. When the room is large in proportion to the window it should be lighted from the center of the square. All irregularly shaped rooms, with the irregular-shaped part of the ceiling divided from the main part by a border, must be lighted from the center of the square.

"After the rooms are centered, place the long gimlet in the brace (be sure it is well secured, because the brace may slip off and break when left hanging from the ceiling), and bore through the ceiling and floor above. There need be no fear of damaging the carpet, as the gimlet will lift it six inches before pushing through, which is enough to mark by. The carpet should be marked at the point over the gimlet to show which side is most convenient to put the pipe under, as all rooms upstairs do not correspond with those downstairs, either in size or location. The gimlet hole in the floor shows which board to take up. When boring plaster or paper center pieces which have candle or oil chandeliers pending from them, select some crevice in the pattern which will leave the gimlet hole in the shadow, then measure to the center and note the direction when cutting the floor above. In paper center pieces bore near enough to the center to allow the ceiling plate to cover the hole. By following this method the chandeliers may hang until the last moment. It also leaves a center for the bit where the chandelier hook is screwed into the joist or into a bridge that can not be moved. A leather shield should be placed over the gimlet near the brace when boring ceilings, to prevent plaster from getting into the working parts of the brace. It seems needless to mention that when there is no other way of locating a joist that it must be done by sounding, or by driving a needle through the plaster and finding it by removing the floor above. The fitter will often find chandelier hooks from six to eight inches long, and will succeed easier by plugging the holes left by such, when he is compelled to use them as centers for the bit. It will be suggested to the reader who may find occasion to do so, that he place the bridging for chandelier hooks, independent of the laths and plaster, and in such a manner that it can be removed without injuring the ceiling. Also, that in no case place a joist directly over the center of a room.

"The interior partitions of such houses as this class of work will bring the reader into are usually of wood, which affords many places to conceal gas risers. One of the following places can be found in any house: First. Beside a sliding door, which gives more room to lower a light and a better chance to bore through or remove the brace between the studding. The writer almost invariably drives down one end of the most convenient brace. Second. Place the riser which is so located for either one or both of the following reasons: First. Because the riser may be placed by lowering through the second floor doorway if there be no cellar immediately under it. Second. Because the stringer over the studding can be cut with much less labor. Any but the best carpets will look a little loose and shabby after being relaid in the same place, and an inexperienced man will pull the wrinkles out until he comes to an angle, when he finds that the carpet has stretched about two inches. Of course it has to be loosened again. To avoid such mishaps, drive larger tacks in the same holes, fasten the principal points first, and divide the slack or mark the carpet and floor in several places along each edge before taking up. Tacks well driven in heavy carpet can be removed easiest by pulling the carpet. But a tack puller must be used on frail or old carpets, because the carpet will either tear or allow the tack heads to pull through. To remove a floor board neatly the fitter should know on which side of the board the groove is, to avoid splitting too deep, as a board can be forced up from the groove side without damaging any but the part under the groove, and there are no nails on the groove side to contend with. The groove side of a board may be discovered in several ways. The first board laid when putting down a new floor is always full width and has the tongue on the outside, while the last board laid is usually cut to fit, and is sometimes narrow at one end, as the last boards of a floor seldom run perfectly parallel with the wall opposite the starting point. The last board is always nailed through the face instead of being toed through the tongue.

"Floors that are used without carpet should not be marred by chisel and hammer marks. The writer uses an old putty knife, or something of similar shape, to open the crack between boards wide enough to admit a very narrow thin blade compass saw. In fine floors always saw the tongues on both sides of the board to be removed. If near an end wall, remove the board to the base; by this means the crack where the board is sawed can be closed by pulling the board forward. Where a pocket (two or three boards) is to be cut out, both ends and the tongue on one side of the first board to be removed should be sawed first, then drift the board over, that the tongue may be sawed on the other side to save reducing the face as much as possible. Saw all boards a little beveling, to prevent the ends from splintering when they are forced up. All boards covering gas pipes should be screwed down. Under boards from two to three and a half inches wide, cut the notches under the tongue side of the board. When fitting houses that have deadened floors, place as much pipe parallel with the joists as possible. Once in a while the good appearance of a floor may be saved by drilling the wall from the outside, instead of cutting up two or three boards to get a long piece of pipe under them.

"Parlor fixtures of the better class are usually hung by ball joints, the lowest part of the fixture being about seven feet from the floor. Ball joints are made of brass, and are not unlike the ordinary unions, except that the collar threads are gas-tight, and that the collar has a set-screw to secure it, after it is screwed tight. The tail-piece is screwed to receive the stem of the fixture, and has an extra large flange, which is ground into the collar in such a manner that it can be moved in any direction as much as 30 degrees from the center line. The advantages of the ball joint are: The fixture will hang perpendicularly, whether the drop be perpendicular or not; should anything strike the fixture it will recede instead of breaking off; when cleaning globes or fixtures, it may be turned instead of moving the ladder; if a burner does not burn properly, the best burner may be turned in the direction where the most light is needed, until the burner is repaired. Fixtures swinging by ball joints should always be turned from the person with the right hand, to prevent any possible chance of the fixture unscrewing.

"Other appliances are often used instead of ball joints. However, ball joints are the best. A swing joint made in the following manner is excellent: Take a piece of white rubber hose which will fit tight on the stem of the fixture, slip it on about three inches and secure it with a hose band; then slip the ceiling plate over the drop, and measure the length of the hose required to slip up to the plate, allowing plenty of hose, to prevent buckling when the fixture swings; cut the hose the proper length, and secure it to the drop with a band. This appliance is used in foundries, furniture factories, etc. Another fitting, used in any place where the fixture must be lifted or removed, in order to remove, handle or set up certain work, has only a vibrating movement and is very easily strained, unless the drop be perfectly true, and will leak then if pushed in any but the proper direction.

"There should be at least two sliding fixtures in a house, one in the library the other in the diningroom. There are many forms of slide fixtures, such as packing sockets, in which the packing is compressed tight enough to hold the fixture in any desired position, and fit only for use on light single and double pendants; others, with packing sockets and weights to counterbalance the fixture. Wedge and spring-joints and friction-ball cases, in fact, all slide fixtures, depend upon the packing socket, except the water slide, or, as called more properly, the hydraulic gasalier. The water-slide fixture should be hung by a ball joint. The fixture is held in position by weights made heavy enough to balance the fixture while filled with water. Persons having water-slide fixtures can tell when the water is low by the fixture creeping up, because the fixture alone is not heavy enough to balance the weights. The bottom or moving part of the fixture has two tubes. The central tube connects to the gasway of the fixture arms. The outer tube has a belt shaped upper end, with proper loops for the weight chains, and is fastened to the base fitting, so as to make a uniform annular space between it and the central tube, in which the stationary drop pipe stands. The weight chains must be short enough to prevent pulling the slides entirely out of place. The objections to water-slide fixtures are that they look clumsy, and if not watched, the water will evaporate enough to break the seal.

"Persons owning such fixtures should make it the duty of one particular person to keep the slides filled. The writer recommends that a stopcock be placed above all water slides, in order to avoid the risk of leaving the gas on during the summer months, while the family are at the watering places or summer resorts, and only the servants have charge of the house. All fixtures should be cemented together with the best quality of cement, especially rope-arm fixtures, because the creases in the rope imitations are deeper than the threads. Parts that cannot be heated with the torch without damaging the finish may be heated by screwing a hot nipple into the threads. Fixture lengths should be obtained by measuring from the floor to the bottom of the drop. When hanging fixtures, those drops that are too long to allow the fixture socket to hold the plate against the ceiling should have the extra space covered with casing of the same finish as the fixture. Factory fixture stems that are too short should be replaced with one piece the proper length, which makes a neater looking fixture when cased. When a slide is not used in the diningroom, the fixture may be placed as low as six feet four inches from the floor. Those who can not afford a slide fixture for the library may use the common drop with movable shade. The style of drop goose neck, which hangs inside the globe and through globe holder, is best.

"Hall fixtures should be placed about seven feet from the floor of small dwellings. Large halls may have the fixtures according to the hight of the ceiling. Other dwelling fixtures, not mentioned here, may be placed six feet eight inches unless otherwise requested. Dressing-case brackets should be of the universal pattern, which can be raised or lowered to suit the person dressing. More satisfaction will be derived from the use of that class of universal brackets which depend upon the friction of the joints to hold them in any desired position than from the use of those that have racket wheels or set-screw attachments, because force of habit will cause those familiar with common brackets to break a racket by a sudden pull when they are not thinking, and persons who are not familiar with gas often think such brackets naturally work hard, and pull until they break them.

"As all gas employed for general lighting at present gives off more or less carbon, smoke bells and plates are used to distribute it (not absorb or destroy, as some people seem to think), thereby making the effect less visible. The shape of bells is only a matter of taste, except that the bell will hang plumb when it is a little heavy on one side, while the plate tends to the heaviest side, however slight the difference may be. The writer prefers to have smoke bells or plates hung from arms screwed into a frame, which, when slipped over the stem of the fixture, forms a break in the casing. There is not always a support over the center of a burner, and when bells are hung from high ceilings, the heat causes them to swing too much, but if hung near the support, their swinging is limited, and the distribution of the soot more effectual. Bells may be hung from twelve to eighteen inches above the jets, according to the fitter's judgment."

The future of gas is apparent. Coal, oil and wood will continue to be converted into gas, but it will be only fuel gas employed in the production of electrical force, which force will supply light and heat and power generally in the near future, as it now does in special cases. The *Chicago Tribune*, in an editorial based on Engineer Swinburne's recent paper on this subject, speaks of the perfection of the system in France and its introduction in England. An arc and incandescent installation at Lisle, France, supplied with current from a dynamo driven by a gas engine, was recently put in place and its workings investigated by a well-known electrical engineer, who thus reports to the Comptes Rendus: Sixteen arcs and seventy-one glow lamps were compared with the gas burners employed in the illumination of the same locality. They gave fifteen per cent. more light than the gas lamps, a fact ascertained by comparative measures of the illumination of the floor surface, and the gas engine consumed seven hundred and fifty-two cubic feet per hour, while the gas lamps consumed nine hundred and twenty-seven feet. The gas used as a motive power for driving a dynamo-supplying current to electric lamps gives a saving of seventeen per cent. in quantity with much more light than if it be consumed directly at the burner. The advantage is so great that it would seem the test must be regarded as conclusively in favor of the dynamo and as warranting a rapid extension of its use in Europe, which is said to be in progress. A similar plant, to supply four thousand incandescent lamps, is now being installed at Alicante, Spain. It is claimed that though at its best a steam engine may work with three pounds of coal per horse-power per hour, yet in practice the consumption is generally over ten, and may rise to nearly twenty pounds, when run in the irregular way required to supply current illumination. This lavish expenditure is only in part avoided in exciting electric force with the use of an accumulator to store up power during those hours of the day when it is least wanted. But the gas engine is less expensive, and can be started and stopped without trouble when desired. It may be so constructed also as to be supplied with compressed air and compressed gas, thus becoming simple in form and giving a double output; that is, exploding at each stroke instead of every second stroke, as at present. And the compressor need not become uneconomical during the day, as it would then run more slowly but with the same economy as when working at full speed. The system compares favorably with the steam engine in first cost, taking up less room, making no smoke, and being far cheaper in running. It is said that many engineers still look on the gas engine as little better than a toy, and as unprofessional, suitable only for hoisting and the running of printing machinery, and this because it has hitherto been limited to the production of a small amount of power in each instance.

Electricity is an invisible, subtle power, as old as Time himself, but little understood even by the people of the present. Centuries before the Christian era philosophy dealt with it, and years ago, before Gilbert or Boyle or Newton or Franklin, experimented with this unknown quantity, Italian, French and Spanish philosophers had a knowledge of its peculiarities. The telegraph and the electric light belong however to modern thought, and the motor to a still later age of thought. The telegraph has been carried beyond the bounds of civilization and under the ocean. The increase in the use of electric lights and electric motors is shown by the *Electrical World* to be even greater during the past few years than most people probably imagine. The number of electric lighting companies in the United States and Canada operating central stations at the beginning of 1886 was four hundred and fifty. This number had increased at the beginning of 1887 to seven hundred and fifty, at the beginning of 1889 to nearly twelve hundred, and at the beginning of 1890 to twelve hundred and seventy-seven, including twenty-five in Mexico and Central America. Meantime two hundred and sixty-six gas companies engaged in electric lighting, so that the total number of companies engaged in electric lighting at the beginning of 1890 was fifteen hundred and forty-three. The number of isolated or private incandescent and arc light plants at the beginning of 1887 was about ten hundred each. In January, 1890, there were thirty-nine hundred and twenty-five private plants in the United States, one hundred and seventy-five in Canada, and two hundred in Mexico and Central America, making forty-three hundred in all.

The number of arc lamps in use in 1882 was six thousand. This number doubled each year for four years, and has since grown rapidly until there were two hundred and thirty-five thousand arc lamps in use in January, 1890. The number of incandescent lights increased from five hundred and twenty-five thousand in November, 1886, to three million in January, 1890. The number of electric motors in operation in the country at that time was estimated at fifteen thousand, many of them from fifteen to fifty horse-power. There were nearly two hundred electric railways in over one hundred and twenty-five towns and cities, which had in operation or under contract one thousand eight hundred and eighty-four cars on one thousand two hundred and sixty miles of track. These motors find their greatest application in connection with electric light plants. Extraordinary improvements in apparatus and phenomenal expansion in the use of electricity, in all forms, mark the years 1890–91. The cottage, where electric call bells were hitherto unknown, now boasts of a system which enables the housewife to bring her servants to their senses in the wee sma' hours. Electricians, however, look for a great development of electric motors for railroads of all kinds during the next two years. Electric light and electric power for mining is a new development of considerable promise. The electric tramway and electric power for pumping, drilling, cutting, etc., have already been adopted to some extent with good results, and that it will succeed coal, water and steam as a house heater is anticipated.

Electric lighting has been a wonderful stimulant to business of many kinds since it was first reduced from a phenomenon of the laboratory to an adjunct of every-day life. Not only have engine-building and other essential industries been greatly stimulated, but an incalculable benefit has been derived from the rapid spread of electric lighting by the greater mechanical precision called for in the manufacture of the necessary apparatus. A higher order of skill and, of course, an increased modicum of intelligence have been required from mechanics employed in this direction. The average engines built in the United States today are better by far than they would have been with all our progressive ideas and inventive genius if electric lighting had not played such an important part with us in the last decade. The magnitude of the electrical industry is shown by the estimate made, presumably by persons well informed on the subject, that some two hundred and fifty thousand persons are now engaged in business in this country depending solely on electricity.

Electricity, if such a word may be applied to a reality, has come to stay. Professor Lodge in his work "Modern views on electricity," states that after all enquiries which have been made as to what is electricity, the answer may have to be: There is no such thing. The words electric and electrification may be retained, but the word electricity may have to be dropped, as it does not stand for a reality. It may be difficult for one who looks at the phenomena rather than to the relations involved in the phenomena to imagine that electricity is not some sort of an entity, and may be described if one knew how, as one would describe any other something.

It would certainly be curious if it should turn out that the reason no answer has been forthcoming to the question, What is electricity? is that there is no such thing and the question is an improper one, as if one should ask, What is odor, or brightness, or zero? Historically there are several parallel cases. A hundred years or more ago heat phenomena was attributed to phlogiston or caloric, each supposed to be an entity of some sort. The latter term is still retained for convenience, but it has ceased to have any significance as a something that gives origin to heat phenomena. When it was discovered that such phenomena were due to atomic and molecular vibrations, or what is now often called a mode of motion, both the above words ceased to have any meaning; in other words, there was no such thing as phlogiston or caloric.

Again, light was once thought to be an entity; now we know that light is a sensation, and properly does not exist independent of the eye. What was treated as light is now called radiant energy or ether waves. Though the term light is retained, it has lost the significance it had when it was supposed to be a created something. The physiologists for a very long time explained the phenomena exhibited by living things, both vegetable and animal, as due to vital force—something supposed to be utterly unlike and not necessarily related to other forces in nature — a force that could control the others in a living organization. Now that has been altogether abandoned. No biologist of any repute now believes in vital force, and the question, What is life? which has baffled every one in his attempt to define it, now turns out to be an improper question, as it is reducible to complicated molecular notions and not to an entity. As magnetism is known to be due to the position of molecules, as chemism may be explained as due to the other pressure, it really seems as if all along the line of knowledge of the physical universe what have been called forces as peculiar somethings, having individuality as matter has, have no existence at all, and that matter and ether and motions of one sort or another are all factors in phenomena. The Professor's statement, then, has a degree of probability added to it by the antecedents in the history of physics.

The science of electricity is as old as human learning. In the remotest times Greek and Arabian philosophers had something of the present electrical knowledge. Last century was full of work of pure electrical knowledge, but what was most remarkable was the tremendous development it had received since 1819. In 1837 the electric telegraph came into existence. The great scientific discoveries of Faraday, which were prepared almost deliberately for the purpose of allowing others to turn them to account for the good of man, had been going on for about fifteen years, when a young man took up the subject with a profound and penetrating genius most rare in any branch of human study, and perceived relations with mechanical power which had never been suspected before. Joulé saw the relations between electricity and force, and his very first determination of the mechanical equivalent was an electrical measurement. His communication to the British association, when it met in Cork in the year 1841, pointed out for the first time the distinct mechanical relation between electric phenomena and mechanical force. Joulé was not a mere visionary, who saw and admired something in the air, but he pursued what he saw to the very utmost practical point of work, and he it was who determined the mechanical equivalent of heat. Afterward he thoroughly confirmed the principle of his first determination of the mechanical equivalent of heat. Both in electricity and mechanical action he laid the foundation of the great development of thermodynamics, which would be looked upon in future generations as the crowning scientific work of the present century. It was not all due to Joulé, but he had achieved one of the very greatest monuments of scientific work in the present century. For an institution of electrical engineers it was interesting to think that the error relating to one of the most important electrical elements, the unit of resistance, now called the ohm, as determined electrically in the first place by a committee of the British association, and by purely electrical method, was first discovered by Joulé's mechanical measurement. It was Joulé's mechanical measurement which first corrected the British association unit and gave the true ohm.

The contribution of Thomas A. Edison to the *North American Review* of November, 1889, on the dangers of electric lighting, contains much that is instructive, outside the subject proper. He says: "So much has of late been said and written upon the subject of high-tension electric currents and their probable or possible danger to human life, and so many different opinions have been advanced by men whose positions serve to surround their utterances with an atmosphere of knowledge of the matter under discussion, that the mind of an unscientific public has been unable to come to any definite conclusion upon the basis of expert testimony. It is most unfortunate that a practical demonstration in support of the real facts of the case could not have been made in a less tragical manner than was witnessed a few days ago in New York by several thousand people; and yet if the martyrdom of this poor victim results in the application of stringent measures for the protection of life in the future, if the lesson taught is appreciated to the full extent of its fatal meaning, the sacrifice will not have been made in vain. With the increase of electric lighting (which to-day is used only to a very limited extent as compared with its inevitable future use) and the multiplication of wires, these dangers which exist now in one thousand different parts of the city will be manifolded many times. In fact the opportunities for repetitions of the accident referred to above will be practically unlimited. I can write upon this subject only as one convinced. I cannot discuss it otherwise. The public would scarcely be interested in the details leading up to the position taken by myself and the conclusions to which I have come, for the reason that it would involve a mass of matter such as they have been attempting to digest during several months past; and, instead of explaining, I might succeed only in adding to the present confusion of popular ideas. But I may say that I have not failed to seek practical demonstrations in support of such facts as have been developed, and I have taken life (not human life) in the belief and full consciousness that the end justified the means.

"The currents used for electric lighting at the present time may generally be divided into four classes: First. The low-tension continuous current, with a pressure not exceeding two hundred volts, used for incandescent lighting. Second. The high-tension continuous current, with a pressure of two thousand volts and over. Third. The high-tension semi-continuous current, with a pressure of two thousand volts and over. Fourth. The alternating current, with a pressure from one thousand to three thousand volts and over. The first is harmless, and can be passed through the human body without producing uncomfortable sensations. The second is dangerous to life. Momentary contact with a conductor of the third, results in paralysis or death, as has frequently occurred, and the passage of the fourth, or alternating current through any living body, means instantaneous death.

"These are simple facts, which can not be disproved. There is a record of nearly one hundred deaths, which furnishes an unanswerable argument in support of these statements. Discussion and controversy may serve the questionable purpose of delaying popular faith in them, but they cannot change them, and the sooner they are accepted and acted upon, the less liability will there be of a recurrence of the late horror, which is still fresh in the minds of all those who witnessed or read of it. It has often been asked why the number of accidents of this nature is larger in the city of New York than in any other city. The reason is that New York has a greater number of wires to the square mile than any other city in the United States. The percentage of deaths in other places will reach that of New York when wires are strung in like numbers, but if electric lighting under its present conditions extends in the latter city proportionately, its death rate will have been greatly multiplied by the time other cities reach its present high percentage. Many suggestions have been made as to the best way in which to remedy the existing evil, and the popular cry seems to be, 'put the wires underground.' But, instead of diminishing, this will increase the danger to life and property. There is no known insulation which will confine these high-tension currents for more than a limited period, and when they are placed beneath the ground, with the present system of conduits, the result will be a series of earth contacts, the fusion of wires, and the formation of powerful electric arcs, which will extend to other metallic conductors in the same conduit, and a whole mass of wires made to receive this dangerous current and convey it into houses, offices, stores, etc.

" It is thus evident that the dangers of such circuits are not confined to the wires which convey the high-tension currents, but other wires conducting harmless currents are liable to be rendered as deadly in effect as the former. It is evident, also, that a single wire carrying a current at high pressure would be a constant menace to the safety of all other wires in the same conduit. Even though these dangerous wires be placed in separate tubes in the same conduit with other tubes, the risk is not diminished. Several instances are on record, and one I have particularly in mind, showing the possibility of serious accident through the crossing of wires. Near the corner of William and Wall streets, New York, the underground conductors of the Edison Illuminating Company became crossed, and the current which was passing through them at a pressure of only one hundred and ten volts melted not only the wires, but several feet of iron tubing in which they were encased, and reduced the paving stones within a radius of three or four feet to a molten mass. This system is so arranged that consumers are not affected by such accidents as this. They may and do mean expense to the company, but the public are entirely free from any possibility of danger. The crossing of wires in this way means the concentration of several hundred horse-power of energy in a small space. What would have been the effect of such a cross as I have described had the pressure been two thousand instead of one hundred and ten volts? And what also might be the effect were it to occur in a conduit in close proximity to hundreds of telephone wires and those of other electric lighting systems? The risk, too, is greatly increased by the fact that consumers who are supplied with currents from a low-tension system are accustomed to handle their electric appliances freely, knowing them to be harmless. If these are to be rendered at any moment dangerous to life, the result will be appalling. I say nothing of the injustice in vendors of harmless supplies of electricity.

"So far, the deaths which have occurred from this source have been chiefly confined to employes of electric lighting and telegraph companies, men whose duties have required them to work in close proximity to the conductors of these death-dealing currents. It is true that a number of accidents, many of them attended with fatal results, have occurred to pedestrians on the streets of New York and other cities through the medium of fallen wires; but the risk incurred by the general public with the present system is really less than it would be if these dangerous conductors were placed in closer proximity to the ground. As the earth is approached, the danger is multiplied. The connection and crossing of two wires by a line of moisture or liquid contact are just as effective as the contact of one wire with another when overhead. That this error of judgment is not confined to the public, but is shared in by the officials of the city of New York, is made apparent by a resolution of the mayor offered at a meeting of the board of electrical control on Monday, October 14, and which is reported in the following form: 'That the numerous deaths caused by the electric light and power wires within the last thirty days, and the shocking manner in which they have occurred, furnish ample and sufficient proof that such wires are not being placed underground with a speed sufficient to insure the safety of the lives of people of this city,' etc. The logical inference here is that the lives of the people will be safe as soon as the wires have been placed under ground. If a nitro-glycerine factory were being operated in the city of New York and the people desired to remove the danger, no one would suggest putting it under ground. When it became necessary for the protection of employes and of the public to regulate boiler pressures in the city, the authorities proceeded on lines entirely different from those which are being followed in connection with electric pressures; and yet the cases are parallel, and the course of reasoning which resulted in a perfect system for the limitation of steam pressure and the periodical inspection of boilers should be retraced, and the principle applied, to secure safety from a pressure which, uncontrolled as at present, is far more dangerous than the former was before steps were taken to render it harmless.

"The insulation of a wire carrying a high-tension current in the most perfect manner known may insure temporary safety; but time is bound to develop defects as the result of the action of the current the insulating material, of a change in the molecular structure of the material itself, and for other reasons. The pulsations or vibrations in an electric conductor cause corresponding vibrations in the insulation. So powerful is this effect that the insulation gives off a sound corresponding to the oscillation of the current. So long as the insulation retains its original elasticity, the current is confined; but the influence of the air or of gas and other agents, tends to change the elasticity, and the billions of vibrations to which it has been subjected finally render it very susceptible of being pierced by a spark of static electricity. Thus an avenue for the ingress of moisture is formed, not only in one spot, but in many, through which the current may be communicated to any conductor of electricity near enough to make physical contact, or a circuit may be completed between the two by a line of moisture or the formation of an electric arc, with its subsequent destructive action. The numerous accidents which have occurred in the city of New York during the past year show to a very large extent the operation of time upon the insulating material which surrounds these wires. When first erected, the current was, to a certain extent, successfully confined, but the air is doing its work, abrasions are more easily made, and, without the adoption of genuine methods of control, accidents may be looked for in larger numbers as time goes on, due not only to deterioration of insulation, but to the multiplying of electric circuits to supply the popular demand for electric light.

"The public may rest absolutely assured that safety will not be secured by burying these wires. The condensation of moisture, the ingress of water, the dissolving influence of coal gas and air-oxidation upon the various insulating compounds will result only in the transfers of deaths to manholes, houses, stores and offices, through the agency of the telephone, the low-pressure systems, and the apparatus of the high-tension current itself. I have no intention, and I am sure none will accuse me, of being an alarmist. When the possibilities of the future are viewed in the light of recent developments, it must be apparent to every one that the time has come when those in authority should adopt proper and adequate measures for the protection of life and property, and my familiarity with the subject enables me to see very clearly the only true remedy which can be applied, namely, the regulation of electric pressures. Once these pressures are reduced to a point which is harmless, the public may retire in security and leave electricians to discuss the merits or demerits of various methods of insulating, the defects of which will only concern those interested in the commerce of electricity. There is no plea which will justify the use of high-tension and alternating currents, either in a scientific or a commercial sense. They are employed solely to reduce investment in copper wire and real estate. For instance, in arc lighting it is customary to put forty lamps on each circuit; each lamp requires a pressure of fifty volts; therefore the total pressure on the circuit is two thousand volts. Now if, instead of using only one wire for all these lamps, four circuits of ten lamps each were to be established, the pressure on each wire would be only five hundred volts. The weight of copper necessary for these four circuits of ten lamps each would be two and one-half times greater than for one circuit of forty lamps, a question, as I have said, simply of investment.

"The alternating current under high pressure and direct current high-pressure systems are also employed, as I have intimated, to save investment in real estate as well as copper. If a certain district is to be supplied with electric light, the natural point from which the currents should be distributed is the center, with wires radiating toward the circumference of the circle of supply; and if, instead of including in any one of these districts an area so large that resort must be had to high pressure in order to reach its limits, the distributing power of a single station be confined to a capacity consistent with safety, and other centers sought from which to furnish current to other areas, the necessity for high electrical pressure vanishes. But real estate in such centers as these is expensive, and the promoters of electric lighting enterprises which spring into existence with the growth and stability of the mushroom, cannot afford to consider permanency, the security of the public, the requirements of small consumers, or any such questions, which would incidentally involve the investment of larger sums of money; but, seeking the outskirts of a district, where land is cheap, or some abandoned building available for sheltering a few dynamo machines, they run small wires to the area of supply, enormous pressure being necessary to force the current through these small conductors over such long distances.

"In the last issue of the *Electrical World*, page 254, is recorded a series of experiments conducted by M. d'Arsonval, a member of the French Academy of Science, showing the effects of continuous and alternating currents on animals. He says: 'A living being is, above all, sensible to a variable state of the current, from which it follows that at a mean equal pressure alternating currents are more dangerous than continuous currents; and with a battery of four hundred and twenty volts (continuous currents) death is only caused by long repeated interruptions of the current.' In other words, the continuous current of the above pressure could not be made to cause death until it was interrupted or made discontinuous, or perhaps a better expression would be semi-continuous. By a variable state of the current is meant a fluctuation of pressure between different extremes of voltage. The human nerve system, up to a certain limit of pressure, cannot detect the flow of a continuous current if the voltage be perfectly constant. This constancy is obtained by multiplying the number of commutator bars on the dynamo. The brushes which are set upon the revolving commutator, and conduct the current from the machine to the outside system, rest alternately upon the different bars of the commutator. The greater the number of bars, the less will be the fluctuation of the current, which may be likened to a wave motion, rising and falling, and producing that variable state referred to by the French scientist.

"Nearly all dynamo machines used for arc lighting are constructed with an insufficient number of commutator bars to produce a steady continuous current. The ranges of variable pressure are not, however, nearly as great as in the alternating system. With respect to the latter, M. d'Arsonval says: 'An alternating Gramme machine caused death when above one hundred and twenty volts mean potential.' This is a small unit to contemplate after the glib manner in which it has been recently stated that this current is harmless at a pressure of one thousand volts. I have myself seen a large healthy dog killed instantly by the alternating current at a pressure of one hundred and sixty-eight volts. It is a simple matter to calculate the ranges of variable pressure in this system. The dynamo machine has no commutator. The armature or bobbin is wound in such a way that the whole of the current under a pressure (say) of two thousand volts, is sent out on the wire first in one direction, then is reversed and sent out at the same pressure in the other direction, or passes through the wire in the opposite direction; and these reversals are generally made about one hundred times in each second.

"The variable state of a continuous current at a pressure of two thousand volts means ordinarily a rise from zero point up to two thousand; after which, owing to the action of the commutator, it varies between (say) seventeen hundred and two thousand, while the variable state of the alternating current means a fluctuation from two thousand volts above the zero point to two thousand below it, or a difference of four thousand volts. The danger to life is probably proportionate to the fluctuation of pressures. When an alternating current of fifteen volts is applied to a human being in the most effective manner, the effect upon the nerve system is so violent and the pain produced so great, that it is absolutely impossible for any one to stand it. As I have said before, the only way in which safety can be secured is to restrict electric pressures. The continuous current should be limited to six hundred or seven hundred volts, with a variable range not exceeding a few volts. As for the alternating current, it is difficult for me to name a safe pressure. Its effect upon muscular action is so great that even at exceedingly low voltage the hand which grasps a conductor cannot free itself, and it is quite possible that in this way the sensitive nervous system of a human being could be shocked for a sufficient length of time to produce death. The electric lighting company with which I am connected purchased, some time ago, the patents for a complete alternating system, and my protest against this action can be found upon its minute book. Up to the present time I have succeeded in inducing them not to offer this system to the public, nor will they ever do so with my consent. My personal desire would be to prohibit entirely the use of alternating currents. They are as unnecessary as they are dangerous. In the city of New York there are many miles of conductors beneath the streets conveying a harmless continuous electric current to thousands of consumers, the maximum pressure on this vast system never exceeding two hundred and twenty volts, which will force so weak a current through the human body that it can barely be detected. Furthermore it is found to be commercially successful, and I can therefore see no justification for the introduction of a system which has no element of permanency and every element of danger to life and property.

"This is no argument in favor of monopoly. If ever there is to be a monopoly of electric lighting in the United States, it will be neither delayed, prevented nor circumnavigated by such subterfuges as these alternating systems, and their use can not be justified on that score. I have always consistently opposed high tension and alternating systems of electric lighting (although perfectly free to use them), not only on account of danger, but because of their general unreliability and unsuitability for any general system of distribution. In contemplating the efforts of the officials of the city of New York to remedy the evils connected with electric lighting, I have been impressed in a way which must have impressed other onlookers. I refer to the apparent difficulty of determining where the authority to take action rests. The hands of those who wish to act appear to be tied, which is unfortunate, considering the exigencies and urgency of the case. In England they handle these matters better. The electric lighting act of 1882 provides in section 6, 'that the Board of Trade may from time to time make such regulations as they may think expedient for securing the safety of the public from personal injury or from fire or otherwise, * * * * and any regulations so made or amended by the Board of Trade shall, from and after the date thereof, have the like effect in every respect as though they had been originally inserted in the license, order, or special act authorizing the undertaking.'

"This same section also provides that 'any local authority within any part of whose district electricity is authorized to be supplied under any license, order or special act, may, in addition to any regulations which may be made under the preceding provisions of this section for securing the safety of the public, from time to time, make, rescind, alter, or repeal by-laws for further securing such safety; and there may be annexed to any breach of such by-laws such penalties, to be recovered in a summary manner, as they may think necessary. Provided, always, that no such by-laws shall have any force or effect unless and until they have been confirmed by the Board of Trade and published in such manner as the Board of Trade may direct.'

"Thus, to a responsible body is given discretionary power for the protection of the public, and local authorities (by which is meant any municipality) have the right to apply to this board for relief from any danger which they believe to exist in connection with electric lighting systems. Certainly, the responsibility for the protection of the people of our city should be as definitely placed, and those to whom such authority is given should adopt rigid rules for the restriction of electric pressure. Perhaps police control would be even more adequate than the English system. I am not altogether familiar with the details of the system of boiler inspection which prevails in New York, but I believe it is very efficient and would serve as an excellent model for the case under discussion. When the authorities require electrical pressures to be kept within the limits of safety, and when there is an efficient corps of inspectors, as in the case of boilers, to see that the rules adopted are carried out, the security which the public demand will be attained; but until then nothing better can be looked for than a multiplication of the casualties of the past few months."

The Boston Manufacturers' Mutual Fire Insurance Company issued a circular in February, 1890, entitled "Hazard from outside electric currents." As this is a subject in which all are interested the circular is reproduced as follows: "Electric light was first introduced in a very few risks insured by this company before the year 1881. In that year, and in the first six months of 1882, it was adopted in a very considerable measure. In this period of its early introduction, prior to April 1, 1882, we received notice of twenty-three fires which had been set by the electric current in only sixty-one mills which had then been equipped. No claim for loss was made on any of these fires, but they disclosed conditions which were very alarming to us. An immediate investigation was made, under the direction of C. J. H. Woodbury, and certain rules were adopted for putting up the apparatus, insulating the wires and guarding against the dangers disclosed in these twenty-three fires. These rules were immediately submitted to all the electric light companies or manufacturers of electric lighting apparatus who had any standing in the community, and were at once adopted by them, as well as by all insurance companies. They have not been changed since that date, except so far as new inventions have called for modifications. Since April 1, 1882, a period of nearly eight years, we have received no notice of any fire which could be attributed to electricity in any risk insured by this company, and of course no claim has been made upon us for a loss which could be attributed to this cause. Our experience, therefore, justifies the conclusion to which we came after the first two years of electric lighting, that under proper safeguards it is the safest method of lighting that can be introduced. Electricity has also been applied in some of the works insured by us as a motive power, and electricity is now applied to lighting or motive power in over six hundred risks which are insured by the factory mutual companies."

The seven rules laid down by Professor Morton for the protection of men engaged in erecting or operating electrical apparatus where powerful currents are generated are as follows:

First. Do not touch or handle any electric wire or apparatus of any sort while standing on the ground, or while in contact with any iron work, gas or water pipe, or stone or brick work, unless your hands are covered with rubber gloves, and you are provided with such properly insulated tools as have been declared to be safe and in good order by the electrician or other competent officer of this company. If it is at any time necessary to stand on the ground, or on any surface not insulated from the ground, while handling electric wires and apparatus, rubber boots or an insulated stool should be used. In moving wires hanging on or lying over electric-light wires, lamps, or fixtures, use a dry hand line.

Second. Never handle any electric wire or apparatus with both hands at once when this can be avoided, and, if it is necessary to do so, be sure that no current is present, or that one or both hands are protected by rubber gloves or other efficient insulation.

Third. When handling line wires, treat each and every wire as if it carried a dangerous current, and under no circumstances allow yourself to make contact between two or more wires at the same time.

Fourth. Never open a circuit which has been in use without giving notice to the superintendent, or whoever is in charge, of your intention to do so, and at the same time request that the same line be opened at the main station and kept open until you have given notice that your work on that line is complete.

Fifth. In the dynamo room never go near the belts or dynamos, nor touch any apparatus unless you are fully informed and instructed how to do so.

Sixth. Tools used by linemen should be provided with insulating handles of hard rubber or other equally good insulator. It is the duty of each lineman to look after his own tools and see that they are in good order, especially as to their insulation. "In construction work, a space of at least twenty inches must be left between the holes for pins on the cross arms, so that a lineman may get to the top of the pole and work without danger."

Seventh. Lamp trimmers and others engaged in the care of lamps must see that the switch putting the lamp in circuit is turned off before they handle the lamp in any way.

The vernacular of electricians and even of laborers connected with electric plants is extensive even if the system is young in practice. On the list of apparatus, the following definitions are based. Pole irons and hood are used in suspending arc lamps over streets or sidewalks. The irons are necessary to support the hood, which protects the light in windy weather, as well as to bear the weight of the whole lamp.

Hood board is the name given to a board to which is attached the cut-off machine, which detaches the lamp from the circuit while the carbons are being put in place.

Outrigger is nothing more than a bracket with hinges near the wall, with rope and pulley attachments. The lamp is attached to the other end, and it may be lowered or elevated by the use of the rope.

Mast arm is a bracket, under another name, extending from a mast or pole out over the street. Rope and pulleys are attached to permit the lighting or extinguishing of the lamp.

Incandescent lighting on arc-light circuits is accomplished, without running a circuit from a separate dynamo, by an automatic cut-out which prevents an open circuit and opens a path for the current. The use of this system obviates the necessity of a second dynamo and provides for a variety of candle power.

Arc-light dynamo is the invention of Professors Elihu Thomson and E. J. Houston, and is a machine which occupies $47x64\frac{1}{2}$ inches floor space, weighs five thousand nine hundred and seventy-five pounds, and has a capacity of fifty two-thousand-candle-power lamps. The incandescent dynamo varies in system and capacity from the arc-light dynamo. The forty-horse-power dynamo weighs four thousand four hundred pounds and supplies four hundred sixteen-candle-power lamps. Other dynamos supply one thousand lamps. Controller-magnet and regulator are two distinct instruments, but auxiliaries. The magnet is a relay for the regulator, which maintains the brushes in a position to render the intensity of the current sufficient for the number of lamps in use.

Switch board is a wooden frame provided with jacks by means of which, in conjunction with the plugs attached to the flexible cables, connections between the dynamos and outside circuits are made. The switch board for arc-light circuits varies in form. Station switches complete the connection between dynamos and feeders and change the circuits. The lightning arrester protects the machinery from lightning discharges.

Ammeter, a regulator of the current generated by dynamos and the index to its intensity or amount.

The single and double lamps of the Thomson-Rice pattern are designed for eight and sixteen-hour light terms. They are self-adjusting, burn without hissing, and show from one thousand two hundred to four thousand candle-power. The short arc lamps are short and compact for use where low ceilings mark the factory or store. The tunnel lamp is made full length for eight hours' service; the focus-lamp differs from the others in construction as well as in its carbon-feeding form. Being an automatic carbon feeder, the light does not lower as in the other lamps, but is maintained at a fixed point before the reflector. The marine search lamp is made on the same principle; but the naval projector as used by the new navy is a hand feeder of six thousand to ten-thousand-candle power with silver lens.

COURT HOUSE AND CITY HALL.

FRENCH RENAISSANCE ON AN ITALIAN BASIS.

ITALIAN DRESS.

Individual distributor is the name given to an apparatus used in maintaining a regular current in a group of incandescent lamps on arc-light circuits.

Feeder boards are used in central station installation in connection with alternating and direct incandescent dynamos.

Ground detectors are employed to detect leakage of current where the wire comes in contact with a metallic substance.

Lightning arrester provides a path to the ground for lightning, leading it away from electrical instruments.

Current indicators show the quantity of current and the number of lamps burning.

The volt meter measures the voltage or potential of a dynamo and points out the quality of the light to the operator.

The transformer receives a high-pressure current through a small wire and distributes to the lamps as if direct from a dynamo of low tension, thus changing the nature of the current from high to low. The alternating dynamo and exciter, a marvelous machine, is used with this system.

Feeder and junction boxes are found at the junction of feeders and mains, provided with safety fuses, cut-offs and means of examination.

The potential indicator shows the pressure of the circuits supplying the lamps.

The Thomson recording Watt-meter is to electricity what the notorious gas meter of Chicago is to gas.

The arc light has been used for lighthouse purposes since 1858; but not until the invention of the Jablochkoff candle, in 1877, was it seriously considered as a competitor with gas. The perfection of the dynamo by Siemens and Grammé, in 1871, rendered it a commercial quantity. The following shows the increase in number of companies using arc apparatus and arc lamps, from October 1, 1883, to July 1, 1890: October 1, 1883, twenty-two companies and sixteen hundred and fifty-three lamps; January 1, 1884, thirty-one companies and twenty-four hundred and seventy-eight lamps; July 1, 1884, forty-four companies and thirty-nine hundred and eighty-eight lamps; January 1, 1885, fifty-nine companies and fifty-eight hundred and sixty-seven lamps; July 1, 1885, eighty-two companies and eighty-nine hundred and sixty-two lamps; January 1, 1886, one hundred and six companies and thirteen thousand two hundred and twenty-seven lamps; July 1, 1886, one hundred and thirty-three companies and sixteen thousand nine hundred and ten lamps; January 1, 1887, one hundred and seventy-one companies and twenty-one thousand eight hundred and forty lamps; July 1, 1887, two hundred and thirty-nine companies and twenty-seven thousand five hundred and sixty-four lamps; January 1, 1888, three hundred and three companies and thirty-six thousand nine hundred and thirty-six lamps; July 1, 1888, three hundred and fifty-eight companies and forty-four thousand four hundred and seventeen lamps; January 1, 1889, four hundred and six companies and fifty-one thousand six hundred and twenty-one lamps; July 1, 1889, four hundred and ninety-seven companies and fifty-eight thousand seven hundred and thirty-six lamps; January 1, 1890, five hundred and eighty-seven companies and sixty-eight thousand two hundred and three lamps; July 1, 1890, six hundred and seventy-six companies and seventy-nine thousand three hundred and eighty-seven lamps.

The number of companies using direct current apparatus and incandescent lamps on July 1, 1887, was ninety, and the number of lamps in use thirty-nine thousand two hundred and five. On July 1, 1888, the number of companies was one hundred and sixty-four, and the number of lamps one hundred and seven thousand and fifty-five; on July 1, 1889, one hundred and eighty-four, and one hundred and thirty-four thousand four hundred and ninety-one; and on July 1, 1890, there were two hundred and eight companies reported, with one hundred and fifty-two thousand seven hundred and sixty lamps in use.

On July 1, 1890, there were three hundred and twenty-eight companies using the alternating current apparatus and incandescent lamps. The number of lamps in use was three hundred and twenty thousand six hundred and ten, against eleven thousand one hundred and ten in use January 1, 1888.

The *Electrical World* of June 14, 1890, published a statistical table giving the number of arc and incandescent lights operated by gas companies. This table is as follows:

SYSTEM.	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,067
Edison	....	13,853
American	1,537	175
United States	632	6,141
Schuyler	1,066	....
Ball	962	6
Western Electric	788	....
Fort Wayne	1,756	8,005
Van Depoele	450	....
Waterhouse	287	....
Heisler	....	3,815
Remington	129	....
Sperry	160	....
Excelsior	205	30
Hockhausen	70	....
Weston	138	....
Fuller	10	....
Reliance	30	....
National	....	1,000
Bernstein	....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the year ending June 1, 1890, is shown in the following figures:

	1889.	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

The electric light manufacturers represented in the city in June, 1891, were: Archer Electric Light Company, Auburn Park Light, Heat, Power and Railroad Company, Ball

Electric Light Company, Bear Magneto Electric Company, Brush Electric Company, Central Electric Light Company, Chicago Arc Light and Power Company, The Chicago Edison Company, Chicago Illuminating Company, Chicago Incandescent Light Company, Consumer's Electric Light Company, Continental Electric Construction Company, Council Bluff Gas and Electric Light Company, Dyer Electric Company, Dyer Light, Heat and Power Company, Eddy Electric Manufacturing Company, Electric Illuminating Company, Englewood Electric Light Company, Electric Dynamo Company, Electrical Construction Company, Eureka Electric Company, Excelsior Electric Company, Hyde Park Thomson-Houston Light Company, Mather Electric Company, Merchants Arc Light and Power Company, Milwaukee Electric Light Company, National Electric Construction Company, Scheicher, Schumm & Co., Henry Newgard, Pennock Battery Electric Light Company, Rockford Electric Light Manufacturing Company, The Sawyerman Electric Company, South Side Electric Company, Sperry Electric Company, O. M. Stone, Thomson Electric Welding Company, Thomson-Houston Electric Company, United States Electric Lighting Company, Western Electric Company, Western Light and Power Company and the Westinghouse Electric Company. Houses dealing in electrical supplies, motors and fixtures have multiplied in later days until the industry has become a mighty one in this city.

The Edison electric light was first introduced in the West by George H. Bliss in 1881. Four years before he engaged in the sale of electric appliances. In 1867 he established the first important manufactory of electrical apparatus in Chicago and in 1872 established the house of George H. Bliss. When the Western Edison Light Company was organized in 1882, he was appointed general superintendent.

Calcium lights were used outside theaters and similar establishments for some years before the arc light was introduced. Thomas Bent, of 33 North Jefferson, was manufacturer of calcium lights in 1872. In 1879 Bent was at 30 Market street and John Knost, Jr., had a similar light shop at 86 Market street. While John Haverly carried on the theater in the old restored postoffice building, where is now the First National bank, the calcium light was a nightly attraction and an advertisement in itself.

In July, 1891, the United States Circuit court handed down a decision in the suit of the Edison Company vs. the United States Electric Light Company. It was full of historical references, even quoting the following sentence from an article by Schwendler, published in the *Telegraphic Journal* in 1879: "Unless we shall be fortunate enough to discover a conductor of electricity with a much higher melting point than platinum, and the specific weight and specific heat of which conductor are also much lower than for platinum, and which at the same time do not combine at high temperatures with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination." The share of Edison in making the incandescent light practical, was stated by the judge as follows: "It was a remarkable discovery that an attenuated thread of carbon would possess all the long-sought qualities of a practical burner when maintained in a perfect vacuum. The extreme fragility of such a structure was calculated to discourage experimentation with it, and it does not detract in the least from the originality of the conception that previous patents had suggested that thin plates, or pencils, or small bridges could be used. The futility of hoping to maintain a burner in vacuo with any permanency had discouraged previous inventors, and Mr. Edison is entitled to the credit of obviating the mechanical difficulties which disheartened them, but what he did in this respect was a matter of only secondary merit and was no longer new in the art, because he had already disclosed it in his French and English patents. What he actually accomplished was to unite the characteristics of high resistance, small radiating surface, and durability in a carbon conductor by making it in a form for extreme tenuity, out of any such materials as we mentioned in the specifications carbonizing it, and arranging it as he had previously arranged his platinum burner in an exhausted bulb made wholly of glass and sealed at all points, including those where the leading wires entered, by the fusion of the glass. He was the first to make a carbon of materials, and by a process which was especially designed to impart high specific resistance to it, the first to make a carbon in the special form for the special purpose of imparting to it high total resistance, and the first to combine such a burner with the necessary adjuncts of lamp construction to prevent its disintegration and give it sufficiently long life. By doing these things, he made a lamp which was practically operative and successful, the embryo of the best lamps now in commercial use, and but for which the subdivision of the electric light by incandescence would still be nothing but the ignus fatuus which it was proclaimed to be in 1879, by some of the learned experts, who are now witnesses, to belittle his achievements and show that it did not rise to the dignity of an invention. The nearest approach in the prior art to the invention of the second claim is undoubtedly the lamp of Edison's French and English patents with a platinum burner. It seems almost preposterous to argue that the subdivision of the carbon filament for the platinum burner of that lamp was an obvious thing to electricians. It would have been, probably, if there had been such a thing as filamentary carbon in the prior art, but the nearest approximation to it were the ribbon-shaped carbon burner of low resistance of Mr. Farmer (which was not a part of the prior art, but an isolated sample known only to a select few), and the low resistance carbon red burner of the patent of Sawyer & Mann."

"Presuming that the decision will stand, it will result in a complete monopoly of the present form of incandescent lamps, and as the lamp is the key to the whole situation, no incandescent lighting being possible without it, it would seem to result in a complete monopoly of electric lighting. The only thing necessary to obtain injunctions against the other users and manufacturers of lamps who were not parties to the suit in New York is the filing of a bill of complaint against them and the asking of an injunction. The business at the present time throughout the country is about fifty thousand lamps a day, or about $25,000. That would mean a business of about $10,000,000 yearly, and of that the Edison Company has been doing only about one-half and the infringers the other half."

The Thomson-Houston Electric Company is the present name of the American Electric Company. In April, 1891, the following named directors were chosen: Henry A. Pevera, Charles A. Coffin, Joseph N. Smith, Benjamin F. Spinney, Charles B. Newhall, T. J. Jefferson, S. Endicott Peabody, F. Thomson and Frederick P. Fish. The annual statement for the year ending February 1, 1891, shows that the company's sales have increased from $426,-987, in 1883, to $10,617,661 in 1890. More than one thousand substantial companies in the United States are using the Thomson-Houston system; five hundred of the arc-lighting companies operate an incandescent system, employing between six hundred thousand and seven hundred thousand Thomson-Houston lights, and the company has more than one hundred and fifty lines of electric railways under contract and in operation, aggregating over two thousand cars. The surplus January 1, 1891, was $6,022,533. The history of this company, as written, shows that the rapid increase in the number of applications of the Thomson-Houston motors and the wide range in the character of these applications, together with their uniform success, have awakened a widespread interest in their development, both mechanical and electrical, as well as their distinguishing features of design and construction. In the following pages will be found interesting facts and figures of the early steps and later efforts which have led to the production of the Thomson-Houston motor as now constructed. In the early days of the development of the dynamo machine, Professors Thomson and Houston pointed out some of the important matters in connection with the transmission of power by electric motors, and at the Franklin institute of Philadelphia, on a number of occasions, used one dynamo to drive another and showed the smallness of the conductor required to carry a number of horse-power. Calculations were also made at the same time of the electro-motive forces and currents required to carry large powers to a considerable distance. Some of these were published. One of the early and interesting experiments which Professor Thomson made use of in his lectures at the Franklin institute, at the time he was located there in 1878, was to run a Gramme machine as a generator and a small Brush machine as a motor; which Brush machine was in turn belted to another smaller Gramme machine generating current, which in turn fed another reciprocating motor, pointing out in this experiment the feasibility of the transfer of power, and even making a double transformation of power into electricity, electricity into power, and again the same set of transformations repeated in the same series of actions. A small Siemens machine, constructed by Professor Thomson in 1876, was run from batteries as an electric motor and developed considerable power, proving the economy of such a machine when used as a motor.

When the American Electric Company, now the Thomson-Houston Company, was organized in New Britain, Conn., in 1880, special exhibits of the apparatus were made for the benefit of the subscribers to the stock. A small power plant was established, the dynamo furnishing current for a motor of several horse power which was used in driving wood-sawing and other machinery in a separate building some distance away. As soon as the works of the company were established in New Britain, an electric motor was put in and used entirely in driving machinery in the pattern shop. The speed of the motor could be varied and its direction of rotation reversed by very simple appliances. Since that time the company has used on a number of occasions electric motors fed from circuits about the factory for doing special work or delivering power at various points. This was long before there was any market for electric motors as such, for commercial use. On the removal of the factory to Lynn from New Britain in 1883, similar use of electric motors were made.

A notable instance of the use of electric power in the factory was in 1885, when the driving of all the shafting and machinery in factory A was accomplished by using a large incandescent dynamo as a motor. The power required was about fifty or fifty-five horse power. The work was rendered more difficult by reason of a large proportion of this power being necessary to turn the many feet of counter shafting which it was required to get under way from the very start, and which threw a very heavy load on the motor at the time of starting. As the potential used was only one hundred and ten volts, it required a specially constructed rheostat of large current capacity in order to start the motor easily and have everything under perfect control. The occasion for the use of the electric motor in this case was the failure of the steam plant which ran factory A, so that it required some ten or twelve days to make the repairs, and during this time the large motor did its work satisfactorily. Two dynamos were put in position in factory B and furnished the energy for driving the motor.

The company now employs in its factory over twenty stationary motors in the various departments, for the distribution of power. They are all of the design commonly known as the "Thomson-Houston stationary motor." The large carpenter shop of the company has been running continuously for the last four years with an electric motor. For the conveyance of both manufactured articles and raw material between its various factories and storehouses, a small electric tramway is in use, which has a number of switches and turnouts and several very heavy grades, the latter in some cases running as high as fourteen per cent. It has been found that by the use of this railway convenient transportation is obtained at a very low cost. The total horse power of motors used in the factory is at present about two hundred and forty-five, including stationary motors, of from three to forty-five horse power, and six railway motors.

The Thomson-Houston Company was one of the earliest companies in the field to undertake the commercial development of the electric motor and its application to various uses.

All the motors are of one type, extremely simple in construction and all parts are interchangeable. They are ordinarily shunt wound, and are built for constant potential circuits of one hundred and ten, two hundred and twenty and five hundred volts. The first two are intended for use in connection with the ordinary two and three wire systems of incandescent lighting, and the last one is for use on railway circuits or for special purposes where power is transmitted over long distances or in units so large that a lower voltage would prove uneconomical. Special motors differing in type from the one here shown, or for other voltages, are built for special cases. By a simple shunt winding, properly proportioned, automatic regulation of speed of less than two per cent. variation is obtained on all of the Thomson-Houston motors, no matter what the fluctuations of load may be. This feature is of especial value, as it permits the simplest possible construction of the motor, and at the same time secures an automatic regulation of speed well within the range of that which is guaranteed for the best regulated high-speed steam engines.

The Thomson-Houston motors thus combine the highest possible electrical efficiency with mechanical perfection, and are the results, as now designed, of the careful investigations of Prof. Elihu Thomson and Mr. E. Wilbur Rice, Jr., the company's electricians.

The cost of electric plants has been a drawback to the wholesale introduction of electric light, but as the system extends, the cost grows less and will decrease by years, until every house in every city, town and village throughout the land, may be lighted, and perhaps heated, at a nominal cost. At present the companies generally charge so much a lamp for the electrical outfit. Suppose that a shop or an office building wanted a system of three hundred lamps. That would require to start with an engine of thirty horse power, for the calculation is that one-horse power will run ten ordinary lamps. The best dynamos run eleven lamps per horse power. A good engine will cost, say $750 set up. Then the dynamo, the wires, the switches and the lamps must be provided by the company owning the system decided on. These will cost $10 a lamp for three hundred lamps if for an office building or a hotel, but for a factory not over $8. The difference is in the finish of the brass-work, the trouble in running wires to the places were wanted, etc. In a hotel much care must be taken in such matters. In a factory there are no hard-finished walls to take care of. A little over $3,000 would pay for a factory plant of three hundred lamps. No account is made of the boiler, because in all buildings where such plants are wanted there is commonly a surplus of boiler capacity on hand. The lamps cost eighty cents each, and are warranted for six hundred hours. If a good system is adopted there is no occasion to hire an expert to care for the plant. An engineer fit to trust with a steam engine is capable of caring for the plant. The dynamo lasts a lifetime, so do the wires, and an intelligent boy screws on a new lamp when the old one wears out. The running expense of the system depends on the cost of coal. It takes practically about five pounds of coal per horse power per hour in an ordinary building. If a good condensing engine is put in, then the consumption of coal is reduced below that. A ton and three-quarters of coal should run three hundred lamps twenty-four hours. If smaller plants are wanted, say twenty-five or fifty lamps, it costs from $12.50 to $13 per lamp for the electrical plant all in and ready to set going. In spite of what has been said about fires, the electrical plants are much safer than oil or candles or gas. The insulation does not wear out when properly put up, because there is nothing to wear it out. If exposed to chafing, as it would be if the wire hung where it could swing against a post or a wall, the rubber will wear off leaving dangerous exposure of the wire.

The telephone or sound transmitter is said to have been known to the ancients, but its introduction to the Caucasian people is of recent date. In 1837 Dr. Page, of Salem, Mass., made some experiments in the transmission of sound; in 1854 Mr. Charles Boursel, of Paris, France, carried enquiry much further; in 1861 Philip Reis, of Friedrichsdorf, brought a sound transmitter almost to the point of perfection, and in 1874–6, A. G. Bell and Elisha Gray, residents of Boston, gave the finishing touches to the ideas of Reis, and made the electric telephone a commercial factor. In April, 1877, a telephone transmitter was patented by Emilé Berliner, and in July, 1877, a transmitter and a receiver were patented by Edison;

the transmitter of Professor Hughes, invented in 1878, and that by Francis Blake, about the same time, are most valuable inventions. The capability of the telephone for the transmission of sound brought it into favor at once in the central business districts of American cities. As the system of exchanges was perfected, the telephone was extended to private houses, and the long-distance telephone supplanted the telegraph. In 1876 the American District Telegraph system ruled in Chicago. In 1878 the telephone ruled.

The electric alarm guard is one of the most valuable protectors of the home, warehouse or store. By the system now in use, the slightest disturbance of property guarded by it is made known at watchman's headquarters with greater despatch and certainty than the fire alarm gives notice to the fire department, for this subtle, invisible guard is automatic, and alarms regardless of the willingness or unwillingness of the disturber, whether it be thief, legitimate visitor or fire.

The National Electric Light association, is a new organization, having on its roll of membership the names of the leaders of thought on this subject in America and Europe. The convention of 1890, held at Kansas City, heard addresses by Prof. Elisha Thomson, Prof. Henry A. Rowland, who based his paper upon an extended correspondence with members of the association, the object of which was to ascertain with what technical questions connected with the art of electric lighting they found the greatest difficulty. Thomas A. Edison addressed the convention by phonograph, in a very perfect imitation of his voice, and loud enough to be heard in all parts of the house. Frank J. Sprague treated the subject "Electricity as applied to street railways;" F. F. Sickles, "The history and theory of the steam engine;" George H. Babcock, "The economic generation of steam;" Myron D. Law, "Nine years with the arc lamp;" C. A. Harber, "Line insulation from the standpoint of practical experience;" T. Carpenter Smith, "A universal system of central station accounts;" A. J. De Camp, "The cost of the products of central stations;" C. J. H. Woodbury, "Central station construction;" C. J. Field, "A recent Edison central station and the results thus far obtained;" Henry W. Pope, "How our paths may be paths of peace," and C. C. Haskins, "Prodigality in economy."

CHAPTER VIII.

THE WATER AND PAVING SYSTEMS, ETC.

DURING the last decade the relations between the building trades and the department of public works have been drawn closer. The water and paving systems of a city are connected in many ways with the building trades. Without them the city would return to its village condition. With them its extension, far beyond the present limits, is made possible, for the modern citizen will not build in the wilderness as the older settlers did. In this chapter the systems are treated, just so far as they relate to building contractors, material and city houses, their history being held over for the proposed volume on the public works of Chicago.

In the days of the Chicago log cabins, Le Mai, Beaubien, Kinzie and other pioneers found the river-water good enough for drinking and cooking purposes. When the settlement increased, wells were excavated and the bucket-and-rope system of hauling up the water adopted, and in 1834 Peter Wolf established his water-cart system. This was a two-wheel vehicle, on which was a large barrel containing several barrels of water. Wolf delivered this water in much the same manner that milkmen deliver milk at the present time, but it was the unadulterated article from the lake at the foot of Randolph street. The excavation of a public well in November, 1834, was completed at a cost of $95.50. In 1836 a water company was chartered, but owing to the panic, this company did not venture on the construction of water works until 1840, when the reservoir, which occupied the corner of Lake street and Michigan avenue, was commenced; but not until 1842 were the works ready to supply water to homes and business houses, at from $10 per annum for cottages to $500 per annum for factories, but the water carriers' trade was not abolished, for up to 1851–2, the water-cart was a well-known institution of the town. Nicholas and Peter Reis and Joseph Scheger or Seger, were the leading water carriers in 1843, and continued to hold the lead for seven or eight years until the system of supply was improved in 1852. A contemporary chronicler describes the condition of the works as follows:

"In May, 1848, the quality of the water was so bad that public action was aroused, and a committee from the Chicago Mechanics' institute submitted a plan for a new supply. It recommended that a pipe be laid three feet below low water-mark, to extend in the lake opposite First street to a depth of twenty feet of water, where the end was to be turned down to within ten feet of the bottom; two reservoirs to be erected on the shore of the lake, each to have a capacity of twenty thousand cubic feet. One reservoir was to be a settling basin for the other. A wooden main was to be carried down First street, across the river, and to the western boundary of the city. Every second block should have lateral mains. It was estimated that these wooden mains could be laid at an expense of $2,000 a mile. In 1850 the Hydraulic company were only supplying about one-fifth of the city. The other four-fifths still patronized the watermen or, if poor, took their supply from the river, which was quite as poor as they. The Hydraulic company had nine and one-quarter miles of wooden mains in use in that year. One thousand hydrants were set, eight hundred of which supplied private families, and the remainder supplied livery stables and public houses. The general health of the city was suffering, and in April, 1850, a public meeting was held at the City hall to devise means to secure a supply of pure and wholesome water. A committee was appointed to obtain facts and to suggest remedies, with members from each division of the city. This committee was composed as follows: Peter Page, chairman; R. H. Foss, T. M. Moody, south side; A. S. Sherman, Luther Marsh, west side; R. J. Hamilton, William E. Jones, north side. To these gentlemen, supported by public sentiment, is due the organization of the second water company."

The insertion of taps and the introduction of water into buildings dates back to February 15, 1854. Before December 31, that year, two thousand seven hundred and forty-five buildings were supplied.

The number of buildings into which water was introduced in 1855 was one thousand five hundred and six. Prior to that year, two thousand seven hundred and forty-five buildings were supplied, or a total of four thousand two hundred and fifty-one at the close of 1855. Of this total, two thousand five hundred and fifty-eight were in the south division; nine hundred in the north and seven hundred and ninety-three in the west division. There were eight hundred and ninety-eight buildings subject to assessment, not supplied at the close of 1855.

The common council of the city passed an ordinance April 30, 1855, which established the following regulations for water takers:

Section 1.—No occupant or owner of any building in which water is introduced, will be allowed to supply other persons or families. If found doing so the supply will be stopped and the amount of payment forfeited.

a.—Whenever two or more parties shall be supplied from one pipe, connecting with the distribution main, the failure, on the part of any one of said parties, to comply with the rules and restrictions of this board, shall authorize the board to withhold a supply of water from such main, without any liability whatsoever, and all payments made shall be forfeited.

b.—No addition or alteration whatever, in or about any conduit, pipe or watercock, shall be made, or caused to be made, by persons taking the water, without notice thereof being previously given to, and permission had, in writing, from the board.

c.—All persons taking the water shall keep their own service pipes, stopcocks, and apparatus, in good repair and protected from frost at their own expense, and shall prevent all unnecessary waste of water; and it is expressly stipulated by the water commissioners, that no claim shall be made against them or the city, by reason of the breaking of any cock or service pipe.

d.—No hydrant will be permitted on the sidewalk or in the front area, neither will they be permitted to be kept ruuniug when not in actual use; taps at washbasins, water-closets, baths and urinals, must be kept closed in like manner.

e.—Applications for water must state, fully and truly, all purposes for which it is required; and when paying the semi-annual charges for it, parties must, frankly and without concealment, answer all questions put to them relating to its consumption. In case of fraudulent misrepresentations on the part of the applicant, or of uses of water not embraced iu the applicant's bill, or of willful or unreasonable waste of water, the board of water commissioners shall have the right to forfeit his payment, and the supply of water will be stopped, unless the party shall promptly pay such additional charge as the board may impose.

f.—The various officers employed by the board, and every person by them delegated for the purpose, must have free access, at proper hours of the day, to all parts of the building, in which the water is delivered and consumed, to examine the pipes and fixtures, and to ascertain whether there is any unnecessary waste of water.

g.—Water-rents must be paid semi-annually in advance, on the first days of May and November, at the water-commissiouers' office. If not paid at their office within thirty days thereafter, ten per cent. will be added for the expenses of collection. At the termination of thirty days, all rents or assessment remaining unpaid, will be collected in the manner provided by law.

h.—For a violation of any of the preceding rules and requirements, this board reserves the right to stop the supply of water without any further or other preliminary notice; nor will it be restored except upon payment of the expenses of shutting it off and putting it on, and upon a satisfactory understanding with the party that no future cause of complaint shall arise.

Sec. 2.—No person shall, in any manner, obstruct the access to any stopcocks connected with any water pipe within any street, alley or common of said city, by means of any lumber, brick, building material, or other article, thing or hindrance whatsoever, under a penalty of not less than $5 nor more than $50.

Sec. 3.—Any person who shall violate any or either of the "rules and restrictions for the government of water-takers," shall, ou conviction, in addition to the enforcement of the forfeitures, liabilities, and stipulations and reservations therein contained, pay a fine of not less than $3 nor more than $20.

The board of water commissioners established a schedule of water rates and published it in their report for January 1, 1856, thus:

FRONTAGE TAX.

FRONT WIDTH.	One story.	Two stories.	Three stories.	Four stories.	Five stories.
14 feet	$ 5	$ 7	$ 9	$ 11	$ 13
16 feet	6	8	10	12	14
18 feet	7	9	11	13	15
20 feet	8	10	12	14	16
22½ feet	9	11	13	15	17
25 feet	10	12	14	16	18
27½ feet	11	13	15	17	19
30 feet	12	14	16	18	20
32½ feet	13	15	17	19	21
35 feet	14	16	18	20	22
37½ feet	15	17	19	21	23
40 feet	16	18	20	22	24
45 feet	18	20	22	24	26
50 feet	20	22	24	26	28

The family occupying the dwelling house to number not more than ten persons; for each person beyond that number, fifty cents per year shall be charged. Dwelling houses occupied by more than one family shall be charged as follows: The second family, one-third of regular rates; the third family, one-fourth regular rates; the fourth family, one-eighth regular rates. Each family over four families, one-eighth regular rates. The board could determine the rates to be charged for extra families.

The miscellaneous rates per annum were: Dry goods, hardware, book stores and others of similar character, \$6; bakeries, average daily use for each barrel of flour, \$3.50; offices of professional persons, from \$3 to \$5; saloons, groceries and provision stores, from \$6 to \$100; hotels, taverns and boarding houses, in addition to the regular rates for private families, each room, \$1; boarding schools, each room, \$1; public schools from \$15 to \$25; bathing tubs (private), each, \$3; bathing tubs (public), each, \$6; water-closets (private), \$3; water-closets (public), \$4; warehouses, \$6; steam engines, each horse power ten hours per day, \$5; printing offices, according to the number of persons, not including steam engines, from \$6 to \$40; printing offices, first power press, \$6; printing offices, balance press, \$4; printing offices, hand press, \$2; private stables, for each horse up to two, \$2; private stables, for each horse over two, \$1; livery stables, including carriage washing, each horse, \$2; dray and team horses, \$1; for each butcher's stall, \$3; railroad depots, each locomotive (trip out) from \$75 to \$100; gas-works from \$100 to \$300; fountains, one-sixteenth of an inch jet, in use four months of the year, average use three hours per day, \$15; fountains, one-eighth of an inch jet, in use four months of the year, average use three hours per day, \$60; workshops for ten persons or under, \$3; workshops, each additional person, twenty-five cents; use of hose, \$5; building purposes, for each barrel of lime or cement, five cents; street sprinklers, for each team employed during the season of sprinkling, per day, fifty cents; water carts, for each hundred gallons taken, and cartmen not to charge over ten cents per barrel, three cents; brewers, for each hundred gallons taken, two cents; distilleries, for each hundred gallons taken, two cents.

Hose for washing windows, front areas, and sidewalks, shall be used only from the first of May to the first of November, from 6 to 7 o'clock in the morning, and from 6 to 7 o'clock in the evening. If allowed to run at any other hours, the supply will be cut off without previous notice. All manufacturing and other business requiring a large supply of water, are to be charged therefore per one hundred gallons, at the average estimated quantity during the year. The year to be estimated at three hundred days, as follows: When the quantity used averages from two hundred to three hundred gallons per day, at the rate of four per cent. per hundred gallons. When the quantity used averages from three hundred to one thousand gallons per day, at the rate of three and a half cents per hundred gallons. When the quantity used averages from one thousand to five thousand gallons per day, at the rate of three cents per hundred gallons. When the quantity used averages from five thousand to ten thousand gallons per day, at the rate of two cents per hundred gallons. When the quantity used exceeds ten thousand gallons per day, the price will in no case be less than one cent per hundred gallons.

The last thirty-five years witnessed giant strides in the system of water supply and the abolition of the carrier and well systems. Withal this progress, the higher buildings of the city have to use the pump to supply the reservoir on the roof, whence the supply for the upper floors is obtained. Water fixtures have been also advanced to a place which brings them into the region of the ornamental, and it is a common thing to behold in cottage and palace a network of pipes, joined with pleasing ingenuity while filling all the useful purposes for which they were intended. House supply pipes are generally of lead, running from the street main to a point under or in the kitchen, whence the several branches go out to bathrooms, laundries and washbasins. As has been stated, the water has to be pumped, in buildings over three stories, to a reservoir on the roof, whence the branch pipes lead to local supply cocks.

The stand pipe fire escape is an institution about twenty years old. Each year since the great fire has witnessed the invention of one or more styles of this combination. One of the most modern consists of a stand pipe with ladders and balconies, supported by brackets firmly anchored in the wall. The railing consists of gas pipe or round iron with either cast or wrought posts. The standard size of the platform is twenty-six inches in width by six feet in length, covering the whole of an ordinary window. The special features of this stand pipe are the arrangement of the ladders. Each ladder extends but one story, and the manhole is at one side of it, at the bottom of each flight. In the ordinary fireescape the ladder is continuous from top to bottom, and the manholes are all in line directly in front of the ladder. The new arrangement avoids the danger of falling from the ladder farther than one story, and also the risk of persons being swept off the ladder by others falling from above. In connection with it is the great stand pipe, with brass automatic Siamese at the base, and brass valves above the level of each floor and at the roof. The hose which could formerly be observed in the basement of large buildings, is now found on each floor, hanging on or near a single or Siamese valve, while close by are fire extinguishers of one or other of the many patents.

In 1847 the canal commissioners established a point called low water mark, in order to have a base line for their topographical surveys, and this was used as an imaginary horizontal plane underlying the entire city. In 1855 this plane was adopted as a base from which the grades of streets were measured and became known as city datum. It is about three feet below the present surface of the river and fourteen feet below the curb grade of the sidewalks in the south division, from State westward to the river. The present grade is much higher and is a great improvement on the first grade of 1855. That grade contemplated a surface drainage of six inches in each block, from Madison street north, and from State street west to the river, making Water street eleven feet above city datum; Lake street, eleven and one-half feet; Randolph street, twelve feet; Washington street, twelve and one-half feet, and Madison street, thirteen feet.

The present grade of Water street is three feet higher than in 1871, thus giving eight and one-half and nine-foot basements, instead of the six-foot basements of that period. At the close of 1871 J. M. Van Osdel and two other architects were invited by the board of public works to determine a grade. The architect named suggested fifteen feet for Michigan above datum, fourteen and one-half for Wabash, and fourteen feet for all other streets in the south division. He also suggested to make a summit at each crossing as now seen on Michigan boulevard, but owing to financial reasons this suggestion was not then acted upon.

In 1855 a board of sewerage commissioners was appointed. This board selected E. S. Chesbrough, chief engineer, and adopted his system of sewers and street grades. The project met with much opposition as it would elevate the sidewalks to the center of the hight of many buildings, and it was questioned whether filling could be obtained to raise the streets to the great hight required by the new grade; but the sewers were a necessity which could no longer be dispensed with, and the people submitted gracefully to the inevitable. The work was necessarily gradual. New buildings were made to conform to the established grade of 1855, and the old ones were raised to the required new position by a simple application of jack-screws, resting on foundations of timber. The old Tremont House, a massive five-story brick building, was raised about eight feet, and a new basement constructed under the entire building. About five thousand jack-screws were employed in this performance. It was found that the sewers would allow an excavation of eighteen inches or two feet of the original soil, and that the earth so removed, to form the new cellars, would prove sufficient to fill the streets to the required grade.

On May 26, 1856, the dissatisfaction of lot owners with the system of street grading pursued on Lake street took visible shape in the form of injunction proceedings. Judge Caton refused to estop the city, and during the ensuring two years, the business section of the village was lifted out of the marsh.

In 1881 radical changes were effected in pipe lines, curbing, sewers and other branches of public works. On Michigan avenue the curb line was changed at the expense of the South park commissioners, and hydrants moved to correspond with such change. Similar work was performed on West Washington street, at the expense of the west park commissioners, while on State street the distribution pipe was moved a few feet eastward from Twelfth street to Harmon court, at the expense of the South Side Cable Company. In the memorable year 1882 other changes were suggested, and since that time thousands of miles of pipe and conduits have been placed, until now the underground city is filled with piping for purposes of all kinds.

The statistics of the department of public works regarding streets in each division of the city, the material used in paving, mileage, etc., are as follows:

TOWNSHIP.	Miles of streets.	PAVED STREETS—MILES.							Total.	Unimproved streets — miles.	Miles repaved in 1880.
		Cedar block.	Macadam.	Medina stone.	Granite.	Sheet asphalt.	Asphalt block.	Brick.			
North division	168.38	76.71	1.07	0.49	0.04	2.19	......	......	80.50	87.88	3.21
South division	228.28	84.72	9.51	1.70	19.64	1.04	4.11	......	120.72	107.56	2.82
West division	372.42	212.93	21.08	0.39	0.80	1.86	......	......	237.06	135.36	1.66
Hyde Park	541.94	1.50	123.19	......	......	......	......	0.38	125.07	416.87	......
Lake	347.09	8.92	40.17	......	......	......	......	......	49.09	298.00	......
Lake View	131.53	24.40	31.65	......	......	......	......	......	56.05	75.48	0.54
Jefferson	242.28	......	......	......	......	......	......	......	......	242.28	......
Cicero	84.79	......	......	......	......	......	......	......	......	84.79	......
Gano*	119.00	......	......	......	......	......	......	......	......	119.00	......
Viaduct approaches	1.15	1.15	......	......	......	......	......	......	1.15	......	......
Total	2,236.86	410.33	226.67	2.58	20.48	5.09	4.11	0.38	669.64	1,567.22	8.23

*Including Washington Heights, West Roseland and part of Calumet.

The Goodspeed Pub. Co. Chicago

J. B. Simpson

Comparatively little asphalt street work has been accomplished. Dearborn avenue and a few south and west-side residence streets are already laid in sheet asphalt, while it has been adopted for other streets.

Asphalt pavement was first introduced in the restoration of Paris, under Baron Hausman. About 1870 it was laid down on two streets of the Irish capital, and in 1871, it was selected as pavement for a few of the London streets. The expense of such an improvement grated harshly on the pocketbooks of property owners in the two last named cities. The cobble stone and cheap labor, to which they were and are accustomed, could not be brought into comparison with the asphalt and skilled labor; yet, the cobble stone was good enough, and their policy being "to let good enough alone," the pavement of civilization was not extended. Washington (D. C.) led in the use of this style of pavement in the United States, and was followed by New York.

Asphalt is in general use at Paris, Vienna, Rome, Madrid, Berlin and other cities of Europe, on both business and residence streets. Under the varying climatic conditions it is stated to wear well. The experience of these cities with the pavement is satisfactory. It is clean and almost noiseless, and can sustain a heavy traffic; it is considered most economical. Paris and London pay much more for their pavement per square yard than New York does.

The ancients used asphalt as cement, and specimens of masonry banded together with it may to-day be seen as strong, if not stronger, than in youth.

The firm of Simpson Bros., workers in Portland and granite-cement walks, and rock asphalt floors, has been in existence twenty-two years, and is doing a large business in asphalt, Portland cement and granite cement (known as granilithic, lithogen or granitoid) pavements, and furnished the Grand Central depot with the following: Neuchatel and Seyssel rock asphalt floors, etc., viz.: Dynamoroom, emigrant waitingroom, lavatories, kitchen, pantry and servingrooms, tower roof and belfry floor. In addition to which, among many others, the following may be mentioned: Chicago, Milwaukee & St. Paul railroad, Kinzie street, freight house floor; Chicago & Northwestern general offices and vaults; Boston & Albany railroad, new station, Springfield, Mass., all platforms; South Framingham, Mass., platforms; Allston repair shops, paint shop floors; Boston & Albany road, Boston milk depot; Michigan state prison, Jackson, kitchen, bath house and bucket yard; Minnesota reformatory, St. Cloud, kitchen, diningroom, laundry, corridors, etc.; Cook county insane asylum, Jefferson, kitchen, diningroom, etc.; Chicago Auditorium, tower and theater roofs; Illinois Steel Company, laboratory floors, South Chicago and Joliet; Knight & Leonard, 107 Madison street, printing house floors; Daily News floors, besides a large number of brewery floors, private stables, school houses, driveways, walks, courtways, basements, balconies, laundries, etc.

The concrete walks, drives, platforms, etc., laid in Boston and neighborhood, are Boston & Albany road, Boston, station platforms, etc.; Newton, station driveway; Newtonville, station driveway and platform; West Newton, station platform; Auburndale, station driveway and platform; Chestnut Hill, station driveway and platform; Newton Centre, station driveway; South Framingham, station driveway and others.

Rock asphalt is a lime ore impregnated naturally, by a geological phenomenon still but imperfectly explained, with bitumen in the proportion of six to ten for one hundred. It is found in strata like coal. It exists in Europe in many places, and is a material relatively rare, but of great value. It is mined principally at Seyssel and Pyrimont, in the valley of the Rhone, France, and in the Val de Travers, canton of Neuchatel, Switzerland. If a piece of asphaltic ore be exposed to a temperature of from 80 degrees to 100 degrees Centigrade, it will become powder. The bitumen, which serves to keep together the molecules of lime, softened by the heat, begins to melt; and, their cohesion thus destroyed, the grains of lime, each coated with a pellicle of bitumen, separate, and form a chocolate-colored powder. If, while it is yet hot, this powder is put into a mold, it will reassume, as soon as it is cold, its former consistency; and the block of ore will have been reconstructed with its same grains, and, in general, its same properties. It is upon this singular property that the principle of laying roadways of compressed asphalt is founded. If, instead of treating asphalt as explained above, it should, after being broken, be heated in kettles (in which a little bitumen has been first put to serve as a foundation) for five or six hours, there will be obtained a sort of black semi-liquid paste which is mastic asphalt. This is the material which, after being mixed with a little gravel, is used for laying walks, floors, roofs, etc. In this operation the bitumen which is first put into the kettle plays the same part as grease in a frying-pan. It stops the asphalt from burning before it is melted, while at the same time it restores the bitumen that the ashpalt has lost by evaporation. The paste referred to is then put in the molds, varying in shape according to the use for which the asphalt is prepared. Generally each of the cakes thus formed bears the manufacturer's mark, which is of great use in detecting frauds, for nothing is easier than to imitate mastic asphalt. With a little bitumen and some macadam powder, any one can make a block that the most practiced eye can not tell from the genuine. It is time alone which denounces the imposture, and often at a disastrous price to those so deluded. Compressed asphalt has long been used in Europe for carriage ways, sidewalks and courtyards, subject to considerable traffic.

E. P. North, C. E., member of A. S. C. E., in his report on the pavements of London and Paris ("Transactions American Society of Civil Engineers," clxxx. page 126), says: "From a sanitary point of view, asphalt is without a peer. Its surface is smooth, regular and non-absorbent, with no cavities or cracks of any kind to retain the infected mud and dust of the streets, and the soil beneath it is kept dry. It is more thoroughly cleaned either by sweeping or washing, than any other pavement. Its freedom from noise, and its other excellences, are fast placing it in all the business and banking streets in the city of London, where it seems to be superseding all other pavements. In comparison with granite, its great economy is to brainworkers and the owners of horses." In an article in Johnson's Cyclopedia, Gen. Q. A. Gilmore says of the "Natural rock asphalt:" "It must be conceded that nothing has yet been discovered which can replace with entire satisfaction the bituminous limestones of Seyssel and Val de Travers. In the natural asphaltic rock, the calcareous matter is so intimately and impalpably combined with the bitumen, resists so thoroughly the action of air and water and even muriatic acid, is so entirely free from moisture, properties due, perhaps, to the vast pressure and intense heat under which the ingredients have been incorporated by nature, that we are forced to attribute the excellence of this material to the existence of certain natural conditions which the most skillful artificial methods fail to reproduce."

Mastic asphalt is used for floors of cellars, stores, breweries, malthouses, hotel kitchens, stables, laundries, conservatories, public buildings, carriage factories, sugar refineries, mills, rinks, etc.; and for any place where a hard, smooth, clean, dry, fire and water-proof, odorless and durable covering of a light color is required, either in basement or upper stories. It can be laid either over cement concrete, brick or wood, in one sheet without seams; also over cement concrete for roofs for fireproof buildings. For dwelling-house cellars, especially on moist or filled land, this material is especially adapted, being water-tight, nonabsorbent, free from mold or dust, impervious to sewer gases, and for sanitary purposes invaluable.

The *Cyclopedia Britannica* tells of the mastic process thus: "The bed of the roadway is prepared with a smooth, level foundation of concrete, which must be thoroughly dry before the application of the asphalt. The mastic is prepared for application by heating the asphaltic stone and breaking it into small pieces, which are then melted with a quantity of mineral tar, to which the same sand is added. The molten mass is then poured over a section of the prepared concrete uniformly to the requisite depth; the surface is smoothed and covered with a coating of fine sand, which is stamped into the asphalt. The proportions of tar and sand used vary with the composition of the asphaltic stone employed and the position occupied by the pavement."

CHEMICAL ANALYSIS.

Val de Travers.

No. 1.

Val de Travers natural rock as mined: carbonate of lime, eighty per cent.; bitumen, twenty per cent.

No. 2.

Val de Travers (Neuchatel) mastic block as prepared for the market: No. 1 pulverized, then melted and four and a quarter to five per cent. of mineral tar added.

No. 3.

Val de Travers (Neuchatel) mastic as laid in floors and roofs, approximately: No. 2, sixty per cent.; bitumen, five to seven per cent.; sharp sand or torpedo, thirty-three to thirty-five per cent.; laid on at about 400 degrees Fahrenheit; surface finished by rubbing with fine sand and wood floats, then marble dust and rubbing stones.

Seyssel.

No. 1.

Seyssel natural rock as mined: carbonate of lime, ninety per cent.; bitumen, ten per cent.

No. 2.

Seyssel mastic block as prepared for the market: No. 1 pulverized, then melted and five to seven per cent. of mineral tar added.

No. 3.

Seyssel mastic as laid in floors and roofs, approximately: No. 2, sixty per cent.; bitumen, five to seven per cent.; sharp sand or torpedo, thirty-three to thirty-five per cent.; laid at about 400 degrees Fahrenheit. Surface finished by rubbing with fine sand and wood floats, then marble dust and rubbing stones.

Weights of asphalt and of mastic, as laid per square foot, are as follows:

Asphalt Block.

1 inch thickness per square foot............8½
¾ inch thickness per square foot...........7
⅝ inch thickness per square foot............6
½ inch thickness per square foot............5

Mastic as Laid.

1 inch thickness per square foot, about.....15
¾ inch thickness per square foot, about....12
⅝ inch thickness per square foot, nearly....11
½ inch thickness per square foot, nearly... 9½

The requisite thickness is thus given: Brewery floors (over wood or cement), one to two inches; courtways and alleys for teams (over cement), one and a half to two inches; basements, except house (over cement), three-quarters to one inch; basements, house (over cement), one-half to five-eighths inches; floors for general business (printing houses, etc.), three-quarters to one inch; stable floors (over wood or cement), one inch.

Quadrilling is cutting into squares for ornamentation, also to obviate the possibility of horses slipping.

Foundations for laying mastic on the ground or over arches make concrete base two and a half to four inches thick, composed of clean, sharp gravel or sand, a quick setting cement, carrying broken stones in such quantities as will allow free mortar to appear on the surface when same is being laid, so that same can be laid absolutely true to a straight edge. Troweled surface not necessary. Over wood specify a layer of dry felt paper, to separate mastic from wood, to prevent the contraction and expansion of the wood from cracking asphalt. If for water-tight floor, upstairs, specify asphalt fillet around columns, partitions, etc.

The advantages of Seyssel and Neuchatel rock asphalt are: It is equally durable over wood, cement or brick, it can be laid in the coldest weather, it is waterproof, it is fireproof, it is odorless, it is non-absorbent, it is impervious to sewer-gas, it is noiseless, it creates neither dust nor mud, it is of a light color, it is hard and smooth, it is dry and durable.

The application of paving brick to the streets of Chicago has yet to be made. On residence streets, particularly short streets, this material appears to be specially adapted. What improvements in manufacture may effect, toward rendering the brick durable enough for heavy travel, is a matter of speculation.

The Purington Paving Brick Company, of Galesburg, Ill., was organized in May, 1890, with a capital of $200,000. They purchased fifty acres of land three miles east of Galesburg, forty-five of which were of shale, which during the last few years have become famous as the material from which the celebrated Galesburg paving brick was made. There have been two yards manufacturing these bricks for several years at Galesburg. The Galesburg Brick and Tile Company and the Galesburg Brick and Terra-Cotta Company; both of these companies have been successful as to quality of bricks and profits.

The intention of the Purington Paving Brick Company was to erect two Chambers machines, artificial dryers and permanent down-draft kilns. Owing to the formation of the land but one of these machines could be erected until a portion of the high bluff had been worked out, so that it was the middle of 1891 before the plant was completed. One large-sized Chambers machine was erected with a two-hundred-and-twenty-five-horse-power Corliss engine; two of the largest-sized Frost Manufacturing Company's dry pans; an Iron-Clad Dryer and six Eudaly kilns, 83x18 inside measurement. Oil is used entirely as a fuel. It is estimated that the output of the yard completed is twenty-five million bricks per year. It is located on the line of the Atchison, Topeka & Santa Fe road, with a switch from the Chicago, Burlington & Quincy, which gives them excellent shipping facilities. A peculiarity about this plant is that no tight and loose pulleys are used, friction clutches being used altogether. The buildings are all of brick, heated by steam, and arranged to run winter and summer continuously. A coil of pipe is extended under the dry pans so as to prevent clay from freezing. The use of oil for paving brick has been already demonstrated to be far superior to wood or coal and the quality of product, and the vitrification seems to be more thorough and complete.

The sidewalk, though under control of the public works' department, is now constructed and paid for at the instance of owners of abutting property. The first self-supporting cut-stone sidewalk was placed in front of McCardle's restaurant on Dearborn street between Lake and Water streets in 1860. The stone, twelve feet long and six inches thick, rested on the outside curb wall and on a light brick wall, erected near the building line. There was hesitation at first in adopting the cut-stone vault covers and on three several occasions attempts were made to construct a series of thin, brick arches, abutting in rolled-iron beams, to support a pavement for sidewalk; but the structures collapsed as soon as the centers were removed from under the arches. In 1860 Reed, the druggist, whose house was on the north side of Lake street between Clark street and La Salle street, had a sidewalk built of stone twenty-four and one-half feet long, sixteen feet wide, and ten inches thick, which weighed nearly twenty tons. This stone was quarried at Singer & Talcott's quarry, Lemont, brought to Chicago on canal boat and moved on rollers from the boat landing to Lake street. At this time the republican convention was in session here and some wag labeled the stone, in large painted letters, the "Republican platform."

CHAPTER IX.

THE LUMBER INTERESTS.

IN those countries in Northern Europe where wooden houses prevail, it is contended that when properly built, wooden dwellings are warmer, less damp and altogether healthier than houses of stone or brick. Dr. Seymour at the meeting of the Royal Asiatic society, of Japan, explained that the remarkably small infant mortality in that country was due in a great measure to the fact that the Japanese live in well-built wooden houses. It is also noticed that those foreigners living in Japan who reside in brick and stone houses are much more subject to diseases and illness than those who live in wooden houses.

But except in the portions of Chicago beyond the fire limits, buildings wholly of wood, will, in a short time, be seen no more, and those choosing to live in wood residences, for healthful or other considerations, must do so at the expense of many of the conveniences incident to location in more central portions of the city. The progress in building in Chicago may be divided into the following eras: Prior to 1832, log structures; 1833–55, frame buildings, with a few brick houses; 1855–71, wooden buildings, with brick and stone fronts; 1872–80, brick buildings, with stone fronts; 1880–91, high brick buildings and residences inside, and frame residences and cottages outside. A consideration of these steps of advancement will bring to mind how wood, which was used exclusively at first, was, to some extent, crowded out by brick and stone and mortar, and later was encroached upon by iron and steel. In the central portions of Chicago little wood is used, except for interior work. But it must be remembered that the development of the lot and house-owning movement, through building associations and otherwise, has conduced greatly to the expansion of the area of cities and towns. In all the outlying parts of Chicago, and in the suburbs, the growth of population has been enormous during the past ten years. The building of thousands of houses has been a direct benefit to the lumber trade, for structures of the cottage and villa order are, in the vast majority of instances, built of wood. The feature of urban and suburban growth indicated, is apparently but a beginning of what is to be seen in future years. This prospect opens out a wide view to the lumber dealer, and he can safely count on a steady increase of demand from this source for years to come.

A remarkable change has been effected in respect to interior finishing within the past two or three years. A dwelling, costing, with the lot on which it stands, $4,000 and upward, that does not contain hardwood finishing in part or wholly, is a rare one. When a real-estate dealer takes a proposed purchaser into a house for the purpose of showing off its merits, he calls attention to the hardwood casings, doors or floors contained in it as features of special merit, but nothing extraordinary. If the house has no hardwood finishing in it, that fact is considered by the agent a subject for apology. It is often the case that the lower story is finished in hardwood, usually oak, while the chambers are equipped with hard pine. In other instances, the reception hall is finished in oak, while the residue of the structure is done in either white or yellow pine or both. The floors are usually of pine, though the kitchen and diningroom in all good houses are generally floored with hardwood, maple and quarter-sawed yellow pine having the preference. In some houses oak has been used below, and black ash in the second story. The last named wood is not to be despised for finish, and could be profitably used much more than it is. So could white ash and soft elm. Gum does not figure as extensively in interior work as it should, though considerable is used.

Among the effects and fancies of architects and projectors of new buildings, it is a fortunate fact that substantiability in structure is a ruling characteristic, and whether timbers or flooring, or whatsoever is the material required, they are calling upon the lumberman for materials in grosser forms, and are putting up their buildings as though they had a faint hope they would endure forever. The occasional visitor looks upon some of the lofty structures planned by modern architects as frail and dangerous, and is fearful to enter such buildings lest by misstep he should topple the whole thing over, but the facts reassure him. The buildings such as are now marking the development of the city are iron and stone, yellow and Norway pine for timbers, and yellow pine and maple for flooring, the most enduring woods that are suitable for such purposes. In one such structure the first layer of flooring is of two-inch yellow pine, then a layer of asbestus; on top of this is a layer of one-inch white pine flooring; another layer of asbestus, and the top of the floor is of one-inch maple, making a four-inch hard lumber flooring and the two of asbestus between.

The following list comprises most woods ever used to any extent for interior work. Some of them are classed as cabinet woods: Bird's-eye maple, curly maple, plain white maple, butternut, red gum, chestnut, whitewood, beech, elm, rock elm, hard maple, basswood, white basswood, long-leaf yellow pine, cypress, California redwood, mahogany, cedar, white holly, rosewood, tulip, cocobola, amaranth, ebony, olivewood, satinwood, sandalwood, lignum vitæ, greenheart, violet, dogwood, thuya, amboine, camwood, zebra. The use of some of these woods has been so small as to be scarcely noteworthy. In the list of fancy cabinet woods ebony, boxwood, tulip, cocoa, cocobola, lignum vitæ, snakewood, zebra, amaranth, rosewood, leopard, greenheart, violet, dogwood, quassia, thuya, amboine, camwood, pimento and letter are most in favor.

Northern white or soft pine has always been considered king among American lumber producing woods. For several generations it was the main dependence throughout the North. In the east the exhaustion of the supply in Maine, Northern Vermont and New York necessitated the larger employment of spruce and hemlock, and a more copious drawing on southern pine. But Canada and Michigan have long furnished vast quantities of white pine for eastern consumption. The great prairie northwest, from its early settlement, has depended on the forests that lie in the upper lake region for a lumber supply. White pine in abundance, convenient to water transportation to distributing points, seemed to have been specially provided by providence to furnish habitations for the treeless plains of the interior. It was here that the white-pine industry and trade assumed its greater magnitude, until it became regnant in the country at large. It has always been the contention of the friends of white pine that no other lumber could prevail against it while the supply should hold out. It has been considered so specially adapted to various uses, and, on account of its light weight, so easy transportable at comparatively small cost, that it could compete against any other kind of lumber, and that, too, in almost any section of the country. In a measure this assumption has been justified by the facts. While the center of consumption is still east of the Mississippi river, the center of supply is moving northwestwardly. Under such circumstances it is plainly to be seen that this city and the territory farther east will hereafter increasingly draw upon Northwestern Wisconsin, and even Minnesota, for a large part of its white-pine supply.

Georgia, Mississippi, Louisiana, Alabama and Arkansas long-leaf pine has been in use in the North for the last two decades. In flooring, wainscoting, etc., it is invaluable, and in Europe, except France, it is highly prized for mantels and other decorative work. This so-called yellow pine ranks first in value and importance among the forest trees of the states mentioned. Its tall, columnar trunk furnishes some of the most popular building material. Close-grained and resinous, it is very durable, and polishes well. This pine is fast increasing in favor as a medium-priced wood for interior work. Its beauty, when given a natural finish, has proven a revelation to many of the builders. As building material spruce, hemlock, North Carolina and yellow pine have for years occupied a large place, while North Carolina pine has recently made such advances that it promises to become the principal wood for ordinary uses.

The oaks are widely distributed over the temperate parts of Europe, Asia, North Africa and North America. On the mountains of Europe and North America they grow only at moderate elevations, none near the Arctic Circle, and they grow well in the northern and middle United States. The oak seems to be everywhere. The only pine forests in which it is not intermixed are on too sandy soil or beyond the northern limit of the wood. Oak is found mixed with pine and spruce in the Green mountains, the New England forests, in Pennsylvania, in the Adirondacks and in Wisconsin and Michigan. Even in the northern portions of Minnesota and Dakota near the northern limit of the wood, the burr oak drags on an existence among the pine and white spruce. This scrubby variety is scattered among the pine in the Black Hills, it is among the pine and Douglas spruce in Colorado, among the pinons or nut pine of New Mexico, and among the pine of Arizona. On the Sierra Nevada the oak region crosses the pine region, and scattering oaks reach far up into the mountains. But the aridity of the climate prevents them from flourishing between the one-hundredth meridian and the eastern base of the Sierras. They have been found scattered among the red wood on both sides of the coast range mountains. Though oak, from the time when the ancient structures of England and continental Europe received their framework and finishing, has been a standard wood, in this country, until recent years, it was mostly used in manufacture, such as required material of strength and endurance, like frames for machinery, stocks of tools, wagons, etc. During the past ten years oak has come into use as house finish to an extent never before known. As this fashion has become prevalent, oak furniture has also come into use. At the same time there has been an increase in consumption in various manufactures. The railroad requirement enlarges as mileage increases. The manufacture of railroad and mural tramway cars is also absorbing an augmenting amount of oak. The tendency of modern architecture and manufacture is to the employment of strong material and that susceptible of an artistic finish. Iron, steel and oak go hand in hand in this tendency. Hereafter the demand for oak, as chief among the hardwoods, is bound to increase from year to year. White oak is a standard wood for interior finish. In the opinion of many, nothing can take its place in attractiveness, and wears better than all other wood. Red oak is a softer working lumber than the white variety and costs less. Both oaks are quarter-sawed, and so cut the former is becoming more popular every year. It has a beautiful silver grain, produced by the sawing, and always holds its place in the market.

Yellow poplar has cheapness to recommend it as a desirable finishing wood, even if it possessed no other desirable qualifications; but when given a hard oil finish it resembles satinwood in appearance. It is also handsomer in its natural state than many other cheap woods.

Cypress is a low priced but handsome wood for interior work. There are few woods that are susceptible of a richer appearance when given a natural finish, and certainly none that will withstand the ravages of time more successfully. The dark-red and curly boards possess an exceptional degree of beauty.

Red gum has become important in the market. There is a multitude of purposes for which it is being used, with increasing admiration on the part of the users. The wood is being used for interior finish, doors, piano and organ cases, furniture, etc. Its use in Chicago for doors, wainscoting, etc., was introduced about twelve years ago. The efforts to prevent its tendency to warp have been attended with marked success, and when the process is perfected red gum will doubtless take the place of the greater number of highly ornamental woods. It has not yet reached the hight of popularity, but has numerous advocates and supporters.

At the Institute of Building Arts is a redwood exhibit which admirably demonstrates the decorative possibilities of that great California wood. The display consists of various natural specimens of veneer, finished and unfinished, including curly, root, blister and burl redwood. The beauty of the wood is practically shown by two handsome tables and a complete mantel, entirely of redwood, which for elegance could scarcely be exceeded by any wood, mahogany or otherwise. The exhibit is daily examined by a large number of visitors, who come to the institute because of the great variety of things among the building arts there displayed, and architects have taken great interest in the wood. The fact is that very little has ever been done in this city in the way of introducing redwood for the various uses to which it is adapted, and intending consumers are more or less at sea in regard to the practical details of its sale and utilization. A great many inquiries are made respecting the cost of veneers, how they can be supplied, etc., and as to how low wide, clear redwood can be sold, but it often requires a good deal of experimenting and figuring before it can be ascertained whether redwood can be used to advantage.

There are some one hundred and fifty species of holly, of which several occur in the temperate northern hemisphere, Northwest America excepted, by far the larger number in tropical Asia and America, and very few in Africa and Australia. White holly grows to some extent in the southern states, but it is a scarce article in the market, the selling price ranging from $160 to $180. There has been a demand exceeding the supply even at these figures. The wood is used largely for inlaid cabinet work and for finishing purposes. A recent bill of specifications called for holly doors, casings, etc., for several rooms of an artistic south side residence.

There are several varieties of elm. The common elm, a doubtful native of England, is found throughout much of Europe, in North Africa, in Asia Minor, and as far east as Japan. It grows on nearly all soils, but thrives best on rich loams. The American or white elm is a hardy and very handsome species, of which the old tree of Boston Common was a representative. Elm has been used to a small extent for interior finish. Rock elm is a low-priced domestic wood that possesses a remarkable degree of rich natural beauty when treated to hard oil, equally as handsome as several of the high-priced foreign woods.

Cedar is found in many parts of the United States, and in building is used principally for piling, posts and veneering, and to some extent has been used for interior finish. Its uses in small wood manufactures are well known.

Cherry has long been valued by cabinetmakers, and has been so popular for interior finish that it is becoming scarce and is consequently augmenting in price. It is used in partition, in Eastlake finish, and in doors and moldings. There are ninety or one hundred varieties of cherry, and it grows in nearly all parts of the world.

Chestnut has for many years been in use as a cabinet wood, and latterly has been employed in interior building. Among the more solid woods it was at one time esteemed second to oak, which it so closely resembles that in old woodwork the two timbers are difficult to distinguish. There are few localities in the better-known parts of the earth where some of the varieties of chestnut do not grow.

Beech has been used somewhat in interior finish.

Boxwood grows throughout Great Britain and Ireland, in Southern Europe, Persia, India, and in the southern part of the United States. It possesses a dense structure and fine grain and has a yellow color. It has been employed somewhat in interiors and is a favorite wood among turners and carvers when they have a demand for really fine work.

Birch possesses good qualities that are being recognized. The sap wood has a sufficient degree of beauty to make it highly prized for ordinary finishing purposes, while the pure red and curly stock is not surpassed in beauty by cherry, mahogany or rosewood. The common birch grows throughout the greater part of Europe, and also in Asia Minor, Siberia and North America, reaching in the north to the limits of forest growth.

Mahogany was first mentioned by Sir Walter Raleigh, who used it in 1595 at Trinidad for repairing his ships. It was not introduced into England, however, until early in the eighteenth century, when it quickly became popular as a cabinet wood. The supply used here is derived from Mexico, Cuba, San Jogo and San Domingo. On account of its expense it is not used largely for interior finish.

The ash is indigenous in Europe and also extends into Asia. The American ash is a very tough timber, and the white ash is beautiful in grain and free from brash, rendering it a good wood for interior building.

Maple and sycamore are of the same family. There are about fifty species, natives of Europe, North America, North Asia, notably the Himalayas and Japan. The earliest known maples occur in the Miocene strata of Oeningen, where nineteen species have been found. Not so many grow in any one locality at this time. Maple is remarkable for its whiteness, but acquires a reddish tinge upon exposure to the light. The varieties sold in the Chicago market and used in Chicago building are the bird's-eye, plain white, curly and hard maples. For a cheap, natural finish all of these maples are used to great advantage. Quarter-sawed sycamore is an aspirant for a greater degree of favor as a finishing and cabinet wood, and possesses remarkable qualities from the standpoint of beauty.

It is a well-known fact among dealers and consumers that fashion in woods rules about as arbitrarily as it does in dress, equipage, household arrangement and decoration, or any other particular in civilized life. As the London tailor and the Paris modiste dictate as to what shall be the fashion, in human garniture, so the purveyors of wood furnishings determine the mode in their specialties. Thus a mercantile factor enters into the problem. Individual and public taste does not altogether decide in the matter. The motive when nearly every fashion is initiated, is to create a demand and secure profit. This it is that instigates the promotion of trade in woods. The consumer does not so much select the lumber he will use, as the dealer chooses it for him. In every instance, however, the dealer is prompted by the quantity of a certain kind of wood he can obtain, and the ease with which it can be handled. He is much influenced by the availability, in all respects, of this or that wood. The woodworker also has something to say about this. Thus there are several influences determining the drift of the trade, but when we go back to the beginning we find that the producer and dealer, with the consumer as an auxiliary, set the fashion in the woods.

A few years ago clear white pine was thought to be good enough for interior finish in first-class houses in the northern states. This was largely so because high-grade white pine was plenty, and led the trade. Hence it was put forward as the best all-round material for interior finish. It was the fashion, simply because dealers did not like to furnish anything else, and always put white pine in the foreground. Of course when a costly structure was in contemplation, mahogany was the thing, and doubtless always will be so long as the wood can be obtained.

As time passed, walnut became the rage for fine finish and furniture, the most fashionable cabinet wood in use. This was because it was found to finish in fine style and was abundant. Manufacturers could find plenty of it to saw, and dealers seized on walnut as an available merchant wood. For this reason it was pushed into recognition and use. All dealers talked walnut, glorified its beauty and scouted other competing woods. All the time the forests in the older producing states were full of red and white oak, but nobody wanted them while walnut was plenty.

The time came when the walnut supply declined to such an extent that dealers could not get hold of a sufficient amount of high-grade stuff to render the trade large and profitable. Then oak was fairly forced in as a substitute in finishing and furniture work. Especially was the forcing process peculiar to red oak, which has become the standard wood in the West in the kind of consumption named. Until about 1880 red oak was a despised wood. It was too brash for timber and machinery and wagon dimension. What was it good for then? Some enterprising genius prepared it as a cabinet wood, and used it as such. Then it was discovered that it had beauty of grain, and was susceptible of a high finish, because it would absorb and hold the "filler" better than ordinary woods. It was also soft enough to work easily. When manufacturers and dealers found that red oak could be thus utilized, they set about pushing it into notice as a fashionable wood, and in two or three years it became the rage. White oak also, on account of its beauty when quarter-sawed, chimed into the oak style with distinguished harmony. Oak still holds its place as the leading cabinet wood. It covers a wider range of use than any other, except pine, in the strictly building trades. The different varieties are adapted to the cheaper furniture as well as finish done in the highest style of the art. The costliest structure would not be considered too poorly finished if nothing better than fine quarter-sawed oak was used in its interior furnishings. Even high priced pianos and organs are incased in oak.

Often oak is spoken of as a fashionable fad that will soon go out of favor. Manufacturers and dealers talk thus because they compare oak with other woods that have risen to the hight of recognition and then dropped back among the mediocre or miscellaneous woods. But oak has a quality and claim to permanency such as no other wood on the American continent possesses. In the first place, it is a timber of great antiquity. The progress of European civilization was marked with the use of oak in structural work and in interior finishing and decoration. It was used in the medieval churches and other religious houses, in the castles of the lords and the cottages of the peasants. Its endurance is attested by observation in many ancient houses that have endured the ravages of time until this day. People respect antiquity, and that is the reason why oak is now finished in the antique, as it is called. Although oak is now the fashion, it is but a revival of the mode that has prevailed from the earliest period of modern history. So we should not think of it as an ephemeral, passing craze that will soon be succeeded by another. Besides, what can take the place of oak? As has been said, manufacturers and dealers do much in setting the fashion, and since oak is the most abundant and available cabinet wood in the country, they will keep it in the front as long as the supply is ample.

After walnut had lost first place as a furniture and finishing wood, cherry came in as the fashion. It is still a popular wood, but it is passing through an evolution like that of walnut. It is becoming scarce, and dealers begin to talk of it as if it were going out of fashion. Sure it is that when it gets so far out of reach of the dealers and consumers that it can not be largely handled and lavishly used, it will fall among the special woods that do not occupy a prominent place in public estimation. Ash had a spurt of popularity a few years ago in the way of furniture, especially for chamber sets. The rage did not last. Attempts have been made to urge maple and gum to the front as cabinet woods. Bird's-eye and curly maple are highly prized as specials, but they do not cut a great figure in the trade. Gum makes haste slowly, but will one day be held in higher esteem than now.

There was a spurt of demand for birch three or four years ago, and dealers who thought they saw a fashion for that kind of wood coming put in stocks of it. Suddenly the birch boom collapsed, and dealers have gazed wistfully upon their piles of that wood ever since. There is a surmise in the minds of dealers that the scarcity of cherry will divert attention to birch, but dealers have not sufficient confidence to go ahead and buy. Probably when the birch craze comes, if it comes at all, it will be after dealers have unloaded their stock at a sacrifice.

So it is throughout the different varieties and sorts of hardwood lumber. No one can tell how long the present craze for red oak for interior finish will last. Yet dealers must go on putting in heavy stocks of that variety, but just now fashion in building decrees it in greatest demand.

In 1607 the settlers on the James river found an almost unbroken forest to the north and south, and westward to the Ohio. Beyond was an unknown land, save to a few French and Spanish explorers, who clothed that region with a glamor of mystery. A few years later the Pilgrims landed in a pathless wilderness. They found, or those who came after them did, the whole of what is now New England one vast sweep of woodland of magnificent proportions, probably extending over ninety-five per cent. of the area. The only cleared lands were the few corn fields of the Indians and an occasional natural meadow along the streams, subject to annual overflow, and the salt marshes near the coast.

The Dutch settlers on Manhattan island found all the region to the north and west to the St. Lawrence and Lakes Ontario and Erie, now comprised within the boundary of New York, all a dark, mysterious forest, the only open land being the mountain summits, the scattered beaver meadows and the clearings surrounding the Indian villages in the interior. Next, the followers of Penn found the same true of the area of the Keystone state, while Delaware and New Jersey were heavily timbered. An average of eighty-five per cent. of the territory of these four states was solid forest. Fully sixty per cent. of the surface of Maryland was timbered, while Virginia, including what is now West Virginia, was more solidly covered than any other of the older states, excepting Kentucky and Maine.

Thence southward to the gulf and westward along the line of the Ohio, across and beyond the Mississippi, to the western boundary of what is now the Indian territory, stretched a more magnificent forest than can be found to-day outside of the tropical regions of Africa and South America, covering fully seventy-five per cent. of the total area, and reaching north in its westerly limits till it included a good slice of Illinois and all of Missouri.

North of the Ohio, Ohio and Indiana were heavily timbered to the extent of fully sixty per cent. of their area, while to the northwest what is now Michigan and Wisconsin was covered with what has probably been the most profitable forest of the country. But not to exceed eighty-five per cent. of Michigan and seventy-five per cent. of Wisconsin was thus covered. Of Minnesota not over sixty per cent. of the total area was timbered, and that practically marked the limit east of the Rocky mountains. The distinctively prairie region is popularly and erroneously supposed to have been one vast treeless buffalo range. In Illinois, which was and is a typical prairie state, when the white man made his advent here every stream of any importance was bordered with a wide fringe of timber, which, in numerous instances, broadened out into extensive forests, while thousands of acres were included in the oak openings, with the southern portion practically all forest land. Not less than twenty-five per cent. of the area of the State was well timbered. Of the other prairie states, Iowa, Kansas, Nebraska and the two Dakotas at time of settlement contained an average of seven per cent. of their area covered with timber.

Up the eastern slopes of the Rockies, there was more or less timber, but much the larger area was a waste of alternate grassy savannas, rocky acclivities and sagebrush plains. Fossil remains show that that section contained much more and larger timber in prehistoric times than since the advent of any known race of men on the continent.

Over the divide, the western slope has for many centuries been the home of the most remarkable flora of the northern temperate zone, the creation of isothermal conditions presented nowhere else, which protected the region from excessive cold or extreme drought. It is impossible to tell how large a portion of New Mexico and Arizona the old Spanish padres found timbered, but from the huge beams yet found in their old adobe missions, it is safe to conclude that large trees then grew where scarcely a shrub is found to-day; and as they show sixteen per cent. of forest, all of ancient growth, there must have been much more at that period, while more than thirty-three per cent. of the surface of California was tree covered, and something like forty per cent. of Oregon and Washington.

Of the remaining mountain territory of the United States, it may be said, it never possessed much timber, being largely volcanic, and it probably contains more to-day than it did fifty years ago, the result of the care of the owners of the cattle and sheep ranges, who realize its value as shelter for stock and as an element in the water supply. A careful analysis and comparison of the foregoing figures will show that of all the territory embraced within the present boundary lines of the country, not more than sixty-seven per cent. was timber land at the time of the first English settlement, two hundred and eighty-three years ago.

At the present time the forest area of the country is less than five hundred million acres, and a large part of this area consists mainly of waste brush land and sparsely treed tracts. The quantity of lumber and wood annually required by the population amounts, in round numbers, to about twenty billion cubic feet, divided thus: Lumber market and manufactures, two billion cubic feet; railroad construction, three hundred and sixty million; charcoal, two hundred and fifty thousand; fences, five hundred million; fuel, seventeen billion five hundred million. Many of the best and most useful trees of our forests are being rapidly thinned out, and the fact is every day being impressed upon the minds of thoughtful lumbermen that the timber resources must be husbanded unless it is wished to see them exhausted sooner than has formerly been thought possible. The history of every country proves that a moderate extent of forest promotes both its agricultural and manufacturing interests. In Europe, as well as in America, the reckless devastation of forests would not only cause a future want of all the materials the woods are producing, but also bring about climatic changes disastrous to agriculture and the welfare of the people. The conditions favorable for a fulfillment of such dangers no doubt are growing with the increase of population. It has been said that the tendency of nature to clothe waste places with a growth of timber was sufficient to restore the ravages made by the ax of the farmer and the lumberman. It is believed that this statement is far from true. It requires a careful management of the still existing forests, or the balance of forest land in the United States can not indefinitely meet the demands of its resources. As has been stated in round numbers, the quantity of lumber and wood annually required in this country for domestic use only, amounts to about twenty billion cubic feet. The export trade would considerably augment this estimate. To this amount add the annual destruction of wood by forest fires, not less than ten million acres of woodland being burned over every year. Not only is the young growth destroyed by these fires, but the capacity of the soil for tree production is diminished. The amount of forest products required by the population must increase enormously within the next century. The average yearly growth of timber in the United States can not be exactly calculated, but while the capacity of the soil, climate and indigenous species of the country are greater than those of Europe, yet in their present condition the forests of America do not compare favorably in regard to annual yield with the well-cared-for and well-stocked continental forest areas. In the South the destruction of forests has not kept pace with that in the North, and the supply there can as yet easily fill the demand, but the recent impetus given to the southern lumber trade, and the prospects of its continuous and rapid increase, lead to the reflection that the want of timber in that region will not be averted much longer than in the northern lumber-producing areas.

During the past twenty-five years the United States has sent abroad, in round numbers, \$720,000,000 of forest product, or \$28,800,000 a year. In this period the entire exportation of all crude and manufactured products which are derived from the forest has increased rapidly and been nearly doubled. The increase is less in the wood manufactures than in the crude products. The following figures of imports and exports are taken from statistics issued by the United States treasury department for 1889 and 1890:

DUTIABLE IMPORTS.	1890. Feet.	1889. Feet.	1890. Value.	1889. Value.
Boards, planks, deals, etc.	715,104,000	655,334,000	$ 8,250,398	$ 7,959,780
Shingles	216,609,000	205,824,000	457,911	442,927
Other lumber			942,375	1,248,316
Timber, hewed and sawed			46,850	4,209
Unmanufactured wood			9,436	8,739
Wood pulp	88,746,565	52,756,374	1,722,988	969,367
Other manufactured woods			1,611,806	1,231,323
Total			$13,041,764	$ 11,864,661
NON-DUTIABLE IMPORTS.				
Manufactured wood			$ 5,019.389	$ 4,065,323
Total			$18,061,153	$ 15,929,984

EXPORTS.	1890. Feet.	1889. Feet.	1890. Value.	1889. Value.
Boards, deals and plank	613,745,000	604,662,000	$10,018,485	$ 10,071,972
Joists and scantling	17,699,000	29,957,000	242,961	422,991
Hoops and hoop-poles			51,307	81,502
Lath (pieces)	8,189,000	13,508,000	20,805	32,716
Palings, pickets and slats (pieces)	1,983,000	3,037,000	20,502	30,714
Shingles (pieces)	41,967,000	34,037,000	127,161	96,598
Box shooks (number)			158,375	101,001
Other shooks (number)	313,655,000	572,457,000	466,315	844,061
Staves and heading			2,626,440	2,519,541
All other lumber			1,038,044	1,593,085
Sawed timber	247,500,000	278,069,000	3,044,856	3,440,197
Hewed timber (cubic)	9,456,536	7,586,607	1,562,896	1,326,947
Logs and other timber			2,254,465	1,673,132
Doors, sash and blinds			305,473	338,318
Moldings and house finish			111,279	117,693
Hogsheads and barrels, empty			417,217	335,331
Household furniture			3,007,531	2,991,447
Wooden ware			390,520	336,279
All other manufacturers			2,026,342	2,448,344
Total			$27,890,974	$ 28,901,869

For twenty-five years the pine business of this city has been of first magnitude in the country and the world. In 1875 the total receipts of lumber in Chicago by lake and rail were one billion one hundred and forty-seven million fifty-three thousand feet. Receipts ran along from year to year without much variation until 1881, when the total rose to one billion four hundred and sixty-six million eight hundred and twenty-seven thousand. From 1875 to 1881 was a period of industrial and commercial depression, which succeeded the panic of 1873, and the lumber trade was no exception to the general rule. In 1879 specie payments were resumed by government, and the country thereafter became prosperous. The period from 1879 to 1883 was the palmy one in the Chicago pine trade.

Receipts and distribution steadily increased, until in 1882 they reached the enormous amount of two billion one hundred and twenty-three million six hundred and thirty thousand feet, which was the climax of the record. This rapid advance resulted from distinct and adequate causes. It was a time of great prosperity throughout the northwest, when vast areas of prairie land were being settled, when railroads were being constructed at the rate of several thousands of miles annually and the larger cities were growing apace. During those years Chicago dealers held the greater share of the trade in trans-Missouri river territory. Yellow pine had not yet disputed possession in that region. Manufacture in northern Minnesota and Wisconsin was but partly developed, and railroad freight rates were so adjusted as to give this market an advantage in the Kansas and Nebraska trade. Chicago dealers established vast systems of yards in trans-river territory, and thus fairly monopolized the lumber trade. It was also a period of good profit to the wholesale handler. Competition was measurably restricted to that between dealers at this point. The manufacturers had not yet adopted the plan of direct car load distribution. It was thought that the only way to market mill output was through the yards in this city. Hence jobbers enjoyed a favorable opportunity to put in supplies by the cargo. The larger share of the product around Lake Michigan came to the open market at the foot of Franklin street. It came, too, well loaded with good lumber, and not, as now, divested of its rich pickings. From 1879 to 1883 the dealers grew rich. The majority acquired their independence as merchants and capitalists during that time. Since then they have made a living and something besides, simply by the power of ample means, which has enabled them to take every advantage, but the task of eking out a fair profit in the handling of lumber has not been an easy one. The log and mill owners have become strong, whereas before 1879 they were financially weak. They have latterly been able to classify their output more closely than in the sixties and seventies, and thus get more profit out of it. What has been their gain has been the wholesale dealer's loss. Neither are the manufacturers obliged to sell with the market as formerly. They are in position to hold stock until they realize the utmost from it. The eastern trade has also come in as a help to their business, as it enables them to have a choice of two general markets.

The effect of the disabilities referred to began to be felt in 1883, when receipts dropped to one billion eight hundred and forty million and twenty-two thousand feet, though something of a depression had come upon the trade and industries of the country in that year. The heavy receipts in 1882, reaching over two billion feet, resulted from a boom, which was in a degree overdone. A reaction came, and dealers the following year bought more sparingly. In 1886 the decline had reached the minimum total of one billion six hundred and fifty-nine million five hundred and sixty-three thousand, and in 1887 it made a gain. A further rise was evident in 1888, when the total passed the two-billion point. In 1889 the total again fell below two billion, but the decline was not sufficient to excite serious mention. The following table exhibits yearly receipts in feet from 1875 to 1889, inclusive:

	Lumber.	Shingles.
1875	1,147,053,432	635,708,000
1876	1,039,785,265	566,978,000
1877	1,065,405,362	559,842,000
1878	1,179,984,000	692,544,700
1879	1,466,827,991	659,856,000
1880	1,565,537,118	650,922,500
1881	1,929,033,000	801,795,000

1882	2,123,630,150	954,548,750
1883	1,840,022,000	1,139,137,000
1884	1,802,727,000	895,528,000
1885	1,744,699,000	765,427,000
1886	1,659,563,000	775,641,000
1887	1,846,187,000	612,990,000
1888	2,012,069,000	629,685,000
1889	1,921,816,000	627,252,000
1890	1,969,689,000	524,440,000
Total	26,314,038,318	11,492,294,950

While 1882 was the climax year in respect to receipts, the amount in 1888 was not far behind. Even the later receipts have not fallen off sufficiently enough to indicate a serious decline in the Chicago trade. In fact there has been nothing in conditions within recent years that can be taken as an evidence that receipts certainly will never, in a future year, equal the amount of 1888, or even 1882. An extraordinary local demand, such as is likely to arise preceding the World's Fair, may induce such a shipment to this point as shall cause the total to pile up as never before. It certainly can not be said that the forest supply has so diminished as to preclude this possibility. There is pine enough left to place three billion feet of lumber in Chicago in a single year, if the incentive of a strong market were present.

Yet it is likely that Chicago has passed its zenith as a concentrating point of northern pine. Influences are at work that are likely to more and more dissipate the Michigan and Wisconsin product. The eastern trade is taking an increasing quantity down the lakes. Direct distribution from the mills is diverting lumber from this market, and yellow pine is cutting off outside demand, as well as seriously invading this city and suburbs. Powerful concerns are going into cypress manufacture with an eye to this market. The forest supply of white pine will gradually diminish, so that we may reasonably conclude that the amount of that kind of lumber to be handled here in the future will show something of a decrease. The loss, if there is to be any, will be felt in the wholesale trade with country dealers. There will probably be an increased local demand, judging from the fact that not more than five or six years ago thirty to forty per cent. of the total receipts was considered large for use in Chicago and its suburbs, while now sixty to seventy per cent. is required for local consumption. The simple fact that while the market has lost a large share of its once heavy trans-Missouri, Iowa and Missouri trade, it has been able to annually dispose of nearly or quite two billion feet, proves clearly enough that the local demand has rapidly enlarged. It is possible for it to go on increasing until a full yearly average, even up to the limit of late yearly receipts, will be wanted in the city and county.

Thus it can be seen that Chicago is bound to be a great concentrating point, on account of local consumption alone. Since this is true, we may conclude that a portion of this stock will continue to be shipped hence in a wholesale way. The Illinois, Indiana and Ohio trade can be supplied from Chicago better, perhaps, than from any other market. As the center of forest supply moves westward, Chicago will more and more become the center of distribution. When logs become scarce along the railroads in lower Michigan, the present severe car-load competition in Indiana and Ohio will diminish. The time is coming when those states will

AMERICANIZED DESIGN OF PORCELAIN MANTEL.

stand to this market as New York and Pennsylvania now do to Tonawanda and Buffalo, or as Illinois now does to Chicago. When a large share of the Wisconsin output shall come to this market, as it eventually will, it will hold the advantage in all the Ohio river states. So it can be seen that it is idle to talk about the utter extinetion of the wholesale trade of this city, as long as the forest supply shall hold out. There will be a good deal of direct distribution from the mills, much of it in the hands of Chicago dealers, however. But there is a large share of the trade that is on too mixed and small a seale to be supplied directly from the mills. There must be a depository of assortments, always available for orders in mixed car loads. The Chicago trade, which is ever supplied as is no other market in the eountry, must command this business. It is one that requires dry lumber, dressed and rough, doors, sash, moldings, shingles of various grades and brands, building paper, plastering hair, and what not, that can be better and quicker delivered from this great multifarious and cheap market, with unlimited shipping facilities, than from anywhere else. In the yards of this city are stocks that all ean draw on freely for sorts, so that the stoeks in the entire number are virtually one, so far as an immediate available supply is concerned.

The territory from which Chieago derives its white pine lumber supply has been for convenienee sake divided into districts known and constituted as follows: West of Chicago district—Duluth district, St. Croix river, Chippewa river, Lumber line (Chicago, St. Paul, Minneapolis & Omaha railroad), Wisconsin river, Mississippi river, miscellaneous mills in Minnesota, Wisconsin Valley division (Chieago, Milwaukee & St. Paul railway), Wisconsin Central railroad, Milwaukee, Lake Shore & Western railway, Wolf river, miscellaneous mills in Wisconsin; Chicago district—Green bay shore distriet, Cheboygan, Manistee, Ludington, White lake, Muskegon, Grand Haven and Spring lake, miscellaneous mills in Chicago and Lake Superior districts; Railroad and interior mills—Chicago & West Michigan railway, Grand Rapids & Indiana railroad, Detroit, Lansing & Northern railroad, Flint & Pere Marquette railroad, Mackinaw division Michigan Central railroad, miscellaneous mills in Michigan; the Saginaw valley; Lake Huron shore; Lake Erie points. Following is a comparative statement of the white pine lumber product of the northwest from 1873 to 1889, inclusive:

YEAR.	West of Chicago district.	Chicago district.	Railroad and interior mills.	The Saginaw valley.	Lake Huron shore.	Lake Erie points.	Total.
1889........	3,594,367,960	2,481,358,356	723,827,866	836,184,171	601,594,924	68,500,000	8,305,833,277
1888........	3,758,453,946	2,376,578,509	700,272,865	876,300,087	621,689,053	55,422,000	8,388,716,460
1887........	3,307,700,150	2,339,873,022	733,362,186	766,375,696	555,855,730	54,750,000	7,757,916,784
1886........	3,115,128,167	2,196,844,347	774,319,007	784,891,224	499,685,698	54,500,000	7,425,368,443
1885........	3,169,018,977	1,977,220,624	663,641,001	725,976,037	464,937,916	52,300,000	7,053,094,555
1884........	3,448,646,757	2,236,270,112	789,032,722	978,564,984	431,268,479	51,250,000	7,935,033,054
1883........	3,134,331,793	2,111,070,076	883,900,850	961,781,164	478,070,903	55,635,000	7,624,789,786
1882........	2,931,924,196	2,188,371,665	922,409,230	1,012,951,211	441,966,134	54,528,380	7,552,150,744
1881........	2,455,315,694	2,110,837,148	906,417,091	982,320,317	313,966,499	....	6,768,856,749
1880........	2,072,257,000	1,801,351,006	628,651,000	862,453,000	286,583,000	....	5,651,295,006
1879........	1,573,198,000	1,531,540,000	653,245,000	736,106,000	312,854,000	....	4,806,943,000
1878........	1,023,974,000	1,251,080,759	566,100,000	574,163,000	214,155,000	....	3,629,472,759
1877........	1,063,298,000	1,138,165,496	624,606,000	640,166,000	129,098,000	....	3,595,333,496
1876........	1,448,874,000	1,118,529,000	589,535,000	573,958,000	148,150,000	....	3,879,046,000
1875........	1,360,331,000	1,120,962,000	747,952,000	581,558,000	157,750,000	....	3,968,553,000
1874........	1,309,442,000	1,044,291,000	659,340,000	573,633,000	164,600,000	....	3,751,306,000
1873........	1,353,000,000	1,226,819,000	621,603,000	619,867,000	172,491,000	....	3,993,780,000

Aside from white pine, this is rapidly becoming a consuming point for yellow pine of the first magnitude. The trade in southern lumber has greatly increased in the past two years, and has made an especially noteworthy gain this year. It is plainly to be seen that in years of the near future the demand here will assume proportions not dreamed of three years ago. Southern producers are already looking to this market as one of first importance.

In some reminiscences lately published in the *Lumberman*, an old lumberman gave some interesting information regarding comparative prices now and in the old days when the Lumberman's Exchange flourished in all its pristine glory. He took as a basis for his comparisons prices for the two years, 1879 and 1880, when to be in the lumber business meant a sure fortune, and when wholesalers had things all their own way, made prices to suit themselves, enjoyed lunches and all such pleasures, and then put up prices to cover the expenses incurred. Continuing, he said: "On such occasions you could always see around the tables the faces of Thad Dean, the wit of the exchange, D. F. Groves, Throop, Van Schaick, Pate, Gardnier, Spry, A. R. Gray, Tom Fleming, C. C. and J. B. Thompson, Al. Soper, Tom Wilce, Perley Lowe, Joe Rathborne, Spooner, Howell, Walkup, Fisher, and the Lord only knows how many more. Those were indeed great days, but they are gone, never to return. After one of their love feasts given the latter part of July, 1879, it was decided that prices were not high enough to warrant such extravagance, so, after a little consideration, they gave values a slight boom. Then on August 15 the fever set in, and up they went again, and up again and again, until it looked as though the lumber business was a veritable gold mine. But let us glance at a few of the prices at that time compared with prices December 1, 1890, the latter in most cases being an average:

	Aug. 1, 1879.	Aug. 15, 1879.	Oct. 15, 1879.	Feb. 1, 1880.	Dec. 1, 1890.
Thick clear	$34 00	$34 00	$40 00	$46 00	$41 00
Thick A, selected	25 00	25 00	30 00	33 00	39 00
Thick B, selected	17 50	18 00	23 00	26 00	34 00
1-inch A, selected	20 50	21 00	30 00	32 00	38 00
1-inch B, selected	15 00	15 00	20 00	22 00	28 00
12-inch D stocks	11 00	11 00	15 00	17 00	25 00
12-inch common stock	.....	10 00	14 00	15 50	15 50
Common flooring	17 00	15 50	22 00	23 00	27 00
Fence flooring	11 50	11 50	15 00	17 00	17 00
Common boards	8 50	10 00	12 00	14 00	13 00
Culled boards	7 00	8 00	10 50	12 50	11 50
Common fence	8 50	9 75	13 00	15 00	15 00
Culled fence	7 00	8 00	10 50	13 00	12 00
Joist, 12 to 18	8 00	9 00	11 00	12 00	12 50
Joist, 20	9 00	10 00	12 00	13 00	14 00
Joist, 22	10 00	11 50	13 00	14 00	16 00
Joist, 24	11 00	11 50	14 00	15 00	16 00
Joist, 26	12 00	13 50	15 50	16 00	18 00
Lath	1 40	1 60	2 25	2 60	2 50
Ex. *A* shingles	2 10	2 10	2 75	2 70	2 50
Standard	1 80	1 90	2 45	2 45	2 10
2-inch ogee battens	0 40	0 40	0 60	0 65	0 45

"There were numerous meetings in 1880, and later, where prices were boosted up and down, piece stuff at one time reaching $14, but space forbids further comparisons, the above sufficing to show how in those days one could afford to be one of a lot of wholesalers and feast at the expense of the consumer."

The following is a comparative statement of the shingle product of the northwest from 1873 to 1889.

YEAR.	West of Chicago district.	Chicago district.	Railroad and interior mills.	The Saginaw valley.	Lake Huron shore.	Total.
1889	1,966,710,800	1,579,004,000	844,509,750	222,246,250	86,505,000	4,698,975,800
1888	1,572,634,350	1,642,493,250	962,320,700	263,784,000	73,414,501	4,514,646,801
1887	1,326,302,000	1,494,256,750	1,045,512,000	196,983,000	53,413,000	4,116,466,750
1886	1,446,756,490	1,625,986,600	1,214,331,500	227,463,000	62,993,120	4,577,530,710
1885	1,547,212,500	1,448,326,250	981,226,250	227,739,750	53,469,000	4,257,973,750
1884	1,575,818,200	1,436,933,050	1,208,053,250	281,325,500	57,696,000	4,559,826,000
1883	1,406,653,000	1,440,505,639	814,668,750	244,631,750	58,297,500	3,964,756,639
1882	1,484,719,200	1,373,428,708	896,066,500	278,514,000	61,549,250	4,094,277,658
1881	1,192,493,343	1,258,299,625	748,315,599	304,025,500	42,872,750	3,546,006,817
1880	924,083,000	1,007,116,000	742,700,000	241,075,160	57,938,000	2,972,912,160
1879	774,253,000	898,515,000	891,610,000	218,934,750	75,800,000	2,859,112,750
1878	661,785,000	778,166,000	906,150,000	153,989,750	61,400,000	2,561,490,750
1877	662,636,000	585,175,000	1,227,174,000	167,971,755	53,900,000	2,696,856,755
1876	833,159,000	509,200,000	1,275,825,000	204,346,725	78,000,000	2,900,530,725
1875	811,803,000	370,315,000	1,042,320,000	224,030,240	67,350,000	2,515,838,240
1874	688,627,000	424,800,000	1,066,300,000	208,489,555	85,000,000	2,473,216,555
1873	668,790,000	393,100,000	905,799,000	218,394,550	91,350,000	2,277,433,550

Perhaps no business in any great market in the country is so destitute of statistics showing its magnitude, stocks received and distributed, as the hardwood trade of Chicago. Rough estimates of the amount of hardwood received in one year, made two or three years ago, placed the amount at two hundred and fifty million feet. That included all woods other than white pine. This total would fall below that of last year, since there has been a great increase here in the consumption of oak, basswood, elm and yellow pine. On May 1, 1890, twenty-nine yards, comprising the bulk of the yard trade at this point, reported on hand sixty-seven million three hundred and ninety-three thousand four hundred and sixty-five feet. In 1889, at a corresponding date, twenty-eight yards reported seventy million three hundred and twenty-three thousand three hundred and forty feet. These figures show that the amount carried in stock did not greatly vary from one year to another. But the yard trade by no means represents the extent of the hardwood business in this market. Large amounts are received direct by the manufactories. In fact, such industries are mainly supplied directly from the mills. Several commission men and car-load dealers are constantly busy handling lumber in blocks and by the car load. The yard dealers do a considerable amount of direct shipment from the mills to local outside buyers, so that, altogether, the yard trade but meagerly represents the magnitude of the amount handled by Chicago men.

Within the past two or three years important changes have occurred in the trade. One is in the method of buying. Until recently the general practice was to buy on Chicago inspection. Dealers purchased by mail or by agents sent out for the purpose. The price agreed on was so much per thousand, f. o. b. Chicago, subject to measurement and grading by licensed inspectors here. This manner of dealing prevailed until mill operators became strong enough financially to demand something more to their advantage. The decrease of supply in Indiana, Ohio and Southern Michigan, and the increase of demand throughout the country, as well as an enlargement of transportation facilities, induced men of means and experience to go into hardwood manufacture on a large scale, and with improved machinery and handling facilities. Such individuals were inclined to make the most of their product, and so took measures to elude the exactions of Chicago yard inspection. Selling directly to the larger consumers increased in favor, since in that case the lumber was inspected and settled for at points of shipment. The commission and car-load dealers also adopted this method to a large extent. Competition in buying thus became so sharp that yard dealers were forced to go to the mills for lumber instead of remaining at home and calling it in as theretofore. A good deal of lumber is still forwarded subject to inspection after arrival, but it comes mostly from scattering mills whose operators are not fully informed as to market conditions, or it is a venture from dealers or mill concerns that have a lot of odds and ends that they can not otherwise dispose of, and they take their chances for getting a little more than freight charges out of their shipments. It is safe to say that the capable manufacturer who is well informed, and knows that his mill turns out good lumber, will not sell until he has had a representative of the buyer on the ground, and the bargain is there made, with stipulations as to quality and price. The yard dealers here have generally accepted the situation, and now make frequent tours among the mills and buy lumber either on stick or to be sawed. The large yards frequently contract to saw blocks of lumber for delivery through the season. Another change is in the decline of the poplar trade at this point. Up to about two years ago poplar was handled in the yards here in large volume. It was the favorite wood in furniture, box, organ and burial-case factories. A heavy volume of common and cull went into consumption. But since the decline of product in Indiana, and the combination of the manufacturers in Tennessee, Kentucky and West Virginia, buying in competition with outside and growing markets has become difficult. Basswood and elm have crowded out common and cull poplar in local consumption to that degree that profitable prices can no longer be secured, and the result has been that Chicago dealers have abandoned poplar to a considerable extent. Moderate stocks are still carried, but little extraordinary effort to maintain and extend trade has lately been made.

The hardwood business of this city has come to be largely the handling of oak. The prevailing fashion for oak house finish and furniture has induced the dealers to pay particular attention to such lumber. Chicago is the great red-oak market of the country. Builders and manufacturers prefer it for general purposes to any other, where durable and handsome work are the requisites. Plain sawed stock is used for finish and furniture of moderate cost, but a larger amount of quarter-sawed is also employed. Quartered white oak is also in demand, and is extensively handled. The demand for red oak has greatly stimulated manufacture in Wisconsin, from whence a large portion of the red oak consumed here is received. There has also, within the past two years, been a great increase of receipts from Tennessee, Kentucky and Arkansas. The walnut trade in this market has recently declined, as it has throughout the country, partly owing to the limitation of supply and the increased employment of oak in finish and cabinet work.

While cherry is still popular, the supply of good Pennsylvania lumber is now so restricted that dealers have been forced to reduce stocks. Prices are so high that but a few yard concerns attempt to secure large supplies. Basswood has, within recent years, advanced to an important position in the trade, so far as respects volume. It is handled on an extremely small margin, and for that reason some dealers do not carry large stocks. Others who have plenty of room, and large resources to draw from, make a specialty of basswood. It is highly prized by the molding and furniture manufacturers, and is gaining in favor for cheap house finish. A moderate business is done in gum and cottonwood. The first named is used for finish and cabinet work, but it gains ground slowly. It is thought, however, to be a coming wood that will eventually be handled here extensively. Cottonwood is mostly consumed in the box factories, though it is employed to some extent for turning and wagon bodies. The minor woods, sycamore, butternut, sassafras, etc., are carried in the majority of yards, but no great account is made of them. The demand for soft elm has greatly increased in recent years. It is a favorite in the parlor frame and general furniture factories. The supply comes mainly from Michigan, the Manistee river valley and the Grand Traverse region furnishing the most abundant and valuable supply. Rock and water elm are in demand for special uses. Hickory for wagon work, if choice, is always salable at good prices. This season there is a scarcity of wagon hickory. Time was when this was a great ash market, and it is not insignificant at the present time. But the using up of the supply in Indiana has crippled Chicago's resources. Besides the larger manufacturers have adopted the policy of securing their ash stock directly from southern mills, which cuts dealers here out of the trade. The ash of the future must come from territory south of the Ohio river. Several concerns handle mahogany, and the amount carried in stock is considerable, there being a yearly increase of demand. This is the greatest center for maple flooring in the country. A number of large concerns carry stocks reaching up into the millions. They have mill facilities that enable them to convert the raw material into flooring, ready bored to nail without liability to split. Flooring thus prepared is shipped to all parts of the United States and to foreign countries. The supply comes chiefly from Michigan and arrives here by lake.

Without question the timber trade is beginning to seriously feel the loss of demand, resulting from the use of iron in the construction of buildings. By this, it is not meant to imply that there is less demand for timber and joists, than there was before iron came so extensively into use, but that heavy dealers in such stuff are failing to realize such increase of demand for wood interiors as they had counted on, as the result of the rapid growth of the city. They still have left as a resource the growing demand for the lighter and shorter timbers and joists, such as enter into the construction of the smaller business and residence houses in outlying districts and in the country regions beyond. But in the immense warehouses and office buildings that are being erected on every hand, iron and steel are being mostly used as supports for floors and interior work. A few years ago the heavier dimension trade in Chicago was derived from the supply of contractors for large buildings. Sales were thus made in large bills, which amounted to hundreds of thousands of dollars' worth each. After the great fire, in the entire business center, between the river and the lake, rebuilding required an immense amount of dimension. The growth of the demand for structural iron has been rapid within the past five years, and lumber dealers have commented upon it as if it were a serious matter. It changes the nature of the requirement for timber and joists, there now being proportionately less long and heavy stuff called for than formerly. Such demand as there is, is being cut into by the increasing use of yellow pine for certain classes of heavy freight warehouses and large manufacturing structures. The use of structural iron has but recently acquired full headway. It is now beginning to be employed in the erection of the medium class of business houses, as well as in the larger and costlier structures. The tendency of recent architecture is to strength, solidity of appearance and ability to resist decay and destruction by fire. Investors are building more for the future than they did in the past. For this reason we may expect to see the use of structural iron increase and the use of wood decrease in corresponding rates. But this observation in regard to wood applies only to timber and joists in city building; but in country and country towns the use of wood will continue so long as the material shall last.

Important claims are made by tin-roofers as to the superiority of a tin roof over a wooden one, but this claim can not be maintained with a number of tin brands now on the market. All the foreign tin plate now made is rolled from Bessemer, or open hearth steel, to a thinness that a few years ago was simply impossible with the machinery and the processes for regulating the amount of carbon then known. After being annealed in a furnace for twelve hours, the plates are passed through cold rolls, still reducing their thickness and closing the fine holes or pores that may develop under the first rolling process, and again subject to the annealing process. These tissue flakes of steel are the tin plates of commerce. Under the old process these plates were dipped in melted tin and simply allowed to drip. Very little of the tin would run off, and it was calculated that thirteen pounds would cover thirty-one thousand five hundred square feet of surface. Then a pair of rollers was invented to remove a portion of the surplus tin. This reduced the amount of tin to eleven pounds. Next, a second pair of rollers was introduced, which reduced the weight of tin to five pounds, and lately a third pair is used which reduces it to three pounds. Each successive rolling renders the tin more worthless. It is pretty plain that such thin plates, with one pound of tin to more than ten thousand square feet of surface, must depend for whatever of durability they possess as a roofing material upon the coat of paint that must be put on at the start, and renewed every year or two. Besides the expansion and contraction of a tin roof is liable to tear it loose from its fastenings, and the whole blow off in a high wind. The alleged "tin" shingles are no better, as the plate and the tin surface are cracked by the dies used in making the fanciful corrugated figure. As to protection from fire, it may be said that only a small proportion of fires have their origin on the roof. The only protection afforded is against sparks from a burning chimney or adjacent buildings. A properly laid roof of good shingles is far better protection from wind and rain than a cheap tin one, and costs less. If kept well painted, it is more durable and can be rendered equally as secure against fire at no great expense. Of course a wooden roof is not admissible within the fire districts of cities and towns, and neither should a cheap tin roof be for that matter.

There has been more or less speculation, of late, as to the future supply of shingle timber. While there need be no fear that it will give out soon, still it is a well-known fact that the amount available for the kinds of shingles at present most in use, is rapidly decreasing. In all the northern and western states, by far the largest number of shingles used are made from white pine, the amount probably being at least seventy-five per cent. of the total amount used. The other twenty-five per cent. is made up of yellow cedar, twelve and a half per cent., redwood and cypress, five per cent. each, and two and a half per cent. made up of white spruce, chestnut, black ash, hemlock, etc., mostly confined to New England local trade. Previous to ten or twelve years ago, the lumbermen left such a large percentage of timber that it was little trouble to procure all the stock wanted, handy to stream or railroad mills. The cull timber left standing or on the ground had little selling value, while it made the best of shingles. Since then, however, high prices for stumpage and closer estimating by sellers have caused the lumbermen to cut closer, and the market for "shop" and "clips" has caused them to rake in pretty much everything that will hold together in log shape long enough to get to the saw. Necessarily, the shingle makers have had to depend upon the old clearings of a more improvident day, which, of course, must have a limit. The above has reference more particularly to the men who make shingles and nothing else. There is a large class of lumbermen who run shingle mills in connection with their saw mills, who continue to run their cull logs into shingles, and the business to-day is largely in the hands of that class of manufacturers, while the old shingle men, as a distinctive trade, are rapidly shutting up shop. But the lumbermen are, as a general thing, sending a smaller percentage of logs to the shingle saw every year, hence it is well enough to look the field over to see whence will come the supply of shingles in the not distant future. The lumbermen referred to above will continue to cut more or less white pine shingles for long years to come. The odds and ends of other species used in the middle and New England states will also continue to afford their usual supply for local demand for on indefinite period, but there is reason to believe that the white cedar, so abundant in Michigan and Wisconsin and other states, will prove the best material with which to fill in any gaps in the supply, as far as home manufacture is concerned.

Red wood has come to be used quite freely in this vicinity for interior finishing. The experiences which people have with it seem to be quite varying in their character. To some it is an excellent wood, while others have found it extremely unsatisfactory. As a matter of fact, red wood can be had, good or bad. Discrimination should be exercised in its selection. The *Timberman*, in a recent issue said: "In order to secure satisfactory results with redwood shingles, those who have had most experience say that they should be carefully selected, so that soft, porous shingles may not be intermixed with those cut from hard-grained, brashy timber. If they are to be painted, or the roof is intended merely for service and not to add to the beauty of the structure, it does not so much matter; but when, as among eastern buyers, the purpose is to produce with them an effect which can not be obtained with ordinary shingles, it is desirable that this precaution should not be neglected. It is hardly necessary to add that red-wood shingles should show no sap, which is as worthless for a roof-covering material as the sap of any other timber; the dimension red-wood shingles which come to this section are not supposed to show so palpable a defect as this."

For several years certain Germans have been experimenting, with a view to utilizing sawdust as a material for mechanical purposes. It was discovered, years ago, that vegetable fiber, after subjection to certain chemical action, and afterward to a pressure sufficient to expel all liquids from it, could be made into a substance almost indestructible by the elements, and of great utility in the mechanical and ornamental arts. The only trouble has been from the fact that but a few kinds of fiber were capable of the transformation under any existing formula. It might almost be said that there was only one fiber, that, so employed, produced results satisfactory in respect of economy of manufacture and beauty and usefulness of the resulting product, and that one fiber is cotton, its delicate structure, strength and ready submission to the action of the necessary chemicals rendering it almost alone in its adaptability for the purpose.

Thus far, almost the only result has been the manufacture of celluloid, which is unsuitable for anything but the finer mechanical uses. Scientists claim, however, that as all vegetable fiber is, to a certain extent, identical, that is, having its essential constituents in common, there must be some means by which the coarser kinds can be transformed into similar substances.

The experimental processes have included nearly the entire list of common vegetables, but within the last few years attention has been specially directed to the waste products of the sawmill, especially the dust. The first results were the production of paper pulp. But as only certain species of timber could be used satisfactorily for that, the experiments have been continued further, with a view to not only using any kind of sawdust, but to broaden the field, so as to produce a substance that can be used for more general purposes than paper or celluloid, and which should, if possible, combine the best characteristics of both substances.

A German scientific journal professes to give the results of the experiments in that country thus far. It claims the production of a substance made from common sawdust, by means of an acid process, that promises to be of great value. It is described as being exceedingly firm of texture and of great hardness, incapable of being bored by a common gimlet or of being penetrated by a nail, more impervious to the action of the elements than the ordinary metals or the common building stones, and practically indestructible by fire, a Bunsen burner simply charring the exterior surface. It is claimed to be stronger than timber for joists and girders, and several times lighter than iron or steel, and, above all, the cost of manufacture is claimed to be so low as to bring it into competition with both wood and iron. It is said that experiments will be made to still further decrease the cost and increase its field of influence, and that its manufacture is to be pushed.

The Lumberman's National Building association was organized in November, 1889, under the laws of Illinois. While its charter gives it power to transact inter-state business, and it has its members in many states, it loans its money principally in Chicago, where it can make ample inspection and inquiry as to securities offered and the faithfulness of borrowers. Its authorized capital is $50,000, and its officers are W. B. Judson, president; Francis Beidler, vice president; C. W. Chandler, secretary; Charles L. Hutchinson, treasurer.

The Lumbermen's Mutual Insurance Company of Chicago, Ill., was chartered January 28, 1889. The incorporators were S. K. Martin, M. T. Green, Granger Farwell, R. L. Henry, J. H. Witbeck, S. W. Wyatt, A. E. Silverthorne, D. S. Pate, Francis Beidler, Joseph Rathborne, Clarence Boyle, Allen R. Vinnedge, Harvey S. Hayden, George E. White and George G. Robinson. The object of the association was "to form a company for the purpose of making insurance on mills, other kinds of buildings, machinery, lumber, stocks, and other property on the plan of mutual insurance, in accordance with the provisions of an act entitled 'An act to incorporate and to govern fire, marine and inland navigation insurance companies,' approved March 11, 1869, and in force July 1, 1869, and all acts amendatory thereof." Its first officers were as follows: M. T. Greene, president; Francis Beidler, first vice president; George E. White, second vice president; T. E. Gilpin, secretary; E. E. Hooper, assistant secretary; Granger Farwell, treasurer; S. K. Martin, Joseph Rathborne, D. S. Pate, executive committee; M. T. Greene, of the Chicago Lumber Company; Francis Beidler, of the South Branch Lumber Company; S. K. Martin, of the S. K. Martin Lumber Company; R. L. Henry, of R. L. Henry & Co.; Granger Farwell, of J. H. Pearson & Co.; Joseph Rathborne, of Joseph Rathborne & Co.; George E. White, of George E. White & Co.; D. S. Pate, of Chase & Pate; Harvey S. Hayden, of Hayden Bros.; George G. Robinson, of George G. Robinson & Co.; Clarence Boyle, of L. V. Boyle & Co.; A. E. Silverthorn, of A. P. & W. E. Kelly Company; C. B. Flinn, of C. B. Flinn & Co.; W. W. Schultz, of Crandall, Schultz & Co.; James Soper, of Soper Lumber Company, directors.

At a meeting of the directors of this corporation held at the office of the company, 701 to 710 Royal Insurance building, in January, 1891, the following officers were elected for the ensuing year: Francis Beidler, president; C. B. Flinn, vice president; Clarence Boyle, second vice president; C. W. Crocker, secretary; E. E. Hooper, assistant secretary; Granger Farwell, treasurer, and C. B. Flinn, C. A. Paltzin and W. W. Schultz, executive committee. The following is the present board of directors: S. K. Martin, C. B. Flinn, Francis Beidler, Granger Farwell, Clarence Boyle, George E. White, D. S. Pate, Joseph Rathborne, W. W. Schultz, C. A. Paltzer, James P. Soper, H. S. Hayden, W. P. Ketcham, H. C. Akeley, Charles Bull.

The Wholesale Sash, Door and Blind Manufacturers association of the Northwest has its headquarters in Chicago, invariably meeting at the Tremont house. The following are the officers: George M. Paine, of the Paine Lumber company, Oshkosh, Wis., president; William Huttig, Sr., of the Huttig Manufacturing Company, Muscatine, Iowa, vice president; William A. Fuller, of Palmer, Fuller & Co., Chicago, treasurer; Frank Adams, Chicago, secretary. The organization has been in existence since about 1878, and has been a power in its time. A few years ago it combined with the jobbers of the Northwest to regulate prices and other important matters, the arrangement continuing less than a year. Now the association meets with much less frequency, to revise price lists and consider other matters relating entirely to manufacture. General price changes are made by means of discounts from the association list, and action of this character by the association is usually adopted by distributers through the Northwest. The membership now comprises about twenty concerns in Illinois, Iowa and Wisconsin. Minnesota withdrew in 1887, and Michigan never joined.

The Chicago Sash, Door and Blind Manufacturers' association was formed for social and business purposes May 15, 1890. The need of such an organization had been felt for some time, and recent labor troubles had emphasized its necessity. There were many matters likely to arise from time to time that might require a meeting of the local sash, door, blind and finish men for consultation and action, and with the trade entirely unorganized it had been found difficult to get the interested parties together. The following officers were elected W. F. Behel, president; George W. Weiss, vice president; F. W. H. Lundt, secretary and treasurer. The organization had in view the regulation of certain evils that have crept into the business, by the formation of rules that would be of benefit to mill men and responsible contractors. It was, among other things, desired that a definite agreement be entered into that no estimates on mill work should be made when a complete bill of the articles wanted was not furnished by the architect or contractor, and furthermore that no estimating should be done on special or fancy articles without full details, the following claims being formulated: "For years estimating has been done in a loose manner, and competition has been so active that even their figures have been readily obtainable on all kinds of jobs, although the estimators were generally in the dark regarding many of the details. By making allowances, on general principles, for items that might be overlooked or suddenly sprung after the contract had been taken at a specified figure, factory men have usually managed to come out whole, but losses have often resulted because the estimator did not really know how much decorative work would have to be put on the interior finish. A man will walk into an office and throw down a set of plans on which he will ask and get an estimate, but the most of the detail is indefinitely stated and must be guessed at. Sometimes a complaint is made that all the stuff contracted for has not been furnished, and since the contract calls for everything going into the building, the factory man generally has to supply what is alleged to be lacking, without really knowing whether all the stuff he has furnished has gone into the particular building under contract. The architect, in all building matters, is a legally constituted autocrat, and mill men claim that he has too much in his own hands. He has more authority over certain matters than the owner of the building under construction. Where the drawings conflict with the specifications he has the right to adjust the matter at his own option. The object of investing an architect with so much power in the premises is to secure public safety, since by ignoring an architects' plans and intentions a building could readily be rendered insecure, and a contractor would have it in his power to shirk expense and put up an unsafe building. But the factory men say that the architects' powers often act against the interest of the owner of a building, because of the opportunity to favor a contractor or mill man, giving him a chance to make unjust profits out of a job. Owing to the legal power of the architect the matter of reforming the contract business is surrounded with difficulty, as the mill men are tied up by contract to do as the architect prescribes, and he can put $25 or $30 worth of work on a flight of stairs, for example, very easily. But by uniting and carrying out a rule to make no estimates without full details, the factory men may be able to protect themselves and the owners of property as well." This subject was fully discussed at an adjourned meeting June 12, and a resolution was adopted declaring that no estimates would be made upon jobs unless a scale drawing and a list of items were furnished, and that no items not called for in the contract would be supplied. At that time about seventy per cent. of the local manufacturers had joined the association.

There is little doubt that the display of woods at the Columbian exposition to be held in Chicago in 1893 will be large, varied and fully representative of the country, but it is desirable that the exhibits shall take both a scientific and practical form, and be arranged in such an orderly system as will render them comprehensive and permanently instructive to visitors. The questions of relative strength and durability, weight, nature and adaptability to innumerable uses, all need to be gone into, which suggests that specimens should be grouped with reference to thorough display and comparison, and that the results of scientific investigations and practical tests should be presented in connection. Singularly enough, the great exhibition of 1851, in London, has, in respect to its wood exhibit, never been surpassed. Of course, England, with her numerous dependencies in every part of the globe, had unusual facilities for making a large display of the woods of the world. The United States was represented by two collections, made by private individuals, containing only about two hundred specimens. Still, taken altogether, the wood (it can not, either in design or importance, be called a lumber) exhibit was very large and interesting, including, as it did, ten to fifteen thousand specimens from nearly every forest-producing country, and it is not probable it will ever, in its own way, be surpassed. At the Crystal Palace exhibition in 1853, in New York, little attention seems to have been paid to the matter of a lumber exhibit, and, in fact, the plan of the exhibition did not embrace any extended display of this kind. A Universal exposition was held in Paris, in 1855, but the wood department was of no importance. At the great London exposition of 1862, no attempt was made to introduce novelty in the wood exhibit. The same may be said of the Paris exhibition of 1867. Here a new classification was adopted, art coming first, and lumber falling under the head of "Products wrought and unwrought of extractive industries." This brings the history down to the American Centennial of 1876, and here very appropriately the United States was very fully represented. Besides the government exhibit, which was chiefly scientific, the specimens being small, seventeen states made separate exhibits, and altogether, native and foreign, there were over one thousand exhibitors and seventeen thousand specimens. Canada had the largest and most attractive display, some immense specimens of white pine being shown, while for completeness and accuracy of attendant information, the Phillipine islands took the first rank. The special value of the latter was the careful labeling of the woods, and cards giving facts concerning the character of the different species and the uses to which they were best adapted.

No systematic attempt seems to have been made in any of the displays to show the relative values of the different kinds of woods, or their strength, weight, durability or the like. At the Paris exposition of 1878, special attention was given to forestry matters, methods of cultivation of forest trees, planting arid slopes and the like, being most instructively shown. The United States showed three hundred cabinet specimens, and Oregon, with characteristic enterprise, exhibited a cabinet made of twenty-five thousand pieces of native woods, representing all the species of trees grown in the territory. Of the exhibit made at the great Paris exposition of 1889, there are no catalogues or reports at hand at present, from which to draw any conclusions. The lumbermen of Chicago are determined that the lumber exhibit at the Columbian exposition shall be complete, instructive and valuable. Toward the large fund necessary to insure the location of the World's Fair in Chicago, the following subscriptions were secured by the Lumbermen's World's Fair committee:

M. T. Greene	$ 5,000
Ed. E. Ayer	2,500
T. W. Harvey	2,500
Peshtigo Lumber Company	2,500
Spalding Lumber Company	2,500
S. B. Barker & Co	2,500
Badenoch Bros	1,000
Brooks-Ross Lumber Company	1,000
Dean, Bader & Co	1,000
H. H. Gardiner & Co	1,000
Hamilton & Merryman Lumber Company	1,000
Hannah, Lay & Co	1,000
John Spry Lumber Company	1,000
J. P. Ketcham & Bro	1,000
Palmer, Fuller & Co	1,000
Thett, John & Marsh Company	1,000
Sawyer-Goodman Company	1,000
Soper Lumber Company	1,000
South Branch Lumber Company	1,000
Watkins & Fuller Lumber Company	1,000
H. Witbeck Company	1,000
Holt Lumber Company	500
Higbee & Peters	500
The Marsh & Bingham Company	500
Mueller, Christy & Raber	500
Northwestern Lumberman	500
Norwood & Butterfield Company	500
C. A. Paltzer & Co	500
William Ripley & Son	500
Martin Ryerson & Co	500
T. H. Sheppard & Co	500
R. B. Stone Lumber Company	500
The Hintze & Baker Company	500
R. A. Wells	500
T. Wilce & Co	500
L. V. Boyle & Co	250
Johnson Bros	250
Chicago Yellow Pine Lumber Company	250
A. F. Fisher & Co	250
A. R. Gray	250
C. W. Davis	$ 100
Hintze & Weise	100
William J. Neebes	100
James Rathborne & Co	1,000
C. B. Flinn & Co	500
Ford River Lumber Company	500
Henry Coatsworth & Co	250
F. C. Jocelyn	250
Walter M. Pond	250
D. S. Pate	250
Rittenhouse & Embree	250
G. G. Robinson & Co	250
Ruddock & Seymour	250
E. L. Roberts & Co	250
W. Shoemaker & Co	250
Lumber Trade Journal	250
The Timberman	250
John Sheriffs & Son	200
Loomis Gillespie	150
George T. Burt	100
C. H. Bogue	100
Seymour Colman	100
B. F. Ferguson	500
Edwin S. Hartwell	500
R. L. Henry	500
O'Brien, Green & Co	100
J. H. Swan	100
John C. Smith	100
C. B. White	100
E. E. Hooper	50
Moses N. Skaggs	50
McElwee, Billings & Carney	30
George B. Daniels	10
Shepard Frost	10
Charles Frost	10
N. A. Fleichin	10
Robert H. Gillespie	10
Robert Harding	10
Total	$48,540

The Lumbermen's Exchange was organized in March, 1869, within a basement at the foot of Franklin street, on South Water street. R. H. Foss was elected president, Eli Bates vice president, and N. Haven secretary. No treasurer was chosen. In the following year the same officers were re-elected. The events arising from the outbreak and progress of the Civil War distracted the attention of parties interested, and the records state that the organization "laid dormant" during the period 1861–65. But the association was reorganized in 1866, with A. Carter as president, George C. Morton as vice president, and John Garrick, as secretary. Changes incident to the advancement of the lumber trade necessitated a more effective organization, and an act to incorporate the Lumbermen's Exchange of Chicago was passed by the legislature and approved March 31, 1869. The incorporators were: Freeland B. Gardiner, Martin Ryerson, Eli Bates, Nelson Ludington, Harrison Ludington, Augustus A. Carpenter, Jesse Spalding, George R. Roberts and Thomas H. Beebe, and their associates. It was ordained that the affairs of the corporation should be managed and condncted by a board of not less than five, nor more than thirteen directors, who should be elected annually, a majority of whom should constitnte a quornm for the transaction of business. It was further provided that the officers of the corporation shonld consist of a president, vice president, secretary and treasurer; the president and vice president to be elected annually by and selected from the board of directors; the secretary and treasurer to be appointed by the board of directors and to be required to give such bond and sureties as might be prescribed by the by-laws of the corporation. The exchange was empowered to appoint inspectors to examine, measure and inspect lumber, timber, shingles, wood and other articles of traffic commonly dealt in by its members or by other persons in the lumber business, and to prescribe the rules and fix the grades by which such inspectors should be governed in the discharge of their duties; the certificate of such inspectors as to quality, quantity or character of such articles inspected, or their mark thereon to be evidence between buyer and seller of the grade, quantity, qnality or character of the same, to be binding upon the members of the association or others interested who should obtain, require or assent to the employment of said inspectors, but it was expressly stipulated that nothing in the act should be construed to compel the employment of any one of any such inspectors. The corporation was authorized to constitute and appoint committees of reference and arbitrations and committees of appeals, who should be governed by such rules and regulations as might be prescribed in the rules, regulations or by-laws, for the settlement of such matters of difference as might be voluntarily submitted for arbitration, by members of the corporation, or by other persons; the acting chairman of either of said committees, when sitting as arbitrators, to have authority to administer oaths to the parties and witnesses, and issue subpœnas and attachments, compelling the attendance of witnesses, the same as justices of the peace, and the writs were in like manner to be directed to any constable to execute. It was further provided that, when any submission should have been made in writing and a final reward should have been rendered (and no appeal taken), on finding such award and submission with the clerk of the Circuit court, an execution might issue upon such award as if it were a judgment rendered in the Circuit court, such award thenceforth to have the force and effect of such a judgment and to be entered upon the judgment docket of said court. It was decreed that this act of incorporation should take effect and be in force from and after its passage.

Having a desire to advance the commercial character, and promote the general lumber interests of the city of Chicago and the Northwest, and wishing to inculcate just and equitable principles in trade, establish and maintain uniformity in the commercial usages of the city, acquire, preserve and disseminate valuable business information, and, with a view to avoid and adjust, as far as practicable, the controversies and misunderstandings which are apt to arise between individuals engaged in trade when they have no acknowledged rules to guide them, the members of the Lumberman's Exchange of Chicago, by virtue of the power vested in them by the charter, agreed to be governed by rules and by-laws which were formulated and adopted to regulate the choice of officers and directors and define their duties, provide for the establishment of grades of lumber, lath, shingles and other material, and to regulate arbitrations, margins on contracts and memberships. The seal adopted bore a figure of a pine tree and the words, "Lumberman's Exchange of Chicago."

Lists of memberships of the exchange prior to 1883 are not obtainable. At different times about all of the prominent and many of the lesser lumbermen of the city were identified with it. In 1883 the membership was as follows: Adams, Lord & Co. (A. L. Adams, E. A. Lord, G. W. Hastings), B. L. Anderson & Co. (B. L. Anderson, J. O'Brien, W. B. Anderson, J. H. Anderson).

E. W. Brooks & Co. (E. W. Brooks, J. D. Ross), Addison Ballard, S. B. Barker & Co., Alexander Bateson, J. Beidler Brothers Lumber Company (J. Beidler, A. F. Beidler, M. F. Rittenhouse), Bigelow Brothers (A. A. Bigelow, C. H. Bigelow), Bogue, Badenoch Co. (J. B. Goodman, C. H. Bogue, J. Badenoch, Jr.), Bryant, Marsh & Wood (I. O. Bryant, M. M. S. Marsh, H. C. Wood), Barton & Jones (Charles R. Barton, Samuel M. Jones), G. C. Benton, Bickford, Knox & Co. (R. K. Bickford, R. Knox), H. A. Billings, S. A. Brown & Co. (S. A. Brown, F. E. Parish).

Cheboygan Lumber Company (W. H. Bullen, E. Nelson), Henry Curtis, Charnley & Lovedall (W. H. Charnley, Thomas Lovedall), Seymour Coleman, Crandall, Cantwell & Co. (J. N. Crandall, J. Cantwell, R. B. Miller), W. W. Calkins, Chicago Cedar Post Company (J. P. Towler, W. H. Golden), J. Charnley & Co. (James Charnley, John M. Douglas, John Marshall Douglas), Chase & Pate (H. C. Chase, D. S. Pate), Chicago Lumber Company (M. T. Greene).

Thad. Dean & Co. (Thad. Dean, Charles Bruce).

E. & C. Eldred (Elisha Eldred, Charles Eldred), R. W. English & Co. (R. W. English, V. A. Watkins, W. A. Fuller).

Fraser & Southworth (James Fraser, W. L. Southworth), Fitzsimmons & Connell (Charles Fitzsimmons, C. J. Connell), S. R. Fuller & Co. (S. R. Fuller, F. H. Markham), Ford River Lumber Company (J. S. McDonald, C. J. Ferry & Brother, Blair P. Auten).

C. A. Gardner & Co., Gardner & Spry Company (John Spry, H. H. Gardner, John C.

Spry), Getchel, Armour & Co. (E. F. Getchel, William Armour, Charles H. Getchel), Goss & Phillips Manufacturing Company (W. B. Phillips, Cornelius Curtis), A. R. Gray & Co. (A. R. Gray, T. H. Shepherd), D. F. Groves & Co. (D. F. Groves, George C. Barrows), Getty & Blanchard (William Getty, William Blanchard), S. T. Gunderson, O. G. Gibbs.

T. W. Harvey, J. S. Hair & Co. (John S. Hair, W. R. Yourt), Hamilton, Merryman & Co. (I. R. Hamilton, W. C. Hamilton, A. C. Merryman), Hannah, Lay & Co. (Perry Hannah, R. Tracy Lay, James Morgan, William Morgan), R. L. & G. W. Henry, Louis Hutt, C. H. Hackley & Co. (C. H. Hackley, Porter Hackley, Thomas Hume, F. Deming), A. D. Hayward, Holt & Balcom (D. R. Holt, Uri Balcom), M. B. Hull & Co. (M. B. Hull, A. B. Watson), Hair & Odiorne.

Johnson & Gibbs (Oscar F. Johnson, George I. Gibbs), O. B. Jacobs.

Kelley, Lowe & Co. (D. Kelley, Perley Lowe, A. D. Kelley), Kelley, Rathborne & Co. (A. P. Kelley, Joseph Rathborne, W. E. Kelley), Kirby-Carpenter Company (A. A. Carpenter, S. M. Stephenson, S. P. Gibbs, W. O. Carpenter), Ketcham & Fick (James P. Ketcham, L. W. Fick).

Ludington, Wells & Van Schaick Company (H. Ludington, E. Wells, Jr., A. G. Van Schaick), N. Ludington Company, T. R. Lyon, agent (E. K. Hubbard), J. Mason Loomis & Co. (J. Mason Loomis, J. McLaren), Marsh Bingham & Ransom (G. A. Marsh, A. E. Bingham, W. B. Ransom).

S. K. Martin, McArthur, Smith & Co. (William McArthur, Archibald McArthur, Charles R. Smith), McMullen & Officer (James McMullen, Alexander Officer), C. Mears & Co., N. & C. H. Mears, Mendsen & Winter (John F. Mendsen, Thaddeus Winter), C. J. L. Meyer (C. J. L. Meyer, Julius Meyer), Michigan Lumber Company (William Rutherford, T. R. Fleming), William Meglade, Michigan Cedar and Lumber Company (S. A. Kent, W. A. Watson), L. E. Merrill, Muller & Christy (William Muller, H. A. Christy).

Noble & Little (John T. Noble, F. B. Little).

Oconto Company (George Farnsworth, N. Mears, C. H. Mears).

Palmer, Fuller & Co. (W. A. Fuller, George B. Marsh, V. A. Watkins), Parsons & Foster (William Parsons, Thomas Foster), Pitt & Cook (H. T. Pitt, George T. Cook), Peshtigo Company (William E. Strong, George C. Hempstead), J. H. Pearson & Co. (James H. Pearson, William J. Neebes, Granger Farwell).

C. Rietz Brothers' Lumber Company (Charles, August F. and E. G. W. Reitz), Richards, Hanks & Co. (E. Richards, Thomas J. Hanks, George E. Wood), Ruddock, Nuttall & Co. (Thomas S. Ruddock, Charles H. Ruddock, L. W. Nuttall), William Ripley & Son (William Ripley, B. W. Ripley), Ruger & Durgin (William Ruger, John C. Durgin), Redington & Chester (Edward D. Redington, H. W. Chester), M. Ryerson & Co. (Martin Ryerson, Charles T. Hills, H. H. Getty, Martin A. Ryerson).

Street, Chatfield & Keep (Charles A. Street, Wayne B. Chatfield, F. A. Keep), South Branch Lumber Company (Jacob Beidler, Francis Beidler, B. F. Ferguson), Sinclair, Morris & Co. (George F. Sinclair, Thomas G. Morris, H. C. Akeley), Sawyer, Goodman Company

(Philetus Sawyer, E. P. Sawyer, James B. Goodman, W. O. Goodman), John Sheriffs & Son (John Sheriffs, Andrew Sheriffs), J. H. Skeele & Co. (J. H. Skeele, W. C. D. Grannis), R. B. Stone, Sturgeon Bay Lumber Company (C. M. Charnley, W. S. Charnley, A. W. Lawrence), W. Shoemaker & Co. (W. Shoemaker, Charles D. Brell), Jesse Spalding, Soper, Pond & Co. (Albert Soper, William M. Pond, A. C. Soper, H. A. Nelson), Soper Brothers & Co. (Albert Soper, James Soper, James P. Soper), W. W. Spooner & Co., G. B. Shaw & Co. (G. B. Shaw, F. Jocelyn), Sands, Louis & Co. (L. Sands, W. H. Bonnell, agent).

C. C. Thompson & Co. (C. C. Thompson, C. A. Paltzer, William A. Thompson), Thompson Bros. & Co. (J. B. Thompson, C. F. Thompson, C. S. Hall), C. Tegtmeyer & Son (C. Tegtmeyer, C. Tegtmeyer, Jr.).

J. S. Vredenburgh & Co. (J. S. Vredenburgh, M. B. Hull).

White, Swan & Co. (C. B. White, J. H. Swan, J. O. Smith), George E. Wood, T. Wilce & Co., Walkup, Fisher & Co. (Thomas Walkup, A. F. Fisher), H. Witbeck & Co. (D. Wells, Jr., H. Witbeck, J. H. Witbeck), Walworth & Reed (N. H. Walworth, E. H. Reed), H. Williston & Co. (H. Williston, George Palmer), O. D. Wetherell.

The hardwood dealers were Boardman & Keep (S. R. Boardman, Chauncey Keep), Boyle, White & Co. (L. V. Boyle, Joseph White, C. E. Boyle, Hy White), P. G. Dodge & Co. (P. G. Dodge, D. W. Holmes), B. G. Gill & Co. (B. G. Gill, A. Andrews), Hatch, Holbrook & Co. R. Hatch, Joseph Holbrook, W. S. Keith), H. N. Holden, Holbrook & Co. (John Whitley), Holden & Pendleton (I. Holden, E. H. Pendleton), L. Miller & Son (L. Miller, C. L. Miller), F. W. Norwood & Co. (F. W. Norwood, R. Winne, H. Oskins), E. Washburne & Son (Edgar Washburne, Charles L. Washburne), R. A. Wells, George E. White & Co., J. H. Wallace & Co.

The inspectors were M. V. Briggs, Cortis & Palmer (John Cortis, Samuel Palmer), Peter Fish, William J. Frawley, Fyfe & Tiffany (W. C. Fyfe, H. A. Tiffany), George F. Gilbert, Charles Gibson, Jaeger & Sons (E. C. Jaeger, Frank Jaeger, Hy Jaeger), H. H. Meacham, William C. Ott, Naason Young.

The non-resident members were Chippewa L. & B. Company, Chippewa Falls (F. Weyerhauser, O. H. Ingram, E. W. Culver, William Irvine); A. R. Colborn & Co., Michigan City; Eau Claire Lumber Company, St. Louis (J. G. Thorp, R. Schulenberg, N. C. Chapman, W. A. Rust); M. Engleman, Manistee; M. C. Huyelt & Co., Detroit (M. C. Huyelt, Ezra D. Frog); C. J. Kershaw & Son, Milwaukee; Methudy & Meyer, St. Louis; W. D. Morton, Detroit; Northwestern Lumber Company, Hannibal (D. R. Moon, S. T. McKnight); O. S. Whitmore & Co., Cadillac.

Names of individuals and firms added in 1884 were as follows: Alexander Agnew (R. B. Stone & Co.), Adams, Hastings & Co. (A. L. Adams, G. W. Hastings, R. B. Currier), Ed E. Ayers, Billings, Porter & Co., C. B. Crombie & Co., Crandall, Schultz & Co. (J. N. Crandall, William Schultz, R. B. Miller), Cutler, White & Boice (D. Cutler, T. S. White, H. M. Boice), James Fraser, T. W. Harvey Lumber Company (T. W. Harvey, A. C. Badger, C. L. Cross, H. H. Badger), S. K. Martin Lumber Company (S. K. Martin, A. Gourley, E. Hines), W. &

THE C., B. & Q. OFFICE BUILDING.

FLORENTINE-ROMANESQUE ARCHITECTURE. ITALIAN ORNAMENT.

A. McArthur, Mackinaw Lumber Company (O. W. Johnson, F. B. Stockbridge, J. L. Houghteling), C. J. L. Meyer & Sons Company, Mann Brothers, Seymour & Sargent (H. F. Seymour, John Sargent), A. F. Fisher. Hardwood dealers—R. A. Wells & Brother (R. A. Wells, James L. Wells). Non-resident member—J. P. Richardson.

The members of 1885–6, whose names do not appear previously, are as follows: C. H. Bogue & Co., Henry Curtis & Co. (H. Curtis, C. B. White), C. B. Crombie, Cook & Rathborne (G. T. Cook, W. W. Rathborne), James Charnley Lumber Company (James Charnley, J. A. Barber), Fisher & Witbeck (A. F. Fisher, J. Witbeck), H. H. Gardner & Co. (H. H. Gardner, C. J. Wood), George F. Gilbert, Gunderson & Barker (S. T. Gunderson, S. A. Barker), O. G. Gibbs, Hatch & Keith (R. Hatch, W. Scott Keith), Hayden Bros. (H. S. Hayden, C. H. Hayden), Hull & Ulrich (M. B. Hull, A. L. Ulrich, J. E. Quintal), J. P. Ketcham & Bro. (J. P. Ketcham, W. P. Ketcham), Robert Larkins, P. Lowe & Co., McLaren & Morris (John McLaren, Thomas Morris), Marsh & Bingham Company (George Marsh, A. E. Bingham, W. D. Walker), W. & A. McArthur (W. McArthur, A. McArthur), H. H. Meacham, C. J. L. Meyers & Sons Co. (C. J. L. Meyers, J. P. Meyers, H. P. Meyers), William Meglade & Co., Mueller, Christy & Raber (William Mueller, H. A. Christy, P. W. Raber), McElwee, Billings & Carney (R. H. McElwee, H. G. Billings, W. J. Carney), William C. Ott, Frank Porter & Co. (Frank Porter, W. E. Sandford), C. A. Paltzer & Co. (C. A. Paltzer, Chase & Pate), Ruddock Bros. & Co. (Fred. S. Ruddock, C. H. Ruddock, H. Meyerding, H. A. Gerhardt), Robinson & Prettyman (George G. Robinson, W. B. Prettyman, W. L. Prettyman), John Spry Lumber Company, R. B. Stone Lumber Company, Spalding Lumber Company (J. Spalding, W. E. Burden), T. D. Stimson, C. C. Thompson & Walkup Co. (C. C. Thompson, T. Walkup, W. A. Thompson), Walther & Peterson, O. D. Wetherell, R. A. Wells & Bro. (R. A. Wells, J. L. Wells, George E. White & Co. (George E. White, J. D. Kline), Naason Young (resigned).

The members of 1887, whose names do not appear previously, are A. R. Beck & Co. (A. R. Beck, J. McLaren, W. McLaren), C. B. Flinn & Co., A. F. Fisher & Co., Goodenow & Hinds (S. Goodenow, E. P. Hinds), Hull, Ullrich & Co. (M. B. Hull, A. L. Ullrich, J. E. Quintal), E. C. Jaeger & Son (E. Charles Jaeger, Henry Jaeger), A. P. & W. E. Kelley, James McMullen, Lord & Bushnell (E. A. Lord, W. Bushnell), Joseph Rathborne & Co.

The hardwood members in 1887 were R. B. Appleby, L. V. Boyle & Co. (L. V. Boyle, C. E. Boyle, C. Boyle, F. P. Woolen), W. B. Crane & Co. (W. B. Crane, J. O. Call), R. Granger & Co., Hatch & Keith, The Holbrook Company, Hayden Brothers (C. H. & H. S. Hayden), Robert Larkins, Thomas McFarland, L. Miller & Co. (L. Miller, C. L. Miller), C. T. Messinger, Rogers & Baldwin (A. W. Rogers, T. D. Baldwin), Vinnedge Brothers (S. J., M. A. & A. R. Vinnedge), Washburn & Sons, J. H. Wallace, George E. White & Co., R. A. Wells & Brothers.

The members of the Lumbermen's association of Chicago, in 1891, are as follows: Ames & Frost, S. B. Barker, J. Beidler Bros., E. W. Brooks, Badenoch Bros., Charles Bruse, A. R. Beck, L. V. Boyle & Co., C. H. Bogue, W. B. Crane & Co., Chicago Lumber Company, Chase & Pate, Crandall, Schultz & Co., Cook & Rathborne, Columbia Hardwood Lumber

Company, Charles W. Davis, Thad. Dean, P. G. Dodge & Co., A. F. Fisher & Co., G. B. Flinn, Arthur Gourley & Co., Granger Lumber Company, S. R. Howell & Co., E. S. Hartwell & Co., Hannah, Lay & Co., Hemlock Lumber Company, Hamilton & Merryman, Hatch & Keith, Hayden Bros., Houston & Co., T. W. Harvey Lumber Company, O. B. Jacobs, J. P. Ketcham & Bros., A. P. & W. E. Kelly & Co., Kirby Carpenter Company, Ludington, Wells & Van Schaick Co., Perley Lowo & Co., Loomis & Gillespie, Lord & Bushnell, T. R. Lyons, agent, S. K. Martin, Marsh & Bingham, N. & C. H. Mears, W. J. Neebes, Green, O'Brien & Co., Peshtigo Lumber Company, C. A. Paltzer, Pearson Lumber Company, Palmer, Fuller & Co., George G. Robinson, Rittenhouse & Embree, Joseph Rathborne & Co., Charles Rietz & Co., Albert Russell, South Branch Lumber Company, I. Stephenson & Co.. Sawyer Goodman & Company, John Spry Lumber Company, Soper Lumber Company, T. H. Sheppard & Co., Walter Shoemaker & Co., Chatfield Street & Co., Adam Schillo, Tegtmeyer Lumber & Box Company, Thompson Bros. & Co., Vinnedge Bros., the H. Witbeck Company, Watkins & Fuller Lumber Company, E. Washburn & Son, George E. White & Co., T. Wilee & Co., R. A. Wells.

The officers since the original organization in 1859 are as follows: 1859--R. H. Foss, president; Eli Bates, vice president; N. Haven, secretary. These officers were re-elected in 1860, but no succeeding officers were elected until 1866, when A. Carter was chosen president; George C. Morton, vice president, and John Garrick, secretary. The same officers served in 1867, aud iu 1868 J. Spalding was president, George C. Morton, vice president, and W. L. Southworth, secretary. The officers under the reorganization have been the following: Presidents, T. M. Avery, 1869; W. D. Houghteiling, 1860, 1870–1; A. G. Van Schaick, 1872, 1881; William Blanchard, 1873–4; A. C. Calkins (of the Dealer's association), 1874 (of the Exchange) 1875; T. Dean, 1876, 1879; M. McDonald, 1877; A. A. Bigelow, 1880; A. A. Carpenter, 1882; J. P. Ketcham, 1883–4; James H. Swan, 1885; Perley Lowe, 1886; John McLaren, 1887; A. C. Soper, 1888; D. S. Pate, 1889; C. A. Paltzer, 1890; W. W. Schultz, 1891. Vice presidents, W. D. Houghteiling, 1869; William Blanchard, 1872; W. D. Phillips, 1873–4; S. A. Irish, 1875, 1877; A. A. Carpenter, 1876; J. McLaren, 1878–9; C. C. Thompson, 1880; S. K. Martin, 1881; W. E. Kelley, 1882–4; Perley Lowe, 1885; John McLaren, 1886; M. B. Hull, 1887; D. S. Pate, 1888; W. O. Goodman, 1889; E. Harry Wilce, 1890; George E. White, 1891. Secretaries, W. L. Southworth, 1869, 1874; C. E. Stockbridge, 1875, 1879; A. H. Hitchcock, 1879–80; G. W. Hotchkiss, 1881, 1886; Theodore F. Swan, 1887, 1889; E. E. Hooper, 1890–91. Treasurers, A. G. Van Schaick, 1869, 1873, 1875, 1880, 1884, 1886; J. J. Borland, 1874; John McLaren, 1881–2, 1889–90; J. H. Swan, 1887–8; James P. Soper, 1891. In March, 1891, the following directors were elected: F. Beidler, W. J. Ketchum, J. B. Soper, C. A. Paulson, W. W. Schultz, D. S. Pate, George E. White, Clarence Boyle and A. R. Vinnedge.

The following appeared in the issue of the *Timberman* for February 14, 1891: "On Saturday evening next, February 28, at a meeting to be held at the rooms of the Lumberman's Exchange, in the Chamber of Commerce building, the three lumber associations of this city, known as the Lumberman's Exchange, the Chicago Lumber Yard Dealers' association and the Chicago Hardwood Dealers' association, will be merged into one association under the title of the Lumbermen's association of Chicago. We are informed that an invitation has been issued to every lumber dealer having a yard in Cook county to be present at this meeting, regardless of whether or not they were members of any of the old associations. The new organization will retain the old Exchange charter, which is a very valuable one, the only change of any importance being in the name. Its scope will be broad enough to take in all branches of the trade, and those who are actively pushing the matter express confidence that the membership will eventually include nearly every dealer in the city. All interests, however, are to be kept separate and distinct. There will be a committee to take charge of all matters pertaining to white pine, another to look after the hardwood interests, and the prospects are that the yellow-pine dealers will soon be enrolled as members of the association, in which case they will select a committee to look after yellow-pine matters. Organization has of late years become an important factor in all branches of trade, and through it much has been accomplished for the lumber interests in all sections of the country. The Chicago trade, with its three associations, has not in the past always enjoyed that unity of action which the furtherance of the best interests of those engaged in the business requires, but under the new state of things it is confidently expected that the local dealers will fully demonstrate the truth of the old saying: 'In union there is strength.' The election of officers will occur on Monday, March 2, at which time the Lumbermen's association will hold its first annual meeting. The old custom of the Exchange in making this meeting the occasion of a feast or social reunion of the trade, will be followed." Later it was said: "The meeting will necessarily be a large one, as there is now contained in the membership of the white pine association about fifty-five firms, the hardwood association twenty, and with the addition of ten yellow-pine firms which are now or will become members of the new association, it will thus be seen that the amalgamated body will contain about one hundred lumber firms."

Upon the above mentioned appointed date, the two other local lumber organizations were merged into the Lumbermen's Exchange, the latter organization taking the name of the Lumbermen's association, and the rules of the Exchange were altered only so far as was necessary to protect all interests under the new order of things. The number of directors was changed from thirteen to nine, of which it was provided three must be hardwood dealers, and five members of the directory were constituted a quorum for the transaction of business in place of seven as formerly. The number constituting the committees of arbitration and appeals was changed from five to six each, these to be divided equally between the pine and hardwood trades; and a committee of five was added to look especially after the hardwood interests. Rule IX was stricken out, a new rule governing the action of the hardwood committee being substituted. A few other minor changes were made, but the above are the ones of importance. The possibility of making this change and incorporating all the lumber associations under one name had occurred in the spring of 1890 when commission men and inspectors withdrew from the Lumber Exchange. The presence of that element was what had driven the wholesale yardmen from the Exchange and led to the organization of the

Chicago Yard Dealers' association. Since the resignation of the element named the membership of the two organizations had become identical. It was considered by the directors of these two associations that one strong organization was preferable to two weaker ones. Before this amalgamation had been attempted a circular letter had been sent to the members of both bodies and only two dissenting votes had been recorded, against seventy-four in favor of the change. It was after the receipt of these favorable notices that the directors of the Exchange had promulgated the formal notice thirty days previous.

For some time it had seemed advisable to change the name of the body. The committee of arbitration and appeal had discussed the matter thoroughly and found it practicable. The time seemed to be ripe when the Lumbermen's exchange and Hardwood committee and Chicago Lumber Yard Dealers' association could act together, and as one organization. The name, Lumbermen's exchange, was a misnomer, such a name implying a buying and selling organization, which the body was not. This change of name was made in accordance with the laws of the state, and hence all the valuable privileges and powers granted in the special charter were in no ways affected. The association rooms were removed from their old and inadequate quarters on South Water street, to the Chamber of Commerce building. Naturally, the Lumber Yard Dealers' association and the Hardwood association, whose memberships were made up largely of members of this association, discontinued their separate organization.

On Monday afternoon, March 2, 1891, at the Tremont house, occurred the fourteenth annual meeting and feast of the Lumberman's exchange and the first of the Lumbermen's association of Chicago. It was given by C. A. Paltzer, the retiring president, and presented a great contrast to the first banquet of fourteen years before. Not many of the old members who used to meet in the corner basement were present. Death has visited the ranks of the Lumbermen's association. Only five of the veterans were present to tell of the pleasures, trials and struggles of early days. The quintet consisted of Alexander Officer, who was in the lumber business in Chicago as early as 1849; A. G. White, who first owned a lumber yard in this city some time in the fifties; J. H. Swan, M. B. Hull and Addison Ballard, who have also grown gray "in the harness." Since the last annual meeting John Spry, Albert Soper, and Charles H. Hayden, three of the older members of the association, had died. The following gentlemen sat down to the table: C. A. Paltzer, J. P. Soper, William P. Ketcham, D. B. Jacobs, D. S. Pate, L. W. Fuller, A. R. Vinnedge, M. A. Vinnedge, C. L. Washburn, J. P. Ketcham, M. B. Hull, R. L. Henry, C. B. Flinn, A. F. Fisher, William Templeton, F. Simonson, J. F. Mendsen, Thomas Walkup, A. C. Calkins, J. H. Severns, Addison Ballard, Alexander Officer, B. F. Davison, William E. Holmes, W. J. Neebes, F. M. Witbeck, J. H. Witbeck, Edward Hines, Willis Seville, P. G. Dodge, C. B. White, H. S. Hahn, W. B. Seville, G. N. Young, J. D. Billings, G. R. Thamer, George T. Houston, George E. White, H. W. Chase, A. R. Gray, W. L. Cadle, C. W. Marsh, A. E. Bingham, W. W. Schultz, W. R. Robbins, William Moore, E. E. Hooper, W. A. Rase, W. G. Matlant, E. C. Chandler, H. E. Jones, A. B. Lewis, B. A. Johnson, J. E. Defebaugh, C. N. Crocker, R. T. Flourney, T. S. Rattle, A. J. Cross, C. L. Mixer, T. K. Edwards and C. L. Rising.

Secretary E. E. Hooper, read his annual report on this occasion, from which it appeared that the association began the year with seventy members; thirty-three new members had been added during the year, and twenty-eight had tendered resignations, twenty being commission men and eight pine-yard dealers, which left the membership at that time a total of seventy-five. The association was in better condition than at any time in its existence. Under the existing rules of the organization both the large and small dealers were admitted, while before this the yard dealers were barred. Nineteen firms had withdrawn from the association during the last year, but their places were soon filled by new dealers. The shipment of lumber for last year showed an increase of 154,000,000 feet over the preceding year.

From his statistics the total receipts of lumber in Chicago in 1890 was 1,969,689,000 feet, shingles 524,440,000, lath 72,773,000, cedar posts 3,893,432, railroad ties 2,652,365, telegraph poles 89,000, cords of wood 35,490, cords of tan-bark 10,599.

Of the figures given 1,406,768,000 feet of lumber and timber were reported from the Customhouse as lake receipts, together with 456,395,000 shingles, leaving 562,921,000 feet of lumber and 68,045,000 shingles to represent the receipts by rail. The total volume of receipts showed an increase in lumber for 1890 of 39,462,000 feet and a decrease in shingle receipts of 115,434,000. The secretary gave the following analysis of the disposition of lumber and shingles at Chicago for years 1889 and 1890:

	Lumber. 1890.	Lumber. 1889.
Inventory at beginning of year	656,708,795	753,399,000
Receipts during the year	1,969,689,000	1,930,227,000
Total	2,626,397,795	2,683,626,000
Inventory at close of year, including South Chicago	527,870,235	656,708,795
Shipment reported by rail and canal	884,058,000	739,510,000
City consumption	1,214,489,560	1,224,131,462
Increase in 1890 in disposition	154,416,098	
	Shingles. 1890.	Shingles. 1889.
Inventory at beginning of year, including South Chicago	423,899,250	421,502,250
Receipts during year	524,440,000	629,874,000
Total	948,339,250	1,051,376,250
Disposition during year	603,565,530	637,377,000
Decrease in 1890 disposition of shingles		33,811,470

"While upon this matter of statistics, I desire to direct your attention to the fact that the disposition of lumber for the year 1890 is the largest known to this market, and the receipts for the year 1890 are the largest, except during the year 1882."

The Hardwood Dealers' association was organized in December, 1888. Its officers were as follows: President, P. G. Dodge, 1888; Geoge E. White, 1889–90. Vice president, George E. White, 1889; A. R. Vinnedge, 1889–90. Secretary, E. E. Hooper, 1888, elected in 1888. Treasurer, Clarence Boyle, 1888–90. The first board of directors was constituted thus: W. E. Frost, O. M. De Kay, Clarence Boyle, A. R. Vinnedge, P. G. Dodge, George E. White, H. S. Hayden. The directors for 1889–90 were George E. White, A. R. Vinnedge, Clarence Boyle, H. S. Hayden, Harvey Wilce.

The Yard Dealers' association was organized in 1887, and in 1888 it was put on a more substantial basis. It may be stated succinctly and comprehensively that it was formed by the yard dealers for the yard dealers. Its officers were as follows: President, C. A. Paltzer, 1887; Francis Beidler, elected in 1888; W. W. Schultz, 1890. Treasurer, W. O. Goodman, 1887; Granger Farwell, 1888; J. P. Soper, 1890. Secretary, W. W. Schultz, 1887; E. E. Hooper, 1888–90. George Green was elected vice president in 1890. The directors chosen in 1888 were Francis Beidler, Granger Farwell, W. O. Goodman, D. S. Pate, M. T. Greene, R. L. Henry, S. K. Martin, George G. Robinson, Joseph Rathborne. The directors for 1890 were W. W. Schultz, Francis Beidler, George Greene, D. S. Pate, M. T. Greene, Joseph Rathborne, S. K. Martin, W. P. Ketcham and James P. Soper.

The primeval sawmill was an affair of wood, with sharks' teeth for the cutting tools or pieces of flint or obsidian set in asphaltum. Later the Egyptians used saws of bronze to saw the huge blocks of stone from the Lybian quarries, used in building the pyramids. Later still, when the iron age had dawned and steel had been discovered, the serrated edge of a roughly forged steel blade took the place of the cast bronze of the Pharaohs. From hence dates the real evolution of the sawmill. The original mill consisted of a long pit in the ground, walled up with stones or logs, with skids across, on which rested the log to be sawed, a long, stout saw, made from a hand-forged plate, with broad, short teeth, with only slightly more pitch than for a cross-cut, the teeth set very wide to make a wide "kerf" to allow for the inequalities in the forging, the blades being yet for many years unground, and with handles at each end at right angles with the flat surface. The motive power was a couple of stout yokels, one standing on top of the log which lay lengthwise of and over the center of the pit, supported by the skids, while the other stood in the pit, and as the saw was drawn downward, the thrust of the cutting points of the teeth cut away the wood. The first improvement on this method was simply to roll the log upon tall "horses" or trestles, thus getting the pit man, as the under man was called, out of the pit. But the name clung to him, and when power came the connecting rod between the power and the saw took the name of the "pitman." The same saw, but very little changed except in the grinding of the blade and the shape and pitch of the teeth, and operated by man power, may be found in ship yards used for getting out irregular shapes. Between 1230 and 1240, windmills were substituted for man power by Germans, and wind sawmills were operated quite successfully throughout the German empire. In 1332 or 1333, one Gotlieb Mueller, who had a little grinding mill run by water on a tributary to the river Rhine, built a rude sawmill and attached the pitman to a crank on his water wheel. So successful was this mill, that others were built, and by the end of the century several had been built in France, as well as in Germany. But it was not till 1663 that any attempt was made to build a power mill in England, and, owing to the opposition of the hand sawyers, the attempt failed. For one hundred and five years the workmen stopped all improvement on the old hand methods in England. In 1768 a water sawmill after the German pattern was built near London and promised to be successful, but was destroyed by a howling mob, who claimed it would destroy the workman's chance to earn a living. A few years later another was erected and protected by the government, was successful and the precursor of many others that speedily followed. For many years the English did not improve on the German mill, except to lighten the saw frame, improve the water wheel slightly, and simplify the feed works and make them automatic.

Meanwhile colonists had built the first water-power sawmill in America, on the Piscataqua river, in what is now Maine, in 1634, or one hundred and thirty-four years before the first mill was successfully operated in England. At the time of the Revolution they were in operation in nearly all the colonies. America has always kept in advance of the mother country in developing the sawmill. To England, however, belongs the honor of the production of the circular saw. It was not the discovery or invention of any one man, but was the result of the experiments of several mechanics and engineers, among whom was Brunell, who has the honor of presenting it to the world in practically its present shape, in 1790 or 1791. It was called a buzz or buzsaw at first, and was a small affair of two or three inches in diameter, was a crosscut used principally by workers in ivory and bone. Changes in its uses brought new forms of teeth, and it was made to cut lumber lengthwise of the grain. For fifty years or more it was used only as a bench saw, however. Meanwhile the muley had been invented, and had largely superseded the gate saw. About 1850 practical efforts were made to use the circular saw to cut lumber from the log, and about 1855 its success was recognized. The Yankee gang and other gangmills had been evolved from the original gatemill. The gang has so many good points that it does not now seem certain that it will ever be superseded entirely. The advent of the band sawmill and its success are of such recent date that it is not necessary to say much of it.

The changes in the sawmill, which have so greatly increased production and lessened the cost of manufacture while vastly improving the quality of the stock, have caused great changes in methods of handling the stock, as well as in the purely office part of business, and they have all occurred within the last thirty-five or forty years. At first, the manufacturer made lumber for the local trade. Every neighborhood had its mill. The settlements were all in a wooded country, and no more lumber was cut than the immediate neighborhood required. Gradually large towns and cities sprang up, and as the timber was cut off, the mills had to be moved out to the source of supply; the local yard took the place of the mill in supplying the consumer, and the mill man became a wholesaler. Later, the railroad became a factor in the business, and also ships and boats; then distributing centers developed, the wholesale yard came to the front, and the mill man graduated into a jobber pure and simple, shipping to the great wholesale yards in gross bulk. When emigration to the prairie states began, and the forests of Michigan and Wisconsin and Minnesota were opened up to the lumberman, then began the halcyon days of the wholesaler and commission jobber, the latter acting as agent for the mill man. Buffalo, Tonawanda, Cleveland, Toledo, Detroit, Chicago, Milwaukee, St. Louis and other places became distributing points, to which the manufacturer shipped his stock in bulk green, or only partially seasoned. He generally did all his business through some commission house, that practically made prices and terms and did all the work of selling and collecting. Lumber was seldom measured or inspected at the mill, and the inspecting business at the cities named became an important factor in the trade and the subject of a great deal of local legislation and personal wrangling. Doing business in this way, the mill man got his cash or equivalent for all his cut at the end of the season. Later, inspection at the place of manufacture was introduced, and in spite of the fierce opposition of the inspectors and wholesalers, who bought all their stock on the market at the receiving ports, the mill tally came to stay, and it is practically the rule to-day. Chicago now retains the largest force of lumber inspectors and measurers of any of the great receiving points. As the mill men prospered, many of them tired of the life at the mill, and left a working partner behind, and moved to the cities, where they sold their lumber and established jobbing offices of their own, dispensing with the commission man altogether. Others, believing they could run that end of the business best, remained at the mill, but put a resident partner or salaried agent at the selling point. In other instances, the wholesale yard men bought interests in or built mills, and jobbed or wholesaled their own stock. All this caused a great change at the large lumber markets, and now there is not one commission man or broker in the business where there were ten twenty years ago.

The building of railroads into the heart of the pineries and the advent of the railroad mill brought the manufacturer and the wholesaler into direct communication, to the discomfort of the jobber, and when the wholesaler began to order lumber shipped directly from the mill to his retailing or consuming customers, the retailer and consumer struck hands with the mill man to do away with the profit of the wholesaler. But the railroad mill man has not found this change without its disadvantages. The necessity of carrying large and varied stocks of dry lumber has called for increased capital, a large line of credits has had to be assumed, a large force of workmen has to be employed and the office has to be reorganized, with credit man, shipping clerks, bill clerks, bookkeepers, etc., and added to this, is the greatly increased chances of loss by bad debts. This has wrought another noted change, as it has weeded out all the men of small means, with their little one-horse mills. The lake shore and river mill men were rather slow grasping the advantages thus secured by the railroad mill man, but as the railroads reached them, and the country dealer came around with his offers of trade, they have largely joined in selling direct to the trade.

Much could be said of the changes in the retail trade, the greatest of which is the buying up or establishing of lines of retail yards by the wholesaler, which has been the direct result of some of the changes heretofore named, coupled with sharp competition. The planingmill, in its connection with the lumber trade, has also undergone a wonderful change. Formerly the consumer got his lumber dressed himself at the point of final distribution. The wholesaler and manufacturer had nothing to do with the business in any shape. But now the demands of trade require costly plants in every wholesale yard, at all the railroad mills, and at many of the others; formerly the bulk of the stock was shipped to the retailer rough, now rough lumber is the exception. The dry kiln also deserves mention as a present necessity of the trade, and its changes from the crude affair of a few years ago to the elaborate and complete establishments of to-day, tell a story of human ingenuity. The changes in styles and forms and dimensions of lumber, in sorting and grading have had a marked influence on the trade and on many departments of building.

The lumber trade of Chicago began shortly after 1830, when Chicago and its tributary country had begun to show considerable advance in settlement, and it was not long before lumber had come to be regarded as an important commodity of importation. West of what is now the great city a large part of the area was prairie land, with great expanses destitute of timber; and it was to the Michigan and Wisconsin woods along the lake shore that the pioneer lumberman looked for his stock in trade. Building material from this source took only second place in the list of Chicago's commercial essentials. A number of sawmills were built along Hickory creek in 1832. In 1833 Charles Cleaver wrote a letter descriptive of Chicago, in which he stated that at that time all of the lumber on sale in the town would have measured up less than ten thousand feet, the prices ranging from $60 to $70 per thousand. One water power and one steam power sawmill was in existence in the vicinity. The former was located about six miles up the North branch. The latter, owned by Capt. Bensley Huntoon, was located at the mouth of the slough, which then emptied itself into the river just south of what is now Division street, and the Captain cut and worked up such timber as grew in his near neighborhood, mostly oak, elm, poplar and white ash, of small growth and not valuable for building, and a little poor pine. With such a scanty supply of growing timber and meager facilities for manufacture, it will be seen that the lumber trade must have been the outgrowth of necessity as improvement advanced in Chicago and its environs. The Huntoon mill was built in 1832, and before Huntoon's proprietorship had been owned and operated by Gurdon S. Hubbard. Captain Huntoon operated it five or six years, adding to it a shingle machine. It was burned in 1834 and refitted in 1835. It was mostly in use during the summer in sawing out three-inch plank, which were used in covering the north pier. The water-power concern of John Miller, fourteen miles up the North branch, was also early known. These mills sawed out such timber as grew conveniently near them, and of the green lumber so made, most of the houses of that period were built.

In the chapters devoted to early buildings, including those of Fort Dearborn, references to the builders, to the lumber used, and to the locality where such lumber was obtained are made. Here it will only be necessary to begin with the first importer of or dealer in lumber, and trace the history of the industry and associations connected directly with it from 1833 to the present date. Prior to 1833 the lumbermen of the city confined themselves to getting out logs and raising single and double cabins. In 1833, David Carver established a yard here, hauling the sawn lumber across the lake, and by so doing gained to himself the credit of having inaugurated the Chicago lumber trade. It was in the spring or early summer of that year that he came to Chicago, where he was regarded as a man of some importance, as he owned a schooner named in his own honor the "David Carver," which was probably the first to ply as a lumber craft between this point and St. Joseph, Mich. Some time in the summer or fall of that year he brought in his first cargo of lumber and opened up the first temporary lumber yard here. It was a cargo of pine, and he ran his schooner into the main river, and unloaded it on the south bank, between La Salle and Wells streets. Within the next two or three years Kinzie, Hunter & Co., Jones, Clark & Co., and perhaps others, were in the trade here, in the same way, employing quite a fleet of vessels and establishing at Chicago a lumber trade center which has witnessed remarkable development in the years that have elapsed since that time. There were no regular lumber yards in the city prior to 1839. Lumber vessels would tie up close to the river bank and deposit their cargoes in a promiscuous pile, from which builders would purchase and do their own assorting. George W. Snow established the first lumber yard in 1839, on a lot 80x150 feet, forming the southwest corner of State and South Water streets. In 1840 Sylvester Lind opened a yard in the angle formed by Randolph, Market and Water streets. This land is not now existing. The town gave Lind the lot immediately north of Randolph street bridge, in lieu of the angle upon which he erected the large five-story building that escaped the fire of 1871.

Wood manufacture began here about the same time that the lumber trade took firm root. In 1839 Andrew Blackie and Samuel Smale advertised themselves as stair builders. Under date, Chicago, December 20, 1839, the following advertisement appeared in the *Chicago Morning Democrat:*

CHICAGO SASH FACTORY.

The subscriber having purchased the Chicago Sash Factory, gives notice to the public that he will keep constantly on hand and manufacture to order any quantity or style of window sash, doors, blinds or anything of that kind. Wood turning done to order. ROBERT SCOTT.

H. Norton & Co's. lumber yard on South Water street was also advertised in this issue. Edwin B. Colvin had a sash, door and blind factory at North Water and Dearborn streets. The Ira Miltimore sash, door and blind factory was a well-known early concern. Of this, Andreas' History of Chicago says: "It was established in 1837 or 1838 by Ira Miltimore, on the South branch. It was purchased by David Scott in 1838, and was burned in July, 1842." It was operated by steam power. John Fussey, a sawyer, had a saw-pit on west Monroe near Canal street, and Jonathan Rowe one near Kinzie street bridge. Allen & Company were lumber merchants on Canal street in 1843, J. C. Walter being the company. The following prices for lumber were quoted April 11, 1840: Lumber, clear, per thousand, \$18 to \$20; merchantable, per thousand, \$12 to \$14; flooring, per thousand, \$14 to \$16; siding, per thousand, \$14 to \$16; refuse, per thousand, \$8 to \$10; shingles, per thousand, \$2.50 to \$4. John Fussey's saw-pit was yet in operation in 1843. Others were operated by J. C. Newcombe, William Pitt, Jonathan Row and Palmer Soper. Other names found mentioned in connection with lumber in the early period were those of William Price, who had a sash factory in 1843, and died on the Isthmus of Panama, in 1850, while en route to California; James Bow, a shinglemaker, who in 1843 had a shop on Madison street near the river; William Howard, shinglemaker; C. Fisher, a wood turner, who in 1843 had a shop on Franklin street south of Lake; D. W. and Trumbull Kent, turners, on Randolph street west of La Salle; John Phillips, who died in 1869; John Phillips, Jr., who died in 1880; W. Phillips, who died in 1876, and the following lumber dealers: Jabez Barber (lost with the steamer Pacific in February, 1856); George Farnsworth; Stephen R. Gillson; Farleton Jones (died 1878); S. Lind: H. Loomis (died in 1886); L. Marsh (died in 1859); William Scorgie, 204 Lake; Andrew Smith (died 1851); George W. Snow (died in 1870); Amos G. Throop; John M. Underwood (died in 1888); Sextus N. Wilcox (drowned in Lake Superior in 1881). Foss & Brothers' planingmill stood on the river bank, between Washington and Madison, in 1843. W. H. Foss died in 1858 and Samuel T. Foss in 1870.

Within the decade ending in 1849 the growth in the number of lumber yards, planingmills, sash, door and blind factories, and the establishment of kindred industries was phenomenal. The dealers in lumber in 1849 were James P. Allen, river near Fort Dearborn; Jabez Barber; Smith Boyington; Walter Briggs; Butler & Norton, Water street near Fulton; Oliver G. Butts, 117 Franklin; Carter & Stockbridge, Canal and Monroe; Chapin & Marsh, Canal and Madison; Festus Clark, Canal and Fulton; D. Clark & Co., Madison street bridge; T. Clarke; James M. Underwood and Co., Canal street; Edward Cooban, Wells near Adams; Peter Crawford; James and J. M. Dalton, Market street; James Elliott, Edina place and Harrison street; Throop, Wait & Co., Market street; Ferguson; W. M. Ferry, Market near Washington; Abel French, Market near Monroe; Walker & Day, Randolph and Clinton; French & Moore, Adams and Market; Goss & Phillips; Green & Holden, Market near Madison; G. M. Higginson, North Water street; A. Officer (now a resident); Howard & Worden, Adams and Market; E. C. Stowell, Adams near State; James & Hammond, Canal near Monroe; D. R. H. Sutherland; S. H. Kerfoot, Dearborn near Ohio; B. W. Thomas; James Leonard, Randolph near Clinton; Lind & Smith, Lake and West Water; James Smith, Adams near State; Walter Lull, Randolph and Jefferson; McCagg, Reed & Co., North Water and La Salle; J. A. Sanborn; Charles Mears; Milne Ferguson & Co., Adams near Michigan avenue; George C. Morton, Canal near Monroe; George R. Roberts, West Water street; N. Rossiter, 68 Michigan avenue; Reuben Scott, 40 Monroe; Andrew Smith, Madison and Clinton; F. B. Gardiner established his yards a year or two later, and in 1854 he and John Spry extended this yard. The sawyers in 1849 were Samuel Hubbell, George Amsler (Eldridge court), John Bishop (Eldridge court), James Pitt, Mr. Burton, J. Haynes, M. T. and Adam Butters, Charles Clark & Son, Harvey G. Cole, John Fussey, Charles Thorp. G. W. Noble had a planingmill in 1849 on Jefferson near Randolph. The sashmakers in 1849 were Brick & Orr (Lake near Canal), Nelson Christopher (Ohio near river), F. Diedrich, William Keel, C. Kessler, John Loubmeyer, Jacob Williams, H. V. Zwoll.

The turners in 1849 were Louis Bilharz, Joseph Frey, R. Zollinger, John Coyde (214 Randolph), George Dixon, Daniel Leopard.

The radical changes that have taken place in the sash, door and blind industry of the Northwest, through all its departments, during the last forty years, would be scarcely apparent to those whose connection with it is wholly within recent years. The numerous factories now in operation capable of overloading the country with stock goods, and the hundreds of concerns that manufacture for local consumption, the large jobbing houses in Chicago and at other central points, the brokers, the scalpers, the semi-jobbers, the associations, pools, elaborate price-lists, etc., were unthought of in the early days. The development in the period 1839–49 has been referred to. It was about the end of this decade that the sash, door and blind business in Chicago entered upon the wonderful era of transition that reaches back into the pioneer days and extends into the great industry of the present. Much of the interesting historical matter of this period which follows was extracted from an article published in the issue of the *Northwestern Lumberman*, for May 31, 1890. Beidler Brothers engaged in the sash, door and blind business in 1849, at the corner of Franklin and Congress streets. The firm was composed of Jacob and Henry Beidler. Jacob Harris had established a planing-mill a few years before, where he matched flooring by hand. It was gauged to surface, and as the boards were of varying thickness, they were edged off by the carpenter to fit the joists. About 1850 Joseph Lyon and John McFall formed the firm of Lyon & McFall, and succeeded Beidler Brothers. In 1852 Lyon sold his interest to his partner. McFall died in 1853, his property going to his widow and his sister. Addison Ballard, the retired lumber dealer, bought out the sister's interest, and Frank McFall, a brother of John, purchased that of the widow, the firm of McFall & Ballard continuing from 1855 to 1857. Mr. Ballard then sold out to his partner, but bought the interest back in 1858, remaining alone until 1860, when he sold out to Will & Roberts, who are still located on the same site. William B. Phillips, of the Goss & Phillips Manufacturing Company, came to Chicago from Massachusetts in 1851.

Sash, doors and blinds were then chiefly made by hand, although ingenious and serviceable machinery was to some extent in use. In those days the largest concern in this line was Hinkle & Guild, of Cincinnati, who from 1850 to 1860 did a big business with the East, West and South, being favorably situated at the head of navigation at a time when railroads were few. The rich southern planters were then among the most profitable customers, as they had the means of gratifying their architectural tastes, and were frequently extravagant in their purchases. Hinkle & Guild were contractors, builders and manufacturers, furnished plans, specifications and everything wanted, and after taking a contract would get out the necessary stuff, load it on a boat, and transport it to its destination, where it would be erected by men sent along for the purpose. The list of goods turned out in Chicago for the trade was small and plain. The only thing that was made to go into stock was sash, the sizes of light chiefly sold being 7x9, 8x10, 10x12, etc. There were then few lumber yards in the interior, and it was the custom for druggists to handle glass and sash. No doors were made for shipment until 1854 or 1855. The machine-made article was in disfavor. Mr. Ballard made doors by hand for years, and claims to be the originator of the ogee door. At that time wide lock rails were popular, and square joint, thin panels were in vogue, into which molding was planted. Mr. Ballard conceived the idea of raising the panels on both sides, and made a special point of this improvement. Competition was lively, and doors were made with one side of panel raised, sometimes with the other side molded, and in other ways. They were neither pinned nor glued, but were knocked together for the carpenter to finish. When sash were made by hand, four cents per light was the price.

Up to 1857 the users of the Woodworth planer, the makers of which had obtained a patent on rotary motion were compelled to pay $1 a thousand royalty on all stuff run through the machines to Robert Foss, who had purchased the right for Cook county. But as the charge for dressing lumber was $5, the planing mill men made a good profit. Other machines were subsequently invented, and the price was rapidly reduced until it had reached so fine a point that Mr. Ballard hauled stuff to and from his mill and ran it through the machine without charge, merely to get the shavings for fuel. While the Woodworth planer was in its palmy days the Triumph planer was brought out, a machine that made a shaving the full size of the board, even though it were two feet wide. The makers had endeavored to get around the Woodworth patent on rotary cutter heads by using stationary knives for surfacing, and rotary saws for matching. A suit for infringement resulted in a victory for the Woodworth machine, and Mr. Foss complacently went over the country collecting back royalty. Mr. Ballard had one of these machines, and was consequently a victim. The Triumph did good work, but the shavings it turned out were an intolerable nuisance, for the wind would carry them in every direction. The authorities compelled Mr. Ballard to cart these shavings off, and, becoming disgusted, he sold the machine to a Pekin man, and when the latter got it in operation, it has been facetiously remarked, his shavings blew all over Tazewell county.

The most laborious work done by hand was sticking moldings, and the first machine that came out for doing the work was joyfully welcomed. One of the interesting facts told by Mr. Ballard is that when he was in the carpenter and building business in Indiana fifty years ago, it was customary to fell a butternut tree, bore holes on two opposite sides, split the log and hollow it out for an eavestrough which served the purpose of a cornice for quite a fine house, to which it was spiked, after having a sort of ogee* molding fashioned upon it. These same houses, constructed in a homely but honest manner, are less decayed to-day than some frame buildings in Chicago that have stood only about ten years.

The character of the early distributing trade can be best understood by a glance at one of the first price-lists of sash and doors that was sent out from Chicago. It was issued by Addison Ballard, and is reproduced below.

PRICE LIST.

Plain sash, 13-16 thick.
- 7x 9 per light, $2\frac{1}{4}$ cents.
- 8x10 per light, $2\frac{1}{4}$ cents.

Plain sash, $1\frac{3}{8}$ thick.
- 8x12 per light, $3\frac{1}{2}$ cents.
- 9x12 per light, $3\frac{1}{2}$ cents.
- 10x12 per light, $3\frac{1}{2}$ cents.
- 9x14 per light, 4 cents.
- 10x14 per light, 4 cents.
- 9x16 per light, $4\frac{1}{2}$ cents.
- 10x16 per light, $4\frac{1}{2}$ cents.

Check sash, $1\frac{3}{8}$ thick.
- 8x10 per light, $4\frac{1}{2}$ cents.
- 9x12 per light, 5 cents.
- 10x12 per light, 5 cents.
- 9x14 per light, $5\frac{1}{2}$ cents.
- 10x14 per light, $5\frac{1}{2}$ cents.
- 9x15 per light, $5\frac{1}{2}$ cents.
- 10x15 per light, 6 cents.
- 9x16 per light, 6 cents.
- 10x16 per light, $6\frac{1}{4}$ cents.

Blinds, 13-16 thick.

8x10	$1 25	9x14	$1 50
9x12	1 38	10x14	1 50
10x12	1 38	10x16	1 63

For $1\frac{3}{8}$ thick, add to above price, 25 cents per pair.

Ogee doors, $1\frac{1}{4}$ thick.

2 feet 6x6 foot 6 2 panels........	$1 25
2 feet 8x6 foot 8 2 panels........	1 25
2 feet 10x6 foot 10 2 panels.........	1 38
2 feet 6x6 foot 6 4 panels........	1 50
2 feet 8x6 foot 8 4 panels........	1 50
2 feet 10x6 foot 10 4 panels........	1 63

Ogee doors, $1\frac{3}{8}$ thick.

2 feet 6x6 foot 6 2 panels........	$1 50
2 feet 8x6 foot 8 2 panels........	1 50
2 feet 10x6 foot 10 2 panels........	1 63
2 feet 6x6 foot 6 4 panels........	1 75
2 feet 8x6 foot 8 4 panels........	1 75
2 feet 10x6 foot 10 4 panels........	1 88

N. B. Panels are all raised on two sides, for which no extra charge is made.

* Carpenters and mill men in writing of this kind of molding designate it thus "O. G."

It was printed on one side of a small card, and, as will be seen, contained just thirty-six items. A comparison of this meager list with the elaborate catalogues issued by the manufacturers of to-day tells an eloquent story of the growth and evolution of the sash and door business.

In this connection the development of manufacture in the Northwest may properly be alluded to as showing the progress of the trade and the conditions which led to the expansion of the wholesale business in Chicago, which naturally became a great center of distribution. In 1855 or 1856 C. J. L. Meyer made a small beginning at Fond du Lac, Wis., and built his first shop in 1861. This was the starting point of a great business, for in 1866 he erected two large factories at Fond du Lac, which were followed by a sawmill in 1868. In 1865 he established a Chicago depot, and in 1875 the north pier plant was erected. The chief facts in the subsequent history of the Meyer concerns, including its failure, in December, 1889, are familiar to Chicagoans.

William B. Phillips was only twenty years of age when he started in business in Chicago, in 1851. In addition to Lyon & McFall, already mentioned, George W. Noble had a shop on Clark street between Randolph and Washington. He afterward built a mill on Canal street, north of Monroe, which was fitted up with the best machinery to be had, but was never started up, from the fact that the panic of 1857 paralyzed business and rendered the enterprise a failure. The mill stood idle for ten years or more, the machinery finally being disposed of, partly to Mr. Phillips. When the latter was casting about for an opening, he visited a man at Racine, Wis., who ran a small mill by horse power, and who, when informed that his visitor had invested $1,500 in sash and door machinery declared that it was too much money to put into the business. Mr. Phillips had meantime encountered Daniel Goss in the upper part of Stowell's sawmill, at the corner of Clark and Twelfth streets. This was a hardwood mill, with a mulay saw, that made a speciality of oak timber, and was supplied with logs from what was known as the Sag, about twenty miles south on the canal, where a limited amount of oak grew. Mr. Goss had one man assisting him, and his machinery inventoried $184. Mr. Phillips bought him out, secured more room and put in the new machinery. Mr. Goss was given a working interest, and the firm became Goss & Phillips. Afterward Mr. Phillips sold his interest to a brother-in-law of Goss, and the style became Goss & Abbott, but he soon bought the interest back. The firm continued at the same location until 1866, when it sold out to Palmer, Fuller & Co. William A. Fuller had for years been a bookkeeper for the firm, and was succeeded by Cornelius Curtis in that capacity. Palmer, Fuller & Co. leased the buildings for a few years, and then erected a factory at their present location, Union and Twenty-second streets, and in the spring of 1871 the Goss & Phillips Manufacturing Company, a partnership, was organized, and started up a large factory on Twenty-second street. The company continued in business until 1887, when it sold out to the new firm of W. F. Behel & Co., having a factory on Center avenue near Twenty-second street, A. H. Andrews & Co., however, taking the plant. Cornelius Curtis has continued to act as secretary for the company to look after its remaining property interests.

In tracing the origin of the firm of Palmer, Fuller & Co., it is necessary to go back to the year 1851, when A. R. Palmer, at Montgomery, Kane county, Ill., began to manufacture, by water power, with such crude machinery as his ingenuity enabled him to devise and build. He was one of the first to establish a mill of this kind in Illinois, beginning manufacturing when there was no railroad connection with Chicago, and was compelled to haul his lumber by wagon from this city to Montgomery, and to haul his product away to neighboring points to market. He had dealt with Vine A. Watkins, who was then established in the lumber business, and the two joined hands at Montgomery, the firm becoming Palmer & Watkins in 1852. In 1866 Mr. Palmer sold out to Mr. Watkins and came to Chicago, while Mr. Watkins remained at Montgomery until 1872, when he sold out, coming to Chicago to enter the firm of Palmer, Fuller & Co. Another branch of the history of the firm connects it with that of Goss & Phillips, whom it succeeded January 1, 1866. Mr. Goss retired from the new firm in 1867, and Mr. Phillips in 1868. It was then composed of A. R. Palmer and W. A. Fuller, the style remaining unchanged; but George B. Marsh, who had been connected with Goss & Phillips for several years, was soon admitted. Palmer, Fuller & Co. remained in the old Goss & Phillips factory building until January 1, 1871, when it became imperative that new quarters should be provided. In 1869 the firm had bought six acres of land at the corner of Twenty-second and Union streets, and three acres of dockage. Upon the former site were erected the present immense works, which cover nearly the entire space. Many additions and improvements have been made, until the plant is one of the largest and most complete in the Northwest. During the building of these works the senior partner, A. R. Palmer, became ill and was obliged to go abroad. He received no benefit, however, and V. A. Watkins was admitted to partnership January 1, 1872, Mr. Palmer having died in the meantime, his widow retaining his interest. G. B. Marsh was a member of the firm until January 1, 1887, when the other members, Mrs. Palmer, W. A. Fuller and V. A. Watkins, bought him out. In January, 1890, the interest of Mrs. Palmer was purchased and the firm was incorporated without change of style, the following officers being elected: William A. Fuller, president and treasurer; Vine A. Watkins, vice president; John R. Laing, secretary. William A. Fuller came from Massachusetts in November, 1854, and engaged with Goss & Phillips as clerk and shipper at their salesroom at 189 Randolph street, afterward becoming bookkeeper and finally manager of the sales department. Mr. Fuller and Mr. Watkins have been the active members of the concern, Mr. Fuller having been its financial manager from the start, and Mr. Watkins in charge of the practical part of the business, the development of which he has watched since the manufacture of sash and doors was in its embryotic stages. Secretary Laing has been one of the fixtures of the firm since 1876, when he entered its employ as bill clerk. The following year he took charge of the order or selling department, and has since continued in that capacity. His connection with the sash and door business in the West has been entirely identified with Palmer, Fuller & Co.

Those mentioned may be regarded as the representative sash, door and blind concerns of the period of development—1849–59. By 1857 there were some twenty planing mills and sash, door and blind factories, in which nearly half a million dollars' capital was invested. The value of manufactures turned out during the year 1856 was more than $1,000,000. From 1852 to 1857 occurred the most wonderful part of this development, the period of depression continuing from the latter year until about 1861. Those who were in the sash and door business met with losses, but both profits and the volume of trade increased so rapidly that adversities were soon forgotten. This latter era of prosperity continued almost uninterruptedly for fifteen years. The amount of lumber transported on the Illinois & Michigan Canal each year since its completion to 1857 was as follows: 1848, 14,425,357 feet; 1849, 26,882,000; 1850, 38,687,528; 1851, 56,510,051; 1852, 58,500,438; 1853, 58,500,438; 1854, 68,272,199; 1855, 82,641,925; 1856, 80,191,006; 1857, 82,122,295. The amount of lumber received by lake, canal and railroad in 1857 was 459,639,198, divided as follows: Lake, 444,396,300; canal, 196,150; railroad, 15,046,748. In the same year shingles were shipped as follows: By lake, 130,462,250; by rail, 1,368,000; total, 131,830,250. Shingle bolts, by lake, 7,182 cords. Shipments: Shingles — by canal, 20,131,250; by rail, 134,696,500; total, 154,827,750. Shingle bolts—by canal, 849 cords; by rail, 76 cords; total, 925 cords.

Pioneers in the sash, door and blind business, like Jacob Biedler, William B. Phillips and Addison Ballard, of this city, when they look back upon the primitive methods in vogue from 1850 to 1860, can scarcely realize the great changes that have taken place in the manufacture and sale of these goods. From making sash, doors, blinds, moldings, etc., with hand tools, to turning out vast quantities by enormous, well-equipped plants, is a big jump. It is remarked regarding the matter of equipment that the principles upon which the different devices employed in a sash and door factory are constructed, have not varied materially since the early day. Machines for sticking, tenoning or mortising have been much improved in detail, but the old principles are retained. A great many machines have been built for doing special parts of the work rapidly, and in a general way early ideas have been perfected and elaborated. Increased capacity simply means a multiplication of machinery. One of the devices in use thirty or forty years ago was a combination machine, which was about six feet square as it stood on the floor, having a sticker, a mortiser and a tenoner on different sides. It was a most ingenious device, and furnished a complete outfit that would do a reasonable amount of work well. The price was $300. W. A. Fay & Co. were among the first to become extensively known as makers of sash, door and blind machinery, and had a factory at Norwich, Conn. Later the H. B. Smith machinery was placed on the market. When Mr. Phillips began manufacturing, the population of Chicago was about 20,000, instead of over 1,100,000, and business was rather slow at certain seasons, because the only means of interior communication was by water. There was only one railroad reaching westward, and the only eastern communication was by lake. Until the opening of the Illinois canal, goods were accustomed to pile up during the spring, but from that time there was ample outlet. Instead of difficulty to sell, supply continued inadequate to demand. Railroads soon followed in rapid succession, and until the Wisconsin factories came upon the field profits were large. The country settled up rapidly, and the wants of the people were usually urgent.

PALMER'S RESIDENCE.

EMBATTLED STYLE. ITALIAN ORNAMENT.

One of the peculiar and highly satisfactory conditions in those days consisted of a cash in advance rule that governed all transactions. The seller and his customer, who often came miles to give an order, were generally strangers, and conditions were such that there was scarcely a basis for credit. There was no special or wholesale price for goods. It followed that when a man took no credit risks, but had the purchase money in hand with which to carry on business at a good profit, prosperity was sure to result, with prudent management. Mr. Phillips bought the first doors turned out by C. J. L. Meyer at his Fond du Lac factory, the profit on which was greater than they would sell for to-day. A four-panel, one and three-eighths-inch, 2–8x6–8 door brought $3.75, less ten per cent.

The proprietors of local molding mills of 1859 were the following: Addison Ballard, Market and Tyler streets; C. Brachvogel, 204 South Clark; Brewer & Co., southeast corner Canal and Adams; William Goldie, 224 Monroe; McCammon & Plumsted, Canal near Madison.

The saw and planing mills of 1859 were operated by Warren Aldrich, 41 Indiana street; William Baker and John McEwen, Wells and Pearson streets; Samuel B. Blackwell, State and North streets; James and George Boggs, South Market and Tyler streets; Jesse C. Boyd, Van Buren and Franklin; George W. Chapman, William C. Marshall and Samuel J. Chapman, 155 South Canal; Cleveland & Russell, 74 and 76 Fulton; Nathan Cobb, L. K. Tucker, W. W. Stewart, 144 to 148 South Canal; Collins & Bunten, Canal and Polk; G. A. Flagg & Co. (E. G. Roberts), 399 South Wells; S. T. Foss and Robert H. Foss, Canal and Monroe streets; John C. Garland, 77 to 81 Sedgwick; David Goodwillie, 100 North Franklin street; Daniel Goss and William B. Phillips, Clark and Twelfth streets; George Hall and H. O. Winch, 324 South Wells; Hall, Merry & Co., State near North street; Peter B. Lamb, Jefferson & Hubbard, McCammon & Plumsted, 65 and 67 South Canal; Hubert Pettit, Clinton north of Randolph; James Robinson, Beach north of North street; Ed A. Rueker, Jefferson and Carroll; Rusco & Clark, 209 and 211 Griswold street; James L. Smith, Payton near Ontario; Vincent, Himrod & Co., 160 South Canal street; John B. Tarr, Canal street north of Meagher; Simeon Mayo, Twelfth and Lumber streets, who had a steam saw and planing-mill; Temple & Wright, Polk and Canal streets, a shinglemill owner.

The leading sash, door and blind manufacturers of 1869 were Fullam* & Lashner, Lumber and Twelfth streets; C. Hahn*†, 34 Clybourn avenue; Hall & Frost*, 144 Sixteenth; Hepp & Schoenthaler, 81 to 87 West Chicago avenue; Palmer, Fuller & Co.*†, Clark and Twelfth; Scheffer, Rupp & Co., 245 South Water, and Woolacott & Coaker, 32 North Canal.

Baeder, Adamson & Co.*, were the only sandpaper manufacturers; C. & J. Cooper & Co., the sawmill manufacturers; D. Cleland & Co. and Hall & Frost, the operators of the scroll and turning mills; L. R. Landy and H. M. Sherwood were the scroll sawyers of 1872, and of the above-named firms of 1869 those marked * were here in 1872, † were here in 1879.

The lumber manufacturers of 1869 were Murphy, Avery & Co.**, Twenty-second and Fisk; Barton & Jones**, Twelfth and Lumber; Bigelow Bros.**, Fisk street near Twenty-second; Bradner, Charnley & Co.**, Quarry and Cologne; H. B. Cone & Son; Estee &

Eggleston, Canal and Eighteenth; Ambrose Gagne, 522 Lumber; Gardiner, Davis & Co.**, 310 Lumber; Gettemy, Parker & Co., Throop street in new lumber district; Hamilton, Merryman & Co.**; Hatch, Holbrook & Co.**; Kirby, Carpenter & Co.** (Stetson's canal lumber district); Ludington, Wells & Van Schaack**, Morgan near Twenty-second; Peshtigo Company**; Beebe & Strong, north pier; Phillips & Brown, 455 Lumber; Roberts, Calkins & Hull; Spalding & Porter, Mason's slip near Twenty-second; T. Wilcox & Co.; J. E. Throop; White & Swan**, and H. Witbeck & Co.** T. S. Constantine dealt in mahogany. William B. Batcham, 337 Canal street, was the principal shingle manufacturer.

In 1872 Biedler Bros.**, C. Brady, Bushnell, Walworth & Reed, John Canfield, Chicago Lumbering Company**, Cushman, Calkins & Co., Davis & Mason, Eggleston, Hazelton & Co., Ferry & Brother**, Ford River Lumber Company**, Goss & Phillips Manufacturing Company**, S. T. Gunderson**, Holt, Balcom & King**, Loomis & Davis, Mears & Bates**, North Ludington Company**, Philips & Brown, Roberts & Hull, Ryan & Young, Spalding & Co. and Porter & Co.

Of the manufacturers of lumber in 1873, the oldest house in the city was that of Goss & Phillips, at the corner of Clark and Twelfth streets. In 1873 it employed six hundred hands and produced annually sash, doors and blinds valued at $1,250,000.

John Brown's sash, door and blind factory was built "out on the prairie," in 1850, a locality later known as Nos. 178 and 180 West Randolph street. In 1873 he employed thirteen men.

Palmer, Fuller & Co., Twenty-second and Union streets, were a leading concern at this time. Every piece of woodwork employed in the building arts could then be produced by the four hundred hands employed.

William Goldie's factory, established in 1851, employed one hundred and sixty men in 1873, at the corner of Canal and Eighteenth streets.

E. Kirchner & Son's, planing and turningmill dates back to 1852. In 1873 they employed fifteen hands in their shops at 415 North Avenue.

The old sash and door factory on Pratt and Morgan streets was started in 1853, and twenty years after employed forty hands. F. F. Mueller was then superintendent.

Hall & Winch's factory, 528 to 536 South Clark street, established in 1857, employed one hundred and forty men in 1873.

David Goodwillie's planingmill, which occupied 35 Ohio street in 1873, was established in 1856.

McDougal & McKinlay established their works in 1856, and in 1873 one hundred employes were employed at 42 and 44 North Sangamon street.

Lull & Sammon's planingmill, at 209 Canal street, was started in 1857, and in 1873 gave employment to forty men.

F. J. Roelle & Son's factory dates back to 1857.

William Stevens established his sash, door and blind factory in 1858, and in 1873 em-

** Here also in 1882.

ployed sixty men. He furnished the sash, doors and blinds for the Grand Pacific and other large buildings after the fire.

George E. White's mills, 122 to 132 North Sangamon street, built in 1858, employed one hundred and fifty men in 1872–3, and produced eleven million feet of lumber.

Soper, Brainard & Co.'s planingmill, on Polk and Beach streets, in 1873, was started in 1859. After the fire this industry employed fifty men.

Robinson's north side planingmill was built at 367 to 371 Sedgwick street in 1872, and fifty-one men employed. Sash, doors, blinds and moldings were also produced here. Wolf Brothers established their planingmill and factory at 168 to 172 West Erie street, and employed thirty men. Cooley & Padgham's mill and factory, 731 and 733 West Kinzie street, gave employment to ten men. Schreever & Linge's factory, 383 Blue Island avenue, employed six hands, and Emery & Straight's planingmill, 253 and 255 Twentieth street, six hands. They were all built in 1872.

Stephens & Healy established a planingmill and box factory at 10 Quarry street, near Archer avenue, in 1873, and employed seventy-five men. Smith Brothers erected a sash, door and blind factory, at 130 and 132 Fulton street, wherein forty men were employed, and Wilce, Stevens & Co., a planingmill and lumber yard, on Throop and Twenty-second streets, wherein thirty hands were employed.

The manufacturers of moldings in 1873 were Austin & Boynton, 25 North Jefferson street, established in 1868; Felix Lang, Twenty-second and Loomis streets, established in 1869; J. C. Hall & Co., 23 North Jefferson street, established in 1870, and Seaver, Tonk & Co., 87 and 89 Lake street, in 1873.

F. L. Smith's shingle factory, at Loomis and Twenty-second streets, was opened in 1855. In 1873 this industry employed twenty men and produced fifteen milllon six hundred thousand shingles.

Hepp & Schoenthaler, who in 1869 established a planingmill at 75–87 West Chicago avenue, employed one hundred and thirty-five hands in 1872–3, and carried on a sash, door and blind factory with their mill.

E. H. Hartwell established a sash, door and blind factory at 28 North Jefferson street, in 1869, and in 1872–3 employed forty-five hands.

The Norris Planing Mill and Lumber Company, 165 West Twenty-second street, dates back to 1869. Three years later seventy-five men were employed.

The Garden City Manufacturing and Supply Company, A. C. Hesing, president, established the then largest planingmill in the world, at Twenty-second and Morgan street, in 1870. The capacity was sixty million feet per year. Sash, doors and blinds were also manufactured and four hundred men were employed in 1872–3.

Cobb & Brothers' mill on Blackwell street was also built in 1870.

The old Holtslander & Randall factory, on Carroll and North Sangamon streets, was destroyed October 8–9, 1871. Immediately after the fire, Holtslander, Randall & Daniels rebuilt, and employed one hundred and twenty-five men. A second fire damaged the building and machinery in 1873.

Homan, Brown & Co., built a sash, door and blind factory at 95 Ohio street, in 1871, and employed twenty-six men. Cronkhite, Mavor & Co. erected one on Kingsbury and Illinois streets, and employed thirty-five men. J. W. Darnley, one at 552 South Clark street, employing fourteen men, and Scammon & Le Beau, one at the foot of Twenty-eighth street, employing fifteen men.

Richards & Hunt, who employed twelve men in their planingmill, 284 Grove street, in 1873, began business in 1861.

The same year W. E. Frost established a sash, door, blind and planing house, at 144 Sixteenth street, and in 1873 employed ninety men.

Hannah & Lyman Star planingmill, established in 1865, employed seventy-five men in 1873, at 72 to 80 Main street. They were also manufacturers of packing boxes.

Gastfield & Joerndt's planingmill, sash, door and blind concern dates back to 1865. In 1873 their works occupied 36 to 40 Second street, and their employes numbered thirty-five.

T. H. & A. S. Brown established a similar concern that year, which was burned in October, 1871. Rebuilding in April, 1872, at 208 to 212 East Van Buren street, they employed thirty men in 1873.

Dufour Brothers & Rowe established their factory in 1865, on Morgan and Twenty-first street, and in 1872–3 furnished the sash, doors and blinds for the old lake front exposition building.

W. V. Johnston's mill, and sash door and blind factory, dates back to 1866. In 1873 he employed one hundred hands at 824 to 828 State street.

In 1867 Witbeck & Dennison started the Mensden Company planingmill, at 256 Twenty-second street and in 1873 employed seventy-five hands. The same year the Sinclair & Atkins Co., built their sash, door and blind factory and planingmill on May and Twenty-second streets, and in 1872–3 employed one hundred hands there.

The O'Neil planingmill, north side, established May 15, 1868, was destroyed in October, 1871; but by October 14, a new building was erected on the opposite corner, northeast corner of Franklin and Ohio streets. In 1873 they employed ninety-seven men.

Pond & Soper's planingmill, at 22 Loomis street, was built in 1868, and in 1873 employed forty men.

Fitzsimmons & Connell's saw and planingmill dates back to 1869. At that time logs were rafted across the lake from Michigan and sawed here. This company had the contract for building and sinking the crib for the south pier in 1873. That year their concern at the foot of Illinois street, gave employment to eighty-two men.

The sash, door and blind manufacturers and dealers of 1872 were; Joel Bullard, W. E. Dankert, Farson, White & Co.; Goss & Phillips Manufacturing Company*†‡, David Goodwillie*†, Hearson & Payne, Heeney & Campbell*, Holtslander, Randall & Daniels*, Palmer, Fuller & Co.*†‡‖, Sands & Wright, William Stevens, Voice, Robinson & Co.*, Garden City Manufacturing Company, S. I. Russell & Co., Wolf Brothers & Co., Wolf & Hubble and a

†Also in 1879. ‡Also in 1882. ‖Also in 1887.

few others. The firms marked thus* operated planingmills in connections with their factories.

The establishment of lumber yards at South Chicago in 1870 is due to accident. In 1869 a vessel was beached at the mouth of the river, and the master had the lumber cast overboard. Early in 1870 Hannahs gathered up this lumber, established yards, and built the first house there, other than the pioneer cabins of Indian days. The South Chicago planingmill of A. S. Griggs & Co. was established in 1873, when five men were employed.

Benning Brothers, of 451 South Morgan street, were the only base knob manufacturers named in 1872.

The planingmills of 1872, other than those named under the head of sash, door and blind factories, were carried on by Thomas G. Atwood, 403 Lumber; L. J. Cobb & Sons, 42 Blackwell; John W. Darnley, 552 Clark; John L. Diez & Co., 34 Indiana; Dufour Bros. & Rowe; Morgan and English; Ferguson & Auten, Throop near Twenty-second; Garden City Manufacturing Company, Twenty-second and Morgan; William Goldie & Co., Eighteenth and Canal; Goodwillie & Benjamin, Twenty-second near Loomis; Hair & Odiorne*, Twenty-second near Laflin; T. W. Harvey*, Twenty-second and Morgan; Hepp & Schoenthaler, 81 Chicago avenue; Hutt & Johnson, Grove near Twentieth; W. V. Johnson & Co., 824 State; Kaeseberg & Co., Division and Crosby; Mrs. Lotta Katz, 249 Milwaukee; Kimball & Sheridan, Seventeenth and Arnold; E. Kirchner & Sons, 413 North avenue; Laft & Burnam, Twenty-second and Throop; L. R. Landy, (rear) 753 State; Jacob Lauer*, North avenue and Halsted; Lull & Holmes, 209 South Canal; John McEwen, 243 North Wells; E. Mendsen Company*, 256 West Twenty-second; O. Newman & Co., 8 West Twelfth; Norris Planing Mill Company, 165 West Twenty-second; Park & Soper*, 775 South Canal; Phoenix planingmill, Sangamon and Carroll; Pond & Soper, Twenty-second and Loomis; J. P. Reed, 439 Archer avenue; Richards, Norris & Co., Twenty-second and Laflin; Richards & Hunt, 284 Grove; J. K. Russell & Co.*, 80 Fulton; Stephens & Clark, Quarry near Archer; E. H. & J. S. Turner, 84 Lumber; John Wartman*, Mitchell near Stewart avenue.

The lumber manufacturers and dealers of 1879 exclusive of those mentioned above, were Adams & Lord, A. Ballard, H. N. Ballard*, George H. Ambrose, B. L. Anderson & Co., Bach, Taylor & Co., Basse & Co., Alexander Bateson*, Boardman & Keep, William Blanchard, S. A. Brown & Co., William Brown, Chapin & Foss, Charles M. Charnley, Chase & Pate*, Cheboygan Lumber Company*, Chicago Cedar Post Company*†, R. R. Clarke, Seymor Coleman, Henry Curtiss, P. G. Dodge, C. W. Davis*, Chauncey Davis, Dean Brothers, George P. Derickson, John Dupee, F. Edler*, E. & C. Eldred,* James Foley*, Lorenz Franz, S. R. Fuller, C. S. Gardiner & Co., B. G. Gill, Gardner & Spry, H. F. Getchell & Sons, W. H. Goodrich, C. Granger & Co., A. R. Gray & Co., D. T. Groves, Grusendorff, Ott & Co.*, J. S. Hair & Co.*, H. N. Holden, Holmes & Co., R. Larkins, Hannah, Lay & Co.*†, T. W. Harvey*, Holbrook & Co., J. J. Holdsworth, S. R. Howell & Co., E. K. Hubbard, Louis Hutt*, W. D. Hitchcock, Henry Barker & Co., S. R. Howell & Co.*, O. B. Jacobs*, T. B. Johns*, Johnson & Ware,

*Here also in 1879.

Kelley, Lowe & Co.*, Kelly, Rathborne & Co.*, Ketcham & Fick*, N. A. King, M. & T. Lorden*, Thomas B. Lyon*, Stockbridge & Houghteling, S. K. Martin*, M. McFarland, Smith, McArthur & Co., McDonald & Billings Lumber Company*, McDonald & Roe, McMullen & Officer*, Messenger & Hubbard, G. W. Meacham & Co.*, L. Miller & Co., Johnson & Welletson, C. J. L. Meyer*, S. C. Moore, Noble & Littel*, Oconto Company*†, Pardee & Cook, Parsons & Foster*, Pentwater Lumber Company*, S. Q. Perry*, J. F. Platt, C. Reitz & Bros., George Robinson, Ruddock, Palmeter & Co., Martin Ryerson & Co.*, Sawyer, Goodman & Co., John Sheriffs & Son*, W. W. Shoemaker, J. H. Skeele & Co.*, Soper, Brainerd & Co., Soper & Pond, Smith & Armstrong, J. W. Smith, Jesse Spalding, P. Stevens, Street, Chatfield & Co.*†, Thompson & Co., Amos G. Throop, E. H. & L. H. Turner, Thompson Brothers, Vandemark & Chandler, J. S. Vredenburg, Waldo & Schillo, F. S. Walkup, Walworth & Reed, O. D. Wetherell, Joseph White & Son, T. Wilce & Co.*, S. N. Wilcox, George E. Wood*, Peter Wood, George Woodley*, E. Washburn and J. H. Wallace.

The leading sash, door and blind manufacturers and dealers of 1882, not previously mentioned, were Bourret, Moisant & Co., 155 Henry; S. A. Brown & Co., 777 South Canal; Deneer & Weise, Purple to Grove, Nineteenth to Twentieth; John L. Diez & Co., 284 to 290 Hawthorne avenue*; Edwin J. Dix (broker), 13, 110 Dearborn; W. E. Frost Manufacturing Company, South Canal corner West Twelfth; Garvey & Jenkinson, 995 to 999 South Paulina; C. O. Hall, 1026 Milwaukee avenue; Edward A. Hartwell, 9 West Lake*; Hintze & Baker, Lumber corner West Twenty-second; Kaeseberg & Rinn, Crosby southwest corner Division; Charles Lange, 548 Loomis*; Jacob Lauer, 689 North Halsted; J. G. Lobstein, Loomis corner Twenty-first; Machek, Dlouhy & Co., 653 Throop; C. J. L. Meyer, north pier; North Branch planingmill, Jacob B. Nepp, proprietor, George street between Lessing and North Sangamon; Northwestern File works, H. S. Holden, proprietor, 65, to 69 South Canal; Otto & Brehm, 3100 South Halsted; Edward L. Roberts, West Twenty-second, southwest corner Lumber*; J. H. Russell & Co., 80 Fulton; Henry Scherer, 416 and 418 Blue Island avenue corner West Fifteenth*; Schroth & Ahrens, 26 Fourth avenue*; South Branch Lumber Company, Jacob Beidler, president, Francis Beidler, secretary, Fisk near West Twenty-second*; Stevens, Wilce & Co., Throop corner West Twenty-second; Western Planing and Manufacturing Company, 134 Fulton; Will & Roberts, Franklin northwest corner Congress; F. J. Williams & Co., 100 West Chicago avenue; Wintermeyer & Dempsey, 542 to 552 South Clark; Wisconsin Sash and Door Company, D. Dickenson, superintendent, 199 and 201 West Twenty-first; Wolff Brothers Manufacturing Company, 170 to 180 West Erie*.

The additional planingmills of 1882, other than those mentioned as sash, door and blind factories, were those of Alexander Bennett, 2637 Main*; Dufour Brothers, West Twenty-first corner South Morgan*; Douglas M. Goodwillie, West Twenty-second corner Allport; Her-

---

*Here also in 1882. †Here in 1887.

*Here also in 1887. At this time John L. Diez & Co. were at 530 North Halsted street; Edward A. Hartwell at 96 West Lake; Schroth & Ahrens at 637 and 639 South Halsted.

man C. Heisler, 1908 Blackwell; A. M. Hinckley & Co., Laflin corner West Twenty-second; G. W. Hinckley & Co., Blue Island avenue corner South Lincoln*; Maxwell Brothers, Loomis near West Twenty-second; Hermann Paepke, 1480 Fifth avenue; Frederick Rossow, West Twenty-first southeast corner Loomis; J. K. Russell, 82 to 96 Fulton*; Soper & Pond Company, West Twenty-second near Laflin; Steinmetz & Eilenberger, 255 Twentieth*; Union Planing Mill Company, 309 West Twenty-second*; John Wartman & Brothers, West Fourteenth between Lumber and Stewart avenue; Oscar D. Wetherell, Blue Island avenue corner South Lincoln, and 2514 Quarry*; T. Wilce & Co., Throop southeast corner West Twenty-second*.

The lumber dealers and manufacturers of 1882, not before mentioned, were the following: Adams, Lord & Co., the B. L. Anderson Company, Andrews, Hamilton & Co., Edward E. Ayer*, Babcock & Park, S. B. Barker & Co.*, Bartin & Jones, Barse & Co.*, the Bay de Noquet Company* (George Farnsworth, president; J. C. Brooks, vice president), J. Beidler & Brother, George C. Benton*, Bigelow Brothers*, H. G. Billings, Bogue, Badenoch & Co., W. H. Bonnell, J. B. Brigham, E. W. Brooks, S. A. Brown, Bryant, Marsh & Wood, James Charnley & Co., Charnley & Loudall*, Chase & Beers, Chicago Lumber Company* (M. T. Greene, manager), John Clark, Seymour Coleman*, Cook, Hallock & Gammon, W. B. Crane & Co.*, W. C. Culbertson & Son, Henry Curtis, Thaddens Dean & Co., John Doerr, Jessie R. Embree, R. W. English, Ferry & Brother, Flinn & Ulrich, S. R. Fuller & Co.*, Charles S. Gardiner, F. B. Gardner, the Gardner & Spry Company, Getchell, Armour & Co., Olney G. Gibbs*, B. G. Gill & Co., Goss & Phillips Manufacturing Company, A. R. Gray & Co.*, D. F. Groves & Co.*, C. H. Hackley, Hair & Odiorne, Hair & Ridgway*, the Hamilton and Merryman Company, Hatch, Holbrook & Co., R. L. and G. W. Henry, Higman Brothers, Hitchcock & Foster, George H. Holt, Holt & Balcom, M. B. Hull & Co., S. A. Irish & Co., Jacob Johnson*, W. C. Kent & Co., the Kirby Carpenter Company* (A. A. Carpenter, president; S. M. Stephenson, vice president and secretary; S. B. Gibbs, treasurer), George Koerner, Robert Larkins*, the N. Ludington Company, the Ludington, Wells & Van Schaick Company (H. Ludington, president; A. G. Van Schaick, vice president; C. S. Burdsall, Jr., secretary; D. Wells, Jr., treasurer), the Mackinaw Lumber Company*, Marsh Brothers & Ransom, Louis Martin, McArthur, Smith & Co., James McDonnell & Co., C. Mears & Co., Nathan & Charles H. Mears*, Mears & Ambrose, Winter S. Mendsen, the Michigan Lumber Company*, Louis Ohlendorf, John Oliver, William C. Ott*, Palmer, Fuller & Co.*, Pardee, Cook & Co.*, R. Peacock & Co., J. H. Pearson & Co.*, the Peshtigo Company* (W. E. Strong, president; G. C. Hempstead, treasurer), Henry W. C. Purmont, Redington & Chester, Richards, Hanks & Co., Charles Rietz & Brother Lumber Company, Robinson & Prettyman, Ruddock, Nuttall & Co., the Sawyer-Goodman Company*, G. B. Shaw & Co.*, Walter Shoemaker & Co.*, Soper Brothers & Co., the Soper & Pond Company, the South Branch Lumber Company*, Jesse Spalding, Street, Chatfield & Keep*, Franklin F. Strong, the Sturgeon Bay Lumber Company (Charles M. Charnley, president; W. A. Lawrence, secretary), Thompson Brothers

* Here also in 1887. At this date Oscar D. Wetherell was at South Wood street and Blue Island avenue.

& Co., C. C. Thompson & Co., Thompson, Hall & Co., E. H. & L. H. Turner, J. S. Vredenburgh & Co., Waldo, Schillo & Chandler, Walkup, Fisher & Co., J. H. Wallace*, Wadworth & Reed*, Ware, Johnston & Co., E. Washburn & Son*, Sylvester Wheelock, R. S. Whitcomb, George E. White & Co.*, Joseph White, White, Swan & Co.*, Wintermeyer & Dempsey, the H. Witbeck Company* (Daniel Wells, Jr., president; John H. Witbeek, secretary), A. L. Wood. The following made a specialty of hardwood lumber: Boardman & Keep, White, Boyle & Co., T. D. Carter, N. Chapin & Son, P. G. Dodge & Co., William J. Frawley, Haring Brothers, Hatch, Holbrook & Co., Holbrook & Co., Henry N. Holden, Holden & Pendleton, Robert Larkins, W. McFarland & Son, Messinger, Hubbard & Granger, L. Miller & Co., J. Willard Smith, John H. Wallaee, Wells & Bingham, Samuel F. White. Lumber dryers: Edward H. Burdsall, Curran & Wolff. Lumber inspeetors: Martin V. Briggs, John Cortes & Co., Charles M. Dillingham, James Doyle & Son, Peter Fish, John Frundt, William C. Fyfe, Charles Gibson, E. C. Jager & Sons, John Long, H. H. Meacham, Mark Olson, William C. Ott, Maasson Young.

The lumber brokers of 1882 were: C. M. Bickford, 8, 242 South Water; Charles S. Burch, 8, 236 South Water; Charles M. Clark, 6, 125 Dearborn; Fyfe & Tiffany, 15, 242 South Water. The lumber commission merehants were: A. B. Battin, 3, 252 South Water; Biekford, Knox & Co., 242 South Water; William L. Cadle, West Twenty-second southwest corner Lumber; W. W. Calkins, 1, 236 South Water; Candee & Co., 368 South Canal; Frazer & Southworth, 254 South Water; John Garrick, 1, 242 South Water; Goodenow & Hinds, 240 South Water; Severt T. Gunderson, 238 South Water; Fred Gusdorff, 13, 163 Washington; Haring Brothers, 15, 242 South Water; A. D. Hayward, 236 South Water; Horn & Joseph, 238 South Water; Johnson & Gibbs, 248 South Water; John Loomis, Mason & Co., 2 Franklin; William Meglade, 2, 232 South Water; Lucas E. Merrill, 236 South Water; Mueller & Christy, 236 South Water; Edward B. Rice, 250 South Water; William Ripley & Son, 238 South Water; Ruger & Durgin, 240 South Water; Herbert F. Seymour, 2, 252 South Water; J. H. Shorp, Fleetwood eorner North avenue; Lindair, Morris & Co., 234 South Water; Smith & Armstrong, 12 Metropolitan block; William Spooner & Co., 35, 94 Washington; George G. Wilcox, 6, 236 South Water. The principal planingmills in 1887 were the following: The Bristow Planing Mill Company, 75 West Chicago avenue; the Campbell Brothers' Manufacturing Company, 110 Ohio; the Chicago Planing Mill, 333 West Lake; the Chicago Sash, Door and Bind Manufaeturing Company, 48 to 62 West North avenue; Cook & Rathborne, I. C. Pier No. 1, foot Randolph; Dencer & Weise, 1925 Purple; the W. E. Frost Manufacturing Company, South Canal and West Twelfth; George W. Goodrich, 40 Fulton; D. M. Goodwillie, West Twenty-seeond corner Allport; the T. W. Harvey Lumber Company; Twenty-second eorner South Morgan; Johnson Brothers, Loek corner Cologne; Felix Lang, Loomis eorner Twenty-first; Felix Lang & Co., Thirty-eighth between Laurel and Ullman; J. G. Lobstein, 455 to 473 West Twenty-first; John W. Merriman, Ullman corner Thirty-seventh; Northwestern Tile works, 65 to 69 South Canal; H. Paepke & Co., 350 to 370 North Sanga-

*Here in 1887.

mon; George W. Straight, 703 Center avenue; Frank W. Swett, saws and knives, 69 Canal; C. Tegtmeyer & Sons, Lumber and Canal; Union Planing Mill Company, 309 West Twenty-second; Western Planing and Manufacturing Company, 130 to 134 Fulton; Will & Roberts, Franklin northwest corner Congress; Wintermeyer & Dempsey, 546 to 552 Clark.

Sash, door and blind manufacturers, not mentioned previously or among planingmills, were: John W. Andrews, 2833 Cottage Grove avenue; Louis A. Bournet, Hinman corner Loomis; F. P. Brehm, 3100 South Halsted; the Baumer & Slomer Company, northwest corner Smith avenue and Weed street; the Chicago Building Supply Company, 243 North Wells; the Clark Stair Wood Manufacturing Company, 42 North Sangamon; William Clayton, 709 West North avenue; Deweese, Lidell & Co., 214 South Clinton; A. Dietsch & Co., 617 Sheffield avenue; Vincent Dlouhy, 651 Throop; W. H. Dow, 15, 159 La Salle; Excelsior Window Company, 13, 164 Randolph; Foster, Carlton & Co., West Twenty-second corner Union place; John A. Gauger & Co., West Twenty-second corner Laflin; the Goss & Phillips Manufacturing Company, West Twenty-second corner Fisk; Haser & Engelhardt, Nineteenth southwest corner Purple; Frank N. Hess, North California avenue northwest corner Berlin; Charles Hillock, 2715 and 2717 Main; the Hintze & Baker Company, Lumber corner West Twenty-second; Hintze & Weise, West Twenty-first corner Brown; Hoff & Kiltz Manufacturing company, North Sangamon northeast corner of George; Hally & Slama, 505 West Twenty-first; Inglund & Peterson, 3226 State; William Jenkinson, 697 Laflin; the Jewett Window Blind Company, 34, 159 La Salle; Peter W. Johnson, North avenue corner Mitchell avenue; Hermann Kirchhoff, 1485 Michigan avenue; Lundquist & Erman, Mitchell avenue southwest corner Bloomingdale road; John C. McEwen, Jr., 243 North Wells; C. J. L. Meyer & Sons, 471 North Water; the North Chicago Manufacturing Company, 55 West Pearson; Joseph A. Olver, 3, 184 Dearborn; Edward Otto, 243 Forty-third; P. H. Rinn & Co., Division southwest corner Crosby; R. Ringwald, 475 Allport; Ristow Rorcher Manufacturing Company, 104 North avenue; Mathias A. Stephens, West Fullerton avenue southwest corner North Western avenue; the C. C. Thompson & Walkup Company, Lincoln corner Blue Island avenue; E. P. Wilce & Co., Throop northeast corner Twenty-second; Willers' Sliding Blinds, 41, 187 La Salle; Wolff Brothers & Nollau, 35 Fullerton avenue and 857 Clybourn avenue.

The lumber dealers and manufacturers of 1887, not above referred to, were the following: Adams, Hastings & Co., Richard B. Appleby, Babcock & Wheeler, the J. Beidler & Brother Lumber Company, S. M. Bloss, C. H. Bogue & Co., E. W. Brooks & Co., S. A. Brown & Co., Calkins & McCallum, Carney Brothers, the James Charnley Lumber Company, Chase & Pate, the Coleman Lumber Company, Cook & Loomis, Cook & Rathborne, Crandall, Schultz & Co., Charles B. Crombie, James O. Cuthbert, Cutter, White & Boice, Francis G. Dalton, Charles W. Davis, the Day & Frees Lumber Company, Dean, Bader & Co., Thaddeus Dean, Dodge, Holmes & Smith, P. J. Doyle & Co., English, Watkins & Fuller, Fick & Oliver, A. F. Fisher & Co., C. B. Flinn & Co., the Ford River Lumber Company, Thomas Foster, James Fraser, the Frees & Hocknell Lumber Company, Charles S. Gardiner & Co., H. H. Gardner & Co., Goodwillie & Goodwillie, Grusendorf, Ott & Co., Frederick Gastorf, Hockley & Hume, J. E. Hair & Co., Hallock & Howard, the Hamilton & Merryman Company; Edwin S. Hartwell, the T. W. Harvey Lumber Company, Hatch & Keith, Hayden Brothers, R. L. Henry & Co., Henry & Coatsworth, Hitchcock & Foster, the Holbrook Company, George H. Holt, Holt & Balcom, John Holtmeier, William H. Horn, George T. Houston & Co., Howard Brothers, S. R. Howell & Co., Hungerford & Co., the Inter State Lumber Company, the Island Cedar Company, Ole B. Jacobs, the John Spry Lumber Company, Johns & Co., Johnson Brothers, Jones & Kennedy, James P. Joy, A. P. & W. E. Kelley, J. P. Ketcham & Brother, W. O. King & Co., Peter Kuntz, John H. Leidigh, John Mason, Loomis & Co., Loomis & Gillespie, Lord & Bushnell, Lowe, Perley & Co., N. Ludington & Co., the N. Ludington Lumber Company, the Lumber Manufacturers' association, Thomas R. Lyon, the Malcolm McDonald Lumber Company, the Marsh & Bingham Company, the S. K. Martin Lumber Company, Archibald McArthur, John W. McDonnell, McElwee, Billings & Carney, Thomas McFarland, McLarren & Morris, James McMullen, Charles Mears & Co., the C. J. L. Meyer & Sons Company, L. Miller & Co., Mueller, Christy & Raber, the National Lumber Company, the Norwood & Butterfield Company, O'Brien & Green, C. A. Paltzer & Co., John Panabaker, George H. Pack, the Pere Marquette Lumber Company, W. B. Prettyman, H. C. Parmont, Joseph Rathborne & Co., J. Rayner, Charles Rietz & Brothers' Lumber and Salt Company, Rittenhouse & Embree, William Ripley & Son, the River Lumber Company, George G. Robinson & Co., Rogers & Baldwin, Ruddock & Seymour, Runner Brothers, Martin Ryerson & Co., Adam Schillo, William Schroeder & Co., T. H. Sheppard & Co., H. O. Sherman & Sons, Sierks Brothers & Co., Skancke & Russell, Smith & Armstrong, the Soper Lumber Company, the Spalding Lumber Company, the John Spry Lumber Company, Thomas D. Stimpson, the St. John & Marsh Company, the R. B. Stone Lumber Company, the Sturgeon Bay Lumber Company, C. Tegtmeyer & Sons, Thompson Brothers & Williams, the C. C. Thompson & Walkup Company, J. S. Vredenburgh, R. A. Wells & Brother, the West Michigan Lumber Company, the Western Lumber Company, Oscar D. Wetherell, the R. S. Whitcomb Cedar Company, the White Lake Lumber Company, the White Pine Lumber Company, George B. Whitman, T. Wilce & Co., S. N. Wilcox Lumber Company, George E. Wood, George Woodley. The following made a specialty of the woods mentioned: Hardwood—R. B. Appleby, L. V. Boyle & Co., Candee & Co., Charles Crombie, James O. Cuthbert, the A. B. Dick Company, Dickason & Schenck, Dodge, Holmes & Smith, Fitzsimons & Connell, R. Granger & Co., George L. Haring, Hatch & Keith, Hayden Brothers, the Holbrook Company, George T. Houston & Co., Hungerford & Co., W. F. Hunt, Johns & Co., S. D. Kimbark, William O. King & Co., Robert Larkins, the Marsh & Bingham Company, Thomas McFarland, Charles T. Messinger, L. Miller & Co., the Norwood & Butterfield Company, Parkhurst & Wilkinson, J. Rayner, Rogers & Baldwin, Sierks Brothers & Co., John B. Siverston, Taylor & Harrington, the Vinnedge Brothers, John H. Wallace, R. A. Wells, George E. White & Co., Samuel F. White. Long leaf yellow pine—Mauer Brothers, the Norwood & Butterfield Company. Mahogany and southern yellow pine—Hatch & Keith. Yellow pine—Charles B. Crombie, James O. Cuthbert. Mahogany and rosewood—J. Rayner, A. H. Andrews & Co., E. H. & W. Burdsall, Curran & Wolff. Hayden Brothers and A. S. Nichols were lumber dryers. The following were lumber inspectors: Barton & Underhill, Martin V. Briggs, James Doyle, Peter Fish, Fish & Irvine, M. J. Frawley and E. C. Jaeger.

The lumbermen, in different branches, in 1890–91, were as follows. The list is compiled mainly from the directory published in the *Northwestern Lumberman:*

P B —A. Bennett, 2637 Main street.
W —G. C. Benton, pine, 5, 108 Dearborn street.
P —Berger Manufacturing Company, hardwoods, interior finish, 530 and 532 South Leavitt street.
C —Bickford, Knox & Co., cargo, 246 South Water street.
—Bigelow Bros. (mill Washburn, Wis.), 308 Tacoma building.
R —H. H. Bishop & Co., 96 Division street.
—C. H. Bogue & Co. (country yards), 10, 108 Dearborn street.
W R —L. V. Boyle & Co., hardwoods, poplar, oak (mills at Obion, Tenn.), North Branch and Eastman streets.
P D —F. P. Brehm, 3100 South Halsted street.
S 2 †—M. Brenock, black walnut logs, 31 to 47 Tolman avenue.
P D R*—Bristow Planing Mill Company, 75 West Chicago avenue.
—E. W. Brooks & Co., 307 Rookery building.
—Brooks & Ross Lumber Company (mill in Wisconsin), 307 Rookery building.
—S. A. Brown & Co. (country yards), 1159 Rookery building.
P R —Bushnell Mill & Lumber Company, Clybourn place and North Branch.
C —W. L. Cadle, buyer, 49, 97 Clark street.
P D —Campbell Bros. Manufacturing Company, Ohio and North Franklin streets.
W C —Candee & Co., hardwoods, poplar, buyer, 11, 110 La Salle street.
W —Agnew, Stone & Co., pine, hardwoods, Hoyne and Blue Island avenues.
P W R—Ames & Frost Co., hardwoods, maple, Blackhawk and Cherry streets; office 302 and 304 Wabash avenue.
P D —J. W. Andrews, 2833 Cottage Grove avenue.
W R —R. B. Appleby, hardwoods, wagon stock, interior finish, 400 Lumber street.
R —Jacob Armstrong, 136 West Polk street.
—Atlas Lumber Company, country yards, 38 Adams Express building.
W —E. E. Ayer, cedar posts, ties, piling, etc., Rookery building.
W R —Badenoch Bros., building material, Thirty-eighth and Ullman streets.
C —Cyrus A. Barker, posts, shingles, etc., 7, 236 South Water street.
W —S. B. Barker & Co., pine, Wood street near Blue Island avenue.
R —Barse & Co., West Division and Elston avenue.
P D —Baumer Manufacturing Company, Smith avenue and Weed street.
—Bay de Noquet Company, cargo (mills in Michigan), 234 South Water street.
—John B. Beavis & Co., hardwoods (mill in Michigan), 242 South Water street.
P D —W. F. Behel & Co., Twenty-second street and Center avenue.
W R —J. Beidler & Bros. Lumber Company, Loomis and Twenty-second streets.
R —Carey-Lombard Lumber Company (also Wichita, Kas.)
P —Carsley & East Manufacturing Company, hardwoods, interior finish, 2242 S. La Salle street.
W —T. D. Carter, hardwoods, Ashland and Carroll avenues.
C —James Charnley & Co., 222 Lake street.
—James Chase & Co., buyers, 242 South Water street.
W —Chase & Pate, pine, sash, doors and blinds, Throop and Twenty-second streets.
P D —Chicago Building Supply Company, 243, 51 North Wells street.

S, saw mill; P, planing mill or machinery; Sh, shingle mill; H, stave and heading mill; W, wholesale dealer; R, Retail dealer; C, commission dealer; D, door, sash and blind factory; B, box factory; * dry kilns; † band saw mill; "Water" means water power, all others steam. Figures, daily capacity in feet: 1—1,500 feet or less; 2—6,000 to 10,000; 3—12,000 to 25,000; 4—30,000 to 50,000; 5—60,000 to 100,000; 6—110,000 to 200,000; 7—225,000 and over.

P D W—Chicago Lumber Company, pine (country yards), Thirty-fifth and Iron streets.
P D —Chicago Sash, Door and Blind Manufacturing Company, 48 to 62 West North avenue.
W R —Chicago Veneer Company (band sawmill for veneers), 507 to 513 West Kinzie street.
W R —Chicago Yellow Pine Lumber Company, yellow pine, Hanover and Thirty-first streets.
W R —City Lumber Company, 7 North avenue.
R —Clark and Lendrum, 20 North Morgan street.
R —William Clayton, 709 and 711 West North avenue.
R —Coleman Lumber Company, 17, 78 Monroe street.
—Compound Lumber Company (see Hegewisch), 176 Twenty-second street.
P R —Cook & Loomis, 53 North avenue.
P R D—Cottage Grove Manufacturing Company, 91 to 101 Thirty-eighth street.
W —Crandall, Schultz & Co., pine, Thirty-fifth and Ullman streets.
R —F. R. & C. Crane, North Branch and Cherry streets, office 210 South Water street.
R —W. B. Crane & Co., hardwoods, Canalport avenue and Johnson street.
W C —Cross, Badger & Co.
—Cornelius Curtis, jobber, sash, doors and blinds, Fisk and Twenty-second streets.
R —F. G. Dalton, East Webster avenue and River street.
W —Charles W. Davis, lumber, dockage, 36 Cologne street.
P D —M. Dencer, Twenty-fourth and Butler streets.
P D R—A. Dietsch & Co., 615 to 619 Sheffield avenue.
P D —J. L. Diez & Co., 530 North Halsted street.
P D —Vincent Dlouhy, 651 Throop street.
W R —P. G. Dodge & Co., hardwoods, poplar, oak, 426 Lumber street.
C —Douglas, Stevenson & Co., 416 Rookery building.
P B —Drummond, Brachvogel & Co., 289 North Branch street.
P D —Dufour Brothers, Twenty-first and Morgan streets.
—W. B. Dutton, hardwoods, 629 Rookery building.
C —Earl Brothers, cooperage, 236 South Water street.
P D —Edmunds & Hay Manufacturing Company, Robey street and Washburne avenue.
—William Farwell & Co., yellow pine (mills in Arkansas), Ashland av. near Twenty-second st.
W R —Field Lumber Company, yellow pine, oak (also Dry Run, Arkansas), 939 Forty-seventh street.
P D —Filip, Raichart & Co., 862 to 870 Allport street near Twenty-second street.
W —A. F. Fischer & Co., pine, Laflin and Twenty-second streets.
W —Fitzsimmons & Connell, heavy timber; mill and yard, north pier; office, Tacoma building.
W —C. B. Flinn & Co. (country yards), 416 Rookery building.
R —James Foley, 203 Center avenue.
—Ford River Lumber Company, cargo (mill in Michigan), 242 South Water street.
R —Thomas Foster, Fulton and Canal streets.
P D —Frantz & Engelhardt, Thirty-eighth and Laurel streets.
C —James Fraser, buyer, heavy timber, 242 South Water street.
—Benjamin M. Frees (country yards) 236 La Salle street.
R —Henry Frerk, 1876 to 1880 Milwaukee avenue.
P D —W. E. Frost Manufacturing Company, Twelfth and Canal streets.
W —S. R. Fuller & Co., pine, Thirty-eighth and Ullman streets.
W —Garden City Paving and Post Company, paving blocks, posts, etc., 504, 167 Dearborn street.
W R —Charles S. Gardiner & Co., Throop and Main streets.
W —H. H. Gardner & Co., cargo, 571 Rookery building.
C —A. & H. Gates, cooperage, cooper's stocks, 21, 226 La Salle street.
P D —John A. Gauger & Co., Twenty-second and Laflin streets.
C —George I. Gibbs, 244 South Water street.
R —O. G. Gibbs, 239 West Twenty-second street.
C —Goodenow & Hinds, shingles, ties, posts, poles, bark, 240 South Water street.
P B R—D. M. & R. J. Goodwillie Company, Twenty-second street and Center avenue.
P B —Goodwillie & Goodwillie Co. (see Wausau, Wis.), 35 Ohio street.
R —Arthur Gourley, 2542 Cologne street.
W —Granger Co., hardwoods, North Branch and Eastman streets.

W R —Grusendorf, Ott & Co., pine, Front and Lessing streets.
C —S. T. Gunderson, pine, hardwoods, 238 South Water street.
P —S. T. Gunderson & Son, moldings, Laflin and Twenty-second streets.
C —Frederick Gustorf, 58, 94 La Salle street.
W —Hackley & Hume (B. F. Deming, agent), cargo (mill at Muskegon), 236 South Water street.
P 6 B —Hair & Ridgway, 545 west Twenty-second street.
—Hallack & Howard Lumber Company, country yards (see Denver) 38 Adams Express building.
W —Hamilton & Merryman Company, pine (mill at Marinette), Loomis and Twenty-second streets.
W R C—Ledra W. Haring, hardwoods, yard Fulton and Union streets., office 242 South Water street.
P D —E. A. Hartwell Company, Fulton and Desplaines streets.
P W —Edwin S. Hartwell, pine, hardwoods, Clybourn and Ashland avenues.
P W —T. W. Harvey Lumber Company, pine, hardwoods, maple, ready-made houses (mill at Marinette), Twenty-second and Morgan streets, office 827 Rookery building.
W R —Hatch & Keith, hardwoods, poplar, yellow pine, mahogany, cypress, cedar, redwood, Twenty-first and Brown streets, Chicago avenue and Sangamon street.
W R —Hayden Brothers, hardwoods, yellow pine, Twenty-second and Jefferson streets.
C —A. D. Hayward, 236 South Water street.
W —Hemlock Lumber Company, hemlock, Cologne street between Deering and Main.
—Henry & Coatsworth Company (country yards), 171, 205 La Salle street.
W —Higbee & Peters, heavy timber (sawmill), Paulina and Twenty-second streets.
P D —Charles Hillock, 2715 and 2717 Main street.
P —G. W. Hinckley & Co., Lincoln and Blue Island avenues.
—Hintze & Baker Company, jobbers, sash, doors and blinds, Lumber and Twenty-second streets.
P D *—Hintze & Weise, Twenty-first and Brown streets.
C —Hitchcock & Foster, 232 South Water street.
W R —Holbrook Company, hardwoods, Archer avenue, Grove and Twenty-second streets.
P D —Holly, Slama & Co., 505 to 509 West Twenty-first street.
W R —Holmes & Smith, hardwoods, poplar, basswood, elm, Union and Lumber streets.
R —Home Lumber Co., 56 North avenue.
—Holt Lumber Co., pine, cargo (see Oconto, Wis.), 407 Rookery building.
R —J. Holtmeier, Dominick street foot of A street.
—W. H. Horn Cedar and Lumber Company (mill in Michigan), 238 South Water street.
W R —George T. Houston & Co., hardwoods, walnut, 330 Lumber street.
—Howard Lumber Co., country yards (see Denver), 381 Adams Express building.
P W R*—S. R. Howell & Co., p. (country yards), Thirty-fifth and Iron streets.
W R —Hungerford & Schwamb Lumber Company, hardwoods, Canal and Eighteenth streets.
W —W. F. Hunt, hardwoods, North Branch and Eastman street.
P W R—L. Hutt, 124 Grove street.
P D R—Hynes Brothers, pine, hardwoods, 3635 to 3643 State street.
R —Illinois Lumber Company, Sixty-sixth and Wallace streets.
—Interior Lumber Company (mill Interior, Michigan), 512, 167 Dearborn street.
W —Inter-State Lumber Company, 185 Dearborn street.
W —Island Cedar Company, posts, piling, ties, 232 South Water street.
P D —William Jackson, Twenty-sixth street and Stewart avenue.
W R —Ole B. Jacobs, 145 Elston avenue.
P D —William Jenkins, Twenty-sixth street and Stewart avenue.
P D —William Jenkinson, Twenty-third and Butterfield streets.
W R —Johns Lumber Company, hardwoods, 65 Southport avenue.
C —Oscar F. Johnson, 6, 242 South Water street.
W —Jones & Kennedy, 2, 236 South Water street.
W C —Will J. Jones & Co.
P D —Kalal & Co., Twenty-first and Allport streets.
W —A. P. & W. E. Kelley Company, pine, Center avenue and Twenty-second street.
P D —Kelley Brothers, 5346 Butterfield street.
W —Kelley, Maus & Co., wagon and carriage stock, Blue Island avenue and Wood street, office 184 to 190 Lake street.

W —J. P. Ketcham & Bro., Hoyne and Blue Island avenue.
P D —Kiltz & Mangson Manufacturing Company, North Sangamon and George streets.
W —S. D. Kimbark (mill, Quincy, Mich.), hardwoods, wagon and carriage stock, 74 to 84 Michigan avenue.
W R —W. O. King & Co., hardwoods, Loomis street bridge; office, 108 Dearborn street.
—Kirby Carpenter Company (mills, Menominee, Mich.), 115 Dearborn street.
P D —Herman Kirchhoff, Milwaukee and Oakley avenues.
P D —Interior Building Company; interior wood furnishings.
W C —Krum, Douglas & Congdon, 345 Rookery buildiug.
P D —Kuhn & Mueller, 42 North Sangamon street.
P R —Felix Lang & Co., Loomis and Twenty-first streets.
P D —Charles Lange, Blue Island avenue and Loomis street.
—John H. Leidigh (country yards), 411 Rookery building.
W —Alexander Lendrum, hardwoods, Lumber and Union streets.
W R —G. B. Lesh Manufacturing Company, Lumber and Union streets.
P D W R*—I. G. Lobstein, Twenty-first and Loomis streets.
R —Lockwood & Strickland, Halsted and Forty-ninth streets.
R —Loomis & Gillespie, Canal and Lumber streets.
W R —Lord & Bushnell Company, pine, Illinois Central slip C.
W —Perley Lowe & Co., pine, Laflin and Twenty-second streets.
W R —Ludington, Wells & Van Schaick Company, pine, Loomis street; office, 165 Randolph street.
W —Thomas R. Lyon, agent, pine (mill, Ludington, Mich.), Robey street and Blue Island avenue.
W —A. J. McBean & Co., cedar posts, Loomis and Twenty-second streets.
W R —Malcolm McDonald Lumber Company, pine, hardwoods, Kinzie and Kingsbury streets.
C —McElwee, Billings and Carney, 244 South Water street.
P —McEwen Building & Manufacturing Company, 247 North Wells street.
W R —McFarland Hardwood Lumber Company, hardwoods, Kinzie and Morgan streets.
—Mackinaw Lumber Company, cargo (mills in Michigan), 401, 59 Dearborn street.
C —Maclean & Co., hardwoods.
W C —Mann Bros., yellow pine, 6 and 8 Wabash avenue.
P D —Maresch, Hajek & Hozicek, 188 to 198 Coulter street.
P W R—Marsh & Bingham Company, pine, hardwoods, heavy timber (sawmill), Thirty-seventh and Iron streets, office 315 Royal Insurance building.
W R —S. K. Martin Lumber Company (country yards), Blue Island avenue and Lincoln street.
P B —Maxwell Bros., Loomis and Twenty-first streets.
W R —N. & C. H. Mears, Blackhawk and North Branch streets.
C —William Meglade, 3, 236 South Water street.
P 6 —I. W. Merriman, Thirty-seventh and Ullman streets.
W R —Messinger Hardwood Lumber Company, hardwoods, foot of B street.
W R —L. Miller & Co., hardwoods, Twenty-second and Lumber streets.
—Montrose Lumber and Coal Company, Montrose
—Morgan Company, jobbers, sash, doors and blinds (mill at Oshkosh), Twenty-second and Union streets.
C —Thomas G. Morris & Co., 2 Franklin street.
W —Mueller, Christy & Raber, telegraph poles, etc., yard Illinois Central pier, office 236 South Water street.
W R —William J. Neebes, Main and Cologne streets.
P D —North Chicago Manufacturing Company, 51 to 55 West Pearson street.
P B W R—North Division Lumber Company, 96 Division street.
W R —Norwood & Butterfield Company, yellow pine (mill at Brookhaven, Miss.), 385 Illinois street.
W R —O'Brien, Green & Co., pine, maple, 2428 Main street.
—Oconto Company, cargo (mills at Oconto), 234 South Water street.
W —Ohio Valley Tie and Lumber Company, oak ties, piling, etc., 6 Rookery building.
W R —Oliver Bros., p., long timber joists, Ullman and Thirty-fifth streets.
—Otter Creek Lumber Company, hardwoods, maple, elm, 629 Rookery building.
P D R—Edward Otto, 245 Forty-third street.

P D W R*—Palmer, Fuller & Co., Twenty-second and Union streets.
W —C. A. Paltzer & Co., 2598 Archer avenue.
—Pardee, Cook & Co. (mill at Ludingtou), 523 Chamber of Commerce buildiug.
W R —Parkhurst & Wilkinson, wagon and carriage stock, 142 to 164 Kinzie street.
P W R*—Pearson Lumber Company (mill at Ashland, Wis.), Laurel and Thirty-ninth streets.
—Pere, Marquette Lumber Company, cargo (mills in Michigan), 2 Franklin street.
W —Peshtigo Company, cargo (mills in Michigau), north pier.
R —Pilsen Lumber Company, Laflin and Twenty-second streets.
R —George E. Plumb & Co., Fullerton avenue bridge.
C —Frank Porter & Co., cargo, 242 South Water street.
W —H. C. Purmort, lumber buyer, Lumber and Twenty-second streets.
P D —Rabbitt, Harty & Foley, moldings, house finish, Loomis and Twenty-first streets.
W —Joseph Rathborne & Co., pine, cypress, ash, Illinois Central pier 2.
W —Julius Rayner, hardwoods, veneers, Fulton and Morgan streets.
C —Reynolds Brothers, 116 La Salle street.
C —E. B. Rice, Blackhawk aud Hooker streets.
W R —Charles Rietz & Brothers' Lumber and Salt Company, 27 North Canal street, Union and Twenty-second streets.
P D —Ph. Rinn & Co., Crosby and Division streets.
W —William Ripley & Son, cedar posts, etc., room A, 76 La Salle street.
P W R—Rittenhouse & Embree, Thirty-fifth and Ullmau streets.
P D —Ristow-Poths Manufacturing Company, 102 North avenue.
W —E. L. Roberts, sash, doors and blinds, interior finish, Twenty-second and Lumber streets.
W —George G. Robinson & Co., pine, Laflin and Twenty-second streets.
—Rothermel, Nelson & Co., manufacturers' agents, 226 and 228 La Salle street.
W R —Ruddock & Seymour, yellow pine, cypress, gum, Illinois Central pier.
C —Ruger & Durgin, 240 South Water street.
R —Albert Russell, 22 Chester street.
P B W—J. K. Russell & Co., 160 North Carpenter street.
—Martin Ryerson & Co., cargo (mill Muskegon), 240 South Water street.
—St. John & Marsh Company (country yards), 663 Rookery building.
W —Sawyer-Goodman Company (mill at Menekaunee), Twenty-second and Lumber streets.
P D —Henry Scherer, 416 to 426 Blue Island avenue.
P D —Schaller & Stafford, Cherry and North Branch streets.
R —Adam Schillo, 68 North avenue.
—Schroth & Ahrens, jobbers, sash, doors and blinds (factory Winona), 637 and 639 S. Halsted st.
P D —Schumacher & Betzel, 96 to 102 West Chicago avenue.
W —T. H. Sheppard & Co., Loomis and Twenty-second streets.
PWR*—Sherman, Bushnell & Co., Clybourn place, near bridge.
W R —Walter Shoemaker & Co., 45 West North avenue.
W —J. Willard Smith, veneers, 157 and 159 South Canal street.
W R —E. Sondheimer & Co., hardwoods, walnut, Blue Island avenue and Wood street.
PBW*—Soper Lumber Company, pine, Twenty-second and Laflin streets.
PDWR*—South Branch Lumber Company, pine, hardwoods, Fisk and Twenty-second streets.
—Spalding Lumber Company, pine, cargo (mill in Michigan), 48 and 50 La Salle street.
W —Standard Lumber Company, Builders & Traders' Exchange building.
W —John Spry Lumber Company, pine (mill in Michigan), Ashland av. and Twenty-second street.
P D —Steinmetz & Eilenberger, Nineteenth and Blackwell streets.
P B —Stephens Box Company, Twenty-second and Loomis streets.
W —I. Stephenson Company (mill at Escanaba, Mich.), 250 West Twenty-second.
W —James G. Stevenson, pine jobber, 1011 Chamber of Commerce building.
—T. D. Stimson, cargo (mills Muskegou), 244 South Water street.
P *—G. W. Straight, 703 to 711 Center avenue.
W R —Street, Chatfield & Co., white and yellow pine, 143 Chicago av., office, 167 Dearborn street.
R —Suburban Lumber Company.
—Swan & Smith, 67 Metropolitan block.

PBWR—Tegtmeyer Lumber and Box Company, 759 to 773 South Canal street.
W R —Thompson Bros. & Co., Wood street and Blue Island avenue.
—C. C. Thompson Lumber Company (mills Washburn, Wis.), 1115 Rookery building.
P D W—Thompson & True Company, Blue Island avenue and Lincoln street.
P —Union Planing Mill Company, 309 West Twenty-second street.
W —Vider, Kinsella & Co., cedar posts, paving material, Elston avenue, and Chicago & North Western railway crossing.
W R —Vinnedge Bros., hardwoods, Division and North Branch streets.
P D —Walker & Co., 7 Thirty-eighth street.
W C —John H. Wallace Hardwood Lumber Company, 242 South Water street.
P —John Wartman & Bros., 673 Center avenue.
W —E. Washburn & Son, hardwoods, Halsted and Kinzie streets.
W —Watkins & Fuller Lumber Company, pine, Throop and Twenty-second streets.
P —Robert W. Wegg, 80 and 82 Fulton street.
P D —George B. Weise & Son, Twentieth street and Wentworth avenue.
W R —R. A. Wells, hardwoods, Clark and Twenty-second streets.
P D —West Chicago Building and Manufacturing Company, Mitchell street and Bloomingdale road.
R —West End Lumber Company.
W —Western Paving and Supply Company, cedar posts, paving material, 232 South Water street.
P —Western Planing and Manufacturing Company, 130 to 134 Fulton street.
—West Michigan Lumber Company (mill in Michigan), 47, 118 Dearborn street.
P 6 —Oscar D. Wetherell, Blue Island avenue and Wood street.
W —R. S. Whitcomb Cedar Company, cedar posts, Robey street and Blue Island avenue.
W R —George E. White & Co., hardwoods, Lake and Elizabeth streets.
C —Samuel F. White, hardwoods, 242 South Water street.
—White Lake Lumber Company (country yards), 72 Metropolitan block.
P D —E. P. Wilce & Co., Throop and Twenty-second streets.
W —T. Wilce & Co., pine, Throop and Twenty-second streets.
—S. N. Wilcox Lumber Company, 34, 162 Washington street.
P D —Will & Roberts, Franklin and Congress streets.
W —H. Witbeck Company (mill Marinette, Wis.), 310 West Twenty-first street.
P —P. Wohler & Co., 523 West Twenty-first street.
P D —Wolf Brothers Manufacturing Company, 166 to 180 West Erie street.
P D —Wolff & Nollau, 35 Fullerton avenue.
—George E. Wood, cargo (mill Muskegon), 236 South Water street.
—George Woodley, buyer, 17, 242 South Water street.
R —Henry Frerk (Avondale).
R —Hunning Brothers (Avondale).
P 5 D R *—Badenoch Brothers (Englewood).
R —Charles Bruse & Co. (Englewood).
P D *—Englewood Sash and Door Company (Englewood).
W R —Rittenhouse & Embree (Englewood).
P D *—Westberg Manufacturing Company (Englewood).
P D *—Bernritter Manufacturing Company (Grand Crossing).
P —Gustafson, Borling & Co. (Grand Crossing).
R —Alexander T. Stewart (Grand Crossing).
R —Park Lumber Co. (Hyde Park).
P W R—C. B. Flinn & Co. (Kensington).
R —H. N. Bishop & Co. (Lake View).
P 5 D*—A. H. Kleinecke & Co. (Lake View).
R —N. & C. H. Mears (Lake View).
R —P. A. Russell & Co., s., d. and b. (Lake View).
R —Charles Reitz & Sons, Lumber and Salt Company (Pacific).
R —Ryland & Rogers (Ravenswood).
P R —C. B. Flinn & Co. (Riverdale).
R —F. A. Reich Lumber Company (Riverdale).

TREMONT HOUSE.

FRENCH RENAISSANCE.

RENAISSANCE ORNAMENT.

R —William Clayton (Simons).
P 4 D R*—A. R. Beck Lumber Company, pine (South Chicago).
P 5 W R*—Charles Bruse & Co., pine (South Chicago).
P 5 *—Calumet Planing Mill Company (South Chicago).
R —Otto F. Hintze & Co., s., d. and b., moldings (South Chicago).
P R —Charles E. Jackisch (South Chicago).
P 5 D —Kraetzer, Fischer & Co. (South Chicago).
P 5 D*—Rasch, Dornedden & Co. (South Chicago).

Up to 1880 the business of distributing standard styles and sizes of sash, doors and blinds from Chicago had been carried on almost exclusively by the manufacturing triangle—Goss & Phillips, Palmer, Fuller & Co. and the C. J. L. Meyer concern. In that year E. L. Roberts stepped to the front as an innovator, and began a wholesale business, which soon took on large and increasing scope. In the same year Hintze & Baker started, and about 1882 a warehouse was established by the Wisconsin Sash and Door Company, composed of six manufacturing concerns of Oshkosh, Wis., namely: the Paine Lumber Company, R. McMillen & Co., James P. Gould, Williamson & Libbey and the Conlee Lumber Company. This business was managed by D. Dickinson, a dealer of Beaver Dam, Wis., up to January 1, 1884, when Alexander Stewart, formerly of McDonald & Stewart, Fond duc Lac, took charge. It was soon found that rottenness existed in the concern, and an investigation showed that two or three of the employes had been systematically embezzling for months. Thus the poor financial success of the undertaking was in large measure explained, and as soon as possible the affairs of the concern were wound up. This unfortunate termination of an important experimental enterprise did not satisfactorily settle the question of the feasability of a plan to pool the interests of northern manufacturers in a jobbing business at a great distributing center. While the company was in business, competition was a little sharper, but profits averaged a great deal better then than they have during the past three or four years. After the Oshkosh combination came to grief, other concerns stepped in to fill the breach. Hintze & Weise began to manufacture and to sell at wholesale, and Carlton, Foster & Co. established a warehouse, that concern having been succeeded in 1889 by the Morgan Company. The Chicago Lumber Company, with its numerous country yard connections, also became an important factor in manufacture and distribution; John A. Gauger & Co. became established; Schroth & Ahrens, of Winona, Minn., started a branch house, and more recently the Thompson & True Company was organized. The latest addition to the list of wholesalers is Radford Bros. & Co., of Oshkosh, whose warehouse is on Twenty-second street at the foot of Johnson street.

The first factory established at Oshkosh was by Richard T. Morgan in 1856, who was succeeded in a year or two by Morgan, Watts & Jones. In 1859 the style was Morgan & Jones, who were succeeded by Morgan, Davis & Co., of which R. McMillen was a member for a short time. R. McMillen & Co. became established about 1860. Foster & Jones started in 1865, and were succeeded by Carlton, Foster & Co., and they by the Morgan Company. In 1866 J. M. Williamson & Co. started, being succeeded by the Williamson & Libbey Lumber Company. C. M. Paine & Co. started in 1874, and in 1881 changed to the Paine Lumber Company. Radford Bros. & Co. started in 1879. The Conlees and James P. Gould also became manufacturers. Finally factories devoted to the production of stock work had sprung up at various points in the Northwest. The enlargement of output became so rapid and the avenues of distribution so numerous that by the time Goss & Phillips, Palmer, Fuller & Co. and C. J. L. Meyer were all established in Chicago as manufacturers the jobber had obtained a footing, and he has continued to multiply and flourish to this day.

From its inception the firm of Palmer, Fuller & Co. has been one of the leading names in the Northwest, always prominent in the councils of the manufacturers of stock goods. William A. Fuller was for several years treasurer of the Wholesale Sash, Door and Blind Manufacturers' association of North America.

The conservative course of the concern has often extended a steadying influence upon the market. Gradually the distribution of regular goods from Wisconsin and Mississippi river points, and by the exclusively wholesaling concerns of Chicago, together with the rapid growth of the special trade, has eliminated the wholesale manufacturers from this market, until Palmer, Fuller & Co. and Hintze & Weise remain the only concerns which may be regarded as solidly established upon such a basis. Palmer, Fuller & Co. have adhered to the manufacture of stock goods as closely as the varying tastes of the community would permit, making no active effort to secure large special contracts. This corporation's sash, door and blind plant has an average daily capacity, as at present operated, of about six hundred doors, one thousand windows and two hundred and fifty pairs of blinds, including a large amount of odd work, but if the works were run exclusively upon stock goods, the output would be about fifty per cent. greater. In illustration of the scope of territory over which the output of the factory is distributed it is related that in one day thirteen car loads of sash, doors and blinds were loaded each for a different state or territory. This circumstance is notable for its peculiarity, rather than for the amount of goods shipped. The arrangement of the plant is admirable, an important feature being the large amount of covered space within the yards. The ground plan is a thing to be studied with interest. The system of sheds is so complete that a board which once enters the yard is continually under cover until it is manufactured and loaded on car. The entire space is 364x511 feet. On West Twenty-second street there is a three-story brick office building, 42x42; a three-story brick machinery building, 60x155 feet; a three-story molding building, 40x60 feet; a three-story finishing department, 60x200 feet; a three-story warehouse building, 42x210 feet; and a two-story glazing house, 50x60 feet. A private railroad track enters the premises on Twenty-second street, passes through the warehouse building, and traverses a storage and shipping shed, 106x375 feet, allowing all loading and unloading to be carried on under cover. The firm of Hintze & Weise is one of the prominent concerns engaged in the manufacture and wholesaling of sash, doors, blinds and other items of interior finish. The members of the firm are Robert A. Hintze and Simon Weise. The former has had about twenty-six years' experience in the business in Chicago. He was connected with the C. J. L. Meyer concern from 1866 to 1880, and had charge of the country business, and in the latter year became associated with W. B. Baker, of Springfield, Ill., under the style of Hintze & Baker, at Twenty-second and Lumber streets. Subsequently, as the business enlarged, the Hintze & Baker Company was formed, Mr. Hintze selling out his interest in January, 1887, forming a partnership with Mr. Weise and taking the manufacturing plant now owned by Hintze & Weise, which has since been enlarged and improved. Mr. Weise has all his life been connected with the practical part of the business of manufacturing sash, doors, blinds, molding, etc. He has entire charge of the factory. The plant of this concern, at Twenty-first and Brown streets, is also very large and valuable. The foundation of the Hintze & Baker Company was organized in 1880. The company's warehouses were located on Twenty-second street up to early in 1890, when the business there and at the down-town branch on Canal street was removed to 50 Green street and consolidated, an office and sampleroom having also been established in the lumber district, at Halsted and Twenty-second streets. The company lays claim to having always been in advance of the trade in carrying certain lines of goods for which a demand existed, but that were not included in the general price lists, and a notable instance cites the introduction of the five-panel door now sold so universally in this city, and to some extent in other parts of the country. The company had worked up a trade of fifty thousand of these doors a year, before they were included in the association price list. It is also contended that the removal of the spacious and well-arranged offices and warerooms on Green and Fulton streets was a move in advance, since the location is accessible to the entire trade, being within a few blocks of all the principal freight depots and steamship docks of the city, while it is estimated that small lots of sash, doors and blinds are shipped from this market by way freight in the ratio of about twenty car loads to one that is unloaded, owing to the fact that northern and southern competition in the lumber business has restricted the field of distribution for the wholesale dealers in the district. In the early days, however, there was no more desirable location for wholesalers of sash, doors and blinds than in the Twenty-second-street locality. The building now occupied by the company fronts eighty feet on Green street, and extends two hundred and fifty feet on Fulton, from Green to Peoria streets.

On a preceding page is given a sash and doormakers' price list of the early days. Its few items present a striking contrast to the list presented by a modern large sash, blind and door concern. A comparison of the two will pretty vividly bring to mind the great strides ahead which have been made in this line. The items in the price list of 1891 are as follows: Plain rail sash, twelve-light windows, in twenty sizes; plain rail sash, eight-light windows, in fourteen sizes; check rail sash, eight-light windows, in thirty-two sizes; check rail sash, twelve-light windows, in twenty-four sizes; check rail sash, four-light windows, in sixty-six sizes; check rail sash, two-light windows, in eighty-two sizes; marginal light sash; transom sash, one and two lights, twenty-nine sizes; pantry-check rail sash, four-light windows, one light wide. six sizes; pantry-check, rail sash two-light windows, one light wide, fourteen sizes; side-lights for doors, with molded panel below, two or three lights in each, seven sizes; hot-bed sash, in any desired size; four-light barn sash in six sizes; fifteen and eighteen-light windows, any size; storm sash, to order; cellar sash, two and three lights, in twenty-nine sizes; O G panel doors, raised panels both sides, fifty-seven sizes; inch doors, four-panel O G, five sizes; O G five-panel doors, raised panels both sides, sixty-two sizes; cottage doors, forty-one sizes; O G sash doors, two and four lights, square top and circle top, ten sizes; sash doors, molded on one side, one and two lights, top glass and corners circle, ten sizes; five-panel chamfered and stub molding doors, ten sizes; four-panel machine chamfered doors, five sizes; five-panel raised molded doors, five sizes; four-panel molded doors, flush or sunk molding, twenty-three sizes; four-panel molded doors, raised molding, twenty-six sizes; store doors, molded panel outside, single strength glass, seven sizes; door blinds, four sizes; outside blinds, twelve, eight, four and two-light windows, about sixty sizes; inside blinds, O G panels or rolling slats, any size to order; outside door frames, for wood and brick buildings, four sizes each; inside door frames, four sizes; window frames, twelve, eight and four-light windows, thirty sizes; circle-top and circle-corner window frames in all sizes as last; patent window blinds of different kinds, to order, in sizes desired; rope moldings, pine, walnut or hardwood, nine sizes; circle rope moldings; moldings of any woods desired, any style and size. Modifications of many kinds of material mentioned in different woods and finishes add greatly to the number of items beyond those mentioned. Some large establishments make a specialty of Eastlake finish and wood-carving, and a few add to the list of their products, stairs, stair railing, balusters, newel posts, mantels, pew ends, etc., but this class of material is treated independently.

Interior building material, turned out by planing mills, is made to order upon the specifications furnished by architects, and is not kept in stock or handled regularly by the trade. It is made of any desired dimensions, of any desired wood, plain or ornate, common appearing or highly finished as may be required, and the prices vary almost without bounds. The advancement in this kind of material is due more to the originality of architects than to that of the mill men, who make what is called for, and in most instances make it well. It is claimed by furnishers of lumber building material that the building world needs architects with a thorough knowledge of different woods. The hardwood trade might profitably assist in imparting to the architects the knowledge required by furnishing them with a better line of samples than most of them possess, and affording them also detailed information relative to the good points of the different desirable woods that are valuable in house-building operations. The growth of the business of manufacturing and supplying all kinds of sawmill and factory machinery has been so rapid, and new devices and improvements have multiplied so greatly, that in these days lumbermen in any branch find it easy to obtain first-class equipments, and there is much less ground for criticising the character of plants than existed a few years ago.

The estimator in the office of the manufacturer or wholesaler of sash, doors and blinds is, perhaps, the most potential individual connected with the industry aside from the manipulators of finances in the various concerns. He has been educated in all of the details of his business, and is, perhaps, one of the most interesting impersonations in the sash-and-door drama. Hundreds of letters are thrown over to him to estimate and answer, and his fertile brain must discover, in many cases, what the inquirer wants without regard to the incomplete data at hand, which may be accompanied by a request for immediate shipment if within a certain figure, etc. His work is as tedious as that of a bank examiner. He is expected to supply the wants of men who know not really what they want, and in some instances must guess at the size of a room in which he is to place woodwork as per the incomplete data sent him. He is expected to supply openings for houses whose outlines are indefinitely set forth by his correspondents. He is interrupted a thousand times a day with inquiries from office associates while preparing his estimates, and is expected to be amiable through it all. His answers to inquiries for estimates must be written so that if the price be too high he may diplomatically catch his customers or retain his correspondents among the list of customers by hook or by crook. His price may be too high for the customer or too low for the manufacturer. In either case he is blamed. He must have great tact, great industry and great patience.

Under date of January 4, 1890, in a review of trade for the season of 1889, a local paper gave figures regarding wood manufacture in the city as follows: " It is estimated that ninety planingmills, sash, door, box and molding factories represent a capital of $3,400,000, employ four thousand five hundred hands, and produced $10,500,000 worth of goods in 1889." Other estimates for the year were as follows: Cooperage, thirty-five concerns, capital, $250,-000, workers, six hundred and fifty, product, $1,350,000; furniture, two hundred and twenty-five concerns, capital, $600,000, twelve thousand workers, product, $20,000,000; picture and mirror frames, fifty-five concerns, capital, $1,300,000, one thousand three hundred workers, product, $2,200,000; pianos and organs, eleven concerns, capital, $1,000,000, one thousand three hundred workers, product, $2,800,000; billiard tables, five concerns, capital, $400,000, three hundred and seventy workers, product, $1,100,000; miscellaneous factories, capital, $700,000, eight hundred workers, product, $2,200,000. Totals were as follows: Number of concerns, three hundred and ninety in 1888, and four hundred and twenty-seven in 1889; capital, $9,665,000 in 1888, and $13,050,000 in 1889; workers, seventeen thousand in 1888, and twenty-one thousand, four hundred and twenty in 1889; product, $33,820,000 in 1888 and $39,950,000 in 1889. In the department of furniture Chicago is forging ahead as the chief manufacturing point in the country.

CHAPTER X.

BUILDERS' METALS AND HARDWARE.

UNDOUBTEDLY the first structure erected in the United States, of which iron formed any considerable composite part, was an iron-front building in New York, erected in 1842, by Daniel D. Badger, president of an architectural iron-works company of that city. Mr. Badger's concern furnished the first iron fronts put up in Chicago. They were introduced here in 1856 by the veteran architect, J. M. Van Osdel. In that year and 1857 there were erected several five-story iron-front structures, which may be further described as follows: A block of stores at the southeast corner of Water and Wells streets, 80½x150 feet, by Allen Robbins; a block of stores at the northeast corner of Lake and State streets, 68x140 feet, by Fred Tuttle; a store on the north side of Lake street adjoining the building last mentioned, twenty-two feet six inches front, by J. McCord; a store adjoining McCord's and of the same size, by George Collins; a store adjoining Collins' and of the same size, by Tuthill King; a double store on the south side of Lake street between State and Wabash, forty-five feet front, by C. & W. Price; a store on the same side of Lake street, also between State and Wabash, 22¾x160 feet, by M. D. Gilman; a store adjoining the double store of C. & W. Price, 22¾x180 feet, by F. W. Waughop; a double store, on the south side of Lake street, east of and near State street, 45x160 feet, by Thomas Church; a store, on the north side of Lake street, between State and Wabash, 22½x135 feet, by S. P. Skinner. A store at the southwest corner of Randolph and Dearborn streets, twenty-two feet front, by Daniel McElroy; a store at the northwest corner of Fifth avenue and Randolph street, eighty feet front on Dearborn, by Alexander Lloyd. The Badger concern furnished many other fronts to Chicago builders, among them that of the Hawley building, on the corner of Madison and Dearborn streets; Miller & Fry's building, 84 and 86 La Salle street; the United States Express building, 87 and 89 Washington, as well as of buildings erected for Styles Burton, Hayden & Key, Henry Corwith and others. Previous to the advent of iron fronts, probably as early as 1848 or 1850, a few first-story iron columns were used in Chicago, and these and some window-caps put in here and these constituted the sum total of iron building parts for some years thereafter.

Thus it will be seen that cast-iron fronts were introduced into local architecture in 1856. That was the first important step in iron construction. It may well be imagined that the earliest iron-front structures attracted much attention from the public and excited much comment among architects and builders. There was little of iron about these buildings, except the fronts. The early prejudice against cast iron may have prevailed, or advocates of stone may have been more eloquent and enterprising than advocates of iron, or stone may have been more easily procured than iron, or all of these influences may have worked in combination. Certain it is that not much more than a decade after the iron-front innovation, stone fronts became popular and in a measure superseded those of iron. But at the same time iron interior pillows came in vogue and arose with the stone fronts. About five years later, just before and after the fire, iron beams were generally introduced in Chicago, and a little later the corrugated iron for floor arches was introduced and remained in use, until crowded out by the modern hollow-tile arches.

The city of Chicago to-day shows no traces of the great fire which almost annihilated it in 1871. It originated near Twelfth and Jefferson streets. Thence the flames sped north, fanned by a strong wind, traversing the heart of the city, and extending as far as Fullerton avenue, near the northern end of Lincoln park. Brick and stone buildings which had been considered fireproof succumbed to the intensity of the heat. Between eighteen thousand and twenty thousand buildings were destroyed, the entire losses being estimated at about $190,000,000, of which only $44,000,000 was covered by insurance. The homes of ninety-eight thousand five hundred persons were consumed. The task of rebuilding the city was undertaken before the embers had fairly died out, and Chicago arose from its ashes with more than its former splendor, a monument to the indomitable spirits and energy of its business men. During the period of early rebuilding, there were numerous iron-front structures erected in Chicago. and others not properly speaking iron fronts, but having more or less iron in their fronts. The Chicago, Rock Island & Pacific and the Lake Shore & Michigan Southern depot sheds constituted the first iron construction on Van Buren street after the fire, replacing the iron sheds of the old depot which had been erected originally in 1852. The portly iron Palmer house, on State and Monroe streets, was begun before the fire, and finished afterward. The Journal building, 159 and 161 Dearborn street, constructed of Cincinnati stone, completed January 1, 1872, was so unique as to attract much attention. Extending to a hight of three stories of its "five stories and basement," the front presented a projecting portico in three divisions formed by massive iron columns for the first story, two on each side of the main entrance, with Corinthian capitals highly ornamented and projecting a proper distance from heavy pilasters, forming the guards to the entrance. These columns were capped with heavy carved stone, forming the base from which spring the fluted Doric stone columns of the second story. The first story was wholly of iron and plate glass. The extreme top of the front was finished with galvanized iron cornices ornamented and bearing in the center of a shield-shaped ground the words "Evening Journal" above the date "1844." The following comprises a measurably complete list of buildings involving much iron construction during the year October, 1871, to October, 1872; Peter Hayden's five-story iron front, 45 to 49 Lake street; Le Grand Butler's five-story iron front (formerly the City hotel), 59 to 63 Lake street; Fred Tuttle's five-story iron front, 58 to 62 Lake street; Robbin's five-story iron front, 190 to 196 Lake street; Drummond's four-story iron front, 65 and 67 Lake street; Henry Corwith's five-story iron fronts, at 51 and 53 and 54 and 56 Lake street; an iron front, 46 and 48 Lake street; the Central warehouse at Rush and Kinzie streets, the first semi-fireproof building on the north side; Dr. Judson's five-story-iron-front on State street; an iron-front structure at 111 State street; an eight-story iron and stone building, 163 to 185 State street, costing $2,500,000; a five-story iron front, 182 State street; Barckley & Wilk's four-story iron and stone front on State street. Iron and brick construction was introduced on Clark street at No. 330, in the Thomas Mackin building; Marks' two-story iron-front building, at Nos. 277 and 279, and Pflamm's three-story iron front, at No. 319, were erected soon after; on Wabash avenue, Lord & Smith's six-story iron front, at No. 86; the Ballard block, at Nos. 163 and 165; a four-story iron front, at Nos. 259 and 261, and Price's four-story iron front, at No. 335 and 337 were built; Dr. Cole's iron-and-stone front, at 189 West Madison; a five-story iron-and-marble building, 98 and 100 Madison; Reed's four-story iron-and-stone building, 156 and 158 Madison; a five-story iron front on the east side of Dearborn street, at the corner of Madison; a four-story iron front, 87 and 89 Washington street; a five-story iron front, 87 and 89 Washington street; the Miller & Fry block, four-story with iron front, at 84 and 86 La Salle street; a five-story iron front, 45 and 47 La Salle street. The City hall building occupied the space, 132 to 150 Adams street, and the entire west side of Dearborn street between Adams and Jackson was devoted to the Customhouse; Culver, Page & Hoyne's five-story pressed brick and-iron-front building on Monroe street was erected during this period.

The so-called pioneer fireproof buildings in Chicago were erected shortly before the great fire. These buildings all contained much iron. Of this class the Tribune building was finished and occupied before the fire. The First National bank building was also finished. The Nixon building was under roof. The Palmer house had been built to the extent of two stories. The Kendall building was basement high. Such portions of these structures as remained were utilized in completing the buildings after the fire. The building at Wabash avenue and Monroe street now occupied by Ely, the tailor, is said to have been another of the pioneer fireproof buildings of Chicago. The conflagration ushered in a new order of things architecturally, and iron at once became in great demand among builders. The era of easily combustible buildings was gone forever. Iron beams were used where before wood beams, supported by iron columns, had been deemed sufficient, but wooden joists were not at once abandoned. Other iron material followed, and fireproofing devices of all kinds received ready and considerate attention. Among other things which came early in the reign of King Safety was corrugated iron, in the form of ceiling arches. It is with the introduction and popularization of iron building materials that this chapter has to do, rather than with the erection of buildings, and structures will be mentioned specifically only as examples of new uses of iron, or as marking eras in iron architecture. The Montauk, Board of Trade and Royal Insurance buildings were the earliest of a class which mark the transition period from the old fireproof structures of the kind above referred to, to the modern fireproof buildings. They also mark the advent of high buildings, and more iron was used in their construction than had been used in any buildings previously erected in the city. The first of them, the Montauk, was finished in 1882. This class of structures is distinguished by masonry walls inclosing fireproof interiors. Other similarly constructed buildings followed, which are familiar to those who go about the streets of Chicago. Wrought iron had to a large extent superseded cast iron, and the time was approaching when steel would to a large extent supersede wrought iron. The first examples of iron and steel construction veneered—the modern fireproof building—in Chicago was the Tacoma building, erected in 1889. Familiar examples of fireproof structures of both these classes are the Chicago Opera house, the Home Insurance building, the Tacoma building, the Rookery, the Auditorium, the Owings building, the Chamber of Commerce building, the Brother Jonathan building, the Gore building, the McCormick flats, the Metropole hotel, the Phenix building, the Counselman building, the Telephone building, Leiter's granite block, the Sibley seed warehouse, the Rand-McNally building, the Calumet building, the Art Institute building, the Pullman building, the Monon block, the Monadnock office building, the Manhattan office building, the new Chicago hotel at Dearborn and Jackson streets, the Herald building, the Masonic Temple, the Woman's Christian Temperance Union building, the Fair building, the Abstract Company's building, the Unity building, and others which might be referred to with equal propriety.

The use of steel in modern buildings was treated by W. L. B. Jenney in March, 1890, when the editors of the *Inland Architect* called on him for an authoritative paper on the subject. "Fireproof work," he said, "has become the rule rather than the exception in all important buildings. Our cities are growing rapidly, land in business centers becoming more and more valuable, and as a necessary consequence the buildings are built higher and higher. Chicago has a very wise law, namely, that all buildings over one hundred feet high shall be fireproof. No hotel, theater nor apartment house can be popular unless fireproof. Any business man would think himself inexcusably careless if he left a thousand-dollar bond over night in other than a fireproof vault, and yet we trust our greatest treasures—our wives and children—in very combustible buildings, and ourselves are often away on business for weeks at a time. Too many sad examples are recorded of the folly of such risks. It is pleasing to see that at length the importance of fireproof dwellings has come well to the front, and is meeting with universal endorsement. This extended use of iron in building, at a time when other demands are fully equal to the average, has advanced the price of raw material and encouraged the 'combination' to advance the price of beams three-tenths cents per pound. Evidently it becomes the duty of the architect to study how he may economize and produce the desired results at least expense. An opportunity is offered in the use of steel instead of iron. The I-beam is the important factor in fireproof construction. When we consider that the ultimate tensile strength of iron beams is but forty-eight thousand to fifty-two thousand pounds per square inch of sectional area, while that of steel is from sixty-three thousand to seventy thousand, it is easy to see that if the section of the beam is such as to give the greatest practical value to the metal used, there is a saving in the weight of metal by the use of steel instead of iron amounting to one-quarter or even one-third.

"As the price per pound is the same for steel and for iron beams, the saving in money is enormous. For example, I have under construction a building which will require $250,000 worth of steel beams. Should iron beams be used, it would add at least $50,000 to the cost, with no advantage, but rather with the disadvantage of the additional load on the columns and foundations. To effect this saving, the architect must base his calculations on a tensile strength of, say, sixty thousand pounds per square inch, and must be sure he obtains it in the steel. To be certain of getting this result, the specifications must not only demand it, but also that test bars be taken from each 'blow' or charge of the converter, and tested in the presence of an agent appointed by the architect; and that no beams will be received unless up to the required strength. That it is not difficult to obtain this strength is seen from the 'test sheets,' showing the testing of two hundred and seventy-six 'blows' of the converters at the mills, made by an engineer from my office. Of the two hundred and seventy-six tests only thirty are below sixty-four thousand pounds, and the lowest is sixty-one thousand five hundred pounds. As the quality of steel improves, these figures enlarge. I think that even now we might insist upon a minimum tensile strength of sixty-four thousand pounds per square inch, without any increase in the cost to the consumer. There are other tests required, for example, to insure that the beams shall not take a permanent set if moderately overloaded; that the beams can be punched without splintering and bent without breaking. After all the physical tests are satisfactory, the beams must be inspected for surface defects, and none but perfectly rolled, straight beams must be received. It is true that such careful, thorough inspection is expensive to the architect, but the saving is so great that there is no other detail in an architect's practice by which he can save so much money for his client, and it should never be neglected.

"There has been so much discussion of late as to the relative value of rolled steel columns. In bridges, the cast iron has entirely passed out of use. In a building to be filled with heavy running machinery, the architect should insist upon rolled steel columns, but for an office building, a store or a warehouse, when the load is steady, it becomes a question of cost. For cast-iron columns, the architect must insist that from each heat of the cupola two test bars be cast, each of which is tested by placing it on supports and loading in the center with a weight, proportionate to the size of the bar and the distance between points of support. Should the bars break, the metal is inferior and not acceptable. Each column should be drilled in two directions, for measuring the thickness of metal, and then careful examination made for surface defects. Cast iron has the disadvantage of being liable to internal defects that the most rigid inspection might fail to detect, and consequently the columns are made heavier than would be otherwise necessary. Even with the disadvantage of greater weight, the 'proposals' for furnishing cast-iron columns are at present usually less than for rolled steel. To avoid the uncertainty which forces the architect to specify cast-iron columns one-quarter heavier than he otherwise would do, some of the leading foundries are now considering the policy of adding to their plant a large testing machine, in which each column may be tested up to double the load which it is calculated to bear. Any foundry that has such a machine can command the best work at the highest price, for it will save to the owner twenty-five per cent. at least in weight of metal now considered necessary for safety."

One of the most obvious and practical lessons of the Chicago fires was the advisability of dividing all the larger buildings, however occupied, with fire-walls, the openings of whatever kind to be closed with fireproof doors. Iron shutters perform a similar office by checking the flames at the start. Among the improved methods were important features, for example the manner of fastening the slate roofing, iron purlines being placed about two feet apart and bolted to the rafters, to be filled in with porous terra cotta blocks three inches thick, to which to attach the slate roofing. Another feature was the very general use of wrought-iron and rolled-steel columns in high buildings, such being preferred to cast iron by some of the leading architects, because less liable to defects at all possible to escape detection, and for the reason that such columns can be tested for strength so that it is known definitely how great a load they can safely bear. The hammer test might fail in a defective casting, it is argued, while a wrought-iron or steel column comprising from eight to sixteen sections could be examined more minutely and in detail. With cast-iron columns, on the other hand, no testing appliances of equal value have been introduced, and they are usually made very heavy in order to assure safety. This does not overcome the feeling of uncertainty, however, while it adds to the weight on each floor of a building. In the hope of overcoming this objection to cast-iron columns, some of the principal foundrymen are inquiring into the cost of suitable testing machines, and propose to add to their plants an apparatus capable of testing the strength of completed columns. They will then be able to guarantee the load which each column will bear, and thus put themselves on a level with the structural mills in furnishing accurate data to architects. Again, in storage warehouses and similar structures where fires are liable to originate internally, the lower flanges of the iron floor beams are protected by terra cotta coverings to guard against warp or twist. In these and other respects methods have radically changed for the better, until large areas of Chicago are covered with structures so constituted as to present a practically impassable barrier to a sweeping conflagration. Many of the modern office buildings are believed to be fireproof in fact as well as in name. The principal streets in the business center present many superb specimens. There are numerous imposing buildings, ranging from nine to sixteen stories in hight, and of the most varied architecture. While a few of the newest of these immense structures are of massive construction, built solidly of stone, the most favored system pursued is the erection of a steel framework, with the outside walls consisting of a mask of terra cotta or other material, not intended to serve as a support for the edifice in any way. The floors consist of steel beams with arched terra cotta tile work filled in between them, and covered either with the usual floor boards, or with ornamental tiles, or mosaic work. The partitions are built of hollow terra cotta tiles. As little wood as possible is used, so that these tall structures are as nearly fireproof as they can be made. Owing to the character of the ground on which Chicago is built, the construction of the foundations of large buildings is a much more serious problem than in most large cities. Water is encountered at a very slight depth below the surface of the ground. Piling was at first used, but experience demonstrated that it did not constitute a satisfactory foundation. The method now employed is the formation of a solid substructure of steel beams or rails and concrete. The steel pieces laid crosswise are of a length proportioned to the weight they will have to sustain, and are imbedded in concrete. Other beams or rails are then laid lengthwise with concrete filled in, and thus several layers are placed in position until the foundation is completed. Hundreds of tons of steel may thus be imbedded in Chicago earth before the walls of a building are on a level with the surface.

W. L. B. Jenney, who justly claims to have been the first architect to introduce the method of building known as the Chicago construction, gives the following description of the system, which is of special interest, as coming directly from him:

"This construction carries all the loads on metal columns which are placed in the piers and in the walls. They not only carry the floor girders, but also the entire walls, story by story, by means of beams or lintels from column to column. Those in street walls are usually placed so as to carry the window heads. Those in the party walls are usually placed so as to carry the floors. The masonry is reduced on the exterior to what is necessary to hold the window frames and to fireproof the metal. Party or partition walls are only of the thickness desired for protection. They are usually the same thickness in all stories—eight, twelve or sixteen inches. The columns were at first of cast iron with ingenious devices to tie the beams rigidly to the columns. As soon as riveted steel columns of a proper quality could be manufactured, their superior advantages at once brought them into use, which has now become general. All column connections are now made with hot rivets. The metal for the work is all tested, and the workmanship inspected at the mills by professional inspectors. The same science, and the same superintendence is required in calculating and erecting one of these high buildings as in a steel railroad bridge of the first order. When the use of the cellar or basement is not inconvenienced by a pyramidal footing, dimension stone may be employed. This, however, is but seldom the case. Therefore the steel footing is in general use. It is composed of cross layers of steel railroad rails or beams, as the calculations and conditions may decide. Usually, the lower tiers, resting on a bed of concrete, twelve to eighteen inches thick, are of rails and the upper tiers of beams. The weight on the column is distributed over the top beams by a cast-iron shoe. The entire footing is bedded in a rich Portland cement concrete. The thorough riveting together of the beams and columns and the rigidity of the fireproof arches in the floors prevent any movement at the joints. The bending movement of the columns under wind pressure must, however, be looked after. Counters or wind tracing set up with turn buckles placed between columns from floor to floor are excellent, when their use can be tolerated. Where there are permanent tile partitions, nothing further is desired. Knees or brackets, as in ship building, are sometimes the only means available. Underlying the business quarter of Chicago is a thick bed of soft clay, sixty to ninety feet thick, and coming up to within twelve or fourteen feet of the sidewalk grade. This clay will carry only about three thousand pounds per square foot without too great a settlement. Even with this load the settlement will be three or four inches, and the building is set four or five inches high anticipating this settlement. That the settlement may be uniform the greatest care must be exercised to obtain a uniform distribution of the actual dead and live loads of the building, that the same weight per square foot of bearing on the clay may obtain over the entire structure. As far as practicable each pier and column has its own independent footing.

"The question is often asked why pile foundations are not used more generally in Chicago, surrounded as their business location is by the lake and river. Pile foundations are used wherever the building is so situated that the tops of the piles can be maintained permanently under water. This is, however, seldom the case with the tall office buildings which are at some distance from the water. The Chicago clay is so impervious that the hight of the water in the lake and river is not the permanent water level under the business center, which at times is often materially lower, so that it is uncertain at what depth it is safe to saw off the piles."

In structures of this character the contract for iron and steel beams, columns, rafters, etc., involves a larger sum of money than is represented in the aggregate of materials for masonry, iron being the principal factor. This item ranges not infrequently between $250,000 and $500,000. A better idea of the cost of the iron parts of structures of different dimensions will perhaps be afforded by a glance at the not exact but pretty nearly correct estimate below of the outlay for iron, both structural and ornamental, for the buildings named: The Rookery, $280,000; the Owings building, $45,000; the Auditorium, $550,000; the Manhattan, $175,000; the Masonic Temple, $450,000; the new Chicago hotel building at Dearborn and Jackson streets, $185,000; the new Fair building, $425,000. Herein is had a glimpse of the Chicago of the future, and that not very remote in point of time. While it may not do to speak too confidently concerning the future, one is none the less justified in believing that a great, sweeping conflagration is altogether impossible in any modern part of Chicago, and this, too, in spite of the fact that in the business districts the buildings are larger and higher, as a rule, than those which formerly occupied their sites. There are parts of the city which have not been thus improved, where the buildings are similar in many respects to those of twenty years ago which were dissolved in a heap of ruins almost as soon as the great mass of flame struck them. But such buildings have been growing fewer every year, as rapidly as the requirements of trade or the results of age have brought them under the operation of the city's building laws, and the newer edifices, if not fireproof, are at least so far fire-resisting as to make their speedy destruction by an interior fire improbable and their quick consumption by a sweeping conflagration impossible. The improvements being introduced into architectural iron work, and all that pertains to fire proof construction, constitute a hopeful sign, and there is reason to believe that ambition will not rest satisfied until in every part of the city where valuable property is found the quality of permanence and durability will be insisted on as a primal consideration. Otherwise, even with an excellent fire department and an abundant water supply, while she may never have another great fire, Chicago may suffer from sweeping conflagrations which may more than faintly recall some of the horrors of October, 1871. This is to be effectually secured only by the selection of materials practically indestructible either by fire or corrosion. With the hazards of fire eliminated, the business man of to-day will build not only for himself but for posterity. Some conception of the appearance of the Chicago of the future may be gained from a contemplation of the most important of the immense structures of to-day and the plans of buildings now under construction and soon to be erected. The contract for the new Fair structure, awarded by Young to George A. Fuller & Co., stipulates for a building to cost something like $3,000,000. This is a mercantile enterprise to occupy the south half of the block bounded by State, Adams and Dearborn streets. The entire construction of the building is covered by this one contract. The new Fair building will be eighteen stories high, and will cost over $3,000,000. When completed it will represent a value of $6,000,000, for the ground on which it will stand is leased at an annual rental of $154,000, which, capitalized on the usual basis of five per cent., makes the property represent $3,080,000. There will be room in the new building for two and a half such stores as the Bon Marché of Paris, which has long been world-famed as the greatest of retail mercantile establishments. The work will go on so as to interfere with the business of the store but slightly. The Dearborn-street frontage will be built up three stories high, roofed over and occupied. Then the Adams-street frontage and last the State-street frontage will be put up in that way. The remaining thirteen stories will be added without interfering but little with the business going on in the lower stories. It has not been decided whether this building will be completed to its projected hight before the close of the Columbian Exposition. At present it is being built in sections to a hight of eight stories. As a fitting climax to the building enterprise shown during the last five years comes the announcement of the intention of the Odd Fellows to build a thirty-four-story structure nearly five hundred feet in hight.

The increasing use of iron is a prominent characteristic of our present industrial age, and every day sees some new application of it in the arts of life. In its native state it is chiefly found in aerolites and in certain ores of platinum, and is, consequently, of comparatively rare occurrence; but the so-called iron ores are very widely distributed over the globe, and are thus briefly classified: First, hematite, specular or red iron ore; second, brown hematite, or brown iron ore; third, magnetic or block iron ore; fourth, ironstone, blackband or clay iron ore; fifth, bog iron ore, or phosphate of iron. The ore richest in the metal is the magnetic. It is found in Sweden, Russia, in the Adirondac region of New York, in New Jersey, Pennsylvania and California. It yields seventy-three per cent. of iron by weight. The red oxide yields seventy per cent. of iron. Specular iron, one of its several varieties, is found on the island of Elba, where it has been worked for more than two thousand years. It is plentiful, also, in the Marquette, Lake Superior and Iron Mountain (Mo.), districts. Another variety, red hematite, is found in many parts of the world, perhaps most plentifully at Whitehaven and Ulverston, in northwest England. Limonite, of which brown hematite is a variety, is an important iron ore. It is found plentifully in New York and New England, and in a region extending from Pennsylvania to Alabama. Bog iron ore is smelted extensively in France. Spathose iron ore, a sparry carbonate of iron, is richly deposited in Prussia and elsewhere in Europe. The most valuable ores of iron are oxides or carbonates; that is, iron in combination with oxygen or carbonic acid. Very few of the geological formations of America are free from iron. Great deposits of iron ore occur around Lake Superior. The two Iron mountains of Missouri are almost literal formations of iron, one six hundred feet and the other two hundred and twenty-eight feet high. Iron is deposited abundantly in the southeast, east and north parts of the State of New York, the Adirondack region being especially rich. In all of the New England and many of the middle and southern states are extensive deposits of iron, and much is found in most of the western states and territories. Few sections of the union are lacking in large deposits of some of the iron ores. Those of Pennsylvania are most valuable, however, though they are not as rich as some others, on account of their nearness to beds of coal and limestone, a fact which renders that state able to compete with any iron-producing district in the world, in both quantity and quality. During the past six years the devolopment of iron production and manufacture in the South has been great. In that part of the country pig iron is the chief manufactured product. While pig iron is turned out in large quantities in the North and East, there is also an immense output of manufactured products of iron and steel.

The last two decades have covered a remarkable period in the material progress of the country, particularly the iron and steel industry. From very modest proportions, so modest that we were supplying merely a part of our requirements, the trade has grown even faster than the population has increased, so that to-day the United States leads the world in output. Our progress has been most marvelous in this time, and the question naturally arises, Will we continue to develop our interests at the same rapid pace in the coming decade? No other country is increasing in population so rapidly as this, and in no other country is the work of development proceeding so rapidly in every section of its domain. Notwithstanding our achievements, the mineral riches of some of the most highly endowed sections have only just begun to be developed, and the speed with which capital is rushing into the work gives promise of a future which shall far surpass everything that has hitherto been accomplished. Taking up the question of iron ore, which is the foundation of the iron industry, we observe that in 1870 only three million thirty-one thousand eight hundred and ninety-one gross tons were mined in the United States. From an annual output of but three million tons, we had advanced by 1880 to seven million one hundred and twenty thousand two hundred and seventy-two tons, while in 1889 our production could not have fallen much short of seven million seven hundred and fifty thousand tons. In the Lake Superior district alone the output of 1889 was very nearly equal to the entire iron-ore production of the country in 1880. These figures show a wonderful development, but 1890 saw them heavily augmented. But new ore districts of great extent are being opened in the South, as well as in the North, to meet all possible requirement of the future expansion of the iron trade, even if the relatively small foreign supply were wholly cut off. The glory of the United States is its boundless wealth of raw materials needed in the manufacture of iron and steel. This is further shown in the statistics of coal production. In 1870 we mined only twenty-nine million three hundred and forty-two thousand five hundred and eighty-one gross tons of coal of all kinds, which total was more than doubled in 1880, when sixty-three million seven hundred and seventy-three thousand six hundred and three tons were mined, and this again was more than doubled in 1890. Large as the annual output of coal is now, the resources of the country will permit its expansion to a much larger quantity, without fear of serious exhaustion of the inexhaustible deposits.

Passing to pig iron, the production of 1870 now seems ridiculously small, as compared with the output of recent years. We then made but one million six hundred and sixty-five thousand one hundred and seventy-nine gross tons of pig iron, or about as much as Allegheny county, in Pennsylvania, will itself turn out annually in but a short time. In 1880 the production of the country had advanced to three million eight hundred and thirty-five thousand one hundred and ninety-one tons, or considerably more than double the yield of 1870. It will be remembered how iron manufacturers commented on these figures at the time when they were made public, and some apprehension was felt that the pig-iron trade was being overdone, but the business kept on growing and the country kept on increasing it powers of absorption, and over ten million tons, or much more than double the production of 1880, was turned out in 1890, and this enormous output hardly met the demand. The South, which was hardly known in 1870 as an iron-producing section, took a respectable rank in 1880, but now it is recognized as a valuable factor in supplying the necessities of the country, contributing to the annual production of pig iron an amount in excess of a million tons, which will grow still larger from year to year. The great growth which can be shown in this period in the production of Bessemer steel rails is merely a record of the progress of an infant to manhood, as the Bessemer process had just been introduced into the United States a short time prior to 1870. In that year only thirty thousand three hundred and fifty-seven gross tons were rolled, but in 1880, ten years later, eight hundred and fifty-two thousand one hundred and ninety-six tons were made, while in 1887, when the maximum output was reached, two million one hundred and one thousand nine hundred and ninety-three tons were turned out from the American works. Since then the steel-rail trade has been less active, the production of 1889 having been about one million four hundred and fifty thousand tons. For some time to come this industry will be more prosperous, and the great output of 1887 may seem small beside the figures to be attained in the coming decade. Taking in a mass the production of all kinds of steel in crude form, including Bessemer ingots, the growth of the past two decades has been most striking. In 1870 an annual output of but sixty-six thousand nine hundred and sixty-four gross tons is recorded. This grew to one million two hundred and forty-seven thousand three hundred and thirty-five tons in 1880, but in 1887 it had attained the enormous yield of three million three hundred and thirty-nine thousand and

THE PARTRIDGE RESIDENCE.

STYLE, MODERN CHATEAU. VENETIAN DRESS.

seventy-one tons. Three years of more moderate trade have intervened, but the consumption of steel has again begun to grow enormously, and the annual output will ere long be larger than ever.

In 1890, for the first time, the United States surpassed Great Britain in the production of pig iron. The total product was ten million three hundred and seven thousand and twenty-eight net tons, or nine million two hundred and two thousand seven hundred and three gross tons, whereas the British product for the year is officially reported at about eight million gross tons. The largest product in any year in Great Britain was eight million five hundred and eighty-six thousand six hundred and eighty gross tons in 1882, which was over six hundred thousand tons, or nearly seven per cent. less than our last year's product. As the increase in our production has been practically continuous for many years, while British production has been stationary, or rather declining, it is reasonable to suppose that from this time forth ours will rank as the foremost nation in the production of iron. In 1880 the output of our furnaces was four million two hundred and seventy-five thousand tons, which was forty per cent. greater than in any previous year, and double that of 1870. It was then regarded as an exceptional production, and few believed that it would be long maintained. And yet the increase has since been almost continuous, and was one hundred and fifty per cent. greater in 1890 than in 1880, against an increase of only about one hundred per cent. in 1880 over 1870.

About the beginning of 1890 there were in the United States five hundred and seventy-five completed blast furnaces whose aggregate capacity was thirteen million one hundred and sixty-eight thousand two hundred and thirty-three net tons; four hundred and forty-five rolling-mills, with four thousand nine hundred and fourteen puddling furnaces, two thousand seven hundred and thirty-three heating furnaces and one thousand five hundred and ten trains of rolls, the aggregate capacity being placed at nine million two hundred and fifteen thousand net tons of finished iron and steel. In November, 1889, there were forty-one standard Bessemer steel works with eighty-eight converters, with a capacity of five million six hundred thousand tons; fourteen Clapp-Griffiths converters, with a capacity of two hundred thousand tons, and eleven Robert converters, with three building. The number of open-hearth furnaces is one hundred and sixteen, with twenty-three building, the capacity of the former being rated at one million net tons of ingots, and of the latter at two hundred thousand tons; forty-three crucible steel works contained in November, 1889, three thousand three hundred and seventy-eight pots, and three with one hundred and fifty pots were building. The activity in the development of the southern iron industry, which became so conspicuous in 1885–6, has been continued up to the present date, and it has been displayed chiefly in the erection of blast furnaces for the manufacture of pig iron. Since the beginning of 1886 there have been built in the states south of the Potomac and the Ohio rivers, twenty-one large and well-equipped furnaces, and fourteen furnaces were in course of erection in those states on July 1, 1888. Of the twenty-one completed furnaces, eighteen were built to use coke, and three to use charcoal as fuel; the fourteen building comprised ten coke and four charcoal furnaces. These thirty-five new furnaces built and building are situated in the following states: Alabama, thirteen coke furnaces built and ten coke and three charcoal furnaces building; Virginia, three coke furnaces built; Tennessee, one coke and three charcoal furnaces built; Kentucky, one coke furnace built; Georgia, one charcoal furnace building. The removal of a coke furnace from Missouri to Kentucky is a recent enterprise. All of these furnaces are of large capacity, and most of them rank among the best in the country. Discarding all abandoned furnaces, the total number of completed furnaces in the states south of the Potomac and the Ohio, not including Missouri, which were in blast, or in a condition to be at once put in blast, July 1, 1889, was one hundred and nine, and, as above stated, fourteen furnaces were in course of erection in those states on that date. Of the completed furnaces, fifty-seven use coke and fifty-two use charcoal as fuel. They are situated in the following states: Alabama, twenty-three coke and ten charcoal furnaces; Virginia, thirteen coke and twenty charcoal furnaces; Tennessee, ten coke and ten charcoal furnaces; West Virginia, six coke and three charcoal furnaces; Kentucky, four coke and three charcoal furnaces; Georgia, two coke and two charcoal furnaces; North Carolina, two charcoal furnaces; and Texas, one charcoal furnace.

The unprecedented development of Chicago is a conspicuous illustration of the conquest of topographical disadvantages by the builders of a city in a location having geographical advantages. The transformation thus effected, as a triumph over unfavorable conditions has been accompanied by remarkable industrial development. Great manufacturing establishments have been built up in Chicago, which are not surpassed in importance or extent elsewhere in the world. Among American cities, Pittsburgh alone surpasses Chicago in the production of iron and steel. The vast agricultural territory for which Chicago is the entrepot has caused huge implement works to be built up in the city. The great railroad interests centering here bave given support to immense steel-rail mills, car-building establishments, machine shops, and factories for the production of all kinds of railroad supplies. It is a noticeable fact in this connection that the first steel rail ever made in this country was rolled in Chicago. This occurred on May 24, 1865, at the mill of the North Chicago Rolling Mill Company, which is now known as the North Works of the Illinois Steel Company. The Chicago steel-rail mills now turn out over one-third of the entire steel-rail production of the country. The consumption of pig iron in Chicago, apart from that converted into steel, amounts to about four hundred thousand tons annually. A large part of it consists of charcoal pig iron, which is used by car-wheel works in making cast-iron car wheels, and by malleable foundries in making malleable castings. The charcoal pig iron is manufactured in Michigan and Wisconsin. The other foundries of Chicago form a very important part of its industrial interests. They produce architectural castings, stoves, mining machinery, and general machine castings, and their manufactures not only go to all parts of this country but are exported to a considerable extent. A large export trade is also conducted in agricultural implements and general farm machinery. It is a characteristic of the present stage of the industrial development of Chicago to shorten processes as much as possible. For instance, solid steel car wheels are manufactured here with the steel forming the tread so densified by rolling that it constitutes an actual tire. Railroad spikes are rolled into finished shape from old rails, being formed in dies on the rolls. Locomotive and car-wheel tires are finished with the initial heat of the ingot, and without a stroke of a hammer. Metal is rolled into sheets for architectural and other uses directly from the molten state. These facts serve to show that, especially in the department of iron and steel, manufacturing processes in Chicago have reached a high stage of development.

It is not usually easy to compile a table of distances for any particular locality which will show its exact situation with reference to its supply of raw materials. Some facts have been obtained on this point which will be found useful in defining Chicago's advantages as an iron manufacturing center. The item of freight in assembling raw materials is a most important element. Other casts are worked down by prudent management and systematic methods to a level with those obtained in other sections, but in the matter of freights a set of circumstances comes into play which can not be governed by those most interested in or affected by them. Raw materials are hauled enormous distances in this country, and Chicago is an illustration of this fact. The longest all-rail haul of Lake Superior iron ore to Chicago blast furnaces is from the Vermillion range mines in Minnesota. The distance is six hundred and ninety miles. Only a limited quantity of ore has taken that route, but the practicability of winter haulage has been demonstrated. The distance by lake and rail combined from the Minnesota mines to Chicago is about one thousand and twenty miles, of which seventy miles comprises the rail haul to Two Harbors, and the remaining distance covers the lake haul across Lake Superior, through the Sault Ste. Marie and the Straits of Mackinac, and up Lake Michigan to Chicago. The Gogebic mines in northern Wisconsin and Michigan, whose shipping point is Ashland, on Lake Superior, are nine hundred and thirty-nine miles from Chicago by rail and lake, but by all rail they are much nearer, say four hundred miles in round numbers. The mines of the Marquette range in northern Michigan, whose shipping port is Marquette, are about six hundred and thirty-five miles from Chicago by lake and rail, the rail haul to the port of Marquette running about twenty-five miles. The all-rail route to Chicago would only be about four hundred miles, or the same distance from the Gogebic mines. The Menominee range mines are situated nearer to Chicago than the mines of the other Lake Superior districts, being only about three hundred and seventy-five miles by rail and lake. Of this distance seventy-five miles covers the rail haul from the mines to Escanaba, on Lake Michigan. By the all-rail route the distance to Chicago would be about three hundred and sixty miles. All these figures seem formidable, but lake freight rates are remarkably low for the distance covered, and rail rates are also very reasonable, on account of water competition, as well as competition between several lines of railroad traversing this section.

Coming next to coke, another set of long-distance figures is encountered. Coke is hauled to Chicago entirely by rail. It is drawn from several sources of supply, namely, the Connellsville and Reynoldsville regions in Pennsylvania and northern and southern districts of

West Virginia. The shortest haul is from the Connellsville region, say five hundred and twenty-five miles. The Reynoldsville, or Rochester and Pittsburgh, coke district is easily six hundred and twenty-five miles from Chicago. The northern coke region of West Virginia is about five hundred and thirty-five miles, and the southern district about 600 miles. A new coke region is being opened up in southwestern Kentucky, about five hundred and twenty-five miles from Chicago, or practically as close as the Connellsville region. Anthracite coal from Pennsylvania is consumed in considerable quantities in Chicago, but not for manufacturing purposes. The usual route it takes is by rail from the mines to Buffalo, say three hundred and twenty-five miles, and by lake thence to Chicago, say nine hundred miles. The bituminous coal used by manufacturers is obtained to a slight extent from Western Pennsylvania, to a greater extent from Ohio and Indiana, but principally from the coal fields of Illinois. When drawn from Western Pennsylvania, it is hauled by rail at least five hundred miles; when obtained from Ohio it is transported from three hundred to three hundred and seventy-five miles, and from Indiana about one hundred and seventy-five miles. The coal fields of Illinois are only fifty to seventy-five miles from Chicago. Crude oil is now an important raw material to numerous Chicago manufacturers, who use it for fuel. The principal source of supply is the Lima district, in Ohio, whence a pipe line two hundred miles long runs to the southern part of the city.

These figures are not given as absolute distances, but are approximately correct, inasmuch as the various districts tapped are themselves of large extent. They serve to show, however, that the manufacturers of Chicago have had to conquer formidable disadvantages in establishing their various enterprises. How well they have succeeded is known to the world. Notwithstanding their remoteness from essential raw materials, they have had compensating advantages which have enabled them to build up enormous plants, with possibilities of a great future growth. The most influential advantages in making Chicago a great iron manufacturing center have been and are its magnificent transportation facilities, which will now be considered.

Although Chicago is termed an inland city, for the reason that it is situated a thousand miles from the ocean, it possesses vast marine interests through its location on Lake Michigan, one of the chain of great lakes stretching along our northern frontier. The magnitude of the lake traffic is shown by the statistics collected by the government. In the year 1889 the arrivals and clearances of vessels at the port of Chicago numbered twenty-one thousand seven hundred and eighty-eight, with an aggregate tonnage of ten million two hundred and fifty-seven thousand eight hundred and thirty-one. A limited means of water communication in a southern direction is enjoyed in the Illinois and Michigan canal, extending from Chicago to the Illinois river, navigable for light craft thence to the Mississippi river. The freight transported over this route in 1889 aggregated nine hundred and seventeen thousand and forty-seven tons. An ambitious scheme in this direction which has been undertaken by the city of Chicago contemplates the construction of a grand waterway, not less than one hundred and sixty feet wide and not less than eighteen feet deep, from Lake Michigan to Lockport, Ill., for the improvement of low-water navigation of the Illinois and Mississippi rivers as well as to afford sanitary relief to Chicago. It is expected that the United States government will coöperate in making the connecting rivers navigable for large vessels, so that the lake and the Mississippi river traffic may interchange. Another waterway, called the Hennepin canal, is projected across the upper part of the state of Illinois, also to connect with the Mississippi river. The railroads, however, are the chief factor in conducting the trade and commerce of Chicago. No other city in the world is so well supplied with railway lines. Twenty-six independent roads run out of the city, diverging to all points of the compass and extending to all parts of the United States, Canada and Mexico. These railroads and their belt-line connections have established a multitude of junction points in and about Chicago, possessing transportation facilities of the most complete character for industrial enterprises. Raw materials originating on the route of any railroad are thus easily delivered to a factory or any other line by a short transfer, practically taking every Chicago railroad to the doors of every Chicago factory. Manufactured products are likewise distributed without difficulty over the region traversed by every railroad line.

Chicago's principal source of supply for pig iron has been and is the Lake Superior district, and Chicago may be said to be the principal market for the products of the Gogebic, Marquette and Menominee mines, which constitute the chief output of that district. Pig iron was formerly brought from Ohio and Pennsylvania. Since the great development of iron production in the South, southern pig iron has been bought in Chicago, on account of its lower price, somewhat to the detriment of the eastern trade. Now Chicago pig iron is in the lead, for it can be produced here more cheaply than it can be purchased elsewhere, and its production now forms one of the city's most considerable industries, though southern iron is still used to some extent. The irons quoted in the Chicago market are as follows: Lake Superior charcoal; local coke foundry, No. 1; local coke foundry, No. 2; local coke foundry, No. 3; Bay View Scotch; American Scotch (strong soft), No. 1; Jackson county, soft and silvery, No. 1; southern coke, No. 1; southern coke, No. 2; southern coke, No. 3; southern gray forge; southern mottled; Tennessee charcoal, No. 1; Alabama car-wheel; Bessemer. In Chicago and its immediate vicinity, there are nineteen coke blast furnaces completed or in course of erection. Of these, seventeen are owned by the Illinois Steel Company, one by the Calumet Iron and Steel Company, and one by the Iroquois Furnace Company. The furnaces not completed comprise four, which are being added to one of the plants of the Illinois Steel Company, and one which is being built by the Iroquois Furnace Company. Engaged in the manufacture of steel, or the rolling of iron and steel into shapes of various forms, there are seventeen separate plants. The products of these steel works and rolling mills consist of steel rails, steel wire rods, merchant bar iron, steel tires, splice bars, cut rails, railroad spikes, car axles, steel car wheels, horseshoes, steel castings, special shapes for agricultural implements and all varieties of rolled iron and steel architectural material. Engaged in the manufacture of steel, or the rolling of iron and steel into different forms, there are seventeen different plants. Included among these are five Bessemer steel works, two Robert Bessemer works, three open-hearth steel works and one crucible works. The products of these steel works and rollingmills consist of steel rails, steel wire rods, merchant bar iron, steel tiers, steel beams, splice bars, cut nails, railroad spikes, car axles, steel car wheels, horse shoes, special shapes for agricultural implements and steel castings. The manufacturers of architectural iron work constitute a very important wing of the foundry trade. Among the leading establishments of this character are those of M. Benner & Co., the Bouton Foundry Company, Clark, Raffen & Co., Holmes, Pyott & Co., Schillo, Crossman & Co., the South Halsted Street Iron works, Vierling, McDowell & Co., Russell & Roberts, Hansell & Elcock and the Dauchy Iron works. The Snead & Co. Iron works, of Louisville, Ky., has an office here.

In the early days of iron manufacture the ores were reduced in simple furnaces placed at the summits of hills where the greatest blasts of wind could be utilized. They were conical in form and were called air bloomeries. Later these furnaces were enlarged, and artificial blasts were introduced. Until 1618 the only fuel used in smelting was charcoal. In that year coal was substituted by Lord Dudley, but the innovation was rejected by iron founders generally; and it was not until 1713 that Abraham Derby revived its use in his furnace at Coalbrookdale. But the use of coal was so poorly understood, however, that iron production in England declined until it had fallen off about one-fourth in 1740. The introduction of coke, about ten years later, imparted a new impetus to the iron trade, and from that date most of the great inventions and improvements in iron production were introduced in rapid succession. Watt's steam engine in 1770; Henry Cort's puddling and rolling process in 1784; Neilson's hotblast at Glasgow in 1830, and Bessemer's process for the production of malleable iron and steel in 1856.

It is probable that few things illustrate more strikingly than iron the difference in value that exists between the same material according to the form and quality in which it is marketed. Cast iron is the crudest, cheapest and most fusible form of iron. Wrought iron, steel and malleable iron are examples of products of iron involving labor and an increased market value. The various modern developments of the earliest methods of iron extraction, consisting of the heating of iron ores with fuel until more or less complete reduction was brought about, and hammering the mass, may be conveniently divided into four classes: First, those in which cast iron is produced by a smelting process and subsequently transformed into steel or wrought iron by decarbonizing the resulting pig iron. Second, those in which malleable iron or steel is obtained direct from the ore at one operation, without passing through the stage of cast iron. Third, those in which steel is formed from wrought iron by directly carbonizing it. Fourth, those in which steel is finally prepared by the intermixture of carbonized and wrought iron in a fluid state. The processes included in the first class are those of the preparation of pig iron; the purification of pig iron by puddling and by heating in contact with iron oxide; the preparation of puddled steel and pneumatic steel and iron, by Bessemer's original process of more or less complete carbonization by blowing air through molten pig iron; and the preparation of Heaton's steel from pig iron decarbonized by nitrate of sodium. The second class includes the Catalan forge and allied processes and the several well-known "direct" methods. The methods of the third class include those of steel manufactured by cementation and partial aeration by case hardening together with other allied methods of producing steel from soft iron. The fourth class includes the Bessemer crushed steel process, in which blown Bessemer metal is made into what is usually known as Bessemer steel by incorporating spiegeleisen with it, and the allied hearth-steel processes, in which wrought and cast iron are melted up together, or iron is decarbonized in a Siemens hearth and then mixed with ferro-manganese, etc., together with various modifications of these processes. Some of these processes are referred to rather more particularly further on.

For building purposes cast iron possesses unequaled advantages of strength, durability and economy. In resisting any kind of strain it is vastly superior to marble, granite, sandstone or brick. Practically it is crushing proof, for a column must be ten miles in hight before it will crush itself by its own weight. Unlike wrought iron and steel it is not subject to rapid oxidation and decay by exposure to the atmosphere, and whatever tendency it may have in that direction can easily be prevented by a proper coating of paint. No other material is so valuable after it has served its original purpose, for it may be recast into new forms and adapted to new uses. In business quarters, where store and office blocks are built up solid, where each building nearly covers the full lot, rear almost butting to rear, with window openings generally only at the front and back, light becomes one of the most important requirements. A light edifice of iron may be safely substituted for the cumbrous structures of other substances and ample strength secured without the exclusion of daylight. Iron in this respect possesses peculiar fitness, having unequaled advantages of strength, ornament, lightness of structure, facility of erection, durability, economy, incombustibility and ready renovation. The adaptability of all building materials depends principally upon their property of resisting the destroying influences of the atmospheric air, be these influences either mechanical or chemical; and much has been said against iron from misconception, it having been found exceedingly difficult by many writers and talkers to separate wrought iron and cast iron in their respective endurance against the weather. Wrought iron oxidizes rapidly and goes to decay when exposed to the atmosphere; cast iron oxidizes slowly in damp situations, but rust does not scale from it and good paint will prevent it rusting altogether. When iron fronts were first introduced it was strenuously asserted by some that expansion and contraction would dislocate the joints and render a building unsafe. An examination of any of the numerous cast-iron structures which, for a number of years, have been exposed to every change of atmospheric temperature without and to the heat of steam boilers, etc., within, will show everything unchanged. This proves that the temperature of one climate throughout its utmost range, from the greatest heat to the greatest cold, exerts upon it no appreciable effect. Events have also proven in the cases of burning of storehouses filled with combustible goods that cast-iron fronts are absolutely fireproof, and will neither warp nor crack nor fall down, unless the entire building falls, pulling the front with it. Only let it be remembered that, in addition to a high and intense heat, the use of a blast is required to reduce cast iron to a molten state, and the ability of iron fronts to stand heat will be readily understood. They are also perfectly safe during thunder storms, the metal presenting so great a mass to the overcharged clouds as to become a huge conductor in itself, and silently conveying all of the electricity to the earth. In them the intensity current is instantly diffused throughout the entire mass and changed into a current of quantity, thus obviating all danger from disruptive discharges. Iron fronts have stood erect in cases where the side brick walls were entirely thrown down and demolished by the elements.

There are very wide differences in quality in the various kinds of cast iron made. The introduction of the hot blasts in ore smelting, famous sixty years ago, had the immediate effect of increasing the quality of pig iron produced from every ton of ore, but at the same time the quality deteriorated somewhat. Now, however, by improved systems of working and applying the hot blast, the difference in quality between iron so made and cold-blast iron is greatly lessened, and is for most purposes practically of no effect. The small quality of cold-blast iron now produced is made for especial purposes. Considerable skill and experience are required to judge of the quality of cast iron from inspection even of a fracture, but there is little or nothing in the outward appearance of a casting to denote quality. The same smelting furnace, with the same description of material, may be made to produce several qualities of iron, according to the proportion of fuel employed in the operation of smelting. It is the art or the business of an iron-founder to know what is the best mixture of iron for any given purpose.

The quality of wrought iron, although depending in the first instance on the kind of pig iron from which it is made, is affected to a great degree by the amount of working to which it is subjected during the process of manufacture. The comparatively recent introduction of machine puddling has tended to render more equable the treatment of the iron during this stage of the manufacture. Bars that by their shape or small section demand more than the average amount of working and rolling are generally of better quality than the larger and simpler sections produced from the same material, but by less labor. The different wrought irons principally used in building are designated thus: "L and T irons," "joist I iron," and "channel U iron." These forms, as well as the ordinary round and flat bars are made in all required sizes. As a general rule, in all structures, economy is served by using bars and plates of ordinary sizes and sections and by avoiding an unnecessary variety of sizes. The strains upon a bridge or roof often require in theory, different sizes of iron varying by fine gradations at different points, but even if a slightly less total weight would be thereby obtained, it will generally be found cheaper to have few and simple, although larger sections. As no one iron worker has rolls for all the various sizes of iron, the greater the variety of sections required the greater is the inconvenience of obtaining them.

Articles of cast iron, if subjected to an after process of annealing, may be softened and acquire some of the toughness of wrought iron. The castings are made from pig iron and by preference from a certain kind. Hematite iron ore is generally employed, and sometimes also the iron scale or block oxide detached from wrought iron in the process of forging or rolling. These and some other ingredients give out, when heated, a considerable amount of oxygen, which, when imparted to the castings, romoves from them the carbon in the form of carbonic acid gas. The castings are kept in an annealing oven at an equable heat for a time varying according to their form and size. By this process and the decarbonizing which takes place, the metal is so changed as to become malleable; and though without the peculiar fibre that rolled or hammered iron possesses, it will exhibit many of the properties of wrought iron and steel. The malleable castings, as they are called, may be bent, hammered and twisted without fracture, and can without risk be exposed to concussion, torsion or other sudden strains which could not be endured by ordinary cast iron. The fact that they can be run, when fluid, into small and intricate molds renders these annealed castings valuable for many situations where forged wrought iron would be very expensive or altogether impossible to deal with. In many cases malleable cast iron will, to a very considerable extent, supply the place of steel. For the shoes and connecting pieces in roof structures ordinary cast iron is sometimes used where the malleable castings would be much better suited to the service required. The cost of the annealed castings depends mainly upon the size of the articles and the quantity made at the same time.

A chemical combination of iron with a certain quantity of carbon is called steel, and with regard to this quantity of carbon, steel stands between cast iron and wrought iron. Cast iron contains about one per cent. of pure carbon and two and a half per cent of carbon mixed with graphite, while the quantity contained in wrought iron is so small as to be inappreciable. Steel is in all cases made from iron, and the different methods of production may be broadly divided into the crucible and Bessemer methods, the first being a process of carbonizing wrought iron, which, as just stated, contains very little carbon, while the latter is the worse process of decarbonizing cast iron which contains too much. Crucible steel is made by melting pieces of blistered steel (steel as first converted from iron) in fire-clay pots or crucibles and pouring it into ingots or molds of a desired shape. The steel thus produced is subjected to after treatment by hammering, rolling etc. The novelty and economy of the process by which Bessemer steel is made consists in its being a direct conversion of cast iron, a portion of the combined carbon and the whole of the mixed carbon being removed during combustion. The Bessemer steel ingots contain about four per cent. of combined carbon, a minute amount of mixed carbon, and a certain quantity of silicon, sulphur, phosphorus and other impurities, the amount of which in any piece of steel to a great extent determines its quality. Part of these impurities are got rid of by hammering or rolling the ingot into the shapes required, or by first remelting it in crucibles and then giving shape to the material thus refined by hammering or rolling. By the former and simpler of the two processes most of the steel plates, rails, L and T, and other shaped bars are obtained. The strength of rolled steel bars and plates for resisting tension varies very widely and depends on the quality of the cast steel and the amount of working afterwards bestowed upon it. It may be stated generally that steel is in most respects twice as strong as wrought iron. There appears, however, to have been no economy in using steel in cases where strength has been the only consideration, and it must depend on the importance which attaches to other qualities whether the application of steel is preferable to that of wrought iron. Such qualities are the greater resistance against wear and tear (as in rails and boiler-plates) possessed by steel and the reduction in weight which its use allows. Though this reduction may be possible, it is only in large self-supporting structures, such as bridges and roofs of great span, that lightness of the metallic parts is of importance, because it is only in such structures that the weight of the metal forms a prominent item in the strains. In small structures the weight of the material bears so slight a proportion to the total load to be provided for, that any reduction in the weight of the parts would have but little influence in reducing the strains, while, on the other hand, the tendency to vibration under moving loads, which in light structures always more or less exists, would be increased. It appears, therefore, that steel can successfully replace wrought iron only in parts of the more simple shape and that even then its application is expedient only in very large structures. As, however, there is a growing disposition in this and in other countries to construct bridges and roofs of very large span, the real capabilities of steel are yearly being tested on an increasing scale. It will be interesting to note in this connection that some architects look with a certain degree of favor on a new system of building houses of steel plates, introduced in France some time ago by M. Danly, manager of the Société des Forges de Chatéleneau, and who has set forth its various advantages in an interesting and plausible manner, attracting considerable attention. M. Danly has satisfactorily ascertained that corrugated sheets, of no more than one mm. in thickness, are sufficiently strong for building houses several stories high, and the material used allows of quite a variety of architectural ornamentation. The plates thus employed are of the finest quality, and, as they are galvanized after they have been cut to the sizes and shapes required, no portion is left exposed to the atmosphere. It is asserted that houses constructed in this manner are very sanitary, and that the necessary ventilating and heating arrangements can be readily carried out.

Steel has been selling at Pittsburgh recently at a lesser price than iron. This well-authenticated statement justifies the idea that we are on the threshold of the much-talked-of "age of steel." The statement, which to many would seem to involve an absurdity, is reasonable enough to the initiated. One of the greatest expenses of manufacturing iron consists in the large amount of labor required, a considerable portion of which is of a highly skilled character, commanding in consequence good wages. Skilled labor is also required in making steel, but the number of men of all grades required to operate a plant of given capacity is small in comparison to running an iron mill with same output in tons. For some purposes, the manufacture of electrical machinery and appliances for instance, iron can never be supplanted by steel, but for most uses the latter is far superior and can be made to generally take the place of the former. But iron is not destined to yield the crown without a struggle. Recent inventions have cheapened the production of bar iron, and a still further reduction in cost seems highly probable. Much iron of good quality is now made direct from the ore, or rather about fifty per cent. of ore is used in connection with an equal quantity of pig. A mass of ore is suspended above an ordinary open hearth, in which is a bath of iron made from the pig metal. The heat wasted in the ordinary process serves to heat the ore to a dull red color. This drives off most of the deleterious matter, after which it is allowed to descend into the bath, producing very good iron. This and other devices may somewhat retard the triumph of steel, but none the less certainly it seems destined to come, and that in the near future. Cheap steel will work wonders for this country and enable us in due time to compete with the manufacturers of the world, and that on an equal footing.

Establishments devoted exclusively to the manufacture of iron work for buildings are of comparatively recent growth. Almost without exception the larger ones now existing have grown from small beginnings, building after building having been added to the original shop until they become great workshops without proper plan for the economical working and handling of materials. Continual improvements are being made in the right application of iron to building purposes, and these react upon and assist each other. The rapid development of blast furnaces, rolling-mills and foundries has rendered available for structural uses innumerable new forms, kinds and qualities of iron, and there are now many architects, who, having an intimate knowledge of the materials at their command, make architectural iron work a special study. Moreover, by the introduction of cast and wrought iron into the number of important building materials, entirely new styles and forms of buildings have arisen, most notable of which are the large iron-glass palaces and towers of modern times. Whatever has been done in iron which deserves censure from critics can be remedied. The material has not been at fault, but the workmanship. Iron can be made to imitate anything perfectly. On the manufacturer depends the artistic appearance of an iron building, as well as its durability. The material is capable of receiving the sharpest kind of lines. But to secure undercuttings and that certain crispness necessary to the proper effect, particularly of carved work, requires a combined technical knowledge of architectural detail, of artistic pattern work, of foundry molding, and of a pride in business reputation. An architect may design a front, but its execution is beyond his control, and its effect, whether ornate or plain, may be spoiled by incompetent mechanics. Between the iron work of to-day and that of not many years ago there is a perceptible difference in favor of the former. The artistic working up of the material is better understood. After years of alterations and comparison boldness of outline and good proportion in every part have been obtained. The grade of men in the iron business in no wise differs from that of other manufacturers, in that there are some whose productions are superior and intrinsically worth more than the like made by others. The thousand items of intricate detail about a job of iron work which go to make up a complete whole, each of which requires the direct supervision of competent principals, but faintly tell of the constant and unwearying watchfulness that must be given to insure good results. In iron, as in other materials, must be observed those undeviating laws of proportion and rules deduced from a refined analysis of what is suitable in the highest degree to the end proposed. There is not a structure erected anywhere but adds its quantum to the good or bad impressions to be directly stamped upon the public mind, hence the increasing and more artistic use of a material which allows greater architectural effect in proportion to the outlay of money than any other. The uses and requirements and values of buildings are changing every day, and iron in its architectural application is to fulfill future requirements such as in the past it has but limitedly supplied. In our new and growing country, the dollars saved in the construction of one building are required for the erection of another. It is primarily a duty of every builder to do the most for his money and the most for art. When the public become thoroughly acquainted with the advantages iron possesses as a building material, it is confidently predicted that for superior buildings of all kinds it will receive a general preference to granite, marble, sandstone or brick.

Formerly there were two distinct divisions in contracting the iron work required for a building. The wrought iron was given to a blacksmith and the cast iron to a foundryman. The custom now is to give the entire work to one establishment. It is a common saying that as a nation we have just begun to use iron, and this branch of iron manufacture has increased enormously since the war, and the probabilities are that the future will develop a still greater proportional growth. Good construction, economy of material and beauty of form in architectural ironwork have made greater progress in this country and particularly in Chicago than elsewhere in the world. Patterns are increasing in variety and extent, demanding a continual outlay of money. There is a growing discrimination between the true and the false in this branch of productive industry. A higher order of taste is being developed and the tendency is toward more perfectly finished and more artistically ornamented work. This is an encouraging fact for the future of the business, and though it involves increased expenditure, it is one which manufacturers must recognize. The enterprising manufacturer who meets the popular demand and gives artistic excellence even in the smallest detail does not look for patronage. The prices of iron material vary considerably, and at times go up with much rapidity. A sudden demand for one kind of iron of course tends to raise its price, but the relative prices of different kinds of iron do not generally change much, and the difference between pig iron, plates, bar and L-iron, etc., are usually in about a uniform proportion. Nor do the prices of architectural castings materially fluctuate with the price of pig iron. The cost of iron which enters into many of the finished articles is not twenty-five per cent. The principal item is labor. The cost of the labor employed is forty to fifty per cent. greater than the labor in this branch in 1860 and 1861. This is due not only to the general increase in wages, but to the greater care and skill required in this special work. The number of parts and the difficulty of casting them are increasing every year, and more skilled labor is required, in proportion to the amount of iron cast, in the work of fitting up. Of still greater importance as affecting the cost of castings is the large amount of capital locked up in patterns, flasks, machinery, buildings, etc., the value of which shrinks every year. Large capital has to be employed, and the proprietors have to work harder than almost any other class of manufacturers. In fact they do double work as manufacturers and contractors. The field is broad enough without calling forth an unhealthy competition. It may be possible that too much is left by the iron founders to the architects. Those engaged in the manufacture of iron work for buildings may need to take a broader comprehension of their business. The magnificent proportions which the manufacture of this class of iron work is to assume in the future can scarcely be realized.

While the use of iron for structural purposes has increased rapidly during the last fifty years the ornamental forms to which the material is especially suited have been more slowly adopted. At first this was owing to the limit which existed as to the strength and other characteristics of iron, and mainly for this reason there was a tendency in designing iron work to adopt to nearly the existing conventional rules for stone and wood. By an increasing knowledge of the capabilities of iron, and especially of cast iron, and by the examples of its use which now abound, a more rational style has been attained in iron construction; but even now some architects seem hardly to be aware how far cast iron may be trusted, for, although it can be made to assume any form usual in wood, stone or clay, its peculiar qualities of hardness, sharpness, strength and durability demand a new style of ornamentation, and it can not be doubted that the quality and rude appearance of many cheap castings have justified considerable prejudice among architects, and have retarded the general introduction of iron in many kinds of work where artistic ornament is desired. There are even some who for aesthetic reasons deplore the introduction of cast iron into architecture at all, and others who will allow ornament to be legitimate only in hammered-wrought iron. As a hand-made article may be preferable to one made by machinery, so a justifiable preference may be expressed for wrought-iron ornament made by the artist-workman as compared with the iron work produced by casting in a mold. But although this kind of wrought-iron work is still occasionally made, and some new designs are most beautifully executed, the art workers in iron, that is to say the men who, being themselves the designers, work at the fire and anvil as the sculptor at his marble, have almost disappeared, since a similar effect to this can be produced in a cheaper way by casting or pressing in a mold. Most of the ornamental wrought-iron work of the present day for railings, church fittings, chandeliers, etc., is hammered in dies, so that there are in the different pieces a repetition and similarity as great as if they were made, in the ordinary way, of cast iron. Many of the designs usually admired in and supposed to be peculiar to hammered wrought iron are obtainable from iron cast into molds, and here there is the advantage over wrought iron, that the metal may be made to swell with much greater freedom and indentations or projections of an arbitrary character may be made with less difficulty. Thus, while cast iron may be fashioned in any form that plastic clay will take or that may be carved in stone, marble or wood, it is nearly equal to hammered iron in giving delicacy of form. Moreover, some designs which are too delicate to be utilized in some other materials are of sufficient strength if made in cast iron. Herein lies its superiority over all other materials used in architecture, and this advantage is not lessened by the fact that another material, such as clay or wood, has to be employed in an early stage of its production. Indeed an art workman has greater scope for design in the clay model stage of cast-iron manufacture than in wrought iron. It would, therefore, be unjust to deny to cast iron the important place now given it by engineers and builders, notwithstanding the aesthetical objections made to it by some architects.

To place an iron structure of given dimensions and cost, the architect requires an intimate knowledge of the relative strength and cost of different classes of iron structural material, and of the weight-bearing capacity of each component part, with the strain upon it. These details are to a large extent tabulated in manuals used by architects, structural material manufacturers and contractors. Beyond this knowledge and its application, the designing of iron structures does not differ greatly from that of structures of a partially or wholly different character, and no special form of contract is employed. The plans of such buildings embrace drawings of each kind of iron material used, with a statement of their dimensions and the number of parts of each description required. Original designs for ornamental iron work are often made, which are followed by the manufacturer, and in nearly all classes of architectural iron work it is the architect rather than the manufacturer who is the innovator and improver.

Some description of iron structural material will be found interesting in this connection. The plate girder is the most simple, and up to a certain size the most economical form of iron beam. It is rigid and durable, and is the most appropriate for small spans. In those of small size the web is made of a plate only. If the hight of the web is great in proportion to the thickness, vertical L or T irons or "gussets" of plate and L iron have to be riveted upon it to prevent its giving way under accumulated compressive strains. Where great rigidity and strength are needed, two web plates are sometimes employed, thus enclosing a space and making what is called a box or tubular girder. The limit of size within which plate girders may be economically constructed depends on too many circumstances to allow any absolute rule to be given; but fifty feet is the limit to which they can usually be employed with advantage. Rolled beams are sometimes used with advantage, instead of plate girders of small depth. They are especially suitable as joists for fireproof floors, as rafters in iron floors, as stanchions and sometimes as longitudinal bearers. These rolled beams or joists are generally made in depths of from four to fourteen inches; but they are occasionally made very much larger. It may be assumed, however, that for a greater depth than ten or twelve inches, a plate girder composed of plates of L iron is preferable to a rolled beam in every respect. The I form is common, but various other forms are made. The ordinary lattice or trellis girders have their top and bottom members composed of plates and angle irons, much in the same way as a plate girder. At regular distances apart, regular stiffeners unite the two flanges, and a series of diagonal bars crossing each other fill up the intermediate spaces. The web of the single trellis girder consists of vertical struts and diagonal ties, the former composed of L, T, I or U iron, or a combination of them with plates, the diagonal ties usually only of flat bars. The name "Warren girder" is usually given to a girder whose web is formed by a single triangulation of bars at an angle of 45 or 60 degrees to each other. Trellis and Warren girders can be constructed on the so-called double or treble system by increasing the number of ties or bars, which are usually made to cross each other.

Girders with parallel flanges do not exhibit, when continuous over two or more spans, any features which exclude them from the classification already made. Their peculiarities consist in a more complicated distribution of strains than exist in independent girders, economy in weight of material and certain facilities in erection. A kind of trellis girder must be mentioned which is called a trussed beam in those cases where it is loaded on the top flange. The most simple illustration of its principle is given by bisecting the top flange in its length and supporting the point thus indicated by a vertical strut and two ties, the latter forming an angle of 45 degrees, or one flatter, with the horizontal line. Two or more such trusses can be arranged together, in which case it is necessary that the top flange shall form one beam, and that the points where the diagonals join the verticals at the bottom shall be connected by a horizontal tie. Curved girders are those which do not have their flanges parallel. They are modifications of the ordinary girder (plate, trellis, etc.), with curved top flange. The fish-bellied girder consists of both curved top and bottom flanges. Girders with concave bottom flanges are sometimes used when continuous over several spans, where they afford added head room below. Trussed roofs present a variety of other girders whose flanges are not parallel, specially designed and adapted to the use to which they are devoted, in a general way each under circumstances peculiar to itself. They are of the materials common to other girders and are modifications or exaggerations of the different kinds of girders described. They are commonly called "roof trusses." Some of the forms of girders above referred to are used principally in bridges; all of them have been used in buildings. Certain portions of some large buildings are constructed on the bridge principle, and, while not used as a means of crossing, are practically bridges supporting other portions of the building above.

Cast-iron columns and pillars are made to order of different sizes, solid or hollow, plain or ornamental, as may be demanded by the plan of the building in which they are to be placed. In ornamental work any designs that can be carved in wood or stone can be imitated with fidelity. The wrought iron and steel uprights employed in modern buildings are made of any desired size and length by a combination of T, I and U, and plate girders, or of some of them, firmly riveted together. Their dimensions are of course determined by those of their constituent parts.

The endless variety of roof structures renders a precise division into classes difficult, and it is only possible to specify those broad distinctions by which, without question, one kind of roofs may be known from another. The chief characteristic in a roof, is its "principal," a generic term which among engineers includes every kind of main rib or truss, whatever be its peculiarities. A primary distinction can at once be made into two classes which will comprise all roof structures: Class A includes roofs in which the pressure of the principal upon its supports is in a vertical direction only. Class B includes roofs in which the pressure is at an angle outward with the vertical. A roof of Class B, has in reality an angular thrust, the vertical component of which is directly sustained by the point of support, while its horizontal component is still free, and has to be met by special arrangements, somtimes offering considerable difficulty. The principals in Class A are complete in themselves, or self-contained, while those of Class B are incomplete, their stability depending on that of their abutments. To these may be added a third class of principals, which, when taken separately, have a horizontal thrust, but which, by being arranged upon a circular, elliptical or polygonal base, and inclined toward a common center, can be made dependent upon each other and independent of abutments, by connecting them at their springing by a tie, which, as it joins all the principals at their springing, is in plan a polygon. Such roofs are called domed or curbed roofs. All principals belonging to Class A are essentially girders or trusses. No attempt will be made here to divide into classes, according to their characteristic features, the innumerable forms adopted for trussed principals, a task hardly possible when it is considered how one system is mixed with another. Roof principals of Class B, having a horizontal thrust, must, in their construction, have such stability at the springing point as will offer to this thrust the necessary resistance. Such arched roofs are supported in different ways, sometimes on abutments formed by the thickening of the walls at proper intervals; sometimes on columns; sometimes in the side building the roof and in other cases the girders carrying an upper floor or gallery, give the necessary stability. In any case there must be a continuity of the strain from the arch to the ground. In the construction of wrought-iron or steel-arched roof principals, the rules by which stone arches are designed need not be adhered to. A stone arch must be of sufficient thickness to inclose within itself all possible lines of pressure resulting from various loads, because it is assumed that the voussoirs of an arch can not well resist a transverse strain. In an iron or steel arch, however, a material so specially suited to resist transverse strains is employed, that the outline of the arch may be designed without strict regard to the lines of pressure, if these are duly considered in determining the dimensions of the parts. An arched roof generally costs more than a trussed roof, if the expense of abutments be included. But if, by the position or arrangement of the building, abutments exist, or for other reasons have to be provided, an arched roof may be better and cheaper.

The economy and fitness of any roof structure depends as much on the simplicity and symmetry of its parts as on the design. The practice of architects differs in regard to the details of their designs, and to some extent this is caused by the facility with which, in different localities, certain kinds of iron can be procured, or because of preference for certain kinds. For trussed roofs of moderate span, the rafters are generally made of T iron, which is a convenient shape for the connections. Where longer and stronger rafters are required, rolled I iron or riveted beams with a plate or lattice web are often employed, the form of rafter being to some extent determined by the distribution of the roof, covering over the entire length of the rafter. Tension rods are made of flat or round iron. Long struts of cast iron are not advantageous. Wrought iron and steel struts are made generally of T bars. Their shape is more symmetrical against compressive strains, and is more convenient for connection than L iron. For large roofs struts resembling those of a girder are used. According to circumstances, L, T or I iron is employed for purlines. Cast iron, malleable iron or steel shoes are used in the connection of struts and ties. Elaborate connections involving anvil work and welds are expensive and increase the risk of failure, and it is considered economical and safe to make all parts as simple as possible. Rivets and screwed

OWINGS BUILDING.

COMMERCIAL ARCHITECTURE. NORMAN-GOTHIC-DUTCH ORNAMENT.

bolts with nuts are both used in iron-roof construction. The measurement, weight and cost of all kinds of roof covering are stated according to the superficial area occupied, and the unit employed is the square of one hundred superficial feet. The materials used differ mainly in weight, the angle at which they are laid, strength, durability and cost. Tiles, slates, galvanized corrugated iron, zinc, lead, felt, glass and other materials are used.

Windows and casements are made of bronze and iron, and are chiefly used when small panes are required. The obstruction of the light is reduced to a mininum by the use of narrow metal bars, which are at the same time much stronger than the wider sections of wood. Small opening casements are much neater and stronger if made in metal. For endurance, bronze or gun-metal is the best of all materials. Many cast-iron and wrought-iron windows are made. The sizes and patterns of windows vary almost without limit.

To Fred Letz must be given the credit of having been the pioneer architectural iron manufacturer of the old class in Chicago. It would be hard to fix the date of his beginning in this line, for the reason that he gradually developed with it from other foundry work, which he had carried on in a small way for some years before he made this a specialty. Some of the oldest and most reliable iron men in Chicago state that Letz may be classed as an architectural iron worker of the old school from about 1843, and he was in the business most of the time until his death a few years ago. He sometimes had partners and operated under the firm name of Letz & Co., but he is familiarly remembered as Fred Letz, and his early plant on Desplaines street near Carroll was more often referred to as "Letz's shop" than by any more dignified title. The Chicago Iron works, owned and operated by a brother of Fred Letz and W. H. Chenowith were destroyed in the great fire of 1871. They were rebuilt soon after, and were well running in 1873, employing nearly two hundred men and turning out construction iron for buildings and bridges. The Union Foundry works of Bouton & Hurlburt were established in 1852, and incorporated about twenty years later. In 1873 their foundry at the corner of Fifteenth and Dearborn streets employed four hundred men. The iron work for the Palmer, Sherman, Grand Pacific and Tremont hotels, the First National bank, Tribune, Journal, Singer and other large buildings erected in 1872–3 was furnished by the Union foundry. This foundry and Letz's were for some years the only ones in Chicago devoted to such work, and from them graduated most of the architectural iron men, in both the structural and ornamental branches, who became known in Chicago subsequently. More will be said of the Union foundry further on. Buckman & Thompson was another early firm. The Bolter foundry, known as the Illinois Iron works, was established in 1856. The foundry of John Clark & Son was established in 1852, and in a few years had developed into one of the leading architectural iron works in Chicago. In 1867 the firm became Clark & Raffen. More of this concern will appear in another connection. The Columbian Iron works of Elmes, Furber & Co., at Paulina and Twenty-second streets, date back to 1858. In 1873 there were seventy-five men employed, but the production of construction iron was confined to castings. After the organization of the firm of John Clark & Son as Clark & Raffen, in 1867, the Ætna Iron works of this company were built at Ohio and Kingsbury streets. They were swept away in the great fire and rebuilt and reopened December 9, 1871, and furnished the iron for the Gardner house, Arcade building, Matteson house, Rosenfield & Rosenberg's building and other houses constructed immediately after the fire. In 1873 this establishment employed one hundred and thirty men. The Globe Foundry of R. M. Eddy, 76 to 80 Illinois street, was established in 1865, destroyed in the great fire, rebuilt within eight weeks, and furnished the iron for the Newbury block, on Wells and Kinzie streets; the Magee block, Randolph and La Salle streets, and Lincoln Park hall, Clark street and Webster avenue. In 1873 there were twenty-five employes. The Washington foundry of Holmes, Pyott & Co., was established in 1863, and castings for architectural work were produced. The iron for the Peter Page building on Washington and State streets, McCormick's hall and other buildings erected in 1872–3, was made by this concern. The iron works of Schillo, Corsman & Co. were established in 1860, and did their part in rebuilding the city after the conflagration. Chicago was well supplied with iron works in 1871. Many of them, as will be seen, made a specialty of building iron of one kind or another, and in the exigencies of rebuilding after the fire, nearly all of them contributed in some manner to supply the demand for iron for structural purposes. The following named establishments were most of them located in Chicago, a few of them located elsewhere had sales agents here: Ætna Iron works, Andrew Bolter; Chicago Iron Company, A. B. Meeker, president, and J. H. Wrenn, secretary; Chicago Iron works, Letts & Co. proprietors; Chicago Novelty foundry; Chicago Plate & Bar Mills; Columbia Iron works, C. D. Elmes, president; Crane Brothers Manufacturing Company; Excelsior Foundry Company; the Globe foundry; Carlile, Mason & Co.'s Iron works; the Lake Shore Iron works, M. E. Stone, proprietor; Livesay's foundry; the Phœnix Iron works, T. K. Holden, proprietor; Red River Iron Company, P. R. Chandler & Son, agents; H. H. Scoville's foundry; the Union foundry works; the Inness-McCune foundry; the Vulcan Iron works, Atkins & Burgess, proprietors; Hall, Kimbark & Co.'s iron and steel warehouses; Wayne Iron & Steel works, W. E. Stockton, agent. The Chicago Architectural Iron works of John McArthur dated back to 1872, when buildings were erected at 70 to 78 Erie and 57 to 67 Ontario streets.

The iron for the Keith Brothers' and Scoville & Allen's buildings, Brown's restaurant, and the Homan building on Madison street, was supplied from this foundry, also for the Hamlin & Frear, J. H. Kedzie and M. C. Stearn buildings, on Randolph street, the Keep & Pease and Wilder buildings on State street. This foundry employed a hundred men in 1872–3. The Globe Iron Works of H. A. Streeter were established in 1867. In 1872–3 this foundry furnished the iron work for the new jail and criminal court buildings, as it had hitherto done for the city bridewell. During the period 1860–71 the Union foundry of N. S. Bouton & Co., the foundry of Fred Letz, the foundry of Holmes, Pyott & Co., the Schillo & Corsman foundry, the Clark & Raffen foundry, and Bolter's Illinois Iron works, had furnished the bulk of the building iron turned out in the city. The advent of other concerns just before and soon after the fire has just been noted. The large amount of building in the city for some years after the fire necessitated as the direct result of the conflagration, and the added amount induced by the rapid growth of the city during the prosperous years since, induced quite a number to embark in this industry, either as small manufacturers or as mere speculators on the products of others; but the major part of the architectural iron work that may be credited to Chicago houses was done by some of the concerns previously mentioned, or by some of the others mentioned later, which have had their business beginning since the date last considered. It must be borne in mind that numerous buildings have been erected by architectural iron concerns of other cities who have not had even so much as a branch office in Chicago as an excuse for underbidding Chicago's business men. Speaking of the architectural iron business during the past decade, the *Iron Age*, an unquestioned authority, said in 1890: "Our columns have borne frequent evidence latterly of the depressing influences prevailing in this branch of the iron trade. It was once most flourishing, and there seemed to be every reason for continued prosperity. The rapid growth of our large cities and the increasing use of iron in business structures caused an expansion of the capacity of architectural iron works which appeared to be in every way legitimate. Taking Chicago as an example, within the past ten years the number of foundries making a specialty of this class of work has increased from five to eighteen. While the number was thus nearly quadrupled, the capacity for production of architectural castings was increased in still greater proportion. In every other important center of building activity a similar expansion was witnessed. The demand for many-storied office buildings increased very considerably the consumption of iron for architectural purposes, and the inference was quite natural that the resources of architectural iron works would be more severely taxed than ever. So sanguine of the future were the manufacturers of architectural castings that those who recently erected works of this character introduced apparatus of the most improved type for the purpose of handling, economically and expeditiously, the heavy castings for which they expected a growing demand. But within the past two years a remarkable change has taken place. The architectural iron trade has abruptly passed from a condition of great prosperity to extreme depression. The experience of the manufacturers of architectural casting is, however, in line with that of sundry other manipulators of iron and steel. Probably in no other industry than the iron trade have such remarkable vicissitudes overtaken so many of its branches. The manufacture of iron rails, once so prosperous, is now totally extinct. The cut-nail trade, in which for many years there was not a single failure, has become a by-word and a reproach among iron and steel men. These and other branches of the iron business have suffered from changing conditions, revolutionary in their character. All of them in their time experienced an expansion of business which so overtaxed the capacity of existing works that their facilities were heavily increased to meet it. And the greatest increase in capacity immediately preceded the decline of the industry. The architectural iron works have passed through just such a period. Their heyday of magnificent prosperity has been succeeded by the gloom of relentless competition from unexpected sources.

"Taking Chicago again as an example, it is estimated by well-informed architectural foundrymen that within the past year no less than $200,000 worth of castings have been displaced by steel. This has been mainly in columns, but for lintels and other parts of building, steel is rapidly gaining the preference over cast iron. It may safely be presumed that the Chicago building trade is not singular in this respect. The manufacturers of structural shapes have their agents in every city of consequence, who are ready to figure with architects on limits of safety and with owners or builders on cost of material. It is further charged by foundrymen that the prices made on steel columns are abnormally and unreasonably low, the manufacturers furnishing them at cost or under and making themselves more than whole through the handsome profit realized on beams. The architectural foundrymen find that even when cast iron is to be used to some extent the structural mills usually figure directly with owners or builders for the beams necessary, and thus all chance of profit is eliminated in that direction. Restricted to cast-iron work alone, the architectural foundrymen are forced to compete with one another most keenly, and the result is a wretchedly profitless business. Thus, cast-iron columns have been sold at lower prices recently than a year since, when pig iron was much cheaper." The eighteen architectural iron foundries referred to in the above quotation were the following: The Bouton Foundry Company, Holmes, Pyott & Co., the Union Foundry works, Hansell, Elcock & Co., Schillo, Cossman & Co., M. Benner & Co., Clark, Raffen & Co., the Dearborn Foundry Company, Vierling, McDowell & Co., Snead & Co., F. E. Roberts, the South Halsted Street Iron works, the W. H. Chenoweth Company, the Winslow Brothers Company, Braumoeller & Moeller, the Dauchy Iron works, A. Bolter & Sons, and H. A. Streeter. Of these, six may be more properly classified as manufacturers of ornamental iron work rather than structural iron work, though they at times contract for the structural work as well, and one is a southern concern, having a regularly established branch office in Chicago under the most competent management. Including the latter, there are eighteen concerns equipped for furnishing structural iron work from their own foundries reduced numerically to twelve, and that number reduced practically to eleven by the succession of the Bouton Foundry Company to the Union Foundry works.

In 1852 N. S. Bouton established the Union foundry on the corner of Fifteenth and Dearborn streets, and soon his trade spread throughout the territory then tributary to Chicago. In 1882 the works were, under the arbitrary law of eminent domain, condemned for railroad purposes, and the company was compelled to seek another location, whereupon it purchased a portion of the stock of a foundry then being organized outside of the city, and allowed the use of its name as a portion of the title of the new company. But finding that the new move was unsatisfactory the Union foundry works sold out its stock and reinvested the proceeds in the present plant, at No. 2600 to 2626 Archer avenue, corner of Quarry street, and reorganized under the title of the Bouton Foundry Company, successors to the Union foundry works. The plant is equipped with all modern appliances for doing all kinds of architectural cast and wrought-iron work, economically and correctly, as well as the great variety of general foundry work. And this new organization of the Union foundry works is pledged to maintain and deserve the reputation acquired by the old organization which it succeeded. The industry was known successively as Bouton & Hurlburt foundry, N. S. Bouton's Union foundry works, N. S. Bouton & Co.'s Union foundry works and Union foundry works (incorporated), of which C. D. Bradley is president, A. E. Coleman, vice president, and H. E. Perry, secretary and treasurer.

Among the great buildings of the city, furnished with iron by this company up to 1886, may be mentioned the Chicago G. L. & C. Co. gasometer house roof, Consumers Generator house roof, Edison electric light building, Palmer house, Sherman house, Tremont house, Grand Pacific hotel, Marshall Field & Co.'s stores, Michigan Southern & Lake Shore railroad depot, Pittsburgh, Fort Wayne & Chicago (Union) depot, Pullman building, old Board of Trade building, new Board of Trade building, old First National bank building, new First National bank building, Union National bank building, Royal insurance building, Gaff building, Maller building, Nixon building, Honore building, Hitchcock building, Tribune building, Major block, Portland block and Hooley's theater.

The firm of John Clark & Son (John and Robert Clark), began their foundry business in Chicago in 1852. It was succeeded by the firm of Clark, Raffen & Co. in 1872. The present partners are Robert Clark, John T. Raffen and William Currer. Their works are located at Ohio and Kingsbury streets. Following are the names of a few of the buildings for which they have furnished iron work: Chicago Opera house, Chicago; Cook county courthouse, Chicago; Tabor block, Denver, Colo.; Columbia theater, Chicago; Arrapahoe county courthouse, Denver, Colo.; Cheeseman building, Denver, Colo.; Academy of Music, Chicago; Hooley's theater, Chicago; Criterion theater, Chicago; Millard hotel, Omaha, Neb.; Central bank, Albcrquerque, N. M.; McKenzie hotel, Winnipeg, Manitoba; Church of the Covenant, Chicago; Commercial bank building, Chicago; Standard theater, Chicago; The United States customhouse and postoffice buildings at Madison, Wis.; Des Moines, Ia.; Cairo, Ill.; La Crosse, Wis.; Oshkosh, Wis.; Macon, Ga.; Denver, Colo.; Clarksburg, W. Va.; Port Townsend, Wash., and Fort Wayne, Ind.; Cobb & Hovey building, New York; Commercial building, St. Louis, Mo.; Myar's Opera house, El Paso, Tex.; Willoughby building, Chicago; State reformatory, St. Cloud, Minn.; Adams' Express building, Chicago; Illinois bank building, Chicago; Meriden Brittania Company's building, Chicago; Rialto building, Chicago; Globe building, St. Paul, Minn.; Palladio building, Duluth, Minn.; Tossetti brewery, Chicago; Wells, Fargo & Co.'s building, El Paso, Tex.; Merrick building, El Paso, Tex.; Maier & Zobelin brewery, Los Angeles, Cal.; Chicago, Kansas & Nebraska railway depot, Topeka, Kas.; Chicago, Kansas & Nebraska railway shops, Horton, Kas.; South Congregational church, Chicago; West Side brewery, Chicago; Leland hotel, Chicago, and the Adams' building, Kansas City, Mo.

The Washington foundry and machine shop of Holmes, Pyott & Co., office 13 North Jefferson street, was established in 1863. It produces architectural work of all kinds, including columns, lintels, sill plates, bridge, railroad and machinery castings, iron and steel eye beams, channels, tees and angle iron, and the company are manufacturers of the Chicago stop cylinder printing press and special machinery. This concern has been long and favorably known. As will be seen on a previous page, it helped to rebuild the city after the great fire, and its iron has gone into a large number of structures of all classes.

The firm of Schillo, Cossman & Co., composed of Peter Schillo, M. Cossman and S. Senn, with works at 87 to 95 West Polk street, manufacturers of heavy and light castings, such as machinery, building and bridge castings, was established in 1860. It has furnished architectural iron for a number of breweries and for many other buildings of importance, as well as for store, office and residence structures.

Vanderkloot's South Halsted street iron works was established in 1872 by M. Vanderkloot. It is now an incorporated concern, with M. Vanderkloot as president and A. Vanderkloot as secretary and treasurer. The works of this establishment are located at 2611 to 2625 South Halsted street. A specialty is made of architectural iron work.

M. Benner & Co.'s iron works and foundry is located at 260 to 264 South Jefferson street. It was established by M. Benner in 1879, and the firm of M. Benner & Co. was formed by the admission of W. D. Kent to partnership in the concern in 1883. This firm are manufacturers and dealers in every description of structural and ornamental iron work, and have been concerned in the erection of many buildings of all kinds. They make a specialty of combination fireescape and stand pipe.

Vierling, McDowell & Co.'s iron works date back to 1881. Their architectural iron work, stair and beam iron work and general foundry work has a good reputation. The members of the company are also engineers and contractors for structural building work.

The Dearborn Foundry Company, No. 1525 Dearborn street, established its business in 1883. Its president is Erastus Foote, Jr., and its secretary and treasurer Edward J. Cushing. Architectural iron work, machinery castings and wrought-iron and steel beams are manufactured and dealt in. Among the more prominent of the many buildings in Chicago, for which this company has furnished structural iron, are the Home Insurance building, the Rookery building, the Board of Trade building, the Presbyterian hospital, the Owings building, the Union League club building, and "the Virginia," otherwise known as the McCormick apartment building.

Hansell, Elcock & Co. began business in 1888. Their office and works are at Archer avenue and Twenty-third place, and they turn out architectural and general foundry work. Among the buildings in Chicago for which they have furnished structural iron may be mentioned the Julian hotel, Havlin's theater, Spooner's building, Goodall's building, the Central warehouse, George B. Hankins' block and Allen's hotel.

The foundry of Russell & Roberts, successor to F. E. Roberts, is located at South Paulina street and Blue Island avenue. This is the youngest of the classified architectural iron concerns of the city, but has done some important work, and stands well in the trade.

The Chicago branch office of the Snead & Co. iron works, of Louisville, Ky., was established in 1885, and C. W. Trowbridge is in charge. It is located in the Home Insurance building. This concern, which began business in 1851, manufactures architectural iron work only, and its annual output is about $500,000 per year. Its work is in every important city in the United States. Among the Chicago buildings for which it has furnished iron are the United States Courthouse and Postoffice, the Art Institute, the Auditorium building and the Manhattan building.

The Illinois Steel Company is a corporation formed by the consolidation of the North Chicago Rolling Mill Company and the Union Steel Company and the purchase of the Joliet Steel Company. The consolidation was effected May 1, 1889, and brought under one control and management five plants, as follows: North Chicago works, South Chicago works and Milwaukee works of the North Chicago Rolling Mill Company; Joliet Steel Company's works at Joliet; Union Steel Company's works at Chicago. Other property, such as coal lands and coke ovens, etc., belonging to the separate companies, was also included, the whole comprising a property which is capitalized at $25,000,000. The five plants of the company occupy over five hundred acres of ground, and the coal lands consist of four thousand five hundred acres of ground, on which there are one thousand one hundred and fifty coke ovens. The company is officered as follows: Jay C. Moore, president; W. R. Stirling, first vice president; H. S. Smith, second vice president; J. C. Stirling, treasurer; B. W. Perkins, secretary. The board of directors is constituted thus: Jay C. Morse, O. W. Potter, H. H. Porter, Norman Williams, W. R. Stirling, H. S. Smith and Marshall Field, of Chicago; Nathaniel Thayer and Francis Bartlett, of Boston; A. J. Forbes-Keith, of New York, and Morgan Rotch, of New Bedford, Mass. The company owns one thousand five hundred cars used in the coke trade, and the internal transportation at the different plants requires the use of five hundred cars and forty-two locomotives of standard gauge, besides seventeen narrow-gauge locomotives hauling special trucks. There are sixty miles of standard gauge and seven miles of narrow gauge railroad in the yards. About ten thousand men are employed in the mills of the company, and the pay rolls for the year ending June 30, 1890, amounted to about $6,000,000. It will be noticed that by far the greater part of the product of the Illinois Steel Company is in the form of rails, and in fact, until within a few years, it might be said that the only product of the several works now owned by the company took that form. All the works were originally built to make rails, and for many years the activity in that trade was such that no other product was thought of, but the increase in the demand for other forms of steel has made it necessary to diversify the product, and the company now makes billets, rods and beams as well as miscellaneous bar iron and steel. A very large open-hearth steel works and platemill are under way, and a mill for rolling all classes of structural steel will be built in the near future. To provide for the increased output, and to make the company independent of outside sources for their supply of pig iron, four new blast furnaces of the largest size are being built and will shortly be blown in.

With the modern additions and improvements the plant of the company comprises the following: Nineteen blast furnaces of an annual capacity of one million two hundred thousand gross tons; four Bessemer works, one million one hundred thousand; one open hearth works, seventy-five thousand; four railmills, eight hundred and fifty thousand; two billetmills, one hundred thousand; one rodmill, sixty thousand; one structuralmill, eighty thousand; one platemill, sixty thousand; one merchantmill, seventy-five thousand, or a total annual capacity of three million six hundred thousand gross tons.

Three of the plants of the company are located within the corporate limits of the city of Chicago—the North Works, the South Works and the Union Works. One is at Milwaukee, Wis., and one is at Joliet, Ill. The North Works, the oldest of the plants of the company, was started in 1857 as a mill for re-rolling iron rails. It became the property of the Chicago Rolling Mills Company in July, 1864, and later was owned by the North Chicago Rolling Mills Company. The manufacture of iron has long been discontinued, and the product at present is steel rails, beams and slabs. The plant is situated on the North branch of the Chicago river, in the northwestern part of the city. The furnaces were built in 1869. Ore for these furnaces is brought by vessel and by rail from the Lake Superior mines, and delivered close to the furnaces. The product is chiefly Bessemer iron, but a good deal of spiegel is made from native and foreign ores. The Bessemer plant was built in 1872. At the time of its construction this was the most completely equipped Bessemer works in America. Some historical interest attaches to this works from the fact that in the old railmill the first steel rails made in America were rolled May 24, 1865, from blooms made at the experimental Bessemer works at Wyandotte, Mich.

The South Works, the largest of the company's works, is situated on the shore of Lake Michigan, twelve miles south from the city's center. The site of this plant was, in 1880, a sand beach, barely above the level of the lake. In that year the erection of four blast furnaces was begun, and in 1881 ground was broken for the Bessemer and railmills. The Bessemer works began operations in June, 1882. Four more blast furnaces are nearly ready to blow in; an open-hearth steel plant and platemill are under way, and a new harbor, two hundred feet wide by two thousand five hundred feet long, has been built for the accommodation of vessels bringing ore to the docks. Nearly all the ore for the supply of fifteen furnaces will be unloaded at the docks of this plant and a large part of it sent by rail to the Joliet and Union works. The Milwaukee works is situated on the shore of Lake Michigan at Bay View, a suburb of Milwaukee, Wis. It is the only works of the Illinois Steel Company where manufactured iron is produced, the other plants being devoted to steel. It was built for a railmill in 1868, and enlarged and adapted to merchant iron work in 1874 and 1884. Ores are brought from the Lake Superior mines and from an interesting deposit at Iron Ridge, Wis. The latter ore is a red oolite, with fifty-five per cent. iron, and over one per cent. phosphorus; is cheaply mined and makes a pig iron very suitable for the basic Bessemer process. The Union works plant is located in the southwestern part of the city of Chicago, on the South branch of the river. Originally built as an iron railmill in 1863, a Bessemer plant was afterward added in which, on July 26, 1871, the first Bessemer steel produced in Chicago was made. Blast furnaces were later erected, as also plate and barmills, a rodmill, and a wire-drawing plant. In 1884 the property came into the hands of the Union Steel Company, and was thoroughly remodeled, a large part of the machinery and buildings being removed and replaced by modern appliances. The product at present is entirely rails. The Bessemer plant made its first blow May 31, 1886, and enjoys the distinction of having made the largest product with two vessels of any plant in America. Ore was formerly received by vessels, but now comes by rail from the South Works, where it can be more cheaply and quickly handled.

The Joliet works were started as an iron railmill in 1870, and a Bessemer works and steel railmill on Holley's designs were added in 1873. Two blast furnaces were built in 1873, the Bessemer and railmill was remodeled in 1885, a Garrett rodmill was put down in 1888, and a third blast furnace was completed in 1890. The product is now rails, billets and rods. The architectural iron and steel of this company is limited to certain sizes. There are several important iron and steel concerns of other cities having offices in Chicago for the sale of architectural and other products. Milliken & Co., agents for the Phœnix Iron Company of Phœnixville, Penn., established their office in Chicago in 1885. It is located at 59 Dearborn street and is in charge of D. Forsythe Morris, manager. O. H. steel beams, channels, tees, angles, girders, roofs, elevated railroad and bridge work are furnished. A specialty is the patent Phœnix columns. Carnegie, Phipps & Co. (limited), of Pittsburgh, Penn., have an office in the Home Insurance building, which was opened January 1, 1886, and is under the management of John C. Fleming, western agent. This concern manufactures beams, channels and other structural material; bridge material, such as iron and steel plates and angles, bar iron, etc.; iron and steel forgings, car axles, etc.; steel billets, rods and wire nails. The Chicago branch office and warehouse of the American Iron and Steel Works of Jones & Laughlin (limited), of Pittsburgh, Penn., at Lake and Canal streets, was established in 1857. Bar and sheet iron and steel, beams, channels, angles, tees, light rails for mine and tramway use, spikes, bolts, chains, nails, etc., are handled, and a specialty is made of soft steel billets for forges. The Columbia Iron and Steel Company of Pittsburgh, Penn., are manufacturers of iron and steel beams, channels, plates, tees, angles, bars, Zee bars and special shapes for architectural and engineering purposes, and blooms, billets and nail plate slabs, have an office at 388 Rookery building, under the management of E. H. Yeager, western sales agent, established in 1889. The New Jersey Steel and Iron Company, of Trenton, N. J., make wrought-iron and steel beams, channels, angles and tees, and are constructors of bridges, roofs and other iron and steel structures. Its Chicago office was opened in 1890, and is under the management of H. N. Elmer.

The following lists contain the names and locations of corporations, firms and individuals now connected prominently with the iron trade of Chicago. As will be seen many of these concerns manufacture ornamental wrought and cast-iron work for building purposes. The specialties of the different concerns are sufficiently indicated, and the connection, near or remote, of each with the building interest will be apparent: The iron manufacturers are Ætna Iron and Steel Company, G. G. Spencer, agent, 556 Rookery; Andrews Bros. Co., John McLauchlan, manager, 59 Dearborn; Chicago Forge and Bolt Company, 701 Rookery building; Illinois Steel Company, tenth floor Rookery; W. S. Mallory & Co., 7 West Randolph; Chr. Muth, 428 Blue Island avenue; New Philadelphia Iron and Steel Company, W. C. Brown, agent, 8, 45 La Salle; Phœnix Iron Company, Milliken & Co., agents, 407, 59 Dearborn; Rewes Iron Company, W. C. Brown, agent, 8, 45 La Salle; Morris Sellers & Co., 216

Phenix building; Springfield Iron Company, James Johnson, agent, 515 Phenix building; Ajax Forge Company, South Hoyne and Blue Island avenue; Benjamin Burgess, 3608 Archer avenue; Carnegie, Phipps & Co., 513, 205 La Salle; Charbonneau & Sundberg, 68 West Washington; Chicago Drop Forge and Foundry Company, Michigan Central railroad corner Kensington avenue; Chicago Forge and Bolt Company, 701 Rookery, works North Franklin and Michigan and Fortieth and Stewart avenue; P. P. Cooley & Co., 11 Illinois; McGuire Manufacturing Company, 122 North Sangamon; Arthur J. O'Leary, Jr., 132 West Lake; Paige Iron Works, 11 and 13 Fifth avenue, works 26 to 38 Ontario; Samson Steam Forge Company, Carroll and Sacramento avenues; Strom Manufacturing Company, 401 and 403 Rookery; Union Drop Forge Company, 70 Ohio; Union Steam Forge Company, P. A. Godey, West Kinzie and Diller; Willard Sons & Bell Co., 708 Phenix building; A. E. Adams, 31 South Canal; Ætna Iron Works, Clark, Raffen & Co., Kingsbury and Ohio; Michael S. Anderson, 130 West Lake; Atlas Foundry, 386 and 388 Throop; F. W. Barker & Co., 614, 164 Dearborn; J. H. Bass, A. Wallace, superintendent, 97 Dearborn; M. Benner & Co., 260 South Jefferson; Andrew Bolter & Son, 172 and 174 Van Buren; Bouton Foundry Company, Thirty-ninth and Winter; Bonton & Co., 217, 164 Dearborn; Brown Brothers Manufacturing Company, Jackson and Clinton; Michael Brucker, 325 North Lincoln; Charles Burdick & Co., Rees and Hooker; Chicago Foundry Company, Redfield and Stein; Chicago Malleable Iron Company, West Twenty-sixth near Blue Island avenue; Chicago Refined Metal Company, South Chicago; Crane Company, 10 North Jefferson; Dauchy Iron Works, 84 to 88 Illinois; Dawson Brothers, 199 to 207 North Halsted; Dearborn Foundry Company, 1525 Dearborn; Eagle Foundry, 590 South Jefferson; East Chicago Foundry Company, 716 Rookery; R. M. Eddy Foundry Company, 43 to 53 Indiana; Eureka foundry, Kolben Johnson, 122 to 126 South Jefferson; Excelsior Iron works, 100 North Clinton; John Featherstone's Sons, 354 to 358 North Halsted; P. H. Fitzpatrick, 60 West Washington; Frazer & Chalmers, Fulton and Union; George Glasebrooke & Co., 386 and 388 Throop; Globe Iron works, 35 to 41 Indiana; Peter A. Godey, 57 Diller; Griffin Wheel and Foundry Company, 602 Phenix building; Hansel, Elcock & Co., Archer avenue and Twenty-third place; Hercules Iron works (Aurora), 22, 189 La Salle; Holmes, Pyott & Co., 13 North Jefferson; Home Foundry Company, Van Horn and Rockwell; Illinois Malleable Iron Company, 581 to 601 Diversey street; Jackman & O'Neill, South Chicago avenue near Ninety-first street; Kalben Johnson, 122 South Jefferson; H. D. Kelly & Co., 2421 Wallace; the King & Andrews Company, 218 to 221 North Union; Kurtz Bros. & Buhrer, 830 Austin avenue; Lake Shore Foundry Company, A. C. Mason, president, J. L. Board, treasurer, 357 and 359 Illinois; Mason & Davis Company, 72 to 76 Lake; McGreevy & Hagerty, 66 Michigan; Timothy McHugh, 109 West Monroe; Daniel Munro, 234 and 236 South Jefferson; James C. O'Brien, 76 North May; Paige Iron works, 11 Fifth avenue; A. Plamondon Manufacturing Company, 57 South Clinton; Peter Reder, 183 Newberry avenue; Francis E. Roberts, South Paulina and Blue Island avenue; Henry Roos & Co., 933 North Fairfield avenue; A. Sandstrom & Co., 4072 La Salle; Schillo, Crossman & Co., 87 to 95 West Polk; W. H. Scoville, 250 to 254 South Clinton;

Soper Foundry Company, 264 Wabash avenue; South Chicago Foundry, South Chicago avenue between Ninetieth and Ninety-first streets; South Halsted Street Iron works, 2611 to 2625 South Halsted; Tarrant & Ramsay, 50 to 56 Indiana; the Snead & Co. iron works (Seville), 414, 205 La Salle; Turner, Dickinson & Co., Churchill and Hoyne; Union foundry works, 614 First National bank building; United States Mitis Company (H. G. Savage, agent), 77 Market; Vail & McDermott, 61 North Wells; Vierling, McDowell & Co., Twenty-third corner Stewart avenue; Vulcan iron works, 86 North Clinton; Webster Manufacturing Company, 195 South Canal; Geo. T. Williamson, 614 First National bank building; L. Wolf Manufacturing Company, North Hoyne and Carroll avenues.

The manufacturers of iron bars are the Illinois Steel Company, tenth floor Rookery; Rewes Iron Company, W. C. Brown, agent, 41 La Salle. The malleable iron works are the Illinois Malleable Iron Company, 581 to 601 Diversey street; Chicago Malleable Iron Company, West Twenty-sixth street near Blue Island avenue. Iron enamel: Nubian Iron Enamel Company, Jackson and Sangamon streets. The corrugated iron works are Edward C. Douglas, 2228 Wabash avenue; Lloyd Iron Roofing & Paint Company, 99 and 101 West Monroe street; the Corrugated Iron Pipe works of James A. Miller & Brother, 129 and 131 South Clinton street. Architectural iron work, structural and ornamental are named as follows: Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn street; M. Benner & Co., 260 to 264 South Jefferson; A. F. Blume, 611 North Halsted; Braumoeller & Mueller, 90 and 92 West Van Buren; Chicago Ornamental Iron Company; 2611 to 2625 South Halsted; Clark, Raffen & Co., Kingsbury corner Ohio; Dauchy Iron works, 84 Illinois street; Dearborn Foundry Company, 1525 Dearborn; Daniel Duffin, 2217 State; Hansel & Elcock, 2437 Butler street; F. M. Hicks & Co. (incorporated) 103 to 107 West Monroe; Holmes, Pyott & Co., 13 North Jefferson; Illinois Iron works, A. Bolter & Son, proprietors, 174 Van Buren; Industrial Iron Works Company, W. H. Chenoweth, president, 76 and 78 West Monroe; Meier & Woltmann, 334 and 336 North avenue; Charles Mulvey, 26 and 28 Charles place; Christian Muth, 428 Blue Island avenue; Pennsylvania Construction Company, 338 Rookery building; Jacob Pfeiffer, 93 West Randolph; Russell & Roberts, Paulina street and Blue Island avenue; A. Sandstrom & Co., 4072 to 4084 La Salle; Schillo, Cossman & Co., 87 to 97 West Polk; A. E. Schreiber, 140 North Desplaines; Scott & Hauge, 46 and 48 Fulton, corner Clinton; F. P. Smith Wire and Iron works, 96 Lake; Snead & Co., iron works of Louisville, Ky., C. W. Trowbridge, manager, 114 Home Insurance building; South Halsted Street Iron works, 2611 to 2625 South Halsted; Union foundry works, N. S. Bouton, president, 1020 Rookery building; Vierling, McDowell & Co., Twenty-third corner Stewart avenue; the Winslow Bros. Co. 376 to 396 Carroll avenue. The iron stair and railing founders include the Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn street; M. Benner & Co., 260 to 264 South Jefferson; Braumoeller & Mueller, 90 and 92 West Van Buren; Illinois Iron works, A. Bolter & Son, proprietors, 174 Van Buren; Industrial Iron Works Company, W. H. Chenoweth, president, 76 and 78 West Monroe; Koop & Reinhard, 259 Clybourn avenue near Halsted; Edward Leger & Son, 124 Franklin street; Charles Mulvey, 26 and 28 Charles place: Jacob Pfeiffer, 93 West Randolph; Joseph Salomon, 308 North Wells; A. Sandstrom & Co., 4072 to 4084 La Salle; A. E. Schreiber, 140 North Desplaines; Scott & Hauge, 46 to 48 Fulton corner Clinton; F. P. Smith Wire and Iron works, 96 Lake; Snead & Co., iron works of Louisville, Ky., C. W. Trowbridge, manager, 114 Home Insurance building; Standard Wire & Iron works, Hickey & Remme, proprietors, 65 Lake, corner State; C. W. Tripp & Co., 112 Monroe street; Union foundry works, N. S. Bouton, president, 1020 Rookery building; Washington Wire works, C. H. Hansen, manager, 106 West Randolph; E. L. Wheeler, 105 and 107 West Monroe; The Winslow Bros. Co., 376 to 396 Carroll avenue.

The iron, wire, fencing and cresting works are operated by the American Electric Fence Company, 301, 85 Dearborn; Baker Wire Company, 645 Rookery building; Baird, Turnbull & Co., foot of Ninety-sixth street, South Chicago; Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn; M. Benner & Co., 260 to 264 South Jefferson; A. F. Blume, 611 North Halsted; Braumoeller & Mueller, 90 and 92 West Van Buren; Daniel Duffin, 2217 State; Samuel D. Eldred, 462 Twenty-second street; Hartmann Manufacturing Company, 508 State street; Illinois Iron works, A. Bolter & Son, proprietors, 174 Van Buren; Industrial Iron Works Company, W. H. Chenoweth, president, 76 and 78 West Monroe; McMullen Woven Wire Fencing Company, 118 North Market; Charles Mulvey, 26 and 28 Charles place; Christian Muth, 428 Blue Island avenue; W. W. Page & Co., 21, 196 La Salle; Price Condit Fence Company, 2515 La Salle; Jacob Pfeiffer, 93 West Randolph; Joseph Salomon, 308 North Wells; A. Sandstrom & Co., 4072 to 4084 La Salle; A. E. Schreiber 140 North Desplaines; Scott & Hauge, 46 and 48 Fulton, corner Clinton; Hermann Schombel, 18 Rees; F. P. Smith Wire and Iron works, 96 Lake; Standard Wire and Iron works, Hickey & Remme, proprietors, 65 Lake, corner State; Union foundry works, N. S. Bouton, president, 1020 Rookery building; Western Fence Company, 441 Rookery building; Wheeler & Co., 91 Thirty-eighth street.

The founders of iron doors and shutters are M. Benner & Co., 260 to 264 South Jefferson; H. J. Berry & Son, 89 and 91 Indiana; A. F. Blume, 611 North Halsted; Braumoeller & Mueller, 90 and 92 West Van Buren; Clark, Raffen & Co., Kingsbury corner Ohio; Daniel Duffin, 2217 State; S. H. Harris, 64 and 66 West Monroe; F. M. Hicks & Co. (incorporated), 103 to 107 West Monroe; Illinois Iron works, A. Bolter & Son, proprietors, 174 Van Buren; Industrial Iron Works Company, W. H. Chenoweth, president, 76 and 78 West Monroe; Koop & Reinhard, 259 Clybourn avenue; Charles Mulvey, 26 and 28 Charles place; Christian Muth, 428 Blue Island avenue; Jacob Pfeiffer, 93 West Randolph; Joseph Salomon, 308 North Wells; A. Sandstrom & Co., 4072 to 4084 La Salle; A. E. Schreiber, 140 North Desplaines; Scott & Hauge, 46 and 48 Fulton, corner Clinton; Snead & Co. iron works, of Louisville, Ky., C. W. Trowbridge, manager, 114 Home Insurance building; H. A. Streeter, 35 to 41 Indiana; Union foundry works, N. S. Bouton, president, 1020 Rookery building; Eugene Zimmerer, Twelfth southeast corner Loomis

The iron pipe industry is represented by Paige Tube Company, for whom C. E. Woodruff is agent, at 35 Fifth avenue, the American and Tube Iron Company, A. L. Chapin, manager, 50 and 52 South Canal, and the National Tube Works Company, North Clinton corner Fulton. Vault doors are manufactured by S. H. Harris, 64 and 66 West Monroe. Ventilation for sewer gas apparatus by William Chappell, 66 Lake; Hartmann & Ertz (agents for Kayser's ventilators), 92 and 94 Illinois. Ventilators by Andrews & Johnson (power and automatic), 59 and 61 Lake; Chicago Water Motor Company (power), 88 Lake; Colby standard ventilators, 35 and 37 South Clark; Edward C. Douglas & Co., 270 South Clinton; J. P. Ekstrom ventilators, 35 and 37 South Clark; Sargent, Greenleaf & Brooks (globe ventilators), 43 and 45 Franklin; Standard Ventilator Company, 35 and 37 South Clark. Fire escapes and improved standpipe are manufactured by M. Benner & Co., 260 to 264 Jefferson street; Hammill Fire Escape Company, 77 Market street; Union Foundry works, 1020 Rookery building; F. P. Smith Wire & Iron works, Lake and Dearborn streets.

Window, door and elevator guards are produced at the shops of the Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn street; Industrial Iron Works Company, W. H. Chenoweth, president, 76 and 78 West Monroe; F. P. Smith Wire & Iron works, 96 Lake; Standard Wire & Iron works, Hickey & Remme, proprietors, 65 Lake, corner of State; Frederick Voss, 67 and 69 West Monroe; Washington Wire works, C. H. Hansen, manager, 106 West Randolph, and E. L. Wheeler, 105 and 107 West Monroe.

The wire and iron works are conducted by the Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn street; Edward Leger & Son, 124 Franklin; Joseph Salomon, 308 North Wells; F. P. Smith Wire & Iron works, 96 Lake; Standard Wire & Iron works, Hickey & Remme, proprietors, 65 Lake corner of State. The wire works by A. H. Andrews & Co., 195 and 197 Wabash avenue; Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn street; Garden City Wire works, C. A. Niebuhr, 393 East Division; Edward Leger & Son, 124 Franklin; F. P. Smith Wire & Iron works, 96 Lake; Frederick Voss, 67 and 69 West Monroe; Washington Wire works, C. H. Hansen, manager, 106 West Randolph. Wire balcony rails by Barbee Wire & Iron Company, G. K. Rix, manager, 44 and 46 Dearborn street; Frederick Voss, 67 and 69 West Monroe. Wire cloth by the Clinton Wire Cloth Company, 137 Lake. Wire lathing by the Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn street; Clinton Wire Cloth Company, 137 Lake; F. P. Smith Wire & Iron works, 96 Lake; Frederick Voss (contractor), 67 and 69 West Monroe. Wire nails by John L. Kneisly, 166 Laflin. Wire rope, steel and iron, by George B. Carpenter & Co., 202 to 208 South Water. Wiring for incandescent lights by the Electrical Construction Company, 175 Randolph. Wire and iron stable fittings by Barbee Wire & Iron works, G. K. Rix, manager, 44 and 46 Dearborn street; Frederick Voss, 67 and 69 West Monroe.

Emery & McFarland, 27 and 29 West Randolph, R. Griffith of Calhoun place and J. O'Brien & Bro. were the principal workers in galvanized iron in 1869.

The American Corrugated Iron Company was represented here in 1872. Messillier, Smith & Slovik's Chicago Cornice Company had shops at 299 West Taylor, and S. B. Munson & Co.'s corrugated iron door and shutter factory was at 27 North Canal street. Tyng & Co.

dealt in galvanized iron, while Boomer & Jenks, Burton & Cook, Robert Griffith, Dewey, Jones & Co., F. J. Emery, L. Fischer, Gallaer & Taylor, Gross & Co., A. Kniseley & Co., McFarland, Price & Co., R. L. Jones of the Reliance Company, Theodore Sinbold and Sokup & Co., were cornice manufacturers. In 1879 the galvanized iron cornice manufacturers were James W. Atkinson, Burkman & Cook, Frank Campe, Phillip R. Garmully, George M. Gross, Hartmann & Claussen, Ed Kirk, Jr., A. Kniseley & Co., Alex. G. Lund, John McVoy, Frank Slavik and William B. White.

Galvanized iron and tin, other forms of iron building material, have an important part in the makeup of structures partially or wholly of iron so called, and are much used in ordinary brick and wooden structures. The most extensively used of these is galvanized iron. This name has for many years been given to articles of iron when coated with zinc, the object of such coating being to preserve the iron from oxidation by the atmosphere. When iron has been thoroughly cleaned and freed from scale, it will, if dipped in a bath of molten zinc, become perfectly coated. When iron is properly coated with zinc, the atmosphere of course has no direct action on the iron, but a thin film of sub-oxide is formed on the zinc coating, which sub-oxide of zinc is sufficiently hard to resist further oxidation and to remain sound when subjected to considerable friction. Galvanized sheet iron is generally corrugated, the wavelike form being given by rolling between cylinders or pressing in dies. The great strength and stiffness which the corrugations give to the iron allow it to be used in sheets of considerable size and for the roofs of buildings of small span almost without framework. The durability of roofs so constructed is limited, but the length of time is mainly determined by the quality of the sheet and the atmosphere to which they are exposed. The sheets are generally galvanized before they are corrugated; but as in the process of corrugation the sheets, especially the thicker ones, will sometimes crack slightly on the surface, unless the iron is of the very highest quality, it is found advantageous at times to galvanize after corrugation, so as to fill up with zinc any cracks that may have occurred. As, moreover, a larger quantity of zinc will adhere to the corrugated than to the flat sheets they have when so coated a distinctly higher value. The value of the sheets depends also on the degree of purity possessed by the spelter, or zinc, and on the skill with which it is applied. There is no case where cheapness obtained by inferior quality is a falser economy than with galvanized iron, for the deterioration, when it begins, is so rapid as to be out of all proportion to the first saving which may have been effected in price. While in pure air properly prepared sheets last long enough to amply repay their cost, in vitiated atmosphere the action upon the zinc will, in a much shorter time, expose the iron to the weather. In gas works, to take an extreme case, galvanized iron is never used. If, when the first gloss has left the new zinc coating, the sheets be painted, their durability will be greatly prolonged. The price of galvanized iron depends mainly on the current rates of iron and zinc. During the past few years galvanized iron has come greatly into favor with builders for cornices and other ornamental portions of buildings formerly made at greater expense and trouble from other materials. The strength of zinc is much below that of iron, and a closer framework is in the parts of immediate support, while, on the other hand, as a covering material impervious to rust it is more to be relied on than the galvanized iron, which has only a coating of zinc. Although sometimes corrugated like the galvanized iron, zinc is more often laid in straight sheets with corrugations only at the points of connection with the framework. For flat roofs, or for steep or mansard roofs, zinc is often used in situations where, formerly, lead was the only available material. Zinc being very ductile, can be readily bent into shape and can be cut and adjusted to exact sizes. It is of great importance that zinc should be perfectly pure, for if it contain iron, as is frequently the case, it will not resist the action of the air. Zinc, though subject to oxidize, has this peculiarity that the oxide does not scale off like that of iron, but forms a permanent coating on the metal impervious to the action of the atmosphere and rendering the use of paint wholly unnecessary. The expansion and contraction of zinc are much greater than those of iron; hence in its use proper attention is paid to the circumstance and plenty of play allowed in the laps or a substantial and durable covering would not be obtained. The cost of zinc building material depends chiefly on the current price of spelter and the size and shape of the parts. The demand for zinc is increasing quite rapidly, and new uses for it are found as necessity seems to demand and the possibilities of invention and application unfold. The comparative advantages of corrugated galvanized iron and zinc may be thus summarized. Zinc is not so well adapted as corrugated iron for places where there may be rough usage and it requires a closer arrangement of the immediate supports. For the latter reason, also, it is more necessary for zinc to be laid on boarding. Rather more skill is necessary for laying zinc and making proper joints. Including the necessary wood rolls, fastenings and closer framing and the cost of laying, the first expense of zinc is the greater; but where, other circumstances permitting, zinc can be conveniently fixed, the ultimate cost is generally less than that of galvanized iron, for the reason that under certain conditions of atmosphere galvanized iron must be periodically painted (say once in four years) to make it last as long as zinc, and when the covering is worn out the old galvanized iron is practically worthless while the old zinc sheets have a regular commercial value, and may appear again in different combination. Tin, the trade name for sheet iron coated with tin, is used to a limited extent in building, principally for small roofs, and requires to be frequently painted to preserve it.

The process of manufacturing tin plate, and indeed the character of the product, appear to be something of a popular mystery which the public, in this country at least, is very slow in comprehending. Anything from a roof to a cup which happens to be made of tin plate is called tin. It was gravely stated in a western paper, a few months ago, that tin plates were being extensively mined in the Black Hills, Dakota. Such ignorance is truly startling, and it would seem about time the public was informed that what is usually called tin is simply sheet iron coated with from two to five per cent. of that metal, and few or no articles of commerce are made of the pure metallic tin itself. When the iron sheets are coated with an alloy of tin, and from twenty-five to sixty per cent. lead, they are known as terne plates, and have a dull leady appearance as compared with bright lustrous tin plate. Terne plates are usually used for roofing purposes, and are not infrequently sold as tin plate, pure and simple. When used for purposes other than the preservation or preparation of foods, terne plate usually fulfills its requirements quite as well as tin plate, and has the great advantage of cheapness. There seems to be a similar misconception as regards galvanized iron, which is simply iron coated with metallic zinc by being immersed in a molten bath of that metal. There does not seem to be any galvanic action whatsoever taking place during the operation, it is an alloying of the iron and zinc, pure and simple. Lead, zinc and copper are used to some extent for roofing purposes, the countries in which they are in vogue outside the United States being Russia, Canada and many new settlements all over the world. Although the first cost is considerable, copper seems to be the cheapest of all roofing material—except, perhaps, iron, if the experiments in iron roofing are successful. Many copper roofs are found in the East in good condition fifty or one hundred years old, while in Europe roofs of that material five hundred years old can be found. Lead as used for roofs, is first cast into small sheets and then rolled out to the size and thickness required, it then being called "mill lead." The sheets are laid upon rolls, in the manner of some kinds of zinc roof, but with close boarding underneath. Lead is mostly suited for flat or steep roofs; but for all roofing purposes, and especially on iron roofs, it is now to a large extent superseded by zinc. Although weight for weight it is cheaper than zinc, the greater thickness necessary in lead renders it more expensive, but it will last proportionately longer.

Lead was known to the ancients and is mentioned in the Old Testament, and the manufacture of lead pipes was a feature of Roman industry. The pipes used to convey water were soldered with an alloy of lead and tin. Lead was largely worked by the Romans in Great Britain, and pigs with Latin inscriptions have been frequently found near old smelting works. England's lead supply comes partially from her Derbyshire mines, but much is imported. Extensive deposits of galena, the principal lead ore, exist in Illinois, Missouri, Iowa and Wisconsin. Other important American lead districts are those of Utah and the upper Mississippi. The Nevada and Colorado lead fields are among the mineral wonders of the world, and until the discovery of their immense deposits carbonate of lead, metallurgically, was not reckoned of much value. All native carbonate of lead seems to be derived from what was originally galena, which, in fact, is always present in it as an admixture, but occasionally presents itself in the form of pure crystals, but more frequently in admixture with clay, limestone, oxide of iron, etc., and sometimes also with coal (black and lead ore). The Nevada mines are mostly near Eureka, where the ore is found in pockets disseminated through limestone, the dimensions of which are variable, one of the most considerable being said to measure 300x60x80 feet. There are contained in the crude ore about thirty per cent. of lead and two-tenths to three-tenths per cent. of silver. The ore of the Colorado lead district was discovered, in 1877, high up in the Rocky Mountains, a few miles from the source of the Arkansas river, by a mining engineer named Stephens. Its deposits are gigantic and of almost constant thickness, between a bed of limestone and a roof of porphyry. It is commercially known as the Leadville ore, and contains from twenty-four to fourty-two per cent. of lead and one-tenth to two per cent. of silver. In Nevada and Colorado the ore is worked

WOMAN'S TEMPLE.

FRENCH-GOTHIC. ROMANESQUE ORNAMENT.

primarily for the silver it contains, but there has been such an advance in this industry since 1878, in the United States, as to seriously affect the price of lead, both here and in Europe. The lead production of the United States in 1889 was one hundred and eighty thousand five hundred and fifty-five short tons, valued at nearly $16,000,000. The extraction of this metal from pure or nearly pure galena is one of the simplest of metallurgical operations, the whole process consisting of heating the ore in the presence of atmospheric oxygen until all the sulphur is burned away and the lead left. The smelting industry of the Rocky mountains handles two principal classes of ores—those containing a notable quantity of lead and those which are silver ores, carrying little of the base metal, but not readily treated by amalgamation. The latter class is generally called "dry ores." The smelting mixture must contain a certain quantity of lead, so that the process may be carried through successfully. The lead business of the country is rapidly drifting into the control of a few organizations. The evidences of success of the lead trust, the combination of the white lead interests, with two smelting plants and one refinery allied with it, has given encouragement to others. It is true that the grand centralization scheme of the other smelters and refiners fell through completely, but since then the two leading Montana smelting works at Great Falls and St. Helena have combined, and fused with them is the large new refinery which is just being completed at Chicago. Some of the group of capitalists who are in control of this combination own also the Colorado Smelting Company at Pueblo and possess mining property in that state. Others are very largely identified with mining interests in Montana and the Cœur d'Alene region, in Idaho.

The Chicago Shot Tower Company, 70 North Clinton street, was organized in 1867, and until 1873 was the sole manufacturer of lead in the city. The Garden City Lead Pipe & Sheet Lead works of N. Lissberger & Co. were established in 1873, at the corner of Clinton and Jackson streets.

Zinc is another metal, much used in house building and house fitting, either pure or in alloy. As a component of brass, zinc was known in metallurgy long before it was recognized as an individual metal. It was described by Libarius in 1597 as "a peculiar kind of tin which was prepared in India." It is not certain to whom history owes acknowledgment as the discoverer of isolated zinc. Zinc smelting has been practiced in England since about 1730. The first continental zinc works were erected at Liege in 1807. Zinc was brought from the East by the Portuguese long before it became an article of commerce in Europe, and is supposed to have been known and made into articles of utility and beauty both in India and China from an early period. It is thought that the Roman brass was produced by smelting ores containing both zinc and copper, some of which are smelted in Sweden at the present day. Only two of the several ores of zinc are of much importance. These are blende and calamine. The former, known also as black jack or sulphuret of zinc, contains, when pure, about sixty-seven per cent. of zinc, but it is rarely found pure. Blende is found in England and in Wales, and in many places on the continent, notably in Sweden, which is rich in this ore. Calamine, or carbonate of zinc, contains, when pure, fifty-two per cent. of zinc. It was formerly exported from England as ballast, through ignorance of its value. The only county in England which now produces it is Cumberland. It is found in Belgium, Silesia and Corinthia, on the continent. This is an oxide of zinc colored by the presence of a small quantity of oxide of manganese, and supplies most of the zinc of American product used in the arts. Red oxide of zinc is found in New Jersey. Silicate of zinc, or electric calamine, is a rare ore generally associated, when found, with calamine. Calamine occurs in Arkansas, Missouri, Virginia and Pennsylvania. There are several distinct processes for the extraction of zinc from its ores, and of these the English, the Belgian and the Silesian are the most important. All include smelting. The Belgian consumes the least fuel, but requires the greatest amount of labor; of the English, the reverse is true; the Silesian holds a sort of middle position between those extremes. All three processes are in quite general use. The spelter and sheet-zinc manufacture of the United States, now a large and growing industry, was successfully introduced by Joseph Wharton, at South Bethlehem, Penn., in 1860, in which year he produced one million, one hundred thousand, five hundred and eighty pounds. In 1861 he produced over three million pounds, and in 1862 nearly four million pounds. The zinc production of the United States for the year 1889, as given by the United States geological report, was fifty-five thousand nine hundred and three short tons, valued at $5,500,855. At the ordinary temperatures, zinc is a comparatively brittle metal, but about the beginning of the present century it was discovered that if heated to between 200 and 300 degrees Fahrenheit, its malleability and ductility were so increased that it could be rolled with facility into thin sheets or drawn into fine wire. Since this was known, the uses of the metal, which formerly was employed only with copper to make brass, have been greatly extended. In sheets it is used for roofing, baths, water tanks, spouting and the like. A considerable quantity is used for name-plates, for engraving upon, and for galvanic batteries. Perforated sheets with various ornamental patterns are manufactured for screens, blinds, light fences and similar objects. As a material for casting artistic works, zinc possesses the desirable properties of having a low melting point and of taking a sharp impression from the mold. It has, in consequence, become a favorite material for making casts of different kinds of ornaments. During late years zinc has been applied with great success to the coating of sheet iron for roofing and other purposes and for coating iron wire of different sizes and for various uses. M. Sorel, a French chemist, is accredited with having introduced galvanized iron into the United States.

The antiquity of tin is well established, for as an ingredient of bronze it must have been in use long before the Trojan war. It is also known that the Phœnicians traded in it, and the Cornish mines were worked at a very early day. At present it exists in more or less amounts in many places in the Eastern and Western hemispheres. In addition to Cornwall, it is found in certain parts of Germany and France, also in southern Asia and Siberia, Madagascar, Burmah and Australia, while in the Western hemisphere it is distributed through some of the South American countries and exists in various parts of the United States, though the latter mines, whatever may be their near prospect, are not yet worked to any extent. All have long depended largely on Wales for the supply of tin plate, and on Cornwall in England, New South Wales and Tasmania in Australia, and the country adjacent to the straits of Penang in Southern Asia for the supply of tin. Attempts have been made to work several of the native deposits, but as year after year passed without the appearance of American tin in the markets, the belief became quite general that tin was at least one metal which the prolific national treasure house did not contain in shape to work successfully. Quite recently, however, discoveries have been made in the Black Hills district of South Dakota*, which prove the existence in that locality of deposits of tin ore, which are claimed to be richer than any heretofore worked in any part of the world. The technical name of tin ore is cassiterite. When pure it is a combination of metallic tin and oxygen. Cassiterite is found in crystals, their size varying from almost imperceptible particles to massive specimens. It must, therefore, first be separated mechanically from the rock in which it is imbedded. In the Black Hills deposit this rock is composed of quartz, mica, albite or feldspar. In some cases, however, the rock has been disintegrated by the action of the elements and the cassiterite has been deposited by itself in beds called placers. Cassiterite thus found is named stream tin. If such placers were of large extent they would be the best source from which to obtain tin, as it would simply be necessary to collect the stream tin and smelt it. But as only small deposits of that character are found, the great reliance must be placed on the cassiterite mined in veins, which are found in the Black Hills to vary in size from a few inches up to three hundred feet in width, and in length from a few yards to more than three miles. The outcrop of the veins so far found are from the surface of the ground up to as much as one hundred and fifty feet above the surface. Tin can not be produced from the earth as easily as silver or gold, or even copper. It is by no means a "poor man's metal." The cassiterite must be separated from the rock by machinery capable of saving every particle of the tin, and such machinery is expensive. Prospectors who discover tin mines are poor men. The first prospectors in the Black Hills sold their claims to an organization of New York capitalists, who established the Harney Peak Tin Mining, Milling and Manufacturing Company. They opened the Etta mine, and in 1885 built a mill near by to work the ore. After a very short run the mill was shut down. Although the ore treated by it averaged over four per cent., less than half of the tin contents were saved, and the machinery was shown to be unadapted to the work. The members of the company were, however, not discouraged, but took the opportunity presented some time after of buying up a large number of tin claims, whose owners were willing to sell out cheaply because they were discouraged by the failure of the mill to treat the ores properly. The Harney Peak Company was afterward reorganized on an English basis, and are now vigorously at work preparing to operate their mines on a large scale. A Chicago company, named the Tin Mountain Company, built a mill in 1887 for the

* The tin plate industry is peculiarly British or Welsh, since the poorly paid, hard and skillful dippers of iron sheets are found there in numbers. The profession of dipping the sheets in molten tin is a hereditary one, just as that of the British hangman has been. Dipping machinery is not yet a practical quantity, and hence the introduction of the tin-plate industry in the United States represents the introduction of the poor, ignorant Welsh dippers into the United States. The Iron creek tinmill of 1890, twenty-two miles southwest of Rapid City, Dak., is the pioneer tinmill of America. The ore is hoisted from the mine to the bins, thence to the concentrators, whence it is shipped to Chicago to be smelted. The first shipment of concentrates yielded sixty-five per cent. of metallic tin.

purpose of developing a tin property, but equipped it with imperfect machinery and it also failed to accomplish anything. Finally the School of Mines, at Rapid City, South Dakota, took up the question of tin separation, and experimented with machinery until a method was found which proved to be entirely satisfactory.

Profiting by these experiments and failures, the Glendale Tin Company of Chicago entered the field in 1888, having acquired control of a property near Hermosa, S. Dak. Beginning operations late in the fall of that year, but little was done until the spring of 1889, when the development of their mines was vigoronsly pushed. Test tunnels and shafts demonstrated the existence of a very large body of rich ore. The mill was then built, but delays in the receipt of its equipment prevented it from being started until late in December. The unavoidable difficulties attendant on the starting of new machinery were experienced, and extremely cold weather embarrassed operations for a time, but all these troubles have been overcome, and the mill is now in regular operation, producing tin for the market. The Glendale Tin Company have thus attained the honor of being the first successful producers of American tin. The Temescal tin district, situated some fifty-five miles east of Los Angeles, Cal., is in the southwestern portion of the San Jacinto estate, and has a superficial measurement of twenty-three square miles, being eleven miles long and two miles wide. The San Bernadino county is said to be the only locality on the Pacific coast where tin ores are found. Within the Temescal district are over sixty well-defined veins of tin stone, varying in width from four to six feet. The ores of the mines are said to be easily reducible, and the average yield is fifteen per cent. of black metal, which will return over sixty-six and one-half per cent. of pig tin from the furnace. The only well-developed mine in this district is the Cajalco, which was first opened in 1868 and the mining of the tin begun, but in 1870 litigation over the property ensued, and all work was suspended until March, 1888, when the title of the property was confirmed on an appeal to the Supreme court of the United States. During this long legal fight the existence of the tin mines was naturally forgotten, but it is predicted that this district will soon be a very important source of tin supply. There appears to be a great similarity between the rocks and geological features of this district and those of the tin producing districts of Cornwall. Tin ore in small and scattered quantities has been discovered at Kings Mountain, N. C.; in Virginia and Georgia; at Winslow, Me.; near Jackson, N. H., and in Mexico. The American public, however, are somewhat suspicious of all statements concerning the prospects of tin mining in this country, though in spite of the numerous disappointments of the past it appears only to be a question of time when tin will be produced here, but whether the particular districts of which so much has been said are to furnish the supply remains for the future to prove.

The idea seems to be prevalent in the United States that in order to establish a tin-plate industry in any country it is requisite for such country to be a metallic tin producer. That such a thing is utterly wrong is fully demonstrated by the following figures: It is stated in the official "Mineral Statistics of the United Kingdom of Great Britain and Ireland," for the year 1889: "The quantity of tin ore mined in Great Britain in 1889 amounted to thirteen thousand eight hundred and nine tons, from which eighty-nine hundred and twelve tons of tin were obtained, against fourteen thousand three hundred and seventy tons of ore mined in 1888, yielding ninety-two hundred and forty-one tons of tin. The importations of tin ore and tin in 1889 amounted to twenty hundred and eight tons ore and thirty thousand and ninety-three tons of tin, against twenty-four hundred and six tons of ore and twenty-eight thousand and forty-nine tons of tin in 1888." It will thus be observed that the amount of metallic tin produced in Great Britain in 1889 was less than one-third the amount imported. In other words, the great bulk of the tin used in this country, in the forms of tin plate, is first imported into England from foreign countries, there made into tin plate, and then exported to the United States for consumption. The valuable portion of tin ore is very small in comparison with the whole mass, and it is so much dispersed that it requires to be stamped to a very fine powder before the metallic particles can be effectually separated. Repeated washings are necessary. The tin ore thus purified has next to be deprived of its sulphur and arsenic. A reverberatory furnace is used, the flues of which are connected with large condensing chambers. In these chambers the arsenic is deposited in a crystalline form. The sulphur, which is present in sulphurate of iron, is decomposed by the heat into sulphuric acid gas and the remaining oxide of iron is removed by a subsequent washing. If sulphuret of copper is present, it is wasted and afterward exposed to the air and thus converted into sulphate of copper, and is then easily dissolved out. The ore is now smelted in a reverberatory furnace. The reduced tin is run off into a casting pan, and thence it is ladled into molds to produce ingots of a convenient size. The tin has now to be purified and refined. The peculiar properties of tin, especially its malleability, its brilliancy, and its slowness of oxidation at usual atmospheric temperature, render it of great service in the arts. With other metals it forms some valuable alloys, not alone bronze, but gun-metal, bell-metal, pewter and solder. The metallic coating of mirrors is formed of an amalgam of tin and mercury. As has been seen, tin is very largely used to coat the surface of other metals, as iron and copper. The applications of tin foil are well known. Tin has been applied instead of silver in ornamenting steel and iron. Compounds of tin and gold, and of tin and other metals, have been used to produce certain colors in glass and pottery. Metastannic acid, prepared by the action of strong nitric acid on tin, is employed in the composition of enamels, and under the name of putty-powder it is much employed in polishing plate and ornamental stones. The manufacture of tin plate is a branch of the iron trade. It seems to have originated in Northern Germany, but the particular place and year in which it was begun are unknown. In the "History of tin and tin plates" (London 1880), P. W. Flower states that it has been very clearly ascertained that in 1620 the trade had already existed for many years in Bohemia. "In that year a knowledge of the manufacture was sought and obtained from Bohemia by the then Duke of Saxony, who immediately commenced the manufacture in his own territories, and it was from Saxony that the secret came to England in the year 1670." Works were first established at Pontypool, but, in consequence of certain difficulties, were subsequently abandoned and neglected for a period of fifty years, and it was not until 1720 that the manufacture of tin plate can be said to have been carried on to any extent. Flower adds that there appears to be no mention of the invention in any of the old French, German or English works on metallurgy, and it seems to be probable that all information relating to this trade was kept very secret with a view to a quiet enjoyment of the monopoly by those who possessed a knowledge of its details. M. de Reaumer, writing in 1725, confirms this idea by saying that the art of making tin plates was considered Germany's own trade.

The French iron masters were not behind the English in introducing this industry into their country, the first successful works having been started in Mansvaux, in Alsace, in 1714, several years before the industry was thoroughly established at Pontypool. Two previous unsuccessful attempts were made to establish the industry in France, one at Chenessy, in Franche Comte, and the other at Beaumont la Ferriere, in Nivernois. The successful works started at Mansvaux, in Alsace, were followed by those of Bains, in Lorraine, in 1733; Imphy, near Nevers, in 1745, and Morambeau, in Franche Comte, in 1751. Works were established near Forsmark, in Sweden, in the year 1739, English tin being imported for the purpose. After the successful start at Pontypool, in 1720, the manufacture began to extend itself through Wales, particularly in those places where water power was available, and where forges already existed for the manufacture of charcoal iron. From Pontypool it spread to Caerleon and Ponthir, in Monmouthshire, to Ynisgerwn, near Neath, and Melin Griffith, near Cardiff, in Glamorganshire, and to Kidwelly and Carmathen Town, in Carmathenshire. For the past one hundred years the manufacture of tin plate in Great Britain has gradually increased, until now she makes a very large per cent. of the world's entire production, the rest coming principally from a few works in Germany and France. In 1887 Germany produced sixteen thousand seven hundred and twenty metric tons of tin plate, basic steel being used almost exclusively for the purpose. It is an interesting fact that while the output of metallic tin from the Cornish mines has gradually decreased within the past twenty years (ten thousand two hundred tons in 1870, and nine thousand one hundred and eighty-three tons in 1888) the production of tin plate in Great Britain has increased at an enormous ratio. In 1889 Great Britain exported four hundred and thirty thousand six hundred and twenty-three tons, of which three hundred and thirty-one thousand three hundred and twelve tons went to the United States. The entire production in 1889 was about four hundred and fifty thousand tons. The great bulk of the metallic tin consumed in Great Britain in the manufacture of tin plate is imported, mostly from Malacca straits and Australia. The same may be said for Germany and France, although some small amounts are still mined in the Zinnwald district in Bohemia.

A brief sketch in this connection of the history of the attempts to establish a tin-plate industry in the United States may not be without some interest. The very high prices of tin plate which prevailed in this market between 1873 and 1878 induced some enterprising persons to establish small tin-plate works at Wellsville, Ohio, in 1873. The quality of the plates made at these works was said to be excellent. Between 1873 and 1875 tin plates were also made, to a limited extent, at Leechburg, Penn. Owing to the fall in prices in 1875, both of these works were obliged to shut down. In the meantime somewhat more extensive works were built at Demmler, near Pittsburgh, Penn., and put in operation early in 1875. The career of these works as such was, however, short-lived, and since they were shut down there does not appear to have been a single pound of tin plate made in the United States for commercial purposes; though there are numerous establishments in this country consuming large quantities of tin plate which are likely to manufacture their own supply, now that they are brought face to face with the fact that, under the new tariff arrangement, tin plates will cost more to import after July 1, 1891.

The St. Louis Stamping Company have already begun to tin sheets for themselves, and will have a large tin plate plant at work next summer. Somers Brothers, of Brooklyn, manufacturers of tin boxes, are, it is said, making arrangements to produce their own tin plate. Other establishments manufacturing tinware in large quantities are inquiring into the costs of plant and improved processes. In every case they expect to realize important economies in cutting up black sheets instead of tin plate, as they do at present. The stamping works will manipulate the black sheets and tin the completed vessel. The first tin plate factory at Chicago was put in operation in December, 1890. Norton Brothers (the Norton Fluid Metal Rolling Company), who have a large can factory at Maywood, Ill., and who are among the heaviest consumers of tin plate in the world, are the pioneers in this new field. They make steel sheets expressly for tin plates, a tinning department forming part of the enterprise. Their appliances were imported from Wales, so that they might be certain to get the most modern and practical devices now in use by the most skillful manufacturers of tin plate. The firm have put in their own special facilities for handling and cleaning in the tinning house, designed after an exhaustive study of the methods pursued in the Welsh tin-plate works. They claim that these appliances are far superior to the system followed in Wales. The force of workmen employed includes expert Welsh tin plate workers, whose experience is needed in starting this new industry. The first tin plates turned out are made from imported black sheets, as the firm are not quite ready to manufacture their own sheets, but will do so in the near future. Meantime they will use imported sheets specially made for tin plates, in order to minimize the troubles incident to the starting of a new industry. The members of this firm have long seen the necessity of making their own tin plates, as their consumption of this class of material is enormous, and continues to increase. They have felt the inconvenience and have realized the disadvantages of depending on sources of production four thousand miles away.

While wages are much higher here than abroad, and it has been claimed by the Welsh maker that even the increased duty will not fully cover the difference, the Messrs. Norton state that they expect to secure advantages in other respects which will make their new enterprise profitable. In the first place, they will trim the black sheets to suit the requirements of their establishment before tinning them. An important item of waste in such large operations as theirs will thus be reduced. Next, they will require no boxes, and a saving will thus be effected which does not enter into most calculations of the cost of manufacture. And further, they will be able to make a careful selection of sheets of the proper gauge before tinning them, thus realizing an advantage in that direction. Last, but not least, they expect to be able to manufacture just the kind of tin plates which they want, and will thus gain an advantage in their can-making departments. With such examples it is predicted that roofers and others using large quantities of tin plate in building operations will soon have their own factories for the manufacture of this material. If the plans now proposed are carried out, the tin-plate trade of this country is likely to be radically changed, and a great deal of tin plate will never see the inside of a box. There are in the United States seventy establishments regularly engaged in the manufacture of iron and steel sheets, distributed as follows: New York, one; New Jersey, two; Pennsylvania, twenty-seven; Delaware, four; Maryland, one; Virginia, one; West Virginia, two; Kentucky, five; Alabama, two; Ohio, twenty-one; Indiana, one; Missouri, three.

In this list are included all works, except crucible steel works, making sheets of any kind and in any quantity. Crucible steel works are omitted because the sheets they turn out are of a wholly different class from the sheet iron of commerce, and, therefore, should not be considered with it. There are not many works in this list which make a specialty of light sheets. In addition to the above, the Springfield Iron Company, of Springfield, Ill., have a plant for rolling steel sheets, but as it has not been operated for several years, it is hardly entitled to be counted. The following list is given of firms who can furnish the black sheets for tinning: Kirkpatrick & Co., Leechburg, Penn.; Canonsburg Iron & Steel Company, Canonsburg, Penn.; Marshall Bros. & Co., Philadelphia; Alan Wood & Co., Conshohocken, Penn.; W. D. Wood Company, McKeesport, Penn.; Wallace, Banfield & Co., Irondale, Ohio; United States Iron & Tin Plate Company, Demmler, Penn.; Jennings, Beale & Co., Leechburg, Penn.; Apollo Iron & Steel Company, Apollo, Penn.; P. H. Laufman & Co., Apollo; St. Louis Stamping Company, St. Louis, Mo., and Republican Iron works, Pittsburgh, Penn. Several other mills can probably furnish sheets of the same character.

Copper besides entering into the composition of bronze and brass, is much employed in its pure state, partly on account of its softness under the tool and partly because it takes enamel and gilding more easily than bronze. It has long been utilized for ornamental purposes and is used to some extent in the manufacture of builder's hardware. In the construction as well as the beautifying of public buildings, copper, bronze and brass have all played an important part, the roof being covered with copper, the monuments dedicated to the honored dead being of bronze, and the decoration of their walls artistically executed in brass. Copper was known probably before the time of Tubal Cain, who was well acquainted with its uses and an educator of workers in brass and iron. Grecian historians say that Cadmus discovered copper and taught its application to the wants of his countrymen. It was brought to notice on the island of Eubœa, near the city of Chalkis, and it may be supposed the Grecians gave it the name of *Chalcos*, by which name the metal was known to Homer and other ancient authors. The old Romans knew copper as *aes cyprum*, and later as *cyprum*, names apparently derived from that of the island of Cyprus, where Pliny says the art of working it was first discovered. Upon this island the Phenicians had opened copper mines, at a very early period. Hence, in the mystic nomenclature of the old alchemists, copper received the name of Venus, the goddess to whom Cyprus was sacred, and among their signs it was known by the astronomical sign of that planet. The English word copper, the German *kupper*, the Spanish *cobre* and the French *cuivre* were probably introduced into those languages during the middle ages and seem but slight modifications of the Latin name. Copper is mentioned in the oldest records, and appears to have been one of the first metals brought into use by mankind. It is generally assumed, without authentic evidenee, that the ancient workers in copper had some alloy of tin and copper which they made so hard that they were able to eut the hardest rocks, and the remains of large temples, whose columns were of porphyry and syenite, seem almost incapable of any explanation except by this supposition. The Incas in Peru, although unable to make any use of the iron ores which lay profusely about them, were familiar with the special properties of this particular hard alloy of copper and tin, and made it in proportions almost the same as those whieh the ancients adopted in the Old World, using it to construct the tools necessary for cutting the stones required in the building of their immense aqueducts and temples. Whether the Phenicians, who carried tin from Britian, acquired the knowledge of making bronze there is not certain; but it may probably be assumed that the weapons and tools of bronze found in the graves of some ancient race in various European lands, and which are known to be Celtic remains, were taken by wandering tribes from that region of Britain, where, at the present day, the deseendants of the same Celts have been and are possibly to-day among the largest copper refiners on the globe; and there the richest, and until recently the only known, tin region within thousands of miles occurs.

At Newlands, near Reswick, in Cumberland, England, some rich mines of eopper were worked as early as 1250, and it seems that in 1470 this place was still famous for the amount of metal it produeed. Ecton Hill, in Staffordshire, was another place where copper was obtained in abundance before the era of copper-mining in Cornwall. The copper used in England prior to the seventeenth century came from the continent, prineipally from Hungary, and not till 1717 is it read of English pennies being made from English copper. About the close of the seventeenth century the attention of Cornish tin-miners was drawn to the more valuable cupreous deposits around them. Deposits began gradually to be opened for the copper they contained about the beginning of the last century, and from that time to the present the produce of the ore has steadily increased, as well as the consumption of the metal taken from it. The discovery of the rich mines in Anglesea in 1768 was followed by the addition of Devonshire and Ireland to the number of copper-producing regions, and later on immense quantities of ore were imported from Cuba, Chili and the Pacific islands. In America copper in paying quantities has been found in nearly every State through which run the Appalaehian chain of mountains. The oldest incorporated mining company appears to have been one for the purpose of reducing ores in Conneetieut, the date of whose eharter is 1709. But all other deposits sufficiently developed to assure a definite knowledge of their value are exceeded by those which within the last twenty-five years have been opened in California, Arizona, New Mexico, and, in particular, in Montana and upon the shores of Lake Superior. The first record of the deposits in this wonderful lake region tributary to Chicago is found in the missionary report of the Society of Jesus for 1659–60. The natives had then rude utensils made from this metal, and large blocks of it were erected and worshiped among their gods. In 1768 an Englishman named Henry, a practical man, carefully examined the old works at great risk, on account of the native hostility, and in 1771 established works which were operated a short time only and then abandoned. The later and more successful mining era begins about the year 1844. The careful inspection of competent scientific men made those regions gradually known to the world, and practical miners, who were drawn thither by the reports of mineral wealth, soon discovered large blocks of copper permeated with silver. A great excitement was caused among adventurers and capitalists, who formed companies in various parts of the world to work in localities of which not even a survey had been made. In 1847, however, the crisis came, and of the then hundreds of nominally existing companies only six were found actually engaged in mining. The results of these early disasters have gradually disappeared. Since then the progress of this region has been healthy and profitable. In this region copper occurs so abundantly that a vein is found which in some places is about two feet in thickness. Henry Morton & Co., in their annual report of the principal copper supplies of the world, make the total product of 1889, two-hundred and sixty-two thousand nine-hundred and ninety gross tons, against two-hundred and fifty-nine thousand one-hundred and twenty-six tons in 1888, and two-hundred and twenty-three thousand nine hundred and seventy-three tons in 1887. To the total of 1889 the United States contributed one-hundred and six-thousand seven hundred and seventy-four tons, while the Spanish Peninsula followed with fifty-seven thousand tons, Chili with twenty-four thousand two-hundred and fifty tons, Germany with seventeen-thousand three-hundrd and fifty-six tons, and Japan with fifteen thousand tons. Thus it will be seen that here is produced more than the three largest other copper producing countries put together. The earlier use of this metal seems to have been in the making of bronze and not in its pure state. It is usually found associated with other metals and minerals, principally with iron and sulphur. In the extraction of copper from its ores the metallurgic processes followed are tedious and complicated, mainly on account of the difficulty of separating the iron and sulphur from the copper. The sulphur is burned away as sulphurous acid, and the iron is carried off by means of fluxes in the form of slag. Ten different steps are enumerated by metallurgists in the production of commercially pure copper. As a component of bronze, tin was used thousands of years before the dawn of history. It does not follow, however, that prehistoric bronzes were made of metallic tin, and when the unalloyed metal was introduced is unknown. Copper for architectural purposes is generally preferred on buildings of the better class. The course of the copper market has not been altogether favorable to the more extended use of this metal for cornice and roofing purposes. With the constantly increasing demand for sheet copper, manufacturers are perhaps scarcely justified in lowering prices, yet a majority of the cornice makers and roofers are ready to declare that with copper a little less in price than at present it would largely supersede iron on all buildings of the better class.

In 1869 Tyng & Co. made brass and copper flues at 15 La Salle street. Crerar, Adams & Co., dealers in brass and copper, 11 and 13 Wells street; J. J. Fawcett, 118 Michigan street; Northwestern Manufacturing Company, 10 North Jefferson; Edward Smeeth*, 125 West Randolph; Union Brass Manufacturing Company*, Court place; George Small, 405 Randolph; Walworth, Twohig & Furse, 225 Lake, and L. Wolff*, 109 Lake, brass founders; Thayer Engraving Company, 42 La Salle, and Kruse, Oppen & Co., 17 South Canal, workers in brass, and the Northwestern Copper works, 65 North Wells. Many changes were made in the brass and copper workers' circle of 1869 by the year 1872. Only the three old firms marked thus * in the list are mentioned in the directory of the last given year. The new firms were: C. & G. Campbell, 116 Desplaines; Chicago Brass works, 74 West Washington; Chicago Railway Lock works, 29 North Jefferson; Clifford Manufacturing Company, 195 West Madison; Conway & Ashworth, 101 Harrison; N. Ditt & Brother, 104 West Lake; John Green, 208 Van Buren; R. Manson & Co., 33 North Jefferson; Luce, Wild & Co.'s north side works, 79 Michigan street; O. Owens, 226 Washington, and the Western Star Metal works, 17 South Canal. The brass and copper workers were the Chicago Water & Gas Pipe Company, 50 to 62 West Washington; Kattentidt & Roesner, 52 Michigan street, and W. C. Lyman, 49 Michigan street. In 1879 there were Anderson & Brother, Banks & Coughlin, Alexander Barnett, L. Wolff Manufacturing Company, Crane Brothers Manufacturing Company, Graham & Johnson, Johnson & Hoyer, P. E. Mayhew, James McAndrews, Owen Owens, H. Thomas & Brother, Union Brass Manufacturing Company, and J. F. Wollensak.

The Manufacturers Association of Brass and Iron, Steam, Gas and Waterworks held their annual convention in New York City December 8, 1886. A. T. Foster was then president, S. L. Morrison, secretary; both of New York City, and J. M. Peck, of New Haven, treasurer. The Crane Brothers was the only Chicago firm represented. The second annual meeting of the Manufacturers' Association of Brass and Iron, Steam, Gas and Waterworks was held at Chicago in December, 1887. The officers elected were: A. T. Foster, president; George T. Coppins, Edward Worcester and Charles Harrison, vice presidents; John M. Peck, treasurer; S. L. Morison, secretary; R. T. Crane, E. H. Cole, James Powell, John Harlin and A. T. Foster, executive committee; John Clifford, W. H. Douglas, W. F. Kyle, W. H. Haines, D. P. Ellis, H. M. Brewster, John Pierce and Charles Jarecki, business committee. The firms or individuals of Chicago whose names appeared on the roll of members were: Crane Brothers Manufacturing Company, Lehner, Johnson, Hoyer & Co., Charles Whittaker and L. Wolff. The latter-day conventions of this association have brought benefits to the manufacturers and workmen alike, for the status of each has been clearly defined.

Nickel has been much used in plating builders' hardware and interior ornaments of metal. Nickel is one of the less abundant elements. It is contained in the sun's atmosphere and in all meteoric iron. Nickel may be said to have been discovered by Cronsted in 1751. In 1754 he succeeded in isolating it in an impure state, and found it to be a semi-metal. Afterward finding it to be present largely in "Kupfer-nickel" he borrowed from that mineral the name for his new element. "Kupfer-nickel" is a combination of nickel and arsenic. Nickel is found in Saxony, Westphalia, Hungary and Sweden, New Caledonia and the United States. The famous nickel mines of New Caledonia lie in the Kanala district and extend for some sixty miles along the east coast, the rocks being coated with green ore, which also occurs in pockets and is extensively worked. These were the richest nickel mines known up to a recent date and were the principal dependence. Considerable quantities of nickel have come from mines in Norway, owned and worked by Sir Hussey Vivian, Bart., M. P. The United States mint derived its supply from mines in Lancaster county, Penn., owned by Joseph Wharton. The discovery of nickel at Sudbury, in Canada, is of recent date, so that the development as yet is very imperfect, but indications point to the existence of the ore in large quantities. These mines are said to be owned jointly by a Cleveland syndicate, the Canadian Copper Company and Sir Hussey Vivian, the latter represented by Emerson Foote, of New York. The matte from Sudbury carries thirty per cent. of copper and fifteen per cent. of nickel, and in this form is sent largely to Swansea, where the pure nickel is extracted. Nickel has been discovered recently in large quantities in Nevada. It is claimed that the ore is found in almost limitless deposits, and of such richness that the lowest grade yields eight to twelve per cent. of pure metal; and that quantities aggregating hundreds of tons are in sight, which give by analysis from twenty to thirty-five and four-tenths per cent. of ingot metal. Nickel has been discovered also in the Lake Superior district and in several other places, but it has not been worked to any considerable extent. Twenty years ago the entire nickel production did not exceed six hundred tons per annum, and the price at that time was between \$3 and \$4 a pound. The present price is a comparatively small fraction of that amount. The largest reduction in price was brought about by the finding, in 1876, of the high grade nickel ores in New Caledonia, the penal colony of France. The output of this section at the present time ranges from eight hundred to one thousand pounds per year, but the cost of mining in this region is very great, owing to natural obstructions. The ore has to be handled or transferred some twelve times before it reaches the European markets.

The consumption of pure nickel in the United States has been estimated at eight hundred thousand pounds per annum. But in this country and elsewhere there will be increased demands, partly as a result of the recent discovery of malleable nickel used as a veneer for iron, which is made a more acceptable material for household utensils.

A reduced supply of nickel is attributable mainly to diminished receipts from New Caledonia. The present price is eighty cents per pound for delivery during the ensuing year. From the foregoing it would appear that the Sudbury mines form the main reliance, although it is by no means certain, if entire dependence can be placed on the latest advices, that Nevada will not in due time be ranked equal, or even of more importance. Developments at these two points will be watched with unusual expectancy, especially if it is true that the New Caledonia mines are less productive than formerly. The purest commercial metal is that obtained from New Caledonia. It often contains only a fraction of one per cent. of impurities. The best commercial cube nickel is always utterly devoid of plasticity;

it breaks under the hammer, although the pure metal, as was shown as early as 1804, by Richter, and confirmed by Deville, in 1856, is highly ductile and tenacious. It is attracted by the magnet, can be welded at a red heat, does not tarnish, and unites in itself all of the virtues of iron with some of the characteristics of the noble metals, and yet its application in the mechanical arts was never thought of until Fleitmann, in 1879, observed that the addition of one-eighth of one per cent. of magnesium to the metal imparted to it all the plasticity of the pure metal. Since the discovery of the value of nickel steel plates, large calculations of profit are indulged in by owners of nickel properties and others interested in smelting works. The future demands for armor plating are put down at large figures, and if accounts are entitled to credence, there is something like a scramble by manufacturers in the United States and Europe to secure themselves from the greed of mine monopolists.

Aluminium is one of the metals present in clay, granite, and other rocky and earthy substances. It was discovered by Wohler in 1828, and was re-examined by him in 1846, when he obtained the metal in minute globules or beads by heating a mixture of chloride of aluminium and sodium. To H. St. Claire Deville, the French scientist, belongs, however, the honor of first isolating aluminium in a sufficiently pure state to determine its true properties. This was in 1854. Through him the world became aware of the existence of a new and very beautiful white metal which resembled silver in luster, finish, and many of its properties, but which far transcended silver in its power to hold its luster and finish against the tarnishing effect of the atmosphere. Compounds of sulphur, such as sulphurous acid and sulphureted hydrogen, generally present in the atmosphere, indoor and out, and which are the commonest as well as the worst enemy to nickel, tin, zinc, as well as silver, were found to exercise absolutely no effect upon aluminium. Here was a metal, then, that rivaled gold in its power to withstand most acids as well as the tarnishing effect of air and water, a metal, too, that was stronger than gold, though quite as ductile and capable to a considerably greater extent to resist drawing under hammer, through die or rolls. The original experiments of Deville were made at the cost of Napoleon III, who subscribed £1,500 and was rewarded by the presentation of two bars of the metal. The process followed by Deville was the same as that suggested by Wohler, and continued to be the only reliable process for the smelting of the pure metal until 1888. Various modifications and improvements made by Deville and others, notably Webster and Castner, have brought the price of aluminium produced by this process from $100 per pound down to $5 per pound. Castner's works in England embody all the improvements made in Deville's process since 1854. One could truthfully say that Deville's process is seen there in its state of absolute perfection, and yet the death-knell of this process, as a commercial operation, was struck when the "direct reduction method," invented by Charles Martin Hall, was perfected in Pittsburgh in the latter part of the year 1888. The greatest step in advance of the Deville process previous to the publishing of the Hall direct method was that of the Cowles electric-furnace process, which consists of smelting the metal direct from corundum, an oxide of aluminium, by means of an electric current coupled with the reducing action of some other metal and solid carbon. Hall had been working years before he succeeded in perfecting his process. Realizing the utter futility of expecting to smelt the metal direct from its ore by means of heat and fluxes, he sought for a solution of the problem by the substitution for the heat of electrolysis. The idea resolved itself, therefore, into the discovery of a flux that would take into solution the aluminium ore at a moderate temperature, but which would remain unchanged and unaffected by the passage of the electric current through it, and which would offer a low electric resistance to the current. Besides this, the bath (flux or electrolyte) must be of less specific gravity than the metallic aluminium, which is very light in weight, to insure the metal sinking to the bottom, and thus not interfering with the operation. To find a bath and proper form of apparatus to do all these things perfectly required years of persistent effort and thousands of experiments. Finally Mr. Hall was put in the way of properly developing his process, which resulted in its perfection. The Pittsburgh Reduction Company, who are working under Mr. Hall's patents in this country and abroad, are now selling pure aluminium at a cheaper rate, bulk for bulk, than nickel. The Scovill Manufacturing Company, of Waterbury, Conn., are rolling and drawing the metal by the ton into sheets, rods, bars, wire and tubing, and are selling the wrought metal at a price considerably below German silver or britannia ware, silver-plated. It was announced in a scientific journal early in the year 1891 that H. Greenway, of Joplin, Mo., had discovered a new method of manufacturing aluminium from clay. His process is carried on by contact of air in two furnaces separately heated, one containing a retort in which the clay is distilled, and the other a peculiarly constructed and arranged reduction chamber composed of refractory fire clay lined with magnesia.

Among the first aluminium products produced by the Hall process was aluminium bronze. In making this alloy copper electrodes were used instead of carbon. The pure aluminium upon being reduced from the ore combines more or less with the copper of the electrodes, which leaves a product containing often as high as fifty per cent. pure copper, the balance, of course, being aluminium. This is a highly crystalline, brittle product that has apparently no value for the arts, except when melted in a crucible or reverberatory furnace, with enough more copper to make the percentage of the latter at least ninety. In this alloy there is what is commonly termed "ten per cent. aluminium bronze," which is particularly remarkable for its great strength. To continue in the scale—increasing the percentage of copper—is likewise to decrease the strength and elasticity of the alloy, but increase the malleability, ductility and rich golden color. Sound castings can be readily made of aluminium, using dry sand molds. The molds can be advantageously lined with plumbago. The metal should be poured quickly, and at very little above the melting point; otherwise the castings will be unsound. Molten aluminium flows readily, and not much larger gates are needed than with brass.

There are two fields for aluminium, one field for the metal in its pure state for all sorts of fancy and useful articles, such as are now made of silver, German silver or britannia-ware, silver-plated and nickel-plated goods, and another field for its alloys with other metals. And as for building bridges, ships, etc., of aluminium which will be "as strong as steel and yet as light as a feather," it is only necessary to say that so long as old mother earth's supply of iron ore continues as abundant as it is there need be no fear of any other metal taking the place of iron and steel for such structural purposes as ships and bridges. The use of aluminium for these purposes is precluded for two reasons: One, however cheaply it may be bought to-day or to-morrow, it will never be produced cheap enough to compete in price with iron; two, it is not strong enough. While the weight of iron is more than three times that of aluminium, bulk for bulk, yet the latter is no stronger than copper, silver or brass. If for no other reason steel will always take the precedence over other metals for bridges, ships and for many other structural purposes, because of its great strength. Aluminium conducts heat and electricity as well as silver, does not oxidize in air, has no action on water at ordinary temperatures, preserves its luster where silver would be tarnished and blackened, is not soluble in dilute sulphuric acid, may be made into the thinnest foil or the most attenuated wire, can be hardened in either wrought or cast form, and has other recognized mechanical advantages; but there are also certain mechanical difficulties in the way of adapting it to manufacture that probably prevent its more general use. It is not an easy metal to forge, can not be welded and is very difficult to solder. These difficulties will, in all probability, be overcome in due time, but they are very important obstacles to the immediate application of the metal. There is another point to bear in mind concerning aluminium, and that is the price of it is reducing at a very rapid rate. The present market price of the metal is but a fraction of what it was a few years ago, there seems to be a probability of its reducing lower still in the near future. In the face of a rapidly falling market it is natural that people do not care to stock up with material, and furthermore, if, for instance, aluminium were $3 a pound, it would be applicable to a certain line of goods and in a certain trade, but if the price suddenly fell to thirty cents per pound it will be readily understood that business arangements in which the metal is involved would have to be readjusted. Until the metal shall reach what is considered a bottom figure, therefore, it will be more or less difficult to push its manufacture.

Alloys are mixtures of two or more metals; and an alloy has often different properties from the component metals and bears a distinct name. Bronze is an alloy of copper and tin, sometimes of copper, tin and zinc, in varying proportions, the proportion of tin being from eight to twenty per cent. Its great fluidity in a molten state, its slight contraction in solidifying, and its density and hardness make it especially suitable for casting, and allow of its taking the impress of the mold with extreme sharpness and delicacy. Its toughness and elasticity are so much increased by tempering and annealing that it can be wrought in almost any shape under the hammer and punch. Brass, which is an alloy of copper and zinc, has been much used, chiefly because it is cheaper than bronze, to which it is inferior in beauty, durability and delicacy of surface. The composition of other alloys used in the manufacture of house furnishings and interior fittings is as follows: Plumbers' solder, one part of tin and two of lead; pewter, four of tin and one of lead; gum-metal, nine of copper and one of tin; bell-metal, three of copper and one of tin; pot or cock-metal, two of copper and one of lead; gilding-metal, sixteen of copper and one to one and one-fourth of zinc; pinchbeck, sixteen of copper and four of zinc; Bristol brass for soldering, sixteen of copper and six of zinc; ordinary brass for casting, sixteen of copper and eight of zinc; Muntz sheathing metal, sixteen of copper and ten and two-thirds of zinc; spelter solder for copper and iron, sixteen of copper and twelve of zinc; spelter solder for brass-work, copper and zinc equal parts; silver solder, according to hardness, four to one, three to one and two to one of silver and copper; German silver, one hundred of coppèr, sixty of zinc and forty of nickel; Britannia metal, fifty of tin, four of antimony, four of bismuth and one of copper. Nickel alloys were used practically long before Cronsted's discovery of the metal. German silver, long known to the Chinese as "pack tong," i. e. "white copper," is one of them. An alloy of German with real silver has lately been introduced as "tiers-argent." It consists of silver, twenty-seven and six-tenths; copper, fifty-nine; zinc, nine and six-tenths; nickel, three-fourths per cent. Nickel coin metal is composed of one part of nickel and three of copper. Aluminium forms with copper several light, very hard, white alloys which have found their way to some extent into manufactures, and a yellow alloy, which though much lighter than gold, is very similar to it in color, and in being faintly acted on by acids. With iron, the new metal yields two alloys, one of which, though containing seventy-five per cent. of iron, will not rust, and may be useful in making steam pipes, etc. Immersed in a heated solution of potash, aluminium presents an appearance resembling frosted silver. Experiments have recently been made with the idea of obtaining the properties of aluminium when alloyed with other metals in small proportions. The results were remarkable and of no little importance, inasmuch as it was demonstrated that the tensile strength of aluminium was enormously increased by the addition of copper. Taking the tensile strength of pure aluminium as twelve tons per square inch of section, the strength of the alloys was found to be as follows: Two per cent. copper, nineteen and sixty-five hundredths tons; four per cent. copper, nineteen and nine-tenths tons; six per cent. copper, twenty-four and seven-tenths tons.

The following price list of metals and plumbers' and steamfitters' supplies as published in the *Metal Worker* under date of January 2, 1891, is given, not so much on account of the market value of the commodities designated as because it affords a measurably complete list of metals and metal goods used in building, exclusive of builders' hardware:

METALS.

TIN.

	Per Pound.
Straits pigs	22½ @ 23c

TIN-PLATES.

Charcoal Plates.—Bright.

Guaranteed plates command special prices according to quality.

Melyn and Calland Brand.	IC, 10 x14	@	$ 7 00
	IC, 12 x12	@	7 00
	IC, 14 x20	@	7 00
	IC, 20 x28	@	14 50
	IX, 10 x14	@	8 50
	IX, 12 x12	@	8 50
	IX, 14 x20	@	8 50
	IX, 20 x28	@	17 50
	DC, 12½x17	@	6 50
	DX, 12½x17	@	8 00
Allaway Grade,	IC, 10 x14	@	6 50
Allaway Grade,	IC, 12 x12	@	6 50
Allaway Grade,	IC, 14 x20	@	6 50
Allaway Grade,	IC, 20 x28	@	13 50
Allaway Grade,	IX, 10 x14	@	7 50
Allaway Grade,	IX, 12 x12	@	7 50
Allaway Grade,	IX, 14 x20	@	7 50
Allaway Grade,	IX, 20 x28	@	15 50
Allaway Grade,	DC, 12½x17	@	6 00
Allaway Grade,	DX, 12½x17	@	7 00

Coke Plates.—Bright.

			Per Box.
Steel Coke.-	IC, 10x14, 14x20	@	$ 6 00
	10x20	@	9 00
	20x28	@	12 50
	IX, 10x14, 14x20	@	7 00
BV Grade.—	IC, 10x14, 14x20	@	6 00

THE GOODALL APARTMENT HOUSE.

QUEEN ANNE STYLE. NORMAN-ROMANESQUE ORNAMENT.

Charcoal Plates.—Terne.

Guaranteed Plates command special prices according to quality.

S. T. P. and Dean Grades:

IC, 14x20	$ 5 50 @ $ 5 62½
20x28	11 00 @ 11 25
IX, 20x28	@ 13 50

Worcester Brand and equal:

IC, 14x20	6 00 @ 6 12½
IC, 20x28	12 00 @ 12 25
IX, 14x20	7 25 @ 7 37½
20x28	14 50 @ 14 75

Tin Boiler Plates.

	Per box of 100 sheets.	Per box of 56 sheets.
X, 14x28	$12 50	......
XX, 14x28	13 50	......
X, 14x31	13 00	......
XX, 14x31	14 50	......
X, 14x56	25 00	$14 00
XX, 14x56	27 00	15 50
X, 14x60	27 00	14 75
XX, 14x60	30 00	16 50

ROLL AND SHEET BRASS.

Brown & Sharpe's gauge the standard.

COMMON HIGH BRASS.		To No. 20 inclusive.	Nos. 21, 22, 23 and 24.	Nos. 25 and 26.	Nos. 27 and 28.
Wider than	And including				
2 in.	10 in..	.21	.22	.22½	.23
10 in.	12 in..	.22	.23	.23½	.24
12 in.	14 in..	.23	.24	.24½	.25
14 in.	16 in..	.25	.26	.27	.28
16 in.	18 in..	.27	.28	.29	.30
18 in.	20 in..	.29	.30	.31	.32
20 in.	22 in..	.31	.32	.33	.34
22 in.	24 in..	.33	.34	.35	.36
24 in.	26 in..	.36	.37	.38	.39
26 in.	28 in..	.39	.40	.41	.42
28 in.	30 in..	.42	.43	.44	.45
30 in.	32 in..	.46	.47	.48	.49
32 in.	34 in..	.50	.51	.52	.53
34 in.	36 in..	.55	.56	.57	.58
36 in.	38 in..	.60	.61	.63	.65
38 in.	40 in..	.65	.68	.71	.75

40 in., special price, not less than eighty cents.

Add nine cents per pound for sheets cut to particular widths and lengths.

Add one-half cent per pound additional on each number thinner than Nos. 28 to 38, inclusive.

Brass thinner than No. 38 is Plater's brass, at fifty-five cents.

Discount from above list twenty per cent.

BB

SHEET IRON.

Black.

		Common American.	Refined.
Nos. 10 to 16	per ℔	3.0c	3.7c
17 to 20	per ℔	3.1c	3.8c
21 to 24	per ℔	3.2c	3.9c
25 and 26	per ℔	3.3c	4.0c
27	per ℔	3.4c	4.1c

Galvanized.

Juniata, or first quality, sixty per cent. discount. Charcoal, or second quality, sixty and two and one-half per cent., discount.

Genuine Russia, Nos. 8 and 9, eleven cents and eleven and one-quarter cents per pound net; Nos. 10 to 12, ten and one-half cents per pound net.

Patent Planished, per pound A, ten and one-quarter cents; B, nine and one-quarter cents, five per cent., discount.

Craig polished sheet steel, per pound, eight and one-half cents.

SPELTER.

Western spelter........................6c @ 6½c

ZINC.

Six hundred pound casks....................7 c

Less than casks per pound..................7½c

LEAD.

Soft pig lead........................4½c @ 5 c

Bar...............................5 c @ 5½c

Pipe......................6½c dis. 10 per cent.

Block tin pipe..............................35c

Sheet.........................7c, dis. 10 per cent.

VALVES, COCKS, ETC.

	Per cent.
Iron body valves	.50
All-iron valves	.50
Compression gauge cocks	.50
Mississippi gauge cocks	.60
Register gauge cocks	.65
Air cocks and radiator air cocks	.60
Steam gauge cocks	.60
Oil cups, plain, elbow, new pattern, T and Lever Handle	.50
Globe oil cups	.40
Common lubricators	.50
Steam whistles	.50
Water gauges	.50
Brass expansion joints	.50
Soldering unions	.60
Soldering nipples	.60
Brass unions (union joints)	.60
Fusible plugs	.20
Oil pumps	.60
Self-acting air valves, Marsh's	33⅓

Vacuum valves..............................40
Steam swing joints..............................50
Iron strainers..............................55 and 10
Jenkins' iron body valves, except gate valves....60
Jenkins' all-iron valves, except gate valves.....50
Jenkins' iron body gate valves..........50 and 10
Jenkins' all-iron gate valves.............50 and 10
Iron cocks, all iron..............................60
Iron cocks witb brass plugs..................50
Brass globe, angle and cross valves............65
Brass globe and angle valves, hose outlet.......65
Brass garden hose valves......................65
Brass horizontal, vertical and angle check valves.65
Brass safety valves..............................50
Brass safety valves, low pressure..............65

SOLDER.

½ and ½..............................14 c
Extra wiping..............................12¾c

The prices of the many other qualities of solder in the market indicated by private brands vary according to composition.

ANTIMONY.

Cookson ....21c @ 22c
Hallett's ....19c @ 20e

WIRE.—See Hardware.

COPPER.

Ingot.

Lake ....17c @ 17½c
Casting brands..............................14c @ 14½c

Sheet and Bolt.

Prices adopted by the Association of Copper Mannfacturers of the United States, December 5, 1890:

Not wider than	Not longer than	And longer than	Weights per square foot and prices per pound. Over 64 oz.	32 up to 64 oz.	16 up to 32 oz.	14 up to 16 oz.	12 up to 14 oz.	10 up to 12 oz.	8 up to 10 oz.	Less than 8 oz.
30	72		22	22	22	23	24	25	28	30
30		72	22	22	22	23	25	27	31	..
36	96		22	22	22	24	26	30	33	..
36		96	22	22	23	25	27	31	35	..
48	96		22	22	24	26	28	32	..	..
48		96	22	22	25	27	29	33	..	..
60	96		22	22	27	29	34	..	..	..
60		96	22	23	28	..	..	..	..	..
84	96		23	24	..	..	..	..	..	..
84		96	24	25	..	..	..	..	..	..
84 and wider.			25	27	..	..	..	..	..	..

Cold or hard rolled copper, fourteen ounces, per square foot and heavier, one cent per pound over the foregoing prices.

Cold or hard rolled copper lighter than fourteen ounce, per square foot, two cents per pound over the foregoing prices.

Bolt copper three-eighths inch in diameter and over, per pound, twenty-five cents.

All bathtub sheets: per pound, sixteen-ounce, twenty-eight cents; fourteen-ounce, thirty eents; twelve-ounee, thirty-two cents; ten-ounce, thirty-five cents. Extras per standard list.

Copper Bottoms, Pits and Flats.

Per Pound.

14 oz. to square foot and heavier..............29c
12 oz. and np to 14 oz. to square foot...........30c
10 oz. and np to 12 oz..............................32c

Circles less than eight inches diameter, five cents per pound additional.

Seamless Brass and Copper Tubes.—Add freight from New York to Chicago to these prices, or sixty-five cents per one hundred pounds.

O. G.	N. G.	⅜	½	⅝	¾	⅞	1	1½
8-14	6-12	39	35	32	31	30	29	26
15	13	40	35	33	32	31	30	27
16	14	41	36	34	33	32	31	27
17	15	42	37	35	34	33	32	28
18	16	44	38	36	34	32	32	29
19	17	45	39	37	36	35	34	31
20	18-19	46	41	39	38	37	36	33
21	20	48	43	41	40	39	38	36
22	21	50	44	42	41	40	39	38
23	22	52	46	44	43	42	41	41
24	23	55	48	46	45	43	42	43
25	24	58	51	48	47	46	45	47

Copper, bronze and gilding tube, fonr cents per pound additional.

Brazed Brass Tubing. (To No. 20 inclusive).—Add freight from New York to Chicago to these prices, or sixty-five cents per one hundred pounds.

Above 5-16 to 3 inch, inclusive..................35c
Plain, above 3 inch..............................45e
Plain, 5-16 inch..............................45c
Plain, ¼ inch..............................60e
Plain, 3-16 inch..............................$1 00
Plain, ⅛ inch..............................$1 50
Fancy tubing, brass, to No. 20, inclusive, per lb.43c

Bronze tubing, tbree cents per pound more than brass, discount from list twenty to twenty-five per cent.

PLUMBERS' AND STEAMFITTERS' SUPPLIES.

FITTINGS.

Per cent.

Cast-iron fittings, black and galvanized, Standard sizes..............................65
Cast-iron fittings, bushings and plugs...........65
Cast-iron fittings, flanges........................65

Malleable-iron bushings	65
Malleable-iron unions	60
Malleable-iron American Unions	30
Wrought-iron nipples	75
Wrought-iron couplings	60
Wrought-iron long screws	60
Malleable-iron fittings	35
Brass butterfly valves	50
Brass throttle valves	50
Brass radiator valves	50
Brass radiator valves, Jenkins'	50
Brass Jenkins' globe, angle, cross, corner, safety and check valves	60
Brass Jenkins' gate valves	45
Brass steam cocks	60
Brass gas, meter and union meter cocks	65
Brass fittings, rough	60
Brass fittings, finished	25
Brass bushings	60

PLUMBERS' BRASS WORK.

	Per cent.
Ground-key work, rough	60
Ground-key work, finished	55
Compression work	60
Chain stays	60
Iron boiler couplings ground face, per set, $1	net
Basin plugs	60
Sink or bath and wash tray plugs	60
Basin clamps	55

WROUGHT-IRON PIPE.

	Per cent.
1¼ and under, plain	dis. 47½
1¼ and under, galvanized	dis. 40
1½ and over, plain	dis. 60
1½ and over, galvanized	dis. 47½

CAST-IRON SOIL PIPE.

	Per cent.
Cast-iron soil pipe, tarred, sizes 2 to 6 inches, inclusive	dis. 65
Other sizes	dis. 55

LEADER PIPES.

	Per cent.
Abendroth's galvanized, spiral riveted	dis. 50
Austin's corrugated	dis. 60
Gordon & Gilbert's corrugated	dis. 40 and 10
Ritchie's (galvanized iron only) corrugated	dis. 50
Ritchie's spiral lock seam, galvanized	50
Austin's spiral ribbed pipe	dis. 55
Plain adjustable elbows	dis. 50
James A. Miller Bros. (galvanized iron only) corrugated	dis. 50

DRAIN PIPE.

	Per cent.
Discount from list	50

PAINTS, OILS, ETC.

Deodorized benzine	8½c @ 9c
Iron paint, bright red	per pound, 2 c
Iron paint, brown	per pound, 1½c
Iron paint, purple	per pound, 2½c
Iron paint, ground in oil, B red	per pound, 6½c
Iron paint, ground in oil, red	per pound, 5½c
Iron paint, ground in oil, brown	per pound, 5½c
Iron paint, ground in oil, purple	per pound, 6 c
Linseed oil, boiled, in barrels	53 c
Linseed oil, raw, in barrels	50 c
Mineral paints	2 @ 4 c
Orange mineral	10¾c
Pure white lead in oil	7¼ @ 7¾c
Dry white lead in barrels	6¾ @ 7¼c
Red lead, American	7¼ @ 7¾c
Red venetian, English dry	$1 65 @ $1 70
Red venetian, in oil, assorted cans, 8½c; kegs	7½c
Sipe's Japan oil, in barrels, per gallon	35c
Spirits turpentine, in barrels, per gallon	43c
Asphaltum, Trinidad refined, per ton	$50
Coal tar felt, 1-ply per pound	2c
Coal tar felt, 2-ply, per roll 108 square feet	$1 50
Coal tar felt, 3-ply, per roll of 108 square feet	2 00
Roofing pitch, per barrel (of 300 pounds)	4 00

Authorities differ as to the names of the pioneer brass founders of Chicago. Most of them were in no way connected with the building interests. The brass foundries for plumbers' supplies in operation at the close of 1873 were Smith's, at 125 West Randolph street (now Edward Smith's, 28 North Desplaines), established in 1853; Wolff's, 109 and 111 West Lake street, established in 1855; Graham, Veazey & Johnson's Chicago Brass works, 40 South Jefferson street, established in 1872; Owens' Brass foundry, 224 and 226 Washington street, established in 1857, burned out in 1871 and rebuilt in 1872; Barnett's, 87 Franklin, established in 1859, burned out in 1871 and rebuilt in 1872, and the Clifford Manufacturing Company, 195 West Madison street, established in 1871. There were many other brass workers then in the city, but their wares were not connected with the plumbers' and builders' trades. At this time the Crane Company, the L. Wolff Manufacturing Company and the

Illinois Malleable Iron Company have extensive establishments devoted to the manufacture of plumbers and gas and steamfitters' supplies. The Crane Company's works front on Jefferson, Desplaines, Judd and Fulton streets. The Jefferson street building, four stories high, is 154x150 feet; the Desplaines street building, also four stories high, is 130x168 feet. These buildings are occupied by the general office and salesroom, gray iron and brass foundry department, tool manufacturing department, brass and iron-valve department. One Judd street building, four stories high, 205x220 feet, is occupied with the malleable and gray iron foundries and iron fitting and radiator departments. Another Judd street building, six stories high, 219x111 feet, is occupied by a gray iron foundry, for the manufacture of steam fittings for wrought-iron pipe, iron-valve department, wrought-iron-pipe warehouse, etc. A building at the corner of Desplaines and Fulton streets, 180x170 feet, is used as a butt-weld pipemill and galvanizing works. The number of hands employed is one thousand eight hundred and fifty. The annual consumption of pig iron and scrap is fifteen thousand tons; of copper, tin and brass, one thousand two hundred tons; of skelp iron, nine thousand tons; of steel, one hundred tons. The products are wrought-iron pipe, cast and malleable iron fittings and brass goods (for steam, gas and water), pipe tools, gate valves and radiators and coils. The L. Wolff Manufacturing Company have a large plant at Lake and Jefferson streets, and also have an iron foundry at Hoyne and Carroll avenues. The foundry is of peculiar construction, having the moldingroom in the second story. The Illinois Malleable Iron Company's works are situated at Nos. 581 to 601 Diversey avenue. They employ two hundred and twenty-five hands, manufacture specialties for plumbers and gasfitters, melt about fifteen tons of pig iron daily, and have recently purchased eight and one-half acres of land, with a view to largely increasing their manufacturing facilities.

The Western Smelting & Refining works of James McAndrews were established about a quarter of a century ago by the present proprietor, and in 1890 was removed from 117 West Lake street to the present plant at 10, 12 and 14 Rockwell street. Mr. McAndrews supplies the wholesale trade with ingot copper, solder, block tin, Babbitt metal, slab spelter, antimony and car builders' supplies, and is a dealer in and refiner of all kinds of drosses.

The Illinois smelting and refining works of M. Weil, 185 to 189 West Kinzie street, was established a few years ago. This concern smelts and refines all kinds of drosses and supplies lead and tin pipe, sheet and bar lead, pig lead, block tin, solder, antimony, antimonial leads, ingot and sheet copper, type, stereotype and electrotype metal, Babbitt metal and spelter.

Brass work in such variety is employed in building and finishing modern business houses and residences that the following list of Chicago's brassfounders and finishers will be found of interest: Brassfounders and finishers—Adams & Westlake Company, Ontario and Franklin; Anderson Bros., 345 South Canal; Michael S. Anderson, 130 West Lake; Samuel Andrews, 376 State; L. S. Baldwin & Co., 213 Randolph; Alexander Barnet, rear 213 Randolph; P. A. Bennett & Co., 96 West Lake; Patrick Brennan, 291 South Canal; Chicago Brass Company, 1, 76 Monroe; Chicago Nickel works, Ontario and Franklin; Diamond Anti-Friction

Metal works, 34 South Clinton; Edmund A. C. Duplaine, 240 South Jefferson; William Gerwein, 7 to 9 South Jefferson; Graham & Johnson, 164 South Clinton; E. T. Harris, 103 to 107 West Monroe; Hewitt Manufacturing Company, 604, 138 Jackson; Robert E. Hills, 57 North Wells; William Holland, 41 South Canal; Illinois Malleable Iron Company, 581 to 601 Diversey avenue; Conrad Kottentidt, 113 Michigan; J. Lang & Co., 44 Michigan; Lehner-Johnson Hoyer Manufacturing Company, 70 West Monroe; Payson E. Mayhew, 13 Union Park place; L. R. McIntosh, 11 South Canal; Robert Owens, 226 Washington and 110 West Monroe; Robinson & Chaney, 195 and 197 South Canal; J. J. Ryan & Co., 72 and 74 West Monroe; Edwin E. Smeeth, 28 North Desplaines; Standard Journal Bearing Company, 105 and 107 South Jefferson; Street, Young & Rent Manufacturing Company, Jefferson, southwest corner Monroe; H. Thomas & Bro., 500, 86 Market; Tripp & Clute, 22 Fourth avenue; Turner Brass works, 4 La Salle avenue.

The following are manufacturers or dealers in various lines of brass, bronze and other metallic builders' materials and trade supplies:

Brass and bronze goods—Robinson & Chaney, 195 and 197 South Canal; Waterbury Manufacturing Company. E. M. Arden, agent, 10, 45 La Salle; Weber Bros., 74 and 76 West Lake. Brass and copper tubes—Ansonia Brass & Copper Company, 133 and 135 Wabash; Randolph & Clowes, proprietors. Brown & Bros., Tubing & Boiler works, Brass & Copper Rolling Mills, Waterbury, Conn, James Cornwall, manager, 71 West Washington. Sheet and tube brassworks—Ansonia Brass & Copper Company, 133 and 135 Wabash avenue. Architectual brassworks—L. S. Baldwin & Co., 211 and 213 Randolph; William Gerwein, 7 and 9 South Jefferson. Architectual brass and bronze works—Chicago Brass & Specialty Manufacturing Company, 218 Washington; Rappleye-Plating & Manufacturing Company, 16 Customhouse place; Robinson & Chaney, 195 and 197 South Canal; Winslow Bros. Co., 366 to 396 Carroll avenue. Brass and wire work—A. H. Andrews & Co., 215 to 221 Wabash; Elijah P. Peacock, 143 and 145 South Clinton. Copper—ingot and electrolytic—Chicago Copper Refining Company, 621 Phenix building. Copper manufacturers—Ansonia Brass & Copper Company, 133 and 135 Wabash avenue; Crerar, Adams & Co., 11 Fifth avenue; Park Bro. & Co. (limited), 243 and 245 Lake. Coppersmith—Charles Holmberg, 50 Michigan street. Copper wire—Ansonia Brass & Copper Company, 133 and 135 Wabash avenue; Washburn & Moen Manufacturing Company, 107 and 109 Lake (Chicago office). Copper and sheet-iron worker—Edward C. Douglas, 2028 Wabash avenue.

It is well known that within a comparatively short period the use of sheet metal for producing architectural effects in building construction has assumed vast proportions in this country, and that the industry affords employment to a veritable army of workmen and represents the investment of very large capital. Formerly the adornment of a structure consisted largely of carvings and moldings of stone or wood, depending, for the most part, upon the material of which the building was composed. As the peculiar characteristics of sheet metal came to be more generally known and recognized, it was in many instances employed for ornamental purposes as a substitute for the materials mentioned. It was found that in addition to strength, lightness and durability certain metals possessed the quality of readily taking the impression of a die, and were, therefore, suitable for architectural ornaments of great variety. It was natural to expect at first that the execution of designs in sheet metal would be somewhat crude and unsatisfactory, but as the merits of the material for ornamental purposes became apparent, special machinery was devised by means of which a high standard of excellence has been reached. For ornamental purposes in building construction, zinc and copper are now most generally employed, the ornaments being "struck up" or stamped by means of suitable dies. These metals are peculiarly adapted for the purpose, being soft yet tough, and light yet durable. The qualities possessed by them also admit of the production of an immense variety of designs, the styles being governed in number only by the ability to produce the dies with which they are made. Only a short time since the fashion in cornices and architectural embellishments in general was small projections and very plain moldings. More recently this has changed, so that now there is a demand for broad projections and moldings and panels decorated in imitation of carved wood. This change in fashion has given great impetus to the ornament trade, with the result of making the trimmings of buildings more ornate than heretofore. Another fact to be alluded to in passing is this, that stamped ornaments at the present time are less of the nature of imitations of stone and cast work than formerly. Modelers and artisans in general seem to have caught something of the spirit of sheet metal, and much that is now produced is distinctively of that material and can no longer be accused of being a servile imitation of something else. This argues well for the trade and will undoubtedly be a corner stone in its future prosperity. Minor changes in processes have resulted in a substantial shortening of time in the production of special ornaments and in some cases in a reduction in cost also. While stock goods are still largely in demand, a very considerable proportion of the trade is for ornaments to order, made to the special designs supplied by architects for given jobs. Heretofore the great trouble in work of this kind has been the length of time required to prepare the dies and make the striking. Now that this interval is being reduced architects find that they can employ stamped ornaments to better advantage than ever before, and accordingly are favoring their use. This, too, argues well for the continued prosperity of this trade.

The time was when the cornice industry was summed up by mentioning the names of a comparatively few manufacturers, but now almost every sheet-metal establishment does cornice work. It is hard to tell who are in the trade, even when the inquiry is confined to a single community. There are very few tin shops that do not do more or less work of the kind that is ordinarily accredited to the cornice business. On the other hand, many concerns prominent in the hardware business, in stoves, in roofing, etc., have cornice departments, and conduct a trade in this line which, if considered separately, would still be creditable to the capital and genius of their promoters and managers. The year just closed has seen the cornice business more generally expanded than ever before. It has seen it taken up by a large number of new concerns, and has witnessed the introduction of so-called cornice machinery in a very large number of shops which have known nothing about the industry in the past.

Sheet-metal cornice work for buildings is more a matter of course to-day than ever before. It is not a question nowadays, as it was formerly, of what material shall the cornice be made, when a building is in contemplation, but rather how shall the cornice be proportioned, constructed or designed, as the case may be, the assumption being that, of course, it will be of sheet metal. Galvanized iron continues to be the ruling material, but the consumption of copper for this kind of work is rapidly increasing, and the better buildings of the country are being trimmed in that metal rather than in iron. Power machinery is a recent feature of the cornice business that should be mentioned in passing. A short time since few concerns used power machinery for the production of architectural work in sheet metal, and even at present there are some who are not convinced of its utility. The fact still remains, however, that a large number of power machines are already in use, and that many others are being constructed for manufacturers who propose to change their scheme of manufacture, and that the trade generally are discussing this problem. The invention of power machinery and more careful equipment of shops devoted exclusively to the cornice business is serving to draw a line of distinction between tin shops and other concerns which do cornice work occasionally, and these things are having their proper effect in the trade. It has been demonstrated that there is a material saving growing out of the use of power machinery in this line as well as in others, and accordingly there is no good reason why manufacturers should not employ it. One of the features of the business recently has been the increasing demand for long machines. It was not so very long ago that six-foot galvanized iron was considered staple, and the majority of cornicemakers employed that size to the exclusion of almost every other. The first eight-foot machines that came into the work were considered radical innovations, but the advantages which they possessed compared with all others soon led to that size being almost universally employed. Within the past year a number of ten-foot machines has been ordered and built, being the results of experiments made only a short time ago both with reference to long machines, as were formerly employed, and also in the matter of successfully obtaining iron of such length. Now, even longer machines are being discussed. Corrugating machines are being made to corrugate iron twelve feet long, and machines are being talked about that will corrugate sixteen feet in length. These facts and figures are significant, for they show in the sheet metal business, as well as in other lines of trade, that large machines and the consequent larger work that they produce is advantageous to the manufacturer. They serve to draw the line between well-equipped establishments and those which do simply a hand business.

The firm of G. A. Crosby & Co., manufacturers of sheet metalworkers' machinery, was founded in 1867. The concern was first known as Crosby & Nesser, then as G. A. Crosby, and its style was changed some eleven years ago to G. A. Crosby & Co. The firm has recently moved into new quarters at 176 and 178 South Clinton street. The building is a three-story iron and brick structure, with a pressed-brick front, built expressly for the firm's purposes, and has been most substantially constructed throughout with heavy walls and girders of double strength, with a view to providing for additional stories, which, if the present rapid increase of business continues, will be needed at an early date. The main structure is one hundred and forty feet deep, thirty-six feet wide in front, and forty-four feet wide in the rear. A court is laid out in the middle of the side of the building, fifty-two feet long and ten feet wide at its narrowest end. The sides of the building fronting on this court are constructed wholly of iron and glass, so as to secure a maximum of light for the benefit of the workmen who are engaged in the central part of the factory. The office occupies the front, in the rear of which is the shippingroom, and the remainder of the floor is devoted to the erecting shop. The office is very neatly arranged and finished in yellow pine, with glass partitions separating the private offices from the general office. The office is furnished with a vault, which is built from the basement to the top story, and has openings on every floor for the storage of articles of value. The shippingroom is supplied with an elevator connecting it with each floor. The elevator is of six thousand pounds' capacity, operated with worm and gear, and was built by Eaton & Prince. The erecting-shop has a toolroom along the side of the rear, in which tools are stored. It is the intention of the firm to put in an electric annunciator, with a button at each machine, so that a workman can call for a tool without leaving his place. A small power elevator is to be put in, to connect each floor with the toolroom. They also intend to connect speaking-tubes from the office to each workman, so that he can be communicated with when any special information is desired. The basement is arranged on the same plan as the first floor, with the exception of an additon in the rear for a blacksmith's shop. This is one and a half stories high, twenty feet wide and forty-four feet long, with a skylight on the roof 12x30 feet, having improved ventilators. It is supplied with a Bement, Miles & Co. direct-acting eleven-hundred-pound steam-hammer, weighing nine tons, and the necessary blacksmith's fires. In the main building, in the immediate vicinity, are racks containing the stock of iron, steel and miscellaneous castings for the various parts of machines built by the firm. In the front of the basement the engine is located, which is of the Hamilton-Corliss make, 12x13 inches. A steel boiler, built by the National Boiler works, of Chicago, furnishes the steam. The large planers used by the company are located on this floor in close proximity to the engine, where there is abundance of room, light, and also a very substantial foundation. The third floor of the building is used for die-work and light machinery work. It is fitted with a large number of lathes, drills, millers, planers, etc., of the very latest pattern, arranged to work automatically as much as possible. The firm have been remarkably prosperous, having never experienced a dull season since the establishment was founded. While they make a general line of sheet metalworkers' machinery, they pay special attention to fruit-canning machinery, lard-pail tools and pieced tinware tools. They have also built up quite a business in every section of the country in the manufacture of presses and dies for soap, such as are used by the manufacturers of all grades of pressed toilet and laundry soap. The reputation of the firm is now so widely established that their trade extends beyond the borders of this country.

In 1856 Frommhold & Preske established their iron cornice window and door cap works, at 164 North Clark street. They were burned out in October, 1871, but rebuilt, and employed eighteen men in 1872–3. Kaltenbach & Wagner established their works at 91 West Randolph street in 1857, and in 1871–3 employed six men. Kniseley Brothers' works were opened in 1859, and in 1873 they employed forty hands in their shops at 72 and 74 West Monroe street. Dewey, Jones & Co., established in 1865, at 140 North Desplaines street, furnished the galvanized iron work for the old Exposition building after the fire. Robert Griffith built his shops in 1868, at Nineteenth and Grove streets, where he employed seventy men in 1872–3. Metal and slate roofing was later added to his cornice work. Warren Brother's ornamental metal and center-piece foundry, dated back to 1868. Gerhard & Gateau's zinc roofing and ornamenting works were begun in 1869 at 118 South Franklin street. The shops were destroyed October 9, 1871, but in March, 1872, a building at 164 and 166 Chicago avenue was completed and opened with a force of fifty employes. Friedly's galvanized cornice works at 337 North Clark street dated back to 1872, when fifteen hands were employed. The same year McFarland & Price established the Phœnix works at 87 North La Salle street, with twenty employes. Boomer, Jenks & Cooper, opened their works in 1873, at 771 South Clark street, with fifty-two men, and Johnson, Wood & Johnson, commenced that year at 33 North State street, with four men. Since the great fire the development of the galvanized iron-cornice industry has been so rapid that to trace the beginnings and careers of different concerns in detail is impossible. The principal concerns engaged in this branch of manufacture and building at this time are named and located as follows: L. Berigen, 1609 Wabash avenue; Louis Biegler, 379 North Clark; Gustave Burkhardt, 942 North Clark; Campe & Haase, 181 Illinois; J. J. Colvin, 125 and 127 Milwaukee avenue; R. E. Dewey & Co., 90 and 92 West Van Buren; Edward C. Douglas & Co., 270 South Clinton; Eagle Cornice works, 966 and 968 North Halsted; Edeler & Schwedland, 2563 Lime, corner Twenty-seventh; Frommhold & Voigtmann, 129 and 131 North Franklin; E. Griffith, 1716 Wabash avenue; Hartman & Clausen, 143 North Wells; Hartmann & Ertz, 92 and 94 Illinois; Ferdinard Hertel, 296 West Division; Robert Hughes, 175 West Adams; H. C. Kelly, Jr. (successor to H. C. Kelly), 104 and 106 Franklin; Edward Kirk, Jr., 3951 Wentworth avenue; Richard Kniseley & Son, 184 South Jefferson; A. G. Lund, 105 East Indiana; Lund & Beckman, 288 West Indiana; J. C. McFarland, 219 and 221 West Lake; John McKeown & Co., 16 Rush, corner Michigan; James A. Miller & Bro. (surviving partners of Kniseley & Miller Bros.), 129 and 131 South Clinton; Charles D. Montague, 337 and 339 West Lake; E. E. Noyes, 714 West Lake; John Peter, Wood corner Ellen; Price & Kaufman, 21 North Green; C. B. Rickert, 190 South Clark; J. H. Rumpf & Co., 548 West Chicago avenue; Salisbury, Meier & Maher, 474 Halsted; Schneider & Meng, 92 East Chicago avenue; Frank Slavik, 425 Blue Island avenue; W. J. Smrcka, & Bro., 251 Twenty-fifth place; Henry Spaltenstein, 120 and 122 Newberry avenue; Spies & Bischoff, 75 East North avenue; J. Wales, 518 Blue Island avenue; R. K. Warner, 233 Van Buren; A. J. Welin, 2254 State; W. B. White, 62 and 64 Pacific avenue; Wolcott & McIlroy, 1515 and 1517 State; Henry C. Zeake, 143 West Jackson.

It was only a short time ago when the ordinary tinner thought of necessity he must make his own conductor pipe. In fact this opinion still prevails in certain communities, while, on the other hand, progressive men have learned that they can buy such things cheaper than they can make them, and, further, that they can secure a quality of goods and a finish from the factories that it is impossible to obtain when things are made in a small way. The manufacture of corrugated iron pipe is a staple industry, and is carried on in several different cities. Philadelphia was the home of the industry originally, and after Philadelphia, in order of time, came Boston. Chicago, a little later on, began upon the same trade, and while these three points at present, in a sense, control the business, corrugated conductor pipes are also made in many other places, with more or less influence upon the trade. Tinners formerly made their own eave troughs and gutters. Now all this is changed, and the best gutters or troughs are made in factories devoted specially to this industry, while jobbers and dealers in tinners' findings in general, carry eave troughs in stock. Large capital has been expended in perfecting the facilities for the manufacture of these goods, and, accordingly, the machinery upon which the industry depends at the present time is very complete and efficient. One feature of the improvement of facilities in this branch of manufacture has been the attempt to supersede solder. There have been a dozen or more patent joints and clasps brought out by different manufacturers in a vain effort to dispense with solder, but, in the estimation of many practical men, they are mostly of questionable utility, and some of these frankly advise their customers that a fairly decent and acceptable job is impossible without solder. The above remarks apply with equal force to conductor pipe.

The manufacture of sheet metal ceilings, another offshoot of the cornice businsss, has, within a comparatively short time, developed into an important special industry. The use of sheet metal for ceiling purposes is rapidly growing in favor among builders and sheet-metal workers generally, and its popularity is likely to become more and more pronounced as its peculiar qualifications for the purpose are better understood. A metal ceiling not only adds to the fireproof qualities of the building in which it is employed, but, by reason of the character of the material, admits of such a variety of rich and effective designs as to contribute in no small degree to the beauty and finish of the apartments in which it is used. The growth of the demand for work of this kind has caused a number of concerns to engage in the manufacture of sheet-metal ceilings, and to make it a prominent feature of their business. While all produce a multiplicity of attractive ceiling designs in plain, embossed and corrugated metal, the methods of application differ in many respects with each manufacturer. The goods upon the market are readily divided into several leading styles and kinds, differing among themselves in process of construction and varying in price. The ceiling business has grown with great rapidity, and, perhaps, in no other period of its history has its expansion been more rapid than in the past year. The largest sales during the year were in the cheaper grades of work, but that there has been a demand for the very best work, that which has the highest finish and the best architectural style, is evidenced by the increasing prosperity of those concerns which have made an earnest effort, by the aid of expensive machinery, to put the very best goods on the market. A number of new ceiling concerns have entered upon the business during the past year. The prospects for the future of this industry are promising, because the goods now produced are better than any produced heretofore, and because there is a growing demand for finish of this kind. Iron and zinc are the metals employed most frequently.

Only a short time since what little there was done in fireproof lath was by architectural iron works and a few roofing establishments, who made sheet metal lath to order. The material produced was expensive, the plan of applying it involved a great deal of labor, not to mention special skill, and that such lath was not entirely satisfactory was evidenced by the demand that arose for better sheet-metal work. The result has been that special concerns have been giving particular attention to the production of improved metal lathing, and sheet metal laths of several well-defined styles and at reasonable prices are now before the public. Some of the styles of the lath now on the market are perhaps too new to have proven their ultimate excellence. All of them, however, are backed by testimonials from practical builders, architects and mechanics. In the near future the competition will be with reference to first cost, convenience of application and the way in which the mortar adheres.

Metal roofs are constructed generally either of iron, tin, zinc or copper. Steel is often used, and white metal and other materials not familiar to builders have been introduced without great success thus far. Tin roofing has long been much in vogue, but its lack of durability as compared with some other materials, and the necessity for frequently painting roofs of tin, have operated to prejudice architects and builders against its use for the better class, of buildings. Yet, notwithstanding these conditions, the tin roofers have long had an advantage over the iron roofers in view of favorable tariff regulations. But no one knows how high tin plates are to be in the future, nor how cheap they will be when American manufacture is once in successful operation. That the iron roofing men at present have the advantage, or are at least on an even footing with the tin roofers must be admitted. Tin plates of the better class, as a rule, are preferred for good buildings. The so-called guarantee plates have been in good demand since their recent introduction. What figure American tin plates are to cut in the roofing trade, time alone can tell. The advantages of making roofing plates of different sizes from those arbitrarily established in Wales, are already being discussed. There would seem to be no reason why the roofer should be compelled to put together small sheets in order to obtain the strips he requires. There are those who advocate the introduction of eight-foot tin plates, but whether anything so revolutionary will be offered at reasonable prices, can not now be predicted. The iron roofers of the country, through their National association, have accomplished a good deal of work in favor of certain clauses of the tariff bill, with the result that they were successful in getting an increase of tariff on tin-plates, thereby handicapping the tin roofers. This has been regarded by many in the trade as a most important matter. It is too early yet for manufacturers to reap the full benefit of this work, and the profits arising from the new condition of affairs will be manifest in the future. During recent years there have been some improvements in machinery and in the general facilities for manufacturing, and efforts have been made during the last year by the National Association of Iron Roofers to systematize the trade and lop off certain customs which were considered disadvantageous to the trade, and which have the effect of diminishing profits. Lately dealers have begun to carry iron roofing in stock to fill orders in their several localities. Formerly agents depended upon the factory for their supplies. This new step indicates a permanency of trade, and argues well for the volume of business that is likely to be obtained in the near future. Prices are effected by the quality of goods, and while low prices prevail for goods of average or low grade, it is comparatively easy to get a better rate where there is an exceptional quality and finish. While competition has been sharper during the past year than ever before, it has been principally upon low-grade goods, and during the year a marked growth in volume of business and general results was developed. White metal roofing is a recent invention. The metal is an alloy covered by letters patent. It has been on trial as roofing for four years without paint, and, it is claimed, shows no change whatever under atmospheric action. The mixture is claimed to contain no iron, and rusting is said to be absolutely impossible.

An important feature in metal roofs is the rate of expansion, and with this metal, it is stated, the expansion is less than with tin plate or copper, and therefore there is less trouble with the seams in hot and cold weather. The cost of the new material is said to be less than tin roofing. The metal is easily soldered, or can be united without solder by passing the hot copper over its surface. For roofing purposes it is put up in rolls of any length and from twenty to twenty-eight inches in width, the advantages of this form economizing time and labor in laying roofs. Wire-wove roofing has now been for some years before the public of England as a substitute for glass roofing and many other purposes. Its application on a large scale has been most successfully accomplished at the royal aquarium, Westminster, the directors of which substituted this transparent wire-wove roofing for glass in the enormous roof of the aquarium, which has been constructed out of this material at an expense of £1,700. The great advantages of the new material are obvious, as the glass roof always caused great trouble and expense for repairs, while unable to prevent the rain from coming in, apart from the danger to visitors to the building from the falling of some of the panes. Another advantage of the new roofing is, it is understood, a reduction in the insurance of upward of £600, which has been granted by the fire offices. For those unacquainted with the material we may state that it is extremely pliant, and may be bent backward and forward like leather and be subjected to very considerable tensile strain with impunity. It is almost as translucent as glass, and is of a pleasing amber color, varying in shade from very light golden to pale brown. The basis of the material is a web of fine iron wire, with warp and weft threads about one-twelfth of an inch apart. This is inclosed, like a fly in amber, in a sheet of translucent varnish, of which the base is linseed oil. There is no resin or gum in the varnish, and once it has become dry it will stand heat and damp without suffering any change, neither hardening nor becoming sticky. Numerous sheet-metal shingles have been patented during the past few years, but few of these novelties have been made ready for the market. In each of the large establishments devoted to the production of these goods minor improvements have been made, both in machinery and in the goods themselves, and altogether the industry shows substantial progress.

Among the early metal roofers in Chicago were Greenebaum & Sons, who began business about 1852; Loomis & Abbott, who began about 1853; Samuel Jenks, who began about 1855; James Parker, who was in business 1855–70; and Kniseley Brothers who began in 1859, a prominent concern later; Kniseley & Miller, now James A. Miller & Brother. At the present time the metal roofing business of the city is principally in the hands of the following named firms and individuals: L. Berigen, 1609 Wabash avenue; Louis Biegler, 379 North Clark; Gustave Burkhardt, 942 North Clark; Campe & Haase, 181 Illinois; J. J. Colvin, 125 and 127 Milwaukee avenue; R. E. Dewey & Co., 90 and 92 West Van Buren; Edward C. Douglas & Co., 270 South Clinton; C. M. French, 175 West Adams; Frentel & Turnbull, 17, 195 La Salle; Frommhold & Voigtmann, 129 and 131 North Franklin; E. Griffith, 1716 Wabash avenue; Hartmann & Clausen, 143 North Wells; Hartmann & Ertz, 92 and 94 Illinois; Robert Hughes, 175 West Adams; H. C. Kelly, Jr. (successor to H. C. Kelly), 104 and 106 Franklin; Edward Kirk, Jr. (also hot air pipes), 3951 Wentworth avenue; Richard Knisceley & Son, 184 South Jefferson; A. G. Lund, 105 East Indiana; Lyman & Warren, 51 and 53 North Jefferson; J. C. McFarland, 219 and 221 West Lake; John McKeown & Co., 16 Rush, corner Michigan; James A. Miller & Bro., surviving partners of Kniseley & Miller Bros., 129 and 131 South Clinton; Charles D. Montague, 337 and 339 West Lake; John Peter, Wood corner Ellen; Price & Kaufmann, 21 North Green; C. B. Rickert, 190 South Clark; J. H. Rumpf & Co., 548 West Chicago avenue; Frank Slavik, 425 Blue Island avenue; W. J. Smrcka & Bro., 251 Twenty-fifth place; Spies & Bischoff, 75 East North avenue; A. J. Welin, 2254 State; W. B. White, 62 and 64 Pacific avenue; Wolcott & McIlroy, 1515 and 1517 State.

Among the many uses to which sheet metal is profitably applied in building is that of siding for structures of various kinds. The character of the material is such as to admit of its readily receiving the impression of dies, and this feature is taken advantage of in stamping the sheets with different designs, giving them the appearance of consisting of numberless shingles. The concerns engaged in the production of siding of this description produce a great variety of goods differing in weight and design adapted for use upon buildings of all kinds. This metal siding has been growing in favor with architects and builders during the past few years, and this branch seems to have a prosperous future before it. A new and extensive application of galvanized iron is in the construction of fronts of buildings. A very interesting example of this construction may be thus described: This building, which is four stories in hight, has its entire front covered with galvanized iron. In the execution of this work one of the principal objects aimed at was to make the front as free and independent as possible from any connection with the brickwork, and with the exception of such flanges as were necessary to stiffen the return columns at each end of the building none were built into the wall. The work was put together at the shop in sections of such size as to be convenient for handling, the various parts of each section being well soldered and riveted before taken to the building. The seams made at the building were for the most part of the lock type. In the execution of this work the lintel or story cornice was first set in place and well anchored and bolted to iron beams or girders over the first story. With the exception of the roof-boards over each story cornice there was no wood-work employed on the entire front. The roof-boards rest on iron braces and were bolted to them. The next step after covering the cornice with galvanized iron was to lay off the distance for the centers of all the columns and set them in place. These columns were made in sections, each section being one story in hight, and were temporarily secured to the floor joists in each story and provided with braces at four points, one at each end of the section and the others spaced off at equal distances between. Each of these braces was provided with two anchors of sufficient length to pierce the wall and turn down on the inside. After the columns were set and secured to the floor joists, the window frames were put in place from the back and locked on to the side of the columns. The window frames were constructed in one piece, the size of opening between columns, and in hight extended up under the cornice above, the flange at the top being turned back. The cornices above the windows in each story were made exactly the length of the space between columns, with a head in each end extending the entire hight of the cornice. On the back of these heads a flange was turned out to lock on to the back of the column in the same manner as employed in connection with the window frames below. The bottom of the cornice extended down over the window frame. The cornices of the different stories returning around the columns to the front were built on to the columns in the shop. As each story of the building was completed, the back was filled in with brick. In the construction of this work, the columns were made of No. 20 iron, the window frames of No. 22 iron, and the cornices of No. 24 iron.

It is only in the larger cities that the skylight industry is considered independent of the cornice and roofing trades, and even now nearly all the cornice works make skylights to order. It is a striking feature of these days of rapid mechanical progress that no man is secure in the possession of any part of the mechanical field. He may hedge about a new invention with innumerable patents, and esteem himself so well protected that he can snap his fingers at competitors. But ere long another genius comes upon the field with an article adapted to the same purposes, but probably made in a wholly different way, so that his operations can not be checked by suit or injunction. Indeed, the former will be most fortunate if the newer production does not supersede his own. There are certain lines of manufacture in which the principles followed have not been changed for so many years that they are regarded as standard, and new works are laid down on the old lines with variations only in details. This has been illustrated in the manufacture of skylights. The last two years of the history of this industry have differed from some years which have preceded them in the fact that there has been no notable litigation in progress. While certain patents are respected in the trade, and lines are closely drawn concerning them, it has been discovered that almost any one can make skylights who wishes to do so, and can make them, too, in a way to be acceptable to architects and builders in general. A few improvements have been made in appliances of manufacture, although none of these have been sufficiently notable to warrant more than a passing mention. In a few directions the wants of builders have been so well defined that manufacturers have ventured to make up stock skylights in the dull season, so as to have them on hand ready for delivery when the active demand comes. This is an exceptional phase of the business, however. "Knock-down" skylights, miters, bars and other parts produced by machinery and sent to the trade to assemble and erect, are yet a thing of the future. Many makers are working in this direction, and perhaps the developments of the new year will result in something of this kind to the benefit of a large circle of mechanics and builders.

The oldest skylight and sidewalk light manufactory in Chicago is that of Brown Brothers, successors to Edwin Lee Brown, at Jackson and Clinton streets, established originally in 1860. Houses making a specialty of skylights at this time are the following: Louis Biegler, 379 North Clark; Gustave Burkhardt, 942 North Clark; Campe & Haase, 181 Illinois; J. J. Colvin, 125 and 127 Milwaukee avenue; R. E. Dewey & Co., 90 and 92 West Van Buren; Edward C. Douglas & Co., 270 South Clinton; Edeler & Schwedland, 2563 Lime, corner Twenty-seventh; Frommhold & Voigtmann, 129 and 131 North Franklin; E. Griffith, 1716 Wabash avenue; Hartman & Clausen, 143 North Wells; Hartmann & Ertz, 92 and 94 Illinois; Edward Kirk, Jr., 3951 Wentworth avenue; Richard Kniseley & Son, 184 South Jefferson; A. G. Lund, 105 East Indiana; J. C. McFarland, 219 and 221 West Lake; John McKeown & Co., 16 Rush, corner Michigan; James A. Miller & Bro. (surviving partners of Kniseley & Miller Brothers), 129 and 131 South Clinton; Charles D. Montague, 337 and 339 West Lake; C. F. Mueller & Co., 251 West Chicago avenue; John Peter, Wood corner Ellen; Price & Kaufmann, 21 North Green; J. H. Rumpf & Co., 548 West Chicago avenue; Salisbury, Meier & Maher, 474 Halsted; Frank Slavik, 425 Blue Island avenue; W. J. Smrcka & Bro., 251 Twenty-fifth place; Spiess & Bischoff, 75 East North avenue; A. J. Welin, 2254 State; W. B. White, 62 and 64 Pacific avenue; Wolcott & McIlroy, 1515 and 1517 State, Those making a specialty of sidewalk and vault lights are Brown Brothers Manufacturing Company, Clinton corner Jackson; Clark, Raffen & Co., Kingsbury corner Ohio; Concrete Illuminating Tile Company, office 103 West Monroe; Dauchy Iron works, 84 to 88 Illinois; James B. French, 357 West Randolph; F. M. Hicks & Co. (incorporated), 103 to 107 West Monroe; Richards & Kelly Manufacturing Company, 389 Twenty-third.

Since the practical application of electricity in some branches of building numerous concerns have sprung into existence which make a specialty of electrical appliances, but it is worthy of mention that the hardware and furnishing stores now handle electrical goods almost as commonly as they a short time since handled certain special tools. The man who desires to arrange a set of call bells in the office, store, warehouse or factory, or who desires to connect his sleepingroom with the office, or to fix a system of signals from office to residence, when the distance is not too great, no longer sends to a special electrical supply house for his materials, but, as a matter of course, goes to the nearest hardware store. In turn, plumbers, bellhangers, tinsmiths and many others do various pieces of electrical work, such as the installation of annunciators, signals, door bells, etc., as a part of their regular business, and accordingly the electrical engineer, as a specialist, is restricted to intricate and more difficult work. All this but marks the tendency of events. We look forward to the time when electrical science will be still better understood by the large majority of people, and when mechanics and artisans will give far more attention to it than at present. Prominent among the few concerns in Chicago making a specialty of electrical goods are the following:

Electric bells, burglar alarms and gas lighting—L. S. Baldwin & Co., 213 Randolph; Electrical Construction Company, 175 Randolph; the National Electric Construction Company, 33, 119 and 121 La Salle; Henry Newgard, 169 East Madison; J. D. O'Neil, 256 Thirty-first; J. Parker & Son, 169 Lincoln avenue; L. B. Scott, 4204½ Cottage Grove avenue; O. M. Stone, 112, 6 to 12 Pacific avenue; John S. Way, 10, 150 Dearborn.

Electric construction—The National Electric Construction Company, 33, 119 and 121 La Salle.

Electric gas lighting—Electrical Construction Company, 175 Randolph; Henry Newgard, 169 East Madison.

Electric light—L. B. Scott, 4204½ Cottage Grove avenue; O. M. Stone, 112, 6 to 12 Pacific avenue.

Electrical and mechanical bell hanging and speaking tubes—Ernst Bartelt, 477 West Twelfth; E. E. Edgerton, 120 Twenty-second; M. M. Fulton, 181½ North Wells; Henry Newgard, 169 Madison; J. Parker & Son, 169 Lincoln avenue; L. B. Scott, 4204½ Cottage Grove avenue; John Seger, 475 North Clark.

Electric and pneumatic bells—E. E. Edgerton, 120 Twenty-second; Henry Newgard, 169 Madison; J. D. O'Neil, 256 Thirty-first.

The Western Electric Company's factory is located at Nos. 227 to 257 South Clinton street, having a frontage of three hundred and twelve feet on Clinton street and one hundred and fifty feet on Congress street. The main building is six stories and basement in hight and the aggregate floor space is about five acres. The number of hands employed is about one thousand one hundred, the average weekly pay roll is about $11,000, and the value of the products annually turned out is $2,500,000, consisting of all kinds of electrical apparatus, including arc and incandescent dynamos, arc lamps, motors, telegraph, telephone, and electric light cables, insulated wires, multiple switch-boards, and magneto bells.

In entering upon the consideration of modern house-heating, it may be well to state that it is for the purpose of presenting, in a brief form, the principles of the several methods without advocating the use of either. Hot-air heating, being the system more generally in use than any other, will be considered first, and may be briefly described thus: A continuous current of air at atmospheric temperature is made to pass through a pipe (generally of wood and known as the cold-air box) to a furnace, and brought into contact with its heating surface, consisting of highly-heated iron plates. The air thus becomes very hot, and then flows upward through flues to the various rooms to be heated. The system of heating by hot water consists of circulating hot water in the radiators instead of steam. The boiler, pipes and radiators are completely filled with water—the flow or circulation pipes being attached to the top of the boiler, and the return pipes to the bottom—and the water in the boiler, when heated, rises and circulates through the pipes and radiators, parts with a portion of its heat, thus becoming colder and heavier, and passes down through the return pipe to the boiler,

MANHATTAN BUILDING.

COMMERCIAL ARCHITECTURE

ROMANESQUE DRESS.

where it is again heated. The system of heating by steam consists in circulating steam through radiators or coils placed in the various rooms in the building to be warmed. Shortly after the fire is started in the boiler, steam is generated and begins to flow through the pipes to the radiators, where it is condensed—parting with its latent heat—and the water of condensation flows back through the return pipes to the boiler. There are two systems of heating by steam, known as the high-pressure and the low-pressure systems. The former is sometimes used in large buildings, but is not used for house-heating on account of the necessity of keeping an engineer to take charge of the boiler, and also because the high-pressure involves risk of an explosion. The low-pressure system is, however, free from the above objections, and is adapted for use in dwellings. There are two methods of utilizing the heat in the low-pressure system, which are called respectively direct and indirect radiation. Direct radiation is effected by placing the radiators in the various rooms. The steam is conducted to the radiators, where it is condensed and parts with its heat, the water of condensation flowing back into the boiler. The air thus warmed is radiated directly into the room, warming the walls, etc., utilizing the entire amount of heat contained in the steam. This being the most economical method, it is generally employed in house-heating. The radiators are of various forms, and are placed beneath the windows, in corners, or wherever the heat is needed, and they can be large or small, and of any number, so that no matter how large a room or hall may be, it can be kept at a perfectly uniform temperature. Many improvements have been made in the form of radiators. Indirect radiation is effected thus: All the radiating surface, consisting of a stack or coil of pipes, is placed in the cellar, and is encased in an air-tight box, communicating with the outside atmosphere by a flue. The steam is admitted to the stack or coil, and is there condensed, heating the cold air which flows around it, which rises, and by means of flues is distributed throughout the house.

The furnace trade has been rapidly increasing in volume for a number of years. Whether or not it has reached its maximum is an open question with many of those who are engaged in it. The total number of furnaces sold each year is astonishingly large, and is only accounted for by the fact that houses of comparatively inexpensive character take furnaces at the present time, when formerly the use of this apparatus was restricted to more expensive houses. The furnace trade in the past year has experienced quite as much competition with hot water and steam as ever before, and some furnace manufacturers have, in a sense, been discouraged on this account. Others, however, point triumphantly to the fact that hot water and steam in a number of cases have been discarded after trial and furnaces put in their place. At present the furnacemen have the advantage of the steam and hot water men to this extent, that there are more furnace setters who are competent to manage their apparatus than there are those who are competent to set and manage steam and hot water. Accordingly, with steam and hot water certain difficulties are encountered, growing altogether out of the fact that those who manage the apparatus are often beginners and not entirely familiar with the goods. The furnace trade, as already indicated, has been of large volume during the year, and has been well distributed. A special feature to which attention should be directed is the advent of ready-made furnace fittings, by which we mean such articles as elbows, register boxes, offsets, and so on to the end of a long list. Double pipe has been on the market for some time past, and some of the new goods referred to are adapted to use with double pipe and some with single pipe. Formerly it was the rule for every retail furnace dealer to make up these articles as required for the different jobs undertaken. With the opportunity, however, to produce them ready made at a price lower, in all probability, than the ordinary cost of production, and of a style and quality better than has heretofore been made, a new impetus has been added to the trade. Again referring to the competition between hot-air heating and steam and hot-water circulation, it should be remarked that many prominent furnacemen who have already built up a reputation for their skill in heating and ventilating houses are now giving attention to the new forms of apparatus, and are advantageously combining the two lines of business. And not only are they combining the two lines of business broadly, but they are also using more or less of the combination apparatus which manufacturers are very ready to supply at the present time. Hence many houses are being supplied with both hot air and hot water or hot water or hot air and steam systems.

Hot-water and steam-heating apparatus was introduced in Chicago about 1844 by J. J. Walworth. In 1854 the Lake View house and the Galena Railroad Company's shops were heated by the Walworth steam and hot-water pipes. The Crane Brothers Manufacturing Company, formerly the Northwestern Manufacturing Company, dates back to 1855. Ten years later articles of incorporation were signed, and in 1872 the name was changed. In 1873 the works on Jefferson, Desplaines and Fulton streets employed over seven hundred men. Wrought-iron pipe, pipe fittings, steam elevators, (passenger and freight), hoisting engines for blast furnaces and mines, steam heaters, etc., were produced in immense quantities and numbers before the smoke of the burned city ceased to rise from the ruins. The steam-heating works of A. L. Winne & Co., established in 1864, were burned out at 114 Dearborn street, in October, 1871, but rebuilt at 57 and 59 Wells street. John Davis & Co. established their steam-heating works in 1861 and 1871–3 employed one hundred and seventy-five hands. After the fire they heated and ventilated the Tremont, Matteson, Clifton and Briggs hotels, the Marine hospital and several of the larger buildings then erected. S. I. Pope & Co.'s works were established in 1872, when twenty-five employes were enrolled. This company furnished steam heaters for the Culver, Page & Hoyne, Pullman Palace Car Company's, Inter Ocean, the Steele & Price buildings, Chicago & North-Western Railroad office, Kinzie and Market streets, and the County jail prior to the close of 1873. Since the fire, the trade in heating apparatus has developed rapidly, but has been largely in the hands of the stove and furnace men and hardware dealers. It has not been until within the past few years that lines have been sharply drawn and any large number of firms or individuals have devoted themselves exclusively to this branch. At present the heating business of the city is principally in the hands of the following concerns:

Furnaces and ranges — Barker & Jackson, 1818 Wabash avenue; Bramhall, Deane & Co., 81 and 83 Market; Frank Buchanan (Universal furnace), 315 Ogden avenue; Andrew Hamilton (Success furnace), 3913 Cottage Grove avenue; L. W. Hess & Co., 586 and 588 West Madison; John Maas, 667 West Van Buren; Isaac Rubel & Son (Lily and Smoke Burner furnace), 114 and 116 Lake.

Furnaces, hot air pipes and registers—Andrews & Johnson (Richmond's Triumph), 59 and 61 Lake; R. F. Brown & Taylor Heating Company, 2131 Wabash avenue; George H. Hess Company, Franklin southwest corner Van Buren; George D. Hoffman, 177 Randolph; Joseph F. Kernan (Palace King and Palace Queen warm air furnaces), 11 and 13 Dearborn; The National Heating & Ventilating Company, 87 Fifth avenue; B. F. Reynolds, 27, 79 Dearborn; C. B. Rickert, 190 South Clark; George L. Rood, 231 Lake; Ruttan Manufacturing Company, Otis Jones, president, 264 Wabash avenue; James D. Ryan, 119 and 121 West Washington; Albert Willey (Enterprise furnace), 107 and 109 Lake.

Steam warming and ventilating apparatus—Ahern & Gordon, 345 and 347 South Canal; Baker & Smith Company, 83 Jackson; Brown & Kavanaugh Steam & Hot Water Heating Apparatus, 48 and 50 Franklin; George B. Cobb, 23 West Lake; The John Davis Company, 75 Michigan avenue; George D. Hoffman, 177 Randolph; Theodore Jacobs & Co., 72 Market; Kroeschell & Bourgeois, 4 to 12 Michigan; F. W. Lamb & Co., 258 Michigan; National Heating & Ventilating Company, 87 Fifth avenue; John B. Olson & Co., 18 North Canal; S. I. Pope & Co., 193 Lake; L. H. Prentice Company, 203 and 205 Van Buren; B. F. Sturtevant steam hot blast for lumber drying, heating and ventilating, Foss & Noble, 31 North Canal. Hot water heating and ventilating apparatus: Ahern & Gordon, 345 and 347 South Canal; R. F. Brown & Taylor Heating Company, 2131 Wabash avenue; George B. Cobb, 23 West Lake; Detroit Heating & Lighting Company, 88 Lake; John F. Matthews, 3241 Cottage Grove avenue, branch 8, 156 Washington; National Heating & Ventilating Company, 87 Fifth avenue; National Hot Water Heater Company, 51 and 53 South Jefferson; Rice & Whitacre Manufacturing Company, 42 and 44 West Monroe; E. S. Wilber, 325 State. Steam and hot water radiators: The Eclipse Manufacturing Company formerly manufactured radiators, and the Crane Brothers Manufacturing Company has long manufactured and dealt in them extensively. The Pierce Steam Heating Company of Buffalo; the A. A. Griffing Iron Company of Jersey City, proprietors of the Bundy radiators; the Michigan Radiator & Iron Company of Detroit; and the Gurney Hot Water Heater Company of Canada all have offices in Chicago for the sale of their radiators and other apparatus. Other concerns and representatives of concerns are mentioned as follows in a directory of this interest: R. F. Brown & Taylor Heating Company, 2131 Wabash avenue; the John Davis Company, 75 Michigan; National Heating & Ventilating Company, 87 Fifth avenue. Hot air pipes and registers—Barker & Jackson, 1818 Wabash avenue; Edward Kirk, Jr., 3951 Wentworth avenue; the National Heating & Ventilating Company, 87 Fifth avenue. Hot and cold air flues and chimney tops—Thomas Connelly, 14 Fourth avenue; William Dee, 165 Adams; Haydenville Mining & Manufacturing Company, 45 and 47 Lake; Pioneer Fire Proof Construction Company, Clark corner Sixteenth; Rhoads & Ramsey Company, 148 Adams; Wight Fire Proofing Company, 266 Dearborn; N. A. Williams, 219 Washington.

Stove men and heating engineers in general are carefully watching the experiments that are being made in electrical heating. No one seems to know how and when a revolution in domestic and public heating will take place, nor that it will occur at all; but, while not probable, it is yet possible that as great a change may be wrought in this direction within the next few years as in the latter part of the seventies, when electric lighting began to compete with gas lighting, and the telephone began to demonstrate its utility in matters of intercommunication.

The laws which govern the designers of bridges in their art have remained the same since bridges were first constructed, and have always been recognized by the most eminent engineers; the progress which has been made, consisting only in the widespread recognition of the laws, partly upon the basis of mathematical science and partly through experiment. Thus, fifty or sixty years ago, the construction of an iron bridge was the task only of a man of genius, while now it is essentially a matter of study. In this industry Chicago has attained an enviable position, having several iron establishments devoted exclusively to the manufacture of iron bridges and other more purely architectural foundries which do much in this line.

Practical mechanics now classify iron bridges according to the design of their superstructure as girder, arched, tubular, suspension, cantalever and modified bridges. In 1775 Mr. Pritchard, of Shrewsbury, England, introducing the use of cast iron in the erection of bridges, originated what has come to be the most universally convenient and substantial style of construction. The use of steam and the development of railway building, with the immense amount of capital at the disposal of engineers for purposes of bridge construction, have caused a rapid evolution of all the principles and possible modes of the art. Among the forms called forth within the century by the increasing demand for facilities for communication are the suspension bridge, the wrought-iron girder and tubular bridges and the cantalever bridge. Several of the new bridges over the Thames are models of engineering skill and taste. The Menai and Britannia bridges were regarded, when erected, as perfect marvels of the art, and yet they have since been surpassed. In America, the suspension and cantalever bridges at Niagara, the Brooklyn bridge, the great Portage viaduct and the bridges at St. Louis, Cincinnati and Havre de Grace are equal to any similar works in the world. The original and best known Niagara suspension bridge was constructed in 1852–5, under the supervision of John A. Roebling, engineer. It has a span of eight hundred and twenty-one feet four inches, and cost about $400,000. At the time of its erection it was regarded for various reasons as the most daring project in the history of bridge construction. The East River bridge, finished in 1883, has a span of one thousand six hundred feet and cost nearly $5,000,000. It was planned by Mr. Roebling, and after his death, carried to completion under direction of his son, Washington A. Roebling, and others. The St. Louis and Illinois bridge, over the Mississippi river, has three spans, each formed with ribbed arches made of cast steel, a novelty in bridge building. The center span is five hundred and twenty feet, and the side spans five hundred and two feet in the clear. The arches carry a double railroad track, and above the track there is a roadway fifty-four feet wide for carriages and foot passengers. It was designed by and constructed under the supervision of the late Capt. James B. Eads, of Mississippi jetty fame, and was finished in 1874. This structure presents the finest example of a metal arch yet erected. The Cincinnati bridge is a suspension bridge of one thousand five hundred and seven feet span. The Niagara cantalever bridge is of comparatively recent erection. The Kinzua viaduct in McKean county, Penn., is one of the phenomena of modern engineering in the last decades. This immense iron structure rises from the bed of a river three hundred and one feet to the railroad grade and stretches across a ravine about two thousand nine hundred and one feet.

A scientific writer in the *Age of Steel* says in the course of a technical article that engineering science has had no more critical and complicated duties than in the building of bridges, and in no accomplishment has it been so honorably distinguished. The engineers in the remoter periods in human history had considerable skill and constructed permanent passages over streams, precipices, and arms of the sea that under the circumstances were marvels of ingenuity and prodigies of accomplishment. It was left, however, to modern times to outdo in daring and skill all historic precedents. The Brooklyn bridge is three thousand four hundred and seventy-five feet in length and keeps its head out of water for some one hundred and thirty-five feet. Its cost was little less than $15,000,000 and it took thirteen years of work to complete it. The Niagara Suspension bridge is eight hundred and twenty-one feet long, has an estimated strength of twelve thousand tons, and hangs its delicate filigree of iron two hundred and forty-five feet above the sublime disorder of the river below. It is proposed to rival all antecedent American examples in the building of a bridge between New York and the north New Jersey shore with a span of not less than two thousand eight hundred and sixty feet. The Lagong bridge built over an arm of the China sea is five miles long, with three hundred arches of stone, seventy feet high, and seventy feet broad. The Britannia bridge crosses the Menai straits, Wales, at the decent distance of one hundred and three feet above high water. It is made entirely of wrought iron, is one thousand five-hundred and eleven feet long, and cost about $3,000,000. The Clifton suspension bridge over the river Avon is two hundred and forty-five feet above the water, has a span of seven-hundred and three feet, a carriage way of twenty feet in width, and a footway of five and one-half feet. The Tower bridge over the Thames will have, when completed, a central arch which can be opened to allow ships to pass, and having, when opened, a foot bridge above, where the modern cockney can scrape his shoes one hundred and thirty-five feet above the river. It is proposed to build a bridge across the Danube—provided the Roumanian government can furnish the necessary cash—that is to be twenty miles in length, and make Dudesci and Tchernavoda the two ends of a series of spans. The St. Louis and Illinois bridge over the Mississippi, designed by James B. Eads, the distinguished engineer, is noted as being an accomplishment unprecedented in modern engineering, the east pier and abutment reaching one hundred and thirty-six feet below high-water mark. The arched spans were at that time the longest in the world, with ribbed arches made of cast steel, the center span five hundred and twenty feet and the other two not less than five hundred feet in the clear. The quantities of iron and steel used are itemized at two thousand five hundred tons of steel, five hundred tons of wrought iron, one thousand tons of rolled iron, and two hundred tons of cast-iron. The Forth bridge in Scotland, crossing the Firth of Tay, is the most stupendous of modern bridges, and among the greatest achievements of engineering science. It is the longest iron bridge in the world. It has eighty-four spans and exceeds two miles in length. Over the navigable part of the Tay it is level, the rails ninety-two feet above high-water mark, leaving eighty-eight feet for the passage of shipping above high water of spring tides. The proposition of a bridge across the English Channel, twenty-five miles in length, is not thought preposterous, and may be a fact in the next decade.

After the introduction in 1775 and the completion of the bridge at Coalbrookdale, England, two years later, cast iron was not unfrequently employed in England. The theory of the metal arch was, however, very imperfectly understood, and the great metal arch of Southwark bridge, completed in 1819, whose longest span is two hundred and forty feet, is little more than a heavy and wasteful imitation of a stone ring. By the use of timber or cast iron instead of stone, the opening which a bridge could span was, however, somewhat increased. An immense stride in this direction was made when suspension bridges were introduced. A bridge of this kind over the Tees, seventy feet in length, was built in 1741 for the use of miners. Similar bridges were also used by Mr. Finley in America, but the introduction of the modern suspension bridge practically dates from about 1820. Galashiels bridge, one hundred and twelve feet in length, was constructed in 1816; also a bridge of similar dimensions at Peebles over the Tweed. In 1819 Telford began the construction of the Menai suspension bridge, in which the span of the catenary is five hundred and seventy feet, and the dip forty-three feet. The success of this structure led to the construction of many other large suspension bridges. This form of bridge as then constructed was not, however, found generally suitable for railway traffic, and, on the introduction of railways, engineers were for many years dependent on stone, brick or cast-iron arches. The design by Robert Stephenson of the Britannia and Conway bridges, to carry the Chester & Holyhead railway across the Menai straits, led to the complete revolution in engineering practice. Mr. Stephenson's first conception was that of a tube partly carried by chains. This would have practically been a suspension bridge stiffened by a girder. Experiment demonstrated that a rectangular tube, of which the top and bottom were cellular, gave the greatest strength with the least material. The span of the Conway tube was four hundred feet; the tubular part of the Britannia bridge consisted of two spans of four hundred and sixty feet, and two of two hundred and thirty feet each in the clear. The foundation stones of these bridges were laid in 1846 and 1847, respectively. Since then many important bridges have been constructed on this principle, one of the largest being the Victoria bridge over the St. Lawrence, near Montreal, the total length of which is nine thousand one hundred and forty-four feet. It is built in twenty-four spans of from two hundred and forty-two to two hundred and forty-seven feet each, and one of three hundred and thirty feet. It was begun in 1854 and finished in 1859.

Notwithstanding their success, tubular bridges have been to a great extent superseded by lattice or trellis bridges, in which there is a great saving in the material composing the sides, effected by the open lattice work, as compared with the solid plated sides of the tube. The Boyne viaduct, and the Dublin & Belfast Junction railway, was the first great structure of this kind. A number of large bridges have been constructed on the cantalever plan, among them the Frazer river bridge and the latest Niagara river bridge, in this country, and the Frith of Forth bridge in Scotland. In America the exigencies of railroad traffic have caused the erection of many modified forms of bridges, such as the cantalever, girder, or compound arch-girder drawbridge.

There is probably no kind of structure in which more ingenuity of design and fertility of resource have been exercised than in the construction of bridges; but, notwithstanding the numerous examples that exist and the immense amount of experience that is accumulating on the subject, almost every new situation requires a special design, and in each case a bridge must be constructed specifically fitted for the service required. It is most important that the designing architect should have very full and accurate knowledge of the site of the proposed bridge, as well as upon the following several points: The length of the projected structure; the nature of the river bed; the service required; local facilities. With such knowledge, he will be able to select that among all known systems of bridges, which is best suited to the circumstances and necessities of the case.

Whatever system be adopted for a bridge, the piers and the superstructure are the two main divisions into which the design may be separated, and the nature of the site and the circumstances of each case determine their relative importance. In this connection it may at this time be of interest to consider how far and in what manner iron enters into the construction of bridge piers. The use of iron for foundations is comparatively of a recent date and was first introduced in England in 1834 by Mitchell through his invention of the screw pile. But very soon thereafter iron in other forms began, first in England and then in America and elsewhere, to replace timber to a great extent as material for the foundations of bridges. An important innovation in bridge construction was the sinking into the river bed of iron columns, cylinders or caissons; for by the use of iron in some shape or other, instead of timber piles, engineers succeeded not only in reducing the cost of foundations, but they were able to build bridges in situations where the difficulties were almost insurmountable before. A classification of the services which iron is called upon to perform in foundation construction may be attempted in the following manner: First, as the piles or columns entirely of iron with an enlarged base (screw piles.) Second, as hollow columns open at the bottom and wholly or partly filled with concrete; the superstructure resting on the iron casing, and through it on the ground below, or on a concrete base formed within the lower part of the column. Third, as hollow columns or cylinders entirely filled with concrete, brickwork or masonry, the pressure of the bridge superstructure being applied directly to the masonry, while the iron column serves to protect and stiffen the pier. Fourth, as caissons, i. e., as water-tight cases sunk into the river bed to shut out the water while the masonry is built as in a chamber, the caissons standing only slightly higher than the ordinary water level, and to be removed after the completion of the pier if possible. They differ from class 3 by not being entirely filled with masonry. Fifth, as an edged curb at the bottom of a hollow masonry pier, the curb cutting its way into the ground, assisted by the constantly increasing weight of the masonry built above, and by the excavation of the soil through the hollow center. Sixth, as coffer dams. The methods of constructing iron piers are the following according to the class of pier: Screwing freely or under pressure; sinking by the weight of the iron itself or by the extra weight placed above; sinking by the pneumatic system; sinking by the falling weight of a pile engine, or sinking by the aid of divers. The different kinds of piers above mentioned are used chiefly in the water channel, the shore supports or abutments being generally constructed of masonry or brickwork; but it sometimes happens that iron is preferable for these for the same reasons that prevail in the mid-channel piers. In such cases any of the methods that have been mentioned for the latter may be adopted for the shore piers also. In an arched bridge the last or shore piers have to be constructed as abutments, to receive finally the thrust of the arches, unless the bridge is continued inshore by stone arches or by iron girders acting as struts, through either of which the horizontal thrust may be transmitted further inshore or divided over a considerable surface in the bridge approaches. Where the approaches of a bridge are of earthwork it is often necessary to build wing walls on each side of the abutments; and these wing walls or abutments are almost invariably made of masonry and form part of the abutments. But where the shore piers or abutments are made of iron, and especially in places where masonry is expensive, the entire wing walls may be constructed of iron also. A series of iron cylinders or screw piles may be forced into the ground, and upon these can be fixed a complete shield or wall of iron plates properly stiffened and braced. It has not been thought necessary to classify. separately piers of iron which stand clear of the water on a foundation of iron or masonry It sometimes happens that on a stone base the necessary hight above the water may be conveniently obtained by an iron structure. This is especially the case in very high bridges, or in viaducts crossing deep valleys, where a stone or brick pier would be heavy and expensive. In such situations a better support can be obtained by a framework of iron strongly braced together. Iron columns or pillars have been placed on wooden piles, and the reverse plan of wooden pillars on iron piles has also been adopted.

Some consideration of the superstructures of iron bridges is now demanded. In the modern construction of girders and bridges, cast iron has to a great extent been superseded by wrought iron, because of the superiority which the latter possesses over the former against every kind of strain with the exception of the quiescent compressive strain. No inconsiderable skill is required to discriminate between the relative advantages of each material, and these depend on the circumstances in every case which comes in question. The occasional prohibition of the use of cast iron for railway bridges is based upon well-known facts, and is exemplified even by government regulations in some countries where an extremely low temperature often occurs. In Russia even short, simple girders of cast iron are not used for railway bridges, and many of the smaller parts of a bridge which in America, England or France would be of cast iron, are made of wrought iron. To make a similar restriction in regard to road bridges would be unnecessary and unwise, because in many cases it is probable that, having a certain sum of money at his disposal, an engineer might construct a stronger and better bridge out of cast iron than wrought iron. In the construction of cast-iron girders, where the upper flange is in compression and the lower one in tension, it is generally considered a matter of importance to regard the greater resistance which cast iron offers against compression than against tension, and the top flanges are accordingly made smaller than the bottom ones. The proportion recommended by different engineers varies from two to one to six to one. Assuming three to one as the proportion to be adopted, the section of the girder should be so arranged that its center of gravity lies in three-fourths of its depth. The most economical shape of a cast-iron girder for an equally distributed load is the parabola, either wholly or approximately. Girders with parallel flanges can be made economically by increasing the area of the flanges toward the middle and increasing the thickness of the web toward the end. The use of cast-iron trellis girders is frequent, but in structures exposed to moving loads, such girders should be tested, as in casting them the shrinking consequent upon cooling may produce dangerous latent strains in some parts without any visible indication of their existence. These strains are sometimes so great as to cause fracture of the affected parts before the casting has quite cooled; and it is not surprising that sometimes after castings have left the foundry in an apparently sound state they should break under the influence of a change of season. This risk can be avoided by a judicious arrangement and proportioning of the metal in the several parts and by the use of proper skill in the casting and cooling. That wrought iron is also affected by cold is proven by evidence too strong to be disputed, and it is probable that in this respect it differs from cast iron only in degree. Science has not yet authoritatively determined the exact arrangement and relation toward each other of the crystals or atoms which constitute a piece of iron, and till this is done no certain knowledge with regard to the effect of cold on iron will be arrived at; but the superior ductility and the high limit of elasticity possessed by wrought iron, as compared to cast iron, afford so large a margin of safety that it may, as applied to structural purposes, be considered practically unaffected by cold.

The quality of iron suitable for wrought-iron girders is of importance not only as affecting the strength of a girder, but also its workmanship, for iron of an inferior quality will not without damage endure the working which in many cases is necessary, and the ultimate value of any structure is determined by the quality of the material and the character of the workmanship as much as by that of the design. In welding or bending bars of T or U section, the quality of the iron is severely tried and defects soon become apparent. In the design of a structure, even when the employment of good iron is insured, bends and welds should be as much as possible avoided, with all sections of the kinds referred to.

Girders can be and have been constructed of all spans up to about five hundred feet. The depth of a girder in proportion to its length varies from about one-eighth to about one-fifteenth for single girders, and from one-tenth to one-twentieth for continuous girders, and is determined within these limits as circumstances may make the application of material convenient or economical, the quantity of iron increasing as the correct proportion is departed from. In some cases, where head-room is valuable and it it impossible to use a deep girder, the necessary strength is given by heavier sections of iron; but the weight of iron required in a girder of insufficient depth is much greater than in one of equal strength where the proper proportions are observed, and, moreover, deflection begins sooner and increases more rapidly. On the other hand, where a girder is made excessively deep, a greater weight of material is necessary in the web, or parts that connect the top and bottom girders.

Bridge girders may be classified in four different ways: First. In regard to the method of carrying the load, girders may be divided into those that carry their load on the top and those that do not. In the former case the crossbeams which sustain the floor unite the top flanges to the girders; in the latter case provision must be made to retain the top flanges in position, because they have always the whole or parts of their length in compression. Where, as in continuous girders, parts of the bottom flange are also in compression, a similar provision must be made in those cases where the platform rests on the top flange. Second. Another classification of girders may be made according to the construction of the flanges. These are either T-shaped or formed like a trough or box, the web of the first being single, that of the latter double. Third. Another and very important classification of girders is made according to the construction of the web, the so-called systems of girders being thus accordingly named plate girders, rolled beams, lattice girders, trellis girders, Warren girders, continuous girders and trussed girders. Fourth. Another classification may be made by dividing girders that have their flanges parallel from those that have not. All systems just mentioned may belong to either of these two classes, but, as in the cases of all the girders previously referred to, it has been assumed that the flanges are parallel, some girders with curved flanges which are not parallel may be noted as exceptions: a. The ordinary girder (plate, trellis, etc.) with curved top flange. b. The parabolic curve, or bow-string girder, consisting of a top flange following the curve of a parabola, the springing of which starts from and is firmly united to the end of the horizontal member. c. The fish-bellied girder, consisting of an upper and lower flange, each having the parabolic curve, but in opposite directions. d. Girders with a concave bottom flange, which have never been used except when continuous over several spans.

A girder bridge, consisting of a pair of girders, with a platform between them, is a complete structure in itself. For this reason, girder bridges are, generally speaking, the simplest as well as the safest structures, and those cases may be considered exceptional where the use of such bridges can not be justified. Arched bridges and inverted arched bridges (generally called suspension bridges) are not independent structures. When laid upon two supports, they are, unlike girder bridges, incomplete, the acting forces and the existing forces not being in equilibrium. This is restored by creating a force or body of resistance at an angle with the vertical line, and such bodies are for arched bridges, called abutments, and for suspension bridges, anchorages. Every well-informed mechanic is presumed to be familiar with the principles which are considered in deciding in any given case between the erection of a girder or an arched bridge. Iron is often used for the construction of arched bridges, and cast iron has often been employed, because it combines great firmness under a compressive strain with a comparatively low price. Wrought iron has been used in the construction of arches chiefly, it may almost be said, where æsthetical considerations have had greater weight in determining the design than more economical and practical ones. There are sometimes cases where the risks of long and hazardous transport render the use of wrought iron expedient, where, but for these incidents, cast iron would be preferable. Suspension bridges are chiefly used for spans too great to be covered by arches or girders at a reasonable cost, and sometimes, also, in cases where, though the span is not excessive, only a roadway for foot passengers is required. The liability of suspension bridges to undulating or oscillating movement, rendered the earlier ones practically unfit for railway use, and it is only since, by the aid of the modern devices of Ordish, Roebling and others, stability and rigidity have been obtained in these structures, which have been regarded as equal to the peculiar strains caused by the passage of a railway train. With regard to the details of suspension bridges, of course many of the parts are of the same character as in other bridges. Their catenary chords or chains form, however, an exceptional feature in construction, and are made in three different ways, viz., of links, of wire rope or of a laminated metal cable. Chain bridges are the most common in Europe; cable bridges are most in use in the United States. Many of the parts common to other iron bridges are used in cantalever bridges. The principle upon which these structures are planned is simply that of an inflexible beam, supported in the middle and firmly anchored at the shore end, the other end of the beam being in the middle of the bridge. The weight of the structure rests upon the buttresses, and the balance is maintained by a firm anchorage at the shore ends. This form of bridge can be successfully built over rapids and cataracts, where central piers are impracticable, as the trussed beams forming the cantalevers and the central fixed span can be put together and built outward from the towers or buttresses and kept self-supporting at every stage of the work. Combined structures, including opening bridges, have been referred to. In some instances, the cantalever bridge, where the distance is not great, swings from an abutment with a door-like motion, but where the distance is longer, a section only of the bridge is swung round to permit the passage of vessels. In most instances, however, the draw is a compound arched and girder, and swings on a central pivot. Several bridges in Chicago illustrate this principle. Girder bridges are best adapted for opening spans, because in an arched bridge, where the continuity of the roadway is destroyed, it would be necessary to make the mid-channel piers same as abutments. In suspension bridges, an opening entirely free above is impossible, but if a vessel can pass under the catenary chain, an opening might be constructed near one of the towers, or an opening in one of the towers may be made below the saddle of the chains, as is done in the suspension bridge over the Seine, at Rouen.

For countries where there is difficulty in obtaining any of the ordinary road materials, an iron platform can be designed so as to carry bridge traffic directly upon the iron. In these cases a special arrangement of the wood plates is necessary, and a proper foothold must be provided for passengers and animals. Cast-iron blocks of a suitable shape and size and with a roughened surface, have been used as a substitute for granite pavement in London. Blocks of this kind can be used only in bridges capable of sustaining a heavy dead load.

As the Chicago river is navigable for lake vessels, and it, with its branches, intersects the heart of the city, a large number of bridges have been required. No less than forty-five now span this small stream. Nearly all are swinging bridges, and many of them are operated by steam. Steel construction has been employed in the bridges most recently erected. Among these the Adams street bridge is a notable structure. It is a four-track bridge, two hundred and fifty-nine feet long on a center truss, and fifty-seven feet in width. This bridge is two feet three inches lower at the east end than at the west end, and at the same time is reversible, the turn-table track being set on a grade of one in one hundred and fifteen. Some doubts were expressed as to its feasibility when the plan was proposed, but the city engineers say that no bridge in the city works better than this one. The railroads entering the city do so in but few instances above or below the street level. Grade crossings are the rule. Engineers have long sought to remedy this state of affairs, which will probably be accomplished in time; but, meanwhile, some relief is being provided at the most dangerous crossings by the erection of viaducts. There are thirty-five of these structures in the city, the largest and finest of which is on Twelfth street, extending from the river to Wabash avenue, crossing the tracks of the Atchison, Topeka & Santa Fé Railroad Company, and costing $209,736. During the year ending December 31, 1890, contracts for four Howe truss swing-bridges and two steel viaducts were let, together with a contract for a draw or lift bridge.

The Howe truss swing bridges are of the ordinary construction of that type of truss, and have combined iron and steel turn-tables of modern design, upon which may be placed, at any future time, iron or steel superstructures, thus changing the structure from second to first class with the least possible delay. All of the above-mentioned bridges and one viaduct are very nearly completed at the present writing. Plats and estimates were prepared for twenty-three viaducts, bridges and sub-ways at different points.

The following named concerns were advertised as bridge builders in the city directory in 1871: F. E. Canda & Co.; R. A. Connolly; the American Bridge Company, L. B. Boomer, president, H. A. Rust, vice president, and J. H. Appleton, secretary and treasurer; and Wells, French & Co. In 1872, Canda & Co., the American Bridge Company, Wells, French & Co., Davis & Soulerin and Fox & Howard were listed. In 1873, the American Bridge Company, F. E. Canda, Fox & Howard, Wells, French & Co., Moritz Lassig, William Linton and Addison Smith. The list was unchanged in 1874. In 1875, the American Bridge Company, with A. B. Stone as president, H. A. Rust as vice president, and W. G. Coolidge as secretary and treasurer; F. E. Canda & Co., Fitzsimmons, Connell & Co., the Keystone Bridge Company, Moritz Lassig, and Wells, French & Co. In 1876, the American Bridge Company, the Chicago Dredging & Dock Company, the Eureka Bridge & Iron Company with D. A. Courter as president and A. T. Bates as secretary, Fitzsimmons & Connell, the Keystone Bridge Company, Moritz Lassig and Wells, French & Co. J. W. Savins' name was added in 1877. The following named bridge builders were noticed in 1878–84, and some of them were still operating at the latter date: The American Bridge Company, last mentioned in 1878; F. E. Canda, last mentioned in 1879; Chicago Dredging & Dock Company, last mentioned in 1882; Fitzsimmons & Connell, last mentioned in 1879; W. B. Howard, last mentioned in 1879; Keystone Bridge Company, last mentioned in 1878; Moritz Lassig to 1881, and afterward Lassig & Alden; J. W. Savin & Co., last mentioned in 1879; Wells, French & Co., with D. C. Wells as president, W. B. Shute as vice president and H. L. Norton as secretary and treasurer; L. B. Boomer & Co., last mentioned in 1881; Delaware Bridge Company, last mentioned in 1883; Rust & Coolidge from 1880; C. & J. Bates, 1881; Max A. Zuercher, 1882; Edward Hemberle & Co., P. E. Lane & Morse Bridge Company, beginning in 1884. The following bridge contractors and builders are listed in the last issue of the Chicago directory: Binder & Seifert, 803 Royal Insurance building; Chicago Bridge & Iron Company, 443 Rookery building; Chicago Forge & Bolt Company, 701 Rookery building, works at Fortieth street and Stewart avenue; Benjamin Hyde, 716 and 717, 167 Dearborn street; Hyde Park Bridge & Iron Company, 617, 164 Dearborn street; Kenwood Bridge Company, 614 First National bank building, works at Grand Crossing; Keystone Bridge Company, 509, 205 La Salle street; King Iron Bridge & Manufacturing Company, 1105 Rookery building; Lane Bridge & Iron Works, 29, 177 La Salle street, works at Fifty-seventh street and Stewart avenue; Lassig Bridge & Iron works, Clybourn and Wrightwood avenues; Massillon Bridge Company, 67, 189 La Salle street; New Jersey Iron & Steel Company, 405 Phenix building; S. V. Ryland, East Ravenswood Park; Shailer & Schniglau, 611 Phenix building; Union Bridge Company of New York, 716 and 717, 167 Dearborn street; Wells & French Company, 506 Phenix building; R. D. Wheaton & Co., 358 Rookery building. Some of these are Chicago concerns, and some of them concerns having their works in other cities, and their Chicago offices as above noted.

The year 1890 witnessed the establishment of a shipyard at Chicago capable of turning out vessels of the best type for lake navigation. Prior to this no iron or steel vessels had been built at Chicago. This new enterprise has been undertaken by the Chicago Shipbuilding Company, composed of experienced steel shipbuilders, who have located their works on the Calumet river, at South Chicago, about a mile above its entrance into Lake Michigan. With a river frontage of one thousand four hundred feet, and an average depth of over six hundred feet, the works cover over twenty acres, affording ample room for the shops necessary for all the various trades and occupations concerned in the building of the complete ship, with large storage ground for material besides. Up to the present only the mold loft, plate, angle and blacksmith shops, with office, storehouse, and stables, have been completed, but a joiner shop goes in immediately, and the boiler shop, forge, machine shop and foundry will follow. A basin drydock four hundred feet long will also be added as soon as sufficient demand for it arises. At the south end of the property three slips, each 400x100 feet, have been excavated to a depth of twelve feet of water, at a right angle to the river, whose sides give berths for building six ships of the largest class at one time, which will be launched sideways into the slips. Across the heads of the slips, equally convenient and accessible to all the berths and other apartments, stretches a building 540x75 feet, containing the boilers and shop engine, heating furnaces for plates and angles, blacksmith shop, plate and angle shops, small machine shop, pattern shop, and in the second story a mold loft with a clear floor 200x50 feet. Here the lines of the ships are laid down full size from the models and dimensions furnished from the drafting office, and the wooden molds made by which the steel angles and the plates are shaped. The shops below are filled with machinery of the latest and most modern types, shears, punches, planers, counter-sinkers, rolls, etc. The steel comes into the yard from the mills over a side track from the Calumet River railroad, a branch of the Pennsylvania system. It is unloaded from the cars and delivered to the shops by a traveling crane of sixty-two feet span, built by the Brown Hoisting & Conveying Machine Company, of Cleveland, Ohio. A system of overhead tracks in the shop carries it to the various tools, and leaving them, a narrow-gauge railway takes it to the building berth. Here a steam cantalever crane of one hundred and twenty feet span, built of steel by the same company, and running on trestlework thirty feet above the ground, picks it up and delivers each plate, beam or angle to its appointed place. The engines will also be put in by this crane before launching. The boilers will be hoisted in place by a steel derrick on the river front after launching. The company are now at work on their first contract—two steel steamers for the Minnesota Steamship Company, to go into the Lake Superior iron ore trade. They are to be two hundred and ninety-two feet keel, three hundred and eight feet over all, forty feet beam, and twenty-four and one-half feet deep, with triple-expansion engines and steel boilers.

In the early days of Chicago the phrase " builders' hardware" conveyed the idea of nails, common latches, staples, hasps and perhaps a padlock. The pioneers sought only for the absolute necessaries of life, and the iron articles named answered their seeking. In 1843 a few church buildings were erected in the city, wherein specimens of ornamental hardware were sparingly used. Within the following half decade regular builders' hardware stores were established, and with such establishments came new goods to be introduced to house builders. Year after year the trade grew in importance.

The dealers in builders' hardware in 1849 were Blair & Stimson, J. K. Botsford, William M. Butler, Edwin Hunt, J. Matteson, 96 Lake, Ryerson & Blakie and William Wheeler & Co. Before the close of 1888 only one of the pioneer dealers was here, for in the list of 1859 the following names appear: Barker & Illsley, 277 State; A. G. Garfield, 3941 State; Greenebaum & Sons, 240 Lake; Honoré & Hall, 51 Lake; Edwin Hunt, 84 Lake; Jewett & Butler, 18 Lake; Larrabee & North, 174 Lake; Rubel Brothers & Co., 173 Lake; A. R. & G. H. Miller, 237 State, and Tuttle, Hibbard & Co., Lake near Wabash.

Baird & Espie, 157 South Canal, and Hale & Ayer, 11 South Wells, were the nut and

The Goodspeed Pub Co. Chicag.

Oswald Lockett

bolt manufacturers in 1869. Boyington & Rust were manufacturers of bridge bolts and castings; M. Loeb, Murray & Gorham, Tyler & Bliss, Oscar Mitchell and Morris, Hoage & Homer, dealers in builders' hardware, and the Union Machine works and foundry, manufacturers of screws and bolts. E. S. Barrows & Co., S. B. Haggard & Co., Hodge & Homer, E. H. Hunt, Larrabee & North, F. B. Orr, Seavey & Co., J. L. Wayne & Son, and Wollensack & Co. were the leading dealers in builders' hardware in 1872, and in 1879 the dealers were Hodge & Homer, Edwin Hunt's Sons, Larrabee & North, Payson & Co., J. F. Wollensack, E. Peterson & Co. and Orr & Lockett.

A history of the rapid progress in the line of builders' hardware and the few prominent firms that have been most closely allied with it can not fail to be interesting, both to those who can look back and remember what Chicago was before the fire of 1871, and to those who only know Chicago as it is. Recollections of Oswald Lockett begin with the year 1863. At that time, he states, "there were but two houses in this line that made any pretension of carrying anything like a fair assortment of builders' hardware and mechanics' tools. These two houses were Larrabee & North, then doing business at 174 Lake street, and the still older house of Edwin Hunt at 84 Lake street, and a person in search of anything a little out of the regular line would be referred to those two houses with the remark, 'if you can not find them there, there will be no use in your looking any farther.' Plain substantial hardware, black japanned cast-iron hinges and white porcelain knobs with plated or porcelain roses and escutcheons, were about as fancy as the average person cared to indulge in, even for a reasonably good house. Occasionally some one would be found who wanted something better or more showy, and to such persons electro-plated silver or hand-plated silver hardware was furnished. About the year 1868, Edwin Hunt fitted up a new office and used some ornamental bronze goods made by Rankins, of Philadelphia. This, however, was nothing but white metal or some cheap soft composition artificially colored dark, and without merit. Next came P. & F. Corbin, with a small line of what we now know to have been very ordinary bronze metal hardware, though at that time it created quite a sensation. Rapidly following this came a line of compression bronze goods made by the Russell & Erwin Manufacturing Company, which, together with a very pretty lava knob and escutcheon to match, constituted the first complete line of real artistic hardware that had been put on the market. This was in the years 1869 and 1870, and they continued to hold the lead until after the great fire of 1871.

"In the latter part of 1872 Hopkins & Dickinson of Newark, N. J., brought out a comparatively full line of ornamental bronze metal hardware of more or less meritorious designs, claiming that the bronze metal mixture used in them was richer and purer than that used by any other manufacturer. Closely following them came the Branford Lock works with an entire line of very pretty designs and various finishes. Then came the Norwalk Lock Company, Mallory, Wheeler & Co. and others, each with his own particular line of special merit. About this time, or in the spring of 1887, the Yale & Towne Manufacturing Company, of Stamford, concluded to enter the field as competitors for the trade in fine builders' hardware. Then began, in earnest, the fight for supremacy, and for some time each sought to produce something a little better than the others, and as a result, there was a rapid advancement in the art. The manufacturer showing goods invariably called the attention of the dealer to the superior merits of the particular articles he was presenting, relying on the quality and not on the price to sell the goods. But this condition of trade could not continue undisturbed, and the increased demand for bronze metal goods brought into life a host of small manufacturers, who would select some article already produced by one of the larger manufacturers and offer to duplicate it for much less money, which he could easily do, as he had no cost for designing or pattern work, but the result was never satisfactory, the dealer did not get the same article for less money, what he really got was a very poor imitation, for which he paid a good round price. But the change had come, the inroads made by these pirates caused many of the older manufacturers to reduce the quality of their goods, and instead of trying to sell goods on their superior merits, as heretofore, they offered them as something a little less in price.

"Imitation was the order of the day, and the market was soon flooded with numberless lines of cheap bronze and imitation bronze, which, though cheap enough at the price charged for it and a great blessing to parties of limited means, putting up inexpensive buildings, was nevertheless, a great drawback to the art, and, in the hands of unscrupulous dealers, very injurious to legitimate trade, as many of the imitations were so close, that while perfectly fresh, none but an expert could detect the fraud. Happily, there are some manufacturers who have had the courage to continue making honest goods and who have made rapid strides forward, until to-day, in spite of the flood of worthless stuff offered on the market, America can justly claim to produce the finest builders' hardware in the world, and Chicago claims to have been the foremost city in its use and to have originated many of the best designs—its handsome residences, magnificent office buildings and its world-renowned Auditorium are furnished with hardware which can not fail to attract attention for its richness and perfect fitness. For many of these buildings, the hardware was specially designed and manufactured—that on the Phenix insurance building was designed by the late John W. Root and furnished by Orr & Lockett, this was the first large building for which a special, private, design was furnished throughout, coupled with an agreement that it should not be duplicated. The Rookery lays claim to being the first office building in the world on which Bower-Barffed iron hardware was used. This was also designed by the late John W. Root and furnished by Orr & Lockett. Many of the other buildings were furnished with special hardware, but these two mark distinct steps in the art and are worthy of special attention.

"At the time of the fire there were in existence besides the two houses already mentioned, those of Hodge & Homer, then doing business on the west side, and Tyler & Bliss, who were doing business in a small store under the City hotel, at the southeast corner of State and Lake streets. The fire destroyed all these places except that of Hodge & Homer. Tyler & Bliss went out of business, but the two old houses of Larrabee & North and Edwin Hunt made a new start, though so seriously crippled by their fire losses that they never regained their former positions. The rebuilding of the city after the great fire brought to the front many new people and firms, among them were Turpin & Cottrell and Orr & Lockett. The former struggled along for a year or two and then gave up the fight, the latter firm composed of Frank B. Orr, who came here from Mansfield, Ohio, where he had earned an enviable position for himself in the hardware trade, and Oswald Lockett, who for many years had been associated with the old house of Edwin Hunt, began business in May, 1872, at 129 West Randolph street, where they remained for one year, when they took a five years' lease of 170 Clark street, at the end of which time, they moved into their present quarters 184 and 186 Clark street and 138 Monroe street. The almost phenomenal growth of their business has compelled them to resort to all sorts of expedients in utilizing every available inch of room. Besides the premises mentioned, including the five floors of the Monroe street store, they have an enormous warehouse packed to overflowing with surplus stock, and will soon be compelled to seek greatly enlarged quarters, as it is impossible for them to obtain sufficient room in their present location. There are, of course, a large number of small hardware houses and manufacturers' agents to share the immense business of this city and its surroudings, but the fact remains that this particular firm has been foremost in the introduction of high class hardware and has done more to advance its use in the large public buildings and beautiful private residences, that adorn this city, and has actually furnished the great proportion of this work."

The first mention of a locksmith in Chicago is made in the directory of 1849, when Michael Arnold had a shop at 164 Monroe street. T. W. Newell opened a lock factory in 1857. In 1873 he employed eight men at 93 Washington street and produced goods valued at $15,000. In 1860 J. F. Wollensack established his lock factory, and thirteen years after he is found at 228 La Salle street, employing fourteen men and producing goods valued at $28,000 annually. Merritt & Fowler dealt in Sargent's locks at 94 Washington street, while Terwilliger & Co., and Tyler & Bliss dealt in Yale and Sargent locks. The locksmiths and bell-hangers of 1869 were Heuel & Collins and John F. Wollensack. In 1871 the Maurice Whittingham Lock Company, established works at 84 West Madison street, and in 1873 with ten men produced $40,000 worth of goods. The bolt manufacturers of 1872 were Clarke, Abbott & Co.; Cregier & Clarke's Continental Bolt Works, Huron and Market; Locke & Co., the American Bridge Company, and the Union Screw & Bolt Company.

The bell hangers of the city in 1859, when the use of house bells came into fashion in the West were: Day, Newell & Miner, 38 Franklin; David A. Foot, 106 Randolph; George Hauslein, 137 North Clark; John Homer, 129 Dearborn; Julius Winter, 166 West Randolph. In 1872 D. A. Foot, Heuel & Collins and J. F. Wollensack were the leading bell hangers.

The following named lock manufacturers were doing business in Chicago in 1872: Durant & Winship, James W. Newell, Sargent & Greenleaf, Maurice Whittingham, and J. F. Wollensack & Co. The list was much the same in 1873, but the Yale Lock Company had then established an agency in Chicago. In 1874 the firm name of Sargent & Greenleaf had been changed to Sargent, Greenleaf & Brooks, and D. S. Covert was announced as the local agent of the Yale Lock Company. O. H. Gilbert advertised himself as a lock manufacturer in 1875, and many of those above mentioned were still in business. There was no considerable increase in the number of lock manufacturers during the next three years. During the six years 1878–84, the following lockmaking concerns were located or represented here, and some of them will be recognized as prominent among those of the present day. The Barlow Lock Company, 1878–81; the Gilbert Lock Company, Sargent, Greenleaf & Brooks, Charles Whittingham, J. F. Wollensack, J. W. Newell, William A. Barlow, 1880–82; William Donovan, 1880–82; Niles & Son, a comparatively short time beginning in 1880; the Yale Lock Company, the Chicago Lock Company, a strong concern, and Gray Iron Company, all beginning about 1882 and none of them manufacturing long; William C. Rogers, 1882–84; the Alarm Lock works, M. McRoberts, manager, 1883; William Gerwein, Nashua Lock Company, 1883–84; Yale & Towne Manufacturing Company, 1883–4; E. C. Turner, 1883; Novelty Lock Company, Chicago Hardware Manufacturing Company and Chicago Automatic Lock & Brass Company, 1884. The following are listed as lock manufacturers in the Chicago directory for 1890: Burton, Harris & Co., 42 South Clinton street; the Corbin Cabinet Lock Company, 63 Washington street; William Gerwein, 7 and 9 South Jefferson street; the Hicks Lock Company, 65 Washington street; the Metropolitan Lock Company, 36 West Washington street; J. W. Newell & Sons, 607, 59 Dearborn street; Sargent, Greenleaf & Brooks, 43 Franklin street; Yale & Towne Manufacturing Company, 152 to 154 Wabash avenue.

The Chicago Metal Manufacturers' association is one of those powerful organizations which the aggressiveness of labor suggested to employers. The officials elected in 1887 were R. T. Crane, president; J. McGregor Adams, John T. Raffen, W. J. Chalmers, vice presidents; Robert Vierling, secretary and treasurer; R. T. Crane, J. McGregor Adams, D. J. Chalmers, Frank L. Pearce, M. C. Bullock, Louis Wolff, George Mason, John T. Raffen, A. Plamondon, executive committee; Edward Worcester, William C. Campbell, N. D. Fraser, W. D. Ewart, J. S. Lane, John Clifford, A. Mason, William Currer and Charles Plamondon, alternates. They are practically the working members of the association to-day.

The project of establishing a mining and metal exchange here was broached in August, 1890, and on the 14th of that month a meeting toward this end was held at the Grand Pacific hotel. The object of the movement is to make Chicago a center for metals, just as it is for grain and lumber. F. A. Bishop was chosen chairman and E. R. Neely secretary. The objects of the meeting were fully explained, and then it was unanimously agreed to form an exchange. A committee, comprising E. R. Neely, W. P. Williams and A. H. Kingman, was appointed to draw articles of incorporation. Another committee, consisting of F. A. Bishop, W. H. Underwood and W. P. Williams, was appointed to secure memberships and explain the affair and its objects. The manufacturers and dealers in metals in Chicago manifested an interest in the organization of such an exchange, and as a result the membership included all of these men. It was the intention to create not only a market for metals, but also one for the stock of manufacturing and smelting concerns. It was decided to offer the first hundred memberships at $100 each.

CHAPTER XI.

PAINTING AND DECORATING.

KINDRED changes in popular taste have led to changes in painting and decorating as well as in architecture and construction. So fluctuating have they been that the house of 1881 is as much out of harmony with that of 1891, as Worth's dresses of the latter period oppose those of the first. Painting, frescoing, and papering have correspondingly changed, and an effort to fashion decoration after some definite style is manifested on all sides. The forms of the French or Italian Renaissance have taken full possession of decorators and, day by day, beneficent results are making themselves felt and visible. Modern metal work, furniture drapery, heating and lighting apparatus, woodwork, wall and ceiling ornaments, parquetry and mosaics all point to the phenomenal change to the growth of taste and the sacrifices made toward surrounding the office-building, apartment house and dwelling with classic ornamentation, which will oppose decennial change and overwhelm the errors of the Queen Anne and Eastlake reign in this city.

To gild refined gold is excess, to give it ornamental form is art. So with the lily and the rainbow. They are perfect without a touch of art; but art may reproduce their colors and form, so as to keep them before the eye in all seasons, as a Michael Angelo or a Raphael pictured a Madonna and conveyed the idea to canvas to dwell among mortals.

Under this chapter title may be grouped all trades having connection with the building arts, which call in æsthetics to aid the eye and the hand in giving color and ornament to the interior of a building.

House painting is the oldest in all lands. The barbarian is found to-day giving color to the interior of his wigwam, as he was when history first looked in upon him. Later, when eastern magnificence caught his eye and charmed him, Egypt rose above her tutors and gave mural paintings of immense area and significance. As described by every writer on the subject, their painting was, in fact, pictorial writings intended to convey to future generations, beliefs and events. Warlike scenes, such as chariots and horsemen, are represented in processional form; this processional form shows itself in depicting religious rites. There is no completeness to the figures, though often there is presented a center of action. No physical emotion is ever displayed in the personages. Whether the Egyptians used oil as a vehicle for their pigments is unknown; they certainly might have obtained oil by distillation of bitumen, of which they had abundance, or by boiling the multitudinous Nile crocodiles. However this may be, those ancient pigments show in the traces left wonderful tenacity of hold, and some of them even retain a certain brightness and depth of color. The ancient Egyptian painter probably found his happiest and most remunerative employment in painting furniture in the houses of the rich. This furniture was made in all fanciful forms, couches and beds representing lions and other wild beasts, in solid bulks and not in mere attached ornaments; the individual who reclined on them adapting himself to the curve of the back. Serpents and other reptiles supplied supports for chairs. All this was a reaction against the stiff formalism enforced by priests in the decoration of temples. The furniture was all the more valued for vivid and strongly contrasting colors. Pigments blue, red, yellow and black were those evidently in most abundance in the valley of the Nile.

The Egyptians of three thousand years ago diluted their colors with glue and water, so that their practice was tempera or distemper; but wax has been discovered in the paint of small pieces of furniture. The blues contained no cobalt, but appear to be oxides of copper, and this pigment, as laid three thousand years ago, continues in great beauty on the upper temples of the Nile. The reds are red oxides of iron mixed with lime. The yellows, which are sometimes of a pure bright sulphur color, appear to be vegetable colors; the greens are a mixture of this yellow with copper blue. The bluish green is a faded blue. The blacks might be from wine, burnt pitch, lees or soot. The pigments are thus formed on good chemical bases. In the tombs of Thebes have been found slabs, mullers, palettes and reed pens. In painting a wall the surface was first smoothed, then covered with a colored wash. Lines were then ruled over it to secure the right proportions of the figures to be drawn, which was done with red lines, as shown by a papyrus drawing. These lines were incised with a chisel, and then the colors were laid on. As showing that the painter was more important than the sculptor, he is found, after departing from his lines, painting within and without on the smooth surface, the abandoned interstices being filled up with plaster, the falling out of which discloses them.

Painting in Greece commenced with more conventional forms, as seen in the vases of what is known as the Archaic period, not a few of these forms being derived from the Egyptians, and then passed through a period of transition to the more minute individualization of natural, human and mythological forms to the great Panhellenic period, when ideal representations prevailed. The records of the art of this period are on fictile vases. The great gods are represented by the artists, and to the lesser divinities is given a severe but noble aspect. After this great age living individual characters prominent in politics appear in the painters' productions, and in religious art the great gods no longer form the chief subject represented, but minor deities and mythological personifications of lower nature such as fauns, satyrs, naiads. In the gods the human attributes are emphasized; Aphrodite and Apollo are made younger, the more sensuous and more divine side of their beauty is made prominent, and as the third century merges over into the fourth, sensuousness in colorings and forms merges into sensualities. In all these phases of his art the painter was the expositor of the changes coming over the minds and feelings of the people. His productions were to be seen as leading decorative attractions on the inner walls of temples, the marble statues of which were colored by his hand. The facades, too, of these temples and other public buildings were enriched with color, it being held that all forms could be beautified and enriched by its means. Under the cloudless Greek sky, the atmosphere bathed in light, the cold marble was given a warm glow. Even the volutes and dentils of the Ionic order were touched up with the brush of the artist, and to the lighter and more ornamental Corinthian order was added increased richness. The tiers of leaves forming the capitals of the columns were given a look of natural hues, and concave and rounded moldings were not only colored, but shaded. Niches in the walls, though of the finest marble, were colored to set off to greater advantage the statues placed within them. With the dissolution of national greatness, mythological subjects ceased to have special attraction, and the painters trained in schools of Pergamas and Rhodes, depicted dramatical and sensational, the comic, the grotesque and the brutal.

Throughout the period of transition Greek painters aimed at excellence in portraying human figures on the verge of action, for the athletic games encouraged physical development, gave the people a passion for beauty in form, and so influenced the spirit of the art. The attitudes of the Greek figures aré restful, however great the life and the suggestions of active vitality may be; there are no sensational momentary poses, or mere display of the technical skill which distinguished later productions. As time went on a greater realism was displayed, and muscular development was exaggerated into ugliness. The best designs of Greek painters have been reproduced in a multitude of engravings, and their examination will repay the study of our painters. There are a few remains of ancient mural painting. With the exception of landscape, the standard of Greek painting was extremely high. The fundamental principle of pictorial art which Greek painters established, is expressed by the word composition. What constitutes a pictorial view, a work of art is the artistic organization which the artist gives to the elements of composition: First, linear composition, in which unity is given by means of an outline to the whole drawing, which meets in some central point; second, perspective composition, in which the representation of distance from the point of vision enables the artist to indicate the foreground and background, with regard to the center of interest; and in the third place, composition is given to a picture by light and shade, the gradation of values of colors and of tone, which give the same artistic unity within variety.

A sketch of the ruined walls of Pompeii conveys an idea of the Græco-Roman notion of decoration. Though not a Greek colony, it came under the influence of the Ionian colonies rather than of the conservative institutions of Rome. In proof of which it is the Greek alphabet one finds on the walls scratched by school children who, even in those days, chose this method of setting forth new ideas on questionable subjects. The pictures in these Roman ruins are scenes in the daily life of Pompcii and subjects drawn from Greek mythology. Where the gods were sensual it is no wonder the pictures are immoral. They are extremely realistic—flogging a boy at school, baker's shop, weavers at work, taverns and other local scenes. It is all a reflection of Greek art in its glorious fading, the composition superior to the execution and the old ideals rendered more human. The idea of house decoration dates from the time of Alexander; before that the Athenians observed an austere simplicity and reserved the splendor of art for the temples and public buildings. In Pompeii there is hardly a house which has not some representation of Bacchus, a personage introduced with the culture of the vine. There are single figures like those of Helen, in which the painter appears to have spent all his science of drawing and execution and his power of expression—Cupids playing with the club of Hercules, or the armor of Mars, or weeping over the slain Adonis, or the infidelity of Theseus. The representation of cupid in a cage held up by a wing for sale was what inspired Goethe's poem and the bas-relief of Thorwaldsen. A large part of the house decorations are of aerial figures, and they reach into the best period of Grecian art, and, being handed down by generations, show the artists at their best. The dancing girl is universal, and in the the theaters of Paris looks just as she is represented in a Greek freize, bands of them carrying young men and women. A furious bacchante kneeling on a centaur, with hands tied behind his back, gives a good idea of the unbridled lust of the young Pompeian, as a lovely girl seated on a female centaur is an image of innocence. There is an occasional picture showing the connecting link between the Egyptian and Grecian cults, each as a child with his forefinger on his mouth like the infant Christ in the old Italian pictures, pointing to himself as the truth, and pigmies climbing palm trees or riding on the backs of crocodiles. What appear to have been garden walls are adorned with landscapes, and animals take the place of figures. Old myths and sacred trees are represented; sea coasts, naval engagements, and villas, but it is always the calm sea, and never the sea in its stormier moods. There is an abundance of still life, a dish of figs, and transparent water bottles.

The works will not bear the test of the rule and compass. They are not masterpieces; they are merely decorations like exquisite sign boards. If the perspective is bad, so much the worse for the perspective, and if the linear perspcetive is worse than the aerial, it is a question of feeling and not of rule. In the more complicated perspective of side views the work is as bad as that of the Chinese. There are no fogs in France except in front of Havre, Calais and Cherbourg. In the landscapes the mists of the English and Dutch schools are entirely wanting, because the damp of their somber climate was unknown to the southern mind. The pictures are simple and never crowded, which was due to the artist's strong love of form. The skies and horizons are high to bring out the topography, and nature is used subordinately as a background for gods, nymphs and naiads. The paintings are fading badly. The heat has turned the yellow ocher red, the cinnabar or vermilion has become black by exposure to the air, and the backgrounds are fading away. The sea sand used in preparation of the stucco has developed saltpeter and lost its firmness. The paintings are ruins as much as the buildings they adorn.

The paintings easily fall into five periods. In the earliest there is no figure painting; they are merely imitations in painted stucco of colored marble panels, the colors being few and decided—violet, yellow, a blue-green, brick-red, white and black. This period corresponds with the peace between the invasion of Hannibal and the Social wars. The second style is not entirely ornamental, but consists of architectural designs where light, shade and perspective are used to give an idea of spaciousness. The marble is imitated in painting instead of stucco, and painted masks are used for ornaments. The architectural designs divide the wall into compartments into which the center piece is set. Vermilion is used for the first time, and light and shade employed with good effect. The period dates from Sulla's colonization. The third style is entirely decorative, and the same means are used to ornament a wall. The imitation of marble is abandoned, and myths, landscapes and single Egyptian figures are represented. The beauty is simple and refined, and the taste is highly developed. It extends early into the first century. The fourth style is highly ornamental, the coloring vivid and varied, and the design more intricate. The favorite colors are yellow and blue and red, and while the earlier treatment was idealistic the latter is more real; while the third was heroic and pathetic the fourth is more sensuous, and the figures, instead of being drawn with careful draperies, are nude. The color is more brilliant and the face more expressive. The fine painting from Herculaneum, "Telephus suckled by the Hind," belongs to this period. The fifth style is marked by a fanciful exuberance. There is entire freedom from rules, but the work is within the bounds of good taste, and stucco work is a feature. Reeds take the place of columns, and temples are supported on candelabra. Figures issue from flowers. Human heads are found on brutes, and it is still the ideal of wall decorations. In his work on mural painting, Crowinshield remarks that the transition from the easel to the wall in painting was an easy matter for the Renaissance artists. All their works were in grand style, whether on paper, panel, canvas or plaster, different technical conditions exacted variations of technique but not conception. A characteristic of Giotto's, Raphael's and Michael Angelo's mural work, and in fact that of all great frescoers is that it looks well both near and far off. Every painter knows how difficult it is to effect this result and make work hold at a distance. The outlines without being hard, show the contour of the figures. In later days the fresco-work grew coarser, more summary, more effective and more scenic. Modern decorators frequently paint too carelessly in the expectation that distance will lessen asperities, but choice of handling should be guided rather by the degree of light than by the degree of distance. A blaze of light will reveal undue roughness or coarseness of execution at a very considerable distance. The excellence of much of the wall painting of the Renaissance is due to the fact that such painting was practiced in the atelier, under the eye of the master, and subsequent collaborations gave the necessary confidence. Thus the pupil thoroughly solved the material mysteries of the wall. Mural paintings presuppose a certain decorative proficiency and knowledge of architectural feeling for structural harmony, and their architecture with a pictorial feeling for ornament. Their field was limited by definite bounds, and they could easily cover it. The Renaissance painters reveled in suggestions of antiquity, and evolved countless combinations of columns, frieze, pilaster, arch arabesque and garland from their inexhaustible fecundity.

It was in the French Renaissance that the beautifying of walls and ceilings in the manner that is now understood was first carried out to any considerable extent. Previously the walls were done in monochrome, ordinarily a stain on the plaster, the chief mural paintings being suspended tapestries, framed paintings, to be removed at any time, the painting and ornamentation of walls being lost sight of for several centuries. In the wainscoted rooms the panels were used for pictorial embellishment by artists famous for their canvas pictures. The French painters had to encounter from the first a liking on the part of the people, or, more properly, the aristocracy, for the covering of walls with the figured silks of Lyons, but this fancy soon declined to the favoring advantage of the painter. The French have paid very great attention to the character of the wall and ceiling embellishment, in the fineness and susceptibility of their colors, so as to have a soft, diaphanous look. In France the painter was sometimes his own plasterer. Plaster here has not been sufficiently studied in relation to the requirements, and hence the reason, as well as for the exercise of a high instructive taste, that French painters have been credited with a high standard as mural and ceiling painters and decorators. In the French Renaissance they were aided by the Italian painters, whose particularity in attending to the plaster or cement groundwork afforded them hints which they have never overlooked. The stucco commonly used by French painters was composed of plaster of Paris and a solution of gelatine, a composition which admitted of a high polish, and which, under the manipulation of the painter's brush, was made to resemble different kinds of scagliola or marbles. Another French wall composition was made of plaster of Paris, glue water and a solution of borax. With plaster and cement they decorated in relief, making borders and panels on flat surfaces. Pilasters, too, abounded in their interiors. They filled large spaces with a number of separate designs within the borders, and brought the coloring of these borders to add to the general effect. Then, again, mirrors and window curtains formed prominent ornamental features of these interiors, the aim apparently being to impart a stately rather than a lightsome effect. A profusion of gold was used, sometimes as grounds, and in relief work. The unlimited use of bronze powders should be decried, and the practical use of gold leaf recommended instead for interior decoration as a rich addition to its effectiveness. The French painters did much to advance the trade and raise it to a standard of high excellence in Europe, and in America their influence was felt even in colonial times.

After the Norman invasion of England the house painter became an institution. Before this he was comparatively unknown; after this he was used solely by the Norman nobles and their wealthy merchants and leading retainers. The new institution was either French or Italian. The British and Anglo-Saxon races, completely reduced to servitude, could not produce one man capable of wielding the brush to suit the artful ideas of their conquerors, and hence expensive workmen had to be called from abroad. In a retrospect of the painting trade in the United States, it is well to look back to the western islands, where its early workmen were mainly recruited. When the first English-speaking people set out to settle in America, decorative art in Greater Britain was dead. Much of what the foreign painters and decorators accomplished in the great cathedrals of the twelfth, thirteenth, fourteenth and fifteenth centuries, was destroyed or forgotten during the latter half of the sixteenth century; so that the Puritan immigrants brought with them only the ideas of utilitarians; shorn, in toto, of art, if not bitterly opposed to art. Simple living was their rule and personal liberty their motto. Two noble models they were, but so rigid was their observance of them that art was undreamed of and tolerance scarcely understood. The establishment of other colonies along the Atlantic coast, the appointment of colonial officials by the British, and the slow but sure growth of wealth, tended to disturb the primitive condition of those self-satisfied people, and to permit the introduction of ornamentation into the homes of their chief men, where wood was painted to imitate marble, as in mantels, and plaster was painted to imitate oak, as in ceilings.

White was the emblem of light, religious purity, innocence, faith, joy and life. In the judge it indicated integrity; in the sick, humility; in the woman, chastity. Red, the ruby, signified fire, divine love, heat of the creative power and royalty. White and red roses express love and wisdom. The red color of the blood has its origin in the action of the heart, which corresponds to or symbolizes love. In an evil sense, red corresponded to the infernal love of evil, hatred, etc. Blue, or the sapphire, expressed heaven, the firmament, truth from a celestial origin, constancy and fidelity. Yellow or gold was the symbol of the sun, of the goodness of God, of marriage and faithfulness. In a bad sense yellow signified inconstancy, jealousy and deceit. Green, the emerald, was the color of the spring, of hope, particularly of the hope of immortality, and of victory, as the color of the laurel and palm. Violet, the amethyst, signified love and truth or passion and suffering. Purple and scarlet signified things good and true from a celestial origin. Black corresponded to despair, darkness, earthliness, mourning, negation, wickedness and death.

The ancient artists observed this law of coloring, and in this observance the tomb and the temple received appropriate colors.

In the United States mural painting was introduced at St. Augustine, Fla.; Mobile, Ala.; New Orleans, La.; Biloxi and Natchez, Miss., by the Spanish and French before the close of the first decade of the eighteenth century; while in Canada, the French introduced it at Quebec and Montreal; for the colonists of Southern Europe brought with them their artists and scholars as well as their laborers, and aimed to give to the New World copies of the works which the bright skies of Italy, Spain and France suggest.

Joseph Scott, in his paper entitled "A retrospect of the painting trade," says, after dealing with the house painters in Germany: "The German painter in the time under review had delighted in strong, vivid colors within and without. Northern Europe, it is to be remembered, has not the bright skies of Italy and France. Europe was never wanting in painters who could fill the panels with storied scenes of domestic life, or Scriptural or comic incidents. But pictorial paintings in Germany were not confined to wooden panels as in France and Italy. The old palaces in Berlin and its neighborhood teem with tableaux illustrative of its national history, chiefly figurative, and the same taste for the pictorial and decorative on walls and ceilings spread among the people all through Germany. It was the same in Austria. All the public and many of the private buildings in Vienna were adorned in this magnificent manner. The history of Austria may be said to be painted in fresco, as round the dome of the Capitol in Washington an allegorical history of the United States has been painted in fresco which was designed and commenced by that famous Italian artist, Brumidi. German painters were very expert draughtsmen, and attained to a high degree of decorative art. I now pass along my marked path and come to England. In early times the house painters' art was only called for in the dwellings of the wealthy, and in many cases these were done by French or Italian painters, particularly in the higher requirements of the art. In England the painter can not be said to have had accorded him, in those early times, the appreciation which was accorded to the painter in France and Italy. Decorative art in England was slowly developed. The earlier work of English painters, still extant, met with in the gilded shrines of the grand cathedrals so numerous there, paintings on altars, on the panels reredos, on the oaken ceilings of churches and dwellings. Soon, however, the painters' art began to flourish, and in the fifteenth and sixteenth centuries the embellishments on the rich carved ceilings of the great aristocratic mansions were of the richest style of art, and fairly glowed in color and gold the all-conceived idea of design.

"There is one thing to be mentioned here. The English painter was not as expert a draughtsman as his co-laborer in France, Italy and Germany. For long series of years, a high polish was considered the acme of mural adornment. Wooden mantels were painted to imitate polished white marble; these, too, were richly carved with urns and wreaths. We must remember that at this early period straw took the place of carpets, tables were mere boards, and diners sat on stools or roughly hewn benches. We can discern a decided improvement among the English in house painting with the entrance of the Huguenots, who had been expelled from France by the revocation of the edict of Nantes (1598). They brought with them many skilled artists, painters, molders, cabinetmakers and weavers, all rich contributors to interior decoration. Relief ornament for structural surfaces took a new bound. Instead of formal lines and curves in plaster relief, tendrils, stalks, flowers and berries made their appearance on walls and ceilings, touched off by natural or fanciful hues, forming friezes as well as borders to ceilings. Later on came wall paper to dispute the painter's domain, wall paper, with outrageous foliage, roses as large as cabbages. The gaudy colors first introduced in wall paper were set aside for somber tints, but it is only within the last fifty years that graceful and attractive patterns have been generally produced. Wall paper, for a long period, was only used to a limited extent. Wainscoting was the favorite mode of adorning the houses of the wealthy. The wainscoting gave the house painter an opportunity for the display of his art. The panels in the wainscoting in the halls were illuminated with portrayals of the chase; those of the reception rooms with scenes taken from poets and romance writers, those of the library with events of classic times. These paintings, thousands of which remain, attest the versatility of the wielders of the brush in those far-away periods. Even prayers in old English text, as well as love scenes, were painted on the panels of a lady's boudoir. Soon, however, these ornamental paintings spread, and the middle class manifested a desire for some decoration. These were generally in conventionalized ornament of the natural types. Taste improved, the house painter with representatives of the decorative arts leading the way. A method of encaustic painting, widely adopted in England until recent years, was to dissolve gum arabic in water and add gum mastic, stirring the mixture on a slow fire, and when the gums were dissolved, adding wax and bringing the whole to a creamy consistency. The pigments were mixed with this composition. Now, however, we have a readier method, by dissolving beeswax in the last coat of paints, which we call flatting. Within the last fifty years distemper painting has been much used inside the houses, particularly on ceilings. In those periods of a past date there was not the hurry and scurry of the present time. Pure linseed oil could then be relied on, as also pure stainers. Plenty of time was given to admit of thorough drying. There was no necessity, in order to complete work within a given time, to use an excess of driers, and thus granulate the oil, to the detriment of the work, occasioning those disfiguring cracks often seen in the work painted.

"We do not find in our researches the complaints of to-day in the treacherous conduct of varnishes and japans. In those past times, the painter had a great deal to do with their manufacture. The varnishes of to-day do not get sufficient time to mature. If they are to do their work properly, a period must be allowed to elapse before using to effect a proper assimilation of the essential parts, for the gases to generate and escape and for all foreign matter to be thoroughly eliminated. The varnishes used in those times were much the same as now in respect to ingredients. A size used by painters was prepared by boiling in water the skins of animals and the fins of fishes, differing only from our solution of glue in containing fewer foreign ingredients."

Up to the Revolution, house painting was confined indeed. After the Revolution people were interested more in obtaining food, clothes and shelter than in art, but yet the spirit of liberty was abroad and, so soon as the impoverishing effects of the war were overmastered by the enriching effects of this spirit of liberty, men looked round for paint and painter to aid in the improvement of their homes.

The great Western country was soon acquired, settlement after settlement grew up, so to speak, out of the western prairies, frame houses took the places of log cabins and the demand for paint was created. White-lead and oil answered the demand, and from 1833 to 1850 the people were quite content with white frames houses. Some time in the fifties white and gold were favorite colors, and the wealthy citizens were pleased to see the interior doors, sash, bases and facings all in white enameled paint, relieved by a touch of gold. Peter M. Almini and M. J. Sullivan, pioneers of this style, died late in 1890, doubting to the last whether the thousand and one colors now in use could repay the jealous goddess of art for the loss of the white and gold paint, and the standard white plaster walls with their golden lines of forty years ago.

From such humble beginnings the painting of houses in the North Atlantic states sprung, and the system spreading out gradually, it was not, in 1775, uncommon to see the houses of the higher officials and wealthy subjects of the Crown painted within and without. Mural decorative painting is confessedly backward, and is too much connected with mechanical house painting. It needs to be advanced. "The decorative artist," says Purdie, writing of old times, "was able to paint fruit, flowers, landscapes, the human figure, Raffalesque ornaments, ornaments and figures en griassaile, and to combine the whole in an artistic manner." Mural painting is given over to arabesque, diaper or figures of a simple architectural or decorative character, but in connection with raised ornament, its scope might be much enlarged, ornamental paneling providing the frame. The use of paneling of dados is comparatively ineffective from the absence of attractively painted designs on the panels, when its use is at once obvious and apparent. The frieze of the present period offers great scope for the decorative artist.

Marshall, in his "Science of æsthetics," ventures the question "Is a science of æsthetics possible?" The attitude of science is the attitude of a searcher. The scientist is looking for laws in the ordering of the phenomena which impress themselves upon him; for the relations between the objective facts of nature, and of his own mental experience. On the other hand, that in æsthetics and religion, which feels an enmity toward and opposes the advance of science, appears in the attitude of a listener and follower of commands. In the two cases, indeed, the voices are very different ones, but the religious devotee on the one hand and the artistic devotee on the other, are trying to express the promptings of "inspiration." With one it is the voice of God, with the other it is the vision of an ideal, which he feels is in whole or in part unknown to his fellows. In each case the individual is submissive to an acknowledged leader, whom he believes to be supreme, and he resents the approach of a new teacher who claims superiority to his master.

Art and science are opponents in the same sense that æstheticism and materialism are. Art is romanticism inanimate, in fact, but full of the artist's life. It has been written that any one who has seriously wielded the pen, from Victor Hugo to Dickens, could not deny the position of poetry as a religious cult. The outcome of the minds and labors of Phidias and Michael Angelo can not be placed in a different category. Each arrived at the head of art. Of all the efforts man can make, those are greatest that are referable to the peculiar faculties with which he has been invested, the intellectual. Of these the greatest is imagination, for it removes him farthest from the animal world. In giving out the inspirations of this divine faculty he is at his best, and when he has been great in this, he has adorned his epoch and has made his country famous as no other human effort has had power to do. Parallel with the poet's teaching it may be possible that occasionally a stronger appeal through art might be made to some minds by impressive symbols of the mysteries that surround human life from its beginning to its close, and be more efficacious to keep alive simple faith than the accumulation of dogmatic utterances. Self flattered by the rigid observance of arbitrary regulations, it is not usual to become indifferent to more simple principles, their very obviousness perhaps, by giving them the look of common things, serving to divest them of that mystic air with which many minds find it necessary to surround all they would consider sacred.

Profoundly deep in the human mind exists a spiritual yearning dependent on no special creed, questionings by nature left without response, yearnings the most perfect knowledge of material things will never stifle. The true prophet, be his language prose or poem, art or music, can transport to regions where earth takes its place among the stars and something beyond of heaven's infinity seems borne upon the air. Yet that figurative language which is accepted from the poet, and is even admitted into our every-day speech in the common use of such expressions as "crowned with success," or "an arm of the sea," seems often to be denied to the artist. A symbolic picture is a thing people ironically say they can not understand. There is, however, an innate poetic sense in almost all, varying in degree, and acted upon equally in individuals. Perceptions and emotions are shut up within the human soul, sleeping and unconscious, till the poet or the artist awakens them. Nature is full of similes—symbols and parables to the eye of faith, poetic sensibility. Where the expression of these is vague, as in music, the utterance will be differently construed, and in the art that would be suggestive rather than representative of material fact, very various emotions and definitions may be conveyed. Not that it is to be asserted that the fine arts are only to be exercised in a solemn manner and for consciously serious purposes. All that is beautiful and graceful appertains to poetry, art and music, and will overlap lines of limitations; they can not be restricted in their utterances. At their noblest they are aids to what is highest in man's nature, but below this exalted range they may be well exercised to cheer, or simply to amuse.

The "Grammar of ornament" by Owens Jones, should be studied as the syntax of painting. The thirty-four rules laid down are well conceived and each one is worthy of study and remembrance:

1. The decorative arts arise from, and should properly be attendant upon, architecture.

2. Architecture is the material expression of the wants, the faculties and sentiments of the age in which it is created.

3. Style in architecture is the peculiar form that expression takes under the influence of climate and material at hand.

4. All works of the decorative art should possess fitness, proportion, harmony, the result of all which is repose.

5. True beauty results from that repose which the mind feels when the eye, the intellect and the affections are satisfied from the abscnee of any want.

6. Construction should be decorated. Decoration should never be purposely constructed. That which is beautiful is true; that which is true must be beautiful.

7. Beauty of form is produced by lines growing out one from the other in gradual undulations; there are no excrescences; nothing could be removed and leave the design equally good or better.

8. The general forms being first cared for, those should be subdivided and ornamented by general lines; the interstices may be filled in with ornament which may again be subdivided and enriched for closer inspection.

9. All ornament should be based upon a geometrical construction. As in every perfect work of architecture a true proportion will be found to reign between all the members which compose it, so throughout the decorative arts every assemblage of forms should be arranged on certain definite proportions, the whole and each particular member should be a multiple of some simple unit.

10. Those proportions will be the most beautiful which will be the most difficult for the eye to detect.

11. Harmony of form consists in the proper balancing and contrasts of the straight, the inclined and the curved.

12. In surface decoration all lines should flow out of a parent stem. Every ornament however distant, should be traced to its branch and root. This is oriental practice.

13. All junctions of curved lines with curved, or of curved lines with straight, should be tangential to each other. This is a natural law.

14. Flowers or other natural objects should not be used as ornament but conventional representations founded upon them sufficiently suggestive to convey the intended image to the mind without destroying the unity of the objects they are employed to decorate. This is universally obeyed in the best periods of art, equally violated when art declines.

15. Color is used to assist in the development of forms, and to distinguish objects or parts of objects from one another.

16. Color is used to assist light and shade, helping the undulations of form by the proper distribution of the several colors.

17. These objects are best attained by the use of the primary colors on small surfaces and in small quantities balanced and supported by the secondary and tertiary colors on the large masses.

18. The primary colors should be used on the upper portions of objects, the secondary and tertiary on the lower.

19. In contrasting colors have a proportionate depth to each color.

20. In using primary colors on molded surfaces we should place blue, which retires, on the concave surfaces, yellow, which advances, on the convex, and red, the intermediate color, on the undersides, separating the colors by white on the vertical planes.

21. Note.—The various colors should be so blended that the objects colored, when viewed at a distance, should present a neutralized bloom.

22. No composition can ever be perfect in which any one of these primaries is wanting, either in its natural state or in combination.

23. When two tones of the same color are juxtaposed, the light color will appear lighter and the dark color darker.

24. When two different colors are juxtaposed they receive a double modification, first, as to their tone (the light color appearing lighter and the dark color appearing darker); secondly, as to their hue, each will become tinged with the complementary color of the other.

25. Colors on white grounds appear darker, on black grounds lighter.

26. Black grounds suffer when opposed to colors which give a luminous complementary.

27. Colors should never be allowed to impinge upon each other.

28. When ornaments in color are on a ground of a contrasting color the ornament should be separated from the ground by an edging of lighter color, as a red flower on a green ground should have an edging of lighter red.

29. When ornaments in a color are on a gold ground the ornament should be separated from the ground by an edging of a darker color.

30. Ornaments of any color may be separated from grounds of any other color by edgings of white, gold or black.

31. Gold ornaments on any kind of ground should be outlined.

32. Ornaments in any color, or in gold, may be used on white or black grounds without outline or edging.

33. In "self tints," tones or shades of the same color a light tint on a dark ground may be used without outline; but a dark ornament on a light gronnd requires to be outlined with a still darker tint.

34. Imitations such as the graining of woods and the various colored marbles are allowable only when the employment of the thing imitated would not have been inconsistent.

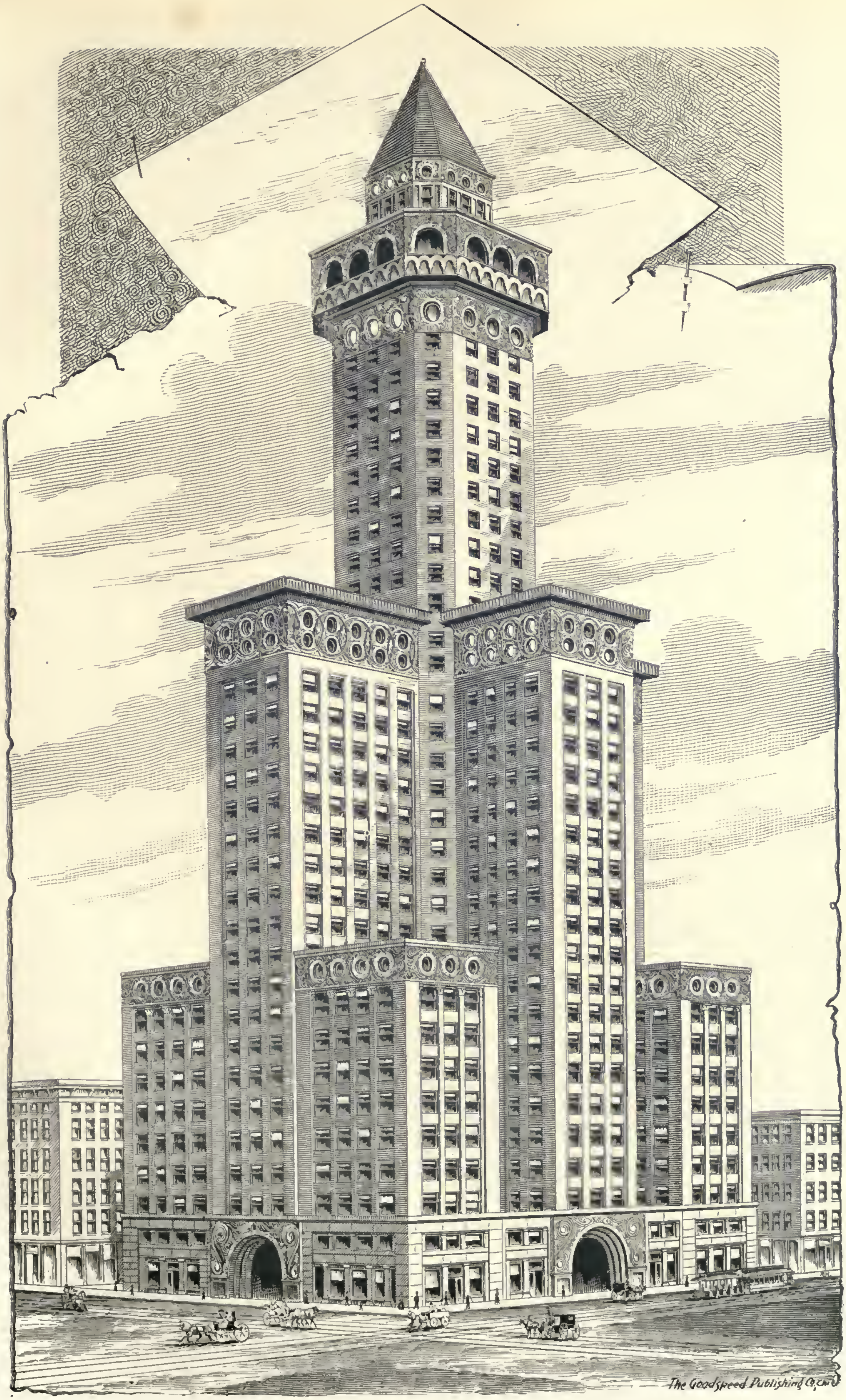
Sometimes colors are arranged according to the taste and disposition of the individual, and which may not be always the result of a preconceived conception of an educated harmony. The following, however, may assist in the proper arrangement of colors. It is taken from a high authority on color: White contrasts with black, brown and harmonizes with any color; yellow contrasts with purple, white and harmonizes with orange and pale; orange contrasts with blue and harmonizes with red and pink; red contrasts with green and harmonizes with crimson; green contrasts with red and harmonizes with yellow; purple contrasts with yellow, white and harmonizes with crimson; black contrasts with pale colors and harmonizes with deep colors; gold contrasts with dark colors and harmonizes with light colors.

Colors will harmonize with one another when they contain the same base in different proportions. All strong colors should be subdued by a neutral color coming in between. With a white ground can be used blues, purples, violet, reds, greens and browns. With a black ground can be used drabs, reds, maroons, gold, blues, greens, purples and salmon. With a blue ground can be used gold, buffs, lighter blues, yellows and drabs. With a green ground can be used reds, gold, yellow, lighter greens, dark drabs, chocolate and buffs. With a red ground can be used gold, greens, buffs, blues and lighter reds. The excellence of any painted pattern depends on the composition and details. The oriental nations, guided in their decorative coloring by what appears to be instinctive good taste, while delighting greatly in complex arrangements of lines and colors, do not destroy the beauty of their work by a too great prominence of these features. Much of the early German painting of interiors lies in the overloading of painted ornament, so that it becomes the most prominent feature. Many of the most famous temples of India positively lose in effect by the excessive richness of the ornamentation.

This idea of the application of rules is best explained in a paper by Louis H. Sullivan, on the ornamentation of the Auditorium:

"The plastic and color decorations are distinctly architectural in conception. They are everywhere kept subordinate to the general effect of the larger structural masses and subdivisions, while lending to them the enchantment of soft tones and of varied light and shade. A single idea or principle is taken as a basis of the color scheme, that is to say, use is made of but one color in each instance, and that color is associated with gold. The color selected varies with each room treated, but the plan of using one color with gold is in no case departed from. Thus the main Auditorium is in old ivory and gold, the recital hall in white and gold, the restaurant in brown and gold, the ladies' parlor in blue and gold. In some instances, the color is graded from a dark to a light tone, in others the color and gold effects are intermingled; in still others they are kept distinctly separate. The materials used are oil colors and pure gold leaf. A consistent use is made in all parts of the building of rich and varied forms in relief, yet such is the sobriety of their placing, and such the delicacy of coloring, that all is rich, quiet and harmonious, showing everywhere one purpose definitely and intelligently adhered to—a clear conception skillfully executed. Rich foreign marbles, onyx and fine woods are much used in the treatment of the main public rooms, and from the beautiful natural colorings of these materials the applied color decorations take their key note in each case, and produce with them a well-balanced unity of effect, either through the contrast or analogy of their respective tones. The stained glass, of which a moderate use is made, is carefully harmonized with the prevailing tone of color in the decoration. The most notable of the decorations are, of course, to be seen in the main Auditorium. Here the color scheme is broad, simple and grand, consisting of gold and old ivory in graded tones. Three large mural paintings form the pièce de résistance. One of these is placed over the proscenium arch, and one on each of the side walls. Their purpose is to express, allegorically, the two great rhythms of nature, namely, growth and decadence. The central painting consists mainly of figures; the side paintings are outdoor scenes, containing each but a solitary figure, that of the poet communing with nature. The direct expression of these paintings tends toward the musical, for that 'the utterance of life is a song, the symphony of nature,' is the burden of the proscenium composition; in its 'allegro' and 'adagio' are expressed the influence of music. The side paintings are further expressive of the symphony of nature, for in them her tender voice sings joyously or sadly to the attentive soul of the poet, awakening those delicate, responsive harmonies, whose name is inspiration. On one side, corresponding with the allegro of the central painting, is the 'spring song,' a scene at dawn within a wooded meadow, by a gently running stream. The poet is abroad to greet the lark; the pale tints of sunrise suffuse the landscape; the early tinge of green is over all; the joy of this awakening life deeply touches the wandering poet, who sings in ecstasy, 'O soft melodious springtime, first born of life and love!'

"The scene then changes to the side corresponding with the adagio. Here is depicted the natural and calm decline of life. It is an autumn reverie, the twilight, the symbol of de-



PROPOSED ODD FELLOWS' TEMPLE.

cadence. The scene is of pathless wilds, in gray, subsiding autumn, where brown leaves settle through the air, descending one by one to join the dead, while winds, adagio, breathe shrill funeral lamentations. Tired nature here, her task performed, divested of her lovely many-colored garment, withdraws behind a falling veil and sinks to sleep. Sadly musing, the poet turns to descend into the deep and somber valley, conscious that 'a great life has passed into the tomb, and there awaits the requiem of winter's snows.' Thus have all things their rise and decline, their dawn and twilight, their spring song and their autumn reverie, and thus by their symbolism do these mural poems suggest the compensating phases of nature and of human life in all their varied manifestations. Naturally are suggested the light and the grave in music, the joyous and the tragic in drama. The central painting, on its more conventional background of gold, expresses in its many minor figures the manifold influence of music on the human mind—the dance, the serenade, the dirge; while a deeper meaning, conveying the rhythmic significance of life's song, is embodied in special groups and figures wholly symbolical in character. At the right is an altar on which burns the lambent flame of life. Before it poses an exultant figure typifying the dawn of life, the springtime of the race, the early flight of imagination. At the left another altar is seen on which a fire is burning and flickering toward its end; near it the type of twilight, of memory, tenderness and compassion, stands with yearning, outstretched arms. The central group signifies the present, the future, and the past. The present, a lyre in her hand, sits enthroned, the embodiment of song, of the utterance of life. Toward her all the elements of the composition tend, and at this focal point is developed their full significance and power, for the present is the magical moment of life; it is from the present that we take the bearings of the future and of the past."

Modern decoration, as summed up by the *Washington Critic*, is simply

A fold of gray,
Half-flung across the window wide,
As if a bit of autumn cloud
Were thrown across the sky to hide
The light;
A gray-white,
Vague, unreal tint;
A little less than touch,
A little more than breath;
An atmosphere of color undefined,
With hint of red to take away the chill,
Looped from a mantel frame,
An old-gold drapery fell
About a mirror's face,
Tossed back with careless grace,
As tawny tresses are,
Which, in their sweet disorder, stray
About the deep, clear eyes
Of some wild-wood nymph
Close to nature's heart,
Thrown on a pictured easel, near,
A shred of soft-blue sky;
And scattered o'er
The polished floor
Lay silken cushions, green and red and gold,
October leaves, wind-strewn,
And blushing 'neath
The kisses of the frost.

The treatment of the interior of a modern dwelling is a most important subject, and one which until of late has scarcely received due attention. Great advances, however, have been made in this direction, and the standard is, in consequence, considerably higher. This applies to all the numerous fittings and furnishings that go to make up a perfect and commodious home, but to none more than that of mantels. The eccentricities prevalent in these as well as most furnishings a few years ago are fortunately of the past. Simplicity of line, beauty of proportion and restrained feeling, have taken their place, and for these advantages no amount of so-called picturesqueness can compensate.

Although there are now recognized six varieties of systems of wall painting, viz.: tempera, fresco, encaustic, oil, stereochrome, and spirit of fresco, they may be divided practically in a general way according to the vehicles used, one being water vehicle, the other oily. Under water vehicles fall tempera, or distemper, fresco or stereochrome; under the second, oil painting proper, encaustic, and spirit fresco. Stereochrome or water glass, speaking strictly, is the only system to which the term water-color is applicable. In it the powdered pigments are applied with a vehicle of pure distilled water alone. In fresco, water mixed with lime is used. In tempera the vehicle is mixed with parchment or glue size, white and yolk of egg, gum and other substances of a glutinous nature. Encaustic appears to have been practiced among the ancients in several ways, some of these resembling the method of modeling in wax by the aid of a heated graver, and others where the wax was held in solution by a volatile oil, such as turpentine and naphtha, the wax itself belonging to the oily division of vehicle. In the recently invented method of spirit fresco, wax is used, mixed with certain resins and oil of spike, exhibiting a curious link between encaustic oil paintings proper, in which oil is mixed with turpentine, and various dryers and plain painting. Oil painting admits of a greater number of pigments than other vehicles and is best able to cope with outside damp. Oil, however, is more absorbent of light than the vehicles used in fresco, tempera, etc., and has a tendency to darken with age, shrinking away from its original freshness. Its cheapness and faculty of application, needing but a simple preparatory grounding, and the endless variety of tints and hues obtainable in its mixed colors, necessarily afforded it a general preference.

It is evident that encaustic painting, in which white wax is incorporated with the colors, will in the future take a prominent place and come to be preferred to fresco painting. It is next in its range of effect to what Italians characterize as the true fresco, the painting in water colors on a dampened plaster (gesso) of lime and sand, for which our climate is unfitted, and is particularly appropriate as an architectural accessory. The wax incorporated with the colors softens their hues, causing them to display a semi-translucency, and having no gloss, the design can be seen at any angle. The term encaustic is derived from the fact that the white wax used is liquefied by fire. Impregnated with colors it imparts to the coating the quality of resisting acids, also that of not being affected by alternations of temperature.

The present Italian methods, so far as can be ascertained—for the Italian painters in their mural decorations instantly stop work should a stranger intrude—appear to be simply the laying on the painting, when finished, a coat of wax in a melted state, then applying blade-shaped heated irons to the wax when cold, causing it to sink into the surface. It is evident in any process much must depend upon the skillful manipulation. A feasible mode of employing wax in painting, and by which a soft glow is imparted to colors, has been practiced successfully in England; this involves the preparation of a composition consisting of a solution of gum arabic, gum mastic and white wax, which, after boiling over a slow fire and continually beaten, forms a cream with which the colors are blended in oil. The boiling is done in a glazed vessel. The proportions are two pints of spring-water, twenty-eight ounces of gum mastic, which is stirred in after the gum arabic and twenty ounces of white wax. When the whole, having been continuously stirred and beaten, is taken off the fire, still being stirred until the boiling temperature has subsided, after which, whilst the preparation is yet hot, two pints of water are added. It is now a cream with which the colors, ground dry, that are used in oil painting are mixed on. The coat of paint is laid on with brushes previously dipped in water. Should the paint be too thick, water is added to bring it to its proper consistency. Having been completed, it receives a coating of melted wax in a warm state, and when this is cold, an iron, moderately warm, is held before, causing the cloudy appearance to vanish, when the colors appear with soft lustrous glow. For this the heated iron is to be frequently applied. Any bubbles may be dissipated by drawing over the surface a piece of smooth baked clay, slightly heated. The finish is given by rubbing the surface with a heated cloth. We shall not be surprised, in view of the results, to see this method extensively applied, but there is still ample scope for experiments, a main point being the thorough incorporation of the wax with the colors. An exterior coat on the painting itself, which is in accordance with ancient treatment, would appear to be indispensable to the best results.

Great moral results follow from people's houses being pretty as well as healthy. It makes an educated man domestic; it makes him a lover of neatness and accuracy; it usually makes him gentle and amiable to give him a pretty home. Taste costs nothing. If you have a given quantity of building materials to arrange in order, it is just as easy and just as cheap to arrange them in a tasteful and graceful order of collocation as in a tasteless, irritating, offensive, and disgusting one. And in this æsthetic age, when there is a general demand for greater beauty in all physical appliances; when bedroom crockery must be of graceful form and embellishment; when grates and fenders, chairs and couches, window curtains and carpets, and paper for covering walls, must all be designed in conformity with the dictates of an elevated taste, it is not too much to hope that the day will come when every human dwelling that shall be built, shall be so built and so placed that it shall form a picture pleasant to all men to look upon. The decoration of our houses is not a mere thing of fashion, but constant recurring pleasure, and, beyond this, to a great extent, the absolute art education of all who dwell within or visit us in our homes. Good artistic work may be done at a reasonable cost, and beauty of form, color, and design may be as economically applied to house decoration and furniture, and with infinitely more satisfaction, than the vulgar hangings and common-place furniture to which we have for so many years been accustomed. Yet it is unfortunately true that in many houses one still finds decoration and furniture in which there is no element of beauty, in which costliness and vulgarity seem to run together. Some of the modern teachers run into eccentricity and grotesqueness of design and coloring, forgetting that in art, as in every-day life, eccentricities, either of design or coloring, are to be avoided, and that in all art decoration we should be able to see general harmony and simplicity of effect, in which there shall be no glaring patterns or colors. True knowledge of decoration and real feeling for things artistic can not be obtained at once. It is only by a constant study of nature, and of the really beautiful things of art, that the eye becomes educated to understand and appreciate beauty of form, outline, and color.

Painters' associations were unknown in the United States until the beginning of the present half of the present century. In the states of Europe each trade had its combination or guild for protection for the honor of their calling. The masters combined for protection against intruders from other states, and the help of the journeymen, after they had obtained a high and honorable distinction of being pronounced masters of the trade (thereby deserving elevation from apprentice to master workmen, and ultimately master tradesmen), was present. On this continent no such guild ever took life, owing, no doubt, to the immigration of the various nationalities, and also owing to the laws of the land. By going back into the history of the trade, the master painters and decorators are found combined in the city of Philadelphia in the year 1806. In a Philadelphia newspaper of that year notice of a certain William Showmen, master of the art of painting and glazing, and called or styled a member of the craft, appears. From that it must be inferred that the painters and glaziers eighty-five years ago must have had some sort of affiliation, as mention is made that he is a member of the craft. Now, following down the present century, the master house painters affiliated together in New York, Philadelphia, Chicago and Pittsburgh. The Pittsburgh association was organized in December, 1851, but very soon dissolved. Still, with all these reverses in past associations, where they have always existed, there is found a desire for organization. The year 1865 was the beginning of the age of association. Truly can it be called so, as about that time most trade workers commenced to organize for mutual learning, for protection or for gain. Master painters were not slow to follow. In 1882 Chicago boasted of a strong association. However, the first call was sounded in the October number of the *Painters' Magazine* of 1880. In that issue a call was made to organize master painters to affiliate themselves together in a national body for the vindication of the craft and the recognition of trade rights. This call was not responded to, and not until January, 1885, did the present National association materialize.

The first National convention of the painters and decorators was held in July, 1885. The constitution of the National association was adopted in January, 1885, and its formal organization was effected in July, 1884. The officers chosen at the first convention (1885) were: Titus Berger, Pittsburgh, Penn., president; Jesse Cornelius, St. Louis, Mo., vice president; F. P. Martin, Atchison, Kas., secretary; P. M. Almini, Chicago, treasurer; E. H. Humphrey and John G. McCarthy of Chicago, members of the board of trustees.

In July, 1886, the apprenticeship question was presented to the Master House Painters association, by J. G. McCarthy, assembled at Philadelphia in their second annual convention. This was a philosophic-historic paper in favor of the employment of apprentices. The president and vice president were reëlected, with J. G. McCarthy, secretary, and Maurice Joy, treasurer. J. B. Sullivan, of Chicago, was chosen a member of the executive board.

At the close of the fiscal year beginning July 20, 1886, and ending July 20, 1887, the association had a membership of seven hundred and twenty-two—six hundred and ninety-three individual or active members and twenty-nine honorary. There was in existence then one State association, the state of New York, and twenty-one locals, namely, Cleveland, Tiffin, Dayton, Toledo, Cincinnati, New York City, Buffalo, Troy, Syracuse, Chicago, Boston, St. Joe, St. Louis, Philadelphia, Pittsburgh, Louisville, Evansville, Indianapolis, Memphis, Washington, Bridgeport.

One of the papers read before the National association in February, 1888, was on the subject, "Modern methods in decoration." The reader said: "Webster defines the word decorate as having its derivative from the Latin words docus and decorus, which signify ornament—beauty. And decorating or decoration is the act and art of adorning and beautifying; whether we decorate our person, adorn our edifices or beautify our parks, the act is the same and the same arts must be employed. To be successful as a decorator three qualities are essential—taste, judgment and technique; either is valueless without the other. Without this combination of qualities, all efforts must be abortive and the object decorated, instead of being rendered more pleasing to the eye, will be cheapened and vulgarized, obtaining the reverse from what was intended. The trite saying, 'A thing of beauty is a joy forever,' should be deeply impressed upon the decorator's mind. He must remember that all true decorations are beautiful in their simplicity. He must constantly exercise his talents to accomplish this result, carefully avoiding all over-labored effects, adding nothing which is not conducive to this purpose. Decorative art should have no amateurs. When a person attaches to his name the word decorator, he must be competent to sustain his calling, otherwise he is a falsifier and not a beautifier. When a decorator has completed some undertaking he must appeal to and abide by the decisions of cultured and intellectual minds. His work is on exhibition and if meritorious its teaching and effects are lasting, if otherwise it will rapidly be consigned to oblivion. As master painters and decorators, all matters pertaining to the adornment of public and private buildings are always interesting and fascinating to us. The various modes of treatment, the rapid changes of capricious fashion, the new inventions in material and tones of color prevent the subject from becoming exhausted, and demand that we meet on occasions like these for an interchange of opinion and ideas, so that we keep pace with the times, and with the purpose of placing our calling on a higher plane and promoting the fraternal spirit which should exist between persons engaged in the same employment. The history of mural decoration in this country is briefly told. It was mainly tinting in the same style and color from generation to generation. When any decorating was done, it was nearly always done by a foreign workman, who brought his designs and method with him, the same which he was taught when an apprentice and which his father used before him. There were few or no changes. As a rule these workmen were well versed in the knowledge of the technique of their craft, skillful with the brush and adepts in drawing in one certain style; the results of the excellent teaching of their masters and their trade schools. But they brought with them one failing which destroyed all hope of progress, and that was egotism, and which a true artist never possesses. Another cause or fault was their want of knowledge of our ways and customs. That caused them to make serious mistakes, so that while at times their work was really good, the effect was lost by the misapplication. A religious edifice should not be adorned like a theater, nor a hall of justice like a concertroom.

"Our forefathers were unaccustomed to the beauties of true decoration, and bestowed indiscreet approbation upon these workmen, until their bump of self esteem grew to such proportions as to unfit them for perfect work. The patron was seldom consulted, except in a superficial way, and was compelled to accept what he received. As America advanced in intellectual and art matters, this method of decorating grew irksome to the independent and thinking minds of our people, and they became very pronounced in asserting their wants, and to-day insist that the decorator render what he starts out to do, make the dwelling beautiful. During the operation, consultations are frequent between the patron and decorator. The decorator must listen to the wishes of his patron, but he must never allow any dictation to so influence him that he will deliver imperfect work. He alone is responsible for that. His art is the basis of his reputation. It can not be purchased. His existence depends upon it. It must not be sacrificed. Within the present decade house decorating has become completely revolutionized. Exterior and interior have been made more beautiful and sightlier than formerly. Our architects have not been idle, but have been planning, and are constantly contending for supremacy in their line. They have adopted the designs and motives of the Old World, and are adapting them to the requirements of our country. To them we ought to be grateful, for they are the pioneers in house decorating, and were instrumental in elevating the painters' trade to an art; for through the alteration of interiors the painter was compelled to study and put in operation all his ability and power to do justice to the architects' work. Of his capability this convention is abundant proof. During this period old systems and rules were overthrown. Different materials and methods were adopted, and as the painter progressed he developed from a painter into an artist. It behooves us then to consider our trade not simply as mechanical, but rather more truly as an elegant and refined art. Let all our designing and coloring appeal to finer and more chaste tastes, thereby beautifying our dwellings and educating and elevating the community as well as the craft.

"In decorating a modern house, no restriction is placed upon the decorator. Choose any material, mode of application or treatment in finishing, as long as the home is made beautiful. Thanks to the able aid of science and manufacturing, we can, to-day, produce more beautiful and satisfactory results than ever before. Look upon the large field of resources to select from. All kinds of wood, of every hue, toughness and grain that are brought to our shores and are used in the construction and embellishment of our homes. All hard woods are cabinet finished and the beauties of the grain brought out, while soft woods are often stained and treated likewise. The woodwork is generally ornamented by the skill of the carver and marquetry worker, but the painter is in requisition to finish, to grain, to imitate, to ornament and gild the same. The metals and bronzes displayed in our residences to-day, act a very important part. Gold, silver, brass, copper and iron are used. It is apparent in the fireplace, bric-a-brac, woodwork, ceiling, cornice, sidewalks, chandeliers and hardware. If the means are not amply sufficient to afford the solid material, the decorator, with brush, bronze and color, imitates the effects. What a change from the everlasting and funeral black, gray or white marble, which is banished from our homes to-day, as not being in accord with our other decorations. But we substitute more brilliant and variegated marbles, onyxes, mosaics and tiles, aiming to harmonize their colorings to the surroundings. The weaver's loom keeps supplying us with new material. All kinds of texture and fabric enter into the combination for decorating. Burlaps, muslin and canvas are used to form backgrounds for distinct and novel treatment. Side walls of parlor and chambers are hung with silk, plush and cretonnes. In many cases, inner doors are removed and the same materials are used for portiéres. Library, diningroom and hall walls are covered with tapestry and rugs; the decorator displaying in the selection and arrangement of these materials his knowledge and taste. Leather, whether plain, studded with nails or embossed and decorated, is frequently used for various objects, while cork, glass, fiber, mica, paper and straw enter into the composition for backgrounds, in our present decorations.

"Stained glass—to what excellency and perfection has it not been brought! No approach to our present decorated glass can be mentioned. It has never been rivaled, and improvements and newer effects are discovered every day. A home without the introduction of stained glass somewhere seems incomplete. It is a necessary adjunct to the scheme of decorating. Papier maché, and all other similar materials, with their imitations of carving, and high and low relief, to what good purposes can they be put. Although comparatively new material, we are thoroughly alive to their many advantages, and use them extensively, but a vast amount is yet to be learned, in knowing how to treat them in the most effective manner. A thankless task it would be to attempt to enumerate to this convention all the styles and qualities of our present assortment of wall-paper hangings. Such variety and quality were never before manufactured. All the previous-described materials are used in the process of their manufacture as well as that they seek to counterfeit their effects.

"The wall paper manufacturer is one of the decorator's most able coadjutors, for upon him devolves the duty to introduce rich and artistic designs and coloring, and through this channel the taste for color and drawing have been greatly promoted and stimulated, thereby creating a desire for higher art decoration. The wall-paper manufacturers are surely factors in educating and elevating the people to the beauty of home adornment. Were it not for hygienic and sanitary reasons, which militate against them, their wares would be more commonly employed. The above-mentioned articles have been more or less used during the different periods of our craft, but what is now rapidly replacing them is plastic relief, whether molded by form or free hand. As a decorative feature its use has been accepted as permanent. Plastic relief is the application of a composition for roughening and combing mural surfaces. Its power of concealing uneven places, its adaptability to fit in irregular spaces, its pliability in a wet state for modeling purposes, its tenacious and durable qualities, all combine to make its virtue apparent to the decorator. Formerly when ornaments in relief were desired, the plasterer would produce and apply them. This was costly, but caused little trouble if suggested in the building plans. We still use this method for heavy ornamentation. It is for light ornaments on blank walls, where the decorator, by the aid of his newly-discovered compound, can give vent to his imagination, introducing into his designs classic or correct forms, or fantastic and grotesque shapes as his fancy suggests, where plastic relief is best available.

"The decorator who desires to use relief always considers the effect he desires to obtain, the design, hight or relief and treatment. Should he conclude to adopt a conventional design with repetitions of pattern and heavy ornamentation, he has a model made from his drawing, from which they are cast in papier mache or other composition, technically called 'solid relief,' of the required number, which are then fastened to the wall and are ready for treatment. The artistic or free-hand method of covering our walls with ornament, traceries, foliage, etc., occasionally requires the services of a professional modeler, for cherubs, trophies, etc., are what impress the decorator mostly. He who can design and paint and has a knowledge of sculpture, what a glorious opportunity he has. With both brush and modeling tool, he can give full scope to his talent and produce almost any effect. He need not apply this material heavily or be confined too closely to detail. His skill with the brush makes it unnecessary. No monotonous repetition of pattern, but all varied and in keeping, and the supreme satisfaction of knowing that the entire work was of his own conception and wrought with his own hands, is what insures its success. Sometimes this material is applied through a stencil of conventional design, on a plain, stippled or combed surface, and if treated properly, makes a durable and novel decoration. Frequently, the relief ground is studded with glass, bits of metal, twigs, stones, etc., in regular or promiscuous manner. The effect, if not always pretty, is striking and unique. Like many other good things, the use of this excellent material has not escaped abuse from the hands of ignorant and unscrupulous workmen, who never consider the fitness of place, design, color or material, but use it indiscriminately, and would misuse any substance, very often by the direction of their employer, who is not always a master painter, but simply a boss. It must not be inferred that the decorator having so many different materials available, neglects to use paints. Far from it. He is constantly employing them, either in oil or distemper. As a rule, all these new materials are used for backgrounds and are intended to be decorated by the artist. In many buildings there are rooms where the decorator applies his pigment to the bare wall surfaces and ornaments in flat and raised designs. One consequence has resulted from the use of so much relief work—the rare demand for hand-painted ornaments and the universal use of the stencil. Ornaments and all artistic work will always be painted by hand, but the practical stencil is being improved and is, to-day, more fully alive to the benefits of distemper or water color and appreciates its many advantages. Its rapid drying, its covering power, the purity and unfading qualities of the coloring, unless when aniline dyes are used, as well as its cheapness, entitles it to the painter's consideration. Unless where there is moisture or hard usage, it is often preferable to oil paint.

"Our methods and treatment in applying our paints are more varied and diverse than ever. Novelty and originality of effects are what we desire to produce. To accomplish this we are not confined to certain systems. We are bolder, broader and more independent than formerly. If the decorator desires the effect of certain material, and the genuine material is unattainable, the painter will imitate the same, whether it be wood, marble, metal or texture. The change from the incongruous and gaudy coloring to warmer, softer and more subdued tones is especial evidence of the growth of refined taste in this country. All persons are susceptible to the influence of color. Some are more sensitive in this regard than others, but it appeals to the eye of all, and will affect them. We are studying the theory of harmony and contrast in relation to color. Each room receives special attention. Each room, whatever shade or tone it may be colored in, must appear cosy and cheerful, at the same time it must suggest repose. The painter is guided in his collection of coloring for each room by its exposure to light, surroundings and purpose of use, and decorates in harmony and accord with them, and should avoid producing gloomy and cheerless impressions.

"A few remarks about the styles in vogue are necessary. Ever since our abodes began to be adorned, which dates from the time of Adam, and in which all nations have been engaged, form and color were first brought into requisition. The colors and implements used were only such as they could produce themselves, and their forms and patterns were suggested to their artist by occular perception; hence the figures, animals, fowls and plants used by them in their natural or conventionalized form, as well as their coloring, will always be identical with the country in which the style originated. It was only as a nation entered other countries, generally for conquest, that they obtained new motives for their decorations and adopted them. This is one reason of the similarity in different styles. To analyze the different styles or to state their uniformity, differentialities or coloring would consume too long a time and be a digression from the subject, so we will hastily review them. We will start with the oriental styles, which are Chinese, Japanese, Egyptian, Arabian, Saracen, Moorish, Indian and Persian. From these it is a broad leap to the Grecian, who developed ornamentation in its highest form, and even their styles are classified into three, the plain Doric, the decorated Ionic and the elaborated Corinthian. The Grecian style is the root from which have sprung almost all of the European styles, the Roman or Romanesque, Pompeian, Cinque Cento (fifteenth century), and Italian Renaissance. The Gothic, Borock, Roccoco and the Louis XIII, XIV, XV and XVI and Empire styles. belonging to the French Renaissance period. German Renaissance, English Gothic, Russian and Byzantine and Celtic are more distinct than either of these, and have a touch of the oriental style in them, while the Queen Anne and Elizabethian styles, all styles which date from the reign of some monarch, are all traced in their origin to the Grecian. The Mediæval or Heraldic and Baronial age has caused a new or modern decoration to spring up, which has been designated 'Antique style.' This style has certainly furnished us with valuable ideas for treatment, and has been the means of introducing realism in our decorations, in the matter of hanging our own walls with arms, trophies, rugs, etc. America has also contributed a new style, which is called 'the Colonial,' and is an adaptation, in a simplified form, of the French Renaissance, and receives its name from the manner in vogue of decorating our edifices, as existed prior to the Revolution, and when the states were colonies.

"In the formation of these different styles we must remember that each nation was concentrating all its energies and power to what, to their reasoning, was the highest standard of art—to which their government and churches lent their financial and moral aid. They did not have the benefits of intercourse or exchange with other nations, nor were books, prints or photographs of their art available for research and study, but they were collectively and individually bent upon giving expression to their own ideas and conceptions, wherefore we to-day have so many diverse styles to select from. To-day we derive the benefits of all these styles, and may choose to decorate with either. If we desire to decorate a building intended for religious worship, a hall for our representatives, or one devoted to mirth and music, or instruction, or for our habitation, we carefully consider which style and coloring are the most beautiful and appropriate, and endeavor to be consonant with the architecture of the building. Upon all who enter a room or building we attempt to impress upon their minds or emotions the object and character of the place. In accomplishing this purpose we are not confining ourselves to any given style or rules, unless we desire to be classical, and decorate in exact accordance to some certain period of time, but we adapt and employ all of them. We have adopted no particular style, but are altering and rearranging the old styles; accepting the beautiful and graceful, and discarding the homely, deformed and inelegant from each, and striving to create an ideal which will be distinctly American style, suitable to the requirements of our people, and in which we will eventually succeed.

"A brief description of the most important changes in the last score of years will be interesting to all. The return to open fireplaces, substitution of electricity for communication and illumination. The covering of our walls with textile fabrics. The increased demand for wainscoting, the added hight of the same. The introduction of deep friezes, the prevalent use of the picture molding. The removal of doors and the replacing of the same with grills and portieres. The general use of bronzes, onyxes and tiles. The fitting up of entire rooms in woodwork. The few but harmonious colors, and the improved taste displayed in their grouping by our painters, and the higher grade of artistic painting on such subjects as the allegorical, emblematic and floral; all these are welcome changes, and conducive to the better enjoyment of home. The American people are called an energetic and practical race, but their senses are not blunted to the refining influence and comfort of a well-regulated home, and will liberally compensate those who contribute to effect this object. The upholsterer and furniture-maker early realized this, and have made desperate efforts to usurp the artist's function. In large cities where, backed by enormous capital, for a few years they attained a measure of success, their own ignorance, conceit and greed have rapidly betrayed their mercenary aim to the enlightened public, who are learning that a graduate from a ribbon counter, promoted to be salesman in a furniture house, is not the right man in whom to entrust the supervision of their home decoration. The upholsterer and woodworker are valuable assistants to the decorator, but they should never attempt to direct the artist, for the true artist who is engaged on an idea will not brook interference, for he knows, were he not listened to, his ideal is destroyed.

"While some of the decorating which has been produced in past years has been most atrocious and wretched abominations, it is satisfactory to reflect that the major portions can be traced to the influence of the furniture houses. They will undertake to decorate a residence at any price—for less than cost—and will recover their outlay on the furniture sold. Our patrons are recognizing this fact, and to-day will give preference to the honest man, who has experience in the theoretical and practical knowledge of painting; who knows the ingredients of which colors are compounded, and their actions under different atmospheric conditions; who has been given continually to research and study and experiment, so as to be perfect in and a credit to his calling. Decorative art in this country is in its infancy. Many of our present methods are mainly in the nature of experiments, and some of them will be discarded and new ones adopted, when made possible by discovery. In the meantime, let us, on all occasions, exercise our minds and talents, and constantly aim to accomplish our mission, which is—to beautify."

The third annual convention was held in New York City in July, 1887. Titus Berger was reëlected president; General Palmer, vice president; F. F. Black, of Philadelphia, secretary, and George J. Mook, of St. Louis, treasurer. A paper on "Our relation to architects," protested against the disposition on the part of architects to ignore the painters in the construction and completion of buildings, and ultimately to make the painting a part of the carpenters' work. In the matter of apprenticeship, the convention trusted in the technical school of the future rather than the dubious semi-slavery system of apprenticeship. The speech of J. G. McCarthy, introducing the president elect, was one of the special features of this convention.

The fourth annual convention of master house painters and decorators was held at Cincinnati, Ohio, in July, 1888. J. G. McCarthy was elected president; J. C. Lee, vice president; the secretary and the treasurer of 1887 were reëlected, while H. J. Milligan was chosen a member of the directory. The original constitution as adopted January 15, 1885, by the New York convention, was subjected to revision and readopted by the Cincinnati convention.

The fifth convention was held at Washington, D. C., in February, 1889. J. G. McCarthy of Michigan was elected president. The offices of secretary and treasurer were consolidated and F. F. Black elected to fill the dual position. M. H. Godfrey, of Detroit, was chosen vice president. The form of "Uniform contract," the draft of a congressional bill for the letting of contracts for the construction of Federal buildings, the question of apprenticeship, the grading of workmen, technical education, analysis of manufactured paints and sundry questions allied with the trade were considered.

The sixth convention was held at Detroit in February, 1890. M. H. Godfrey was elected president; Albert Haberstroh, of Boston, vice president; and F. F. Black, secretary. The celebrated reports on the constituent parts and prices of "Chrome yellows," by the Chicago association; on "Raw umbers," by the Philadelphia association; on "Green colors," by the St. Louis association; on "Burnt umbers," by the Cincinnati association.

The seventh annual convention of house painters and decorators was held at Boston in February, 1891. Marshall H. Godfrey the president; Albert Haberstroh, vice president; F. F. Black, secretary and treasurer; George J. Brennan, F. A. Ballinger, Fred. Bamford, M. F. Shay, J. G. McCarthy, J. C. Lachance, A. S. Barbier, John Theobold and George M. Brack, members of the executive committee; the officers of 1890, were present. The Brooklyn, N. Y., association presented an elaborate paper on prepared "Indian red" paint, giving an analysis of various samples of prepared paints. A paper on "Outside varnishes," was presented by the New York association; one on "Lampblack" and "Carbon black," by the Jersey City association, and one on "Ready mixed paints," by the Pittsburgh association. Many subjects connected closely with the trade were considered at length. John Beattie, of New York, was elected president.

Before the convention of 1891 a valuable contribution to the literature of paints was read by a Mr. Lucas. The subject was, "Barytes, its uses and abuses." For practical convenience he divided the subject into the following headings: First, Where and how it is found? Second, What is it? Third, What are its faults in its native state? Subdivided as follows: (a) How are these faults overcome? (b) What are the properties of the finished product when manufactured into a pigment? Fourth, Its associates and rivals as a pigment. Fifth, Barytes, its uses and abuses.

First, where and how found, and said: "Associated with many of the most valuable mineral products of the earth, barytes accompanies the ores as a matrix or gangue; as you can see for yourselves in the samples before you. I would particularly call your attention to its love for galena or sulphide of lead, also to the presence of iron, both of which minerals are almost always accompanied by the 'heavy spar.' In Missouri it is almost always associated with lead and zinc as sulphide and with the iron ores. In Virginia it is found contiguous to gold bearing ore, also with manganese and iron ore. In New England it is frequently associated with lime and iron; almost all foreign lead ores have barytes as the gangue. At Gassington, Yorkshire, England, the lead ore is composed of sulphate of lead, carbonate of lead and a gangue of carbonate of lime and barytes. At Lea (near Alston Moor) the ore consists of fifty-five per cent. of sulphate of lead, twenty-three per cent. carbonate of lead, nineteen per cent. sulphate of barium, or barytes, and eight per cent. clay. In the great lead mines at Cremnitz, Austria, barytes is the gangue. So much for where and how it is found, but right here let me add that nature would seem to advise us to make use of both lead and barytes when it teaches us so forcibly and practically their close friendship and association in mother earth.

"Second, barytes—What is it? Chemically, barytes is the sulphate of barium. Generally crystalline, sometimes transparent, irregular in structure, and often opaque or milk white. The opaque varieties are much the softest, and are those commonly used in the manufacture of the barytes used in paints. Its specific gravity is less than hydrocarbonate of lead and less than oxide of zinc.

"Fifth, What are its faults in the native state? If merely powdered, barytes ore is so stubbornly irregular in structure and quality that it is difficult to reduce it to a uniform powder by grinding or crushing. Again it is so transparent from its crystalline structure that it has little or no color when used as a pigment, and for these reasons its use as a raw product ought to be discouraged and discountenanced.

"Fourth (a), How are these faults overcome? In the first place a wise manufacturer of barytes, the pigment, will use great care in selecting the very white and opaque ores. These ores are carefully washed, to free them from all earthy matter; then heated to break up the crystalline structure; then powdered, and to free it from lead, iron, zinc and other ores, it is washed with a solution of acid, sulphuric or hydro-chloric; after repeated washings with pure water, until all acids and foreign matter are removed, it is ground in a pulp or moist state to an impalpable powder and floated. This floating process consists in running the pulp barytes into large vats; the lighter and finer particles will naturally be last to settle, and these are run off into other vats in succession. Those that float the farthest are naturally the finest and most opaque. This product, after settling, is removed to pans, where it is dried by steam, and yields a beautiful, soft, white powder, known under a variety of names, and recognized as a pigment by manufacturers throughout the world. Another variety of barytes, the pigment, is made by decomposing the sulphate of barytes into soluble barium salt, which is reprecipitated by means of sulphuric acid or any soluble sulphate, to sulphate of barytes, a very white and impalpable powder, known in France, where it was first manufactured, as Blanc Fixe; in Germany, as Permanent White. (b) What are the properties of this manufactured article as a pigment? First, its whiteness is noticable. Second, it is absolutely non-poisonous. Third, its indestructibility is very remarkable; acids, light, heat and water have little or no effect upon it. It is not acted upon by any chemical compounds or any chemically made colors, that may be associated with it. When mixed with oil it is positively inert, and for these reasons it never chalks, it never peels, it never cracks. Its one great fault, but to a less degree than in its native state, is that it is somewhat translucent, and from its nature a decomposer of light, and consequently has poor body and is of but little value when used alone. Fifth, its associates and rivals. In the introduction to this subject of barytes we have taken some pains to show both sides of the question, its faults and its merits. It would only be just to apply a like analysis to its associates and rivals.

"First, carbonate of lead. The most opaque pigment known, and therefore it has the best 'body' or covering power. This property distinguishes it as a pigment. On the other hand, what are its faults? Pure white lead is a mixture, chemically, of carbonate of lead and hydroxide or hydrate of lead—the best varieties being combined in proportion of two of the carbonate to one of the hydrate. These chemical compounds are noticeable, being easily acted upon by oxygen or any acids or gases that may be in the air. Carbonic acid, which is mixed through all air and absorbed by rain-water, dissolves them; sulphureted hydrogen, a gas that is almost always present in the atmosphere of all large cities, decomposes the pure white lead, causing the yellow and blackened effect that is so common to us all where pure white lead has been used. Again, these chemical constituents of lead, above referred to, are chemically active and react with the oils with which they may be ground; the hydrate is decomposed by the acid, forming oleate of lead, which is commonly known as soap of lead. This soap of lead is soluble in water, and you will readily understand from this explanation what is known as the chalking of pure white lead. It is merely the solvent action of water on the soap of lead.

"Second, its poisonous effects. Let me recite an authentic report by a celebrated French physician, Monsieur de Roulz, who states that during the eight years ending 1844, the number of patients admitted to one hospital in Paris that were affected by lead colic amounted to one thousand one hundred and sixty-three, of which four hundred and six were employed in the manufacture of white lead; the others were painters. Fortunately for humanity the modern methods of the manufacture of white lead have decreased its terrible effects to a minimum in the process of manufacture, but to show you that this effect upon painters who have no good means of protecting themselves has not been lessened, I beg to quote a line from the *Painter's Manual:* 'It is supposed that the painters in the aggregate pay an interest on their life of about twenty-four per cent., that is, they shorten their lives about three months every year for the privilege of following the noxious business, and it is statistically true that the average lives of painters do not come up to the standard of longevity.'

"Second, zinc—Unsurpassed in its whiteness, magnificent in its texture and covering properties, but open to the same fault that as an oxide it combines with the acids of oil, forming very hard laminated scales, and as a result we commonly see buildings painted with oxide of zinc scaling and cracking.

"Third, terra alba—Sulphate of lime or plaster, and hardly to be associated as a pig ment, almost always contains the oxide of calcium or lime, which is chemically very active, forming a soap with the acids of lead and chalks; comparatively poor body and poor texture.

"Fourth, Paris white—Carbonate of lime; also contains oxide of lime; is unstable and chemically very active. It absorbs much color and chalks outrageously.

"Sixth, barytes—its uses and abuses—(a) The history of barytes as a pigment. Ever since the manufacture of paints and pigments has had a distinctive character, barytes has always occupied a position as a pigment; but you will ask, where was it used and how were the paints labeled and branded in which it was used? One of the so-called 'apostles of purity' says, in a recent article published in a Philadelphia magazine, that the 'Master house painters of the United States have only recently found out that they have been using twenty to twenty-five per cent. of barytes in their pet brands of paint for twenty-five or thirty years, or all their lives.' I might add that the master painters of the world have been using paints of which barytes was a component part almost ever since paints have been manufactured. In England, pure hydrocarbonate of lead was never ground pure, unless specially required. Whites were always compounds in which barytes occupied a conspicuous part. In France it was seldom known as pure, but was listed and branded as follows: White lead, superfine, containing fifteen per cent. of barytes. White lead, No. 1, containing thirty per cent. of barytes. White lead, No. 2, containing forty per cent. of barytes. White lead, No. 3, containing from fifty to sixty per cent. of barytes. Blanc fixe, pure barytes, one hundred per cent. pure.

"In Austria much the same customs as were common in Germany prevailed, but in place of blanc fixe, or permanent white, pure barytes in oil is labeled, 'tyrolese,' or 'tyrolean white lead.' In Germany, pure white lead in oil was known as 'cremnitz white.' Venetian white, containing fifty per cent. of barytes; Hamburg white, containing upward of sixty-seven per cent. of barytes; Holland white, containing seventy-five per cent. of barytes, and permanent white, were common and in general use. I would beg to call your attention to the names given to pure barytes in oil by our French and German friends, 'blanc fixe' and 'permanent white,' both very indicative of the indestructibility of the pigment used in them, manufactured barytes, sulphate of barium.

"In America, let me quote from an able article from the celebrated and successful manufacturer, John W. Masury, formerly, I believe, a 'knight of the brush,' that 'the manufacture of white lead in this country was mostly, if not wholly, confined to Salem, Brooklyn and Philadelphia. The makers by agreement or combination resolved to put out three grades of the article, and the containing packages were branded respectively 'Pure' 'Extra' and 'No. 1.' A common trick, whereby to cheat the public. The so-called 'pure' was in theory the least adulterated. 'Extra' followed in order, and 'No. 1' came in last. This we may suppose was not overloaded with white lead. If, therefore, cheap white paints are offered in the market under the name of white lead, let it be remembered that white lead manufacturers set the example.'' Again, I quote German price lists. The English are similar; both lists of reputable manufacturers:

"White lead, No. 1; white lead, No. 2; white lead, No. 3; white lead, No. 4. Four grades you will notice. Another: Patent white lead, C. P., dry and in oil; patent white lead, I; patent white lead, II; patent white lead, III. French lists are as they were formerly.

"And now, gentlemen, I come to the barytes of to-day; the barytes of America, its uses and abuses, both of which are closely allied and associated. This plunges us into the midst of the present controversy which is going on in the trade papers as to 'What are pure paints.' I can not do better than quote a recent article from the *Paint, Oil and Drug Review*, of Chicago, as follows: 'Of late much printers' ink has been wasted in asking and answering the riddle, 'What is pure paint?' Wasted, because the word 'pure' means unmixed and therefore becomes meaningless when yoked with paint; all paint is per se impure or a mixture, and for that reason the phrase 'pure paint' is a sophism. Pigments and paint materials may be pure commercially, but pure paint is an impossible absurdity. By keeping this fact in view the perplexed question is freed of all perplexity.' Again quoting Mr. John W. Masury, 'the proof of the pudding is the eating.' The test of a paint for outside use is its permanency and durability, in color and substance. Whatever will best stand this test is the one to be sought for.' Again quoting Mr. C. P. Dudley, chemist of the Pennsylvania railroad company and a thoroughly talented and practical gentleman, 'the requisites of all good paints are: 1. To work properly during application. 2. To dry with sufficient rapidity. 3. Durability. 4. Covering power. The question of durability may be regarded as the most important one.' My statements as to what are good paints and what are bad paints are the result of forty-two years of hard work and practical experience. In the technical part of the foregoing, I have endeavored to show you that manufactured barytes, the pigment, has properties of intrinsic value, when used in combination, as a paint.

"Barytes—its uses.—Almost all dry colors chemically prepared have been extended or combined with barytes ever since they have been manufactured. It is not found in the dry earth paints, such as ochers, umbers and siennas. You all know, however, that there are varying grades of earth paints—nature having extended them with the sulphate of lime, silicates or carbonate of lime; on the other hand nature does not extend chemically prepared colors; they have been and are extended for well-defined reasons by the manufacturers.

"First. Chemically pure greens, which are precipitated mixtures of blue and yellow, are very hard in their texture, and in grinding them there is always great danger of combustion, either frictional or chemical. Again, painters seldom have use for many of the chemically pure colors—the cost being too high for the practical purposes for which they use paints. Chemically pure dry colors are often changed by reactions between their component parts. Pale yellows, for instance, often change color after being packed, on account of the chemical action between the chromates, sulphates and carbonates of lead.

"In many of the colors in oil, or painters' colors barytes should not be used because painters desire their colors for tinting purposes, and therefore strength of color is a necessity. All representative manufacturers have a first or best quality of colors in oil that approaches commercial purity. For ourselves, we have carried a full line of C. P. colors in oil and listed them since 1885, and, like other manufacturers, without an exception, two lower grades of colors in oil, to meet the demand of the general trade. These lower grades are sold at prices that could not possibly admit of commercial purity. There are however, exceptions, when practical experience and experiments would seem to demand the use of some inert material, in connection with colors in oil, notably those chemically prepared. Why? Chemically pure chrome yellow (chromate of lead) reacts with, and is acted upon, by the acids of the oil, and you frequently see, after a pure yellow has been exposed for a short time, that it has gone a greenish hue or tinge. You have all also observed the peculiar odor that emanates from chemically pure yellows in oil. This is unquestionably due to decomposition, and does not take place in extended yellows.

"Reds in oil.—You have also all observed and know that it is not considered practicable to grind pure red lead in oil, for the reason that there is almost an immediate chemical reaction between the oxide of lead and the acids of the oil, forming a hard and unmixable compound.

"Greens in oil.—Here you have again a reaction between the yellow in the green and the acid in the oil above referred to in my remarks upon the yellows. What is the result? A chemically pure green on exposure in many cases becomes what is known among painters as

GRILLE WORK.

'burnt.' In order to obviate these chemical reactions between the pigment and the oil, the presence of some inert matter has been found by practical experiment and innumerable tests to be necessary. In my foregoing remarks I have tried to show you that of these materials manufactured barytes is the most indestructible, most inert, and for all practical purposes the most useful. You will possibly ask, Why has not hydrocarbonate of lead or oxide of zinc been used? In the first place, they are not inert, and for another very practical reason, they are not as useful as barytes, because they drink in or absorb color, whereas barytes, from the very fact of its translucency, is a non-absorbent of color, and yet extends the particles of color sufficiently to prevent their chemical activity.

"Next we come to whites in oil, and the question of white leads and zincs vs. combination whites. Briefly recapitulating, white lead chalks, when exposed to the air, blacken in the presence of deleterious gases, or when kept in the dark, but has unequaled body or covering capacity. Oxide of zinc cracks and peels, but has color and body in its favor. Barytes by itself has little or no body, but possesses inertness and indestructibility. On the other hand a combination of white lead, zinc and barytes has been found by innumerable and practical experiments, well authenticated, the best paint to stand all the disintegrating attacks of nature; seldom to chalk, seldom to peel; comparatively non-poisonous, and of all known compositions the most durable as a paint.

"I am the manufacturer, for upward of forty years, of a compound white paint, well known under the brand of 'Capitol lead,' and will guarantee that it is more durable than any pure lead manufactured in this or any other country, either for inside or outside work, and in any climate. Many years ago, the National Guards hall, Race between Fifth and Sixth streets, Philadelphia, was painted with this brand, by prominent painters, now members of this association, Carlisle & Joy. As a practical test, the buildings on each side were painted with perfectly pure white lead, manufactured by two of the most reputable manufacturers in this city. Every few months the buildings so painted were critically examined; finally when the buildings painted with pure white lead had chalked and partially washed off, the capitol or compound white paint, was in good condition.

"Let me here insert the query, 'Have painters paid as much for these compound whites as they have to pay for pure white leads?' In answer to this I beg to quote two extracts from A. S. Barbier's article on 'Paint as we know it,' delivered at the sixth annual convention of the Master House Painters' association, as follows: 'The next thing I wish to discuss is the trouble with our white lead of to-day; after closely looking into the matter we find a queer state of things. The first result of my investigation is that pure white lead properly corroded, ground in linseed oil, bleached properly, care being taken in the different processes and with the requisite of age to make it durable, can not be manufactured and sold at six and a half cents a pound and bear any profit. I think that the standard lead of Great Britain sells in the English market for a sum equal to $9 per hundred; this is a country where interest is low and labor cheap. Under these circumstances I have to come to the conclusion that an article of that kind manufactured here would be worth ten and a half cents per pound. I went to a manufacturer and corroder to get prices. I very innocently put the following conundrum to him: 'How is it that pure white lead being worth six and a quarter cents per pound, you grind it in a vehicle at eight and a half cents per pound, also cost of handling, grinding, putting in kegs, and sell it for six and three-quarter cents per pound?' The answer I received was a very knowing smile. In my opinion, gentlemen, a man is a fool to use an expensive article when he can get a cheaper article that will do the same work better. Another argument is the assertion that barytes is merely used to make weight. The specific gravity of a mineral is its weight compared with another substance of equal volume. In the figures given the comparison is made with equal volumes of water. The specific gravity of white lead is about six and a half, zinc five and a half, and barytes four and a half.

"Rather a remarkable scientific fact is that barytes has the lowest specific gravity of the three pigments, and this fact is verified in the practical combination of zinc and barytes; zinc packs when in oil, barytes remains in suspension. For example, one hundred pounds of a mixture of one part zinc and three parts barytes, ground in oil, will take a larger package than a mixture of three parts of zinc and one of barytes, ground to the same consistency. Right here, in connection with the abuses of barytes, I would like to refer to the labeling of these combination whites. The corroders, as I have already told you, initiated the practice of misrepresenting the contents of a can or package. All manufacturers have inherited this custom, but personally I would advocate the adoption of the old German custom of calling all combination paints by some distinctive name, as 'Holland white,' 'Dutch white,' 'Cremnitz white,' etc. The argument that the label on the can should tell what its component parts are is practically absurd. One of the advocates of this policy recently made the following statement in a letter to a local magazine: 'If barytes is named in the label its unlimited use would be quite proper and unobjectionable;' and, again, in the same magazine of a later date, he makes the statement 'that Tuscan red is a mixture of bright Indian red with a lake color. As the lake color requires some kind of a body to carry it, it is practically impossible to establish any standard of purity for this article; further, rose pink as a rule is merely whiting colored with any suitable red coloring matter. Sulphate of lime may be used as a vehicle for carrying organic colors, and is a very useful one. Further, it will be seen that a standard of purity does not exist for Indian red, and can not properly be established for Tuscan or Venetian red.' And yet, gentlemen, in the face of these assertions, this 'apostle of purity' attempts to argue that all manufacturers shall state on the label what there is in the can. Personally I do not favor any such statement on the label as the following: '$100 in gold will be paid if the contents of this package is not strictly pure. For whiteness, fineness and covering property it is unsurpassed by any white lead in the market.' This package was labeled 'Pure white lead,' and the analysis, as given by the Lead trust, made it about fifty per cent. barytes and fifty per cent. oxide of zinc. Such labels are unquestionably abuses.

"Ready mixed paints.—Eight out of the ten leading paint manufacturers of the United

States use barytes in their mixed paints in combination with lead and zinc; the vehicle in these eight combinations, as nearly as can be determined, is pure linseed oil and japan dryers. How about the other two? In these the pigment is a combination of lead, as sulphate or carbonate and oxide of zinc. The vehicle, on the contrary, contains a large percentage of benzine and water—in one case the analysis yielding nineteen per cent. of benzine and eighteen per cent. of water; and this, gentlemen, in face of the statement of the representative of the house that makes the paint that 'I would personally sooner have a paint that was half barytes and half pigment, with all pure oil, than a paint that was pure pigment with adulterated linseed oil.' This, gentlemen, is the abuse of barytes, not the abuse by barytes. They prefer water and benzine to barytes. Quoting this same able authority and 'apostle of purity'—'the permanency of a paint depends upon the durability of the oil which is the vehicle of its application, and the more there is of the oil the longer it will take for the elements to destroy the paint.' For ourselves, you will probably be told in the report to be made by the Pittsburgh association, at the National association convention, on the analysis of ready mixed paints, that J. L. & Co.'s pure oil-tinted gloss liquid paint contains a percentage of barytes; you will also be told, if the analysis is a correct one, that the vehicle is pure linseed oil and japan dryers. Are we ashamed of this paint? Are we afraid to have painters use it? No! emphatically no! for on every label and on every sample color card having our name we make the emphatic statement in the directions: 'The employment of practical painters will insure good work.' Are these mixed paints—these combinations of ready mixed lead, zinc and barytes—any good? In reply, let me quote from the report of the third annual convention of the Master House Painters' association of the United States, held at New York, July, 1887, speaking on the resolution: 'That the members of this National convention pledge themselves that they will not deal with or purchase goods from any one who manufactures or sells mixed paints.' "

The Master Painters and Decorators' association was organized at Chicago, April 19, 1882, with George B. Drake, president; Peter M. Almini, vice president; George Barry, secretary; J. B. Sullivan, treasurer; E. H. Humphrey, H. J. Milligan, Hermann Tripp, N. S. Lapperr and John Rowe, trustees. This meeting was called by five master painters of the city, and the call was responded to by thirty-three firms.

The first annual meeting was held March 13, 1883, when the president, vice president and trustees were reëlected, with W. P. Nelson, secretary, and George Barry, treasurer. The roll of charter members was reported at this time. With the names given, above appear the following: W. P. Nelson, George A. Sheffield, John McDermott, George Stephenson, J. J. McCarthy, W. Wilson, Otto Schmitt, G. W. Carney, William Strang, R. Kleinofen, T. E. O'Brien, W. H. Emerson, W. Tehle, James C. Burns, B. S. Mills, John Paulding, T. J. Manning, Phillip, Dennis Norton and Peter Emmel.

The officers of 1884–5 were: J. B. Sullivan, president; B. S. Mills, vice president; Herman Tripp, secretary; H. J. Milligan, treasurer; George Barry, N. S. Lapperr, W. Wilson, W. H. Emerson and John Rowe, trustees. The relations of journeymen to the master painters; the pay of the journeymen, and the responsibility of the painters for glass broken in a building, whether by carpenter, bricklayer or painter, were the principal subjects considered. The election of 1885 resulted in the choice of E. H. Humphrey, president; W. H. Emerson, vice president; B. S. Mills, secretary, and the treasurer held over. The National Convention of Painters assembled at Chicago that year, and the question of incorporation for the local association was suggested. In 1886 J. J. McCarthy was chosen president; H. J. Milligan, vice president; B. S. Mills, secretary; N. S. Lapperr, treasurer; with Messrs. Emmet, Burns and Emerson, new trustees. The association adopted a grade for journeymen, and issued a card to the journeyman bearing the name of the grade in which he was recognized. The vote of the journeymen painters of Chicago, on the question of the eight-hour day, was taken with the following result:

Employer.	Men voting for 8 hours.	For 10 hours, against 8 hours.	Non-Committal.
H. J. Milligan's shop	123	43	3
George Barry's shop	143	10	8
William Phillipson's shop	...	67	12
M. B. Sullivan's shop	126	15	2
G. E. Langer's shop	17	12	7
P. M. Almini's shop, ninety per cent. in favor of eight hours.	...	...	..
W. P. Nelson's shop	60	10	..
N. S. Lapperr's shop	44	1	4
George Stephenson's shop	1	19	..
Otto Schmitt's shop	9	6	8
John Rowe's shop	25	3	..
G. W. Carney's shop, 66⅔ per cent. in favor of eight hours,	...	...	..
R. Kleinofen's shop	23	2	..
T. E. O'Brien's shop, sixty per cent. in favor of eight hours,	...	...	..
W. E. Emerson's shop	1	25	..
J. G. McCarthy's shop	4	59	..
Walter Tehle's shop, all in favor of ten hours	...	...	..
James C. Burns' shop	...	34	..
B. S. Mills' shop	2	10	..
T. J. Manning's shop	...	18	..
Dennis Norton's shop	1	32	1
H. G. Emmet's shop	...	75	..
C. H. Horton's shop, no record	...	...	..
F. A. Crandall's shop	18	22	..
Perkins Bros.' shop	15	35	..
J. Pease's shop	2	15	..
Edgar French's shop	24	1	2
William Strang's shop	62	10	..
Estimate	860	604	47

The report of this election was decidedly in favor of the eight-hour day; but the varied opinions relating to it, within the circle of master painters, tended to leave the subject in abeyance.

In January, 1886, the following paper was read before the Chicago association by B. S. Mills: "The time was when boys were taught the art and mystery of a trade, and time frequently developed the fact that they were taught more of the mystery than of the trade.

Generally, if you envelop a thing in mystery you add very much to its interest. There are, indeed, persons who value a thing or proposition in proportion to the mystery surrounding it. The element of mystery may be a very good thing in its place. Without it and the article faith, very few cures would be produced by medicines. And it is of very great use in helping on many an enterprising tradesman. Many a trade would be off if we knew the exact truth and status of affairs. Our craft has passed through, or is passing through, this phase. I have known the time, for instance, when a grainer would hang up a sheet before him while graining a door, so that others may not see how he did it, and would willfully mislead, if he could, as to the materials and process. An inventor, or discoverer of a new process, is legally and morally entitled to certain profits of his skill, but in law this right runs out after a specified time. As a member of the human family, no man has a right to shut up within himself, beyond a reasonable limit, any knowledge which would be generally useful.

"Is the world advancing too rapidly? I have sometimes thought that there must be some other reason than a desire to benefit others, which causes some dealers in art goods, and some dealers and makers of scientific appliances—sanitary or otherwise—to be so anxious to educate the masses and spread abroad so much light. But if the result be good, never mind the motive. And so, at the risk of some impugning of my motives, and of some laughter at my simplicity, I offer you the following upon an interesting subject, and I hope that you will not construe the act as an evidence that I consider that the treasures of wisdom and knowledge are shut up in me, or that I am by any means your superior. I believe that there are many of my brother members who can instruct me. I wish to draw them out. I am anxious to know if there be a better way. The most that I claim is that I am among my peers, my associates and equals, for the time being at least, and upon this floor.

"I am going to give you the main facts in my experience and the results of some thirty-five or forty years in mixing colors, and also what I have read of that of others. I start the ball a rolling, courting your criticism. Please, however, to remember that 'whoever expects a faultless piece to see, expects what never was, nor is, nor ever shall be.' In combining colors so that they would look pretty together, I was guided for the most of my time only by an innate idea of beauty. I could not tell why some colors looked better together than others, but after some experiment and twisting of my head, I was able to get up some pretty contrasts, and to do this I sometimes had considerable trouble, and often had to wash out or paint over my work, to please either myself or my employer, taking into account also the difference there is in taste. Now how to do this thing scientifically and in accordance with the laws of harmony is worth knowing. Color harmony, it is claimed, is susceptible of almost a mathematical demonstration; that is, it can be figured out just as a melody in music can be harmonized by the laws of thorough bass. There are differing theories in regard to the primitive colors, one being that of Young, Heelmholtz, Maxwell, Rood and others. This is claimed to be the latest and most scientific, according to this theory. Red, green and violet are the primitive colors. Heelmholtz concludes that there are five (5) primitive colors—red, yellow, green, blue and violet. Maxwell regards as the only essential primaries, scarlet, red, green and violet. Church says that in experimenting with light the most remarkable of the results are the facts that red and bluish green make yellow, and that when this yellow is mixed with indigo it produces white.

"The reasons for this theory appear to be strong, and I have neither power nor wish to controvert them in detail. They are based on analysis of light, and concern more the science of optics than the art of painting; also, as according to one of its main advocates (Rood), the system must be regarded rather as a problem than as a solution. I pass it by, simply saying that in the most important matter which concerns us at present—namely, that of complementary colors—it is very nearly identical with that system which I am about to explain, and which is sometimes lightly decried as the musical theory; but this name is not a bad one, especially if it be true, as one writer claims, that one art explains another. Why should not the laws of music explain or help to explain the laws of color? I had searched in vain, through many years for a plain and comprehensive system that could be applied to practice. I read the fifteen discoveries of Sir Joshua Reynolds before the Royal academy, without finding that which I believe he did not know, a formulated law of harmony. I have since read Chevreul with great profit. This celebrated Frenchman made a great stride in the science of color harmony by formulating the law of simultaneous contrast. It would illy become me to criticise his work; there is a mass of excellent matter of observation, facts and laws, which I can not and have no wish to controvert, such as that the proximity of colors modify each other. Black, white and gold are neutral as regards harmony, and are good to separate colors. Yellow is advancing, red is normal, blue retiring. If we look steadily upon a red wafer upon a white ground, a greenish halo appears around it. This is the subjective color or complement. Looking steadily upon a bright yellow, the eye instinctively seeks rest, and calls up its complement, purple. In the edition I read of, 'Chevreul on color,' out of four hundred and sixty-five pages there were two hundred and eighty-eight pages and seven hundred and thirty sections which I would like always to have on my mind, comprising formulas of harmony and series of colors that harmonized. etc., but there was too much to remember. I could never hope to appropriate even a large part of them. I wanted some simple laws that were practical, easily remembered, and that could be amplified at will. Such a system Sir Christopher Dresser has described; perhaps he is not its author or inventor, for other names —Brewster, Chevreul, Mayer, Lambert, Range and Le Blond—seem, in some shape or other, to have some of the honor. This system commends itself to practical men, for as painters we know and can demonstrate in a few minutes at any time in our shops, that a good yellow pigment and a good blue will make a green. We do not know, and do not care, for our purpose, that blue and yellow light will not make a green light. Red and green light may make a yellow light, but red and yellow pigments will not make a yellow pigment; nothing else but yellow will make a yellow paint. Yellow, therefore, we call a primary or first color.

"Blue and red are also primaries for the same reason, and not by any amount of skill in mixing, short of chemistry, can we make these colors from any others; but if we have these colors we can make all the rest. The primary colors, then, all theory to the contrary, notwithstanding are red, blue and yellow, and the typical or true idea of these colors is, as they are found in the spectrum now midway between the red and yellow in the rainbow, or the spectrum is an orange, and midway between the yellow and the blue is a green, apparently by the mixing of the two, and at the end of the spectrum, or where it would join the other end if bent to a circle, and thus make it midway between the blue and the red, is a violet or purple, thus seemingly confounding the theorists by their own proof. These colors—the orange, the green and the violet—are binary or secondary colors, because they are formed by a union of two of the primary colors. And so, further, by mixing two of the secondary colors, we get the Tertiaries, from Tertius Third. The Tertiary colors are by mixing orange and green a citrine, by mixing green and violet a slate, by mixing violet and orange a russet. The citrine is sometimes called a yellow gray. By mixing further the Tertiaries together we get only poorly defined tones, or hues of grays. All theories suppose that we could obtain pigments of the purity and brilliancy of the colors of the spectrum. We might obtain a pure white, supposing the mixture to be in the same proportions as they are found in the rainbow. The nearest approach thus far to this is only a gray or grayish white, but I believe it is a recognized truth in chemistry that an analysis is easier to perform than a synthesis; that is, it is easier to find out the components of a body than it is to put the elements together and form that body; a diamond being an example, and so is white. The theory of harmony starts out with the idea as a foundation that the primitive colors, and through them the others as they exist in the rainbow, are all necessary to a complete or perfect harmony, and in the same proportion they exist in that analysis of white light. If this be so, somebody has greatly erred in disparaging pure white. It is indeed the summum bonum of harmony and beauty. The beau ideal of all goodness, purity and truth. To be sure, it seems out of place when to any considerable extent it is combined with loud and strong colors. It is simply out of place, as in the union of a simple and pure maiden of eighteen with an old and worn out man of seventy—the marriage of May and December. The relative proportions of the primitive colors are said to be three parts of yellow, five parts of red and eight parts of blue, and this can be partly verified by any one who will look at the rainbow or the spectrum. He will see that the blue preponderates over red, and the red over yellow. There is, hence, an analogy to music, the major cords of which, do, me, sol, do, being the first, third, fifth and eighth intervals.

"There are many analyses between musical and color harmony. A noticeable one is this—that both have to an extent left the simple, elemental chords, and are seeking finer and more abstruse harmonies, such as are found in the minor scale and in Wagnerian music. The first principles have been left to children and to uncultivated people or races. To cultivated decorators and colorists the crude and bright primitive harmony of red, blue, and yellow is too loud, glaring and old. It may do well enough for flags, for children or for Indians, but a cultivated taste runs to the secondary and tertiary colors. It is, of course, allowable to spice the feast with a primitive here and there, just as it is a few major chords or unisons in harmonizing a musical air, or as sugar, salt, or pepper are used in well-prepared food, but the prevailing idea in progressive art seems to be to get as near a discord as possible and just miss it. Drosser says, 'the rarest harmonies lie close upon the verge of discord,' and later on, no doubt, it will be the right thing to harmonize a discord, and then will come the golden age, when the music of the spheres will be heard and understood by all.

"Returning to our figures again—The primary law of harmony is: Yellow 3, red 5, blue 8. These figures together make 16, which represents the sum total or complement of harmony for the primary and secondary colors. Example.—Orange is represented by 8, because it is composed of yellow 3 and red 5—making 8. Now, blue is 8 also, and together they make 16, therefore blue and orange harmonize, or rather orange is the complement of blue. Again.—Green is 11, being blue 8 and yellow 3, making 11. This lacks 5 of making 16, and this number is found in red, which is 5. Thus, $11+5=16$; therefore green and red are complementary. And so again.—Purple and yellow. Purple is 13; that is, blue 8 and red $5=13$. This lacks 3, and yellow being 3, makes up the complement of 16, and is, therefore, harmonious. You will notice that all of the three primary colors are in these combinations. Red harmonizes with green, because the other two primaries, blue and yellow, are in the green, and so with the others, the principle being to make up the full set of three colors in their proper proportions, namely, 16.

"The secondaries are purple 13, green 11, orange 8, together, 32. This sum is the complement of harmony for the secondaries with the tertiaries. One of the tertiary colors is slate, composed of purple 13 and green $11=24$; necessary to make up the complement of 32 is 8. This is orange, being yellow 3 and red $5=8$, consequently orange is the complement of slate. Another tertiary color is citrine, composed of green 11 and orange $8=19$; necessary to make up the full number of 32 is 13. This number is found in purple, 13; red 5, blue $8=13$, which added to citrine, 19, is 32, and so is the complement of purple, and must harmonize. Russet is another tertiary color. This is composed of purple 13 and orange $8=21$; the number necessary to make up the sum 32 is 11. This is green, being blue 8, yellow $3=11$. Russet therefore goes well with green.

"We have been dealing mostly with common chords. It is probably true that most persons who have given attention at all to the harmonious blending of colors are acquainted with the foregoing statements in the main. Ladies who have studied good taste in dress, as well as professional decorators, but few, perhaps, comparatively realize the mathematical nicety of the formulas to which even these common chords are reduced. Sir Christopher Dresser puts the case thus: 'Imagine ten hues between green and yellow, that is, more and more yellow, and ten hues between the green and the blue, more and more of a bluish green, and so on with the other primary and secondary colors, and we shall have fifty-four colors and hues of color. Imagine, further, each of these colors and hues of color to have 10 degrees of depth, and we shall have five hundred and forty colors, hues, tints and shades, all differing from one another to an obvious degree; and mark this fact, that if you fix upon one color in this number of five hundred and forty, there is but one other color which is complementary to it, and that alone will perfectly harmonize with it.' Now, when we consider that the above number is by no means a large one to make in this way, and that the Tertiaries are not even named in it, we can easily see that it is by no means a small accomplishment to determine the exact complement of a color by the common chords of harmony, and yet it is as easy for an adept colorist to do so as it is for an expert musical tuner to get the exact pitch of a piano note in harmony. Dresser recommends students to construct a diagram for detecting at once the complement of any color or tint. Remember that a complementary color is that which completes the presence of the three primary colors, and also that colors which perfectly harmonize improve each other to the utmost.

"Now, following the analogy of music, which we have started on, there is evidence that in an ascending scale of color-harmony are effects corresponding to the minor scale in music. There is also evidence, although the idea is sometimes thought fanciful, that the mind and feelings can be operated upon by color combinations, just as they can be by musical composition, and if it be proper to have such music as is proper to the time, circumstances and place, just so there is a proper coloring fit for every place and purpose, and useful to develop and strengthen a class of feelings religious, gay, quiet or martial. This is the province of true art, to manifest thought or feeling, whether it be in music or painting; and, although I am no prophet, I venture the assertion that the time may come when our other sensory organs, taste and smell, will be known under similar law, and professors therein will be able to play upon all our feelings with the same exactness and beauty that our best musical performers do, and know the exact place for every note, color, shape, condiment, perfume or feeling in the harmony of life. It would be interesting, had I the space, and were I able to follow the analogy between music and painting further. But there are deep waters in color harmony as there are in music. Even Professor Dresser says that 'there are subtleties in harmony which are hard to understand.' My opinion is that the principle underlying high art, properly so-called, is that of recognizing the world, as a whole, as beautiful with all its evil, and hence is optimistic and not pessimistic, as generally supposed. The Bible even says that God created evil. Evil certainly exists, and we are wise as we make the best of it. There are thorns as well as roses, bitter as well as sweet. The highest art is in combining them harmoniously, making a virtue of necessity, and in discovering use and beauty in sounds, colors, and everything in which those who are uneducated see none. A writer on the æsthetic laws which govern beauty in forms, enumerates thus the principals equilibrium, stability, solidity, elegance, lightness, strength, proportion, suitability, complication, confusion, eurythemy, alternation, intersection. The term confusion or complication perhaps illustrates the high-art idea partly; excessive order and regularity are painful. There is order in the complication and confusion seemingly apparent in nature. It takes a master hand to bring order out of confusion, though. This appears to be Wagner's main idea. But there are charlatans in music as there are in painting who succeed splendidly in making confusion worse confounded. There are, no doubt, rules and laws governing all things.

"I think a great mistake is made by many in supposing that man, as he is now constituted, is able to subsist on spirituality, or on sweetmeats and perfumes. Give us, if you please, a little at least of plain food in our viands and in our art. A little of these higher laws may be good just to tempt us forward toward the heavenly and sublime, but do not feed us wholly on ozone; there is but a step from the sublime to the ridiculous. We are not yet angelic, and may perish by extreme cultivation. Respecting the ethics of art then, especially of high art, it assumes that there are more beautiful things in this world, or order of things, than is generally supposed; that dullness and discord even have their places; that men and women should not be miserable because the joys and pleasures which satisfied them in the springtime of youth have paled in using, inasmuch as the storehouse of nature is full of finer and more educated types of experience; that evil is a necessary factor in the sum of human happiness, as humanity is constituted; and that the world, as it is, is beautiful, as a whole, and can not be according to a better plan or more suitable for us. And so, therefore, when we see a confirmed grumbler going about and advertising himself as a miserable man, we may think of him as a very child, a young or old man, whose education is incomplete, or an artist who has not yet learned what to do with the dull colors and the discords of life."

The officers for 1887–8 were the president and vice president of 1886; N. S. Lapperr, treasurer, and B. S. Mills, secretary. The death of John Rowe was recorded in February, 1887. The strike of this year was serious to the journeymen, whose losses fell upon their families. On January 3, 1888, a resolution was adopted asking the journeymen or employes to permit the members of the association to look after their own affairs and binding the members to so look after their own interests in the face of every opposition from the journeymen. In November, 1888, the question of establishing the Painters' Exchange was settled, and the trustees authorized to rent quarters and manage this new department. The annual election took place in March, 1888, when M. J. Sullivan was chosen president; Messrs. Mills and Lapperr were reëlected, and Messrs. Valk, Burns and Remaine were elected trustees. In January, 1889, H. J. Milligan was elected president; R. H. Stewart, vice president; secretary and treasurer reëlected, with Edgar French, J. G. McCarthy and Garrett D. Green, trustees. The death of J. B. Sullivan was recorded this year. In 1890 R. H. Stewart was chosen president; George Stephenson, vice president; G. D. Green, secretary; F. H. Remaine, treasurer; W. Wilson, E. Norton and H. E. Brand, trustees. The president and secretary were reëlected in 1891, with William Wilson, vice president; Thomas Olsen, treasurer; A. Barker, George Stephenson and F. H. Remaine, trustees. There were sixty members reported March 5, 1891.

The work of the association to improve the status of the trade has been recognized. As a teacher it has been successful. A thorough course in house painting requires a perfect knowledge of nine departments, and it has been the object of the association to impress this knowledge upon employers and journeymen. The nine departments are outlined as follows:

Department I.—1. Explanation of the use of the various kinds of brushes. 2. How to tie up a brush. 3. How to hold and use different brushes; wrist practice, keeping hands clean, etc. 4. Preparing wood for painting, sandpapering, killing knots and sappy places, the injurious use of stout shellac on new wood, etc. 5. Making putty and puttying up nail holes. 6. First coat (priming); how to avoid plattering the paint, etc. 7. Second coat. 8. Third coat. 9. The care of brushes. 10. Manner of cleaning paint pots and keeping them clean. 11. The necessity of handling brushes cleanly, the danger of eating with dirty hands or allowing paint to remain on them, and allowing paint to remain under the finger nails.

Department II.—1. The names of the various colors and stainers and their use. 2. Grinding lead or any other color. 3. The different kinds of oil and their use; different kinds of dryers and when used. 4. How to mix white paint. 5. How to mix paint of different shades and colors. 6. The analysis of colors; their chemical properties. 7. Contrasts and harmony in colors. 8. Painting doors in three shades. 9. Burning off old paint. 10. Stippling and its use. 11. Polish white and enamel and their preparation. 12. Flat colors.

Department III.—1. Exterior painting; preparing brick, tin and wood. 2. Painting and flatting brick; penciling joints. 3. Painting tin and galvanized iron. 4. Painting wood, etc.

Department IV.—1. Glazing, bedding, etc. 2. Cleaning glass. 3. Reglazing; hacking out.

Department V.—1. Varnishing; first coat; rubbing down and flowing coat. 2. Polishing.

Department VI.—1. Wall painting; general treatment of walls for paint. 2. Preparing damp walls. 3. Preparing smoky walls. 4. Shellac on walls. 5. Sizing on walls; its use and abuse. 6. Painting walls in flat and oil.

Department VII.—1. Kalsomining or distemper; mixing kalsomine. 2. Plastering cracks, patches, and cleaning off old paper. 3. Sizing for paper on bare walls and painted ones. 4. Plain kalsomining. 5. Mixing colors. 6. Stenciling patters and borders. 7. Lining; how to hold straight edge and fitch.

Department VIII.—1. Treatment of different kinds of woods; cleaning, etc. 2. Staining. 3. Oiling. 4. Polishing, etc.

Department IX.—1. Paperhanging; explanation of tools used. 2. Making paste; ill effects of improper materials in paste.

The Painters' Exchange was first established at 172 Randolph street, but moved to 78 Fifth avenue in 1889. The principal exhibitors were Murphy & Co., the largest varnish manufacturers in the world; the DeGolyer Varnish Company, Berry Brothers' Varnish Company, D. B. Shipman, St. Louis Lead & Oil Company, the Southern White Lead Company, Collier White Lead & Oil Company, manufacturers of white lead; John W. Masury & Son, Heath & Milligan Manufacturing Company, Coffin, Devoe & Co., Graves & Company (of Philadelphia), and Wadsworth & Howland, paint manufacturers; Gerts, Lumbard & Co., manufacturers of paint brushes; James H. Rice & Co., window glass dealers; and J. Marshching & Co., decorators and manufacturers of bronze ornaments. There were other exhibitors such as McCully & Mills, George F. Kimball, Sherwin, Williams & Co., C. T.

Raynolds & Co., Cary, Ogden & Parker, Champion Paint & Color Company, Chicago White Lead & Oil Company, H. M. Hooker, Eckstein White Lead Company, American Varnish Company, Alstora Manufacturing Company, Western Sand Blast Company, Wright & Lawther, D. Webster, King & Co., Bridgeport Wood Finishing Company, E. Ehrman and Strahan & Foster.

The Chicago Paint & Varnish club is one of the new organizations which necessity brought into existence for the protection of manufacturers and dealers against the evils which these days of competition, promiscuous counterfeiting of labels and adulterations, foster. In July, 1890, the club was presided over by G. H. Vrooman, with the publisher of the *Review*, secretary; while P. P. Senour, of Chicago, was secretary of the National association.

In April, 1890, this club inaugurated the war against the system of exchanging paints, and asked the National association to adopt a similar measure. The Chicago paint firms who agreed not to take in exchange old stock of other manufacturers, signing the resolution were: Wadsworth, Howland Company, Senour Manufacturing Company, Bradley & Vrooman, Coffin, Devoe & Co., C. T. Raynolds & Co., Currey Manufacturing Company, the Alston Manufacturing Company, John W. Masury & Son, the Cary-Ogden Company, George W. Pitkin & Co., Goldsmith & Co., Aquilla Rich Paint & Color Company, and the Rubber Paint Company.

The journeymen painters produce employers daily. From their ranks come the master painters and decorators. There was no National organization of journeymen painters and decorators prior to the year 1887. March 15 of that year the Brotherhood of Painters and Decorators of America was founded. Its growth has been so rapid that it now has two hundred and fifty local unions. Chicago still clung to the Knights of Labor assembly 1,940, and did not come into the brotherhood until 1890. Between 1856 and 1871 the painters in every state had been striving to bring about an organization of the craft that would place them in a position to command that consideration and recognition from employers which other branches of labor had already obtained. In 1871 the New York Operative & Benevolent union formed the Painters' Grand Lodge. This organization extended into several states and held four annual conventions—three in New York and one in Baltimore. But the grand lodge fell at the time when the agitation for the eight-hour working day was greatest. In 1887 the brotherhood was organized, from which the four unions of Chicago have sprung. They struck work in 1888 and demand thirty-seven and one-half cents an hour and an eight-hour working day. This was altogether too big a dose for the employers to swallow with a grimace. They banded together to defeat the men. Knights of Labor 1,940 soon showed the effect of the belief in its omnipotence. The men grew dissatisfied with what they thought was mismanagement of their leaders. The bosses won the fight against the men, and from that moment the union collapsed. The painters and decorators were in a thoroughly disorganized condition. They imagined that victory was theirs just as soon as they declared a strike, but their confidence in their own strength was so rudely shaken that they grew disheartened and left Assembly 1,940 in hundreds. They were so discouraged that all attempts to reorganize were abandoned as futile. But the present Brotherhood of Painters & Decorators, which has arisen from the ruins of the Knights of Labor organization, has taken warning from the defeat of 1888.

After the total collapse of Assembly 1,940 in Chicago, and the disbanding of the twenty-four hundred members, no attempt was made to reorganize until 1889. One of the prominent painters in the old assembly did all in his power to rouse up enthusiasm among his brethren in the spring of that year. But the recollection of the utter defeat in 1888 proved a heavy hill to climb. The men thought it was useless to combine against their employers. The latter had shown such an unbroken front that the men despaired of ever breaking it again. The movement, however, was attended with some little success. The lack of interest in the union shown by the men soon killed his endeavors. The new organization languished for several months and then died away. It was like the final flicker of a burned-out candle—a breath of opposition was sufficient to put it out.

Though the time was not ripe for a new organization, in 1889 the leaders were working quietly for a new union. The idea then was to become connected with the Brotherhood of America, which had been established in 1887. March, 1890, a few painters called a meeting at 321 West Madison street, to form an independent union. It was a tentative movement, but the men who were at the head of it thought it best to try to bring the painters and decorators of Chicago together for the purpose of obtaining their rights. The movement was a complete success. After bringing the men to several halls to listen to their arguments, the leaders were determined to establish a branch of the brotherhood. This was done April 1, when the foundation stone of the new organization was laid by seven men—T. J. Mitchell, Charles Hanson, George Kunkle, C. Ingraham, M. Johnson, W. Blaire and George Erb. Two of these men were contractors. Monthly meetings were held at Bricklayers' hall. The organizers of the branch traveled every inch of the city to appeal to painters, decorators and paperhangers to join the union for their own benefit. The work was hard, for the mountain of doubt as to ultimate success had to be overcome before the men could be induced to join. There was plenty of enthusiasm at the meetings, but the men did not join quickly. They were waiting to see if others would join. The refusal of the leaders of the old assembly to accept the compromise of thirty-five cents an hour in 1888, caused many of the men to hold back from the new union, No. 147. Perseverance, however, accomplished the object aimed at by such energetic organizers as T. J. Mitchell and Charles Hanson. Union No. 184 was established at Englewood in August, 1890. Two months later Union 191 was organized, and in November, 1890, Union 194 was added to the list. The success of the brotherhood in Chicago has been unprecedented in the history of the painters and decorators. Within a year the number of members has grown from the original seven to more than fifteen hundred. Union 147 has five hundred members, and so has Union 191. Union 194 has three hundred and fifty members, most of whom are Scandinavians. Charles Hanson is the president of this union. There are one hundred and seventy-five members in Union 184.

In January, 1891, the Painters' council was formed as a general legislative body for the members of the different unions. The present officers of the council are: S. D. Ohlson, president; O. Hall, vice president; James D. Teel, secretary; William Stevenson, financial secretary; T. J. Mitchell, treasurer; E. Ronan, sergeant-at-arms. T. J. Mitchell is the district organizer and also holds the position of president of Union 147. The other officers of 147 are: D. J. Ronan, vice president; James D. Teel, secretary; William Price, financial secretary, and James Glackin, treasurer. The present officers of Union 184 are: William Stevenson, president; George Wilder, vice president; Frank Hall, secretary; John C. Higgins, financial secretary; Peter Bell, treasurer, and J. Newman, preceptor. S. D. Ohlson is the president of Union 191, and J. Green is vice president; L. Bunyon is recording secretary, J. F. Chandler, financial secretary, and D. Lewis, treasurer. Charles Hanson is the president of Union 194. Each union sends three delegates to the Painters' council. The objects of the brotherhood are to obtain an increase of wages from twenty-seven to thirty-five cents an hour and the eight-hour day. The rapid increase in membership has made them feel that a day will come when they can demand with success all that they desire. They are often exposed to the heat of summer and the frosts of winter, and to dangers of life and limb. Their work causes them wear and tear of clothing, and to counteract the poisoning effects of the materials used it is absolutely necessary for them to eat wholesome and nutritious food. They feel that they are not properly recompensed for their skill and toil, for their risks and for the years spent in learning the trade. This is why they organize, because they know that without unity among painters and decorators they can never hope to fight against unscrupulous bosses and grasping capitalists. They do not believe in inciting strikes, yet they will in future whenever trade difficulties are forced upon them sustain each other to the victorious end. They have not combined to form a secret organization only so far as it is necessary to protect members.

The pioneer house painters and decorators of the city were J. M. Atwood (Randolph), James Bond, Cleveland & Co. (Dearborn street), A. Cole (129 Lake street), Wayman & Dimmock. Olivier Lozier, Louis Mason, John A. Oliver, Noah Sturtevant, William Wesencraft (Clinton and Monroe streets), and Alexander White (North Water street). They were all here in 1839. The resident painters in 1843 are named as follows: Alexander White (died in 1872), A. Frank, Oliver Jagger (4 Morrison's row), H. N. Morgan (died in 1852), John A. Oliver (died in 1887), A. H. Palmer, Thomas Rees, James Robinson, Thomas Shergold, L. G. Sinclair (died in 1860), Noah Sturtevant, James B. Wayman, Samuel Wayman, William Weisencraft (died in 1862), Henry Atkinson (died in February, 1871), J. Baldwin with Dimmock & Stowe, Samuel S. Barry (Monroe near Clark), N. S. Cushing (Monroe near Clark), Alphonso Bent (later Gaylord & Bent, died in Missouri, June, 1863), James Bond, Charles Calson, Mark B. Clancy with A. White, O. J. Clark (Hastings street), Alvin Cleveland (Madison west of Clark), Dimmock & Stowe (202 Lake) and John I. Dow & Co. (40 Clark). Six years later (1849) the directory gives the names of the following journeymen and master painters: M. Aign, with Gurnee & Hayden, Atkinson & Williams (102 Randolph), Matthias

Barth, T. C. Benteen, A. Bird, T. Blaney, Jacob Blum, James Bond, Daniel Brobston, P. Bumgarten, O. Burton, M. Butler, Miss H. Case, I. S. Chamberlain, G. P. Chapin, —— Chapman, Oliver Clayton, F. D. Clisbee, John Craggs, David P. Daniel, E. Dimmock & Co. (47 Franklin), Henry Dingman, William Dingman, A. Fankhauser, Thomas Frazier, Louis Gerber, Edwin P. Groom, L. G. Hager, Alanson Hall, Austin Handrehan, Hans Hanson, William Hardy, George Hartman, John Hearse, Samuel Helms, J. Hogbruin, N. Hurst, Thomas Hutton, Henry O. Irish, T. Jackson, O. Jagger, J. B. Johnson, John Kennedy, Stephen Kimball, G. Knapp, Adam Kuhr, F. W. Legg, E. P. Lewis, Thomas Lonergan, John Miller, E. Morey, D. Newberger, Magnus Noble, Jerry O'Neil, Alfred H. Peats, Henry Penny, William Plumb, J. A. Rigby, Alexander Robinson, A. Rowley, Mark Scales, L. G. Sinclair, William Sissons, L. D. Strong, Ed Trudeau, J. Vierscheilling, William Villes, Isaac Wright, Wayman & Dimmock, William Webber, Peter Webber, Jr., Alexander White, Samuel Wilson, J. Thompson & Co., F. B. Young.

The fresco painters in 1859 were Leopold Beckert, 56 Wells; Chambers & Dubois, 115 and 117 Dearborn; Doussaent & Wachter, 218½ Wells; Gottig & Fritz, 44 La Salle; Jevne & Almini, 101 Washington; Klienhafen & Rasmussen, 205 North Clark, and J. E. Reas, 230 State.

The ornamental painters included the above named with Blake & Felch, 91 Randolph; E. A. Bowen, 100 Dearborn; W. & E. Cooke, 313 State; Anthony C. Daly, Court place; Drake & Brother, 224 South Clark; Gettins & Sullivan, 209 Chicago avenue; Lewis Horn, 149 North Clark; Miles Hobley & Co., 151 North Clark; Thomas Nelson, 17 Michigan avenue; Charles Stephens, 166 State; Wesley & Barron, 24 North Clark, and E. C. H. Willoughby, 166 State.

The above named also appear as house painters with Alt & Zwissler (193 West Lake), Barry & Cushing (92 Madison), William Bellin, Brechbill & Smith, Daniel Brobston, Joe Brund, J. & D. Champion, Benjamin F. Chase, Clettenberg & Brother, Coburn & Corliss, W. & E. Cook, John Cragg, John Dewald, T. J. Dunn, Robert Elliott, Peter Emmell, Peter Engell, John Gimbell, Thomas Harris, Heath & Hurd, H. A. Hendricks, Hill & Cuttin, E. H. Hitchcock, Hodge & Gilmore, Louis Horn, Theodore Hodge, George Howard, C. W. Hummer, Kallenbrun & Co., Bezer Keith, A. H. Kluss, H. N. Lathrop, Theodore Lattan, John Lilly, Mollier & Messinger, Patterson & Elder, Joseph Reis, F. E. Rigby & Son, John Robb, Benjamin F. Robbins, G. Schaaf, Schock & Worley, Otto Sleitz, Trowbridge & Reed, August Ulrich, Solomon Unger, A. B. Van Doren, William Voegtlin, Walzem & Karle, Weber & Doeten, Werley & Barron, O. S. Williams, Lewis Young, and Zander & Brother.

The leading dealers in oils and paints in 1869 were Chase, Hanford & Co.* (179 South Water) and F. E. Rigby (89 Randolph); Ferguson Brothers were manufacturers of linseed oil on Jackson and Clinton streets; Monahan & Myers, paint manufacturers; George Pitkin*, dealer in mineral paints; Fuller & Finch (22 to 26 Market street), C. H. Cutter & Co., J. B. Sullivan & Bro.*, C. T. Raynolds & Co.* (59 Michigan avenue), Hansen & Waldhauser, L.

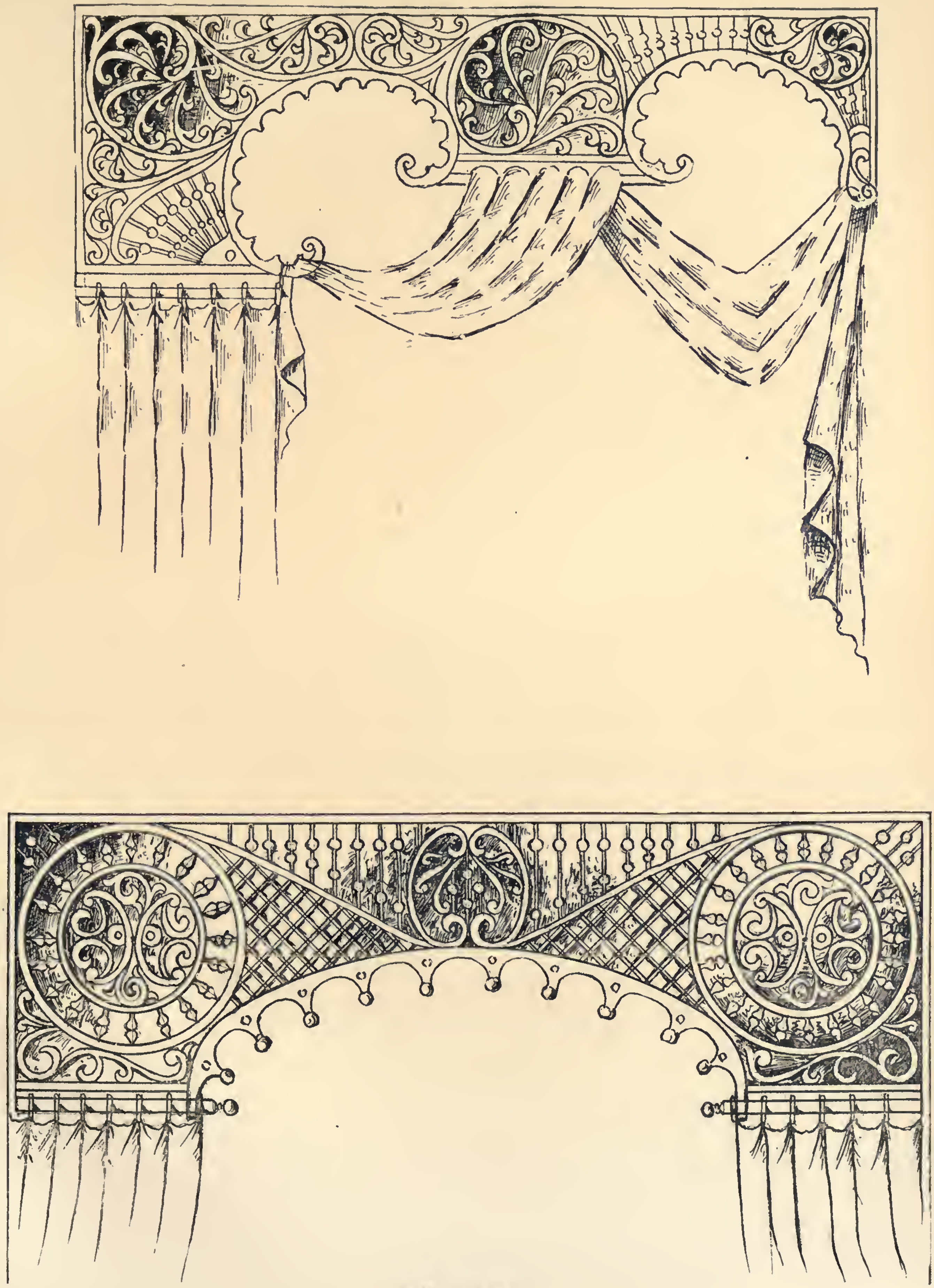
* Were here in 1872, with E. S. Alexander, E. R. T. Armstrong, J. F. Weare, Wolcott, Smith & Co., Cory, Barrett, Hanna & Co., and a few others.

Bridges, Lewis Hane & Co., Page & Sprague, Pennsylvania Oil Company, and Tolman & King, dealers in paints, oil and glass. The Colgate Varnish Company and the Enterprise Varnish Company were in existence in 1869.

The house and sign painters of 1869 were Barry & Cushing*, George P. Beardsley*, Alexander Drake, J. H. Forsyth, Warren Gilmore, William P. Lockwood, H. E. Osgood, Joseph Pearson & Son, Robbins & Carroll, Henry Schiessle, Smith & Jenkins, J. B. Sullivan, Van Doren & Co., Frank Warren, H. D. Beeson, Chase & Hild, H. M. Percy and L. Beckert. Alexander Drake, 184 Clark; J. J. McGrath, 78 Randolph; Chase & Walker, 109 Randolph; M. A. Howell & Co., Spear, Prince & Co., Allen & Mackey, James Durham, Bellamy & Haskins, and F. E. Rigby, Jr., were the leading paperhangers and decorators in 1869.

The house and sign painters of 1872 were Barry & Cushing*, 145 State; Bauman & Patzen, 142 Clybourn; George P. Beardsley, 119 South Jefferson; L. Beckert*, 44 Fifth avenue; R. P. Bell* & Co., 149 Eighteenth street; Bischoff & Maxwell, 321 Division street; F. Blackburn, 145 Fourth avenue; Boughton & Seymour, 1018 Indiana avenue; E. A. Bowen, 89 South Hoyne; M. Brand*, 297 North avenue; Brandell & Germain, 312 Larrabee; Louis Brittin, 244 West Randolph; Brookfield & Siebert, 439 Milwaukee; A. L. Brumfield, 661 West Lake; James C. Burns, 204 Illinois; James N. Burns, Sedgwick and Grant place; Burns & Co., 25 Menominee; Cheney & Benzler, 622 North Clark; E. L. Clements, 9 Vincennes avenue; Dahinden & Schroeder, 173 Milwaukee avenue; W. E. Dankert & Co., 63 Clybourn; H. Daverkosen & Son, 369 Clybourn; S. C. Demarest, 145 Twentieth street; Thomas Dempsey, 1400 State; H. C. Dingman, 687 South Halsted; Dixon & Renshaw, 39 North Wells; George P. Dodge, 665 Wabash; Dodge & Minsen, 210 Madison; Doyle & Clancy, 1507 State; George V. Drake, 211 South Peoria; William H. Emmerson*, 622 Wabash; Ed Fischer*, 921 Clark; G. Frauenberger, 210 North Wells; B. Freckman, 92 Randolph; J. Frudenthall, 823 State; Funnel & Silk, Harrison and Fourth avenue; Patrick Furey, 1556 South Halsted; Albert Guade, 319 Larrabee; Matthias Gillen, 278 Arnold; David Goldberg*, 750 State; E. S. Goold, 96 South Desplaines; G. F. Harris & Co., 348 Wabash; Hatch & Pratt, 199 Chicago avenue; John Hawkshaw, 842 West Lake; A. Hayner, 603 Wabash; G. H. Hickman, 98 Twenty-ninth street; S. S. Hodge, 271 West Taylor; J. E. Hood, 51 North Clinton; George Howard, 100 West Lake; Hunt & May, 103 Archer avenue; Peter A. Huss, 155 Hubbard; H. Johnson, 130 Johnson street; R. Jones*, 200 West Madison; H. Kurtz*, 321 Fourth avenue; C. Kurtz*, 599 North Halsted; Louis Lattan, 74 West Randolph; Charles Leanthall, 39 South Union, Lehman & Haskell, 18 Harrison; L. A. Lightenborne, 908 West Washington; Henry Lovi*, 718 West Lake; Lund, Alloway & Co., Ann and Carroll streets; Martin & Leonard, 125 West Madison; Mayhew & Zurist, 24 West Randolph; James H. McBride, 38 West Madison; John McClelland, 18 Harmon court; J. McDermott* & Co., 63 South Jefferson; W. McIlcole, 265 West Lake; Charles Mehmeil, 27 Vine street; Mills & Dabb, 919 State; Joseph Minogue, 369 Wabash; Morrison & Brother, 346 State; G. H. Morton, 233 Cottage Grove; Thomas Nelson*, 629 State; Denis Norton, 630 State; Thomas O'Neil,

* Here in 1879 also.



GRILLE WORK.

196 Twenty-Sixth street; Oosterling & Paridon, 420 West Harrison; Overbeck & Co., 122 North Wells; W. A. Reason, 711 State; Julius Roberts, 344 West Van Buren; H. E. Rossing*, 189 North Clark; Henry Rudling, 1344 State; Saalfield, Vorbeck & Co., 696 Wabash; Safarik & Peek, 453 South Canal; Thomas Scheidecker, 195 Church; H. Schiessle*, 218 Chicago avenue; Schlau & Schlau, 252 Division; Schmitt* & Zahner, 309 State; Jacob Schram, 152 Hurlbut; John Seamus, 106 South Sangamon; F. W. Seyer*, 133 Clybourn; Sickel & Luth, 32 Willow street; Henry Subellin, 775 North Halsted; Sleeper & Wilkinson, 196 West Madison; E. Smith, 289 Division; Fred F. Smith, 244 West Randolph; T. H. Smith, 85 Twenty-Ninth street; Patrick H. Stanton, 113 Hubbard; Stevenson* & Myers, 112 Clark; J. L. Storms & Co., 383 Wabash; W. & R. Strang*, 337 West Randolph; Straub & Moran, 1485 State street; Alfred J. Stronts, 43 West Washington; Svenson & Lind, 148 Townsend; S. W. Swift, 133 La Salle; C. W. Sword, 1013 State; J. C. Tanner*, 101 South Clinton; F. R. Thormeyer, 142 North Wells; F. W. Thomas, 1065 State; Tighe & Ehmes, 112 Eighteenth street; A. B. Vandoren, 476 Wabash; Joseph Wallner*, 224 Mohawk; Walter & Steinbrown, 173 Catherine; Wank & Sutterloh, 315 North Ashland; F. Warren, 52 Third avenue; James Warwick, 728 Cottage Grove; Peter Webber, 332 North State; J. H. Whiting, 340 State; Woollensen & Anderson, 169 Milwaukee, and Theodore Zander, 148 Clybourn.

The house and sign painters of 1879 other than those who were here in 1872 and earlier years and residents in 1879, are named as follows: Allaway & Scherning, Harry Allen, Jacob and William Alt, Charles Ament, Buckli Brothers, D. T. Bagley, C. W. Barnes, S. S. Barry & Son, R. F. Beckwith, Beemer & Co., M. Beitzel, J. W. Bickerdyke, Bermingham & Strong, Henry Bocsh, Harry Bristow, S. V. Brobst, C. J. Brown, Burdick & Beck, August Burdt, J. C. Burket, H. Busching, A. M. Buth, G. W. Carney, C. Carstens, Philip Caulfield, B. F. Chase & Co., Chipman & Weston, Henry Collins, Collins & Duffra, W. L. Constantine, Frank A. Crandall, Cushing & Geary, John M. Dahl, Nathan Davis, William Dillon, J. Dion & Co., J. Doerr & Co., M. Dougherty & Co., Eugene Douglass, T. W. Draper, James E. Duffy, William Dumain, Thomas Duncan, James W. Dwyer, John L. Eckert, Peter Emmel, M. Erl, Joseph Forsyth, Thomas Fraser, Frazee & Dowie, Fred Fuller, John I. Fulsen, Henry Funnell, Peter Gausman, John H. Gattrell, John Grasser, L. S. Grout, Thomas Hancock, W. H. Haskell, Henry Hawes, John S. Henry, A. R. Hensel, Thomas Hill, Charles Holmes, E. H. Humphrey, C. G. Hunt, Janssen & Schubert, Samuel Jenners, J. J. Johnson, John Karl, Terence Keegan, George Keller, R. Klienhoffen, Krieger & Pitchman, William Kroemer, Maurice Lacy, Daniel F. Lee, Michael Lehman, Nathan S. Lapperr, Reuben Lott, George Manning, Louis Maypenney, C. Matthial, T. D. McCarthy, Edward McCaffrey, John McCallum, Jerry G. McCarthy, McCarthy & Underwood, Alexander McDonald, McLaughlinn & Mott, M. McNulty, M. A. Mease, Fred Meier, J. S. Miller, Henry J. Milligan, J. D. Milliken, O. D. Mooers, William Muller, Murray & Watson, Newman & Stuba, George Norton, C. Offenloch, Oliver & Morselow, John Orteman, Otto Brothers, John Paulding, S. J.

*Here in 1879 also.

Peardon, Penfield & Triman, Joseph Pullock, Adolph Reichel, Remien & Hilgert, John Renshaw, Robbins & Carroll, Julius D. Roberts, R. B. Roseman, David Rosenstein, Samuelson & Olsen, William Saue, A. Schoubey, William Schubert, Scott & Son, E. F. Shaw, George Sheffield, George E. Smith, Smith & Himrod, J. W. Stoetzel, William Stonehouse, R. Stuivinga, Sutton & Johnson, C. Sword, Tehle Brothers, Henry Thomas, Byron Van Dyke, H. Versema, A. Wagner, John H. Wayman, G. W. Weedon, Charles Wetzel, Thomas Williams.

The calciminer was unknown in Chicago until after the war. His position was filled by the whitewasher during the earlier years of the city. In 1849 the whitewashers of the city were Henry Johnson, S. Long, Fred Beaumgartner, Sherman & Jackson, John Cannon, George Sublit, John Collins, Henry Hamilton, William Thompson. Twenty years later the calciminers were here in force, and many of the painters made this system of whitewashing a branch of the trade. The master calciminers of 1869 were J. H. Forsyth and F. E. Rigby, Jr., and the only whitewasher — John Kribill. Ten years later there were nineteen calciminers here—C. Balchli & Co., Coleman Brodd, Fred Brettle, Beverly Champ, Charles Harder, Theo. Holzapfel, John Johnson, Howard Lewis, George Meineger, Fred Mohr, Morrison & Brother, Henry Orthman, John Powell, J. Ruebhausen, Thomas Simpson, Frank Stoever, C. Tuebor, William Tucker and C. Schneider. Modern times have suppressed the line between the calciminer and painter and the painter and frescoer in many cases. A contract for painting may include the other two branches, and, by a little further extension, paperhanging as well. Although there are men within the trades who devote special attention to each branch, great numbers of house painters can and do perform the work of the specialists.

Wall paper may be said to have its birth in the Renaissance, when science appeared, hand in hand with nature, assisting the artist. It became apparent to both Italians and French, at an early date, that a study of the rules or mannerisms of the great painters, a knowledge of the scientific measurement of color, was a necessity in house decoration, even more so than in scenic or portrait painting. This was correct, because the decorator who claims to do original work has nothing before him as an example, and has, so to speak, to create a subject. In the successful accomplishment of decoration he must be aided by a precise knowledge of the two sets of primary colors, i. e., of the colors of the three primary pigments and the colors of primary sensations. The more thoroughly he applies this knowledge the better the work.

This fact, once accepted, gave birth to designs for wall paper, and led to all that harmony which now obtains in the cheaper grades of paper, as well as in the expensive relief papier maché.

The history of wall paper is interesting to the politician as well as to the house owner. A few centuries ago its use was confined to Italy, Spain and France, its manufacture spreading out from the first to Spain and France. Toward the close of the seventeenth century the French introduced the paper to the wealthy classes in England, and, in 1662, George Tomlyn patented an improved method in which the roller press and engraved plates were the leading features. William Bayley invented another method about thirty years later.

Meantime great improvements were made in the manufacture of wall paper in the civilized countries of Europe, so that the British consumer sought French paper, and ignored his own countrymen's product. This led to the first prohibitory laws of England and to the immigration of a number of French paper manufacturers.

Gold paper was first produced by John Hantsch, of Murembourg, who used an amalgam of tin and copper for gilt paper, up to his death in 1676. One hundred and seventeen years later the Eckhart system of gilding paper was patented; but the German and English gilt papers were never used by those who were able to purchase the French goods, and hence at the close of the eighteenth century the British extended the protection to this branch of the trade.

It must be remembered that the wall paper of the period was not attached to the walls as at present, but in the form of textile hangings. To place within the means of the people a chance to mimic in their homes the beautiful frescoes and mural hangings of the wealthy classes, was the object of Reveillon of Paris, who was the first manufacturer of wall paper. Establishing a workshop at Belleville, in 1680, he engaged artists and entered on the work of producing the decorated paper. For two years he carried this enterprise forward, but owing to the poor wages given to his employes, they rebelled in 1682, and burned the shops. The government aided him in restoring the industry, and shortly after he adopted the block system in lieu of the painting system.

In 1724 the marbling process was invented by Jones & Rodwick. The Deighton method was patented in 1753, and the long, light blocks used in former years began to give way to a truer system. One Balleyreaf introduced fine coloring in 1754, and ten years after the beginnings of embossed paper were made.

The same year (1764) the Fryer machine for printing colors on leather, silk, cotton and paper came into use. Copper cylinders and leather rollers marked this invention. In 1786 the Bunnett machine provided for the printing of an indefinite number of colors on ten pieces of cotton at the same time. Ten years later the Walshe patent for heated brass plates, to prevent the spreading or clogging of size and colors, was introduced. The Eckhards—Anthony G. and Francis—contributed valuable improvements, their Italian workmen being the inventors. In 1796 the Hancock patent for embossing wall paper was recorded, but his system gave place to that of Thomas Cobb, in 1822. Three years after the Louis Robert attempt at endless wall paper was made, but Dudot's venture to make paper from twelve inches to one hundred and forty-four inches wide without seam was the first success, and not until 1805 did the endless sheet become a reality at the hands of John Brul. The Cooper method of producing pictures on paper, at stated distances, received some attention in 1816, while Poole's design impressor from engraved plates and his system of hand painting the impressions mark the same year. In 1820 the plain stripe machine was introduced; in 1835 the wire-lines of Fisher Tanner; in 1846 the color-supply regulator of H. Potter and the old age of wall paper manufacture became a matter of history.

American wall papers were originally copies of French and English goods, but after the trade had assumed imposing proportions, and manufacturers began to get wealthy, a stand was made for producing goods of strictly American design. This idea was greatly fostered by the establishment of a wall-paper pool, which by supporting the prices, gave manufacturers an opportunity of rivaling the finest goods made in either France or England. During pool times American designers and block-cutters obtained very remunerative employment in preparing original and elaborate patterns, but since the breaking up of the pool, with the result of free competition in prices, the result has been that ten factories have been forced to go out of business, and the remainder are straining every nerve to economize in the productions of their factories.

It is true that those firms who made a reputation during pool times for producing superior goods still turn out beautiful designs, but these are not so plentiful as formerly.

In England and France there is not the same desire on the part of the public for having new designs in wall paper every year as there is in the United States. Competition in wall paper in Europe is based upon the intrinsic merit of the designs themselves, whereas competition in the United States is based, to a great extent, upon the efforts of the machinery, the aim of each manufacturer being to turn out more goods than any of his competitors. The American system of producing a new set of patterns every year, has had the effect of educating the American people to demand fresh effects every season. The case is somewhat similar to a man who has had hot rolls for his breakfast all his life. He is bound to have hot rolls every time, even though he is killed by eating them. American taste, therefore, has been largely suppressed, or killed by being fed on mere novelty, instead of artistic productions. A pattern that sells in England for twenty consecutive seasons would be voted stale at the end of twelve months in this country. Notwithstanding these drawbacks in the manufacture of American wall papers, there are certain special lines of goods made here that are not made elsewhere, and therefore, people requiring such goods must necessarily purchase American productions. We refer to the Colonial style as a strictly American product. This style is unknown in both France and England. Of course, it is a revival of the classic styles that prevailed in the colonial times, all colonial buildings of the better class in America being modeled upon the classic styles then prevailing in Europe. There is also the Romanesque style, introduced and elaborated in American architecture by the late architect, Richardson, of Boston. This style also is largely represented in domestic wall papers.

In floral designs and geometrical arabesques, the American papers are much less flamboyant in style than the corresponding English goods, and are more suited to wall surfaces in color tone than the highly elaborated French papers, some of which almost sufficiently decorate a room without the addition of furniture. We do not consider it good taste to employ a wall paper having as many as twenty different colors, as some of the French papers have, or a motive such as a large bouquet of flowers, having the appearance of standing out a foot or more from the wall. American floral designs lie flat upon the wall, as becomes their character as a background, and in this the papers possess a decided advantage over many of their foreign prototypes. The small size of the apartments in American houses necessitates a much smaller floral motive, for English wall-paper designs are intended to cover the walls of the immense apartments that prevail in a large proportion of the better class of houses in England. In special effects the American papers present combinations of the most artistic character, that it would be hard to duplicate elsewhere. The following are a few of the leading specialties.

In lacquer papers the special treatment of mica in printing both the ground and the design calls for the greatest commendation. The design is so accurately blended with the ground that, in holding the paper at a certain angle, it is impossible to see where the paper begins or ends, as the sheen of the paper is exactly alike over both ground and pattern. The mixing of the mica with the ordinary pulp colors employed gives a curiously blotched look to the design, which is extremely artistic, and is a refreshing method of printing wall papers, because it is so different to the ordinary solid tint that is so often employed.

In American pressed goods there is great elaborateness manifested both in the design and coloring. These papers more nearly resemble Japanese leather papers and Spanish illuminated leathers than anything else we know of, and are eminently suitable for halls, libraries and diningrooms. One firm manufactures a line of leather papers that are known as "cedar bas-reliefs." They are so called because they are made from the fibers of the red cedar, a material that is fragrant, sanitary and durable. Leather papers are more or less conventional in style, and after being applied to the wall can be coated with lacquer, or stained the desired color; then by wiping off the high parts of the pattern, the effect of old stamped leather, stamped metals, pottery, or colored ivory can be produced.

In many pressed papers all the vagaries and brilliancy of hand-pressed plastic relief work are produced, and it is hardly possible to distinguish such papers from sheets of brass cast in relief, ivory carving, burnished copper, or illuminated leather.

A feature of American wall hangings is canvas, or burlap hangings. The design is a stenciled flower, or heraldic arabesque, printed in dull colors at regular intervals on the ordinary uncolored surface of the fabric, which looks like well-beetled bagging. It is unique and cheap, two prime factors in popularity.

Brocatelle grounds form an effective class of American goods. This brocatelle ground is very peculiar. It has an invisible bronze effect, quite distinct from the gold or ordinary bronze ground. The metal is seen to gleam in a finely powdered state, thoroughly mixed with the tint, and it more nearly resembles a piece of real bronze metal than anything else we know of. The designs are generally in floral effects, and some of these are in three or four shades of olive, drab, pale red, pale green and other colors on variously tinted metallic grounds.

Ingrains are an American idea, the original inventor being Mr. Monroe, of Boston; hence the term "Monroe Ingrains." Nearly every manufacturer makes a quality of ingrain peculiar to himself. In small apartments there is no form of wall decorations so charming and agreeable as a softly tinted plain ingrain. Beautiful friezes in flat tints outlined with flitter, or in various lines of flock or cheviot are prepared as friezes for ingrain decorated walls.

The common papers produced at London, England, are more popular than elaborate. Their washables, plain and varnished, receive special attention, and their popularity increases with enormous bounds. They also produce other classes of goods—fine staircases, golds, and very fine tapestry designs. A class of goods not made to any extent by American manufacturers are nursery papers, and this firm produce a Gilbert and Sullivan nursery paper of which they are justly proud. It has pictures from all the comic operas of these gentlemen, and presents a most amusing variety to the eye of the child. The Jeffreys also print nurseries of the first order of merit, very different from the usual monotonous abominations that go by that name. Their "Sleeping beauty," for instance, is a work of art.

There are many other English wall-paper firms producing work of equal excellence to those above named, but space will not permit further attention to this most interesting subject. We will content ourselves by giving some description of these broad, free, artistic effects of the English papers: One pattern is a floral design in three shades of buff and a cream mica ground. The design is by Arthur, of London, but the particular paper represented is an American reproduction by Strahan & Co., of Boston. The original paper cost $1.50 a roll, but the American reprint, fifty cents a roll, a fact that even high-class decorators, who deal "exclusively in imported papers," are not slow to appreciate.

Another design is a mica by Arthur, reproduced by H. W. Birge & Sons. It is a large, free floral pattern in three shades of blue on a white mica ground. The pattern is thrown upon a pale blue reed pattern in the background, which gives depth to the entire decoration.

A real English paper is made by Saunderson & Co., of London. It is a large lily pattern, made expressly for the American market. The lily is in white mica with smoke-colored shading. The pistils of the flower and granulations on the petals and tips of the leaves and stems are in yellow and chocolate. The ground is a light blue, having a dark blue floral stencil. It is altogether a splendid example of pure realism in decoration, more suitable as an ornament in itself than as a mere background for pictures or furniture.

French papers exhibit the ne plus ultra of decorative art. Some of the specimens examined are superior to anything produced in wall papers elsewhere. There is originality of design combined with marvelous grace of execution, produced in the purest and most tender of colors. Many of the designs are reproductions of the refined voluptuousness of the eighteenth century, when woman reigned supreme. The Louis XV style, with its grace, coquetry and apotheosis of refinement, reproduced in modern tapestry brocade, damask, chintz and cotton papers; the Louis XVI and Marie Antoinette styles, with their triumphs of nymphs and birds, their delicate garlands of flowers, their delightful carvings and flutings, the joyous dances of ribboned shepherds and shepherdesses, their worship of Cupid, are revived in papers which, glorified by art, seem too tender, too priceless, for mere mural application. For bedroom and boudoir a jonquil-colored chintz paper with its delicious garlands of natural flowers is by all odds the most graceful decoration possible.

In direct antagonism to all this brightness, French tapestry papers are marvels of somber austerity. These papers are usually embossed in corded lines and the designs covered with a network of black lines or dots to represent the rough threads of the woven fabric which they imitate. Some of the designs are grotesqueness itself. One has a kind of guillotine for the motive, with screw clamps to hold the victim down. Another has a dog with an eagle's bill, rampant, supporting a bush like a giant asparagus. Other papers are examples of excessively somber blues and greens, the motives being floral with legendary or real animals. A semicircular dragon with a dog's body or a dog with dragon's wings takes possession of a design. He sits on the outspread leaf of a rambunctious thistle, his back forming a Roman arch. The feathers of his wings look like planks from Noah's ark. The prevailing colors are dark blues, grays, greens and reds on steel-black and sad green-gray grounds. The tone of these tapestry papers is too somber, with too much repose, for the average American, who demands more cheerful colors on his walls.

The cheaper French papers incline to the brightness observable in the more costly productions. There is a total absence of that harsh mechanical expression observable in American machine goods. For bedroom papers in particular we commend the following examples: First, clear red flowers and dull green leaves on an embossed cream ground. Second, a large blue iris with gray-green leaves on a smooth drab ground. Third, a cretonne paper, roses and carnations on a light-cream ground. Fourth, a bouquet of wild flowers on a French-gray ground. Fifth, large red and blue carnation with olive-green leaves on a pale blue-cream ground. Sixth, a chintz paper; wild red roses and blue and red chrysanthemums, with olive and sap-green leaves and stems, on a light drab ground, shadowy flowers in the background. Seventh, a bouquet of garden flowers, dewy roses, poppies, clover, etc., in natural bloom on a crystalline-blue ground—a superb paper, with colors of the brightest and purest tones. Eighth, flowers in two shades of white on a pale cinnamon-brown, satin embossed, crystalline ground. Ninth, oak leaves in autumn, in brilliant reds, browns and yellows, heaped on each other, with variegated hummingbirds and butterflies flying about on a pale azure ground, shadowy leaves in the background. Tenth, roses, red and yellow, dropping to pieces in infinite richness, with bright blue bonnets, on a pale-cream ground. The frieze is a marvel of enormous roses, white, red and yellow, with bright soft green leaves on a pale-blue satin ground. There is not a particle of metal on any of the examples named.

A strange motive is seen on a gold paper—gold, red and blue thistles, inwrought upon a shield of open network meshes of gold cord. The border of the shield is a circle of heavy reduplicated gold braiding, fashioned in oval form on a green-drab ground. Another design is a French tapestry pattern. The motive is an old-fashioned rose in four shades of red, with foliage in a sap-green tint shaded with clay-brown and sad steel-blue. The ground is a cream tint. The design is by Zuber, of Alsace, but the paper itself is an English reproduction.

The following principles have much to do with the successful decoration of an apartment;

First. Papers with perpendicular designs tend to highten the wall and raise the low ceiling.

Second. A large pattern is not appropriate for a small room, as it will make the room look smaller.

Third. Yellow tints bring the walls near the occupant, while blue tones make the room appear larger, and red colors preserve its actual size.

Fourth. While furniture and costumes show to better advantage when the walls of the room are dark, yet it is safer to obtain as much happiness and cheer as possible by means of the lightness and brightness of your hangings.

Fifth. A chamber with a cold northern light can be warmed and cheered, while a room flooded with southern sunlight can be shaded and subdued, by the choice of proper colors in the paper.

Sixth. Having chosen the paper for a wall space, the frieze ought to be lighter, brighter and more elegant in tone than the wall filler itself.

Seventh. A low ceiling requires light, dainty, delicate patterns and colors, surrounded by a strong stiling and bright border.

Eighth. A high ceiling requires a dull ground, large figures, broad stiling and heavy border.

There are papers which permit a close observance of the eight principles given, and no excuse can be offered for non-observance. The same principles apply to lincrusta Walton and other relief work, as well as mosaic and metal decorative material.

The decoration of walls is as old as the historical period. It was begun by the stone and marble sculptors of Egypt, who left their low relief work on the interior walls of temple and of tomb. The marble and alabaster veneer succeeded sculpture, and enameled brick and tile followed the veneer. The age of figures in stucco for the interior came with Mahommed, as opposed to the rich Italian exterior stuccos, and this was followed by the ages of embossed leather, painted cloth and paper hangings. In the painting of walls Egypt led the way, followed by Greece, Pagan Rome, Christian Rome, Spain and France. The Aztecs and ancient Peruvians decorated their walls with engraved wood, the engravers using the glass chisel in their difficult work. Not content with the relief on stone, marble, stucco, alabaster and wood, the Caucasians, Asiatics and Aztecs resorted to colors, and in the greater number of instances shaded the figures raised by the sculptor. They had almost the identical ideas of color symbolism which are held by the people of the present.

The decorator in paper work has undoubtedly advanced his art within the last two decades. This fact is so well recognized that it is a question whether he has not outstripped the architect, the painter and the sculptor in the race for superiority. William R. Bradshaw, in his paper on decorative art, tells of this wonderful advance. There is a great variety of decorative specialties for walls, made of paper fiber, which do not come under the head of wall paper. The process of manufacture is different in each case from that of wall paper, and, generally, each specialty has its own peculiar method of production. There are a number of decorations for walls in paper relief that bear a strong typical resemblance to each other, such as papier mache or paper stucco, anaglypta, lignomur, Venetian leather, etc. These substances are hard, thick cartridge papers pressed into high or low relief, generally when in a soft state, and are sometimes as hard as boards and of varying degrees of density and thickness. Some are prepared with a plain white surface, which, after being applied to the walls, can be decorated in any style of art, while others are made already decorated and only require application. Decorative sheathing of this kind is, of course, more expensive than ordinary wall paper. There is a distinct tendency at present to get away from the flat decorative effects of wall paper and fresco work, and to cover walls with imitations of hand-carved or hand-molded ornament—a species of incrustation that seems to fill the gap between the utterly flat decoration of the painter and the sculptures of antique decorators, such as are seen on the walls of the Alhambra in Spain, the interiors of Mohammedan mausoleums in India and the temples of Aztec civilization in Yucatan. There are many other substances from which decorative incrustations for walls are made, but paper-pulp specialties will only be described.

The invention of paper stucco as a substitute for plaster-of-paris ornaments furnished the key note for the other varieties of paper decoration already referred to. There is a substance which for lightness, durability, toughness and adaptability is a worthy rival of plaster. It will not crack or separate with the shrinkage of houses, and is an infinitely cleaner material to work with. The most plastic designs are produced in paper pulp or by means of thick layers of paper fastened together, pressed in molds, called carton pierre, or stone paper, the heaviest and strongest kind of paper stucco, and is molded into the highest relief.

Lignomur is a comparatively new material in paper relief. The name means "wall of wood," but the substance is really a paper pulp made by a chemical treatment of wood fiber by a process similar to that of paper stucco. The strength of this material, together with the manner of manufacture, causes it to retain the sharpness of relief of the patterns without any impairment when hung. One important advantage that lignomur possesses over some of the other raised papers is in its comparative incombustibility, for as no oil enters into its composition it is no more inflammable than the woodwork with which rooms are finished. The nature of the chemical wood fiber renders the material well adapted for artistic treatment in either water, oil color or bronzes, or by any of the methods known to decorators. It is put up in fifty-yard pieces, and is sold either plain, white or ready decorated. The decorated styles have been much admired, especially some of the effects in imitation of old ivory and of Royal Worcester ware.

Anaglypta is a variety of paper stucco that resembles lignomur on the one hand and lincrusta Walton on the other, and in fact partakes of the best qualities of both these substances. Anaglypta is a most appropriate term, etymologically considered, for this new and inexpensive relief fabric. Among the ancient Greeks glypta was the synonym for every variety of engraved work until, at a later date, the art of cameo-cutting became popular among them, and it became necessary to add to their vocabulary in order to define the new art. Cameo was, of course, raised work, as distinct from intaglio or incised cutting by lapidaries, and the word ana, meaning raised, was therefore added as a prefix to the preceding term in order to express their meaning. Subsequently the word "anaglypta" came into general use to describe every kind of bas-relief. The difference between anaglypta and other embossed paper fabrics is this: All the other fabrics have been first made as ordinary paper and then embossed as a separate process, while anaglypta is embossed in the pulp or plastic state before it becomes paper. It is an exceedingly tough substance, easily applied to the wall or ceiling, and in beauty of effect is equal to any other relief material; and the fact that it comes already decorated in most cases makes it a formidable rival to lincrusta. For those who desire relief decoration it is difficult to conceive of a material so light and so indestructible as this. It can be either painted or washed, and there is no possibility of the design being flattened in the process of fixing it to the walls.

Venetian leather is the name of another relief paper of American production. This highly pressed paper seems to be a rival of Japanese leather paper. The design shows great artistic merit, and proves that American art can hold its own with that of any other country.

Antique repousse, otherwise known as Vail's crumpled paper, is an idea whereby repousse and plastic effects are produced at but little cost. One sheet of paper is crumpled into every conceivable irregularity, and in this state is backed with another smooth sheet. It thus needs no lining paper and is hung in the usual way. The seams are not jointed, but torn, ragged and overlap each other. The surface can be tinted with dry aniline dyes or dragged over with various colored bronzes and finished with a coat of light color hard oil. The effect resembles ornamental rough-coated plaster-work. The imitation has a surprising look of reality. Should it be desired to paint the repousse, the surface should be first coated with shellac or sized with a solution of glue and alum.

Sponge fiber, although not strictly a paper, has all the characteristics of the softest ingrains when plain, and those of pressed stucco papers when embossed. It is made from small particles of sponge pressed into a soft fabric by a felting process; when embossed in relief figures it is peculiarly effective. For dados or friezes, ceilings or panels, it is a choice material. It has an irregular mottled surface when plain, and is very receptive of color. It is very effective when used as a ground for stenciling in single colors. Very rich effects can be produced by giving it a wash of some color, such as Indian red, terra cotta or peacock blue, and then touching up the high lights with bronzes. The effects can be materially varied by altering the process. In embossed effects are some excellent examples bronzed in old gold shade or in antique silver. Sponge fiber is largely sold in the simple colors for house decoration, many ladies creating lovely effects by the use of bronze and colors. Very rich effects can be purchased in bold stencil friezes printed on the plain color.

Cortexa is another specialty susceptible of many varieties of treatment. It is made of finely chopped cork fastened to a paper backing. It is sold by the yard, and can be had in the raw state for bronzing or painting, or sold already decorated; but it has been found more desirable for the trade to purchase in a raw condition and paint or color it to match the decorations with which it is used.

Indented wood fiber or corrugated paper is a paper made solely from wood pulp. It is well known to the trade and is susceptible of varied treatment. The paper is sold in twenty and thirty-six-inch widths in white stock, or twenty-inch widths in the colored bronzes.

Washing with a simple color with flitter, used on the more prominent surfaces, gives a very beautiful effect.

Muraline is an English material for wall hangings, which will probably take a prominent place amongst competing wall decorations in this country. It is washable and can be scrubbed with a scrubbing brush. It is also damp-proof and non-poisonous. The material is paper, and the painting, printing or embossing is done entirely in oil colors. The result is a very smooth surface and a soft effect. The surface can be treated so as to resemble damask silk, and, in the case of crepe muraline, a flock effect is produced which is perfect of its kind. The drawback of flock papers to collect dust is avoided in this paper, for the rough surface that produces the effect of a flock can be scrubbed, and therefore be kept clean; besides being damp-proof, these hangings are not affected by gas or sunsight, as the oil colors are too strong to be drawn. Thus the hangings are permanent, and are sold cheaply, taking into consideration their many good qualities and the width of the roll, which is twenty-four inches. The whole operation of painting, printing and embossing is performed by extremely simple machinery, and each machine is capable of producing from eighty to one hundred and fifty yards per hour, according to the nature of the material employed. The designs are very tasteful and elegant, being chiefly of a lacey character, and having the effects of old tapestries and silks. There is seldom seen anything more handsome than the crepe muraline, one specimen having a ground of salmon-red with a rich floral design in the same.

Muraline, as known to the trade in this country, is an imported real satin hanging, enriched with flock designs. It is very recherche, and is extensively used in decorating the better classes of houses. It is analogous to the English duro-textile, which is a cloth wall hanging, which possesses all the advantages of crepe muraline, and is printed in much the same way.

Embossed tapestry is made of the same cloth as the duro-textile. The raised parts are filled in underneath, and the hanging is thus made solid and waterproof, and can not be damaged by bruising or indentation. It has all the effects of leather, and is considered superior to lincrusta.

Lincrusta Walton naturally belongs to the category of wall-hanging specialties. Although not actually made of paper pulp, it is so much a part of the wall-paper trade that it may be considered a wall-paper specialty. It was invented by a Mr. Walton, of Sunbury, London, and was originally termed "muralis." It is practically linoleum, lined with canvas, that it may be fitted to walls or ceilings.

Linoleum, as is well known, is solidified linseed oil, the agent of solidification being chloride of sulphur. When brought by a certain treatment to the consistency of dough or putty and mixed with fiber, it is stamped by machinery with ornamentations in relief. The result is that artistic designs are produced in delicate low relief, very clear and sharp, like carving or plaster stamping.

The merits claimed for lincrusta Walton are a warm and comfortable appearance. It does not absorb moisture, and it offers an impermeable resistance to wet from within or without. Any kind of design can be reproduced in the material, and Frederick Beck & Co., of New York, who control the business in this country, have produced Egyptian, Greek, Persian, Hindoo, Moresque, Japanese, Celtic, Mediæval, Venetian, Renaissance, Florentine, Louis XVI, Early English, Eastlake and other designs in this incomparably decorative material. Lincrusta is so wonderfully plastic that it lends itself to the most intricate designs, as well as the boldest. The greatest skill has been lavished on its treatment. When slightly warmed, it becomes plastic, and will cover a pillar as easily as a wall. Any good paperhanger can hang lincrusta, and with judgment and care will make a more perfect job than with paper hangings. It is a beautiful wall decoration, and has become firmly established as a permanent industry of the country. A series of decorative panels have recently been produced by the manufacturers, one illustrating Shakespeare's dramatic works, and another medallions of American poets. Its use is spreading among the finer classes of residences, but is too high in price to come into general use. It is more extensively used in halls, vestibules, bathrooms, and for dados and borders in diningrooms and libraries than elsewhere, and is an invaluable adjunct to the wall-paper trade.

Lincrusta Walton was brought prominently before the public in 1878, when the silver medal of the Paris universal exposition was conferred upon the manufacturers.

This modern adaptation of paper is wonderful in many respects. It may be applied to the ornamentation, if not sole construction, of dadoes, fillings, friezes and borders, wood mantels and over mantels, wood doors, panels and frames, paintings on plain crepe, for panels, and for door and fire screens, beveled and other forms for mirrors and picture frames, splash screens for washstands, dinner mats, table mats, finger plates, pilasters, substitute for carving on woodwork of doors, and for the external ornamentation of wooden houses.

It is prepared in rolls or sheets, and resembles the embossed leather hangings of olden days in its toughness and pliability. James Renwick, the architect of St. Patrick's, New York, writing in 1889, gives his opinion that it is one of the most valuable materials for architectural and decorative purposes ever invented, as the most beautiful designs may be produced in solid relief. The styles usually adopted are Greek, Repoussé, Appliqué, Romanesque, Renaissance, Gothic, Louis XV, Empire, Louis XVI, stucco and colonial. Its introduction here dates back to 1879, but not until 1882 did the old wall-paper and decoration firm of J. J. McGrath & Co., apply it extensively.

As embossed designs in lincrusta are stamped expressly to assist the decorator in producing fac-similes of Cordovan or embossed leathers, it will be of service to many painters to indicate the mode of procedure. The most brilliant effects are attained by first preparing ground of gold or silver, then painting in strongly, with color-glazing varnishes, the raised or embossed pattern. Now tone the background with some leading color, or better, some half-tone, by mixture of tints, using always the colored-glazing varnishes diluted with white glazing varnish. As these colors dry with great rapidity, an equal rapidity is required in the laying of them. When this wash of toning color has been laid evenly upon the background and over some portions of the ornament in low relief, leaving bare the remaining spaces of bright crude color, pass a coat of white glazing varnish over the whole, and complete by taking a sprinkling of gold dust, or bronze powder, upon a soft bristle brush, and polish the entire surface briskly, finishing with a chamois leather or well-worn flannel cloth. This last process blends and harmonizes the coloring, purposely kept crude until the end. Dark leathers may be colored by adding brown dryer and bronzes in powder to oil colors, mixing them well together with a palette knife.

The new Japanese leather papers are in boldly contrasting tints, which is a change from the gold lacquer, which has been hitherto so extensively employed in these papers. The pattern is wrought in high relief, while the ground usually has a fancy embossing. One handsome pattern consists of a floral design in gold leaf, with butterflys, also in gold, on an embossed cream ground. A choice example exhibits old ivory foliage and fruit, heavily embossed on a ground of smooth maroon lacquer. There is a fine frieze of Roman scrolls in silver, with large floral discs in silver, on a copper-bronze ground. Scrolls in copper lacquer on green lacquer grounds are very prominent. A chrysanthemum motive is in pink, yellow, green and drab lacquers on a white ground. The demand for high-class Japanese papers is steadily increasing, and their worth is being more and more recognized by people of means.

The great charm of leather hangings and their specific imitations, either in ordinary wall paper or other materials, is their beauty of design, rich coloring, boldness of execution, variety of pattern and great elegance of appearance. The real leathers themselves are manufactured from dressed skins. The Spaniards stretched the skins by means of iron frames over highly-polished slabs, where they were allowed to remain until dry. A thin size was then rubbed into the skin with the hands, and a surface of gold or silver leaf, or some color, was then imparted. When again dry, the leather so prepared was ready to receive the pattern intended to be embossed. This was affected by a wooden plate, on which the design was carved. The plate being first treated with a rosinous preparation, the skin was stretched tightly over it, and pressed so as to take off the impression. This done, the last, and perhaps most laborious stage was reached, as the workman had then to emboss on the leather the pattern which had become printed on it. Beautiful designs were produced by cutting the leather with a penknife only. At a later date this primitive process was superseded by the use of punches, by means of which sunk and raised ornaments could be traced.

At one time the trade in leather decoration was of great magnitude. After spreading, in the course of centuries, through France and the Netherlands, Spain, Hungary and England, the trade declined through the seventeenth, and finally died out in the eighteenth century.

"Cordelova" is a new pulp wall decoration, in which are reproduced the finest examples of old Cordova and Venetian leathers. The material can be finished in either a pulp or canvas finish, but as the former method lends itself more readily to treatment after the manner of old leathers, it is more generally adopted. It is an invention of an Edinburgh decorator, and its colorings range from the plain simple tints to highly decorative effects in gold lacquers and color, happily executed in the many skillful methods of scumbling over, wiping off, etc. The boldness of its relief and its fine modeling admit of such a course of treatment with comparatively little trouble. Its greater width than ordinary wall paper, and its great flexibility admits of Cordelova being easily hung with stout paste, with the addition of a little glue mixed with the paste. It possesses great durability, and when one is tired of it a different scheme of coloring can be adopted at little cost.

"Calcorian" is another English imitation of Cordovan and Venetian illuminated leathers. Calcorian is simply the modern mechanical reproduction of an almost extinct art, and this new wall hanging is a perfect imitation of those beautiful wall coverings which are in every way fitted to suit the requirements of modern decoration. The material itself is a combination of stout paper, ground cork and india rubber, which imparts to it elasticity equal to that of stamped leather. This is imparted to the paper by passing it through metal rollers worked by steam machinery at a very high rate of pressure. The natural color is a dull buff hue, but the company who manufacture it produce designs decorated in a variety of well chosen colors without additional cost. The color is first coated over the whole surface of the work, and then wiped off from the raised portions of the pattern, which has the effect of bringing out the details into still greater prominence than that afforded by the high relief given them in the embossing process. The patterns are then glazed, and when the glazing body is fairly hardened the material is complete for all ordinary purposes.

"Calcorian," like its prototype, real leather, harmonizes perfectly with richly carved paneling and wainscoting. It is par excellence the decorative material for halls and dining-rooms, and its archæological correctness in preference to ordinary wall paper for rooms furnished in mediæval or early English styles is apparent.

Decorators find themselves called upon more and more to undertake the functions of the upholsterer in decorating interiors. They have not only to suggest the style of decoration to apply to walls and ceiling, but are frequently called upon to choose the style of carpets, upholstery and draperies. In the matter of draperies, portieres and window curtains still retain their popularity, not only for their desirability and appropriateness, but for their decorative effects. Sometimes also the wall is sheathed with silk or worsted tapestries instead of wall paper, hence the decorator requires to have a correct knowledge of decorative textile fabrics. The most fashionable portieres are made of brocatelles, tapestries, silk damask, silk-and-cotton chenille and the ordinary Turcoman curtains. In all these fabrics there is a wide field of choice as regards color, the newer shades of gold being specially prominent. Like terra cotta, gold harmonizes with almost any style of interior decoration, and maize is another adaptable shade. The newest and most fashionable shades are paille, a light straw color, and bouton d'or, a golden shade. In blues, electric blue, gobelin blue and robin's egg blue are the favorite colors. Eiffel is the newest shade of red. In greens there are bottle green, reseda, absinthe and aloe-green, while in yellow, citron, lemon, sulphur, solferino and heliotrope are used. In window draperies there is a wide array of sumptuous fabrics. There are old worsted tapestries of Louis XII, Henry II and the Pompadour periods, and brocades of Louis XV and colonial designs. There are silk tapestries, old Italian textile fabrics and old Italian velours, exhibiting rare effects. There is a royal Renaissance tapestry, which appears like fine hand-embroidered sateen with a wrinkled ground in dull gold. There are Arab tapestries in all the intricacies of Eastern patterns, generally arranged in stripes with running designs thereon full of the details of Saracenic symbols.

There is a large assortment of what might be fitly called Pompadour fabrics, which include Recamier damasks, royal damasks of Louis XII and XIV styles, brocaded silks of Louis XV and XVI. All these goods are expensive and rich in appearance, the designs being delicately-colored floral patterns. In Eastern silks there are Nagpore, Mysore, Rumchuddah fabrics, which are made from the best raw stock and possess those clinging, supple qualities which distinguish Eastern goods. Bengal satin is a beautiful stuff; its colors are delicate and the gleam of the fabric resembles the quiver of mercury. Agra gauze is a gossamer fabric, transparent as veiling and light and cobweb, yet both firm and strong. In cretonnes there is a wide range of beautiful floral effects, salmon-red and China-blue patterns on light grounds being the most prominent. Many of these goods are being applied to walls instead of wall paper in the better class of houses. The effect is luxurious in the extreme.

Decoration in plastico or alabaster composition in the United States by American artists, and with the product of American manufacturers is an agreeable innovation. The allegorical history of the United States, painted round the dome of the nation's capitol, is the work of the Italian-Brumide and by far the greater part of the decorations of the leading public buildings, churches, and business blocks throughout America is credited to Italian and French artists.

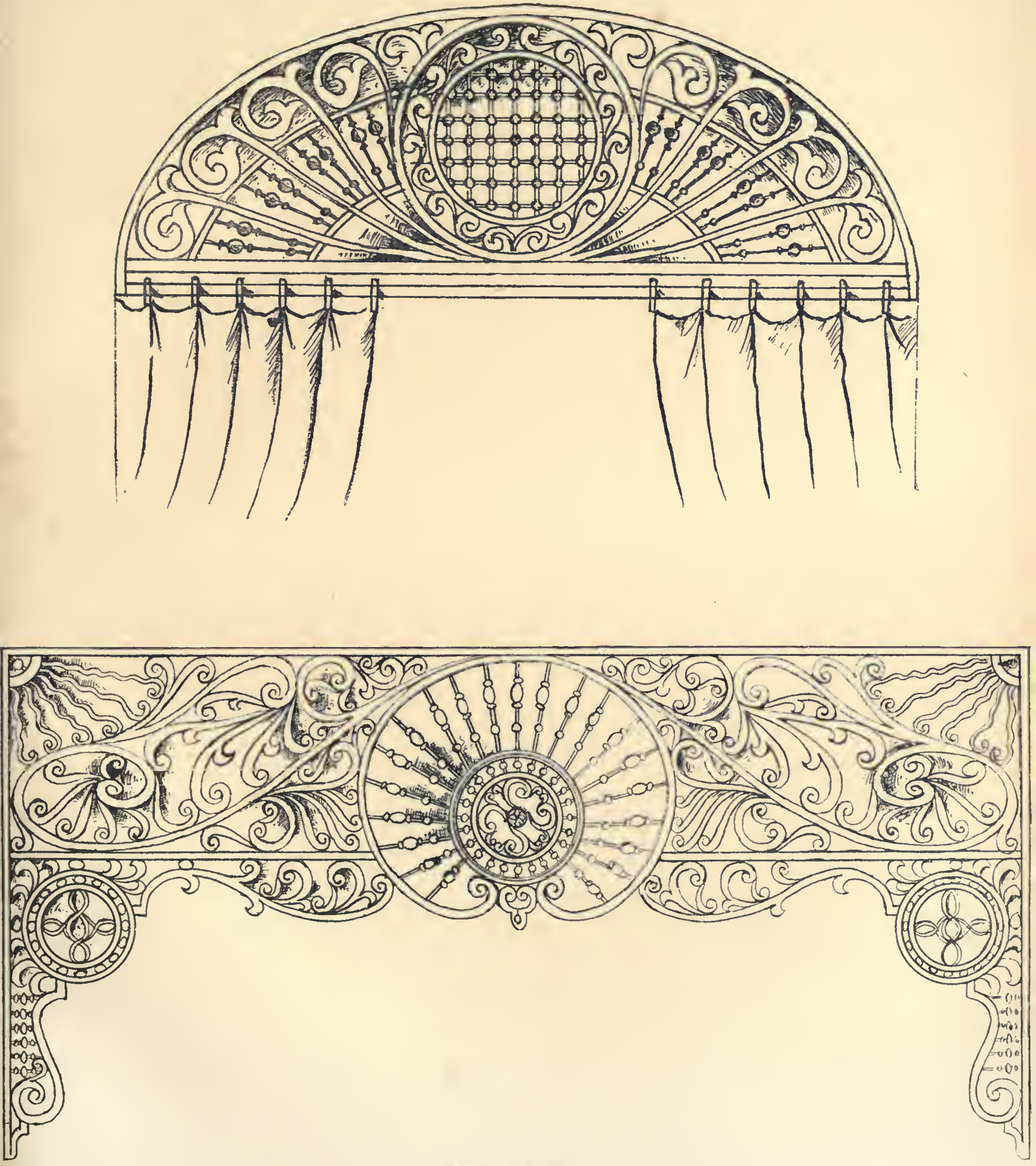
Plastico is an entirely new material in house decoration, and can be adapted to the varied needs of the decorator in producing raised or flat effects. It is an article peculiarly adapted to making a clean, cheap and sanitary coating for walls and ceilings, and is composed mainly of sulphate of lime, known as gypsum or alabaster, which has been calcined by subjecting it to great heat in retorts, or boiled in large kettles until its water of crystallization is driven off, so that when water is added to it again it will take up its original water of crystallization. This process is called setting and takes place naturally in about seven or eight minutes, reforming a stone much like the original stone in the quarry, but more porous. This rock in the natural state as it is ground at Grand Rapids contains from thirty-five to forty per cent. of sulphuric acid. The better grades of this rock, after calcining, are so manipulated in making this article for walls, that this setting process is retarded for a number of hours, adapting the plastic, or liquid, to being spread upon walls with a brush in a very thin condition, so that fifty coats as applied to walls from time to time form a hard, porous shell not thicker than card paper, and the coat is not of a glue or paste nature, the size and admixtures used to retard the setting having been absorbed by the base in taking up its water in setting. The most artistic and fanciful designs can be elaborated upon ceilings and walls with this very plastic material without tinting.

A new decorative composition is in the market called "stereo-relief." It is not affected by water or any change of temperature; is not expensive, but is strong, light and uninflammable, being absolutely fireproof. An elevation of from six to eight inches can be as readily shown as one of a half inch, and as the material is cast in flexible molds, a perfect undercut is obtained with ease. Fruits, flowers and vines are brought out with excellent fidelity to nature in matter of form, and particularly adapted is the work to the scrolls and richness of design developed in the sixteenth century. This composition can be molded into an infinite variety of artistic forms, in pure white or in tints, and can be gilded, silvered or bronzed, thus readily reproducing or duplicating any desired design furnished by architects or decorators.

The two historical bas-reliefs in McVicker's theater were produced in 1891 by Johannes Gelért. Each is 18x4½ feet, finished in imitation of old ivory. One represents La Salle's explorations in the Illinois country, and the other the Fort Dearborn massacre.

The effect on entering the theater is striking. There is no cheap ornamentation; there are no startling colors; no architectural freaks striving for effect. There seems to be no parts to the theater; it appeals in its unity. The prevailing shades in the decorations seem formulated on the same body. In reality there are several browns, terra-cotta pink and mahogany red, but their combined effect is the indescribable luster on the surface of freshly broken brown earth. All the decorations are brought out and toned by gold leaf in bands, and no other shade. All the usual kaleidoscopic colors and effects that dazzle for a moment and then disgust with their tawdry finery have no place in the new playhouse, so that the ideas of Healy and Millet obtain. The proscenium arch starts almost in the center of the ceiling. It is in six diminishing sections, each section being a different part of a component whole. The arch is of filigree work, and canopies the orchestra and part of the parquette. Its smallest base is thirty-four by twenty-eight feet. The only thing in anywise startling in the interior architecture is the absence of the balcony boxes. On either side their place is supplied by a fine bas-relief from the master hand of Gelert. The pieces are sixteen feet long, and the figures life-proportioned. The subject of the right-hand bas-relief is "La Salle entering Illinois," and the other "The Fort Dearborn massacre of 1812." The original conception and the modeling of both subjects is highly artistic. It took Johannes Gelert three months to each, and cost McVicker $3,000 each before the modeling was completed. Terra cotta filagree work trimmed in lined gold furnishes the setting for the bas-reliefs. The boxes beneath are three in number on each side, and on a line with the stage. They are divided by Doric columns and ornamented pilasters, but uncurtained. They are entered by a special aisle, and through doors of upholstered satin, olive in color.

In front of the proscenium opening hangs a $7,000 drop-curtain by Ernest Albert. The subject is Grecian and suggested by a line from Sappho: "To sit and muse by thee in twilight realms." Athens with the Acropolis and the Mediterranean lie in the foreground as a part of the panorama spread before the gaze of the two Grecian figures seated on a circular marble bench and occupying the most prominent place in the composition. A fallen temple



GRILLE WORK.

and various ancient dwellings with the necessary detail complete a powerful and striking picture. The fire curtain, which is made of asbestus, is used as an ordinary drop and between-acts curtain. It is surfaced with a study by Walter Burridge. The subject chosen represents the Pottawatomie Indians ceding territory to the United States on the site now occupied by Chicago. The composition throughout is in unison with the subject, and the supplementary ornamention of painted frame and draperies is in the prevailing tones of the theater.

In March, 1891, the decorators turned the corner room of the Gossage store over to the owners perfect in its dress of gold and alabaster. The massive columns are covered with alabaster and gold mosaic. The ceiling is a magnificent work of art. It is composed of figures and designs in bas-relief decorated in pale blue, pink and gold. In panels are placed fresco paintings of figures that are very attractive to the eye. The cost of the ceiling alone is said to have been $10,000. The floor is of the same minute mosiac used in the Auditorium, and is arranged in beautiful designs. In order that these designs may not be obscured, all the solid mahogany fixtures are mounted on bronze legs.

American parquetry or wood carpeting varies from the thick European parquetry in being light and durable. The Chicago manufacturer produces a carpet one-fourth of an inch thick, in widths of twenty, twenty-eight and thirty-six inches, with borders three and one-half, five and six inches wide. The woods used are walnut, oak, cherry or maple, all kiln-dried, glued in alternate strips on cloth, and capable of being rolled up like ordinary carpet. American manufacturers adopted the one-fourth-inch thickness to obviate the necessity of shortening doors, as would have to be done were the thick European parquetry used here, to facilitate spring house-cleaning, to meet all the requirements of carpets without being dust holders, and to be suitable for wainscoting and other decorative purposes. For the latter purpose it is manufactured in thirty-six-inch widths, thirty inches high, with moldings to match, at fifty-five cents per linear foot; for carpeting it ranges from $1.25 to $1.75 per square yard. In 1873 the Dunfee wood-carpet works were established here, but not until 1883 did the industry reach importance. During the last few years parquetry has been considered a branch of decorative work and its growth has kept pace with the growth of decorative art.

Wood tapestry or parquetry is the name applied to wood veneers on panels or imitation of marquetry. The machine is capable of handling a log twelve feet in length. The logs, of course, are of the choicest wood known to the decorator or cabinetmaker, and before being operated upon are first thoroughly soaked in water, so as to obtain all the expansion the wood is capable of bearing. The log thus prepared passes through the machine, whose knives are capable of cutting it into veneers so thin that it requires as many as from one hundred and twenty-five to one hundred and seventy-five thicknesses to make a thickness of one inch, according to the character of the wood. When the veneers are cut from a log they are placed upon a platform where they are coated with elastic cement, and then specially tough but thin paper is immediately applied to the cemented surface and the veneers are piled away in stacks. The effect of the cement upon the wood is to absolutely prevent any further shrinkage while being strengthened by the paper packing; it is as easily manipulated by the decorator as ordinary wall paper, and lends itself readily to any ordinary plastered surface, either wall or ceiling. It is necessary to cover the walls before applying the veneers with a thin glazed muslin, rendered adhesive with ordinary paper-hangers' paste. After the veneer has been once firmly fixed to the surface of the work, it is claimed that it is absolutely imperishable, and the cement packing renders it impenetrable to moisture, so that it may be scrubbed without doing it the slightest injury, while for the same reason it will neither expand nor contract in changes of temperature. The veneers are manufactured from plain and burled butternut, olive, amaranth, pink bird's-eye maple, ash burl, laurel burl, mahogany, rosewood, American walnut, satinwood and sycamore. The veneers are usually sold in sheets varying from eight feet to eleven feet six inches in length by ten to twenty-two inches in width. The burls are in sheets which contain from one to six square feet. The decorative uses of wood tapestry are practically inexhaustible. For ceilings, it may, by the use of wood moldings, be laid out in panels, center-pieces, etc., and when used in conjunction with the patent natural wood carving, possesses all the effect of elegant hand carving, which imparts a richness and perfection to the work that must be seen to be realized at its full value. The system applies equally to old walls and pine woodwork as to new houses. A room with papered walls and painted woodwork may be transformed at a comparatively small outlay into a modern hardwood, cabinet-finished apartment.

The process of manufacturing natural wood carvings is very interesting. The veneers to be embossed are first cemented to strong cardboard, and then another layer of veneer is added with another layer of cardboard, thus forming a wood and paper sandwich. The pieces thus prepared are placed in a hydraulic press between hollow dies, heated with steam and subjected to the pressure of about four hundred tons. The elastic cement used in attaching the cardboard to the veneer hardens under the heat of the steam dies, and permanently sets the veneer and its backing to the exact conformation of the die used. The veneer is pressed dry, and not moistened, as in the usual method of embossing wood. The panels prepared by this method possesses great advantages over solid wood carvings, as they are not affected by moisture and never crack or warp. Their cost is far less than hand carvings, and much superior to any, except the very choicest, in their finish. Another important point is that all these designs are produced with the grain, and not, as in other methods, by taking the wood on end. This insures greater durability than the older process. The carvings are remarkable for their high relief and wonderfully sharp outline, and in certain examples, such as moldings to be used as dado rolls or for panels, this feature is very noticeable. Many of the moldings exceed half an inch in depth without the slightest rupture of the face of the wood. For the decoration of doors and window ornaments, paneled dadoes, mantels and over-mantels, cabinets, chairs, sofas, wardrobes and every article that goes to make up a well-appointed apartment, these productions will be found to be especially suitable. There is undoubtedly a wide field open for these productions, and decorators are indebted to the manufacturers for the possession of a novelty which is both economical and pleasing, one that already commands a widespread use. Only twenty-three years ago did E. C. Hussey introduce this decorative parquetry flooring into the United States. In 1873 the Dunfees established their works in Chicago, and since that time a few others have established houses here, while many dealers in house furnishing material hold wood carpet, parquetry and inlaid floors in stock.

Marble mosaic work is an interesting study. The new pavements, to be seen in the great modern buildings of Chicago, and the walls and ceilings of mosaic, which modern architectural ideas revived, are the open books where the student must look for practical information.

The history and description of mosaic work links the Rome of early Christian times with the Chicago of our own days. It tells of the works in marble destroyed at Pompeii or buried at Rome, and leaps, as it were, over the ocean and across half a continent, to discuss the Renaissance in a city, which, only twenty years ago, was wiped out like Pompeii.

The old Romans prided themselves on the marble floors of their dwellings, and the proof of their knowledge of its durability is demonstrated by the recent discoveries made in Roman ruins, where the marble mosaic pavement retains its original designs and colors. Of late years, an Italian artist, John Caretti, has done work of this kind here in residences and business buildings. In his establishment can be found the finest and most beautiful designs of Roman mosaic marble flooring; and he has done much toward advancing and rendering popular this style of flooring. His workmanship is perfect. Specimens of his work can be found, not only in many of the fine residences of the prominent men and in other buildings in this city, but in various parts of the Northwest. He is his own designer and has nothing but the latest styles, and he sees to it that they are perfectly executed by skilled workmen. He also does all kinds of fresco painting and interior decoration for residences. He is a native of Italy, has been a resident of Chicago for over twenty years, and is the founder and senior member of the firm of John Caretti & Co., his partners being John Fracassi, Antony Francescon, John Dambrosio, and Antony and Angelo Bernardini. They are located at 234 Michigan street.

The making of mosaics is a mechanical art, and yet it deserves to be classed as a species of painting, as it requires a cartoon or color design like a fresco, with a correct knowledge of form, composition and color. It dates back to the remotest period. The earliest existence of mosaics belongs to one of the least important branches of art, that is, to the ornamentation of jewels and ivory thrones, rarely of architecture. The oldest remains are some fine enamels in the Louvre, and beautiful ivory carvings in the British Museum—low reliefs from Nineveh and Egypt, representing deities, lotus, papyrus and plants, enriched with lapsus lasuli and other gem-like stones. Each piece is separated from others by a cloison or ivory of the thickness of cardboard. Birds and winged serpents are favorite patterns. The Romans used marble and opaque glass. The mosaics found in Pompeii were many of them decorations of niches, fountains and statues. This city was very rich in mosaics;

almost every house had its hall paved with them. In a Pompeian bath the pavement is incrusted with mosaics. The mosaics of San Diamiano and St. Cosmo Before Christ are the finest of Christian Rome. In the Apse of St. Clemens the Christian mosaics are full of mystic meaning. The old Roman edifices were luxurious and magnificent, rather than harmonious in beauty. Their exterior pavements were of stone tiles, porphyry and other durable materials laid in cement; within, the floors were of mosaic work. This style is supposed to have originated among the Egyptians and Greeks. Mosaic took the form of sculpture in the fourth century, when the dogmas of the iconoclasts forced the architects to seek some other ornamentation. The Romans acquired their knowledge from the Greeks, who had borrowed it from the Asiatics. By all of them it was applied as an ornament to pavements. To represent inanimate objects scattered over the floor, seemed to be the aim of the artist. From Britain to the Euphrates ancient Roman mosaics have been frequently exhumed. One variety is formed of stone of different colors, cut geometrically and cemented together. Floors were of cubes of stone, forming designs in colors. Another mode was that of colored cubes of clay, or glass of every tint, set up as the compositor does his type. These produced elaborately finished pictures. After the overthrow of paganism, Christianity used them for the walls and ceilings of sacred edifices, and from their use in mural decoration, they preserved, by their durability, a knowledge of the religious ideas of the middle ages. The mosaics and illuminated manuscripts in the churches are the most interesting and valuable remains of pictorial art, from the seventh to the ninth centuries. The oldest representations extant of the Virgin are given in the old mosaics in the churches of Pisa, Rome and Venice. The cubes are used on a blue and white ground, while the Byzantines were on gold, but the work was coarser. The finest of the mosaics were done in Italy, in the fourth and sixth centuries. The most splendid have been found in Rome and Ravenna; those in the churches of the latter city are the finest. In the fifth century, when the arts and sciences found a refuge in Constantinople, arose the Byzantine style, which predominated for five hundred years throughout Europe and the East. The grandest example of this is Saint Sophia, built by Jusinian, and adorned with a perfect wealth of mosaics, of which now only a colossal seraphim and a figure of the Madonna remain from the destruction of Mohammeden iconoclasts. It gained a foothold in Rome in the seventeenth century, where the native school had lapsed into decay. Venice contains the purest specimens of that style in Italy, in the fine mosaics of St. Mark's, which were executed between the eleventh and the fourteenth centuries, and cover ten thousand square feet of the walls, roof and cupolas. These are upon a gold ground. Titian, Tintoretto and other masters furnished the cartoons. It is a grand and a gigantic work, which all the wealth of Venice spent six hundred years in compiling. In the twelfth century arose the Romanesque style, founded upon the Byzantine traditions. In the thirteenth century, Northern Italy began to work from original conceptions of nature. A figure of our Savior, fourteen feet high, was produced by Andres Zuppi, the famous mosaicist, while Giotto created his noted Novicella. At St. Peter's, in Rome, Ghirlandijo, the tutor of Michael Angelo, brought this art to great perfection. At the beginning of the seventeenth century, Clement VIII employed numerous artists to decorate the interior of St. Peter's with copies of eminent artists, and each succeeding age has added to works of this kind deposited in that church. In the nineteenth century, Christophori established a school for mosaic in Rome, where the art is now taught and practiced on a grander scale than in any other part of the world. Too high a polish destroys the effect by the glittering of too many reflected lights. The mastic becomes as hard as stone, and is then susceptible of a fine, crystal-like polish. The effect, under the blaze of electric light, is gorgeous. A mosaic copy of St. John, the Baptist, was sent, in 1853, by Pius IX, to the Crystal Palace, which is a copy of Chercini's painting. This was valued at $60,000, and could not be told from an oil painting at a short distance. New York has some new buildings much admired for their mosaic decorations, while the grand Auditorium and other buildings of Chicago have added to their other ornamentation that of mosaic.

*Of all the art revivals which the present century has witnessed, none has been more remarkable than that of mosaic, in the form of tesselated pavements of Roman times, and this revival, although one of the latest, bids fair to surpass all others in its widespread adoption. Little more than thirty years ago a mosaic pavement of later date than the sixth century was nowhere to be found, but within the last twenty years over a million feet have been laid by the writer's firm in Europe, and there is not a town of any importance in Britain, France, Germany or Belgium whose public and private buildings are not now paved with small cubes of marble; this country, although the latest to follow suite, has taken up the art with something like enthusiasm, and in a very few years the superficial area laid in the United States will be counted by millions of feet.

"The word mosaic in its most extended sense may be employed to designate every combination of minute particles of any material which can, by the connection of parts, in themselves inexpressive, be so arranged as to convey a feeling of unity and of variety of design."

This, the definition of an eminent authority, is substantially correct; the word mosaic, in its modern use, has a generic meaning in the sense thus expressed.

Figuratively it has been used by writers of old—by Milton in the sixth book of Paradise Lost:

> Each beauteous flower,
> Iris all hues, roses and jessamin,
> Rear'd high their flourish'd heads between, and wrought Mosaick.

And by Sir Philip Sidney in "Arcadia," book first:

> The trees were to them (the flowers) a pavilion and they to the trees a mosaical floor.

In latter times it has been used to denote a medley; thus, a critic has spoken of a collection of verses on different subjects as a "poetical mosaic."

One of the chapters in Russell Lowell's "Fireside Travels," is called "A few bits of Roman Mosaic."

In the third number of a monthly journal called the *Illustrated World's Fair*, appears a

* The following historical account of the mosaic art was contributed by Wm. Henry Burke.

series of sketches, overlapping each other, of some eight or ten views of Jackson park; the sketches are entitled "Our artist in his study—A Mosaic of the hour."

Authorities agree that the word comes to us from the Latin Opus musivum, that its root was the Greek word, Mousa, one of the nine goddesses, in ancient fable, supposed to preside over the arts, and invoked by Shakespeare in the Prologue to Henry V.,

O! for a Muse of fire.

Derived, and cognate with this word is "museum," a collection of specimens of art of various descriptions, and so opus musivum is art work and musivarius a worker in it.

But the opus musivum of the Romans is very different from what is now understood to be mosaic, or rather it should be said that in its later use mosaic includes work to which they applied different appellations.

Ciampini, a writer of preëminent authority on the subject of mosaics, says that the finest production of the mosaic artists (musivarii) were esteemed and regarded by the ancients in the light in which we are wont to consider pictures in the present day, merely as pieces of portable furniture.

The musivarii attained great celebrity as artists; among the most celebrated being Dioscorides of Samos, whose name has been found on two valuable mosaics discovered at Pompeii in 1838, one of which is supposed to represent the battle of Issus and, when perfect, is said to have been composed of one million three hundred and eighty-four thousand cubes of marble; at present over nine thousand can be counted in each square foot.

Pliny (Hist. Nat. 36, 60.) affirms that the art had its origin among the Greeks, who carried it to great perfection, and he records that Sosos of Pergamos surpassed every preexisting attempt in the elaboration of a mosaic picture which he describes.

A piece of mosaic found in excavating the site of Hadrian's villa at Tivoli is supposed to be the picture he descanted on, and for that reason it has been called "Pliny's Doves." It is by far the most exquisite example of the art of the musivarii still existing. Through the numerous repetitions of this work, annually manufactured, its general outline and character must be familiar to every one. None, certainly, but those who have seen the original can conceive an accurate notion of the delicacy of taste expressed in its forms. It is preserved in the museum of the Capitol at Rome and represents a metal basin, on the edge of which four doves are sitting; one of them is stooping to drink and not only the shadow cast by it, but even the reflection of part of the head in the water is beautifully given. The execution of the plumage, the heads and eyes, is most minute and is as refined as the idea and composition of the whole are graceful and captivating. This interesting relic enables us to guess at what may have been the perfection of those pictures the value of which, we are assured, exceeded that of many towns.

What, however, are now called mosaic pavements were included by the Romans in the generic term of opus lithostrotum (literally, stone-laid work), and it was of two kinds—opus tesselatum and opus sectile. Opus sectile, as its name imparts, was formed of sectilia, that is, slabs of marble cut into geometrical shapes and forms, and generally arranged in patterns.

Opus tesselatum was a pavement composed of small cubes of marble, called tesseræ or tesselæ (hence tesselated pavements), varying from three-eighths to half an inch, rarely exceeding the latter, sawn or worked by hand into such simple geometrical shapes as, when combined, would best compose a figure, equally geometrical, but of course characterized by a greater or lesser degree of intricacy.

The ornament known as the Greek fret was constantly worked out in this material, and various graceful combinations of square and circular lines are of frequent occurrence.

The word lithostrotum, the classic generic term, occurs three times in the septuagint II Chron. vii: 3: "And when all the children of Israel saw how the fire came down, and the glory of the Lord upon the house, they bowed themselves with their faces to the ground upon the (lithostrotum) pavement, and worshipped and praised the Lord."

Cant iii: 10: "He made the pillars thereof of silver, the bottom thereof of gold, the covering of it of purple, the midst thereof (lithostrotum), paved with love for the daughters of Jerusalem."

Esther i: 6: "The beds (couches) were of gold and silver, upon a (lithostrotum) pavement or red and blue and white and black marble."

The word occurs but once in the New Testament. John xix: 13: "When, therefore, Pilate heard these words, he brought Jesus forth and sat down in the judgment seat, in a place called the (lithostrotum) Pavement, but in the Hebrew Gabbatha."

Many tesselated pavements were laid in Jerusalem. About thirty years ago Mr. Henry Maudsley conducted extensive excavations in that sacred city, and sent to London several cases of tesseræ he had collected. A quantity of these were used in the making of a pavement laid at the entrance to the grand lodge of the Free Masons, London, as the following inscription thereon testifies:

"This pavement formed of antique tesseræ collected at Jerusalem by the Worshipful Henry Maudsley, P. G. D., and presented by him to Grand Lodge, was laid in the fourth year of the Grand Mastership of H. R. H., Albert Edward, Prince of Wales, A. L. 5877, F. P. Cockerell, Gd. Supt. of works."

These tesseræ are said to be cœval with the birth of our Lord, and it may well be that the pavement on which stood the judgment seat of Pilate was opus tesselatum.

Vitruvius establishes a clear distinction between the two kinds of lithostrotum, opus sectile and opus tesselatum, in these words: "*Supra nucleam ad regulum et libellam exacta pavimenta struantur sive sectilibus sive tesseris.*" That is, "Upon the bedding (concrete foundation) pavements are to be laid according to rule and level, either in sectilia or with tesseræ."

Both these kinds of pavement are spoken of as mosaic by the writer, whose definition of mosaic is previously given. He says, "The date of the first introduction of this species of mosaic (opus sectile) may be assumed at about fifty years before Christ, and the most noble specimen of it now extant is the splendid pavement of the Pantheon at Rome, in which the several pieces are of very great superficial extent. Porphyry, Giallo Antico and Pavonazzetto are the principal marbles used, and they are arranged simply in alternate round and square slabs. As the building, according to the inscription on the frieze, was finished during the third consulate of Agrippa, B. C. 26, and must necessarily have taken a long time to complete, it is probable that the pavement was laid some years before that period."

That rich and costly pavements were used in very early times, there can be no doubt; we have direct testimony that they were, by the Persians, in the days of Ahasuerus, for the one described in the sixth verse of the first chapter of Esther is mentioned as an instance of the luxurious magnificence of the royal palace of Shushan.

As to the nature of the construction or design of this particular pavement nothing now remains to impart information, but it would seem to be a distinct reference to mosaic, and in the colors and material selected there appears a manifest intention to produce such effect in ornamentation and design.

Homer in the opening of the fourth book of the Iliad describes the celestial pavement as being golden: "The gods sitting by Jove were conversing on the golden pavement."

Shakespeare, in the "Merchant of Venice," has a beautiful passage, in the conception of which he seems to have been actuated by a similar idea.

> Sit, Jessica; look, how the floor of heaven
> Is thick inlaid with patens of bright gold;
> There's not the smallest orb which thou behold'st
> But in its motion like an angel sings.

The meaning of both is evident and equally in point.

The learned Padre Secchi tells us that in the days of Alexander of Macedon the luxury of pavements formed of various colored marbles prevailed generally and extensively throughout Greece, and that the ornamentation bestowed on the floors frequently excelled that lavished on the walls and ceilings.

The dictum of Pliny notwithstanding, it has been doubted whether opus tesselatum (tesselated pavements) did not orignate in Africa. Carthaginians, at the time of their conquest by the Romans, were far more advanced in many arts and sciences than were their conquerors. From the occupation of Carthage by the Romans much knowledge was diffused—from it they are said to have acquired the method of paving roads and of constructing ships, as well as many practices and habits adopted in domestic life, and it is not unreasonable to inquire how far it may have been from the Carthaginians that the Greeks and Romans received the art of fabricating tesselated pavements.

Dr. R. N. Davis, fellow of the Royal Geographical society, was engaged many years in exploring the site of Carthage. In the progress of his labors he found, near the surface, abundant evidences of Roman work, but at a greater depth he encountered objects clearly dating from an earlier period. At one spot no less than three mosaic floors were brought to light; they were nearly one above the other, but portions of each were uncovered without the removal of the others. Those near the surface were undoubtedly of Roman date, but those below are assigned by Dr. Davis, with good reason, to a Punic age. To reach the one below, the others had to be broken through, in the course of which operation numerous evidences were disclosed of successive reconstruction. It has been shown that in the costumes and general treatment of the figures in this third pavement there are variations from the ordinary work of Greek and Roman artists, and that they apparently belong to a period when both Greece and Rome were young, but when Carthage had attained to a high state of affluence and wealth. This beautiful piece of work (as well as some easily distinguished as of Roman origin) is now in the British museum, London. The observer can not but be struck with a sense of its individuality, a something which is unlike everything else, and in no other example in the national collection does there appear more magnificence in the work and details. In the treatment of the busts and in the objects selected, as well as in the borderings, there is something at least uncommon, if not unique; we miss the twisted and braided bands of the guilloche, the labyrinthine frets, the geometrical figures and prescribed designs universal in Roman pavements, which, though often debased in their treatment at the hands of Roman artists, reflect the predominating forms employed by the artists of Greece.

This pavement is not hampered with these conditions, it displays great wealth of color; trees, foliage, flowers and fruit are thrown everywhere in reckless profusion, and, in place of linear regularity, we find waves in every direction.

With the two pavements of a later period no such distinctions are presented. They harmonize with discoveries at other places. The peculiar character of the earlier specimens would tend, therefore, to the belief that, if not actually invented by the Carthaginians, tesselated pavements were known to them at a very early period. Many Greek colonists were doubtless acquainted with the civilization of northern Africa and may have brought about the use of these tesselated floors. They are said to have been first introduced into Rome by Sylla, who constructed one in the temple of Fortune at Praeneste, a city besieged in B. C. 82, when the inhabitants were put to the sword and the military colony established. "The pavement" writes Pliny, "remains to be seen to this day." To Sylla the glories of Carthage must have been well known; and if we may credit the statement that to him the introduction of mosaic pavements into Rome was due, there is still greater reason for ascribing to the art a Punic origin.

Be that, however, as it may, it is certain that mosaic once adopted by the Romans, became of general use among them, not only tesselated pavements, but also the true opus musivum. During the reign of the Cæsars mosaic work rose to an unexampled popularity, and its artificers were among the most honored in the city. The prevalence of this fashion and feeling was doubtless much promoted by the enormous accumulations of precious materials introduced into Rome after each successive conquest.

From the monuments of every kind, still existing, the art would appear to have advanced to its highest perfection during the reign of Hadrian (A. D. 117 to 138), and for one hundred years before that period there is little doubt that no building of any importance was erected which did not largely involve the employment of this most graceful embellishment.

That the walls as well as the pavements were enriched in like manner we have proof, for

Catullus informs us that Mamurra was "The first who employed mosaic to decorate the walls of his house."

And in those days when the Roman Empire overshadowed the then known world, when their conquering armies invaded the countries of Europe, Asia and Africa, wheresoever their hosts went they introduced the art. Julius Cæsar, as we learn from Suetonis, Vit cap. 46, carried about with him in his expeditions pieces of marble, with which to adorn his pretorium. "*In expeditionibus tesselata et sectilia pavimenta circumtulisse.*" Wherever Roman energy planted its foot, traces may be seen of this cherished art, one of the links in the chain of evidence to guide the historian in tracing the progress of Roman civilization. From the reign of Hadrian to that of Caracalla, the art appears to have lost in quality what it gained in the quantity of its specimens. In the Lateran museum of Rome is to be seen a large mosaic, removed from the baths of Caracalla, which, though still of great magnificence, lacks the refinement of treatment of earlier work, the tesseræ being coarse and the design vulgar. From the year 220 the art as applied to pavements became obscured by clouds from which it rarely emerged, and after the lapse of another century it entirely ceased to be practiced except in the shape of another kind of pavement known as Opus Alexandrinum generally regarded as resembling that introduced into Rome by Alexander Severus, A. D. 222–225. It may be described as an arrangement of small pieces, of all shapes, squares, triangles, polygons, trapezoids, of all sizes, arranged together in severe geometrical patterns, surrounded by large strips, and surrounding squares and circles of other colored marbles. Generally speaking, the materials employed were of the richest kinds, red and green Egyptian porphyries, Giallo Antico, and green serpentine marble, being the most prevalent. The finest specimens of this work are to be found in the Basilicas of Rome, San Lorenzo, and San Giovanni e Paolo, and one of the least imperfect is in the Capella Palatino at Palmero. This variety of pavement, however, was not in general use, and was discontinued almost totally toward the end of the thirteenth century.

Since then, and up to the middle of the present century, the old Roman opus tesselatum was a thing of the past, if not a lost, it was at least an unpracticed art. The pavements which may be called a modification or simplification of the opus sectile, henceforward held sway.

It is curious to note that in the sixteenth century, when the revival of the fine arts swept over the civilized world, when painting, sculpture and architecture received that great impulse called the Renaissance (new birth), the tesselated pavement of classic times was entirely neglected. Not so, however, the other kindred arts, more especially that branch of the opus musivum classified as opus figlinum, now known as modern Roman mosaic, specimens of which are seen in the shape of personal ornaments in all the jeweler's shops in Rome.

In the seventeenth century there was established at Rome a regular school for opus musivum and a manufactory, called the Fabrica. At the commencement of these works as large a sum as four *scudi* (equal $4), per square palm (about two-thirds of a square foot) was paid for the labor of forming coarse mosaic; but in consequence of the influx of artists from all parts of Italy attracted to Rome. "*Fama tam immodici pretii et copiæ Musivi operis quod inibi construi cœperat,*" the price for the same quantity of similar work was considerably diminished.

A short notice of the process followed at Rome may not be uninteresting: A plate, generally of metal, of the size of the picture to be copied, is first surrounded by a margin rising about three-quarters of an inch from its surface, making it thus into a tray; this is then coated over with a layer a quarter of an inch in thickness, of mastic cement composed of powdered Travertine stone, lime and linseed oil, which, when set, is entirely covered with plaster of Paris rising to a level with the surrounding margin, intended to be exactly that of the finished mosaic. On this is traced a very carefully drawn outline of the picture to be copied, and with a fine chisel just so much is removed from time to time as will admit of the small pieces of smalti. This smalti is a vitreous paste, the principal manufacture of which is carried on in Murano, one of the small islands surrounding Venice. The operator then proceeds to select from the great depository, wherein are preserved in trays nearly ten thousand varieties of colors, a piece of the particular tint he may require; this he brings to the necessary shape by striking the smalti with a sharp-edged hammer directly over a piece of iron, with a similar edge placed vertically beneath. The concussion breaks the smalti to very nearly the form desired, and the precise shape and size are afterward obtained by grinding upon a leaden wheel covered with emery powder. The piece thus shaped is then moistened with a little cement and bedded in its proper situation, the process being repeated until the picture is finished, when the whole, being ground to an even surface and polished, becomes an imperishable work of art, rescuing from oblivion beautiful forms too often subject to mutability and destruction. Thus have been elaborated those noble specimens of mosaic that decorate the altars of St. Peter's, those wonderful minute records of the past or passing beauties of Raphael's Transfiguration, of Domenichino's St. Jerome, and of Guercino's Santa Petronilla, which latter, as an enthusiastic German traveller remarks: "*Wie am Tage ihrer vollendurg so strahlen sie noch yetzt in schimmernden Farbenfrische, und werden es, so lang nur ein Steinchen neben dem andern sitzt.*"

But there was no manufactory or Fabrica for tesselated pavements. In the seventeenth century, when the monarchs of France were lavishing millions in rearing magnificent palaces; when the kings and princelings of Germany were following the example of Louis XIV., and erecting on a smaller scale chateaux, sans soucis and monbijoux; when to adorn these sumptuous buildings rich and costly marbles were fixed on the walls, carved into elaborate mantels, and laid on floors in the simplified form of opus sectile; when quarries producing these marbles were opening up in different parts of western Europe, the once so much admired and prized opus-tesselatum was entirely overlooked and forgotten. In none of these palatial structures is there to be found a vestige thereof. The art was apparently dead, and buried so deep as to be beyond resuscitation, not figuratively only, but actually and in fact; for all those elaborate pavements mentioned by Roman authorities were far beneath the surface. Pompeii, where not a single dwelling of any size was unadorned with elegant tesselated pavements, had been overwhelmed and engulfed (A. D. 79) beneath thick crusts of volcanic lava. Its neighboring city, Herculaneum, had equally suffered from its proximity to Vesuvius, and the pavements of Rome were beneath the ruins of the sumptuous edifices that had been a prey to the destructive propensities of the barbaric hosts that successively laid low the architectural monuments of the once-proud empress of the world. Above the existing surface there were, therefore, few, if any, examples of the Roman opus tesselatum; their existence was known to scholars from the writings of Pliny, Vitruvius and other authors of classical times. In the eighteenth century a few excavations were commenced—the famous mosaic, Pliny's Doves, was found by Cardinal Furietti, in 1737, in searching for such objects in Hadrian's villa at Tivoli, and was afterward sold by him to Pope Clement XIII. (Carlo Rezzonico); they were carried on, however, in only a half-hearted way, but they had the effect of whetting the appetite of the succeeding generation. The nineteenth century has witnessed the birth of a legion of antiquaries whose pastime has been to search for and find the treasure houses of antiquity. Layard has uncovered Nineveh, Dr. Schlieman discovered the Homeric city of Troy, and, not to mention a small army of other diggers and delvers, the Italian governments have annually appropriated sums of money for removing the accumulated rubbish of centuries from the sites of the unfortunate sister cities near Naples, of such world-renowned places as Hadrian's villa at Tivoli, the palace of the Cæsars, the golden house of Nero, the baths of Caracalla at Rome, and of others too numerous to set out.

Thus were brought to light the works of the Musivarii for the sight of which scholars and antiquarians had so long yearned; pavements were uncovered to excite the admiration of beholders and stimulate the desire to add this beautiful and useful ornamentation to the buildings of the present times.

For many years all efforts to revive this dormant art failed of success; even down to the year 1851, epoch of the first great international exhibition, it had not succeeded in finding any one of sufficient enthusiasm and commercial activity to run the pecuniary risk of launching what was practically a new industry. Many attempts at imitation had been brought before the public, and, in 1820, a patent was obtained for a mode of imitating tesselated pavements by inlaying stone with colored cement; but pavements thus constructed were found to be uneven in use in consequence of the unequal hardness of the materials. Terra cotta and burnt clay had also been tried, but found liable to the same objections.

However, by these and similar efforts, general attention was attracted to the subject and the way opened to the closer study thereof.

And what largely stimulated the revival, was, indeed, an important factor therein, was the increasing facilities of travel. Prior to the fifth decade of the present century traveling in Italy, the principal storehouse of ancient art, was a luxury posssible to those, who were masters, not only of wealth, but of their time, on which they need fear no urgent business calls.

With the extension of the facilities of movement and the shortening of time required to attain long distances, came the great influx of visitors to the Sunny Land of Europe. To accommodate these guests new hotels had to be built, and in these were laid the earliest mosaic pavements of modern times. Thus began the first chapter of a new history.

The men who engaged in this art, now, however, less of an art than a craft, came from villages in the neighborhood of the town of Udine, a city of Venetia mentioned by Pliny among the municipalities of that country; and an important town in the middle ages as the capital of the province of Friule. These men traveled from one Italian city to another, practicing their craft much after the fashion of the artisans in the middle ages. They needed but few tools; a hammer, such as previously described, and an anvil of iron eight inches long and four inches square, were all that were necessary. Wherever they went they found the materials they wanted; any sort of marble or limestone answered their purpose, and in cases where these were not to be had they availed themselves of pebbles. Hammer in one hand and a piece of marble in the other, the men, some with great dexterity, fashioned their cubes to the dimensions their work required. From Italy they found their way, in groups, to the neighboring countries of France, Austria and Hungary, and established themselves, in a small way, at Vienna, Buda-Pesth, Nimes in the south of France and at Lyons. The remodeling of Paris by Napoleon III. attracted them to that city, and there for many years their northern progress was arrested. At first the Mosaicists (Italian Mosaicisti, French Mosaistes), as they were now called, worked in combinations and coöperatively, but by degrees the shrewder men among them with business aptitude developed into employers (Italian Padrone, American Bosses) of their fellow countrymen. Their operations were, however, on a small scale—the most important works executed were at the Tribunal of Commerce and the Grand Opera House at Paris, and, for the rest, in a few of the houses of the nobility, as the Pompeian villa of Prince Jerome. So that at the outbreak of the Franco-Prussian war in 1870, the total area of Mosaic pavements laid in Europe did not exceed, if it even equaled, fifty thousand superficial feet; but the ball had been set rolling, and the industry was soon to extend by leaps and bounds.

The following description penned in 1879 by an English writer of the great impetus given to this work, may not be out of place; "Most of our great discoveries both in art and science have been the result of accident or chance; the same may hold with our revivals. Some years since mosaic pavement was but a name in England. It chanced, however, that as the fact of the laureate, waiting for the train at Coventry, shaped the city's legend into the glorious poem on Lady Godiva, so on one occasion when Mr. Burke, the parent of modern mosaic in England, waited in the 'Salle des Pas Perdus,' of the Tribunal of Commerce in Paris, he noted the mosaic pavement up and down which he paced with the persistence with which scores of litigants have corrugated the halls of lost footsteps in every country in which Themis, unrepresented by Mr. Justice Lynch holds sway. The idea of reviving the art in England occupied his mind, and the results are now patent throughout the country, under circumstances so incongruous."

This somewhat flowery description is however misleading. It is true that the writer of this paper was the first to cause mosaic pavements to be adopted in Great Britain, and that, as a result of his standing with architects and artists, a fashion was quickly set, so that within a very few years the areas laid were to be reckoned by tens of thousands of feet (between 1872 and 1880 the writer's firm put down nearly a million superficial feet), but it is certain that if he had not taken up the narrative some one else would; his only merit is that he saw the time was ripe, he seized the occasion with enthusiasm, and gave velocity to a movement that had already begun. The Italians, at that time engaged in this industry, were wholly lacking education; few of them could read, and fewer still could write even their native tongue; all they knew about making mosaic came from observation and self-teaching. As the craft had not been practiced for centuries there were no traditions such as exist in other trades and are taught to youthful apprentices. In this branch there were no teachers, there could be no apprentices, and from their want of education, the works of the authorities were to these men sealed books.

The writer of this paper, even as all architects and artists at the time, had a theoretical knowledge of mosaic, gathered from reading, study and travel, he had seen the glorious works of the past at Pompeii, Rome, Venice and other cities of Italy, and having decided to practice this art, not in a dilettante spirit, but largely and commercially, he resolved to devote further time to the study of the examples of the old masters.

At that epoch (1870) many churches and public edifices were building in England, architects like the late William Burges, whose fame as an artist is not confined to his own country, and the late George Edmund Street, architect of the new law courts in London, were calling to their aid, in council, men who had devoted their time to the study of the artistic branches of the building trade. Encouraged by promises of support from these and other architects, the writer made many journeys to Italy visiting and dwelling in the cities and towns where any remains of Roman pavements were to be seen.

Even as two thousand years past, tesselated pavements once introduced into Rome speedily became a fashion, so after it was known that they could be had at a cost within the bounds of reason, superficial area upon area was embellished with mosaic.

Among the artists who stamped the work with their approval in the strongest manner, that is by personal selection, were, the marvelous producer of marbles and tesserae upon canvas, Alma Tadema, the late Edwin Long (whose antiquarian research was only equaled by his power of hand), Sir Frederick Leighton, president of the Royal Academy, and Sir John Millais, all of whom entrusted commissions to the writer's firm.

Some time about 1875 there came to New York, Domenico Pasquale and a fellow countryman, both from the same part of Italy as the Italians previously mentioned. They were engaged in the year 1878 by the firm of Herter Brothers, of that city, to lay pavements in the houses of Jay Gould and D. O. Mills. These Italians subsequently paved some small vestibules in New York and Boston, but their success was not great, and after a short stay they left the United States and went to one or other of the countries in South America. In 1879 Herter Brothers imported from Paris some elaborate mosaic which was placed in the house of

W. H. Vanderbilt, and in 1881 the same firm organized a department for the making of mosaic and have since carried out considerable work in various parts of the country. In 1881 Giuseppe Pasquale, another of the pioneers, who had practiced the craft in Austria and Switzerland, came over to New York, and, in a few months, associated himself with a Swiss, and founded the house of Pasquale & Aeschlimann.

The writer's firm in 1879 received a commission for a very elaborate pavement to be laid, and for several panels in Venetian enamel mosaic to be fixed, in Grace Church, New York. The designs were made by Messrs. Clayton & Bell, of London, the eminent artists who designed the stained-glass windows on the church, and, later on, the stained-glass windows for the cathedral in Garden City, L. I., with which is associated the name of the late A. T. Stewart. In December, 1883, Giovanni Primavori, who for several years had been employed at the factory, established by the writer's firm in Paris, came to Chicago and induced John Caretti to interest himself in mosaic.

The commissions entrusted to the latter were at first very small, mantel facings and hearths being the principal part of his work, the first pavement of any importance laid by him being in Lincoln, Neb.

That talented man, architect and artist, the late John W. Root, whose death in 1891 was so keenly felt by all who had the privilege of his friendship, and who was so great a loss to the city of Chicago, during a visit to Europe in the year 1886, witnessed the development which had been going on in this art, and saw the numerous beautiful pavements that had been laid and were laying in the public and private buildings in Europe, and most extensively in London and Paris. Contemplating at that time the erection of the Rookery building, and desirous that, in every respect, it should be abreast of any structure of its kind, he invited the writer of this paper to visit Chicago. The result is to be seen in the first floor of that magnificent edifice, and this pavement was the first mosaic of any magnitude laid down in Chicago.

To this succeeded the paving of various areas in the theater and hotel of the Auditorium building, and in quick succession came the floors of the remodeled Chamber of Commerce building. In this latter, not only have floors been covered with mosaic, but ceilings have been put up that may claim to be the first thus treated in marble mosaic since the third century.

And now, in all the colossal piles, the Monadnock, the Woman's Temple, the big hotel facing the postoffice, the Masonic Temple, the Manhattan, the Monon, the Germania theater and various others, built and building, mosaic is the pavement selected. Thus in four years from the time (1887) when the writer of this paper came to Chicago, there have been laid over one hundred thousand superficial feet of mosaic pavements in the city alone, and before the World's Fair opens these figures will be increased until the sum will be nearly half a million feet.

Other cities have availed themselves of the possibilities and advantages of this new industry. The halls and corridors of the Ponce de Leon hotel, St. Augustine, Fla., of the buildings of the New York Life Assurance Company in Kansas City, in Saint Paul and in Minneapolis; of the Mills building in San Francisco; of several buildings in Boston, Pittsburgh and St. Louis; the chancels and sanctuaries of All Saints Cathedral, Albany, N. Y., and the Church of St. Paul's, Buffalo; the Ambulatory of the national memorial to General Garfield at Cleveland, Ohio, are paved with small cubes of marble. Cathedrals and churches, hotels and apartment houses, theaters and halls, office buildings and private dwellings, all bear testimony to the popularity of the work of the mosaicist.

Thus, in a measure, history repeats itself. On its first introduction, before the Christian era, to the Roman people, mosaic work was acclaimed with enthusiasm, and soon prevailed throughout the civilized world. With the eclipse of civilization came the long trance of the mosaic art, a trance so deep and so enduring, so much like death, that awakening seemed past hope. Phœnix-like, however, it rose at length from the ashes that for nearly two thousand years had hidden it from human sight, and within thirty years of its new existence it has spread to lands unknown, undreamt of by the Musivarii; not as of old, in the wake of the remorseless warrior, but in the company of plain and simple soldiers of the peaceful army of arts and commerce.

In the old method of producing mosaic the artisan placed the cubes, one by one, direct on his groundwork, and so formed the pattern as he proceeded. Under such circumstances progress was very slow; he had to work sitting or kneeling, consequently in a cramped posture, moreover, the design, when there was one, had to be drawn on the cement, in which the cubes were to be inserted, and this was a long and tedious process. In these days, when time means money, a different principle had to be adopted. The method now obtaining is to gum the cubes on sheets of brown paper, in pieces from two to three feet square, thus enabling the work to be laid in masses, instead of cube by cube.

The present method of laying mosaic is much the same as of old. Upon a firm and solid bed of concrete is imposed a coating of cement varying in thickness according to circumstances, on this the mosaicist lays the material as before described, gumed on paper, the paper being uppermost. He then saturates the surface with water and passes over it a heavy granite roller until the paper, no longer of use, loosens and comes away. After carefully washing off all traces of paper and gum, the operator with a rammer, of special fashion, beats and hammers down the cubes, until the cement oozes up around every joint, so that each one is, except on face, entirely surrounded by cement and being rough on four sides keys itself therein. From this very ramming comes the word pavement, pavire, to ram, pavimentum, the thing rammed. With the heavy granite roller, previously mentioned, he then further consolidates the whole. It will thus be seen that the principle of this work is the thorough consolidation of the marble cubes with the cement and of the latter with the concrete. When the whole has become sufficiently set, the surface is rubbed down to a uniform level and the colors are brought out by friction and oiling. Thus is formed a homogeneous pavement, solid and silent, affording a secure and pleasant foothold, free from the clank and hollow sound which are inseparable from other kinds, and with this great advan-

FIBRE CEMENT FOR EXTERIOR.

tage, that if after a few years, evidences of wear and tear become sensible to the foot, the level can be restored at a very trifling cost by rubbing down with a grit stone.

Doubtless this solidity and firmness have been a great recommendation to its adoption, especially in Chicago, where architects are trying to outvie the Romans in building, not for an age but for all time.

Another and important element is the scope given to variation of design and to the introduction of color effects. In designing, mosaic may be accommodated to any shape or style, and as there is no mechanical necessity of producing the same pattern, each pavement becomes an individual work. To the architect, and they of the present day have not been slow to see this great advantage, mosaic affords the most durable and probably the most beautiful means of adding, to the charms of well-studied and varied form, the graces of color. It affords to him in its simple geometrical character a variety of design almost unparalleled in decorative resources, one that harmonizes alike with the severer forms of monumental style and the more free and graceful peculiarities of domestic and social requirements.

The design of the late William Burges for the apse of Cork Cathedral (St. Fin Barrs), may be cited as a case in point. The design was an illustration of the "Miracle of the Fishes" and the text, "Be ye fishers of men." In the outer hemicycle, corks, representing the buoys, are seen to float, in the next rank come conventional waves, then a border representing the outer meshes of a net; while the groundwork gives the reticulation in which are swept together all classes and conditions of men, from the king to the peasant; Doctor, Rusticus, Piscator, Venator, Mercator, Agricola, Artifex, Servus, are all collected together along with various fishes of the deep, in this seine net of life. In the architect's own house the subject of the pavement is the Cretan Labyrinth with the faithless Lothario, Theseus, the quickly loved and soon deserted Ariadne, and the dreaded Minotaur, all found within its mazes.

Architect George Keller, of Hartford, Conn., when arranging his grand color scheme for the interior decoration of the splendid Garfield memorial in Lake View cemetery, Cleveland, welcomed to his aid this revived art. A frieze in marble mosaic divided into eight compartments encircles the hall. In each compartment is a representative group of figures—War, Labor, Literature, Concord, Law, Justice, the Offerings of Veterans, bring in procession tributes of love and respect to the Bier of the late president over which bend in mournful attitude Columbia and her sister states. As the works of the Musivarii are at this time as vivid in color as the day they left the hands of the artist, two thousand years ago, so will this frieze endure, unless destroyed by iconoclastic hands, to show future generations what was done by artists in the later decades of the nineteenth century.

When drawing the architectural embellishments for the Auditorium, Mr. Sullivan, fully alive to the opportunity offered by mosaic to his fertile pencil, specially designed the landings of the hotel and theater. They are different from any designs ever before translated into mosaic and are as beautiful as they are unique. In one of the single nooks of the box tier of the theater is to be seen a frieze, in mosiac, which in originality of design, in delicacy

II

of treatment, in wealth of color, brings to mind the Treasure Trove in the British museum, the pavements of Carthage.

All this shows the progress made and the position attained in a very few years by the lithostratic art, a progress that only requires careful study of the best models to become thoroughly rooted. True and artistic work, carefully and solidly executed, must in the end conquer; but clumsy, coarse and inartistic attempts will bring the mosaic art down until it will have " fallen into the position of weeds and outworn faces."

And here Mr. Burke's excellent article ends.

In this mosaic work the revival of handicraft, among English speaking peoples, is made manifest. This revival may be said to have begun about twenty years ago, with a movement initiated in London by William Morris, Dante G. Rossetti, and J. E. Millais, well-known names in the world of letters and art. A fund of some few hundreds or thousands, of pounds, was subscribed by those men and their friends, and a store opened, with the sign, " Morris, Rossetti & Co." for the purpose of rehabilitating handicraft and artistic design in various kinds of household art. They furnished the designs and skilled workmen from France and Italy executed such designs in metal, stone and wood. A writer in *Scribner's Magazine* is positive that the aim was to reassert the true dignity of handicraft, and the undertaking assumed the form of a practical protest against the leveling and often tawdry influence of machine manufacture in many kinds of industry, which obliterates all sense of the artistic, and is destructive of skilled craftsmanship. The activity of the time is marked by a moving forward of the mass at the expense of the individual, for the exclusively utilitarian aim of machine manufacture tends to level all distinctions.

The Caretti mosaics, Burke & Co's. mosaics and other less extensive workers in ornamental marbles, all tell of the sudden growth of handicraft and art in Chicago.

The fireplace and mantel take a leading part in making up the modern home. In one of the departments of the French exposition there was a rudely-constructed hut of unhewn stones, having the roof arched like the Esquimaux huts in the story-books, and in the center of the floor was a depression where the fire was placed. Such was the primitive hearth of our ancestors a few thousand years back, and when its nature is considered no wonder can be felt at the unwillingness of the savage to fight for his altars and his fires, for it was easier to make a hearth and build a fire somewhere else than to strike, in Marco Bozzaris fashion, for the one he had. But man is quick to learn, and no longer time elapsed after the invention of houses and the discovery of fire before it was ascertained that smoke was an exceedingly disagreeable thing to have in the house, so a hole was made in the roof, and behold the first chimney. But having advanced thus far a halt was called, and not for many ages was further progress effected. The chimney is, almost beyond doubt, a modern invention. The ancients, with all their boasted civilization, did not know enough to make a chimney, for in the Greek houses the fires were kindled in the halls and the smoke escaped through the doors, by way of the windows, when there were any, and through a hole in the roof. Winter must have been a disagreeable season, if the frequent allusions to the

unpleasantness of the smoky houses and the general discomfort of such a means of warming an assembled company be considered. The conceited Greeks looked down on all other nations as savages, but the Romans had sufficient regard for their own comfort as well as sense enough to make a vast improvement on house-warming, for in Pompeii have been discovered furnaces in the cellars of the palaces, having hot-air pipes by which the rooms were made habitable. But even in these cases careful examination has disclosed no chimney, the smoke from the furnace being simply turned out of doors through an opening on a level with the ground.

But the open-air habits of the people there rendered much artificial warmth unnecessary. These furnaces were only for the very wealthy, and in the house of an ordinary citizen, when his family or guest became cold, a servant brought in a brazier of coals, which in turn was passed to each guest, who warmed his hands over it and handed it on to his neighbor. Nor is this practice discontinued even now in Italy, for a brazier of burning charcoal is in many, if not most, houses the sole reliance of warmth in the winter season. A more convenient foot-warmer was the hot-water jug employed by the fair sex in the middle ages, and a chronicler of Froissart's time gives a funny picture of a party of gossips on a cold day, each with her gown carefully tucked in around a jug of hot water safely bestowed between her feet. But the brazier and the hot-water bottle, while sufficient for the few days of frosty weather in the south of Europe, were a mockery and a sham in the north, where during half the year it is always raining, except when it snows. So in northern countries as early as the tenth century devices appear for the promotion of domestic comfort in the matter of house warmth. In several of the castles of England built in the Norman era regular fireplaces appear, and that they were not due to Saxon intelligence is inferred from the fact that the same kind of fireplaces are found in the Norman castles in France built during the same age, while the Saxon literature, though often mentioning hearths, generally locates them in the center of the room, and several allusions are made of the agonies suffered by cooks and housekeepers from the smoke. The chimney, in a rudimentary form, appears for the first time in these Norman fireplaces, and in Rochester, Bodiam, Dover, Carnarvon and other castles of the French period are found short passages built in the wall, leading from the hearth to the outer air. These chimneys are, however, always short and often of the same width as the fireplace, so that they must have let in as much air as they let out, and when the wind was in the wrong direction, of course, all the smoke blew back into the room, thus making the condition of the occupants as miserable as could be conceived from such a cause. In the twelfth and thirteenth centuries the chimneys became longer; in the thirteenth and fourteenth some glimmering of the philosophy of their construction began to be evident, but not until the present century was the chimney really built to achieve the purpose for which it is intended.

Except in the extreme north, the fireplace was more for the purpose of cooking than of warming, and was built in very commodious fashion—one ten feet wide was far from uncommon, while in the great hall of Hastings Castle, a royal fortress, was a mighty fireplace nearly sixteen feet wide and capable of taking in a four-horse load of wood at one time. The back-log in the olden times was quite as much of an institution as in modern days. The yule-log was brought in with great rejoicings at Christmas time, and the fireplace being cleared for the occasion, as many men as could get hold of its ponderous bulk raised it from the ground and laid it next the wall while healths were drunk to the success of all undertakings while the yule-log lasted. An odd survival this, of a pagan custom, as it without doubt originally was, for the great Druidical midwinter fell on a day near our Christmas, and then all fires in dwellings were extinguished, to be relighted from the sacred flame kept ever burning in the round towers on the altars. After Christianity came into the west of Europe, however, the hearth fires were not extinguished for religious or any other purpose; for to let the fire go out was an accident as serious as in the backwoods of America a hundred years ago. There are men now living who remember making an occasional trip to a neighbor's house for fire when by some accident the sacred flame on the family altar had been allowed to perish; and such will read with interest an account by one of the Saxon chroniclers of a visit made by Harold Harefoot to Ely Monastery. His majesty was well received by the brotherhood, but as their fire had gone out, one of the monks was dispatched post-haste to the nearest village for burning coals to relight it, that suitable entertainment might be provided. A rare accident, no doubt, it was to happen in a monastery, for the kitchen was then an important part of the establishment and the well-fed condition of the monks was matter of comment, not always couched in the most respectful language, from Land's End to John O'Groat's house. Frequently the abbeys had a kitchen building apart from the main edifice, as at Glastonbury, the kitchen of which was built so strongly and of so solid material that it still stands, though all the monastery buildings beside are in ruins. But this was a notable kitchen, built by a dinner-loving abbot, who on one occasion was visited by a free-booter knight and his troop of cutthroats, and after receiving the best in the house the rogues rewarded his reverence by burning down his kitchen. "Odds bodkins," said the holy man, or words to that effect, "I'll build a kitchen they can't burn down," and so rose the Glastonbury kitchen, famous to this day in the south of England as having stone walls three feet thick and eight monstrous fireplaces, each capable of roasting a beef whole.

In the castles and monasteries the fireplaces were built for use and not for show, and on all common occasions the kitchen was the general sittingroom for everybody in the house. Cooking and eating were done in the same room. All watched with interest the progress of the roast as it twirled, suspended on the cord before the glowing coals; all joked with or scolded the cook as he bustled to and fro, from time to time dipping up a huge ladle of the dripping, and pouring it over the leg of beef, lest the meat should burn. When everything was ready for the dinner, two or three men united their forces and burned their hands in laying the joint on the huge platter provided for it, then each, armed with his hunting knife, cut off what pleased him and ate it with the fingers heaven provided, for even Queen Elizabeth had but one fork, and that was gold and kept for show. When, however, people began to be a little more civilized, they sat somewhere else than in the kitchen, and made the decoration of the day rooms a matter of special attention, the fireplace became prominent as a center of decorative effort. The first attempt in the direction of ornament was probably the execution of rude carvings in the material of which the jambs were constructed. In several very old fireplaces the sides and top were of granite, and, as this looked too heavy, the builder made efforts to lighten the general effect by carving cable moldings round the jambs and above the recess for the fire. From this beginning further progress was easy, and, as desire for decoration increased, so the ornamention of the fireplace and its surroundings went on, until this part of the room was the most attractive. There was a good reason for the fact. The position of a fireplace in a room is always conspicuous, since, on entering, the eye always turns naturally to the fire, and builders with pride in their work, and householders with desire to emulate the splendor of their neighbors, vied with each other in adorning the fireplace and making it as elegant as means and material would permit. Hence came the decorated fireplaces of the last three hundred years, and such was the zeal of designers, artists and stonecutters, that their joint efforts left little to be desired. There was plenty of room for them, for the old-fashioned fireplace was boundless in its capacities, frequently taking up all one side of a room, and within the great recess thus furnished seats and benches, sometimes of wood, oftener of stone, were built, so that a whole family could be gathered literally "into the fireplace," and thus defy the drafts of air that came from open door and badly-closed window, and went howling up the ample chimney. So, all sorts of ornaments were piled on, according to taste. When the taste of the architect or owner was good, the fireplace corresponded, so that it came to be a proverb: "Show me your fireplace and I will tell you who you are."

One of the most splendid fireplaces ever built is a French fireplace, constructed in the seventeenth century for a French palace. Ingenuity can go no further in heaping on ornament. The granite jambs are carved as seated lions of gigantic size; above the fireplace proper rises a huge mass of marble carved in the most profuse style of the Renaissance. Five female statues divide the front into four panels, while figures and foliage, birds, beasts, flowers and monsters crowd every inch of the marble and confuse alike by their numbers and the curious intricacy with which they are combined, a part of one forming a part of another, until the eye refuses to distinguish between them. This is ornament gone mad, and relief is found in turning from so extravagant a piece of work to the simple Persian fireplace made for a French nobleman who had a fancy to fit up the various rooms of his house after the style of several different nations. So far as the Persian room was concerned his success was perfect, as was also that of the Turkish room, the fireplace in the latter being fitted with divans on each side, in genuine oriental style, the model being taken from the palace of an Ottoman pasha in Keresoun. Almost as beautiful, but in a different style, are some of the English fireplaces of the last century. One, in Dorchester house, is of gray marble, the jambs represented by two half-kneeling female figures of life size supporting a mantel loaded with heavy ornament. The Chateau de Fleurigny, in France, has a fireplace of the seventeenth century, and many of the chateaus of the Loire boast of mantels of exceeding richness in material and architecture.

A grate fire, even in the yawning old-time fireplaces, is a "cheering sight to see," and when the fire is surrounded by the beautifnl trappings of the present day, it is doubly attractive.

*The word *ceramic* has probably its origin from the Greek, and its pronuneiation should properly be keramik. The produetion of ceramic dates as far back as to the Egyptians and Assyrians. These people molded or stamped bricks in relief with figures and inscriptions, and coated them in siliceous enamel. In the same manner slabs, or tiles for wall-linings were made. These, however, were oftener made in the shape of stars and closely fitted together, though they sometimes were made rectangular or square. Ceramic and pottery go hand in hand through the centuries. The potters wheel was known as early as eighteen hundred years before Christ, and is mentioned by Homeros. Isaia speaks about how potters' clay was prepared in his days. Damascus and Rhodes are prominently mentioned as producers of works in ceramic. The word majolica (by which is commonly understood colored glazes burned into ceramic ware) is derived probably from the name of the island Majorca, where the Moors produced eeramie ware to a great extent in the early centuries. Faenza or Faience was a higher grade of decorated ware. Specimens of Rhodes-Faienee work are exhibited in Musée Clunny, Paris. The Italians and Greeks were among the first who made the production of ceramic an art. Luca della Robbia is said to have discovered the tinglaizure (1399 to 1482). He is referred to as "the master of works in ceramics." This kind of ware was after him often called Robbia-works. But in the eleventh and twelfth centuries the Moslem builders of Persia brought this art to great perfection, and used it on a large scale, covering the walls with thiek slabs, overlaid with a white enamel. The inside of these mosques had their walls, to a great extent, covered with glazed tiles, which had very delicate and minute patterns painted on the surface and burned into the glaze. Sometimes friezes with Arabic inscriptions, modeled boldly in high relief, were used to break up the monotony of the surfaee. Nothing can surpass the splendor of effeet produced by these tile coverings, varieties of which, dating from the twelfth to the seventeenth centuries, were largely used in all the chief buildings of Persia. The most remarkable examples for beauty of design and extent of surfaee covered by these tiles are the mosque at Tabriz, built by Ali Khoja in the twelfth century, the ruined tomb of sultan Rhodabend in the fourteenth century at Sultanich, the palace of Sha Abbas I. and the tomb of Abbas II. (in the seventeenth century) at Ispahan, all of which buildings are covered almost entirely inside and out with this magnifieent sort of decoration. In the fourteenth century the Spanish Moors manufactured another class of wall-tiles called azulejos. These were made in a very different style, being designed to suggest or imitate mosaic. They had intricate interlacing geometrical patterns marked out by lines in slight relief; brilliant enamel eolors were then burned into the tile, the projeeting lines forming boundaries for the pigments. A very rich effect was produced by this eombination of relief and color. The more important buildings in which the most beautiful examples of these azulejos were used, are the Alhambra and Generalife palaces

* This article on Ceramics was contributed by Mr. S. Linderoth.

in Granada, completed in the fourteenth century, and the Alcazar at Seville. The latter building owes its decorations to Pedro the Cruel (1364 A. D.) who employed Moorish workmen in placing its tile coverings and other ornaments. Many other buildings in southern Spain are enriched in the same way, some as late as the sixteenth and seventeenth centuries. The process of making ceramic glazes and enamels has always been regarded as a great secret, and has been jealously guarded by manufacturers; yet the art is now known to many successful manufacturers in France, Belgium, Germany, Great Britain and Sweden, where splendid tiles and enameled bricks are made. In northern Europe, particularly in northern Germany, Sweden, Finland and Russia, is manufactured what we would term a mantel or stove, reaching from the floor nearly to the ceiling. This mantel is made out of clay and burned, glazed and often richly decorated. Many of the designs command admiration. It should be mentioned here that, in addition to their unapproachable beauty, these ceramic, or porcelain mantels are perfect radiators, the flues passing twice up around and under the fire in the base before escaping into the chimney. Some of these artistic heaters are found with mirrors in the upper part, making them very handsome pieces of furniture, besides their utility. The more handsomely decorated and inlaid with gold the German grandee can have his Kackelofen, the more is he satisfied. The Swedish noble is equally proud of his kakelugn as the humblest subject of the czar is of his peachkoo. Porcelain mantels have been manufactured in the above mentioned countries for at least four hundred or five hundred years, and have reached their highest development in Sweden where they have been very effective in keeping out old Boreas. A few of these porcelain mantels from Sweden were shown at the Philadelphia centennial exposition in 1876, took the first prize, and were eagerly sought after and bought up by the Astors and Vanderbilts of the land at high prices, but, notwithstanding the appreciation in which they were held, no further effort seems to have been made to introduce them into this country. The day, however, has at last arrived when it is possible for Americans to have the very best obtainable in this line of industrial art. The Linderoth Ceramic Company has erected a large factory at Fifty-second and Wallace streets, in this city, for the manufacture of these mantels, and it is very gratifying to know that this industry will now be conducted within the commercial heart of the country. The same company will also make superior enameled bricks, tiles, vases and other fancy ceramics, and it is claimed that their glazed or enameled products will not craze or crack in the surface, as has been the case with domestic made ware of this kind hitherto. The newspapers of the city have repeatedly urged enterprising men to take up and develop the art of glazed or enameled brick, as the price of imported bricks has been and is $125 per one thousand. There is no good reason why these products should not be successfully made in this country. There is just as good clay here as that which was deposited on the shores of the Nile, and just as pure silica as that of the sandy deserts of Egypt. As to chemicals they are here, and no longer will the American people be compelled to acknowledge that they do not possess the skill required. Of course both enameled bricks and tiles have been produced in the United States, but the product lacked much in the matter of perfection. This may be partly due to the fact that it is impossible to make an analysis of the foreign product, as some of the chemicals used in the glaze have evaporated or otherwise vanished in the burning process, but which were essentials for producing good results. An illustration of a porcelain mantel is given in this volume to represent the state of this art in Chicago in 1891.

The modern wood mantel is no less a thing of art than these just described. Meyer in his reference to it says: "Their use comes to us sanctioned by the past. Continental Europe, England, or what is nearer and dearer to us, New England and the Old Dominion, still show us splendid examples, which illustrate fully not only beauty of design and cunning workmanship, but permanence and durability also. In the modern mantel this last quality is still further insured to us by reason of improved methods in construction and the use of material unknown, or known to a limited degree only, by our progenitors. The substitution of wood with its beautiful markings and artistic lines for the gravestone-like marble or slate we are too familiar with, is a matter for congratulation, and a distinct mark of the advance in our national taste. But few buildings of any pretension whatever are fitted with other than wood mantels. Builders of houses for renting purposes, hotel proprietors, etc., are becoming aware that a wood mantel, with its tiles and brass and its mirror, forms no inconsiderable factor in the letting of a house or the furnishing of a room. Using the utilitarian side of the matter as the main argument, and throwing into the scale the many artistic excellences possessed by the wood, it is easy to be seen that a return to the monstrosities in marble, imitation marble, iron, etc., is impossible. In art as in other things, the world advances, not recedes. The wood mantel affords the architect and designer an unrivaled field for the exercise of taste and skill. It is the central point of the room, and in it should be focused the "motif" or leading idea for the whole scheme of decoration. This fact is being utilized more and more each day in the best class of houses, where consistency and fitness is studied. Nor need it be confined to the homes of luxury exclusively; simple and artistic lines, chaste and quiet colors can be had to help to beautify the humblest cottage, and at a surprisingly economical rate also. But little need be said of the sanitary value of the open fireplace, it affords the simplest and most effective means of ventilating a room and drawing off injurious gases and odors, known to us, and by dint of modern methods in grates, heating, cleanliness, etc., it is brought as near perfection as seems possible. Many writers have exerted themselves in the praise of the fireside, and have drawn the picture of the burning logs, gleaming brass, gorgeous tiles and cunning carving, forming an artistic whole, and giving such a sense of comfort and cheer, the like of which nothing else can give. Outside the wintry winds may rage without ice-cold breath and swirling snow, with curtains drawn, chair close up and feet on the fender, we are oblivious, and feel we can defy them all while basking in the light and warmth of that magic circle, our own fireside."

The ornamental tile appears to be part and parcel of the fireplace and mantel.

Tiles in these days form an important part of every real well-built house, and as their beauty and usefulness become better understood, there is no reason against their adoption in place of materials less permanent and suitable for many purposes. They are now brought to

Geo. F. Kimball

a high pitch of excellence in manufacture, and, considering their indestructibility, to a very moderate figure in cost. For vestibules and hall floors there is no material superior and but few at all equal to unglazed tiles. In connection with mantels, and for bathrooms, wainscots and general wall decoration, the beautiful productions of home and foreign makers of to-day are beyond anything conceived or executed by the ancients, notwithstanding the quaint and artistic handiwork of those past-masters and pioneers in this line. Their variety is boundless, and the tones and tints of the glazes and enamels as various in shades as can well be conceived. Their use with mantels affords a keynote of color for the decorator in a room, as no other feature does or can. For bathrooms, there is nothing so clean and sanituary as tiling. For floors, they will wear longer, look brighter and resist dirt better than any material known. Patterns, unless in colors, afford, of course, no idea at all, and even when in color but a weak notion of the depth and luster of the glazes.

Windows are prime factors in good architectural design. From the days when the galleys of the Phœnicians brought settlers to the coasts of Europe and the islands, down to the present day glass has been used. With the rise of Rome the glassmaker rose to importance, and in the later days of the Roman empire he was installed in every large town throughout its length and breadth, until the flat glasses, such as the crown-glass and the sheet-glass, the hollow glasses, such as blown flint-glass, Bohemian-glass, Venetian-glass, bottle-glass, slag-glass and tube and gage glass; the pressed and massive glasses, such as flint-glass, optical-glass, rod-glass, Strass marbles and beads; the colored, opaque and enameled glasses, such as glass mosaics and hot-cast porcelain, were found in every country where the Roman eagle or the Christian cross told of Roman civilization.

The manufacture of glass for drinking cups, urns and ornaments began in Egypt, spread to Greece and thence to Rome. Early in the history of Rome the art of glassmaking reached a high stage, for the colors and ornaments of the time stand to-day unimitated, if not inimitable. Venice became the rival of Rome in producing glass vessels and statuary, and from Venice went forth the pioneers of the trade to establish themselves in Spain, France and in the Islands. Colored glass for windows and plate glass for mirrors were produced at Venice, but not until the factories of Paris and Cherbourg were established, in 1665–8, did these branches of the industry merit attention, although stained or colored glass representing religious scenes was placed in the window frames of the cathedral of Florence as early as 1390, and used in French and German churches prior to that year. The history of glass manufacture shows its introduction into each nation to be contemporaneous with the introduction of civilization. The advances in the art of glassmaking in Europe make dates for advances in civilization in Europe, but not in the United States; for England controlled the industries, as well as the people, until the revolution set them free. The building up of a great nation within a century, the extent of territory to be reclaimed from the wilderness, the happy contentment of the actors in the drama of settlement, and the disposition to allow art to wait on the accumulation of wealth, tended to check the demand for anything and everything that was not absolutely necessary in every-day life. For that reason the advances in glass manufacture here were delayed.

Albert Gallatin, a Swiss immigrant, who became secretary of the United States treasury and a power in the republic, established the first glass works in the United States, importing workers from his native land. By degrees the industry grew and to-day forms a most important factor in the industrial life of the country. W. H. Low, in reviewing the more completed art of stained-glass manufacture, predicts for the whole glass industry greater advances than are now acknowledged. The art of the glass-stainer, which in the hands of its more legitimate heirs in Germany, France, and England, by the grafting of elements antogonistic to its growth, had become a mere shadow of its former self, has acquired new vigor, and even now blossoms as the rose. That this art, which is so nearly allied to the old world of the past, should find its renaissance in the last years of the nineteenth century amidst the dust and clamor of our new-world mart is curious enough. But in a country where, in default of cathedrals inherited from ages gone by, our interest in the church is in part manifested by the fact that there are more than four thousand religious edifices of different denominations now in course of construction, this revival is more than curious; it becomes a question of eminent artistic importance. In the old world the field of the glass-stainer is virtually limited to the Roman Catholic church, and the Established Church of England. Here, with the widening of sect-distinctions, the churches of nearly all denominations are open to him, and it needs no gift of prophecy to foresee, in the near future, the clear sunshine gaining admittance to all our churches through colored glass and carrying with it messages of faith and fortitude, of joyous hope and reverent memory.

To uphold frankly the theory that the stained glass now made in the United States is better than that obtainable elsewhere, and by reference to ancient standards to explain the reason for this belief, is the object of this article; but first it becomes necessary to go back to the origin of stained glass as we know it. Glass, colored either by mixture of coloring matter in its making, or by painting the glass already made with vitrifiable colors, was known to the Greeks; but although writers as ancient as Gregoire de Tours (544–595) speak with more or less detail of leaded glass, the earliest specimen that can be authenticated is that in a church at Neuweiler, in Alsace, which dates from the eleventh century. It would appear from its purely decorative character, and from its inherent limitations, which to this day surround it, that stained glass had arrived at its apogee at a time when the art of painting was just bursting from the Byzantine bud. Well on in the thirteenth century the Italian glass had accomplished more than the sister art of fresco, and the designs for the windows in the Duomo at Florence made by Taddeo or Agnolo Gaddi seem much more modern than their painting. The glass of this and the following century, much of which still exists, is notable for the subdued splendor of its color, and is almost (in the earlier specimens entirely) without painting. In fact it was not until the fifteenth century that elaborate glass painting was attempted, and from that period ensues a decadence in which the French and Germans, and to a great extent the English still remain. For it is from the period of Raphael, when men began to paint freely and became high-priests at the altar of art instead of humble worshipers, that the mosaic of glass began to disappear and that transparent painting usurped its place.

Before this, the windows depending upon the actual color of the glass were made in a manner not unlike the common dissected map of our childhood. To make a window, a design was made, generally the simple figure of a saint, with a purely decorative background; pieces of glass of varying and appropriate colors were cut and placed in their proper places, and it only remained to bind these pieces firmly together by a ribbon of lead with a groove on either side, which was soldered at the junction of the pieces, and to place the whole in an iron frame, crossed at intervals by thin bars placed horizontally, to which the leads were fastened by wires. The result would be a stained-glass window somewhat resembling that of the thirteenth century, or, so little have methods changed, that of the present time. When this frame, filled with glass, was placed in the opening of the wall for which it was destined, it would be seen that the light coming through the transparent glass brought into dark relief the lead-lines, which thus served as the outlines of the various forms represented. This was the earliest development of stained glass.

In the two centuries that followed, painting with vitrifiable colors was resorted to in order to represent modeled surfaces, and commencing from rude and timid outlines to define the features of the face or the division of the fingers, painting was at last used with little discrimination on all portions of the window. Another of the limitations of the early glass-stainer which was a blessing in disguise, was also to disappear with the mechanical improvement in the manufacture of glass. At first his glass was blown, not cast or rolled (indeed the latter method of fabrication is of late date), and therefore the glass came to him in small pieces, and as the mixture of the ingredients or the intensity of the fire would vary, so would the quality of the color. This gave him great variety of tint from which to choose, although it occasionally entailed arbitrary leading, such as, to take a common instance, a lead-line crossing the neck of a figure between the chin and shoulders, and thereby giving the saint a decapitated look. But by improvements in the fabrication of glass, larger pieces were obtainable, and always it would appear as though the makers had an ideal only admirable in a plate-glass window manufacturer, of making a sheet of glass uniform in color and texture. On these large sheets of glass the painter had full swing; more and more vitrifiable colors were invented; a process of cutting away the surface so as to make a design appear in light upon the darker body of the glass was devised; the colors became more and more uniform, until proceeding rapidly, we reach this century—though in taking this arbitrary step, which the limits of an article such as this command, we must pass by much that is admirable.

Any one who has lingered in the aisles of the old cathedrals, moved by the color of the glass, which is glowing and jewel-like, never garish or harsh, and then has turned, as we can do in some cathedral towns, to the modern fabric, and has seen how crude in color, how small in treatment, how uniform in texture, how manufactured, turned out by the *metre carre* it all is—such a one is apt to count glass-staining as one of the lost arts. The continent is full of such places, where literally acres of stained glass are made each year. The designs are sometimes admirably drawn, though somewhat too conventionally composed, the painting of head and hands is of marvelous dexterity, while the draperies are generally overloaded with painting. In Germany the retention of the archaic features shows how closely the old masters are followed, however heavy the work appears.

The ray from the lamp of convention by which the makers of glass in Europe had guided their steps did not reach across the Atlantic, and the first windows were made by virtually reinventing the whole process. Makers of the commoner kinds of stained glass had long been established here, and the genius of the American mechanic had devised or adapted machines by which large sheets of colored glass could be rolled, sheets both broad and long, and of uniform color and depth throughout. These were admirable results of mechanical skill, but essentially inartistic. They furnished the first glass, but as they proved inadequate and as other color and textures were imperatively demanded, the proprietor of a large glassmaking establishment, I think in Brooklyn, grudgingly conceded the use of some of his material and men who, under the direction of our pioneer glass-stainers, made glass that was slightly better in quality. And then the interesting discovery was made that glass made by the one-man power, as we may say, in small quantities, of uneven thickness, and undoubtedly improved by happy accident (as when by a failure to make one color another, and perhaps better one, was obtained), was greatly more varied in tone and color than that made by modern improved processes. By this discovery, and by the consequent demand for such glass, a new field was opened for ambitious men, who from workmen became masters on a small scale, and it is from such men as these, constantly experimenting and working with a small force and by hand power, that the best glass is still obtained. As uniformity had been the criterion of excellence, now the variety obtained the palm, and it has kept it, until to-day the larger stained-glass-window manufacturers carry a stock of glass that in its variety of hue and shade far exceeds the range of the painter's palette.

Soon after the commencement of the new-old art came the introduction of the opalescent glass. The credit of its introduction has been a matter of controversy which need not enter here, and the claim has also been made that it was known to the old glass-makers, but, as far as I know this claim is supported by little proof. The opalescent glass, which has formed so large an element in the beauty of American glass, is by itself somewhat poreclain-like in appearance, but against the light, and at certain angles, has much of the fire and the changing hue of the opal. It can be combined with any other color, which then partakes of the same characteristics. Used with discretion in a window it is capable of charming effect, lighting up and vivifying tones which by themselves would be somber and quasi-opaque.

All of these countries, it is needless to say, have, until a comparatively recent date, furnished our churches with their windows, and opportunities to judge them are not lacking. But a change was at hand, and if the result had been less good than we maintained it to be, the attempt at making stained glass in this country would still have been interesting from the spontaneity of its growth, from its resemblance to the manner in which, in the old days, painting sprung full-blossomed from the Florentine soil. It came about the Centennial year, the date from which our future Vasari, if we ever deserve one, will trace the first concerted art movement in this country. Before that time we had in more or less isolation men who perhaps under happier auspices would have developed more, who at any rate, in a community that was more in sympathy with them, would have found more employment for certain of their faculties.

La Farge and Tiffany had, from the commencement, men who worked with them and very near them, and soon the number increased, until to-day, with the facilities which are common or nearly so to them all, there is a remarkable unity of merit in American glass, the differences being largely matters of taste or dependent upon the artistic merit of the original design. Here, of course, there can be the usual variety of opinion; but it is almost without parallel that the means employed to render the effect of the original cartoon should be so uniformly good. It is somewhat like a school of painting, where the technical execution of every artist should be the same, leaving only the difference which the temperament of the different men would impose in subject and sentiment. But this fair edifice was not built in a day. Many were the failures, many were the paths diligently followed only to find that they ended in quagmires, before this uniformity of excellence, worthy to be classed as a school, was reached. In the effort to avoid the error into which the European makers had fallen, of depending too largely upon painting the glass, our early makers tried various expedients. The first and most natural of these was little else than an adaptation of the principle on which are made the familiar porcelain glass lamp shades, with landscapes modeled on their surface. As the picture is seen in transparence, it is necessary to make the darkest accents the thickest and most opaque portions of the glass, and proceeding in this manner, making thinner or thicker the glass as the intensity or the delicacy of the tone requires, a curious sort of bass-relief is made, which, placed in front of a light, appears to be painted on the surface.

With great effort heads and draperies were modeled in this manner and cast in glass, but the effect was never satisfactory; and having learned the lesson that one may be too much of a purist, our glassmakers now use vitrifiable colors when it is necessary. In the course of this experiment an advantage was gained by the making of what is now technically known as drapery glass. This is made from the glass, as it is thrown, in a melted state, upon a flat table of iron to be rolled into a disk. When the glass is spread out, very much like pie-crust, the roller by which it is spread keeping up the resemblance, the edges are seized by the glassmaker, armed with short tongs, who overlaps an edge, or pulls and twists it in various directions as his fancy may suggest. This glass when annealed and cooled reveals in great variety the flow and twist of folds of drapery, and when the artist-artisan, with the main direction of the lines of the draperies of the cartoon which he is following firmly fixed in his mind, visits the racks in which, row upon row, the disks of glass are stored, he is generally able to select pieces which, placed in the window, represent in the color of the glass, unaided by the painter's skill, the most subtile gradations of light and shade in the form of the drapery. For the heads, and indeed whenever it becomes necessary, recourse is had to the painter. Here the French and Germans, with their long experience, have been, until very lately, greatly our superiors. Painting upon glass is at the best a tedious mechanical process, and a clever piece of painting may be utterly spoiled in the "firing" which is necessary to vitrify the colors used. But already we have acquired experience, and some of our work is in effect as good as that done abroad, while the grade of artists employed is somewhat better, giving occasionally a more personal character to the work.

In fact as the art stands here to-day, it has kept a more distinctly artistic character than in the Old World. In Europe, with governmental patronage, and with museums ready to receive works of a large size which such encouragement creates, it is an inferior class of artists, as a rule, who engage in making stained glass. Here, on the contrary, almost every man who has the technical equipment to create large decorative work has been more or less engaged in designing for or making glass.

Given the extreme variety and richness of our glass, it has been possible to attempt subjects of such complexity of effect that we have gone beyond the limit by which the European glassmaker is restricted. Herein lies the ground for a reproach which is often aimed at our glass, generally by men of strict adherence to ecclesiastical formula. The reproach, which affects only glass for church purposes, is, in sum, that it is too vivid, too realistic, and has too great similarity to mere decoration, irrespective of the sacred character of the place for which it is destined. While the same reproach could be applied with equal justice to the whole Venetian school of painting—to which our glass is somewhat allied—there is a foundation for it in the fact that, from the limitation which restriction in the manufacture of glass imposed upon the old makers of church windows, a more conventional treatment and greater austerity of effect was usual with them. But as Viollet le Duc has pointed out, in the thirteenth century glass, where perspective is often grossly violated, this was not done, in order to keep the window within the limits of mural decoration, but through sheer ignorance of the laws of perspective. In a similar vein we may remark that, in coming from the glowing windows of Santa Croce, in Florence, it is hard to believe that a thirteenth-century glass stainer would have willingly resigned the opportunities which come with the curious and beautifully variegated glass which we have at our command, and which enable us to approach somewhat nearer to the glories of sun and shadow, of tinted cloud or far-reaching horizon. The sad-colored harmonies of the English glass seem too arbitrarily restrained, as does their deliberate archaism in making a lead line—which is purposely kept as heavy as those in the old glass, although a lead line always makes itself evident enough, and we have to-day much lighter lead at our service—cut across an arm or a fold of drapery where no actual need of construction calls for it.

Although public taste favors the use of pot metal glass in leaded forms, whether for pictorial or other effects, there are evidences of some revival in glass painting, or staining, in which views are depicted on single sheets, with details and shading by the brush, such as are appropriate to painting on canvas, especially through foreign artists in this branch, who have located themselves in various cities. This process of painting, or rather staining—the pigments laid on only uniting with the surface of the glass on firing in the kiln, though yielding less intensity of hue than if the colors were thoroughly incorporated—allows, on this very account, of more extensive use than would be desirable in stained glass in window decoration. The delicately gradated tints are, in fact, less exclusive of the light, the eye is not wearied by the mild luster of the tones, and imagination, uninterfered with by hatchings and leaded divisions, may indulge in the pleasing illusion of reality, or follow any suggestive train of fancy. The art is very old. Grand memorials still exist in foreign abbeys and cathedrals of fifteenth century work, when halls, castles and noblemen's mansions were adorned with it. The severity of fresco was superseded by the new fascination; but presently, as some of the splendor of glass painting was introduced into oil painting, with greater facility of representing nature, and not only the old tempera and fresco were neglected, but painting on glass itself, as if it had done its work, and in no long time the process to which it owed its former glory were forgotten. It has been reserved for our own day to carry pictorial painting on glass to a high degree of excellence. No great amount of pot metal or stained glass can be admitted to room, as the colors would prove too dominant, or self-assertive. Its best application is in the upper division of windows or as borders, in stalk and leaf forms, and in mosaic. Pictorial painting on glass takes a milder form, may be used more freely, and all descriptions of veins may be portrayed, with all the naturalness seen on canvas. In these certain metallic pigments are employed, which, combined with a blue, blend into the half molten surface of the glass. The glass mosaics seen in the Central market on State street, near the bridge designed by the late John W. Root, show the possibilities of ornamental glass.

Otto Jevne & Co. established their works in 1854. After the fire they are found at 224 to 226 Washington street, employing twenty men and producing ornamental glass valued at $35,000 annually. Prior to 1873 they furnished the Church of the Messiah, the oriental Masonic lodge, Wilson Sewing Machine Company's store, Academy of Music and other buildings with glass, and in 1873 exhibited the "Adoration of the angels" in beautiful colors.

George A. Misch & Brother, established here in 1860, were burned out on Calhoun place in October, 1871, and in July, 1872, moved from temporary buildings to 217 Washington street, where they employed thirty men and produced $100,000 worth of ornamental glass within the ensuing year, including that furnished to the First and Union Park Congregational, Unity, Grace Methodist Episcopal and Grace Protestant Episcopal churches.

James Berry & Co's. works were opened in 1869 at 23 North Jefferson street, but moved to 85 Jackson street in August, 1873, where eleven men were employed. The ornamental glass for the Palmer, Tremont and Grand Pacific hotels, and the Ashland block, was furnished by them prior to 1873.

Wells & Brothers' stained glass works were established at 40 to 50 Franklin street, in 1870. By 1873 they had factories at 209 Superior street, employed forty men and produced glass valued at $75,000 during the year. Their glass was used in the Sherman house, Western Union Telegraph office, old Board of Trade building, Bank of Montreal, *Times*, *Tribune* and *Journal* offices, and in many other buildings.

George E. Androvette & Co. established their leaded glass works on Quincy and Clinton streets. Beveled plate glass, set in lead and copper frame, is one of their specialties.

The window-glass dealers of 1859 were Joseph A. Grass, 193 Lake street; Abner Burlingame, 125 South Water street; Burnham & Smith, 23 Lake street; Crawford, Dickson & Co., 26 South Market street; August Fredin, 107 and 109 Dearborn street; O. F. Fuller & Co., 244 Lake street; C. S. Hull, 218 Lake street; J. H. Reed & Co., 144 Lake street; William Sattler, 27 South La Salle street; Thomson & Alston, 181 Randolph street, and Julius Van Hoeval & Co., 172 Lake street.

The Northwestern Window Glass Manufacturing Company had their works on Twenty-second street and Center avenue in 1869. Fuller, Finch & Fuller, and Lyman Bridges were the leading dealers, and W. S. Carse, E. Lippins and George A. Misch were the principal glass stainers of that period.

In 1872 the window-glass dealers were John Alston & Co., 57 to 61 North Desplaines street; Barlow, Page & Co., 133 La Salle street; French & Todd, 69 North Wells street; W. H. Wells, 96 Fulton street, and Wolcott, Smith & Co., 306 and 308 Wabash avenue, dealers in plate glass.

The ornamental and stained-glass manufacturers and dealers in 1879 were W. H. Wells & Brother, 48 and 50 Franklin street; Miles & McCully, 182 Adams street; George A. Misch, 217 Washington street; James F. and Robert Carse, 288 West Lake street, and Zero Marx, 184 Madison street.

The dealers in window and plate glass in 1879 were James H. Rice, 80 and 82 Adams street, Sprague, Smith & Co., 49 Dearborn street, and W. H. Wells, 50 Franklin street.

E. L. Brown & Brothers established their vault-light factory in 1860, and in 1873 employed eighty-five men in their works at Clinton and Jackson streets. During eight months of 1872 they laid down two miles of sidewalk or vault lights in this city.

The French Vault-Light Company, Jacob G. Curtis, R. Carter and J. C. French, officers, established their works at 54 South Clinton street in 1872, and employed forty men. Sidewalk, roof and vault lights were placed in the J. Y. Scammon, the Hale & Ayer and Hall & Kimbark buildings that year.

The window and plate-glass dealers of the city in 1891 are Charles Bergner, 237 Ninety-second; Bradley & Co., 18 River; Chicago Window Glass Company, 56 to 60 South Canal and 55 to 59 West Water; Dewey & Pugh, 157 La Salle; Eagle Glass & Metal Company, Auditorium; B. W. Eisendrath & Co., 117 and 119 Lake; Benjamin C. Ernst, 132 La Salle; Erasmus Grom, 909 Milwaukee avenue; Heroy & Marrenner, 151 Michigan avenue; Hills, Turner & Co., 35, 243 State; H. M. Hooker Company, 59 West Randolph; George F. Kimball, 315 to 321 Wabash avenue; Linden Glass Company, 1216 Michigan avenue; James H. Rice Company, 34 to 40 South Water; Robert H. Potter, 194 South Clinton; A. Riegelman, 271 Wabash avenue; Sprague, Smith & Co., 209 Randolph; Charles H. Stephens, 134 Van Buren; Robert Stevenson & Co., 92 Lake; Tyler & Hippach, 150 Michigan avenue; George W. Trent & Co., manufacturers of sand blast and embossed ornamental glass, 30 West Washington; United Glass Company, Auditorium building; Thomas Wightman & Co., 243 State.

The glass bevelers of the city in 1891 are American Looking Glass Company, 67 South Canal; George E. Androvette & Company, 173 South Clinton; Bradley & Company, 18 River; J. D. Roberts & Co. 79 West Van Buren, and Wells Glass Company, 298 Wabash avenue.

The manufacturers of glass signs are Acme sign works, C. W. Prichard, manager, 9 West Randolph; Frank S. French, 651 West Madison, and G. W. Williamson, 674 West Madison.

The glass stainers of 1891 are named as follows: Henry Bentzien, 242 Rumsey; William F. Block, 259 Randolph; James F. Carse, 138 West Lake; Chicago Art Glass Company, 54 Franklin; Chicago Mosaic Glass works, 134 Van Buren; Joseph W. Chladek, 170 Forty-third; William A. Ebert, 546 West North avenue; William A. Fischer, 160 Menomonee; Flanagan & Bredenweg, 210 Kinzie; Healy & Millet, 223 Wabash avenue; Johnson & Co., 148 Michigan avenue; F. D. Kinsella & Co., Custom House place; Kinsella & Co., 84 Market; Linden Glass Company, 1216 Michigan avenue; McCully & Miles, 14 Monroe; George A. Misch, 217 Washington; Rawson & Evans, 151 West Washington; Frederick Schneider, 404, 80 Market; Scott & Jennings Company, 411 Dearborn; F. Steere, 271 Wabash avenue; Suess Ornamental Glass Company, 590 West Taylor; Tiffany Glass Company, 524 Pullman building; Wahl & Schorr, 30 West Randolph; The Wells Glass Company; 304 Wabash avenue, and Western Sand Blast Company, West Jackson northwest corner South Clinton. The other departments of glass manufacture are well represented.

A new substitute for window glass, in the form of varnished-covered wire, is being used where glass will not stand the vibration or other conditions. The transparent wire-wove roofing, which is translucent, pliable as leather, and unbreakable, has for its basis a web of fine iron wire, with warp and weft threads about one-twelfth of an inch apart. This netting is covered on both sides with a thick translucent varnish, containing a large percentage of linseed oil. The process of manufacture is conducted by dipping the sheets into deep tanks containing the composition until the required thickness is obtained; the sheets are then dried in a heating chamber, and after being stored for some time till thoroughly set, are ready for use. The sheets can be made any color from amber to pale brown. The new material adapts itself to curves or angles in roofing, and is unaffected by steam, the heat of the sun, frost, hail, rain, or any atmospheric changes. Being a nonconductor, buildings remain cool in summer and warm in winter.

The place which glass is destined to take as a building material is outlined in the first volume, and the manufacture of building glass described.

The future of the glass industry in the United States is encouraging, for it is only since the war that the manufacture of polished plate has grown up; and they are now running, or building, enough furnaces to supply all that will be used in this country. It is within the last ten years that the manufacture of cathedral and rough plate has been thoroughly established, at first disputing and then controlling the home market against England and Belgium. The improvement in window glass has been great, and there are workmen and manufacturers who think they see the rising sun of much better days and a much better American glass. The concentration of capital in powerful concerns must certainly lead to changes in the system of labor that are bound to insure a more finished product. This concentration may prove in everyway beneficial. Only a little while ago the window-glass trust was organized, and as soon disorganized. A Chicago wholesale house which controls several glass factories in Ohio and Indiana was the cause of this downfall, for with such an independent power outside the crystal circle, the aims of the trust to enrich its individual members at the expense of the people could not be true.

The reign of art has not overlooked iron. For almost three hundred years the workers of art metal, among English-speaking people, slept. Only a few years ago was the nightmare of ignorance cast off and a return to the models of old art metal decided upon. The best workers of continental Europe appeared in the middle of the tenth century. Up to the close of the first quarter of the sixteenth century, the art metal worker was looked upon as an artisan of the first class, and the designer ranked with the architect. Look at the cathedrals of the period, and from the great hinge-strap and escutcheon plate to the bolt head will claim attention at once. They tell the traveler, in convincing language, of the golden age of art, teach him to appreciate excellence and foster in him a desire for the return of that age. In the descriptions of the Chamber of Commerce and other buildings of Chicago, the character of modern art metal work is outlined, and in the notices of a few of the principal workers in architectural iron some description as given. From a catalogue, issued by a Chicago firm of architectural iron workers, much relating to architectural sheet metal may be learned. Zinc is the material commonly used, but copper and brass are equally applicable, and are occasionally employed. Statues of liberty, justice and law are shown in this catalogue, which the firm turn out in heroic size ten feet high. They are well executed, being the work of most skillful designers. Other figures, such as eagles, boys, etc., are shown. Relief panels of mythical creatures, leaf and scroll work, and human and animal heads are shown in varied forms of ornamentation. Flanges and moldings and friezes are of highly artistic patterns. Attention has been given to sheet metal ceilings, and a number of very rich and effective designs are shown. Many pages are devoted to center pieces, rosettes, leaves for brackets, leaves for garlands, and fancy pieces intended for miscellaneous ornamentation. Gargoyles are shown in numerous patterns. Rock face, frieze for bay windows, drapery for mansard decks, crestings, molding enrichments, scrolls, finials and capitals all evince originality, boldness of treatment and remarkable wealth of creative talent.

The large use of zinc and sheet metal for architectural ornamentation in Chicago is one of the notable facts which the records of contemporary building brings to notice. Cornices, window dressings, mansard and other roofs, dormers, bays, and ornaments are largely formed of sheet metal, fixed upon brackets to the walls, or otherwise secured to the structure. Unfortunately, there is no definite information as to the durability of this sort of architectural decoration, though, judging from experience of metal work and zinc applied externally, there is little promise of the permanence of these appliances. Zinc appears to be used for ornamental ceilings, with very beneficial results, while for richness of ornamentation and beauty of design it is said to be unrivaled. The ceiling is divided into deep and rich panels, handsomely decorated and gilded. The chief advantages of a zinc ceiling are that it can be soon fixed without dirt, and is a comparatively light material. Certainly, its internal employment is more likely to be a success than its external application. The metal can be molded into panels or coffers, and fixed up in large pieces, and the material can be decorated or gilded. Molded zinc cornices can be fixed in situ. The acoustic properties of the material is a point that has to be tested. One thing in its favor is its durability. One question is the fixing of the sheets, and the allowance to be made for expansion and contraction. To cover old ceilings, or to prevent the appearance of cracks, the metal ceiling is well adapted, as the sheets can be easily fixed, care being taken to prevent the unpleasant rattling of the sheets from vibration or shaking of the floor.

The use of bronzed and oxidized metal has only recently been approved. Within the last few years the question of manufacturing art metal, after designs by the architect of a great building, for such building, was decided. The greater buildings of the city fairly illustrate the point, that there has been great advancement in the manufacture of builders' hardware. This is to be noted from the standpoint of the artistic and the useful alike. Designers of great skill are constantly employed by manufacturers to cater to the demand of the public for the artistic and beautiful. Buildings are no longer marred in their interior effect by unsightly knobs, hinges, locks, etc., but are beautified rather than otherwise by the present styles. A similar improvement is to be noted in their utility, for inventions of great merit have been made and adopted, therefore, it may be safely said that the builders' hardware and art metal work of to-day far surpasses that of a few years ago in its artistic designs and utility.

The alloys in art metal work have been discussed recently, the *Inter-Ocean* of this city, as well as the *Herald* giving the subject much attention. From a history and description of alloys, given in the first named journal it is learned that the Roman artists appreciated the tintings as well as the texture of metals. Pliny describes a bronze statue of a dying lady, the coloring of which was so delicately accentuated that the life appeared to be receding from the extremities of the limbs. Another metal statue mentioned by this writer was that of a lady whom the artist endowed with a blush suffusing the cheeks; a result obtained by inserting points of iron in the bronze, the atmospheric oxidization of the iron giving the ruddy tint to the features. Taste of to-day may be inclined to question whether an effort should be made to impart color, natural though it be, to large works, which should mainly depend on beauty of form. Ruskin writes: "No great sculptor from the beginning of art to the end of it ever carved, or ever will, deception drapery. A man who will carve a limb or a face never finishes inferior parts, but either with a hasty or scornful chisel, or with such grace and strict selection of their lines as you know at once to be imaginative, not imitative." In Ghiberti's famous gate of the Baptistery at Florence does no more than suggest the actual texture of the fruit and flowers he employs with such skill, chiefly blending them for beauty of form. The niello or incrustations of gold and silver, with which the Greek and Roman sculptors enriched the garments of their figures, are not considered in the art metal work of to-day, but the exact imitation of material surfaces of wood or fabric in articles of virtu. The Japanese are the real authorities to whom we must turu for guidance in the treatment of alloys, both in texture and color. First, as regards texture, they seem to delight in copying in metal work the most delicate texture; even the bloom of the fruit is not beyond their skill. There is a wide range of alloys, but the principal of them are but few. There is an alloy of silver and copper, sometimes with equal proportions of base metal, and there are endless varieties of copper of different degrees of purity. There are several kinds of brass; and a series in which the precious metal replaces the tin and zinc of ordinary bronze.

The first is shaku-do (this contains copper, silver, gold, lead, traces of iron and arsenic); in addition to about ninety-five per cent. of copper, there is as much as four per cent. of gold. Gowland, an eminent authority on Japanese metal work, says that shaku-do has never been used for very large works. It has been erroneously stated that a colossal statue cast at Nara in the seventh century is made of it; but it has only about one per cent. of the precious metal. The next important Japanesque alloy is Shibu-ichi; this is nearly one-half silver and gold. There are many varieties of it, but in both alloys the point of interest is that the precious metals are, as it were, sacrificed in order to produce definite results, gold and silver, when used pure, being employed very sparingly to highten the general effect. In the case of shaku-do, the gold enables the metal to take a rich, beautiful purple coat, or patina, when treated with certain pickling solutions, while shibu-ichi possesses a peculiar silver gray tint of its own, which, under ordinary atmospheric influences, becomes very beautiful, and to which the Japanese artists are very partial. With regard to the use of pickling solutions, the first is composed of verdigris, sulphate of copper, nitre, common salt, sulphur, water, vinegar. There are three of these with varying proportions. The first solution is most widely employed, and when boiled in the third, will turn a brownish red, while the shaku-do, which contains bulk gold, becomes purple. Metallic impurities make curious effects; copper containing traces of antimony gives a shade quite different from pure copper. The so-called antimony, or shiro-me, of the Japanese art metal workers, in some alloys, is a complex mixture containing copper, lead, arsenic and antimony, so that a metal worker has an almost infinite series at command with which to secure any particular shade. The Japanese take copper and dilute it, sometimes half copper and half or one-third silver, and obtain a series of grey alloys which, by exposure to atmospheric influences, or treatment of suitable pickles, give beautiful light and dark greys which are as popular in Japan as shibu-ichi. Working in no small measure by the rule of thumb, the Japanese find that certain varieties of copper are best suited for definite processes, and by using very pure copper and varying mode of pickling obtain a wide range of color.

To leave the field of chemical analysis, we may observe the results of its workings in the wonderful bronzes of the Japanese that until recently have not been successfully duplicated elsewhere, a triumph that is to be credited to an American (Tiffany). The artist has cut the design on the plate and inlaid it with shaku-do, and it comes out as an India-ink painting, in a dark and comparatively light shade, on a piece of glazed-brown paper. There is no attempt to produce an effect by a raised surface, but the design is completed by an inlay of dark shaku-do on a lighter one on a bronze base. To illustrate a larger plate and a more complex system of alloys, the plain surface has a raised ornament. The outline of the leaf is scooped out, undercut to a certain extent, making the leaf to be inserted of a particular alloy, it may be shaku-do tipped with gold, the surface being roughened and the gold hammered on as a dentist would, then the entire design fitted in like a puzzle. The result is a picture built up gradually of alloys colored by the action of a pickle. Here is a leaf not really raised but sunk below the surface of the plate, the only relief it possesses being obtained by hammering gold over it. Here is a shibu-ichi leaf, half of which is red su-aka, and the bird of saku-do with all of its feathers, carefully lined, hovers over it. Then comes a shibu-ichi flower with a golden center. This is a typical work, they simply inlay colored alloys on a somber base.

Another very interesting series of alloys are the moku-me (wood grain) and mizi-nagashi (marbled). They are taken in thin sheets and soldered together in alternate layers. Conical holes are then drilled of greater or less depth, and then beaten up from behind, gaining from the different strata beautifully-banded effects. The vase is an example of remarkable merit in this line of manipulative skill. The neck, band and foot are of shaku-do inlaid with gold, while the body is mizi-nigashi with a silver panel bearing a bird wrought in and colored with alloys beaten into the silver. The large bead is a half sphere of gray shibu-ichi, the rest of finely-soldered plates, showing how perfectly an alloy may be worked in a rounded surface. The sword socket is of alternate layers of copper and shaku-do, the effect of wood grain being exactly imitated. The writer paid a high tribute to the work of the Tiffanys, and the vases they made of five alloys that were so doubled on themselves as to get twenty-five layers, and considers their work as among the greatest manipulative triumphs in metal that the Paris exposition contained. He further states that the lobster red of the Japanese is not the product of pickling at all, but is a cuprous oxide, formed by heating copper in air, and then burnishing it; but it is admitted that no one outside the Japanese have conquered this color. With all the American manipulative skill in metals, and our mastery of chemistry, the Japanese are still the acknowledged leaders in the use of alloys in art metal work.

Metal etching is a revived art. The plain metal is covered with etching wax. This is etched with needles and other instruments, and then subjected to an acid bath, which eats away the unnecessary metal, and leaves the etched effect. The background is oxidized and lacquered, which preserves the metal from tarnishing.

Overlooking some painful eccentricites it is evident to any observant person that since the Philadelphia exposition, which furnished the first impulse, the taste of a good many people has risen to a higher standard. All over the country the public are rapidly developing an appreciation of artistic merit. Those who cater to it skillfully, whether they be manufacturers or dealers, will reap the reward for which all business men strive. It is believed that Americans have passed the period when some clever mechanical device, some neat knack of promoting comfort, is the best and the only selling point. There is no desire to convey the impression that such features have or are likely to lose their attractiveness to the average American buyer; but that, other things being equal, that article which possesses artistic merit will be given the preference even at a higher cost. Beyond certain narrow limits manufacturers can not afford and will not undertake to assume the part of educators of the public. It would be an unwise business policy to aim too high. Yet it is certain that those who are nearest to the buyer, the retail dealers, must make some efforts to promote a movement which is in harmony with the evident tendency of the times if they want to participate in the profits which always come to those who furnish the people with what they want. For the present, perhaps, the greatest chance of success lies in giving attractive form to the higher class of goods, but the day is not far off when even the cheapest grades must be made to cater to more than bold, ugly utility. In sterling and plated ware, jewelry, lamps, glassware and china there has been quite a revolution during the past ten or fifteen years. Any one who will spend a few hours in the stores of any town of moderate size will be quickly convinced of it. The same movement is beginning in other lines closer to the hardware and metal trades, and what is more significant, it is reaching a far greater fraction of the population. It is generally recognized by those who have had the opportunity to compare American work with what is being done in Europe that Americans are not abreast of some European rivals in the grace and beauty of the many metal articles which enter into furnishing houses and decorating buildings. To frankly acknowledge that fact and to seek the best means of robbing it of its truth is the first step toward the supremacy for which the people must strive.

The Chicago Society of Decorative Art, suggested by Mrs. Wheeler, of New York, and outlined May 17, 1877, at the home of Mrs. Willing, was organized on June 27, 1877, with the object of establishing a permanent exposition for sculptures, paintings, wood carvings, lace work, art and ecclesiastical needle work, tapestries, and decorative work of all kinds done by women. The new organization was at once affiliated with the parent society of New York City, and suitable rooms were opened later. On June 19, Mrs. Scammon read the first paper. The officers for the year were: Mrs. J. Young Scammon, president; Mrs. Palmer V. Kellogg, vice president; Mrs. Franklin MacVeagh, vice president; Mrs. Levi Z. Leiter, secretary; Mrs. W. K. Nixon, treasurer.

The additional members of the board of managers were Mesdames R. N. Isham, Clinton Locke, R. P. H. Durkee, Bryan Lathrop, A. T. Galt, Edward S. Stickney, N. B. Judd, T. B. Blackstone, Henry J. Willing.

The members of the advisory council were Mesdames Mark Skinner, M. D. Ogden, T. B. Bryan, L. J. McCormick, John D. Caton and Messrs. J. Young Scammon, Mark Skinner, Levi Z. Leiter, Ezra B. McCagg and J. H. Prentiss.

In 1878 Mrs. Scammon was reëlected president with Mesdames McVeigh, Leiter and Loomis, vice presidents; Mrs. Bryan Lathrop, correspondent; Miss Emma C. Kellogg, recorder, and Mrs. W. K. Nixon, treasurer. Some changes were made in the board of managers; the board of associate members was created and the advisory council increased by the addition of three members. The first loan exhibit was held in the fall of 1878, the collection and arrangement being made by Stanley Waters.

Mrs. Flower's name appears as treasurer early in 1879 and Mrs. Galt was appointed recorder vice Miss Kellogg, resigned. In November, 1879, Mrs. Scammon was reëlected president and Miss A. V. Hibbard, elected recorder. During the ensuing year papers were read on various subjects relating to decorative art and woman's work. In November, 1880, Mrs. Scammon declined a renomination for the presidency and Mrs. J. N. Jewett was elected president with Miss A. H. Gregory, recorder; Miss Mary Park, correspondent and Mrs. J. M. Flower, treasurer. No less than nine committees were in existence this year together with the board of directors and advisory council. In 1881-2 Mrs. Henry C. Humphrey was recorder and Mrs. John A. Yale, treasurer. The elections of November, 1882, resulted in the choice of Mrs. B. F. Ayer for president, Mrs. A. T. Galt for correspondent, the recorder and secretary being reëlected. The changes made in 1883, in the constitution brought the annual meeting in April instead of November. Mrs. Ayer was reëlected president, Mrs. Galt, recorder; Mrs. Hall McCormick correspondent and Mrs. Yale, treasurer. In April, 1884, Mrs. Jewett was chosen president; Mrs. Locke, recorder; Mrs. K. G. Maguire, correspondent and Mrs. Yale, treasurer.

On April 19, 1886, a certificate of incorporation was issued by the secretary of State, and the following directors named therein: Mesdames R. H. McCormick, Clinton Locke, J. Y. Scammon, B. P. Moulton, J. G. Glessner, W. G. McCormick, Frank Gilbert, J. M. Flower, J. N. Jewett, S. M. Nickerson, B. F. Ayer, J. A. Yale, Charles Henrotin, T. B. Blackstone, J. S. Peaseley, O. W. Potter, S. C. Griggs, H. W. King, F. S. Eames, J. M. Walker, U. W. Windette, Bryan Lathrop and C. J. Blair, with Mlle.'s Snow, Cotton and Frances Keep. The corporators were Ellen M. Henrotin, Ellen Potter and Ellen R. Jewett. Mrs. R. H. McCormick was elected president, and in 1887 was succeeded by Mrs. Potter Palmer; Mrs. J. W. Cotton being elected secretary, and Mrs. D. Wilkinson, treasurer. In December, 1887, the directory decided to open free classes in the manual arts, and the Art Institute donated a room for the use of such classes. During the winter thirty teachers received instruction, and in the spring of 1888 over four hundred boys were enrolled. In the fall the classes were resumed and continued until June, 1889. During the term forty-seven mission school teachers attended for the purpose of acquiring such knowledge as would enable them to instruct the one thousand boys in the schools under their charge in drawing, clay modeling and color decoration.

In 1888 the proposition of Mrs. M. E. Pode, then superintendent, to purchase the goodwill and stock of goods was accepted. She offered to pay $3,000, continue the contributor's department and carry on free classes.

On October 10, 1889, changes in the constitution were adopted, and through the erroneous impression that the secretary of State had to approve of such changes, they were submitted to him. In his reply, he pointed out to the ladies that the power to amend lay entirely in their own hands. On receipt of this information the society was not slow to act, and the following amendments were adopted and signed by Maria S. Scammon, president, and Mrs. N. S. Davis, Jr., corresponding secretary.

Article I. Article IV is so amended as to permit the society to elect only such officers as the majority present at any meeting at which an election takes place may determine, and such officers as shall be elected shall be its board of directors without reference to the number thereof, and shall have entire control of the affairs of the society.

Article II. The remaining articles of the constitution and the by-laws are hereby so amended as to give the board of directors in all respects the full powers intended to be conferred by Article I of these amendments; and the board of directors may determine from time to time the number that shall constitute a quorum, and give to its officers such power and authority in relation to the business and affairs of the society as they may deem expedient.

Article III. At the end of Article XIII, add,

The rules for changing the articles of association, shall be the same as for amendments to the constitution.

The classes in architecture at the Art Institute have now been in operation two years. A number of important changes have been made for the coming year. Text books have been adopted and arrangements have been made for regular examinations. The system of lectures, the usefulness of which was well demonstrated by Mr. Jenney's long course on construction last year, is to be extended. The history of architecture is to be treated by William A. Otis, the theory of design by Irving K. Pond, sewerage and ventilation by William S. MacHarg, in extended courses of lectures. Mr. Millet continues to take the general direction of the studies and to teach the theory of architecture and ornamental designing. The extension of the schoolrooms will give additional space to the students of this department, while improved draughting tables and other appliances will add to their convenience. It is hoped that with these advantages the classes in architecture and decorative designing will assume their proper relative importance. The art school generally was very prosperous last year, numbering more than five hundred students at one time. The greatest need of the architectural department is an extensive library of books and photographs.

The following is the two years' course in architecture recently adopted by the board of directors of the Art institute: First year, first term—plane and solid geometry, descriptive geometry; study of the five orders, history of architecture, lectures and prescribed reading; free-hand and instrumental drawing, lettering. Second term—descriptive geometry, plane trigonometry, logarithms and use of tables; history of architecture, lectures and prescribed reading, original architectural designs, problems; free-hand and instrumental drawing, water colors. Third term—descriptive geometry, shades and shadows, plane trigonometry; theory of design, lectures and prescribed reading, original architectural design, problems; free-hand and instrumental drawing, water colors. Second year, first term—shades and shadows, perspective, graphic statics; general construction, materials, foundations and superstructure, by lectures, original architectural design, problems; free-hand instrumental drawing, water colors. Second term—perspective; specifications and estimates, general construction, by lectures, original architectural design, problems, history of ornament, reading perscribed; free-hand and instrumental drawing, pen and ink, water colors. Third term—specifications and estimates, general construction, with reference to ventilation, sewerage, etc., by lectures, original architectural design, problems, ornament, problems and lectures; free-hand and instrumental drawing, pen and ink, water colors.

At a meeting of the society held at the Art institute, April 14, 1891, it was unanimously resolved, that the money then in the treasury, or to come into it from the sale of its property, should be used as a nucleus for a fund to be called the "Chicago Society of Decorative Art fund," this fund to be applied to the purchase of articles pertaining to the industrial arts, such as pottery, china, embroideries, laces, etc., to be presented to the Art institute and marked in such a way that credit will be given to the society for the gift. It was further resolved, that an effort be made to increase the membership of the society by asking old members to renew their subscriptions and others to become members, the fees collected to be added to the funds on hand, and used to buy for the Art institute similar articles, such as meet the approval of the board of directors of the Decorative Art society, and the executive board of the Art institute, any member being at liberty to subscribe for an unlimited number of memberships at $5 each. The officers signing the resolutions were: Mrs. J. Y. Scammon, president; Mrs. John N. Jewett, vice president; Mrs. Dudley P. Wilkinson, treasurer; Miss Emma C. Kellogg, secretary; Mrs. T. B. Blackstone, Mrs. S. M. Nickerson, Mrs. Charles Henrotin, directors.

This society has exerted a beneficial influence on decorative work in Chicago. Outside its membership there are a thousand women equally earnest in the decoration of homes; but to the members of the society the credit of organized effort must be given. The people of Chicago are far behind those of one or more European countries in the matter of household decoration; although in Chicago and other large American cities there are many handsomely furnished houses. A book on America, published by a Frenchman several years ago, contains the statement that there were more vulgar rooms in the American household than in any other country in the world. A professional decorator who read that book came hither prepared for the most barbaric combinations in household decoration. Of course, he was surprised, as is every other European, for, while the Americans were behind the French, the average rooms were found better furnished than those of England and Germany. The French household is, as a rule, better furnished than any others. The trouble in this country is that the people do not understand the laws of harmony in furnishing houses. They run to color and novelty too much without consulting adaptability and ensemble. The best bit of furniture or bric-a-brac is made conspicuous at the expense of other features of a room. The Chicago parlor is a great institution, and if a little more taste were displayed in its appointment, would far outshine the drawingroom and salon of Europe. It may sound strange, but it is a fact, nevertheless, that the homes of the richest people in this city are the most poorly furnished. As a rule, rich people crowd too many things in their rooms. What makes the Chicago parlor such a great success is the fact that it combines the good qualities of the drawingroom and salon and omits the evil of both. The parlors one sees in the homes of the middle classes are gems in their way. The individual taste of the women of such homes is charmingly displayed in the decoration of the parlor, and gives a better idea of the artistic capabilities of the people of this country than the houses of the rich, where everything is bought and placed without much regard to harmony and color.

To educate those who have a competence and wish to surround their homes with appropriate decorations and to check the excesses of the wealthy are some of the objects of the Society of Decorative art.

Day by day their teachings are bearing fruit and, throughout the city, old and new dwellings, hotels and stores have been decorated according to the modern idea. The Mandel residence, on the southwest corner of Michigan boulevard and Thirty-fourth street, built in 1890–91, may be taken as an example. A reference to it has already been made, but for the purposes of this chapter the following description of its interior and furnishing is taken from the *Herald:* The ground dimensions of the structure are about 52x92 feet. The building occupies a commanding location and is surrounded by an extensive lawn. The exterior style of the dwelling is of the more modern type of architecture, and nothing in the west surpasses it in effects. The large reception hall has an Italian marble mosaic floor, and one of its attractive features is an old Moorish fireplace. To the right is an inglenook, or receptionroom, and to the left the library, fronting toward Michigan avenue.

The general tone of the finishings of the library will be Egyptian blue. The walls above the book cases will be finished in plain wood tapestry, embroidered in panels, the frieze and ceiling being finished in oil in colors to harmonize. The book cases and furniture of the room will be of mahogany, and the chandelier of old silver to blend with the blue tone of the surroundings. Adjoining the library is the drawingroom, the walls of which will be satin damask in gold, with wreaths of ivory running through it. The ceiling will be of burnished gold, and the same color will predominate in the upholstering of the Louis XV style of furniture of the apartment. On the floor will be a very large Aubison rug, woven in one piece, the cost of which runs into thousands of dollars. The two windows of the room will have duchess lace curtains, and the draperies will be of pale rose, with lines of gold tracery through it.

The general tone of the musicroom is green, a shade chosen to blend with the prevailing color of the conservatory which adjoins it. Rich oriental rugs on a polished hardwood floor and Mexican onyx columns between the musicroom and conservatory will be pleasing features of this apartment, as will also the four frescoes on the ceiling of the room representing the muses. The portieres will be of silk cloth, hand embroidered, to match the decorations of the apartment. In one corner of the room will stand a baby grand piano, and in another a harp. Music ottomans and other articles, in pale green and gold, will complete the furnishing.

The diningroom walls will be finished in old tapestry, running in shade from green to terra cotta, and the mahogany ceiling will be divided into sixty squares, with a fruit relief piece depending from each. At the end of the room is a large bay finished with beveled art glass leaded with an occasional bit of color. There is also an imported picture by an Italian master representing a scene from mediæval times. The immense and richly carved mantel occupies nearly a whole side of the room and forms a very handsome grate and fireplace furnishing. Opposite the mantel is the sideboard, built into the wall, a very handsome affair matching the mantel in colors and finish. The chairs, elaborately upholstered in old tapestry, and the richly carved table standing upon an elegant oriental rug covering the polished hardwood floor will carry out the harmonious effects.

The first chamber and adjoining dressingroom on the second floor will be finished in pale blue, with same tone in finishings and draperies. Two beds of French pattern, in maple, will be under a large canopy draped in pale blue. The carpet will be Scotch Axminster of the same tone. Miss Mandel's room will be finished in pink throughout, Wilton cream and pink carpet, brass bed with pink canopy, draperies and furnishings in pink.

Lemon and sea foam will be the prevailing tones in the guest chamber. The walls will be frescoed and paneled in silk, with lemon moldings. The draperies will be brocaded silk and the carpet a Wilton. A couch and easy chair, a duchess dresser draped in light-weight brocaded silk, a verne martine table, ottoman and small brass chair will complete the furnishings of the room.

Another chamber will be finished in heavier fabrics and heavier color of dark rose tone throughout. There are studyrooms adjoining, and the student's requirements and conveniences will be fully provided for. Other chambers, retiringrooms and dressingrooms occupy this floor, and are all to be elaborately finished.

The large ballroom is on the third floor. Its walls and ceiling are paneled and frescoed in roccoco style of decoration, pale pink and gold being the more pronounced colors. At one end of the room is a large painting representing Terpsichore surrounded by six dancing cupids. A completely fitted movable stage is among the furnishings of the apartment.

The main stairway of the structure is an elaborate piece of work, showing the perfection of the woodworker's art. There are four bathrooms finished in white marble and onyx, the main bathroom having onyx wainscoting extending upward five feet, above which is frescoing of pond lily design. The bathroom adjoining the owner's apartments contains a barber's chair and all the appurtenances of a tonsorial establishment. The fireplaces throughout the building are the richest obtainable, as are also the chandeliers and all other furnishings. The house is supplied with elevators and every convenience conducive to luxuriant home comforts.

In closing this chapter, the influence of architectural and trade associations upon taste in painting and decorating must be regarded.

Those associations of architects, painters and contractors are replete in the capacity for good. Before every convention the leading building ideas of the age are expressed for the enlightenment of the future. One single year witnesses this wonderful growth of thought. Through the press it is conveyed to the world outside the associations. Only a little while ago this method of mutual education was inaugurated. To-day it prevails in all local and national organizations of architects and builders. Take a few of the papers delivered before the American institute. That by Frederick Baumann, read at Washington, D. C., in October, 1890, entitled "Thoughts on architecture," is full of meaning. He says:

"Of deep interest in the history of art is the description of the ancient tabernacle given in

Exodus xxv to xxviii. Moses is commanded to take from the people an offering: 'Gold and silver and brass—and blue linen and purple and goats' hair—and rams' skins died red, and badgers' skins and shittim wood—oil for the light, spices for the anointing oil and for sweet incense—onyx stones and stones to be set in the ephod and in the breastplate, and to build thereof a tabernacle' as minutely described. This sacred and most costly tent was, as we know, moved from place to place as occasion demanded, lastly to be supplanted by the far more splendid temple of Solomon. What is most interesting to us is its peculiar ornamentation. Its wooden parts were of the best of that material known, yet all are wholly enveloped with plates beaten of pure gold. It has curtains of the most artistic fabric; 'a vail of purple and blue and scarlet and fine twined linen of rare and cunning work with cherubims shall be made.' Silver was used on the columns of the court, which were with brazen feet. The court gate had a hanging made 'of blue and purple and scarlet and fine twined linen wrought with needle work.' We are left ignorant whether the gold was left plain and bright, or whether it had been covered with handiwork of any kind, or even some other material, be this wax or varnish, intended to tone down the original excessive luster of the gold. Yet the description spurs the mind to more and deeper investigation and leads speculation back to the very origin of art.

"This first origin or, if you prefer, the first invention of art must be presumed to have been the work of primitive man at an age infinitely remote and perhaps prior to the invention of speech. He found the textile products of nature and intertwined them in useful fabries, beginning with the plainest and simplest. Follow by degrees the art of braiding, stitching, weaving, lacing and what else there may be of the kind. The principle, the style, of these arts is a simple or a more complicated flat pattern, without relief, any more than must result from the thickness of threads of tapes therein used. It represents a drawing of one or more geometric designs, singly or in endless repetition. Later on, after the properties of moistened clay had been observed and fire had been utilized in the process of hardening, objects were formed, soon to be dedicated to sacred use and become variously ornamented. We find that all the prior ornaments invented of textile products were transformed into useful shapes and employed upon the exterior of useful vessels. Thus, probably for many centuries, existed textile and keramic arts, before any occasion was found for the art of building. But whenever, at a later time, architecture came into existence, it stood upon no other ground than the one cultivated prior to it. How could it stand upon any other? It results, then, that we must seek the enigma of original forms of architecture in the sister arts prior to it, which had fruited the soil from which it originated. Thus it came upon the world as a natural child, and it is in vain for human reason to attempt the fabrication of any originally new system of it. This has been tried, and ever has been buried with the 'inventor' or prior to his demise.

"Architecture has its own especial language. Its works narrate its history. Is this possible in a language which has not been descended from generation to generation? Architectural construction, according to Semper, bases on four constituent parts: The fireside as center, the protecting roof, the circummulation, the substruction. From these originally very modest parts, the temple bases its origin. It starts with the simplest wood to become the finest marble structure. The sacredness of the purpose demanded the best material at command. And this did not suffice. Even the finest, and at the time the most appreciated of wood materials, the 'cedar of Lebanon,' had to be ornamented and wholly covered with metal, precious gold not excepted. In this fashion, which must have been at the time thousands of years old, we find the tabernacle gorgeously ornamented as related in Scripture. Its partitions were mere curtains of the most precious kind. This most original fashion of partitioning off was retained by Solomon in the georgeous construction of his stable temple. Palaces in olden times had partitions merely fashioned in this style. The king was equal at least to a demi-god and was entitled to ornament his domicile accordingly. Even in later times we find partitions thus made. Think of Polonius stabbed by Hamlet when listening behind a partition made of cloth. But later in the advance of civilization partitions were made of solid material. Yet, wherever they thus appear, they are not artistically treated as structural parts. They are decorated in a manner to represent curtains, and at no time become an expressed mechanical element. Do we not at the present day decorate the entire wall space within parts of an edifice exclusively in this fashion? Can our papering and fresco-painting be taken as anything but a sham of the original curtain? More correctly do we work with gobelin tapestry, the designs of which being stretched upon wooden frames and thus secured to the wall. The partition proper, however, bears no artistic relation to the art of any such decoration.

"Empaistic art, i. e., the art of covering structural wooden parts with costly metal, did by no means remain on first principles. The glare of plain gold upon large surfaces was soon found offensive to the eye. Designs were wrought upon and into it, and its surface was covered with wax transparent enough to allow a subdued show of the metal. Precious gold covered with mean wax! Can this be possible? Can this be art? According to Ruskin, in the meaning of his doctrines, it should be called barbarism, but in accordance with the principles by which ancient art was governed, it was true art which in those times knew of no construction as such. As well might we speak of the construction of a large block of stone or marble for purposes of a large statuary work. The material secondarily considered, was a mere matter of necessity for mechanical being. We have a right to assume that the woodwork of the great temple at Ephesus, destroyed by Herostratus, 356 B. C., had been empaistically treated. How could it burn without wood, and why should such wood have been left bare contrary to the fashion of art prevailing at the time of its first construction?

"Later on we find empaistic art, with a new method, taken up by the sculptors, who, like the great Phidias, employed on their statuary, wood, ivory and gold, the latter unquestionably deprived of its natural luster. Thus we find an art, barbaric in its origin, transformed into the highest art that ever distinguished man's ideal mastery over nature. Greek art, however, began early to utilize building stone as an appropriate material. The first stone quarried was a poor sort of oolithic limestone, called Poros stone, which received a covering of plaster made very smooth for purposes of imitating—as must be presumed—as nearly as possible, the former covering of the wood with metal. Column, pilaster and wall thus plastered, were then correspondingly tinted and waxed. Later on the celebrated marble of Pentelicus was quarried and used, to be tinted by the painter without the employment of stucco. For with this fine material the work could be wrought to absolute mechanical perfection, fit to afford the painter a surface more polished and more true than could formerly be obtained by plastering the poor stone. It has become evident, beyond doubt, that this marble at no instance remained without its due tint, probably at first the very one originally obtained by tinting and waxing the metal in various degrees and shades. The tints evidently were necessary in an æsthetic sense to gratify the exquisite state of the ancients so generally acknowledged. Not only the temples, but all statues, as it appears, were also tinted. Modern archæologists, besides, will have it that this tinting was a universal rule also in the days of the Roman Empire. We modern people stand here as before an insolvable enigma. We expressly leave our better buildings and all statuary with the original tints of their material. Many arguments have been had on this subject, but the decision has—universally so—ever preponderated in favor of our fashion. It is possible that at a later day the true tints will be discovered which may convert our taste and ourselves.

"From the above premises it would seem evident that, as already indicated, in Greek architecture the material is nothing and the form is all. The temple is a unit without parallel in the history of art. Semper says in an article, 'Original element of architecture and polychromy.' Comparing the various styles in architectural history we meet with the idea that all are based on very sound principles of statics and mechanics. One of the nations, however, succeeded in imparting organic life into its architectural creations and its industrial productions. The temples and monuments of Greece are not built; they seem to have grown; they are not merely ornamented, like the temples of Egypt, with applied work; their forms are such as are produced by organic life in its strife against gravity and substances. Otherwise we fail to comprehend or explain the incomparable beauty of a Greek column. The age of architecture in which we live, however, is emphatically one of construction, so that I find myself induced to give here some facts of what to the Greeks was mere bywork, the construction of the Parthenon, taken from a comparatively recent work of Adolph Boetticher, entitled 'The Acropolis of Athens.' According to measurements the walls were six feet thick, with alternate courses two feet in hight. One course consisted of a solid block of stone six feet wide; the other of two parallel blocks each two feet six inches wide, leaving a vacant space of one foot between them. They were doweled into each other and anchored with heavy irons carefully inserted. The drums of the columns were six feet in diameter, four feet high, connected with each other by means of central stone dowels. The sacredness of the building prohibited the use of mortar, and the blocks most carefully and precisely wrought to form by the hands of skillful mechanics, were set dry one upon the other, and this was done without allowing the occurrence of any sort of spawling off. Considering the extreme difficulty of thus setting course upon course, and the high degree of perfection in which the mutilated remnants appear at the present day, we must bow deeply with respect before the mechanics who accomplished this, be this with tools even more perfect than our own. Yet perfect, absolutely without blemish—judging from remaining ruins—as this work was, the consideration of this particular quality bore no weight, it was a matter of course, of no special account. The building was a work of fine art in the widest as well as in the narrowest sense of the word. The like of it, on the scale of high art, as on the scale of mechanical art, can nowhere be found, and it must unquestionably be placed at the head of all buildings ever erected in this wide world in any age. The Parthenon served for a thousand years as a Christian church, until taken possession of by the Turks.

"The founding of Alexandria gave origin to the ideas subsequently followed by the Romans, whose practical genius adopted Greek architecture to the multifarious uses coming in demand. The basilica and the Pantheon find existence, either one a prototype of subsequent Christian churches, the former for the West, the latter for the East. Constantine is credited to be the author of a thousand churches with small central domes, but not until under Justinian a new and original form was inaugurated. I refer to the Hagia Sophia at Constantinople. Its originality consists in the circular dome over a square room with adjoined extensions toward the four sides. This huge edifice, celebrated for its originality as well as for its mechanical perfection and size, was completed in the amazingly brief space of five years, while it took one hundred and sixty years to complete St. Peter's, and forty to build St. Paul's, to say nothing of the Gothic cathedrals, most of which were left incomplete. The arched basilica became the type of the Romanesque style so called, samples of which are principally scattered over Germany and France.

"When the Christian spirit, as in the mediæval ages it was understood, and which more and more alienated the human mind from this earth, had reached the hearts of the masses in a measure to inspire them to march to the liberation of the Holy Temple at Jerusalem, then had arrived the time for the Christian mind to be dissatisfied with the hight and extent of churches as they were. Roofs and spires were to be raised higher up to the clouds to satisfy a most general demand. Arches were consequently made pointed to gratify this desire, and thus churches became the grandest edifices in existence. When we consider that the idea of grandeur has ever been a captivating one to the human mind, even regardless of higher considerations, we must contemplate with due respect the admiration and awe with which these edifices were and even are now regarded, though it is due to us to be conscious of the fact that they are productions of what we call dark ages. The cathedrals are essentially constructive in all their being, but they fail in construction because too complicated in detail for the means then at command of man. Hence the great number of incomplete edifices and the early decay of the comparatively few which were, at least in a measure, completed. Mechanical art of the present day begins to be able to master buildings of this character. The central tower on the roof of the Cologne cathedral was first erected about forty years ago. It is taken down to-day because frail and fast decaying, to make room for the construction of a wholly new tower, of identical exterior, on approved modern principles.

"The Renaissance, i. e., the period of dissolution of mediæval ideas and customs, and the quickening of human thought with the fruits of ancient culture, which gradually followed the crusades, completely overthrew the architectural conceptions of the middle ages. Classic architecture of ancient Rome was brought to light and cultivated to a higher degree. Renaissance ideas prevailed, and style succeeded style and fashion followed fashion, until it arrived at classic Renaissance so called, inaugurated by Winkleman and Stewart and Revet, for a time followed by architects in all countries, of whom Schinkel at Berlin was evidently the most conspicuous and refined. He is the author of a number of celebrated buildings. They were but poorly constructed, for the reason of the then reigning poverty of the country. And his greatest and most originally classic designs of rare beauty were left unexecuted. Schinkel was one of the few architects who understood how to impart life into a Greek column, while generally the same appear, like mere corpses, telling a form carefully constructed in accordance with Vitruvius' rules, yet without the spirit of true art, which alone gives them life.

"The subtle forms of Greek architecture are in most direct distinction from Gothic, which rests on a mechanical basis, the positive correctness and harmony of all parts of the structure, must come as it were, like a revelation to the well-trained eye of the architect. As much, and perhaps more so, than the true expression of a human face reveals itself to the artist painter who undertakes to cast it upon his canvas. Greek architecture, in its true bearings and compass, is a subject which cannot be mastered by superficial study. On the continent of Europe its acquirement belongs to the necessary requisites of a student desirous of introduction into the profession. In England, and in our country, however, it is treated with a sort of levity, as I believe. This should be otherwise. Younger architects in particular should set at work to become acquainted with the lofty secrets of Greek architecture. Not that they might be led to strictly follow it in their designs, but that through its study their minds may become elevated far enough above the common level to enable them to impart life to their designs, and thus give them a character of a higher nobility. The spirit of Greek architecture is and should be acknowledged as being one of the greatest treasures of common humanity."

From what has been written, it is very evident that wonderful progress has marked the painters' and decorators' trades of this city. Beautiful and complex designs are conceived and executed here now with almost as much case as the artists of the old city could conceive and execute the design of a Chicago cow-bell. The changes in architecture and the studies in architecture by house owners or prospective house owners have led to changes in almost everything which enters into house furnishing and decoration, and the demands for change in all departments of building arts have been met almost as soon as made. The schools of ornamentation follow the schools of architecture and are known as the Byzantine, Romanesque, Moresque, Gothic, German, Italian and French Renaissance and Colonial. There are local schools also, as the Louis XIV, Louis XV, Louis XVI, Clermont, Auvergne, Florensac, Queen Anne and Eastlake. All except the Queen Anne are recognized by artists, and are therefore constitutional, for they are simply revived classical models which will live forever unimproved and unimprovable.

CHAPTER XII.

RECENT AND MISCELLANEOUS BUILDING EVENTS.

AS the architect or house owner generally desires a great or little change to be made in plans, during the progress of a building, and something to add or take away after its completion, so with the compiler or publisher of a work. Looking back over the chapters, one would think that nothing can be said which has not hitherto been said. The building interests of Chicago do away with the thought; for, notwithstanding the industry of reporters and the vigilance of the city newspapers, some idea, novel, or artful, or massive, awaits the dawn of the Chicago day to take form or to be materialized before noon. Hence this chapter. It is largely a collection of descriptions of buildings, designed within the last few months; of special papers relating to the building arts, brought to light within that time, and of some miscellaneous descriptions. Let the descriptions of the new buildings be given first:

The armory of the First regiment, I. N. G., was completed in the fall of 1891, and dedicated in August, 1891. In the plan, a space 164x174 feet is covered. To the hight of thirty-five feet the exterior walls are heavy masses of somber brown stone, unbroken by any but a single aperture, the forty-foot doorway or regimental sallyport on Michigan boulevard, through which the command may march in company front. This opening is barred by a heavy oak and steel door, swung like a portcullis, and lying back of the embrasures in the thickness of the walls. It is protected by firing slots on either side. The lowest window sill in the entire building is thirty-five feet from the ground and six feet from the floor within. The windows themselves are bound by heavy iron grills, while beneath each window is a narrow port for firing, which is splayed on the outer and inner jamb, to give greater range, and when not in use is closed by an oaken door. The whole exterior mass is crowned by heavily-corbeled cornice, forming both breastworks and firing ports, through which latter the face of the walls below is commanded. Each corner of the building is marked by a heavy round turret, from which an enfilading fire may be maintained along the face of all the outer main walls. The design is to the last degree military, and can not fail to impress the passer by with the full extent of its purpose and the ability to carry it out.

In perfect keeping with the exterior is the general design and arrangement of the interior. The building covers a basement, a first story on a level with the street, and two stories above. The plan is simple and direct. The basement and first story cover the entire lot area, bounded by Michigan boulevard, Sixteenth street, the railroad tracks and the alley. The two upper floors form themselves around a skylighted court, 64x122 feet. The basement has no outer entrance save one that lies beneath the Michigan boulevard sidewalk, and through which ashes are removed and coal put in. This is closed by heavy steel plates at the wall line. In the basement are four rifle ranges with brick wall at the sides and brick arches overhead. Here also are kitchen arrangements sufficient to provide for the entire regiment, with store, ice and other rooms. The heating apparatus and general toiletrooms are also located here.

On a level with the street is the great drillroom. The walls and fireplace are of red brick, and the wood of the galleries and ceiling of dark, heavy oak. Two very broad staircases lead to the visitors' gallery, and thence stairs of great width ascend to the upper floor. In the second story the quarters of the field and staff extend across the front, with separate rooms for the colonel, lieutenant-colonel and adjutant, for the surgeons, quartermaster, inspector of rifle practice, chaplain and majors. These will have exclusive baths and other toilet arrangements attached. On each side, opening on a ten-foot gallery, which runs clear around the court, are the company quarters, twelve in all. They are to be fitted as club or reception parlors. Each is 20x40 feet, provided with an officer's room, a masonry fireplace and a stairway leading to the squadroom above, where the lockers are located and the general company work is to be conducted.

West of the companyrooms, on the second floor, are the library on the one side and the servingrooms for the banquet hall on the other. The great banquet hall lies at the west end of the building, and forms one side of the court. It is 30x50 feet, and runs through two stories. It is to be sumptuous and beautiful, and will also be used for the general meetings of the officers.

The third story has in the front the quarters of the non-commissioned officers, including those attached on special service. In the northeast corner of this floor is the large room of the regimental veteran corps. In the southeast corner is a large room which will be fitted up as a gymnasium, but arranged so that it may quickly be utilized for hospital purposes should the occasion ever arise. In the northwest end is a large shower bath, sufficiently commodious to accommodate a considerable number of men at one time. In the southwest corner are the quarters for the band, drum and bugle corps, which are shut off from the main part by several doors. The corner stone of the new armory was placed in April, 1890. Since that time the work has progressed but slowly. It was found difficult to raise the money necessary to complete the building, and several times work was stopped owing to lack of necessary funds. As it is the command was not able to do much more than take mere possession. The property was moved from the old to the new armory, in September, 1891, but the quarters had not been furnished and will not be for some time to come. The amount of money thus far expended is $150,000, of which $75,000 was secured by bonding the property.

Alfred Smith

At present $16,000 of the bonds remain unsold, but Charles L. Hutchinson and John J. Mitchell, of the board of armory trustees, and who have the matter in charge, expect to find purchasers, so that the work may be promptly pushed forward. As it is, the gallery which is to surround the great drill hall on the north, south, and west sides has not been completed.

The pleasant feature is to be the social life in the armory. The floor of the main hall is of hardwood, highly polished, and will be kept in excellent condition for dancing. With this end in view the men will be required to wear rubber-soled shoes while drilling. The only feature requiring criticism is the hanging of the great main door. This weighs twelve thousand eight hundred pounds, and is balanced by a large weight, making the entire strain twenty-five thousand six hundred pounds, which is supported on five single pulleys, attached to a light beam, secured to the ceiling of the second floor.

The Fourth Baptist church, Ashland boulevard and Monroe street, presents many Norman features, in Spanish-Romanesque dress. The building fronts on three thoroughfares—Ashland boulevard, Monroe street and Ogden avenue, and its extreme length is two hundred feet and its greatest width ninety-three feet. The principal entrance is under the tower at Ashland boulevard and Monroe street. The whole of the interior is finished in antique oak. The main auditorium has a seating capacity of one thousand and fifty, and it has some unusual features. One of these is the unusually large platform upon which stands the pulpit. The unusual width and depth of the platform is explained by the large open baptistery just behind the pulpit. Another feature is a choir gallery capable of accommodating one hundred singers. In the basement are baptistery dressingrooms, and in the tower there is a fireproof library and several readingrooms.

The Mallers warehouse, on Quincy and Market streets, was commenced in August, 1891, and suggested his greater building on the opposite corner to be commenced in 1892. It is ten stories in hight, with a frontage on Quincy street of one hundred and fourteen feet and on Market street of forty-two feet, and cost $150,000. This lot was purchased by Mr. Mallers in October, 1890, from the Rubber Paint Company, of Cleveland, for $100,000. The new building, it is said, will pay its owner an annual rental of $21,000. A novel feature of the building is the top floor, which is twenty-five feet in hight and constructed largely of glass. This is done to afford the tenants a light, airy room for exhibiting samples of goods on hand. Mr. Mallers claims that he built, in 1881, the first seven-story business building erected in this city, and that when he built the Mallers' building on La Salle street, in 1884, it was the first twelve-story office building in the United States.

The nine-story warehouse on the southeast corner of Washington and Canal streets was commenced in September, 1891, after plans by Treat & Foltz, for J. B. Wollensack. The estimated cost is $100,000. The building is 75x100 feet with front of pressed brick, stone and galvanized iron. The interior is of mill construction, heated by steam and equipped with elevators.

The building for the congregation of the Church of the Visitation, on Garfield boulevard and Peoria street, was designed in September, 1891, by Architect Carr, to cost $60,000. Its architecture is of the Decorated Gothic style, and it will be built of pressed brick, save the basement, which is to be constructed of Bedford stone. The windows will be of stained glass, and a novel feature will be that the sanctuary is to be raised above the side altars, which are to be surrounded by glass-work. The church will be one hundred and thirty-eight feet long, seventy-two feet across the nave and seventy-eight feet across the transept. The tower will be one hundred and sixty feet high. Its normal seating capacity will be nine hundred and fifty-six. The roof will be slated, the interior frescoed and heated by steam. The gas fixtures, bell, organ, pews and altars are being especially designed.

The Fowler Methodist church on Millard avenue and Twenty-third street, was begun September 4, 1891. The house will be a two-story building, 48x65 feet with tower. On the first floor will be a Sunday-school room with a seating capacity of four hundred and fifty, and north of that, to be connected by sliding sash, will be an infant classroom, seating seventy-five, the northwest corner containing a libraryroom and the northeast corner the kitchen, closets, etc. The second story will contain the auditorium, which, with the gallery, will have a seating capacity of six hundred, the seats being arranged in amphitheater form, with the pulpit on the north side and room in the rear of the pulpit for a pipe organ and a choir gallery, the pastor's study being in the northwest corner. The windows of the auditorium will be of stained glass, the roof slated, and the total cost, when completed, about $16,000. The exterior will be finished this fall, also the rooms in the first story, where the society will worship until their finances will warrant the completing of the entire structure. The church has been named in honor of Charles H. Fowler, DD. LLD., a Methodist bishop. Architecturally it presents some Norman features mixed with Florentine and Gothic.

In July, 1891, plans for the Chicago Medical college, on the east side of Dearborn, between Twenty-fourth and Twenty-fifth streets, at a cost of $100,000, were made by S. S. Beman. The structure has a frontage of one hundred and ten and a depth of one hundred and six feet. It is four stories and basement high, the stories being fourteen feet high. The walls are constructed of pressed brick, stone and terra cotta. In the center of the building is an arched entrance, fourteen feet wide, leading through a hallway twenty feet wide to the passenger elevator in the rear. The office, room for the faculty, museum and an amphitheater, extending from the basement through the first floor and having a seating capacity of three hundred, are located in the first story. The second and third stories are cut up into laboratories, library and museum, the third floor having a lectureroom, with a seating capacity of two hundred and twenty-five. The entire fourth story, the top floor, is used for a dissectingroom, the skylight extending over the entire space and the openings from the four sides of the building giving ample light. The cloakrooms, janitor's quarters and one classroom are in the basement. The building is supplied with the most modern equipment, heated by steam and lighted by electricity.

The hotel Metropole, on the southwest corner of Michigan boulevard and Twenty-third street, is a seven-story brown stone and red brick building, costing, with the ground, about $500,000. The main entrance is built after the Romanesque style and opens out on the rotunda, which shows marble everywhere. The walls are decorated in cream and gold.

The Goodspeed Publishing Co. Chicago

G B Goodall

Right at the west end of the rotunda is the main diningroom, which shows the decorator's art more than any other room in the house, with the exception, perhaps, of the restaurant. The colorings of the diningroom are soft creams and tans and delicate salmon pinks and pistache green. The woodwork is in the old ivory enamel finish. The decoration is in plastic relief, enriched with Louis XVI cartouches, shields and scrolls. The ladies' entrance on Twenty-third street leads into a receptionroom which is decorated in Morris paper. The ceilings are frescoed and the hangings and carpets have been designed by William Morris. The restaurant in the northeast corner of the building is decorated in Louis XVI style, the scroll work being colored in subtle shades of buff, cream and tan. The stucco decorations alone have cost $10,000. On the south side of the main entrance overlooking Michigan avenue is a wide stone portico. Instead of a barroom the hotel will have a mixingroom, which will be connected with every suite of rooms by electric bells. Above the first floor the apartments begin. There are three hundred rooms in all, which can be converted at will into suites of from two to six rooms. The large and small banquetrooms are on the second floor. By the system of dividing the structure into courts, the windows in every room on the north side look out upon the street.

The work on the proposed apartment house, known as The Mecca, was begun September 12, 1891. The location is at the southwest corner of State and Thirty-fourth streets, with frontages of two hundred and sixty-six feet south on the latter, two hundred and thirty-four feet west on Dearborn and two hundred and sixty-six feet north to a private alley. The ground was sold in July, 1891, by H. C. Hullinger to Frank Ray and P. J. Sorg, for $200,000. The purchasers leased it back to Hullinger at an annual rental of $12,000, being on a basis of six per cent. This leasehold interest was subsequently sold to "The Mecca Company" for a bonus of $35,000. The company named has George W. Henry as president and George F. Montgomery as secretary and treasurer. They intend to erect upon the premises a four-story apartment block, which, when finished, will cost $600,000. Each floor of the building will have an area of nearly two acres. The structure will be built in two principal sections, with a large open court sixty-six feet wide and one hundred and fifty-two feet deep in the center. This central court will open on Thirty-fourth street, and will form the main entrance. It will contain a miniature park with a fountain. A covered light court, 33x170 feet, with surrounding balconies, will be in the center of each wing, giving each an interior appointment similar to that of the Chamber of Commerce building. The heating, lighting and ventilation plants will be in the basement, and in the three hundred and twenty-four foot State street frontage will be twelve stores. The remainder of the first floor will contain twenty flats of from four to seven rooms each. The upper three stories will contain each twenty-two seven-room and four four-room flats, so that the entire block will contain one hundred flats. The block is to be called "The Mecca," because the projectors confidently expect that it will be the destination of many people. The rent of the flats will range from $50 to $75, and of the stores from $75 to $150 a month, so that the returns from the enterprise, if all the premises are tenanted, will net ten per cent. on the investment. The design of the building is as original as that of any of the many big structures now in course of erection. The outside facing of the entire structure will be of pressed brick, with trimmings of terra cotta and stone.

In August, 1891, a permit was issued to Mesdames Eliza J. Hopson, Elizabeth E. Sexton, Joseph Addison Hopson and Joseph Hopson, to erect an eight-story hotel building at the corner of Michigan boulevard and Twelfth street, at a cost of $250,000. The fronts are of Buena Vista sandstone, and the style Grecian. When Indiana avenue is vacated by the Illinois Central Railroad company it is the purpose to extend the building line eastward, thus giving a front of eighty-three feet on the boulevard, three hundred and ten feet on Twelfth street and two hundred and fifty feet on Indiana avenue. The first section of the building is in progress after plans by Baumann & Cady.

The Newberry library building, on Oak street west of Dearborn avenue, was designed by Henry Ives Cobb, in 1889, but the first architectural description was not published until September 18, 1891, when the first section of the proposed house was nearing completion. This description points out that the new building occupies the south side of the old Ogden property, and contemplates an extension entirely around the lot, forming a hollow square. It covers an area of three hundred feet on Oak street, facing Washington park, by one hundred feet one North Clark street, and will be one hundred feet in hight. The material is dressed reddish granite from New Hampshire. The design is severely classical and Romanesque. The Oak street elevation consists of a base consisting of low cellar windows and the first story, a shaft consisting of the second and third stories, and a frieze, consisting of the fourth story. It is treated with three bays—one in the center, and one at each end—projecting fifteen feet beyond the main walls. The two stories in the shaft are treated as one, each tier of double windows being grouped under the same arch. Each bay is three double windows in width, grouped under corresponding arches in the third story. In the frieze the windows are massed. The only entrance is through a triple-arched doorway in the basement of the center bay. The cornice is of granite, and very simple. The roof is low, and the ridge line is straight. The design, as a whole, is on a very large scale, and very plain, serious and impressive.

The basement is devoted to machinery, power and heating. The first floor has an auditorium, with a seating capacity of six hundred, in the North Clark street end, a museum in the Dearborn avenue end, and the administration offices between them. The remaining floors are devoted to bookrooms, which will be about fifty in number, and of almost as many sizes and shapes. Mr. Cobb says that he can form no idea what the building will cost. When it is continued all around the lot, he thinks it will cost $3,000,000, but he considers that the present section will answer all purposes for fifty years, and that all four sections will not be needed for a hundred years to come. He also says that he has no idea when it will be finished. The work is of a character that is necessarily slow, and he does not expect the present section of the buildings to be under roof until September, 1892.

The convent and school buildings on Forty-eighth street, near Ashland avenue, were designed in August, 1891, by Architect Carr. The building is to have a frontage of ninety-

Engd by Henry Taylor Jr for
The Goodspeed Pub Co Chicago

Florian P. Nelson

eight feet on Forty-eighth street and sixty-two feet on Dreyer street. It will be constructed of local brick, with pressed brick trimmings, a mansard slated roof, an interior finish of pine and hardwood flooring. Including the furniture and steam heaters throughout, it will cost $25,000. The first floor will be devoted to the boys of the school, the second to girls, and the third will be a large entertainment hall. The convent has a frontage of thirty-six feet on Dreyer street and a depth of seventy-nine feet. The superior's apartments will be on the first floor, also the receptionroom, communityroom, diningroom and kitchen. Dormitories and the chapel will occupy the second floor.

The west side Masonic Temple on Madison street, Colorado and California avenues, designed early in the year, was commenced in September, 1891. The building will be five stories high in front, constructed of Bedford stone and chocolate pressed brick. The inside trimmings throughout will be of polished oak, and the windows in the building will be of plate glass. The banquet and dancing hall on the second story will be 64x41 feet, with two tiers of parlors in front, ladies' reception and toiletrooms, smoking, cloak, and musician-rooms. The lodge hall will be 60x41 feet and will be adapted for any kind of Masonic work. Two tiers of parlors will be connected with the lodgeroom, including committeerooms, armory, reception and preparationrooms.

The proposed Illinois Central depot will combine a magnificent passenger station and office building, nine stories high, and will be erected to the north of the present ruin at the southeast corner of South Water street and Central avenue, with one hundred and fifty feet on the former and one-hundred and eighty-five feet on the latter street. To the south of the station, and extending almost to the north line of Randolph street, a train shed 500x150 feet, will be erected, the entire enclosure, with the passenger station and office buiding extending over about a block. The shed will be constructed upon the parabolic truss principle, as adopted in the construction of the machinery hall at the Paris exposition, combining a number of features which have never been used in this country. An effort will be made to have ample light and avoid the gloom which usually hovers about stations, and to this end the shed will be built entirely of steel, iron and glass. Inside of this shed there will be station facilities for eleven tracks. The ground floor of the main building will be used for the Central station, and will be divided into waitingrooms, ticket offices, freight and express offices and the like. The eight floors above will be used for offices. The entrance to the station will be from Central avenue, and there will be a carriage entrance from Lake street. The cost of the building will be not less than $1,000,000.

The project of building an Odd Fellows' temple was made public in September, 1891, when the Odd Fellows' Building association issued a prospectus and the president and secretary stated the great project was far removed from the region of dreamland. Among other things set forth in the prospectus, the directors say: "The project which is herewith placed before the members of our order involves the purchase in the very heart of the business district of Chicago of a tract of ground containing nearly forty-three thousand square feet of surface, so situated with regard to streets and other open spaces that, by devoting a comparatively small area to the purposes of a court, we obtain a structure measuring 177x210 feet on the ground available for building purposes, with ample space for light and air on four sides. In planning the proposed building it was soon found that there was no conflict between economic and æsthetic considerations. The broad base, covering the entire lot to a hight of thirty feet above the sidewalk, was called for by structural, economic and artistic requirements, and from these jointly have also been developed the groupings and divisions of the entire external treatment. The bold breaks and deep recesses of the long facades serve at once to admit external light and air to the interior of the building and to give an interesting diversity of outline and an effective play of light and shade to the long street fronts. The discontinuance of the terminal bays above the tenth story prevents the casting of light-destroying shadows into the lower offices, and develops the second element of the progressive recessions from base to pinnacle, which constitute an important feature of the design. Structurally these terminal features serve as buttresses for the long arms of the cross, which is the typical characteristic of the plan, and from the center of which, buttressed in every direction, rises the noble tower which is the culminating feature of the structure. The tower will serve as a landmark for the country within a radius of sixty miles around Chicago, and will be visible from Michigan City, La Porte, Aurora, Elgin, Waukegan and intermediate points. This tower, while of the utmost artistic and symbolic significance in the design, will possess a marked economic value. It will contain one hundred and thirty-two offices above the roof level of the building, and from its location becomes the center of approach and communication for the entire building. Within it will be eighteen elevators and four main staircases. And as these become less in number in the higher parts of the building, their places will be taken by offices, so that there will be in addition to the one hundred and thirty-two offices in the upper or free standing part of the tower also sixty corner offices in the intermediate parts of the same. It is intended that twenty-four lodgerooms and public halls of various dimensions shall occupy the third, fourth, fifth, sixth and tenth stories, the great drill hall occupying the whole of one end of the tenth story and measuring nearly eight thousand square feet in area. The remainder of the building will be available for business purposes. The entire number of rooms available for rental, exclusive of the halls and lodgerooms, will be eleven hundred and ten, and their aggregate area will be over two hundred and fifty thousand square feet, while including lodgerooms and public halls the area inclosed (exclusive of walls, partitions, corridors, etc.), will be three hundred and fifty thousand square feet.

"Estimates of rental and deduction for operating expenses have been made, based upon the experience of other first-class business buildings in this city, without making allowance for the unusual and almost phenomenal additional value which will accrue to business premises self-advertising as these, and containing within their inclosing walls a business population equal to that of cities of over one hundred thousand inhabitants. The net income shown by these figures is $675,000 per annum. This sum will be sufficient to allow, in addition to the sources of income in tower observatory and basement story, ignored in making up the foregoing figures, a large margin for possible loss of rentals, as also to pay interest on $3,000,000 in bonds and to contribute toward a sinking fund for redemption of bonds, $100,000 each year. After all these allowances and deductions there will be left applicable to dividends upon stock the enormous sum of $375,000 per annum. The concentrations of immense loads incident to the construction of this building render necessary unusual precautions in the construction of the foundations, and consultations had by our architects, Adler and Sullivan, with eminent engineers, among them Gen. William Sooy Smith, have resulted in the design of a system of foundation construction which will, without excessive cost, carry the weight of the building down to the underlying bed rock, and, therefore, far below any disturbing influences that may occur in consequence of the construction of subways, etc. The design of the superstructure involves the use of riveted steel pillars and steel girders immovably knit together at all joints, vertical as well as horizontal, by steel or iron rivets, and a system of diagonal wind-braces of steel, so thorough and far-reaching and all-pervading that, reinforced by the masses of masonry which will surround the pillars in the lower parts of the structure, there will be attained that combination of masonry and skeleton construction required for successful resistance to the wind strains to which so high a building will necessarily be exposed."

The design of the superstructure involves the use of riveted steel pillars and steel girders immovably knit together at all joints, vertical as well as horizontal, by steel or iron rivets, and a system of diagonal wind-braces of steel, so thorough and all-pervading that, re-enforced by the masses of masonry which will surround the pillars in the lower parts of the structure, there will be attained that combination of masonry and skeleton construction required for succesful resistance to the wind strains to which so high a building will necessarily be exposed. All the structural iron and steel will be surrounded by non-conducting, fire-resisting inclosures; the fillings between floor beams and between pillars will all be of non-combustible material; stairs and elevator guides and inclosures will be of metal, hall and corridor floor will be of mosaic, and to the remotest detail of the erection of this building it will embody, it is said, the best architectural practice of the day and every advance and improvement upon the same that can be discovered before the execution of the work. William C. McClintock, president of the Odd Fellows in the state of Illinois, is personally supervising all the preparations for the big undertaking. He was a newspaper man for over twenty-one years; was first vice president of the National Editorial association of 1889, and has been secretary of the Ohio Editorial association for the past ten years. The president, with J. P. Ellacott, the vice president, and N. Totten, treasurer, are the active members.

The plans for the proposed Public Library building are not yet made; but the action of the Library board, in session September 16, 1891, shows what has been accomplished. The following resolutions were adopted:

Resolved, That in the construction of the library building in Dearborn park, it is the sense of this committee that five architects or architect firms be selected to prepare plans, in competition, in accordance generally with the interior designs prepared by this committee, and that, of said firms three may be residents of Chicago, one of New York and one of Boston. And that the sum of $5,000 be appropriated therefor, $1,000 to each firm or architect.

Resolved, That the following architects be selected under the foregoing resolution: Chicago, Solon S. Beman, Jenney & Mundie and Huling & Schmidt; New York, not yet selected; Boston, Shepley, Rutan & Coolidge. This resolution is not intended to exclude competition by any other firm or architect who may choose to compete, but who shall be entitled to no compensation for plans or designs unless they may be adopted by this board.

Your committee would further state that about October 1, next, their architect, N. E. Weydert, will have completed and have ready the preliminary sketch plans, and that at the next meeting of the board your committee will report for your approval the instructions compiled by them for the guidance of the architects in making their plans.

On August 29, 1891, authentic information in the matter of the proposed theater building on Jackson street was given to the public through the press. The old First Regiment Armory on Jackson street is to be torn down to give place to a twelve-story theater and office building. Bowerman, Farnum & Ware, acting for a syndicate of local and eastern capitalists, have leased the ground for ninety-nine years, and are having plans made for this new structure. The lot has a frontage of eighty feet and a depth of one hundred and sixty feet, and is surrounded by alleys on three sides. The terms of the lease are an annual rental of $15,000 for the first twenty-one years, and $16,000 for the balance of the term. On a five per cent. basis this represents a total land valuation of $300,000. This is a front foot valuation of $3,750, and a square foot valuation of about $23.50. The theater will be radically different from any of the Chicago play houses in many respects. It will not be very large, having a seating capacity of only thirteen hundred. The body of the theater will be lowered and will be fitted up with stalls, after the English fashion. There will be only one balcony and no gallery. The building will be constructed of steel, brick and terra cotta, will be twelve stories high and will cost $600,000. The ground floor will contain two stores, one on either side of the main entrance, and the upper floors will be divided into offices, of which there will be about two hundred. The roof is to be fitted up as a garden. It will be inclosed with plate glass, and will form a veritable crystal palace. Rare exotic plants will serve to give it the appearance of a botanical garden. An electric fountain will be located in the center of the room, while an orchestra will discourse sweet music to the patrons. A broad promenade balcony will surround the entire roof, which will command a magnificent view of the lake and the city. A cafe and restaurant will also form a part of this garden in the skies, which will be placed in charge of a first-class caterer.

The proposed Mallers building on Jackson, Quincy and Market streets, was made a certainty on September 6, 1891. At this date the plans were merely outlined by Flanders & Zimmerman, who gave the following description:

"The building will be ten stories high, absolutely fireproof, of steel construction, with a brick and terra cotta shell. There will be no attempt at elaborate decoration. It will be a plain commercial building. Narrow piers will divide the window spaces, which will be as wide and numerous as possible.

"There will be no court. A covered passage, sixteen feet wide, will extend along the river frontage under the building. The ground slopes from market street to the river, so that this passage way will virtually be in the basement, although on the level of Quincy street

Napoleon Provost

at its embouchure on the river. All goods will be received and discharged in this passage, on which the elevators will open.

"The building will be divided by partitions into stores, the exact number of which have not been settled. The idea will be to have each store and the lofts above it distinct, although a part of the same building. No court will be necessary, as the building has light on all four sides. The elevator shafts will be arranged at the partitions between stores, so that all tenants can be accommodated. The tenth story will be twenty-five feet high, lighted by sky-lights. It will be used for a sample showroom."

The building will cost about $600,000. Work will not begin before May 1, 1892, at which time the leases of the present tenants expire.

The Ludington estate decided to erect a great building on the southwest corner of Wabash avenue and Harmon court, at a cost of $200,000 to $250,000, in August, 1891. The ground is owned by this estate, and is now occupied by several three-story frame buildings. It has a frontage of one hundred and twenty feet on Wabash avenue and one hundred and sixty five feet on Harmon court, and will be fully covered by the new structure. The details of this important improvement are in the hands of Charles J. Barnes, the managing director of the American Book Company. The plans for the building are being prepared by Architect L. G. Hollberg, and it promises to be a magnificent creation. The details have not yet been decided upon, but it is determined that the building shall be eight stories high, constructed of steel and stone, and thoroughly fireproof. The exterior will be built of stone, but whether it is to be cut or rough is yet to be decided. The first story will be used for a store or stores, with an entrance at the side leading to the elevators. It is not known what the stories immediately above the first will be devoted to, but it is probable that the upper stories of the building will be occupied by the American Book Company, which now occupies the whole building at 258 and 260 Wabash avenue, with one other used as a warehouse.

The sixteen-story office building, designed in September, 1891, by Clinton J. Warren, for James F. Keeney and others, is to occupy the southeast corner of Fifth avenue and Madison street, being 100x48 feet. Two forms of construction will be recognized. The sixteen-story or two hundred foot tower will be in solid masonry, while the fourteen-story wings will be Chicago construction or steel encased in a pink-yellow brick and terra cotta, above the third floor level, the first and second stories presenting granite fronts. The vertical prevails in the tower. Five great piers rise from the first band almost to the fourteenth story. Two great Roman arches lead into the vestibule, and these, with the exception of the four arches finishing the central piers of the tower, are the only Italian features of the building. A great square bay, resting on modillions, appears on each side of the tower, and one on the Madison street front. The cornices of the main building and towers are highly ornamental, and form a beautiful sky line.

The proposed Gunning building, on Third avenue, north of Harrison street, near the Manhattan, is to be $73\frac{1}{2}$x$101\frac{1}{2}$ feet in ground area and ten stories in hight. It is to be a central building, devoted to small newspaper and magazine offices.

The question of giving a modern building to the southeast corner of State and Washington streets, appears to be definitely decided. On September 22, 1891, the outline of a $1,000,000 house was made by W. W. Boyington for Van H. Higgins and H. J. Furber. The proposed building will be sixteen stories high, and Spanish in architectural style. The first three stories will be faced with terra cotta, while the upper stories will be of brick and terra cotta. It will be absolutely fireproof, and of combined steel frame and solid masonry construction. The south and east walls will be of masonry four feet in thickness at the base, and will check any tendency toward vibration. On the ground floor will be two stores, 42x90 feet, opening on State street. These will be fitted up in the best possible manner, and will be the finest stores in the country. Between these will appear the grand entrance, twelve feet in width. Over this entrance will be placed a colossal statue of Columbus in bronze. It will be nine feet in hight and after an original design. It will represent the discoverer in the act of taking possession of the New World. On the two sides of the main entrance will be placed two memorial tablets in bronze. On the two tablets will be placed the following inscriptions:

CHRISTOPHER COLUMBUS. Born at Genoa in 1435. Discovered America the 12th day of October, 1492. Died at Valladolid the 20th day of May, 1506.	Erected in honor of COLUMBUS in the year 1892, being the 400th anniversary of the discovery of America.

Above the eleventh and sixteenth stories will be cornices, which will be decorated with Spanish medallions and coats of arms. In fact the decorations of the entire exterior will be Spanish in character. The street angle of the building will be surmounted by an octagonal tower at least two stories high. The corner bays will be carried up into this tower. Extending over the entrance, and just below the statue, which will occupy a recessed space, will be the words "The Columbus" in heavy bronze. The first five floors will be for business houses. The floors above will be divided into offices. A light shaft will extend up through the entire building from the second floor, taking out a space in the southeast corner 33x33 feet. The portion of the store floor over which this shaft will open will be roofed with prismatic glass. A bank of six elevators will give suitable elevator service.

A $1,000,000 hotel project was described in the *Tribune* of September 23, 1891, as follows: "Another great hotel project, including the improvement of the southeast corner of Park row and Michigan avenue, is being exploited. According to Niblock & Palmer, a Chicago real-estate firm, a syndicate of Toronto capitalists, has practically completed negotiations with the owner of the corner, E. W. Shirk, for a ninety-nine-year lease of the land. The corner has a frontage of one hundred and seventy-five feet on Michigan avenue and one hundred and thirty-five feet on Park row. The terms of the lease are not made public, but it is said that a valuation of $400,000 has been placed on the property. The terms of the lease call for

Césaire Gareau

the erection of a $1,000,000 building. It is said that a bond to secure the lease of $2,500,000 has been signed."

On July 3, 1891, the foundations of the Unity building were completed, and on August 10, the iron work of eleven stories was reported finished. The *Inter Ocean* of August 11, noticing this extraordinary progress, says: "The remarkable fact about this building is that between Tuesday and Friday of last week the iron frame of two stories was completed. This feat is regarded by builders generally as something extraordinary. The dimensions of the building are 120x80 feet and two hundred feet high. A. Vanderkloot, who has had charge of the construction, says that the iron work of the entire building, eighteen floors, will be completed before September 1. 'This time could not possibly be made,' he says, 'if steel columns were used. We use cast iron, and this is the first iron building constructed in Chicago with material manufactured at home. All the other sky-scrapers are built of steel, manufactured at Pittsburgh. I think I see in the construction of this building the inauguration of a new era in Chicago architecture, for if this proves a success, capitalists will not go away from home in the future to buy their materials. We have about forty-five men working eight hours a day. With this force all the work has been done. Everything is systematized, and each man knows what his duty is without being told. The Unity building is, therefore, being put up in less time than has been consumed in the erection of any other high building in Chicago.' In the course of the erection of the iron frame work, it became necessary to cut into the south wall of the McCormick building. The particles of brick and mortar that accumulated between the wall and the iron pillars of the Unity building caused the latter structure to sag somewhat, but the perpendicularity was restored."

The Eureka is a six-story-and-basement business block on West Madison, with front of St. Louis pressed brick. Four great pilasters rise from the level of the second floor and receive three arches at the fifth-floor level. The sixth story shows nine arched windows in three sets with labels, while below the cornice, forming the frieze, is the corbel-table. The style is Romanesque reduced, of course, to the commercial idea.

The plans for the new Parker apartment house, to be erected on Cottage Grove avenue and Fortieth, were made in September, 1891, by Holabird & Roche. This building will be seven stories high and show a fontage of one hundred feet on Cottage Grove avenue and one hundred and fifteen feet on Fortieth street. Peerless pressed brick, with Marquette rain-drop cut-stone, and terra-cotta trimmings, are shown in the fronts. The bay windows are to be of twelve-ounce gold-rolled copper and American polished plate glass, with ornamental balconies and cast-iron, frost-proof platforms, supported by cast-iron modillions. The interior finish will be of hardwood, trimmed with red oak, and the mantels, electric bells, speaking-tubes, etc., of latest designs and manufacture. Marble and mosaic floors will be used in all corridors. The electric-light plant in the basements will furnish power for one thousand one hundred and nineteen incandescent lights, distributed throughout the entire building, and contracts are let for steam-heating apparatus. Passenger and freight elevators, with the latest safety appliances will connect all floors. The building will contain thirty-two flats of seven and eight rooms each, together with private baths connected with every suite. The first floor will contain six large stores and a corner room to be devoted to banking purposes. The basement will contain seven storerooms besides safety-vaults and other rooms.

The building proposed to occupy the northeast corner of Lake avenue and Forty-seventh street was designed in September, 1891, by C. J. Warren for J. G. Cozzens, to cost about $200,000. The plans provide for the erection of a seven-story structure of a most ornate design, the walls of which will be constructed of brick and stone. The interior will contain eighty-four suites of apartments and will be fireproof. The first floor will contain the hotel office and a large diningroom and drug store. The main entrance will be on Forty-seventh street with a ladies' entrance on Lake avenue. The house will be known as the Hotel Kenwood.

The plans for a double dwelling, to be erected on the lake shore drive (between Goethe and Scott streets), for George H. High and J. W. Farlin, were made in September, 1891, by Henry Ives Cobb. The house will be three stories and basement high, with a frontage of fifty-four feet, extending back the entire depth of the lot. The design is in the English Gothic style, and will be built of the finest tool-chiseled blue Bedford stone, with a red-tiled roof. The entrance to Mr. Farlin's house will be through an inclosed porch, while Mr. High's will be through a vestibule, built entirely of stone from the floor to the ceiling to match the exterior of the house. In the former, the library, drawingroom and diningroom, with a spacious hall, will take up the entire first floor, while in the latter, the first story will contain the library, a large hall, receptionroom, a large oval diningroom and kitchen. The second and a part of the third story will be divided into sleepingrooms, while in the rear half of the latter, extending the full width of both houses, will be a magnificent ballroom. The ceiling will be arched, and as the house will be wired for electricity, the ballroom will be lighted by one hundred electric lamps. In the center of the two houses is a light well, which also affords communication from one house to the other, but, should it be desired, this can be closed and communication thus cut off. The interior will be beautifully finished in different kinds of hardwood and heated by steam. The toiletrooms will be laid in tile, and the plumbing, which will be open, will be of the most approved design.

The Chapman eight-story building, on West Monroe street, was erected in 1891 for the purposes of a storage warehouse and printing office. It is the second commercial building erected by the Chapman Brothers in that vicinity within the last few years. The style is Commercial throughout.

The freight and passenger elevator systems of Chicago, prior to 1871, was simplicity itself. Years ago, the rope and pulley hoist was introduced in the Dole and Peck stores, and from this contrivance was evolved the hoisting machines of post-bellum days. These machines suited the requirements of the time admirably. The leading local manufacturers of hoisting machines in 1869 were James W. Reedy, 49 North Clark, and the Franklin Iron works, 74 Washington. The era of steam and hydraulic hoists soon followed, and in 1879 hydraulic elevators were manufactured by W. E. Hale & Co., and steam elevators by the Chase Elevator Company, Crane Brothers Manufacturing Company, Ed P. De Wolff, T. W. Eaton & Co., W. E. Hale & Co., F. W. Krause, Mitchell & Co., J. W. Reedy and John Wallace. The latter a manufacturer of hand elevators. John Y. Macomb and Herbert H. Thomas were manufactures of hod elevators. The electric hoist is one of the latest developments of the electrician, and one which promises to supplant the steam hoist as steam did the old horse power hoist. The motor is series wound with a rheostat for regulating speed, a level for controlling the friction clutch and a brake. This invention abolishes the hod carrier even in small buildings, for the little machine may be carried around easily and power obtained from the nearest wire.

The great modern grain elevators deserve some notice. They have played and do play a most important part in the progress of Chicago. A few references have been made to the early grain warehouses. They would compare with those great buildings of the present as the old Saloon block or Green Tree tavern would compare with the Monadnock. The Armour elevator has a capacity of 2,000,000 bushels; the Chicago, Burlington & Quincy railroad company's elevator and the Dale & Co. elevator of 1,800,000 bushels each. The Sibley Elevator Company, office 405 Rialto building, dates from 1869. The elevators of the Sibley Elevator Company, located at Thirty-first street and Stewart avenue, are two in number, and have a storage capacity of three hundred thousand bushels of grain. Auxiliaries in business to the elevators are several warehouses for the storage and handling of hay, straw, bran, middlings, and all other kinds of feedstuffs. The wholesale and retail transactions of this corporation in these lines being possibly the largest in the city. Connected with the elevators there is an improved grain dryer, the patentee and inventor of which is the president of the elevator company, D. E. Sibley. This is machine of far greater utility than any other dryer in use, and the only one which does not increase the rate of insurance. But the machine which possesses almost unrivaled value and which also is the invention of D. E. Sibley, is "the double endless belted grain scourer," which thoroughly and completely removes all smut from the dirtiest wheat, making it sweet and suitable for milling. Usually over fifteen per cent. of the entire crop is smutted, reducing the value from six to ten cents per bushel of about fifty to seventy-five million bushels of wheat. By a change of brushes this same machine will clip oats, barley and malt, and by another change it will hull and polish rice. This machine has just been patented in the United States, Canada and Great Britain, and it began operations on August 1, 1891. The *Inter-Ocean* published in November, 1890, an autobiography of one of the great grain elevators. From it the following description is taken: "In the matter of elevators, man's inventive faculties have, as you may be aware, gone considerably farther, in that grain is now elevated and stored away in thousand-bushel lots about as quickly and neatly as that old-time establishment handled single pecks. My owners came down with the dust—that is to say, they shelled out about $500,000 when they built me, and one of the items in the bill of expenses was for 12,000,000 feet of lumber. Notwithstanding the fact that such an immense quantity of wood enters into my composition, I am not by fire-insurance men regarded as a very hazardous risk, and for these reasons: My outside brick wall is sixteen inches thick, and a fire wall, averaging two feet in thickness, cuts me squarely in twain. Over the top of each of these divisions iron fire ladders pass, reaching from the ground on one side to the ground on the opposite side, each ladder measuring about three hundred and seventy feet. Where necessary, my windows are protected by massive iron shutters, and other iron doors in my fire wall are opened and closed at will by electricity. On all floors there are electric push buttons, communicating with annunciators in my engineroom, and in the latter department there is also a fire pump with a capacity equaling that of four steam fire engines. Two hundred barrels of water, each accompanied by a couple of iron pails, are scattered about over different floors, and twenty-two chemical fire extinguishers are placed at my disposal. Forty-four fire plugs, to each of which is attached one thousand feet of two-and-a-half inch rubber hose, together with fourteen fire-alarm boxes, about complete my precautionary measures for combating the devouring element. Upon leaving the cars the grain falls through an iron grating into the hopper beneath the floor, and is immediately carried by the elevator buckets up to the cupola, a distance of one hundred and fifty-five feet. There it is discharged over the heads of the elevators into scale hoppers, twelve in number, each having a capacity of two thousand bushels. Our twenty-four carloads of grain having already reached the weigher, you may proceed upward more leisurely. You can take an improved passenger elevator to reach the upper stories. The first or receiving floor is twenty feet in hight. The second is called the bin floor. There are three hundred and seventy-nine bins, or, since a portion of them are divided into three partitions, four hundred and twenty-eight receptacles in all, each sixty-six feet in depth, and made to hold from one thousand seven hundred to six thousand five hundred bushels, the latter figures representing the capacity of the three hundred and seventy-nine undivided cribs. Above this floor is the "spout," "turntable," or "revolver" floor as it is variously designated. Around each spout are grouped in a circle a dozen or more funnels. The spout revolves and readily connects with these funnels, and by having a number of these revolvers grain is distributed to any of the bins. Next is the scale floor, where twenty-eight large Fairbanks scales do the weighing, and then comes two shaft or machinery floors.

"The 'marine leg' is worth describing. It is a device ninety feet in length, vertical, consisting of an endless belt in a movable leg, to which belt are attached buckets capable of carrying eighteen pounds each. The elevator is carried on guides, and will lift sixty feet, taking grain from the hold of the largest propeller at the rate of 10,000 bushels an hour. With the marine leg, vessels holding 50,000 bushels are unloaded in five hours.

"The bulk of the grain received here enters, of course, by rail. Formerly cars were made to hold about 400 bushels; but of late years they are built large enough to carry 1,300 bushels of wheat, or 1,600 bushels of oats. One shipping and two receiving tracks pass entirely through the warehouse, by means of which the cars are switched into position opposite the receiving elevator legs. An elevator leg, by the way, is a long wooden box enclosing an endless belt, to which are fastened 320 buckets, each capable of carrying fifteen pounds of grain. There are sixteen of these receiving legs in the building, each having a capacity for conveying to the garners near the roof 10,500 bushels of grain per hour. The legs rest on iron boots, within water-tight tanks, made of boiler iron, twenty-five feet long, ten feet wide and twelve feet deep, in the basement. These tanks completely encase the hopper which receives the grain, and discharges it into the elevator buckets.

"To move my extensive and ponderous machinery I am supplied with a one-thousand horse power compound Corliss engine, making fifty-six revolutions per minute without varying one revolution in a day's run. This is one of the most elaborately finished pieces of mechanism in existence, and was constructed without regard to expense, as you may know when I state that its cost was nearly $50,000. The diameter of the drive wheel is twenty feet, and that of the shaft eighteen inches. Crank bins, fourteen inches in diameter, and fourteen-inch steel pins are provided, the momentum of which adds impetus to the work of the engine. My main belt is of rubber, two hundred feet in length and five feet in width. It is the largest bit of ribbon ever manufactured from any material by any firm for any purpose requiring special machinery in its construction. I deem it hardly worth while to mention that it is the product of a Chicago rubber company. The big chimney has a fourteen-foot base and an altitude of one hundred and fifty-four feet."

Architecturally, the elevator is a rough Gothic structure, wherein grain congregates and to which its worshipers turn their eyes and hearts. True there are no grand porticoes, Corinthian pillars and Roman arches, but the nave, the aisles and the clearstory are all there. It is not always veneered with brick nor is it always frame, for, as hitherto shown, the idea of placing scantling horizontally has been accepted, and many elevators built in this way are found here. Those immense grainhouses are purely Chicagoan, originating their massive forms here like the Chicago construction of later days.

In the matter of fireproof construction the city has made wonderful strides. In September, 1891, T. A. Bowden, superintendent of surveys of the Chicago Underwriters' Association, made a compilation of the number of feet of street frontage occupied by buildings of fireproof construction in the business district north of Harrison street, the *Economist*, in noticing this novel survey said, "That question has been raised by many of the citizens who are conceded to keep abreast of the times, and particularly with the growth of Chicago, and very few, if any, have estimated more than five or six thousand feet. When told that Mr. Bowden had found, by actual measurement, that there are fourteen thousand seven hundred and eighty-five feet, or nearly three miles, the most sanguine Chicagoan holds his breath for a moment and thinks a big think. How much this means to the owners of the millions invested in buildings and merchandise in the district is incalculable. From Michigan avenue to the river is about two thousand feet; from Harrison street to the river is about two thousand five hundred feet. There are, therefore, more than enough fireproof constructions to make a barrier of protection covering a space of a block and one-half from Michigan avenue along Harrison to the river, then north to the main branch. While it is true that such a wall of protection around the business district would preclude all possibility of another conflagration from the outlying territory, still it can not be inferred that the buildings in their present localities would permit of a general conflagration, but quite the contrary inference is the most reasonable deduction. All who have lived in Chicago for twenty-five years do not look for a conflagration from any source, but if one must needs come, all eyes would be turned to the southwest for its incipiency."

Safety is not the only requirement of the times. The great buildings whether church, hotel, theater, or commercial, must be given a definite style and an ornamentation which will never grow old. It is not always wisdom to sacrifice beauty to utility. If it would remain the rule to raise up a giant in a region of Lilliputians, the giant should be so constructed and decorated that he will appear a successful marshal in the midst of his army corps. It is the policy of utility which urges the farmer to build a large barn with curb roof and cupola, near the cabin which shelters his human chattels. The policy is wrong there, as it is in some of the great modern houses of this city.

The number of residences, commercial buildings and manufacturing houses completed or commenced in 1891, prior to September 20, points out the faith of builders, merchants and manufacturers in Chicago. The greater buildings have been described, but thousands of houses, which cost from $8,000 to $50,000, have been passed over in the pages devoted to architectural descriptions, leaving the description of a few to answer for all. The reason is obvious. The rock-faced stone-front dwelling or flat of 1890–91 is not a definite style. Its novelty recommended it. Already people have been weaned from this novelty, and as there being nothing architecturally definite in it, it has to give way to a style, where repose will control. The French chateau can only satisfy him who has the means to build a great residence, the city house of the Renaissance must be the model for the detached or semi-detached residence in a block, and the Romanesque must prevail in the great commercial houses. A uniform style will undoubtedly be adopted, to remedy the vagaries of independent thought in building a city house.

The special papers connected with the building arts which were written or brought to light after kindred papers were given their proper place in the preceding pages are no less valuable, and a study of them must bring benefits to every one engaged in the building trades. The first paper is historical and comparative.

In October, 1887, W. W. Boyington considered the architecture of that time and compared it with the styles and construction known fifty years before. "Fifty years ago," he states, "is an earlier period than my experience as an architect extends; it was, however, in the early years of my studies in architecture. In order to demonstrate fully the progress of architecture during the last half century, would it not be well to compare its progress with some of the other arts and sciences, for instance, steam and electricity, as they are closely allied to architecture in the complete construction of buildings? Steam was better understood fifty years ago in this country than architecture or electricity. Architecture was then understood and practiced as a separate profession by very few persons. I think it is safe to say that there are more architects in practice to-day in the city of Chicago than there were then in the whole United States. I think it is also safe to say that with the exception of the science of electricity, architecture has made greater strides than any other of the arts and sciences. I claim that architecture combines both art and science to a greater degree than any other profession. To-day, we can vie with any country in the world in style and permanency of construction. Fifty years ago this country knew no style in architecture, except the classic and the gothic, and but very few pure examples of either of those styles were executed in this country. The majority of buildings at that period were planned and built by master builders, who usually made their plans on the face of the trestle-board, and shaded them with white, red and blue chalk to designate wood, brick and stone. Details were made, full size, in the same way. My father was a master builder, and used to make his own plans, largely in the way mentioned. Architectural works in that early period were but few. Foreign works at that day were very expensive. I recollect the works of Benjamin Hill, La Fevre, and a few other authors, not to exceed half a dozen altogether. At the present time we have a very large number of architectural publications, and upward of three thousand practicing architects. I trust a majority of them are doing a legitimate commission business, and are not mere tools of contractors. Fifty years ago, and even less, architects were largely supported by contractors. Now, and for years past, the owners have found it to their advantage to deal directly with architects. Still, there are many impecunious persons who think that it is money wasted to employ an architect, so long as they get the services of one through their contractor, when, by so doing, they do, as a usual thing, indirectly pay three prices for their plans. I think I am correct in stating that Philadelphia is the largest city in the country which can boast that it has the most buildings built in the last fifty years, in proportion to its inhabitants, without the employment of architects. They used to build miles of street fronts, with builders to duplicate a certain mold, with but slight variations to suit localities or notions of proprietors. That system, I am glad to say, is largely done away with, even in Philadelphia, and architects' services are more fully appreciated. Still, in Philadelphia, there are, to-day, a less number of architects, per capita, than in any other large city.

"When I came to Chicago, thirty-four years ago, I found the architects then in practice were recent master builders or contractors. Chicago and the West at that time could hardly be said to require the services of architects, separately as such. At that time the structures were but simple buildings, but the builders soon found that it would be better for them to have plans made, rather than to spend their time in making them, so they clubbed together and induced one of them, most apt in drawing plans, to give up contracting and to devote his whole time to architecture, and guaranteed him a compensation of $2 per day, which should be paid to him if he did not get business enough to aggregate that amount. I have been told by a person, who was acquainted with the early workings of the first architect of this city, that he had an order for a set of plans for a dwelling, which he made, and charged $5 for them, and was much elated over the circumstance. From this small beginning others started, and on my arrival I was introduced by friends, or had letters of introduction to citizens, as a young architect from Massachusetts. This simply shows as a profession it was not understood. It is not so now. No profession is better or more favorably known. Having mentioned the small compensation which architects were obtaining for plans, and that it came largely from contractors, I might state that when I commenced business in Chicago I immediately instituted the custom of charging a percentage on the cost of buildings as the only proper course to pursue, and always collected it from the owners. This departure was rather up-hill work, but I have plenty of witnesses now to show that it was a success. And from that small beginning we can, to-day, boast of as fine and as capable a corps of architects as any city of the union, and the architect who first commenced practice in this city is still living. Chicago has been a sort of radiating point. My sphere of practice has extended from the Gulf of Mexico on the south, to Manitoba on the north, and from the Atlantic to the Pacific, together with the intermediate cities on the lines from east to west and from north to south. How is it with other arts, sciences and professions? Have they kept equal pace? Railroads were but little known fifty years ago; the same with electricity. Steam power was well developed, but the mechanism was very crude as compared with the present. Electricity can hardly be said to have developed into any practical use half a century ago. Consequently, I think we must give way to the scientific development of electricity. I well remember some few simple electrical experiments made by stringing wires around a town hall, and, with a crude instrument and battery, a circuit was made around the hall and a few interesting experimental freaks were produced. From this small beginning the world has been brought together within speaking communication, and a power produced yet in its infancy, which is destined to be improved to the wonder and astonishment of the world. Hence, we must assign to it the place of the leading science of the past fifty years. While we accord this we must not forget the very crude construction of railroads. First, the wood stringer with iron strap rails, more familiarly known as the 'snake-head' rail. On these rails the engines were constructed to run without tenders or covers of any kind to protect the engineers or firemen. They used to stand on the open platform, exposed to the severity of the weather and storms. It was in the year, 1840, I think, that I was called upon by the master mechanic and general superintendent of the Boston & Albany railroad, to see if I could not devise some kind of protection, at least partially, to cover the engineer and fireman, and have it sufficiently open not to obstruct their view. I examined an engine and reported that I could construct a cover. I was at once employed to make the necessary drawings and superintend the construction of the first cab over an engine in this or any other country. The result was a perfect success, upon which there has not been any material improvement, as it was almost identical with the cab now in use. I need hardly inform you that its use was immediately adopted throughout this country. Had I had forethought enough to have secured a patent for the device, I probably would not have been called upon to prepare this paper. I trust you will forgive me for diverging so far from the subject given me. The mention of these somewhat kindred subjects has been prompted by the incidents in my early life that were fastened so strongly in my mind in connection with my studies and practice in architecture."

The logic of architectural design, from the point of view of C. H. Howard, is philosophical. He maintains that the relation of architecture to the exact sciences is far from being clearly defined. Combining, as it necessarily does, the elements of a science with those of an art, it has been looked upon askance, on the one hand as indefinite in its methods, on the other as occasionally too mechanical in its results. As far as construction is concerned, graphical statics and formulas supply all needs with sufficient exactness, for architectural construction seldom reaches the inspirational stage, and when such an event occurs the assistance of an engineer is usually solicited. But construction is not, apart from its necessary adequacy, the most important part of architecture, which is to be regarded for its æsthetic qualities. The objection can justly be made that it is assumed that the inspiration of genius and the vague, intangible, æsthetic sense disarm all criticism. Æsthetic, curiously enough, however, is defined as "pertaining to the science of beauty," and science means certain knowledge; therefore it would seem that the principal thing desired in architectural study should be the certain knowledge of beauty. The completeness of this knowledge is frequently questioned, and it is presumed that there is no fixed standard and no fixed set of laws by which beauty can be determined or gauged, a freedom from bondage, an erratic liberty of expression being its prerogative by a sort of divine right, and essential to many of its forms. Yet, upon observation, there seems to be a very close relation between beauty and utility, between the pleasing thing and the necessary thing, and whatever is given to one at the expense of the other appears to injure both. It is a perfectly easy matter to attempt to beautify at the expense of constructive expression, and just along this line lie most of the errors of æsthetic taste; but it is a very difficult matter to construct well at the expense of artistic expression, since the influence of the force of gravity alone requires an organic method, and a set of forms, masses and lines, which will be found more pleasurable to the eye in proportion as they more nearly perform their exact duty. Whether this is from hereditary perception of instability, or from the tendency of like to attract like, man, a highly developed organism, being appealed to most strongly by the organic quality in his environment, is a subject for mental philosophy. That the fact exists is undeniable. It follows, then, that there are two methods of making a building ugly—first, by a lack of development of its organic qualities, that is, by crude and inefficient expression of its constructive requirements; and, secondly, by the addition of non-essential forms, so-called artistic accessories, contrary to those requirements.

Conversely, there are two methods of making a building beautiful—by the fullest and most subtle development of constructive requirements, and by the application of forms which accentuate the organic qualities of the work. Taking this for granted, and, certainly, but slight objection can be made to the general statement, the basis of all design must necessarily be a thorough sense of constructive requirements in order to possess the knowledge of the proper points to accentuate, and this should be, not a perception of a number of petty details, of minor threatening weaknesses, but a pervading sense of the great law governing all building, the law of gravitation. The first necessity, then, is stability, which means that all main lines, except those of metal, must be horizontal or perpendicular, and that the bottom must not be incapable of supporting the top. This latter necessity has a marked influence upon the disposition and size of openings, and creates the general rule that voids are preferably placed over voids, and solids over solids. The position of the center of gravity, real or apparent, creates the desire for more solids in proportion to openings at the lower part of the building, than at the upper, and the consequent increase in number of openings in the upper part, and the same desire makes the two sides of a building of the same general density, preventing the weighting of one side more than the other. This wish for apparent balance is the reason for symmetry, which is, practically, corresponding density on either side of a central axis, and which occasions to a great degree the planning of buildings on axes, and the subsequent balancing of the masses of the façade. As far as construction is concerned, this need of lateral balance is imaginary, but it is the first and only important departure of the æsthetic requirement from the constructive one, and has as its basis the feeling that all masses are most stable when equally distributed upon a horizontal plane.

Theoretically this is true, so that the artistic sense, in this case at least, seems to require more rigid adherence to the theoretical law of solids than does the constructive necessity, a rather suggestive fact to those who claim that art is irrational in its methods. The wall and columns carrying a lintel or a wall are the simplest of constructive units, and are the antecedents of all early architectural forms until the arch made its appearance. To the wall as it is built in horizontal courses is applied the horizontal scheme of lines; to the column and its associate the pier, the perpendicular scheme. In each the æsthetic method accents the constructional precedent; in the one by the use of accented joinings and by molded string-courses, cornices, etc., in the other by flutings and panels. The horizontal lines carried through a facade are influenced in their relation to one another in size and distance apart by two desires: First, to make the lower part of a building seem stronger than the upper; secondly, to divide organic portions of the building one from another. The first influence is felt in the grading of horizontal joints, so that the larger and wider stones are below, and the interval between the joints decreases toward the top, and, as in the use of more numerous openings as the wall ascends, there is produced a graded tone, a tone of comparative strength, expressed by a gradual shading toward the top of the building. The same result is obtained frequently by changing the texture of the stone, as, for instance, when rock or splitface is used in the first story and ashlar above. The American custom of having the first story of buildings of a different and stronger material than is the rest of the facade, is a logical result of the same reasoning.

The same diminution of a tone appears in the scale of moldings as they ascend in position. There is, however, a prevalent idea, caused by the fusing of form by distance, that all ornament inertia of horizontal masses is injured by being shot through with the nervous vigor of perpendicular supports, and the energy of ascending columns and piers is dulled by the heavy long lines of inert masses. Architecture is not a stuff with warp and woof; it needs a dominant motive, for otherwise the æsthetic sense suspects instability. To it exact equilibrium is uncertain equilibrium, and it prefers the certainty of dominant horizontal or perpendicular lines to the plaid of conflicting forces. Above all, a building is an organism of which each part should perform its functions not only actually but manifestly, and architectural design should be devoted to denoting unmistakably how each function is performed. Disguise is affectation. Frank exposition of construction is alone commendable, giving logical quality to design, and it is soon apparent that the æsthetic desire, once recognizing this fact, will suggest the most satisfactory construction, while at the same time it satisfies itself.

"A few practical hints" was the title of an address delivered before the Chicago Architectural Sketch club, by W. L. B. Jenney, in January, 1889. He said: "Some thirty years ago there were read on the same night, before the Linnean society in London, two very remarkable papers that startled the scientific world, demonstrating the then new and far-reaching facts on the origin of species. One of these papers was by Wallace, written in the Malayan archipelago, and the other was by Darwin, written in London, after his return from the voyage in the Beagle. These two naturalists reached the same conclusion—that species were evolved and not created; that environment was an important factor in the evolution; that species adapted to the environment lived and prospered, and that those illy adapted to the environment perished. During the last thirty years these great truths have rapidly gained ground until they are the great principle in every department of natural science, and have become common knowledge. The great lesson I would draw from this is that the same law of 'the survival of the fittest' is just as true of the order primates, genus homo, species, member of the Chicago Architectural Sketch club, as of other animals. Architects live in an environment consisting of clients, male and female, very exacting, and often unreasonable. They require novelty, beauty, thorough protection from the elements. They must be warm in winter, cool in summer, and comfortable at all times. There must be universal adaptability of things. Every one of their whims and habits and notions must be satisfied. Each one must have something handsomer, more novel and generally better than any one ever had before. All this must often be crowded into a twenty-five foot lot, and produced at an expenditure that will not pay for the halls.

"See what Vitruvius wrote, some twenty-five years before the Christian era: 'Architecture is a science arising out of many other sciences, and adorned with much and varied learning, by the help of which a judgment is formed of those works which are the result of other arts. Practice and theory are its parents. An architect should be ingenious and apt in the acquisition of knowledge. Deficient in either of these qualities, he can not be a perfect master. He should be a good, a skillful draughtsman, versed in geometry and optics, good at figures, acquainted with history, informed on the principles of natural and moral philosophy, somewhat of a musician, not ignorant of the sciences both of law and physics, nor of the motions, laws and relations to one another of the heavenly bodies. Moral philosophy will teach the architect to be above meanness in his dealings, and to avoid arrogance, and make him just, compliant and faithful to his employers, and, what is of the highest importance, it will prevent them from gaining an ascendancy over him, for he should not be blinded with the thoughts of filling his coffers, nor with the desire of grasping everything in the shape of gain, but, by the gravity of his manners and a good character, should be careful to preserve his dignity. Law should be an object of his study, especially those parts of it which relate to party walls, to the free course and discharge of the eaves-waters, the regulation of cesspools and sewage, and those relating to window lights. The laws of sewage require his particular attention, that he may prevent his employers being involved in lawsuits when the building is finished. Contracts, also, for the execution of the works should be drawn with care and precision, because, when without legal flaws, neither party will be able to take advantage of the other. Pythias, one of the ancients, architect of the noble temple of Minerva, at Priene, says in his commentaries that an architect should have that perfect knowledge of each art and science which is not even acquired by the professors of any one in particular, who have had every opportunity of improving themselves in it. Practice alone can lead to excellence in any art; that architect, therefore, is sufficiently educated whose general knowledge enables him to give his opinion on any branch when required to do so.' Well, that was about all that was required of an architect nineteen hundred years ago; but since then the environment has expanded, and has taken in such things as plumbing, steam-heating, electric regulators, electric lighting and electric bells, elevators, automatic mercurial firealarms, exhaust ventilators, innumerable luxuries and a dozen or more stories added to the hight of the buildings, exceeded only by the tower of Babel. As the environment expands, so must the knowledge, skill and ingenuity of the architect expand. He must keep pace with the environment, and be adapted thereto, that he may live long and prosper.

"My subject is 'A few practical hints,' and the object of this introduction is to get on the track that we may spin along more smoothly for a half hour or so. Everything now runs at high speed, high pressure, and on a limited vestibule train. When you pay one of the old fogies the high compliment to invite him to read a paper before your club, he should try to give you some of the results of his experience that can be turned to practical account, even if they are a little dry. I am sure you will bear with him, for he knows some things from sad experience that he wishes he could have learned at your age.

"Engineering is the science of building well and economically, and architecture is the application of art to engineering. Ferguson's definition, 'Architecture is ornamental and ornamented construction,' is the same, both in idea and in application, and is but another way of expressing the same thing. First, the construction, i. e., the engineering, which, it goes without saying, must be substantial and economical. Then the application of art, the adjusting of the proportions so that the construction is pleasing in its appearance, and then, for further ornamentation, the details of the construction are accented by moldings and carving that is ornamented. The practical is at the bottom of the whole, and underlies all that makes claim to architecture. The plan and the entire construction, from turret to foundation stone, is purely practical science, leaving but a small and superficial area for the application of art.

"Inasmuch as art and architecture must, from the very necessities of the case, be used sparingly, like all other precious things, we find at the outset one of the fundamental rules of art almost forced upon us. We must admit, however, that the ingenuity of some architects has found the means of ignoring this rule. Instead of using art to accent the construction, designing with skill, making the details appropriate and subordinate to the construction, they have spread them all over the surface, hiding the construction, and, if we may judge by the results, they seem to have aimed to show how much labor and how little real art could be put upon a square yard. Let us remember the great golden rule of art in architecture: 'Ornamentation must be used with great moderation, and must in every instance be appropriate, and of the very highest type. Poorly designed and poorly executed carving is a disfigurement. Far better a plain surface.' Gen. J. D. Webster, chief of staff to General Sherman, an old resident of Chicago, and a man of great refinement, once said to me: 'If my cane was only a wand with which I could wipe off the miles of poor carving and ill-designed moldings that disfigure our buildings, how much I could improve the architecture of Chicago.' It is a good rule. Whenever, after repeated trials, you can not design an ornament that is thoroughly satisfactory, rub it out and leave the surface plain. A plain surface is never offensive.

"It is not, however, with the art side of architecture that I propose to occupy your time this evening. On that subject you need no instruction from the old fogies, other than perhaps the caution to 'go it slow.' You are on the right road. You are all young, enthusiastic, and full of energy, and are taking what I believe to be the right method to learn architectural art. You have formed this Sketch club. You go to nature for your models. You are all learning to see art in nature, and to conventionalize it; that is, simply make it more geometrical, and to translate it into architectual ornament to be cut in stone or wood. It is the purely practical side of architecture, the engineering, the science of building well and economically, that I would call your attention. There are no fascinations, no opportunity for enthusiasm in this, and, in consequence, it is often neglected in the early studies of the architectural student.

"To build well and economically necessitates that the building shall be the most convenient, the best adapted to the purpose, and thoroughly substantial. The material shall be the best to be obtained at a reasonable cost, and shall be used economically; that is, properly disposed, and every piece calculated to do the work required of it with a proper coefficient of safety, enough and no more than enough. We will begin with the plan. This is the great essential, the fundamental principle. It is to obtain the plan that the building is erected. We are not speaking of monuments. That is a special art. The success of all buildings devoted to the wants of life depends almost entirely on the plan. No amount of art can overcome the defects of the plan, and although it is perfectly possible to harmonize the two conditions of a good plan and an artistic exterior, still, the first essential is the plan, and no convenience of arrangement, no opportunity to obtain sufficient light, no pleasing and desirable effect of interior, must be sacrificed or even injured for the sake of the exterior. However, it is often possible by careful study to so arrange the plan that the desired exterior can be obtained without any injury to the interior. A perfect building will have a plan that satisfies every requirement of convenience and of pleasing effect, and the same time an artistic exterior, and, as a whole, will leave nothing to desire. But, if we must hold to the one and lose the other, let us hold to the plan. In all French competitions, where the jury is chosen in part from the architects, members of the Academy of France, the first importance is attached to the plan. No elegance or beauty of exterior can redeem a defective plan.

"In the one competition in this country where, perhaps, the best endeavor was made to treat this architectural delusion and snare in the least objectionable manner, the award was made wholly on the plan. I had it from the principal expert. He called in an architect to assist him, and together they studied the plans, and finally selected six that would do to execute. They then selected six elevations. And then they discovered that the plans of only two of these six selected elevations were to be found among the six selected plans. The experts again examined the six selected plans and the six selected elevations. Of the plans there were four without elevations. These elevations were found, again studied, and again discarded. From the six plans one was chosen as the best. Its elevations were again examined and again discarded as unworthy of execution, and finally the award was made to this best plan without any elevation, and solely upon the condition that the architect presenting said best plan should design an exterior acceptable to the committee. Such is the importance attached to a plan by those who stand at the head of the architectural profession in this country and in Europe. It is for this reason that in designing a building it is best to confine ourself solely to the plan, with little or no regard for an elevation until a satisfactory plan is obtained. Then design the best elevation the plan will admit of, modifying the plan if desirable, wherever this can be done without injury, but never sacrifice any part of the plan to the elevation. If you can not make your elevation what you wish without injury to the plan, tant pis for the elevation. I do not expect you to agree with me, and I am well aware that some of the most successful architects have at times ruined a building for the sake of a monumental exterior, claiming that they make their reputations on the street view which is seen by thousands, while a few only see the interior. This is not only morally wrong, for it is not their duty to their client who employs them and pays them to produce the building best adapted to his purpose, but it is sometimes fatal to the reputation of the architect. In planning a house for the residence of the parties building, it is not at all sufficient that the architect should pronounce the plan a good one. He must go over it in the most minute details with those who are to live in it, learn their habits, their tastes, and even their whims, all of which must be satisfied. It is sometimes very difficult to separate the well-established wishes, which must be satisfied or cause disappointment, from those ideas which occur at the moment and will disappear as quickly.

"A client does not wish the architect to allow him to have his own way, against the architect's judgment without argument and without protest. If he is wrong, he desires to be shown why he is wrong, and, if possible, convinced that something other than his pet idea is better; but at the same time he insists on being the judge, from whose final decision there is no appeal. It is difficult to decide how far the architect can go on insisting upon what he feels that he knows to be for the best. I once had a serious quarrel with a client for allowing him to have his own way, after I thought I had done all that was becoming in me to prevent it. I have dwelt so long on what I fear you will call the self-evident proposition, 'A good plan is essential to the success of a building,' because experience has taught me that, in general, this is where a young, enthusiastic, talented, artistic architect is most liable to fail, while those who show no ability at designing an elevation or an artistic detail will often produce the best plans.

"The soil under the business portion of Chicago is compressible clay of great depth. The few soundings I have known show about sixty feet. The soil is quite uniform, except that there is an occasional bowlder that cuts no figure, and that there are a few old sloughs whose bottom must be reached or there will be trouble. Experience has shown that the only reliable foundation on this soil consists of independent piers loaded uniformly per square foot of bearing surface; that the building must be tied together in every direction, rigidly, with iron, so that the slightest tendency to settle in any part will cause that part to be sustained by the balance of the building. To this end the tie rods and anchors must be strong, and must be so placed and tightened with screws and nuts, or with turn-buckles, that the slightest movement is transmitted immediately entirely across the building. The common way of bolting beams to lugs on the columns over the brackets is insufficient. There is too much play. A rod hooked onto the beam or between beams by notching the flange, and the other end passing through the column and screwed up tight by a good, large nut, satisfies all the requirements in a simple, inexpensive way. There should be tie rods over every opening, built into the walls, where practicable, across the entire elevation, to tie it all together that there may be no spread. All this tieing and anchoring is quite as essential as the even distribution of the load per square foot of foundation. The latter can never be calculated with more than approximate accuracy, liable at times, by the unexpected use of parts of the building, to be gravely at fault. In calculating the sizes of the columns and the beams, the maximum load must be considered, multiplied by a proper coefficient of safety; but for the foundations the probable load should be used, or the interior columns will settle less than the walls. Experience has taught that foundations calculated to carry three thousand five hundred to four thousand pounds per square foot of bearing on the clay, will settle about five inches, and the grade line of the elevations should be placed that distance above the inside grade of the sidewalk, and the vault covers, or the prismatic glass nearest the building, should be left off until the building has settled.

"There are two methods of constructing the footings, one of masonry, and the other a combination of masonry and iron. First, a bed of concrete, two feet or more thick. On this, in the one case, the dimension or rubble stone, and in the other case, railroad irons or steel I beams. The use of iron underground is new, and has not been tried long enough to give any data as to its durability, a question upon which engineers are not at all agreed. Instances are cited where iron has perished underground in a few years, particularly where the filling has been coal ashes, which is often used for such purposes. There are situations which make the use of iron a necessity. The best soil we have in the business district is the top of the clay, some eleven or twelve feet below sidewalk grade. This, being somewhat exposed to the air, has partially dried and hardened, and is called by comparison 'hard pan.' It is two or three feet thick, and then gradually passes into soft, wet clay, which continues to great depths. Masonry piers under the tall, heavy fireproof buildings will take up most of the cellar. Wherever this cellar can be used to advantage, iron piers must be resorted to. The iron piers should be covered with boiling tar or other protective coating, and then imbedded in rich concrete formed of English Portland cement and fine, clean gravel, to keep the water and air from the metal. Do not paint the iron with red lead, as the lead in contact with the iron in impure water will give some electric action injurious to the iron. If a metal paint is used, it should be ground iron ore and pure raw linseed oil. Steel is preferable to iron, as being less susceptible to oxidation. From our present knowledge, wherever the conditions will admit of masonry piers, they should have the preference.

"There are instances in this city where wooden timber has been used in heavy foundations. This I think dangerous. Timber continually under water will last indefinitely, but subjected to being at times wet and at times dry, it will decay in a few years. Some years since I had a hole dug, for a test, on the lot at the northeast corner of Washington street and Wabash avenue to a depth below the sewers and below the water of the lake. I watched it for some months. At times it was quite dry, and then, although there had been no rain, it would fill with water to the sewers, and then again become dry. I could form no theory for this periodic change in the water level. The fact remained, however, that I could not use timber foundations in that hole. In one instance an artesian well was used to flood timber foundations. So long as they are kept flooded they will endure, but an artesian well may cease to flow, particularly if the water vein is tapped by other wells in the vicinity, so that it is best to avoid timber foundations in Chicago, and, when it is impracticable to use masonry, employ heavy steel I beams, protected by every known means.

"Every new building in the business quarter is now carried to ten stories or more. The condition will sometimes arise where it will be impracticable to disturb the basement of the adjoining building, filled, perhaps, with steam-heating apparatus and electric lighting machinery, so that, to build at all, the addition to the party wall must be entirely on the side of the new building. Although one of the first principles of a good foundation, under ordinary circumstances, is that the center of gravity of the load should be in the center of the footings, in this instance we must find a method to place the footings largely to one side of the center of gravity, and yet prevent the tilting of the foundation. A given force acting in one direction can be counteracted by an equal force acting in the opposite direction, and in case of necessity we can use this principle of elementary mechanics, tieing the party wall to the opposite outer wall similarly constructed. Often intermediate vaults, chimneys, heavy partitions, etc., can be used to assist in holding the wall and counteracting the thrust. Strange as it may seem, there have been attempts made to build walls on our compressible soil, with the center of gravity of the weights considerably to one side of the center of the foundations, without any attempt to counteract the thrust. As a matter of course, the result was a disaster.

"Architects not familiar with Chicago soil have made sad mistakes with their foundations. Mr. Richardson designed the American Express building. Before the front was built to the top story it became necessary to take it down and rebuild the foundations. The foundations for the Government building consisted of a continuous bed of concrete some three feet thick, which was then treated much like a ledge of rock. Unfortunately it did not behave like one. The heaviest piers punched through the concrete, while the light ones remained on top of a large piece, so that the areas of the footings arranged themselves somewhat in the inverse order of the weights thereon. The result is well known. The building settled unequally until about two years ago, when, I am informed by Mr. Bell, late supervising architect, that the test levels show that it had stopped. There was little or no anchoring or tieing, and the building began to spread. I am told, though I do not know on what authority, that the cornice is some ten inches longer than when constructed. The building has recently been tied together by a system of rods, eight in each story, from out to out, four from east to west, and four from north to south, the rods tightened by turn buckles, so that it is probable there will be no further movement. Where the soil is compressible, in putting a heavy building beside one not built in this new way, unless some means are taken to keep the party wall up in place, the adjacent building will be seriously injured. The best method is to put the party wall on jack-screws, and by means of a Y level and a bench mark on some building far enough away not to be disturbed, any settlement of the party wall can be detected and the walls screwed up into place. At times, when the heavy weight is first applied, it will be necessary to take the levels daily, and even twice each day. Later the movement will be much slower, until finally it will cease entirely, and then the screws can be removed.

"Architects are often called upon to raise entire buildings. This requires great care, and is only safe in the hands of experienced men provided with every necessary appliance. The building must be carefully examined, and unless every floor is thoroughly tied together, temporary ties must be put in entirely across the building, from out to out, and in sufficient number to prevent any possibility of spreading. A few weeks since I had occasion to raise one wing of a large brick four-story building. The contractor separated the wing from the building by sawing through the brick wall, after taking out the iron lintels, with a large handsaw, such as is used for cutting of joist, from the cornice down to the jack-screws. I was surprised at the ease with which this was done. The method was decidedly economical. This is one of those very many things which an architect learns from the intelligent contractor, and as we grow older we are more and more astonished at the number of useful things we can learn from the so-called practical men, things not found in the books.

"I once designed four pinnacles at the junction of a square tower and an octagon spire, carefully working out the details, developing the faces of the stone, and showing the intersections. One Monday morning the contractor for the masonry called at my office with the results of his Sunday work. He had made horizontal sections each foot in hight, which he exhibited with some pride, and proposed that I should go with him to the stonecutter's, stating that he felt sure the stonecutter could not understand stereotomy. We went to the stonecutter's yard, and were surprised to find still another method of solving the problem. The stonecutter had carefully constructed a tower, a pinnacle, and the lower part of the spire, all of strings, very much as the celebrated Oliver made his models in descriptive geometry, each surface having strings of a special color, so as to be easily distinguished. With zinc sheets and shears the yard-foreman was cutting patterns and fitting them to the strings. The whole method was so thoroughly practical and accurate, with scarcely a possibility of error, that we complimented his ingenuity, and left him without showing our horizontal sections or the elaborately designed geometrical details. The stonecutter and his foreman had done better than either of us.

"The engineer corps of the army, during the war, was an excellent school in which to learn expedients. The problems, as usually presented, were: To rebuild a bridge burned by the enemy; to construct a pontoon across a wide, rapid stream; to fortify a mile or so of front. Usually only a few hours were allowed for this work. The army furnished any number of men and army wagons, a limited number of tools, and sometimes boats. All material had to be found in the neighborhood. The frame of a cotton-gin furnished excellent bridge timbers; the seats of a church made good floor boards; the chimneys of a few houses served to sink the trestles; and, as if to make them more handy for this purpose, the chimneys of southern houses were usually built outside; cotton-bale rope served for lashings; grapevines made excellent gabions, and the telegraph wires made lashings for fascines of cane. The means were always found and the work was done. Black river, a considerable stream below Vicksburg, the night after the battle of Champion Hills, was bridged in a few hours with cotton bales and the timbers from negro huts, and by morning one entire division of Grant's army had crossed it in safety with artillery and baggage wagons. So expert did Sherman's army become on the Atlanta campaign in building bridges, that a southern paper announced that it was useless to burn any more railroad bridges, for Sherman carried a large supply, all ready made, and from the short delay the blowing up of a railroad tunnel caused him, they suspected that he also carried ready-made tunnels. It is just this same ingenuity in devising expedients that an architect needs to learn. He finds himself called upon in the office and at the buildings to find a good economical method of accomplishing an end. The best school to learn expedients in is at the building, from intelligent contractors and their foremen. This is just what the observing, practical man can teach. It is safe to say that no architect worthy the name ever supervised the designs and superintended the construction of a building of any considerable importance without learning several things that he could make a note of for future use.

"The best school in which to learn the practical details of construction, and the necessity of being clear and explicit in design, is at the building, and architects should give their assistants the opportunity to superintend work upon the designs on which they have been specially employed. The method now in vogue, of employing a general superintendent to take charge of the construction of a considerable number of buildings, is open to serious objections. First, no general superintendent can be as thoroughly familiar with the details as the draughtsman who has had the building particularly in charge. Second, it does not allow the draughtsman the opportunity to learn the thousand practical things so necessary to his complete education. I believe it is far better, for all concerned, to have the superintendence done by the draughtsman who has done the most important work on the designs. Every change in detail in the construction, and every omission immediately catches his eye. Every time he visits the building he is beset with numerous questions. He sees the defects in his designs, and will be more explicit another time, and he learns a thousand practical things that make him of more value in the office and advances his education.

"The best detail drawings I have seen are those of French architects. I do not mean those from students of the Ecole des Beaux arts, who have had little or no practice. Far from it, for that is essentially an art school, of which I once heard an old French engineer remark: 'The students of the Ecole des Beaux arts make beautiful drawings, but the chances are that they are entirely unconstructible.' I refer to details from the offices of French architects in successful practice. Everything is thereon shown or explained by elevations, sections, bits of perspective or by written explanation. These written explanations amount often to a full specification for that special work, far more likely to meet the eye of the mechanic than when written solely in the usual form, all under one cover, which is too often left in the contractor's desk, only to be examined when he sits down to make his bill of extras before the final settlement."

The question of uniformity in building is one which has been discussed in Chicago since the close of the Civil war. There seems to be a demand from both the technical and lay press for a greater uniformity in building, and for more care in the embellishment of our cities by the construction of buildings. A close observation is not needed to prove that the demand rests on a very broad basis. It does not take a generation to make a motley city in which buildings of every description present their ragged, hap-hazard appearance to public view. A few years will suffice to produce a city with the appearance of the joined fragments of every age of building through which the world has gone, and with many styles, that has never had a precedent and will never become one. There is hardly a city in the country to-day that has not been disfigured and its growth checked by the lack of unity of design among its inhabitants. The location of most cities was a matter of chance, and their growth more a matter of surprise than of foresight. Fifty years ago no one anticipated the great increase in the urban population of the country. This is no discredit, for the changes wrought by invention could not have been foreseen.

But while acquitting the fathers of a lack of foresight, it is time that the sons entered upon a broader and more sagacious policy in the management and government of cities. There is no direction in which such a policy is more needed than in beautifying cities and making them attractive to the eye. For two hundred years the severest style of architecture alone was permissible in Philadelphia. Red brick, with white marble trimmings, was considered ornamental enough for the private residence; while the Greek pillar and pediment answered for the public building. But within five years a new impulse has been given to city architecture, and ambitious structures now vary the old styles on all the principal streets. It is not to be supposed, nor is it desirable that such care should be bestowed on buildings in beautifying cities or in obtaining that strictness and severity in uniformity that would produce monotony or weary the eye by lack of variety. Yet there is room for severe criticism for the construction of a large number of buildings, out of place, out of proportion and out of everything else but that part of the city where they should not be.

Thirty years ago the architects counted for very little on the ordinary buildings. Few architects had had a careful training or education at home or abroad. Some were simply builders with a little additional training and aptitude for design. There were many honorable, conspicuous and brilliant exceptions, but it was undoubtedly true in many cases that the architects who could design did not know how to build and those who knew how to build could not design. The past thirty years have greatly altered this. American architects have received an artistic and technical training equal to that of architects anywhere. Their share in the work of a building has greatly increased. Design has become more important, and each year sees it rated at a higher value. In addition, our courts have held architects to a responsibility for poor construction for which the builder has in the past been held accountable. All these changes have tended to alter the position of the architect. It has given him increased importance, greater control, and a more immediate supervision. Nothing can change the necessity for the contractors or for some central authority. No architect can afford to give an edifice the supervision needed while under construction, to add to his labors the control and management of the capital needed in building. At the same time, the tendency is certain to be toward the direct contact of the architect with the group of contractors engaged on a building. This may be through one contractor who takes the entire edifice and sub-lets it; it may be through a clerk-of-works or superintendent paid by the owner, or it may be by some one representing the architect. No one plan will suit all cases; but it is safe to say that all plans in practice will tend to give increasing scope and importance to architects; although architects as a class will find it is to their professional and personal advantage that there are master-builders, with the capital, experience and ability needed in assuming the erection of a great building.

Repose in architecture is another subject of importance. Too much of the architecture of to-day, says an authority, lacks the element which is most conducive to dignity—repose. The buildings are like the people, full of a nervous, restless energy; quaint, picturesque, striking, perhaps, but rarely restful. They are too fond of producing feats of architectural gymnastics, buildings, which cause men to stop, look and wonder, but as seen day after day, men grow tired of them and long for something different. They are astonished and startled by what is seen around, but the work of the architect is too much like the sensational novel of the day turned to stone. On the banks of the Danube, six miles away from the old town of Ratisbon, stands a building, erected by King Louis of Bavaria, to commemorate the illustrious dead of Germany. Built upon a massive granite base, upon which winds a broad staircase, is an exquisite Greek Doric temple of pure white marble. The hillside is covered with forest trees, in the midst of which the granite walls stand out prominently, while the Walhalla itself is seen clear cut against the distant sky. As men gaze upon it, they are almost awe-stricken with its sublime beauty and majesty dominating the landscape with a calm serenity, contrasting strangely with the rushing torrent of the mighty river at the foot of the hill. Few, if any, of the great Gothic cathedrals, with their sky-towering vaults and uplifted spires, can produce the same feeling of sublimity, for none of them exhibit the same majestic repose.

As you walk up Corinthian avenue in Philadelphia and see the exquisite facade of Girard college, one can not help feeling the fascination which its quiet majesty exerts. There is no wonder excited within the minds as to what holds the building up amid the thrust and counter-thrust of innumerable arches, pinnacles and buttresses. There is no startling combination of colors or materials which flash upon and dazzle the sight, as the blare of trumpets deafens the ears. Instead, there are vast columns, carrying the simple downward thrust of the weight above them. Men can see, without puzzling themselves, that the building will stand, because it can not help it. The horizontal lines dominating the composition produce the effect of repose, which gives the vast white marble building its peculiar majesty. People may smile as they choose at a three-story building in the cella of a temple, but can they, when brought face to face with it, truthfully say they can view it without feeling impressed by its majestic beauty?

This element of repose is an essential one in all architectural compositions which make any pretense to being monumental in their character, but is rarely possible in combination with the picturesque. While this latter quality may not be out of place in the cottage or in the village street, it seems to be better suited to out-of-the-way places than to the busy haunts of men. It has no place in the great warehouse, the office building or the business house. These should not be buildings which attract, perchance, by their quaintness, their odd conceits or the elaboration of their detail. Men have no time in this busy work-a-day world to stop in the midst of toil for such things as these. They worry, with their oddities and their strange conceits. They are as much out of place as a novel would be in the counting-house. Business building should have a quiet dignity, a simple, massive grandeur that will not grow tiresome, that will, by the very sight of them, tend to rest men from the worry and turmoil of the struggle for bread. People should study the use of plain wall surfaces, of horizontal moldings, of exquisite perfection of detail, rather than that of ornament, piled on wherever there is space large enough to be carved, or arches of every conceivable shape, or of crow-stepped gables turning themselves toward city streets in such profusion that the skyline resembles more the teeth of some huge demon saw than the roofs of buildings for the use of sober men. Is it not possible for restless American nature to curb its exuberance and learn to appreciate the value of repose in architecture, even though they may never allow themselves any rest in the struggle for the money?

Is architecture an art or a business? This is another question capable of sober discussion. The principles underlying the profession of architecture, or at least the principles made clear in the work of a designer, are those which underlie an art rather than upon which a business is constructed. Indeed, it is difficult to conceive of any portion of the bickerings and dickerings inseparable from business ever entering the ideal life of the architectural designer. He is simply given the amount of money which can be spent upon any piece of work entrusted to his hands, and, with the material at his command, he is expected to make an artistic design. If he follows closely the principles of art, he will bring forth a design adapted to the purpose for which it is to be used, and thoroughly honest in every part. The qualities usually attributed to an artistic design are those which catch the eye by their novelty, but the true mark of the artist is the perfect adaptation of all the component parts of the design to each other, and the perfectness and completeness of the whole. While a good architect must be able to evolve such genuinely artistic plans, he must, perforce, be a thorough business man in order to do it. He must be able to calculate the difference in the cost of a wall when the openings are shaped after the Grecian style of architecture, or when they are designed in the Gothic. Here is the element of success, apparently—that the architect must know the utmost which he can do with the money at his disposal, and then make his plan to conform thereto. It is evident that many architects do not possess this preliminary business qualification, or there would not be so many cases where the actual cost is so much greater than the estimated cost.

On the West Side, there is a house, the side view of which is a continued source of delight to the eye, but the front elevation is a constant disappointment. A glimpse at the plans of the architect has often been desired in order to see what the final completed design would show the front to be, for, although the house has been occupied many months, it is evident that the actual cost overran the architect's estimates so much that the owner could not complete the construction. There are many cases where architects have descended from their own ideas of the requirements of art and yielded to the crude ideas of show possessed by their clients. When this is done, the architect ceases to be an artist and becomes a business man, pandering to the uneducated tastes of his patrons in order to secure their dollars.

There are many features of architectural practice, as it exists in this country to-day, which ally the profession to a business. The system of competitions which is almost universally condemned, yet out of which designs for most of the representative buildings grow, is the chief factor which degrades the profession, or art, into a mere business. So long as an architect is obliged to depend upon income derived from work secured by competing with the designs of others, so long is he a business man and no more. The tendency of all competitions is toward a business basis. The aim of the architect is to supply a little larger building, or a little more ornamentation, for a given sum, than his competing brother. The principle is the same employed by the grocer in disposing of his sugar. The more pounds for a dollar brings the more customers. So with the competing architects. The more design he can show, the more apt is he to secure the award. There is a feature of competition for which the architect is in no way to blame, but which causes the result above described. It is the composition of the awarding committee. Composed of business men usually, the architect must use business methods to secure their favor. They know nothing of pure architecture, and as mince pie pleases the most uneducated palate, so a concoction of Greco-Roman-Gothic is likely to secure more sympathy from a member of a building committee than would a severely classic design.

The remedy for this the architects themselves have discovered. It is to have the committee of award composed of architects eminent in the profession. This plan is fully embodied in the report on competitions made by a committee of the old Western Association of Architects at its St. Louis meeting. If the representatives of public building schemes can be made to adopt the recommendations, the status of public architecture would be greatly improved. The association made an effort to compel the adoption of the system, by binding its members to keep out of competitions not conducted in conformity with the association's plan.

The time was once when an architect was a sculptor, a painter, and an artist in design, as well as a superintendent of construction. There are changes in architectural practice which make it appear as if the profession, having already ceased to be sculptors and painters, would also cease to be artists in design and become mere constructive superintendents. There is ground for this fear in the conduct of the profession toward the different manufacturers of ornamental and useful building materials. In terra cotta, for instance, an architect is served with an elaborate catalogue of artistic designs made by the talented designers in the employment of the manufacturers, and is given to understand that in cases where these designs can not well be used, special designs will be submitted for adoption in accordance with the roughly expressed ideas of the architect. The same is true of ornamental brick work, of which beautiful and useful material, many handsome designs are shown for mantels, chimney tops, window and door caps, etc. The architect is relieved of all study and designing work, if he will but indicate his intention to use terra cotta or brick from any one manufacturer. In case of structural iron work, where a great deal of calculation is necessary to determine the strength of trusses and girders, columns and lintels, the company will gladly submit a complete plan drawn to scale for all the iron work which will be let to them. If the architect allows himself to be relieved of all this troublesome calculation, he will gradually be educated without preparing himself for it, and lose control of that branch of his work also.

This tendency of accepting the work of persons outside his office, but interested in the work, is closely connected with the modern question of consulting specialists. It is obviously unnecessary for an architect to plan the entire details of a large steam-heating plant, or of an electric plant, but where to draw the line between work which he ought to do himself and work which he can safely accept from others, and still retain the ancient and honorable respect for the art, is a puzzling question. If an electrician be consulted on lighting, why not a sanitarian on plumbing? If an engineer be consulted on heating, why not a sculptor on decoration? This gradual stripping off of the functions which used to be inherent in the profession, one by one, like branches from a tree, will leave the architect, like a gaunt trunk, a plain superintendent, with power and authority, but without the embellishment of ideas. Architecture as now being treated is threatened with partial extinction in another manner. Plans for houses, for store fronts, for stables, for churches, and in fact for everything except for special purposes, like a great opera house or a monstrous office building, can be purchased at the book stores for small amounts, with complete sheets of details and specifications. Architects will work hard on a design only to furnish it free to a "Building journal" or "Every man his own architect," or the "American architect's exterminator," where it can be purchased for $1 a volume and used by every one who happens to take a fancy to it, either professional or non-professional. Recognized architectural journals, technical in their character and subscribed to only by members of the profession, are not open to this criticism.

"To what extent is it necessary in design to emphasize the essentially structural elements of a building," was the subject of the third symposium before the Illinois State Association of Architects. It was presented by W. W. Clay, who said, "Perhaps no subject in the discussion of architectual design leads us more thoroughly into a consideration of its moral condition and tendencies, and of its honest rights and privileges, than that to which your attention is especially invited by the symposium of to-day. If I may be permitted to take the bull by the horns immediately, and without a further introduction delve into the heart of the matter by attempting at the very start to solve the riddle, I would answer in a broad and general way, and, as a text, to build an argument upon, perhaps, that it should be demanded of design that the emphasis placed upon the essentially structural elements of a building should be at least a polite acknowledgment of their several and individual existences and candid recognition of their worth and usefulness. This is, either fortunately or unfortunately, too frequently not the case. For, alas! or happily (it is not for me to say), how often has the structural element been called upon to pose as something else, or hide itself entirely, in order that a freak of selfishness may find solution and development.

"It will not be the object of this inital paper to discuss the merits or demerits of any style of treatment, or seek for architectual harmony between the parts, or to define it, or wage a wordy war against veneers of stone or brick or slate, or breathe contempt upon the use of sheet iron, tin or copper; or even open up the question as to whether the designer should confine himself to giving grace of form and beautiful enrichment to structural elements alone; omitting all adornments, all appendages, all extraneous or superfluous conceits that may constitute a useful or component part. This latter may be, and doubtless is, though fraught with difficulty, the truest, noblest, highest form of architectual design; but is not to be considered here except, that if there be design at all, it shall so treat its subjects that they do not seem composed of what they are not, and do not seem to be performing functions which they do not.

"From such thought as I have given to the subject, I am inclined to this opinon: That within the reasonable limits of the question there are at least two principal divisions under which it may be rightfully discussed; to these kindred thoughts suggested by them I will confine myself at present. We may then, perhaps, consider design in building and its relation to the structural elements under these two general heads. First, those considerations which have reference to the material used, as represented by the design. Second, those considerations which have reference to the implied strength and fitness of the construction, as represented by the design.

"I may say here by way of explanation, that I have chosen the above division of the subject because I believe it to have a more important and vital interest than any variation of the ancient dictum, which calls upon us to decorate construction and not construct the decoration; and because I think that if the principle of truth is kept well defined before him the designer needs but little else to guide him, and I trust you will be satisfied if, in what I have to say or have said, I leave it to yourselves to find the limits of design in this connection, by declaring only on what ground it may not stand.

"It has been told to me that the celebrated artist Turner, in reply to certain adverse criticism, once remarked that if it took two suns to produce the light and shade he wanted, he would have them. I presume that with no better cause he would have had a half dozen if the two were insufficient. I may be misinformed regarding persons, but the anecdote adapts itself to what I mean, and illustrates in art what I have chosen (for lack of better phraseology), to call a freak of selfishness, and which in architectural design as considered here consists, first, in a misrepresentation of materials used, and, secondly, in a denial of the true construction. The former is usually, though not invariably, prompted by a desire to produce a given form, detail, or effect, upon a more economic basis; the latter by a determination to retain a given form or detail at any cost, so that for instance, a real support is hidden and the favored form appears to do the work. While it may be undignified and not at all respectful before an audience of those who know too well already, to quote examples, still I am impelled to say, for sake of illustration, that I consider an element of iron cast to imitate wrought work or stone, and an arch without intrinsic strength or lateral support, its load sustained by hidden beams, for instance, as fair examples of the two principles of deceit above alluded to. In the one case we find the real material unrecognized, distorted or misrepresented; in the other, the construction covered up and practically ignored. I have asked for recognition of the structural elements, and I have shown that recognition is not always given them, and would draw the inference that this lack of recognition is not from necessity, but in a great degree, from desire to indulge a fancy; sometimes at lesser, sometimes at greater, cost, but, 'Put money in thy purse.'

"We must admit, however, that this power to evolve the beautiful, this power which has turned primeval 'building' into 'architecture,' this power which has given so much life and soul to man's creations, should have some scope and privilege. But to what extent, and with a hope of what advantage to itself or us, shall it be permitted to conceal the truth or formulate a falsehood?

"It is said, the first impulse of human nature in regard to things of fact, is to declare the truth; and that falsehood is the result of due deliberation, being prompted by a consideration either of the disadvantages which might follow a disclosure or of the benefits which might be derived through misrepresentation. The former incentive to dishonesty, leading as it does, with its inherent selfishness, to a cowardly avoidance of penalties and punishments has little to commend it for consideration, as, however right may have been the deed, its denial robs it of its self respect. But the latter incentive in which may be discovered that problematic principle by which the end is made to justify the means, and which for centuries past has been a firm belief, if not a ruling passion, among the few whose duty it has been to educate the morals of the mass—this incentive, gives a field at least for some discussion, although it may not yield us the conclusion that 'the truth, the whole truth and nothing but the truth' is not as absolutely essential in some other things as it is upon the witness stand.

"And here it would be well, perhaps, for us to pause and briefly trace, if possible, what effect a code of morals such as this may have upon design in architecture. Upon the ground that falsehood in design is to a great degree a freak of selfishness, there is clearly naught but condemnation for the act. But upon the ground that beauty, however false, becomes a public educator in form, in color, in detail, regardless of construction and of material too, so that the form and color and detail are good, so that they come within the modest means of those who may be taught, so that each home is brightened by the teaching; the selfishness is turned to sacrifice, the means seem justified and the artist pushes on—to what? Alas! To what? I fear—to license.

"The story of the ages has been told, the impulsiveness of innocence, the temptations of ignorance, the violence of license, the necessity of law, the threat of punishment, the promise of reward, the doctrine of salvation, the decline of fear, the development of reason, the dethronement of superstition, the establishment of freedom, the inspiration of truth.

"For as we take this search along the pathway of progressive morals we may discern, so near at hand that even now we seem to be within its very precincts, inspired truth; truth on which no longer hangs the mantle of the innocent, which, knowing naught of evil, evil doeth not; truth, which, with a firm belief that error uncorrected or denied, leads on to error without hope, would suffer all, than shield that error by a falsehood—truth, deep seated in the heart of which there dwells the strong conviction that no dissemblance, however rich, may seem its fruit to-day, can ever nurse that fruit to ripeness, can ever hope for pleasure or reward of gratitude in such an offspring. Truth, established by the love of truth, which, arising from amid those struggling efforts of the past finds in itself, and in itself alone, the rich experience, the manly courage, the steadfast purpose, which constitute the only hope, the noblest guidance, the highest leadership."

House building from a surgical point of view was considered in the pages of the *Sanitary News*, about four years ago, by Dr. H. C. Wyman, who said: "I want to describe some of the things found about badly constructed houses which interfere with the health and happiness of the inmates by causing something besides malaria. Everybody talks about malaria, until the word is made to represent so many human ills that it is difficult to assign it any scientific meaning. For one I would like a change, after having heard the varied use of the word for many years, and think it must be possible that other diseases have their origin in faulty dwellings. One case of hip-joint disease, which I think is often caused by bad stairways, represents a larger sum of human suffering in the two to ten years commonly comprised in its course, than twenty cases of the varied and uncertain malady known as malaria. I have wearied of the constant ding dong about sewerage and ventilation, and desire to hear discussion about something besides traps, drains, fans, shafts, flues and closets. When we consider the immense influence which accidents have upon our death rate, we see the need of something to diminish their number. The American Public Health association has endeavored, by means of prize essays, to popularize means for the prevention of accidents in large manufacturing institutions. Rules for the care of injured persons and lectures to employes of railways have told how and what to do for the aid of the wounded before the arrival of a surgeon, but much of the information set forth in that way may be summed up in the answer of the medical student who, when asked during his final examination for the doctor's degree what he would do in case he was called to attend a man with a bleeding artery, said he would run like blazes for a doctor. For these implied reasons I wish first to speak of stairs because they are in many instances the source of accident and serious disease. Often the stairways are too steep, the tread being too narrow and the rise too high, and persons are consequently quite likely to fall. The ideal stair would be represented by a tread double the width of the rise. That is, a tread twelve inches wide would have a rise six inches high. In former years, when ceilings were low, houses not infrequently contained stairways with a tread of twelve inches and a rise of five; but such a step to our unaccustomed feet is not easy and therefore not always safe. Children suffer more frequently than adults from defective stairs. The not uncommon picture is presented of a mother or some guardian member of the family leading a little one of two to five years down a stairway, holding on to the little hand, with the arm extended above the head; the stairway steep, the rise perhaps seven or eight inches and the tread not a whit wider. The little one, with his weight half suspended, suddenly drops upon one hip in such a way as to bring the full weight of the body upon that part. This act being repeated as many times as there are steps in the stairs, gives us one of the surest means of producing the dread calamity known as hip-joint disease. When we think of the extreme frailty of the hip joint in these little ones, how the bones of the hip are not yet firmly united together, we appreciate how necessary it is that the weight of the superimposed structure should be evenly distributed over both hips and all the tissues composing the joints, in order to avoid one part being subjected to more strain than another, and in consequence more likely to become the seat of disease.

"That portion of the tread of a stairway which projects over the rise, and is known as the nosing, often projects too far, so that in ascending, old persons, whose muscular sense has become impaired by age, are very likely to stumble and fall, frequently producing fracture of the hip or other portions of the body. My own experience in accidents resulting from this cause embraces several cases of fracture of the neck of the femur, occurring in persons over sixty years of age, not one of whom has ever been able to use the limb with anything like comfort or facility.

"The light of stairways is often bad. For some reason builders find it convenient oftentimes to put the stairway in the darkest portion of the house, and for the purpose of economizing space, not infrequently stairways that are dark make sharp turns, which are still darker, and which are veritable pitfalls to those ascending or descending who are not, by the experience of several falls, familiar with their location. The turn in such stairways usually embraces a series of steps which are much narrower at one end than at the other, and consequently have a tread varying in width in the same step, so that in the darkness a person unaccustomed to them is certain to make false steps and fall. Innumerable bruises, wounds of the scalp, abrasions of the face, fractures of the jaw, of the leg, of the arm and of the thigh, have in my experience resulted from this cause. The turning point in stairs of the character just described should have ample illumination by a window.

"The rail and newel-post of stairways should always be of sufficient strength to perform the purpose for which they are intended, namely, to provide a grasping place and to sustain the weight of any person ascending or descending the stairway and to serve as a life rope in cases of falls, or stumbles resulting from unpreventable causes. The fact that children and the younger members of the family are sometimes disposed to use the banister as a toboggan slide, and that they often meet with accident by falling to the floor or striking against the newel post, would make it appear advisable to have the stairway rail constructed in such a manner as to make sliding on it impossible.

"The head room in stairways is often insufficient, and tall persons descending such stairways many times receive serious injuries of the head or spine by striking their heads. The writer has known one rather tall lady to get a serious disease of the bones of the neck which will cripple her for life by striking her head while ascending one of these narrow stairs with insufficient head room. The tendency among house builders of the last generation to get as much space as possible between floor and ceiling has led to the erection of steep and unsafe stairways of the kind just mentioned. Oftentimes the length and breadth of rooms is less than the hight, and such a plan necessarily imposes steep stairs, with narrow treads, high rises and low head room.

"No doubt the hight between floor and ceiling is largely for the purpose of increasing the quantity of air contained in the rooms; but we should not lose sight of the fact that in the endeavor to secure plenty of fresh air by this means we may impose upon the inmates of the house greater dangers from accidents upon steep and badly constructed stairways than would naturally result from breathing the air of rooms of lesser hight.

"Stairways that are much frequented by children ought, I think, to be covered with thick pads and carpet, the latter securely fastened with strong nails to prevent its catching or tangling the feet; because children are very apt to stumble and strike upon stairways in such a way as to produce concussion of the spine, which often bruises the cartilages between the bones of the spine, and lays the foundation for most serious disease and deformity. If the force of such falls is broken by striking upon something soft, like the pads just mentioned, dangers of this kind would be greatly diminished.

"These measures to many may seem extreme, but any one who has ever seen a case of Potts' disease of the spine, who has noticed the gradual loss of strength, the constant pain, the sleepless nights, the peevish cry, and who has seen the sharp angular curvature of the spine which follows; the fever and the sweats and the pus from deep-seated abscesses, and who has watched over the little one and helped him to use the crutches, the braces or the casts which the surgeon has devised for the purpose of mitigating the disease and preventing the dreadful curvature and deformity of the spine, can not find fault with any measure, no matter how elaborate or expensive, which gives promise of diminishing any of the accidents which are likely to be followed by this disease.

"The floors of houses are not always as they should be to give the minimum number of accidents. Unevenness of surface provokes falls which require the services of the surgeon to make bodily repairs. Different rooms sometimes have floors of different hights. A very common defect in the ordinary houses of Michigan and the North and West is found in having a difference in the hight of the floors of the kitchen and dining or sittingroom. The L portion of the annex to that part of the house commonly known as the upright, usually contains the kitchen and the rooms in which much of the female labor of the domestic establishment is performed. This very commonly is six or eight inches, sometimes a foot or more lower than the adjacent or upright portion of the house, which in many instances will contain the diningroom and will be constantly visited by the women who are working in the lower portion of the house, making it necessary for them in the ordinary pursuit of their labors to step up and down this place innumerable times every day. It is not necessary for me to speak of the various accidents and injuries which result to women from this cause. They must be apparent to every one who will for a moment think of the amount of muscular effort which is necessary to lift the body innumerable times every day to the hight represented by the step or steps indicated. I know of no reason why this difference in the hight of floors between these two portions of the house should be so common; but if you will take the pains to notice you will find that one-half of the houses being erected to-day in this village will contain the very defect mentioned. Another matter which concerns the floors of houses is that of nailing a board upon them varying in thickness from a half inch to an inch and a half under every door, known as a threshold. This relic of barbarism, which has occasioned more broken heads and noses than all the shillalahs of old Ireland, is happily quite uniformly left out of modern houses; but it is still found often enough to keep the wolf from the surgeon's door and should be torn out without further delay. Its purpose originally, I presume, was to compensate for any imperfection in a nice work of door hanging and door framing, which only skilled carpenters can do. Without the threshold, the door post and the hangings must be perfectly perpendicular, else the door rubs upon the floor and is not easily moved. But there is no excuse for such imperfections in these days of skilled mechanics.

"New floors sometimes contain ragged boards which sliver easily. I have known several accidents of a serious nature to result from this cause. Striking the bare feet against them, they penetrate and wound the foot. Children playing and sliding or creeping, as they often do, upon the floor, have had these splinters of wood driven not only deeply into the skin but even into the joints, like the knee and ankle, setting up most serious disease.

"The windows of houses are a constant menace to the fingers, hands and heads of those persons who find it necessary to raise and lower them. The frequent want of perfect fixing apparatus for holding the sash to prevent its falling has led to many fractures, and in some instances, to amputations of the finger and hands. The weights that are attached to sashes and run inside the frames to serve as a counterpoise should be carefully constructed. Defects here may be very often the source of accident. The person lowering the window, not knowing that the rope is broken, pulls out the stick or lifts the catch with one hand resting on the window sill, and suddenly finds the sash descending like a guillotine, crushing the hand or fingers beneath it. I have known the head to be cut and the deep tissues of the neck seriously bruised by imperfection in the window fixtures. The fastenings by which the windows are secured when closed or held when opened should be maintained in perfect working order, and should be of a kind that rarely ever get out of order. The haste with which people sometimes endeavor to lower or raise a window at the approach of storms, or for other reasons, leads them to grasp these fastenings violently and to exert such an amount of force that when the fastenings do not yield readily the fingers are often badly torn, and felons and abscesses of the tendons and bones of the fingers and hands result.

"The keys, bolts and knobs, the fastenings of doors should be in perfect, easy, working order. A bolt which refuses to slide, or a knob that hesitates to turn, or a key that rubs and chafes in the lock, may cripple and wound the hand that pushes or turns it. Felons are very often caused by defects in these articles. Too much force is put upon the recreant bolt and the soft structures overlying the bones of the finger or hand become injured, bruised or broken. Inflammation and abscess follow, giving rise to a felon or palmer abscess. The former often leaves a finger ruined for life, the latter frequently leaves the hand useless by contracting all its tendons, pulling the fingers in upon the palm and distorting it out of shapeliness and usefulness. Knobs are set too near the door edge, so that in opening the door the fingers are caught and bruised against the door frame. Springs are sometimes put upon doors to make them shut automatically. They are in some cases too strong and drive the doors to with such force that the children and weaker members of the family are unable to hold them. Serious bruises and crushed fingers and toes have been thus caused.

"Gas fixtures on the walls are very commonly projected at a point so low that they are an imminent source of danger to anyone groping his way in the dark. They are usually about five feet from the floor and project eight to twelve inches from the wall, are often surmounted by sharp prongs which hold a globe that is sometimes in fragments, and located at just the right hight to strike the face, eyes, ears and neck, causing dangerous hemorrhages and making frightful scars which sometimes disfigure for life, and have been known to blind.

"The chandelier depending from the center piece is oftentimes so low that the heads of members of the household strike against it. On one occasion the writer had a little patient

J. F. Rees

whose head had been thrust against one of these chandeliers by a fond uncle, whose delight it was to catch up the little one and toss him as high as he could with probable safety. Not noticing that he stood beneath the chandelier, the baby was tossed upward, striking its head against one of the projecting prongs, whose only apparent purpose was to hang jumping jacks and toys upon. A very serious wound of the head was produced. The habit of tossing babies into the air has very little to do with house building, but if the male members of a family can not show their appreciation of the little ones in any other way, architects and builders ought to place the chandeliers high enough to be beyond the reach of disasters of the kind just mentioned.

"Hatchways into cellars should be protected by railings when open. One man let his mother-in-law fall down the cellar stairway and was very properly sentenced for life for attempted murder. The stairs leading to cellars should be carefully guarded. The frequency of accidents in this part of the house makes the need of protection of this kind quite apparent.

"A great many accidents in houses are caused by falling plaster. One of the lost arts seems to be that of making plaster. For some reason the plasterer entrusts the most delicate and essential portion of his art to the least skilled of his kind. The cheapest laborer mixes the plaster, and it is not strange that the proportions of lime and sand—of calcium and silicic acid—are not evenly and properly mixed, to insure a good, firm setting plaster, and in consequence it sometimes falls crushing onto the heads of people, occasioning a large variety of surgical injuries. The hair which should enter into the plaster is sometimes of inferior quality; too short and brittle, diminishing the tenacity of the key which projects through the lath and lops over, holding the plaster securely in position. The quality of lime, of sand, of hair and of labor, are factors which enter into the manufacture of plaster, which if not properly observed and carried out make a poor article, that falls from the walls at the most inopportune moments, occasioning maiming and even death of those who may be beneath it.

"Chimneys, when not built of proper materials, so that the bricks are held firmly together, become a source of danger to people about houses. High winds dislodge any loose bricks which may be about, fracturing the heads of people with whom they come in contact.

"Roofs with loose boards, rafters, tiles, slates or iron railings upon them, should have all these articles removed or securely fastened. The force of winds upon roofs is difficult to calculate and too much pains can not be taken to guard against any of the articles mentioned being blown off and falling upon the heads of people who may be passing. In cities and villages accidents from this cause are numerous.

"It has not been my intention to mention all of the defects which exist in houses, and which are responsible for many of the scars, crooked limbs, distorted spines and sickly bodies of our fellow-men; but to mention a few of the more glaring evils which are most easily remedied."

The line between engineering and architecture is not very clearly defined. Engineering covers a broad field. One, eminent as a professor and writer on this subject, has said that

"Engineering is the art and science by which the mechanical properties of matter are made to serve the ends of man," or, in other words, it is "the useful application of mechanical science to those ends." In the widest sense, almost every one is, more or less, a practical engineer, the man who makes a passage across a torrent, by means of a fallen tree, as well as the one who constructs the most complicated piece of machinery, or rears a lighthouse on the most exposed rock of the ocean.

Little or nothing can be constructed or built without encroaching on the province of the engineer. The objects treated by the science of engineering may be classified under two heads—structures and machines—the former being those "combinations of solid materials whose parts are not intended to have relative motion, and the latter those whose parts are intended to have relative motion and to perform work." A machine may be a structure, but structures are not necessarily machines. In the words of the same writer, "the theory of structures, which is founded on the principles of statics or the science of equilibrium, is divided into two parts, relating, respectively, to the two requisites of stability and strength; stability being the power of resisting forces tending to overthrow the structure or to derange the parts of which it is made, from their proper relative positions; and strength, the power of resisting forces tending to alter the figures of those parts, or to break them in pieces."

It is evident, therefore, that the engineer, to be proficient in his calling, must inform himself on the special properties of the materials employed in constructions, whether earth, stone, brick, timber, iron, or other substance, as well as on the kind of treatment, or workmanship to which such material may be subjected, and the form in which it may be most advantageously used. He must learn, by practical experience, of the action of materials under service, and in all accidental conditions to which they may be exposed, and by this experience he should be enabled to allow for all such conditions, and for variations which may occur in the recognized properties belonging to these materials.

Engineering is an exact science, and its application to any construction involves the principles by which the structure may be built, in the whole, and in each part, according to the best design for accomplishing the uses to which it is to be adapted, and for resisting the forces that must be sustained by it. The more nearly these conditions are fulfilled, the more efficient, durable and economical the structure will be; and also, to the educated or artistic eye, the more beautiful, as the lines and proportions will be the best and truest to satisfy the purposes of the structure.

Engineering may be divided into two grand departments—civil and military. With the latter we need not now be concerned.

Civil engineering, in its most general signification, may be said to involve those applications of mechanics and the arts of construction which treat of the formation and building of lines of transport for freight and passengers, whether by water, highway or railroad; the construction of works for water supply and drainage; the theory and practice of mining; and the formation of harbors and works for protection of the coast, and for aid to navigation. All of these works comprise "combinations of structures and machines;" "structures in earth-works, as cuttings, embankments and reservoirs; in masonry, timber and iron, as bridges, viaducts, aqueducts, tunnels, locks, basins, piers and breakwaters; machines, such as carriages, locomotive and stationary engines, lock gates, sluices and valves, pumping engines and dredging machines." And, in the old days, the civil engineer was expected to undertake all of these objects. In modern times, however, business has so much increased in each department that engineers can afford to devote themselves to particular subjects, and civil engineering is rapidly dividing into specialties.

One of these may be considered as involving "the laying out and constructing of lines of transport, and selecting the sites for works in the best manner possible, with reference to the features of the country, so as to secure economy in execution and working."

Hydraulic engineering takes up the question of water supply and requires study of the laws of rainfall, the supply and flow of streams; sanitary engineering comprises matters of drainage and ventilation; the engineer of coast works must understand the action of waves and tides, the laws of river and ocean currents, the formation of sand-bars, etc.; the mining engineer requires knowledge of sinking shafts, of tunneling, and must be familiar with geology, mineralogy and chemistry; the mechanical engineer must be able to consider all questions of machines, motive power, etc.; the electrical engineer manages all matters in the application of electricity to the uses of man; the bridge engineer constructs bridges, and the building engineer, or, may we not say, the architectural engineer, takes up all questions in relation to the construction and strength of buildings.

Architecture, strictly speaking, is a fine art; as Fergusson expresses it, the "queen of the technic arts;" "the art of ornamental and ornamented construction."

While architecture has its roots in pure utility, it is a question whether, when the first shelters were constructed, it was not engineering ability that accomplished the work, architecture only developing when man began to ornament and to decorate his constructions in order to gratify his inborn craving for beauty and love of proportion. The pure architect begins where the engineer ends. Without the engineer, the architect would give strength to his constructions merely by satisfying his eye and sense of proportion, leaving the rest to chance. So soon as he begins to work up the sizes of the parts for the loads they have to sustain, or to consider the strength of materials and the forces to be resisted, then he becomes an engineer, an architectural engineer.

One may by study and experience become an expert on the subject of architectural engineering, yet never make an architect, lacking talent and artistic taste; but the field of the pure architect is a very limited one. All engineers can not be architects, but all practicing architects must be engineers, more or less, and the more ability one possesses in this line, the more chance for his success in the great constructions of the day. One merges into and becomes an essential part of the other, architecture being all the more beautiful and satisfying, as well as practically correct, when its lines correspond with the lines of engineering construction. "The one is the prose, the other the poetry of the art of building."

The ingenious M. Eiffel and the artistic M. Bartholdi, says an English paper, have been gravely pondering the Colossus of Rhodes—measuring it and weighing it as per description; and they conclude that the thing was simply impossible. It could not have been set up, to begin with, and when set up it could not have stood the pressure of the wind. This is demonstrated by all the rules of modern science, and he who does not admit the demonstration must be prepared to show that two and two do not make four. These antique personages who professed to have seen the Colossus were victims of an ocular delusion or flat story tellers, and that greater number who mention it incidentally, and we might mention the ruins of the Colosseum, were credulous gossips. The fact is that Eiffel and Bartholdi argued in the fashion usual with engineers. Not all of them would pretend that they know any law of nature which applies in such a case. But very few would listen patiently if it were urged that the ancients knew some laws with which they are unacquainted.

So it appears, however, to the disinterested student; and we can bring forward evidence enough. If it be true that the Colossus of Rhodes is really proved impossible, according to the best modern authorities, this is a good illustration to begin with; for its existence is as well authenticated as the temple at Delphi and the statue of Olympian Zeus—or the Tower of London for that matter, to one who has never seen it. By some means it was set up, and by adaptation of some natural laws it was made to stand until an earthquake overthrew it. One is embarrassed by the number and variety of illustrations to the same effect which crowd upon the mind. Since the Colosseum has been mentioned, we may choose examples of that class. Is M. Eiffel prepared to put an awning over Trafalgar square when the sun shines, and remove it promptly, without the aid of a central support, of steam engines, or even chains? The area of the Colosseum is certainly not less. This may seem a trifling matter to the thoughtless, because they have never considered it. Roman engineers covered in that vast expanse with some woolen material, and they worked the ponderous sheet so easily and smoothly that it was drawn and withdrawn as the sky changed. The bulk of it must have weighed hundreds of tons, all depending by ropes from the circumference. But the ancients thought so little of this feat that they have left us only one trivial detail of the method. So Julius Cæsar stretched an awning above the Forum Romanum and great part of the Via Sacra in the space of a single night. Have any of our modern engineers pondered the contemporary descriptions of Alexander's durbar tent before Babylon? That, again, appears to have had no central support. It was upheld, says Phylarchus, by eight pillars of solid gold. Of the glorious plenishing within we have not to speak, since our theme is mechanics. Around the throne and the great courtiers, stood five hundred Macedonian guards; in a circle beyond them five hundred Persian guards; beyond these again one thousand archers. To fix a tent which held two thousand soldiers on duty with arms and accouterments, surrounding, in successive circles, the most gorgeous oriental court that ever was, with hundreds of satraps, councilors, generals, eunuchs and slaves, would perplex a mechanician of the nineteenth century. He will reply that the story is false—must be, because he can not match it. Happily the awning of the Colosseum stands beyond dispute, and Alexander's tent is a small matter compared with that.

But we undertook to deal with the engineering of the ancients in connection with the theater, having chanced on that class of illustration. Pliny tells how Metellus Scaurus, Ædile, built a wondrous edifice, which stirred his rival, C. Curio, to frantic jealousy. It may be worth while, in passing, since we are all so much interested in the theater nowadays and think so much of our new ones, to tell what sort of a building that Curio set himself to outdo. It had three hundred and sixty marble columns, each thirty-eight feet high and thirty-eight feet apart. About three thousand bronze statues stood among them. The stage had three floors, as was usual; the lowest paved and fitted with marble, the second with glass, the third gilded, boards and all. It held eighty thousand people. This account will seem so fabulous to steady-going people that it is prudent to give chapter and verse. The description will be found, with curious details and passionate reflections on the luxury of the day, in Pliny's "Natural history," xxxiii: 24,

Such was the wonder which Curio resolved to beat, and feeling himself unable to vie in outlay, he summoned the engineers of the period to design something to "fetch" the public. They built two enormous theaters of wood, each to contain an audience of twenty-five thousand, which stood back to back. When the spectators assembled in the forenoon, Curio was chaffed, no doubt, on the issue of his attempt to excel Scaurus. But the audience returned in the afternoon, for these entertainments were devoted to the manes of Curio's father and lasted a month. In the place of two theaters back to back, they found an amphitheater holding eighty thousand persons, wherein gladiators and wild beasts contended until dewy eve. The two great buildings had been swung around and united, and day by day, for the month following, this colossal trick was repeated. The perfervid indignation of Pliny could not make him altogether indifferent to the ingenuity of the thing. The fact is, in brief, that those who know what ancient engineers did, with their imperfect means, feel a qualified admiration for the work of the moderns. If Archimedes or Stasicrates had been acquainted with the forces and the laws with which every old woman is familiar in these days, they would have changed the face of the earth and the destinies of mankind.

Architectural acoustics and the theory of harmonic form another important subject. This theory of harmonic proportion is based upon the ratio which intervals in combinations of musical tones bear to each other. This ratio is always expressible by the numbers 1, 2, 3, 4, 5 and 6. Beyond this ratio there is an inability to appreciate musical combinations with agreeableness. Musical instruments are constructed upon two principles: First, to secure vibrations at will which are of sufficient frequency to produce certain tones, and, second, to construct a means of intensifying those vibrations and giving them impulse upon the surrounding air. The Stradivarius violins exhibit the most successful application of scientific acoustic principles to musical instruments. The materials of which these wonderful instruments were made, and the method followed in shaping them, have provided a little sounding chamber which transmits the tones, caused by the vibration of its strings to every portion of the largest room. It has been found out that this old violinmaker simply followed the ratios which are expressed by 1, 2, 3, 4, 5 and 6 in shaping the dimensions of his violin boxes, and that he had provided two parabolic reflectors with a common axis.

Oakey has pointed out that the average speaker is heard at a distance of ninety feet in front, seventy-five feet on each side, thirty feet behind and forty-five feet vertically, and that these are in harmonic proportions. For instance:

90, 30, 45 = 6:2:3,
or:
90, 75, 45 = 6:5:3,
or:
30, 75, 45 = 2:5:3.

These proportions must always be followed to secure correct results. If they seem to give a hall of harmonic proportions, care must be followed not to overlook another important aspect of the acoustic problem. That is, the nature of the opposing walls and the influences they have in repelling or assisting vibrations.

Air, when set in motion, develops that motion in a spheroidal body. This hint gives an indication as to the best possible shape for a public building, but curves can not be employed indiscriminately, or whispering galleries, or worse still, echoing galleries, will result. The same author before quoted, supposes a hall in which the harmonic proportions have been followed. "Then let us suppose that the wall opposite the speaker or orchestra is a very gradual parabola in plan, so gradual that the focus is very near the wall; and let the cornice and wall vertically be half this same parabola, and the result is that there is only one point on the floor near the wall where there is a possibility of a reflection—that is, at the focus, for the end of our hall is formed by the parabola we have chosen, describing half a revolution on its axis." There are other problems which can not be solved, definitely, by the use of any rule of harmonic proportions. These non-measurable factors are connected with requirements of sight for all auditors, and of ventilation. In general, it may be surmised that architects are required first to furnish the maximum seating room, where a direct view of the stage may be had, and that the question of hearing is a secondary consideration. It has come to be pretty well understood by theatrical and church architects that the system of ventilation should be so devised as to use the currents of air to aid in carrying the voice vibrations out from the stage to the audience. That the fresh air should be introduced at, or near the stage, and removed under the galleries, can then be used as a precept in architectural construction. The mass of absorbent material presented by the seated audience in front is an objection necessary to overcome for the benefit of the persons in the rear, hence the gradual rise of the seats in amphitheatrical form is quite as important on account of hearing as it is of sight. This rise should be at least six inches for each row of seats, or nine inches if possible. The respired and rising warm air also acts as a cushion to send the voice vibrations upward. Other difficulties are presented in finishing interiors of public halls. The laws of vibration of musical tones would say so arrange the interior finish that the room will become one vast sounding box. But as this finish requires wood with air chambers behind it, our demand for fireproof buildings, for places of public resort, will not permit it, and it is necessary to restrict architects to reflective hard surfaces where required, and absorbent porous surfaces where angles might cause echoes, both to be fireproof in their character.

A comparison of building systems in Europe and the United States was recently made


Thos. Tully

by William Delaney, an American contractor, traveling in Europe. "In England" he says, "the business of building is much different from that in the United States. The contract is usually let by the architect to one firm of builders, who are responsible for the full completion of the building. The builder employs a competent foreman for each department of the work. The men devote their whole attention to the supervision of their particular part of the work to be done, the employer or architect exercising a general supervision over the whole. While this may have the effect of attaining more satisfactory results in the matter of having every detail of construction and finish attended to by one head and in consequence worked up to the letter of the contract, yet such a system would hardly find a firm foothold with us, as every individual American mechanic has an ambition to become at some time a boss in his particular line. Therefore he begins by taking subcontracts, a dealing which is not very well known in Europe. This European system is really good for the journeyman mechanic, so far as it goes, as he is more constantly employed, and in fact loses very little time, which, of course, to him represents money. In the case of the sub-contracting the journeyman is often idle, because the subcontractor has for the time being run out of work. It often happens in Europe that both skilled and unskilled labor in the building line work for years without losing time, except that caused by bad weather, and in these cases a mason may be employed laying mosaic work and all kinds of inside work, which is done after the building is covered in.

"Bricks in Europe differ very much from those of the United States. In England the bricks are usually $9\frac{1}{4}$x$3\frac{1}{2}$x$4\frac{5}{8}$ inches. These sizes vary some in different localities. There is a very hard brick called a 'blue brick,' $9\frac{1}{8}$x3x$4\frac{1}{2}$ inches. It is mostly used in the arches of railroads, a kind of work that requires a brick nearly as hard as limestone. Most of the bricks are rough in appearance. They cost from $20 to $50 a thousand, according to quality. Some glazed bricks of good quality bring even a higher price. The French brick is about the same in size as the English, averaging about eight courses to twenty-four inches. The Holland brick is much smoother and of a more uniform color than any other I saw in Europe. It measures 2x$4\frac{1}{2}$x9 inches, and has a good, dark red color. The number of bricks supposed to be laid in England by each man varies, as with us, with the class of the work. On rough work one thousand per day is a good average, the work being rather slowly done, but in a very solid and straight manner. In France, Germany, Belgium and Holland, the average is much less. On all fine work, such as fronts and enameled work, pains are taken to keep the bond plumb and straight. In the case of outside work, such as front and rear walls, they are always laid in Flemish bond, although in some parts of England and the continent of Europe I saw heavy buildings laid every second course a header, a style called English bond. I saw also some walls where every course was laid in headers. A brick or stonemason in Europe is expected to do all kinds of work pertaining to his trade, such as setting stone steps and stairs and sometimes laying encaustic and mosaic tiling.

"Outside work is usually put up rough in England and afterward tuck-pointed, except in large buildings, where the joints are struck. The dwelling-houses are not, as a rule, as handsome or convenient as those of the States, but the work both inside and out is always well put up. There is much more work for bricklayers in most of the buildings than in the United States. In England there is a great deal of arching, nearly all large buildings being groin-arched. The heavy, substantial character of the work requires much more time. The buildings, therefore, are often two or three years in course of construction and give more constant employment. Segment arches over window openings are seldom seen. They are nearly always arched with straight or camber arches, sometimes called 'Jack arches.' I have found mortar in old buildings as hard as rock, although the buildings were several centuries old. I picked up some scraps of mortar at Fountain Abbey, in Derbyshire, a ruin seven centuries old, and found it to be as hard as the stone. This style of building, though old, is still copied in modern buildings. The beauty of the workmanship and the elegance of detail are often carried out almost exactly. I have noticed that in all those historical buildings of England and the continent each piece of stone is of a convenient size to handle by hand. All through England the class of brick and stone work is much the same. There is much more of both used in building than with us, and for that reason the men make more time in the year. But as the wages are low compared with the cost of living they have no real advantage from the steadier time.

"In Paris I think the highest perfection of the building trade is attained. The city as a building center is the queen city of the world. Everything is artistic, from the beginning of the building to the last stroke of the painter's brush. Every artisan and mechanic in Paris is an artist. He takes an artist's pride in his work. He has every opportunity to develop his taste for the beautiful in art, for on every side he turns he sees everything done with a view to being artistic and beautiful. For the Frenchman's benefit and education the state maintains museums, art galleries and gardens, which are free to all comers, and the Parisian workman avails himself of these opportunities. As a consequence he becomes the better mechanic, or I might use the word artist, as every mechanic in Paris works with an eye to what would be beautiful and artistic in his industry. The public buildings of Paris both ancient and modern, are beautiful in every detail of exterior and interior finish. The workman is not in a hurry to get the work off his hands. He tries to make his work look good, and he generally succeeds. The leading trade in the building business of Paris is that of stonecutter and carver. Almost all outside work is stone, beautifully carved in almost every place where a piece of ornamental work can be put. The public buildings sometimes take years to complete, as everything inside and outside is made with the intention of being ornamental. Next to the stonecutter in importance is the Parisian plasterer. There is an immense lot of ornamental plastering done, both in private and in public buildings. I was among some of the Parisian masons and worked with them a short time. Their methods of work and tools are much different from ours, and to an American mechanic look crude. For instance, their trowel is similar to an American mortar hoe. Although not so wide, the tang of the trowel is almost exactly the same as the hoe. The trowels of Germany, Holland and Belgium are much the same, and are very awkward to handle. The brick-hod is a flat board with a piece cut out for a man to pass his neck through. While it rests on his shoulders the bricks are placed on each end of the board. The mortar-hod is an oblong trough about two feet long, made to rest on the shoulder, with two handles from one end to steady it while being carried on either shoulder.

"Not alone in public buildings, but in private houses is the skill of the French artisan displayed, even in the minutest detail of exterior and interior finish and decoration. There is a great deal of stone, both rough and cut, used in French buildings. At Paris there is one of the largest pieces of brickwork that I ever saw. It consists of a reservoir for supplying a portion of the city with water. It covers a space of forty thousand yards and is a two-story basin, the first story the same size as the second, and containing two thousand five hundred columns of brick, each twenty-one inches square and about eight feet high. The whole is arched over with groin arches in brick, and again there is the same number of columns, about the same hight, and again arched over in a similar manner for the second floor. Each floor carries about four feet of water, and the whole is covered over with glass. A man goes over both lakes twice each day, in a boat constructed for the purpose, to see that all is secure. The bricklayers in England do not seem to be well organized. They have a union in almost every large city, but all bricklayers are not members. Some men object to organization because there is a system prevailing which allows a man to go from town to town at the expense of the union, and this opportunity is sometimes abused. Others claim they can do as well outside of a union, but the general result is that they are not quite so independent in manner and appearance as the American workman of the same class. I saw no trace of organization anywhere else in Europe, except Paris, where there is a labor bureau where all labor organizations meet. This bureau is established by the Municipal Council of Paris. The hours of labor in England are mostly ten per day, with a half holiday on Saturday, making an average of about fifty-four hours per week. The English mechanic goes to work at six in the morning and takes a half-hour for breakfast at about nine. In France the hours of labor are eleven and twelve a day, and half a day on Saturday, but they do not work as steadily during the day as the English. In Germany, Belgium and Holland the hours of labor are even longer. Sometimes, in Holland, the men work until dark in the summer, but they work very slowly and accomplish little in the day.

"In England men are paid by the hour and receive from fifteen cents in some parts to sixteen cents in London. In Paris the wages are about the same as in London. In Germany the wages average one dollar per day in United States money. In Holland the rate is a trifle less. The wages of stonecutters are about the same as those of bricklayers in most parts of Europe. The terms of apprenticeship are usually about four years in Europe, but this is a question into which I had little chance to enter. In no part of Europe do the men live as well as the American mechanic, nor are they housed and clothed as well. They seldom save any money. They usually dress as a class; that is to say, they can be readily recognized as belonging to certain trades by the manner of their dress. Especially is this so in the building trades. In Paris it is easy to tell the building mechanic, as he wears a long white blouse something like a nightshirt. In Germany they are not as neat in personal appearance and workmanship as the Parisian workman, nor do they by any means come up to the American workman. The English building mechanics do not lose much time during the building season, and indeed very little in the winters, as the winters are usually mild, and when the season is cold there is often inside work for them to do. The European masons do not, as a general rule, have as comfortable homes as the American mechanic of the same grade. They and their children are not as bright looking as the same class in America, nor are their houses furnished as cheerfully. On the whole, there is really nothing in the building business in Europe that can come up to the American methods, except it may be the solidity of construction and the pains that are taken to carry out the idea of the architect, even in the smallest detail."

A paper delivered in 1890 before the National Association of Builders by M. J. Sullivan, entitled "Subcontracting," forms a valuable addition to the literature of the labor problem. "It is almost unnecessary to say that, in consequence of the great development of building within the past decade, or for a longer period, this problem of the just and equitable distribution of the responsibilities, the emoluments, and the honorable recognition by the public, of every master workman, every guiding hand and directing mind engaged in the construction and embellishment of a building, has called forth much diversity of opinion and no small amount of discontent on the part of those to whom this question comes directly home, namely the subcontractors, that large and by far most numerous class of mechanics or craftsmen—call them by what name you will—whose lifelong training must of necessity be intense, peculiar and all-absorbing, and upon whose efforts, in the very nature of things, the success of every building project, great or small, hinges and depends; and it is on behalf of this class of subcontractors that I essay a few words of argument, or rather explanation, with respect to rights which are sometimes unjustly invaded, often thoughtlessly overlooked, and, when so slighted, always to the injury of the purchasing public.

"The practice of awarding extensive building contracts, embodying many and peculiar branches of mechanical and decorative industry, to an individual or a firm, assuming the functions of a general contractor, in other words, the general contract system, as opposed to the separate or independent contract system, which gives to the one, business man or mechanic as he may be, the financial control—and any further control is mere pretense—of the many specially trained and expert subcontractors, while it may command the approbation of the few, appeals, in my humble judgment, mainly to one dominant feeling—avarice—the feeling which prompts the one to absorb the profits of the many, oblivious of, or indifferent to, consequences respecting the just aims and aspirations which must ever guide and control the capable and accomplished artisan, and, deprived of which aims and incentives, he can not arrive at the goal of acknowledged excellence, the master's rank, to which constructive and decorative efforts must ever be directed or fail of the highest achievement. The specific questions implied in the preceding remarks seem to me plain, and answerable only on the part of the subcontractor. I shall state them briefly:

"We expect of the master mechanic, the subcontractor, that he shall be a practical workman, shall have worked at and learned his trade, and that, in his line of mechanical industry he shall be esteemed an expert, a recognized master. Can such a man pursue his calling and obtain such recognition without a just pride in his work, and an equally just hope of ample regard for the mastery and skill he has acquired? Assuredly he can not, else he would be more or less than human. Acquirements, competence, distinction, honor, these are, and should be his impelling motives. Can these motives be subserved, his honest ambition gratified, his incentives to greater effort stimulated if he finds that his efforts, his distinctive personal aims, or personal consequence, are apt to be merged in those of another, or, as I have before intimated, entirely overlooked, and, not infrequently, his just profits partly or wholly absorbed by the spirit of greed which, under the guise of convenience or facility, prompts the system of general contracting? Here it may be urged that I assume too much, as bearing against the subcontractor, that I am, so to speak, begging this question of his just and honorable recognition, which I claim as the grand motive that should actuate every true artsian. I do not think the experience of the large majority of those to whom I address myself, who have figured in the role of subcontractors, could be quoted adversely to my position, and it is a question only to be tested and settled by such experience.

"How often have we received the attentive consideration, even of the owners, during the progress of their buildings, where the general contract system obtains? Do we not know that such cases are merely incidental, and that, even they are as frequently of a discouraging as of a cheering character? Referring now to the pleas of convenience, facility, the capitalizing of building projects, and other kindred pretexts, the ostensible ones which might be and are urged in favor of building on the general contract system. Granting that at times these may be fairly advanced, are they not frequently overestimated? To whom do these considerations become of most consequence? To the owner? Perhaps so, when financial management, credit, or some such underlying motive must influence him, but not always even then, and with a counterpoise in that lack of closer business relation, appreciation, and confident esteem which, on every true principle of economy, should prevail between the owner, who is the actual buyer, and the artisan, the master mechanic, who is the actual producer, the actual seller.

"Again, does the convenience or the facility of the general system come home to the architect? I answer: It would hardly be an argument in its favor if it did, because the architect's first and paramount care should be excellence of work, and my experience with members of that honorable profession is that excellence is the dominant idea, but, the fact is —and close examination will bear out the statement—that the general contract system relieves the careful and conscientious architect not at all, and too often, in the adjustment of differences between the general and subcontractor, occupies many of his overtaxed hours. Let me here state that many, very many, times I have been brought into relation with principal contractors under the general system, and such experience satisfies me that there are and will always be found such men of high character and personal skill, yet here comes in another and I may say my final consideration, which is: That no matter what the character or experience of the general contractor, no matter what special training he may possess, let us not lose sight of the vital question, namely, the vast strides made in the art of building, in this country, even within the past few years, the almost total revolution in the application of building materials and decorative inventions, the advance in masonry, stone, wood, and iron and steel construction, and the complex nature of the many items of the sanitary work, convenience or adornment which go to complete the modern American edifice, and who will deny that these results, astounding in their magnitude and variety, and in the inventive genius displayed, are the fruitful outcome of the labor of the tireless mechanic, the artisan, the inventor, the master of his craft, surely not of the general contractor.

"I say then, with all confidence in your judgment, let us not approve any system of contracting which, however remotely, could tend to relegate that individual merit, that heretofore triumphant energy of the artisan, to obscurity. Let us not divert one ray of light, in all the turmoil of our daily lives, from the individual form of the master mechanic. Rather let us say, with that giant in intellect, that noble friend, teacher and toiler for art, and the artisan, John Ruskin: 'In all buying consider, first, what condition of existence you cause in the producers of what you buy; secondly, whether the sum you have paid is just to the producer; thirdly, to how much clear use, for food, knowledge, or joy, this that you have bought can be put; and fourthly, to whom and in what way it can be most speedily and serviceably distributed; in all dealings, whatsoever, insisting on entire openness and stern fulfillment; and in all doings, on perfection and loveliness of accomplishment.' No great nation without great artisans, great producers, great toilers! To them, as in this splendid passage, will the thoughts of great men ever be directed, and it is for them too, the master mechanics, the artisans, the toilers in this greatest of all human industries, to whose fertile brains and busy hands this great land already owes so much, that I would present my humble plea."

The recent paper on construction and foundation work by Architect H. B. Seeley speaks of the daily progress of thought in Chicago, and particularly of thought directed toward the perfection of great buildings. The *New York Sun*, writing in August, 1891, on the proposed twenty-six story house in that city, acknowledged this fact in the following language: "To Chicago more than to any other city is due the development of the revolution in modern building, in consequence of which there is practically no limit to the hight to which buildings of sufficient foundation area may be carried. Most recent building there has been on the steel framework principle, and outside walls as a support to the structure are there becoming less and less common. In some of Chicago's later buildings the walls and skin, as in Mr. Dinkelberg's proposed building, have been practically outside of calculations for strength. It was not until the success of the all-steel principle was proved in practice in Chicago that New York men took it up to any extent, and even then chiefly in a modified form. The question of foundation might be a grave one had not Chicago made experiments for us. There are few, if any, cities in the country where conditions are worse for the erection of heavy buildings than in Chicago, and what has proved successful there will be more suc-

J Whiting

cessful here, as foundations here are strong. Cellars are dug fifteen or twenty feet into the clay. If the soil below that is unusually yielding it is piled thickly, but piling is often dispensed with. For the solid steel building, a large, solid, flat base is found sufficient. The principle involved is that of the snowshoe. As the weight of a man distributed over the broad surface of his snowshoe can be sustained upon the surface of yielding snow, so can the weight of a giant building, if distributed over a firm and broad foundation, be sustained upon an otherwise insecure surface. So the Chicago engineer builds a great iron snowshoe to fit the size of his cellar. He makes its frame of girders and criss-crosses it with old iron rails. Then he pours cement over the whole thing and puts in more rails. Thus he builds a solid platform, over which the weight of his building distributes itself evenly."

Since the New York editor penned the foregoing testimonial, Chicago has revolutionized ideas on this subject. Architect Seeley's new system has been approved by such authorities as W. L. B. Jenney, and D. Adler already. What the opinion of Frederick Baumann, who is one of the earliest Chicago writers on foundations, may be, is not stated, nor is it possible to present the paper now, as it has only been read before a coterie of architectural talent for special criticism, but not for publication.

The times and manners are testimony to to-morrow. The city grows great in numbers at the expense of the country. It is recruited from the country, and it has been so since the foundation of cities before the Christian era, as the tendency of youth is generally toward the city and away from pastoral life and its happy influences. In the old countries, but more particularly in the United States, this tendency was held in check until the headlight of the locomotive cast its ray from ocean to ocean and from the northern lakes to the Gulf of Mexico. As the iron rails were soldered, so to speak, to trans-Alleghany earth, the movement of the people westward and toward the city was entered upon, so that to-day whole counties in the eastern states, and parishes in the southern states, must look to the West and to the city for the children of their pioneers.

No city in the wide, wide world has benefited, in a greater degree, from this tendency to centralization than Chicago. Marvelous in its advance, it tells the story of the exodus and of the immigration. This movement is now in its infancy. To-morrow the city must be the home of the people. The architect, the builder, the house and lot owner and the servants of the people can not realize this too soon, and their aims should be to provide for this great, this assured future. The city of to-day, with all its enterprise, with all its local grandeur, is only a shadowy substance of Chicago of to-morrow—the dream of the prospector compared with the realism of the silver king who owns the quartz mountain and controls the placers.

CHAPTER XIII.

MANUFACTURERS OF SEWERAGE, BUILDERS' IRON AND LUMBER MATERIALS.

Norman A. Williams is the sole Chicago representative and general western agent of the American Sewer Pipe Company of Akron, Ohio, which organization is composed of five sewerpipe manufacturing companies of that city. He has represented this combination of companies, or portions of it, in Chicago for twenty-two years. During that long period he has furnished large quantities of material to the leading contractors here, and has come to be recognized as the oldest and largest dealer in this line in the United States. He has four yards in this city—at 219 Washington street, at Clark and Forty-fifth streets, at Belmont avenue and Chicago & Eastern Illinois railroad, and at Adams and Rockwell streets. His sales have grown from $50,000 annually, until, during the present year, he handles over $750,000 worth of material, and his business is constantly increasing. He has furnished the vitrified pipe for over ninety per cent. of Chicago's public sewers. He handles the Mt. Savage and several other first-class brands of fire brick, and has placed this material in many of the most important buildings of the city. He has furnished the Pullman Palace Car Company all the bricks they have used, and large supplies have been sent in other directions. He also manufactures and deals in fire clay, flue linings, etc., of which his annual output is about eighteen hundred carloads of different kinds of goods in this line, including the best material manufactured in the country. His trade is one of the most important connected with the building interests of Chicago, but his operations are, of course, not confined to Chicago, but have widened out into the country districts, until they extend over the entire West. Mr. Williams was born in Auburn, N. Y., in July, 1821, a son of James and Dorcas (Austin) Williams, also natives of the Empire state. He was reared and educated and became a builder in his native state, where he operated with considerable success until 1853, when he removed to Cleveland, Ohio. There, as a member of the firm of Southworth & Williams, he was an extensive general contractor and builder until 1868, when he removed to Aurora, Ill. His stay there was brief, however, for in the following year he became a resident of Chicago, embarking in the important and wonderfully successful enterprise sketched above. Mr. Williams is a genial, whole-souled man, with an enviable business record, exceed-

The Goodspeed Publishing Co Chicago

ingly popular in building, commercial and social circles, and is a member of the Illinois club. He was married in 1842 to Miss Parmelia De Puy (now deceased), by whom he has a son, M. D. Williams, general manager of the office affairs of the American Sewer Pipe Company in Akron, Ohio. He was again married in 1872, Lucy G. Merwin, a native of New York, becoming his second wife.

Thomas Rowland has been connected with the building interests of Chicago since 1875, and the contracts for the excavations for the following noted edifices were awarded him: Central music hall; the Academy of Music; the Criterion theater building; the Windsor theater building; Armour's elevator, on Goose Island; Allerton's block, on State and South Water streets; Crilly's building, on North Wells and Eugenie streets, and a large amount of residence work, in the execution of which he has proven himself an expert. As an excavator he has shown himself to be very competent, his methods being sound and practical. He is recognized as capable, experienced and trustworthy, and has a large business from the best trade connected with the building interests, and justly merits his high reputation. He was born in Ireland in 1839, and until he attained manhood's years his life was spent upon a farm in the land of his birth. In 1864 he came to the United States, and upon his arrival in this country almost immediately located in this city, where he soon secured employment as a laborer in a brewing establishment. Contrary to the usual customs of young men, he saved his earnings, and in 1875 was enabled to establish himself in his present calling, which has proved remunerative and reasonably successful. He is a member of the Builders & Traders' exchange. His residence is at 127 Chestnut street.

George Wragg is an excavator of considerable prominence in Chicago, and as a contractor of this business, as well as for grading, sodding, etc., he is considered thoroughly reliable, competent and energetic. As he has devoted his attention to this work for the past fifteen years, it can readily be seen that it is a large and paying one, and that he has been successful and his work highly satisfactory it is only necessary to refer to those who have had the benefit of his services. His residence and place of business is at 416 Fifty-seventh street, and he keeps constantly employed eight teams. He is a native of England, in which country he was born July 3, 1846, his education having been also received in his native land. He became a resident of the United States in 1866, and soon after settled in Chicago, but did not engage in the excavating, grading and sodding business until 1876, at which time he found a ready field for this business in opening subdivisions, and in excavating and filling in the district laid waste by the great fire of 1871. He has done considerable work for many of the prominent men of the city, and as he has made his own way in life, he has the satisfaction of knowing that the property of which he is now the owner has been accumulated by his own earnest endeavors. He is the owner of considerable real estate, and is well off financially. He was married in 1875 to Miss Marietta Clark, who was born in Lake county, Ill. They have seven children: Willie, Mina, Frank, Grace, Maude, Robert and George, Jr. Mr. Wragg is a member of the I. O. of F.

Sebastian Krug has been actively engaged in excavating for buildings of this city for the past thirteen years, and is one of its most successful operators. He is well known among the builders of Chicago. The satisfactory character of his work is shown by the great demand among the builders for his services, and by his extensive business and high reputation. He did the excavating for the south division high-school building, at Twenty-sixth street and Wabash avenue, one of the largest of the local educational structures; also at the corner of State and Pierce streets he did the excavating for the Ogden school building. So great has been the demand for his services that since he has been in Chicago he has done one of the largest excavating businesses in the history of the city, the excavations for the following buildings being done by him: The large theater building at the corner of Eighteenth street and Wabash avenue; the fine parochial school building, at the corner of Fifty-fifth and Wentworth avenue; the large elevator building, on Lumber and Twenty-second streets; the Phœnix & Marshall building, at Fifteenth and Canal streets; and others; a very extensive line of excavating being done for P. D. Armour, on Armour avenue, between Thirty-third and Thirty-fourth streets; an extensive job on Twenty-seventh street and Shields avenue; also on Twenty-third street and Michigan avenue for the large fine hotel about to be constructed there; the hotel building, at Twenty-sixth and Calumet avenue; at One Hundred and Nineteenth street, for the extensive vinegar factory; a whole block between Greenwood and Berkley avenues on Forty-third street, for Dr. Chamberlain; the Erring Woman's Refuge, on Fifty-first street and Indiana avenue; a big job on Congress street and Wabash avenue, for C. H. Walker, the carriage manufacturer; the big Lexington hotel, Twenty-second street and Michigan avenue; the hotel at the southeast corner of Thirty-third street and Cottage Grove avenue; and the extensive excavation at the stock yards for Libby, McNeill & Libby, going fifteen feet below grade, besides many other places thoroughout the city and suburbs. He does a very large business, and employs an average of about one hundred men per day. He is not confined merely to excavating, but has extended his business to embrace a preparation of building stone and sand. His office is at Thirty-first street and Stewart avenue. He is one of the most active, conscientious and reputable excavators of the city. He was born at Hesse Castle, Germany, in 1858, and when five years of age came to America with his parents, who located soon after on a farm near Hammond, Ind., where Sebastian remained until he was eighteen years of age. He then went to Iowa, where he worked for one year in a brick yard, coming in 1878 to Chicago and engaging in teaming. By industry and economy he soon saved enough to engage in the excavating business on a limited scale, and by his own push and energy has built up his own large patronage. He is a self-made man, and has been the architect of his own fortunes. In 1879 he was married to Miss Christina Pieritz, a native of Germany, who was brought to this country at the age of two years. They have two sons and one daughter, and they now have a comfortable and pleasant residence at 2912 Fifth avenue. Mr. Krug is a member of the Builders & Traders' exchange and the Independent Order of Foresters, Court Apollo No. 96 of Chicago.

Daniel H. Flavin is one of the most conscientious excavating, filling and grading contractors here, and has a residence at 5932 State street. He was born in Chicago, May 10, 1845, and was reared on a farm in McHenry county, Ill., but was brought back to this city in the winter of 1854–5, and attended school in the old building at the corner of Polk and Clark streets. In 1866 he began farming in McHenry county, continuing until 1872, when he returned to Chicago, and until 1880 was engaged in contracting, excavating, grading and filling, doing, during this time, a very large business, and becoming well known to the local builders. He did the excavating for some of the most important contractors of the city during that period, and also designed and built the Jockey club race track, Madison and W. Fortieth streets. From 1880 to 1891 he was engaged in farming in McHenry county, but at the latter date he returned to Chicago and resumed his old calling, though he still owns the old homestead of two hundred acres of well improved land in McHenry county. In 1881 he was elected a member of the board of supervisors of McHenry county, representing the town of Hartland, and held this important position from 1881 to 1891, showing in what high esteem his sound judgment and unflinching honesty were held. While in McHenry county he also filled for seven years the position of justice of the peace. He is a strong democrat and an enterprising business man. He was married February 10, 1866, to Miss Margaret E. Quinn, a native of Hartland, Ill., by whom he has six children: Lucinda M., Daniel T., William H., Edwin G., John H. and Laura A.

William Carden, of Carden & Crowley, excavators and general street contractors. The stonecutter's trade is one of the most important branches connected with the building interests, and that Mr. Carden is the master of this art is acknowledged by all competent judges, He learned the trade in the city of Chicago in 1867, serving an apprenticeship with John Egan, and completing his knowledge of the business with Henry Kerber, and being a wide-awake, intelligent and industrious young man, he soon became very skillful in the use of his tools, and was a rapid, yet careful workman. In his boyhood days he worked at popmaking, and in 1865, after coming to Chicago, he followed that business for some time, and did a reasonably profitable business. In 1880 Mr. Carden started in the street improvement business with John Crowley, the firm taking the name of Carden & Crowley, and in this most important business he has continued up to the present time. He is a man who interests himself in every enterprise for the improvement of the city, and of late years he has been especially interested in that most important of industries in any large city—the street improvement, and so assiduously has he devoted his time to this business that he is now in excellent circumstances financially. He is the owner of a good residence at 797 West Taylor street, and also some valuable lots on West Madison street. On the 4th of March, 1891, Mr. Carden returned to this country from the Sandwich Islands where he had spent some time in visiting a brother who resides at Honolulu, the capital of Hawaii. Mr. Carden was born in Waterton, Canada, November 24, 1849, to Patrick Carden and wife, and received a public-school education. He has made his own way in the world and his career may be said to have been a very successful one. He is a democrat in his political views and socially is a member of the

Foresters and the A. O. U. W. He also belongs to the Builders & Traders' exchange. He was married in May, 1877, to Mary A. Dunn, a daughter of John and Mary Dunn of Cincinnati, Ohio, and by her became the father of eight children, four of whom are living: Mary M., John P., William T. and Edwin I.

John Crowley is a member of the firm of Carden & Crowley, excavators and general street contractors, and is a native of Ireland, born June 25, 1847. He was educated in Ireland, and came to Chicago in 1862, where he served an apprenticeship of three years at the stonecutter's trade, in the employ of W. C. Deakman, who died here about five or six years ago. Mr. Crowley, after finishing his apprenticeship, worked for ten years at the stonecutter's trade as a journeyman, but fourteen years ago he took up the street curbing business, as a member of the firm of Carden & Crowley, and for ten years past has been busily engaged in excavating, curbing, etc. Two years ago he added street paving to his other specialties. He is doing a large and lucrative business, is well known to the public men of the city, and his services are often employed in the construction of public works. He paved California avenue, from Twelfth to Twenty-sixth street; Ogden avenue, from Twelfth to California avenue; Twelfth street, from Ashland avenue to Western avenue, besides much other similar work. The durability of his work, and the care with which it is performed, assures him of many jobs in the future from the city government. He is a member of the Builders & Traders' exchange, is a democrat, a member of the Catholic church, and resides at 797 West Taylor street. He was married, in 1871, to Miss B. Carden, who was born in New York state, by whom he has ten children: Mary, Peter, Louisa, Nellie, William, Frank, Jane, Thomas, and Maggie and Julia (twins).

J. A. Sackley is a member of the firm of Sackley & Peterson, excavators and general contractors for street improvement, their office being at 161 La Salle street. The firm was organized in 1886, but since that time it has been reorganized and is now considered one of the leading firms in its line in the city. Mr. Sackley is a native of Chicago, and was born on the west side, June 27, 1859; and as he has resided here all his life, he has taken great interest and pride in the progress and development of the city, and has done all in his power to further its every interest. His father, John Sackley, who was a Canadian by birth, came to Chicago in early life, and here was married and reared his family. For about twenty years he carried on a contracting business, and it may with truth be said that he was a thorough master of his calling and became possessed of a competency. He is now living, retired from the active duties of life in the enjoyment of fairly good health. He was a member of the Builders & Traders' exchange, of which his son, J. A., is also a prominent and worthy member. The latter received his education in the Chicago schools, attending the old Hay school, but his knowledge of his trade was learned under the able instruction of his father, and his life, thus far, has been successfully spent in the contracting business. This firm has had some of the most prominent street improvement contracts in the city, and have at all times endeavored to live up to their obligations and to be prompt, at the same time thorough. Mr. Sackley possesses far more than the average intelligence, and his enterprise and push have become proverbial among those who know him. He possesses those principles which go to make upright, honorable men, and for the success which has attended his efforts he deserves much commendation. Some of the work which he and his partner have conducted to a successful completion is as follows: the Twelfth street viaduct over the Chicago river, the Jackson street viaduct, and numerous other important contracts. Mr. Sackley was married in 1886 to Miss Mary F. Rigney, by whom he has one son, John B. Mr. and Mrs. Sackley are worthy members of the Catholic church.

P. Peterson, a member of the above mentioned well-known firm, is a native of Denmark and possesses in an eminent degree the charcteristics of his countrymen—perseverance, enterprise, energy and honesty. He first saw the light of day in the year 1846, his youth and early manhood being spent in his native land, where he was given the advantages of the public schools and made rapid progress in his studies. He learned his trade in Denmark, at which he served an apprenticeship of four years, but coming to the conclusion that America offered a better field for his labors, he emigrated to this country in 1868, landing in the city of New York. He soon after removed to Oshkosh, Wis., and about two years later went to St. Louis, Mo., where he engaged in business for himself, being one of the leading contractors of that city until 1881, when he came to Chicago. He followed his calling alone here until 1886, when he became associated in business with Mr. Sackley, which partnership has resulted very satisfactorily to both. While alone he did the paving for C. B. Holmes, on Wabash avenue, and also for the cable car line on that street, which was the first granite block paving put down in the city. He is a remarkably skillful workman, and no contract which he undertakes is slighted in the least, his personal supervision being given to every detail. Miss Pauline Brascham, a native of France, became his wife in 1872.

Cornelius Gaffney, of the firm of Gaffney & Long, paving, excavating, grading, filling and cement sidewalk contractors, have their office at room 91, 159 La Salle street. Mr. Gaffney was born in Ireland, March 30, 1847, was educated in Europe, and at the age of eighteen years began learning the paving business in England, and to this calling has since devoted his attention. He came to the United States in 1872, the following ten years being spent at Lowell and Boston, Mass., working at his trade. In 1882 he came to Chicago, and since 1883 has been a pavement contractor of this city. His first work in Chicago was some granite block paving on Dearborn street, between Monroe and Adams streets. He remained alone in the business until April, 1890, when Mr. Long became his partner, and they now rank among the leading granite block pavers in the city. They have had the city contract for laying and repairing the conduit work of the Edison, and a portion of the telephone wires, and last year they did the repairing for about eight miles of conduits. They are now engaged in cement sidewalk contracting, and stand at the head in this line of work. Mr. Gaffney laid the first portion of conduit work (telephone conduit) on Washington street, between Canal and Desplaines streets. He has been a member of the Builders & Traders' exchange since its organization. He was married, in 1872, to Miss Emma Powell, by whom he has five children: Maggie, Mamie, Lizzie, Annie and Matthew. His parents died in Ireland, his father at the age of seventy-one years and his mother when seventy-two years of age. John Long, his partner, is a native of Syracuse, N. Y., where he was born, June 24, 1846, a son of John and Margaret (Barry) Long. He came with his parents to Chicago in 1854, and in this city the parents died, the father in 1860, and the mother in 1876. John Long, in early life was a student of the public schools, notably the Scammon school, of Foster's school and of St. Patrick's Academy, acquiring an education that has been of great practical benefit to him in his business career. In 1863 he began learning the plumber's trade in the employ of J. S. Bassett, and continued with him until 1874. From 1875 to 1879 he was inspector of plumbing for the city, and then for seven years was sergeant-at-arms of the city council. At the expiration of this time he was appointed inspector of pavements and underground conduit work, and since April, 1890, he has been Mr. Gaffney's partner. His business principles are most upright, his knowledge of his business is thorough, and his methods are intelligent and practical, in fact, he is an able and successful business man. He is a member of the National Union, Stephen A. Douglas council No. 66, the A. O. U. W., Star of the West lodge No. 85, and is an earnest member of the Catholic church. He was married in 1871, to Miss Maggie Ryan, who was born in Kane county, Ill. Their children are as follows: Nora, John, Jr.; May, Maggie A., Nellie and James. Mr. Long is a democrat. He resides at 351 South Lincoln street.

Charles M. Netterstrom, a prominent street contractor and builder of this city, has lived here for many years and occupied a leading position among the city's better class of building and business men. In early life his schooling was obtained in Chicago, and while he was yet quite young he began supporting himself by working at the latter trade, receiving pay by the piece. At the age of fourteen years he began learning the cooper's trade and continued thus actively at work until seventeen years of age, when he began lathing and plastering on his own account. At the same time he did considerable mason work and general building. Since 1887 he has been engaged in the general paving business, his first important contract for city paving being three miles of cedar block and two miles of macadam on North Clark street, which job took him five months to complete. For three years he was a member of the firm of Olof Vider & Co., but in the spring of 1891 he withdrew from that firm, since which time he has been in business alone. He is a practical paver of wide experience and high reputation. He is now building for himself a store and flat building at 155 Division street on the site of the old Netterstrom homestead. His residence is at 1535 School street, and is worth $18,000. He has certainly made life a success. He employs from fifty to sixty men and may always be relied upon for an excellent quality of work. From 1881 to 1887 he was a member of the Lake View board of trustees, and as such took an active part in the improvement of that suburb. He was married October 30, 1869, to Miss Anna M. Anderson, a native of Sweden, who was brought to Chicago by her parents when two years of age. They have five children: Emma M., now the wife of Alexander Allender; Minnie C., Walter B., Reuben E. and Arthur M. Mr. Netterstrom is a member of Norman Lodge No. 329, of the K. of P., and the Builders & Traders' exchange since its organization.

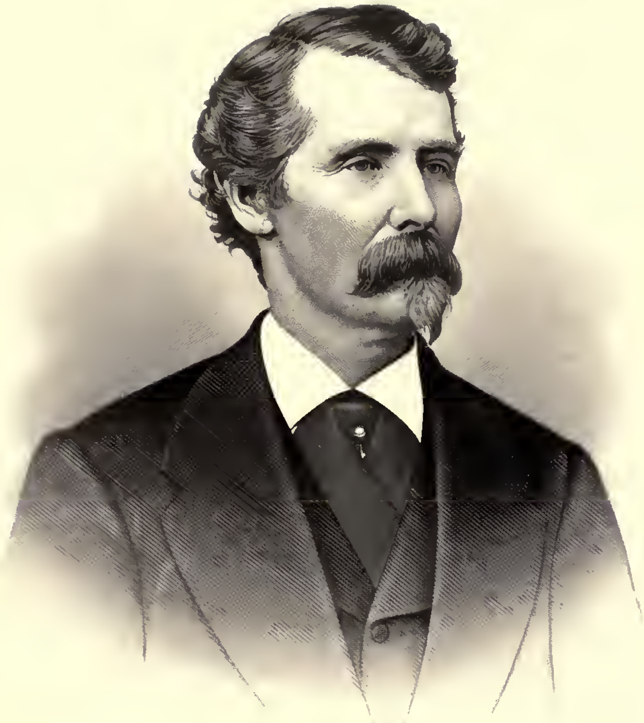
He is a native of Norway, born September 24, 1847, and was brought by his parents to the United States in 1854, coming directly to Chicago, where the family secured a home on the present site of the Chicago & Northwestern passenger station. The father was John C. Netterstrom, a cooper by trade, and an honest, reputable citizen. The mother was Serena Netterstrom, also a native of Norway, who yet resides in Chicago. Of their eight children only four are now living.

Olof Vider, of the firm of Vider & La Bounty, contractors for wood and stone paving, curbwalls, curbstones, and street fillings, have their mill at Elston avenue and the Chicago & Northwestern railroad crossing, their office being at room 19, 80 Dearborn street. Mr. Vider has been in the paving business for the past twenty years, and during that long period has proved himself an honorable, upright, and active man of business, and one who thoroughly understands the details of his calling. He was born in the southern part of Sweden March 17, 1834, and upon coming to this country was engaged in gardening for some time, having previously worked at that trade in the garden of the king of Sweden for one year. He came to Chicago in 1854, and with the exception of two years has been a resident of this city and one of its most honored business men. The present firm was organized in 1891, and gives every promise of future success, for the members are both practical, experienced and reliable business men, and earnestly endeavor to fulfill their contracts to the letter. Mr. Vider has made his own way in life, and the evidences of his skill in his particular line of business may be seen on North Clark street from Division street to Chicago avenue, and on Dearborn street from Adams to Polk streets. He was married in 1862 to Miss Louisa Samson, a native of Sweden, by whom he has four children: Nora, Liva, Hannah and Emma. He resides at the corner of Garfield avenue and Sedgwick street, and is a member of the I. O. O. F., the Foresters, the Knights of Honor, and two Swedish societies. In politics he is a republican. Both his parents died in this city in 1854.

John Cavanaugh, contractor for breakwater, pile driving, Portland cement sidewalks at South Evanston, has been in this business for the past nine years, and is thoroughly experienced and competent. He built the breakwater at Evanston, North Edgewater and Kenilworth, and an immense amount of sidewalk in Evanston, South Evanston, Ravenswood, Waukegan, Kenilworth and others, and is one of the most extensive followers of his calling in the city of Chicago. He came to South Evanston and went into the cement sidewalk business nine years ago. The first sidewalks laid by him did not meet with universal approval, for people doubted the stability of the same, but time has proved that he thoroughly understood his business, and is competent to fill large and important contracts. The Edgewater breakwaters is of Mr. Cavanaugh's own invention, and consists of piling and sheeting sunk about five feet below the water's surface in two rows with sheeting on the inside and fitted with stone, which admirably fulfills its purpose, and proves Mr. Cavanaugh to be a man of original and thoughtful mind, who puts to a practical use the results of his reflection and hours of study.

William H. Launder is a sewerage contractor with office at No. 14 Customhouse place, and makes sewerage ventilation a specialty. He is an old, reliable and well-known house drainer, and many evidences of his skill and knowledge of his calling may be seen in the three great divisions of Chicago, in which city he has worked at his trade for the past thirty-two years. He was born in England in 1830, and in 1848 came to the United States, and in 1855 to Chicago. After learning the trade of brick-mason, he worked at it in Chicago before engaging in the house-drainage business, in which he embarked about 1858, and which he has since continued, with the exception of four years, when he was a resident of Mississippi. Among the many buildings which have been drained by him are McVicker's theater (three times); Mrs. Dexter's residence, on Prairie avenue; Marshall Field's residence, also on Prairie avenue; the buildings for Wheelock & Clay, at the northwest corner of Twenty-sixth street and Michigan avenue; the Saratoga hotel; De Wolf's block, at the corner of Fifty-fifth street and State street; the fine residence of D. Henry Haminer, at the corner of Thirty-seventh street and Grand boulevard; the large flat building at the corner of Fortieth street and Grand boulevard; several houses for Will H. Moore on Grand boulevard; eleven houses on Calumet avenue for George A. Springer; several residences for Barry Bros. on Ellis avenue, Forty-fifth and Forty-sixth streets; a large amount of work for O. F. Aldis, agent for the Brooks estate and for George H. Laflin; the residence of S. W. Lamson on Grand boulevard; that of A. A. Libby, near Thirty-fourth street and Michigan avenue, and the Masonic temple now under construction, besides numerous other buildings, all of which show that he is the thorough master of the sewer business. He is one of the best known sewer-builders of Chicago or the West, and has a handsome residence at 3624 Stanton avenue. Formerly a whig in politics, he is now a republican. He is a member of the A. F. & A. M., Landmark lodge No. 422, Fairview chapter No. 161 and Apollo commandery No. 1. He was married in New York city, in 1855, to Miss Louise E. Heydinger, by whom he has four children: Charles G., Mary L., Hattie J. and Ada May.

William H. Chenoweth, a large manufacturer of artistic architectural iron, was born in Baltimore in 1825, the son of Henry and Louisa (Bell) Chenoweth, of Welsh descent, the family having first come to America in about 1720. His great-grandfather was an officer in the French and Indian war, and his grandfather served with distinction in the Revolution. Two of his uncles served in the War of 1812, and were in the engagement at North Point. William H. Chenoweth spent his youth in Baltimore. At the age of fourteen, his father having died when he was three years old, he was an apprentice for seven years to the blacksmith's trade, but after serving five and one-half years, went, in 1847, to Cincinnati, Ohio, where he accepted a position as superintendent with the firm of Horton & Baker, with whom he remained until 1854, when he came to Chicago, arriving July 10. He began as a superintendent for Letz & Burling, remaining with them until 1857, when he bought an interest in the business, the name becoming Letz & Co., consisting of George F. Letz, W. H. Chenoweth and John M. Johnson. In 1860 he retired from this firm and formed a partnership



W H Chenoweth

with Andrew Bolter, continuing until 1862. In August, of that year, he enlisted as a private in Company K, Fifty-first Illinois regiment, known as the Chicago Legion, and was placed on recruiting service for a time. Later in the year he was, by the order of General Veach, appointed quarterly sergeant of Hurlbut's Light battery, stationed at Memphis, Tenn., and for some time patroled the Mississippi river from Island Thirty-two to Helena, Ark. He was detached in September, 1863, and became a member of Company I, First Illinois battery, and for some time afterward was in the rear of Vicksburg, but later was sent with his battery to Missouri Ridge, where he was taken sick and sent home. June 27, 1864, he joined his command at the battle of Kenesaw Mountain, and during the remainder of his military career passed through all the grades to first lieutenantcy. In September, 1865, he was honorably mustered out of the service, but this was not the extent of his military career. When the war broke out with Mexico, in 1847, he was elected first lieutenant of a company of volunteer riflemen, but before it could be mustered into service peace was declared. Mr. Chenoweth was a charter member of the organization known as the Rover guards of Cincinnati, eighty-six of the original ninety-four members of which served as officers in the Rebellion. He was an early member of the George H. Thomas post, in which he has filled all the offices, having been post commander in 1885. He is a thirty-second degree Mason and one of the oldest Red Men in the world, having been past sachem as early as 1851, and was a charter member of the Miami tribe of Cincinnati. He is also a member of the Loyal Legion. He was one of the first members of the Builders & Traders' exchange, and was a member of the first board of directors and chairman of the finance committee. He was married, in 1853, in Cincinnati, to Miss Sophia Kettler. They have had a family of four sons and four daughters, but one son died in infancy. In his line Mr. Chenoweth is the oldest manufacturer in the city of the period succeeding the war. He early took charge of Letz & Co.'s works, and purchased an interest in the concern in 1870. The great fire of 1871 crippled the firm, but they paid dollar for dollar, though they lost about $75,000. They continued business until 1874, when Mr. Chenoweth became a member of the firm of Gabriel & Chenoweth. About a year later he became sole proprietor of the business thus established, and so continued until the incorporation of the W. H. Chenoweth Company, successors to the Industrial Iron Works Company, with William H. Chenoweth as president and treasurer, and Fred H. Chenoweth as vice president and secretary, with a capital of $30,000. Mr. Chenoweth's office has been at 76 and 78 West Monroe street since 1875. The foundry of this corporation is a complete one, occupying a space of 126x286 feet at Rockwell and Fillmore streets. The work turned out is of the higher class, and in this line the concern has supplied iron work for many of the large office and commercial buildings, as well as for numerous private residences, making a specialty of iron shutters, fencing and window guards, and manufacturing under license from the owners of the patents Meaker's counter-balance doors for elevator shafts, life-guard gates for open elevators, and Andren's fireproof shutters and doors. Among the more important contracts of this company may be mentioned the placing of some of its specialties in the Auditorium building and Marshall Field's wholesale house, all the ornamental ironwork for McVicker's theater (four times, the building having been two times burned), the step rails and platform work for the Insurance building, special work on the Phenix building, and all the fancy artistic iron work in the Traders' building. Fred H. Chenoweth, of this concern, is Mr. Chenoweth's eldest son. He is popularly known as Captain Chenoweth, ranking thus in the First regiment Illinois national guards, of which he has been a member for fifteen consecutive years.

"Frederick Letz, one of the earliest machinists of Chicago, having conducted a machine shop and foundry here for nearly forty years, was born in Pfaffenhoven, Alsace, Lorraine, in 1810. At an early age he was apprenticed to learn the trade of machinist. In 1832 he came to this country and located in Baltimore, where he remained four years, two of which were spent in working as a journeyman, and the remaining two in business on his own account as a member of the firm of Letz & Morgan. In 1836 he came to Chicago, and almost immediately bought a farm in the southern part of Cook county, which he worked until 1843, when he established the Chicago Iron works in a small shop on La Salle between Randolph and Washington streets. In 1847 he built a shop on Fifth avenue, between Randolph and Lake streets, and there he carried on the manufacture of iron work for buildings, such as railings, shutters, iron fronts, etc. In 1855, needing a foreman for his works, he went to Cincinnati in search of one, and there engaged W. H. Chenoweth, who was his foreman until January, 1857, in which year Mr. Letz sold his works to a firm composed of his brother, Jacob Letz, and W. H. Chenoweth. In 1857 Jacob Letz died, and his interest in the business was purchased by J. M. Johnson, and under the firm name of Letz & Co. the works were conducted until 1860. In that year Mr. Chenoweth retired from the firm, and the business was then carried on by Messrs. Letz & Johnson. In 1864 Frederick Letz purchased the works and continued to operate them alone until 1867, when he took his son, George F. Letz, into partnership, and three years afterward sold his interest to Mr. Chenoweth and August Gabriel, the three gentlemen last mentioned continuing the business under the old firm name of Letz & Co., until after the great fire of 1871. After that event Mr. Chenoweth and Mr. Gabriel established what is still known as the Industrial Iron works. Fred Letz, after the sale of the Chicago Iron works in 1870, remained out of business until 1877, when he started a machine shop at No. 476 South Canal street. This he carried on until June, 1882, and then feeling the weight of years coming upon him, he disposed of his plant and retired permanently from active business life. In 1861 Mr. Letz was elected a member of the board of public works, and held that office until 1867." The above is from a biographical sketch of Mr. Letz, published in 1885.* Mr. Letz has since died.

One of the oldest establishments in its special line of manufacture in the city is the Illinois Iron works, A. Bolter & Sons, proprietors, manufacturers of all kinds of building work, Nos. 172 and 174 Van Buren street, which was founded in 1856 by Mr. A. Bolter, who carried on the business on Washington street four years, and afterward secured the present premises. At the time of the great fire in 1871 the works were entirely destroyed, but were

* History of Chicago, Andreas; Vol. II, page 679.

immediately rebuilt and the business prosecuted with greater vigor. The building, a three-story structure, has dimensions of 50x100 feet, and is divided into several departments, including foundry and blacksmith shop. Every facility and convenience is at hand, in tools and machinery and steam power, and from fifteen to twenty-five practical, expert workmen are employed, who are engaged in the manufacture of iron work for buildings, iron stairs, railings, doors, shutters, etc. Particular attention is given to fitting up fireproof buildings and manufacturing iron work for the same to order. Mr. A. Bolter, who established the business, came to this country from Germany in 1852. He is seventy-three years of age, and by trade is a blacksmith and iron worker. His sons, J. C. Bolter and E. A. Bolter, were both born in this city. They were brought up in the business under the tuition of their father, and were admitted to an interest in 1885.

The history of the firm of Schillo, Cossman & Co., 87 to 95 West Polk street, has been intimately connected with the development of the great iron interests of Chicago. Established in 1861 by two of the present members of the firm, and beginning operations in a small and unpretentious way, they have grown with the growth of the city, and to-day in the midst of a life of busy usefulness are well entitled to enjoy the prosperity their unceasing industry has fairly won. They have studied carefully the wants of this market, made promptness and fidelity in the fulfillment of all orders guiding stars, as it were, to their conduct, and it has naturally followed that they now have one of the most extensive and valuable plants in their line in any of the northwestern states. Yet no better compliment could be paid this firm than the mere statement that the bulk of their trade is local, and it rarely occurs that they have to go beyond the metes and bounds of this municipality for orders. They may be said to be exceptions to the rule that prophets are honored everywhere else save in their own country, for here, in Chicago, where they are best known, they are most esteemed for their honorable business character. Employing a large number of men in all departments, running an immense engine, their foundry is two stories high and 100x75 feet large, surrounded by ample yard room and storage space, and thoroughly supplied with all the best modern machinery and improved appliances; and the works are noted for the excellence of their products in large and small, heavy and light castings, especially such as machinery, building and bridge castings. They have an infinite variety of molds and patterns, and are amply able to make all kinds of patterns to order, or to do special work in their line of any description. The encomiums passed upon their products by the patrons of the establishment are extremely flattering, but they are justly entitled to praise, for they have long been operating in such a way as to conduce to the general industrial thrift of the city, and have achieved a high position among those interests for which Chicago is most celebrated. Their annual trade has reached $145,000, while the average amount of manufactured stock on hand, their goods being manufactured to order, is nominal. Mr. P. Schillo, of this firm, is a German, but has been a resident of Chicago for thirty years, and Mr. M. Cossman, also a native of Germany, has lived in Chicago since 1849, both actively engaged in business the whole time. Considering the comparatively limited age of the beautiful Garden city, this firm can well be among its pioneer manufacturers. Their business is closely allied to the great staple manufactures of the city, and conducted upon enterprising and honorable principles is entitled to the just esteem of the community.

One of the great industries of Chicago is the Ætna Iron works of Clark, Raffen & Co., at the corner of Kingsbury and Ohio streets. No house stands higher or more justly deserves the confidence and patronage which crown earnest, honest enterprise. A visit to these works is a lesson in life; the great buildings, 100x200 feet, are busy hives of industrial life; one reads the experience, the ability, the energy of the firm, in the ceaseless whirl of the wheels, and the clank of hammers; ample machinery of the most approved pattern fills every want, and moves as if endowed with reason; all receive momentum from splendid engines of immense power; wide-awake and skilled workmen give life and character to the scene, and their cheerful faces tell of liberal wages and fair employers. These works were originally started by Robert and John Clark and John T. Raffen. John Clark died in 1871. William Currer became a member in 1881. All of them were natives of the canny land "o' cakes," and brought with them the true Scottish thrift and industry. They have been residents of Chicago for more than forty years. They carry a stock of materials amounting to many thousands of dollars, and their business is extended all over the North and Northwest. They also have a large local trade, and their aggregate business exceeds two hundred thousand dollars per annum. Their speciality is in the manufacture of all kinds of iron work for buildings, and they are prepared to do all work with dispatch.

One of the important industrial establishments in Chicago is the Garden City foundry, located at Churchill street and Hoyne avenue. The works were founded in 1885 by Turner & Dickinson, and in June, 1886, were incorporated under the above title, with a capital of $6,000. The premises utilized are divided into departments, each of which is fitted with the necessary machinery and appliances driven by steam power, and in the foundry there is a cupola having a large capacity. A large number of competent workmen are given employment in connection with the business, and a large local trade is carried on. The products of the works comprise all kinds of gray iron castings and manufactured light machinery and patternmaking, particular attention being given to special ordered work, including light building work which is executed in the best manner. The officers of the company are Mr. Paul Dickinson, president, who was born at Cleveland, Ohio, in 1864, and for twelve years has been a resident of Chicago. The vice president and superintendent is Mr. George D. Turner, who is a practical experienced molder. He was born thirty-five years ago in Illinois, and since 1871 has been located in this city.

Francis E. Roberts is a member of the Builders & Traders' exchange, and the successor of the firm of Russell & Roberts, architectural iron work contractors and general founders. His foundry and works are located on Paulina street, south of Blue Island avenue, but he has an office also at 157 La Salle street. He is a general iron founder, but makes a specialty of architectural iron work and cast-iron curbs and covers. His gutter curbs may be seen throughout the entire city and the public parks. He is unquestionably the largest manufacturer of this class of work in the West, and keeps on hand at all times large quantities of his products. His specialty of cast-iron curbs and covers has been made by him for about five years and during the years of 1887–8–91, he had the contracts for finishing the cast-iron curbs and covers of the streets, boulevards and public parks of Chicago. He has the leading trade in his line in the city. He employs about one hundred men, and is doing a vast business. He is full of intelligent enterprise and genuine Chicago spirit and pluck, and has unusual ability as a business man. He is a native of the Green Mountain state, born September 6, 1862, and came to Chicago in 1872. In youth he obtained a common-school education in his native state, and in 1868 began learning the iron molder's trade in Montpelier, Vt., and after reaching Chicago he continued working at his trade until 1876, when he went to Rockford, Ill., and also there worked at his trade until 1881, when he organized the Union Foundry & Machine Company. He was connected with that company until 1883, when he sold his interest and removed to Dubuque, Iowa, where he established a foundry, which was later incorporated under the name of the Roberts & Langworthy Iron works. He remained in Dubuque until 1885, when he again came to Chicago and became a member of the firm of Russell & Roberts; and, when in 1889 Mr. Russell withdrew, Mr. Roberts became sole proprietor and has since carried on the business alone with good success. His father was Andrew J. Roberts, a native of Vermont, born in 1827, and was also a molder by trade as well as a farmer. The father came to Chicago in 1887. The mother was formerly Miss Matilda Bailey, also a native of Vermont, born in 1833, and is now a resident of Chicago. Mr. Roberts was married in 1873 to Miss Lorinda Buffum, a native of Du Page county, Ill., born in 1850. They have three children: Francis E., Jr., Charles H. and Albert E. Mr. Roberts is a Mason.

One of the largest and most important establishments of the kind in the West is the old Globe foundry, 43 to 55 Indiana street. This concern turns out all kinds of heavy and light castings for boiler fronts, buildings, machinery, etc. In the heavy casting line it has no superior, and its trade is very large and extensive. The business was established in 1865, under the firm name of Gardner & Eddy, which was changed in 1869 to R. M. Eddy, and in 1884 to R. M. Eddy's Sons, which firm was succeeded by the R. M. Eddy Foundry Company, an incorporated concern.

The firm of Braumoeller & Mueller are large manufacturers of iron railing, iron doors, shutters, sash and grating, and all kinds of ornamental iron work for buildings. Mr. Henry Braumoeller has been a resident of Chicago for nearly thirty-five years, and Mr. Herman Mueller for about twenty-five years. Their establishment was started in 1871, on a very small scale, but the increase has been very large and rapid. A goodly number of men are kept employed in their works at 92 West Van Buren street, which are supplied with all the necessary machinery, run by steam. Their trade is confined within no special limits. They made the iron work for the residence of Mr. Potter, the president of the North Chicago Rolling Mill, and for numerous other buildings of all classes.

The Snead & Co. Iron works, of Louisville, Ky., is represented in Chicago by C. W. Trowbridge, 415, 205 La Salle street. This company has erected a number of the most prominent iron structures in the city, and receives further mention elsewhere in these pages.

The J. L. Mott Iron Works is one of the oldest and most reputable in the United States. It was first established in New York in 1828, and was incorporated in 1856. Its trade was very expansive, has extended all over the world, and fortunes have been made by the proprietors. The father of the present Mr. Mott, who died about twenty years ago, was the original patentee of the anthracite coal stove, and many other useful inventions appertaining to stoves and heaters, which was primarily the business of the firm. The company has foundries at Mott Haven, N. Y., also at Brooklyn and Peekskill. Jordan L. Mott is president, Jordan L. Mott, Jr., vice president, and John Reid, secretary and treasurer. The company established a branch here in 1884, and deals extensively in fine plumbing specialties, stable fixtures, furnaces and ranges, iron fountains, vases, lamp pillars and high art metal work. The high standing of this house, the excellence of its work have, since 1884, given them one of the largest trades in Chicago. The company has furnished the plumbing supplies for the Auditorium, Tacoma, Rookery and Rialto buildings, Marshall Field & Co.'s wholesale structure, the Masonic Temple, the W. C. T. U. building, and many other of the finest structures of this city. The company annually imports porcelain and earthenware to the value of from $250,000 to $300,000. Their trade is principally throughout the United States, Canada, and in South and Central Americas. Mr. D. A. Mudge, the present gentlemanly and courteous manager, under whose supervision the Chicago branch of the department was established, has become widely known among the local active business men. He is a Philadelphian by birth, and first entered the services of the present company as an office boy, and his careful attention to its interests and conscientious performance of his duty, and the splendid results accomplished by him for his employers, have made his services invaluable to the company. He resides at Evanston and is a member of the Union and Evanston clubs.

Within the past year death has claimed another old settler and one of Chicago's most prominent citizens in the person of Henry Witbeck, president of the Union Planing Mill Company and vice president of the National bank of America. Since 1868 Mr. Witbeck had been one of the most prominent men in the lumber trade of the city. Eight years ago he was elected vice president of the National bank of America. He was a man of sterling integrity and the most rigid ideas of commercial honor. At the age of sixteen he was apprenticed to learn the blacksmith's trade, and in 1843 came to Chicago. In 1845 he established himself in business at the corner of Randolph and Jefferson streets, manufacturing wagons and plows. The business prospered, and, in 1865, he went into the lumber business, the firm name being Cutler, Witbeck & Co. In 1869 the firm became incorporated under the name of the Henry Witbeck Company. Besides his manufacturing and lumber interests, he was largely interested in several barge lines, and at one time was president of the barge company. In 1881 he withdrew from active business, retaining only the presidency of the Union Planing Mill Company and the vice presidency of the National bank of America. During

1871 and 1872 he represented the Twelfth ward in the city council, but could not be induced to allow his name to be put up for reëlection. He continued, however, to take an active interest in politics up to within the last two or three years.

John Spry, president of the John Spry Lumber Company, was born in Cornwall, England, August 13, 1828, and died at his residence in Chicago, February 5, 1891. He came to Chicago at the age of thirteen years and soon found employment in Andrew Smith's lumber yards at the paltry salary of $12 per month. Thus humbly was begun what proved to be a long and in many respects remarkable business career. But it was a day of small things in the Chicago lumber trade which had then seen but little development compared to that of the present time. It was confined to a limited district and had a circumscribed commercial area. In 1855 Mr. Spry acquired a working interest in the business of F. B. Gardner, and retained it until 1866, when he secured a general interest which he held, and finally the firm of Gardner & Spry was formed, H. H. Gardner being the senior partner. The Gardner & Spry Lumber Company succeeded this firm in 1869. In 1885 Mr. Gardner retired from the company, when the John Spry Lumber Company was formed, and has since been a leading concern. Mr. Spry was president, and with him were associated his three sons, John C., S. A. and George E. Spry. The company, one of the largest lumber concerns in the country, owns about twenty million acres of timber land in Michigan, several miles of railway and half a dozen steam and sail lake vessels, and has heavy operations in the Lake Superior region, its annual business averaging more than $1,000,000. Its present officers are John C. Spry, president; S. A. Spry, vice president, and George E. Spry, secretary and treasurer. Mr. Spry was for years prominent in public affairs. He was one of the earliest members of the Board of Trade, was tax collector on the west side in 1849, was a county commissioner in 1888, and in 1890 was a candidate on the republican ticket for drainage commissioner. He was prominent also in Masonic circles and a member of the Illinois and La Salle clubs. His business and commercial standing were high during his entire active career, and he was cut down in the prime of what had been a vigorous life. He was a man of the most unswerving integrity, and was the living embodiment of honor. His disposition was genial and kindly, and it is related of him that if he could not speak well of a man it was his almost invariable rule not to mention him at all. He was strong in his friendship, and cherished the most tender regard for home and family. The yard of the John Spry Lumber Company occupies the dock and street frontage extending along Ashland avenue from the waterworks to Mud lake (south branch), the main water front being on slip A. The length of the premises is about three thousand feet. The piling capacity of the yard is forty million feet. The company handles seventy-five million to eighty million feet of lumber annually. Their lumber is piled and seasoned at their mills, so that when it arrives at the yard it is dry enough for immediate consumption. The company claims to constantly carry the largest stock of dry lumber in the city, and is thus always ready to meet a heavy demand for such material. It also makes a specialty of high-grade stock, claiming that the average value of its entire yard supply is over $20 a thousand. The company has an extended trade, reaching out for customers in all parts of the country. Its tracks are nearly always crowded with loading cars. During the receiving season the dock front of the yard presents a busy scene. The company owns a fleet of barges of large carrying capacity, the manager of the transportation department taking especial delight in reducing the cost of that operation by loading astonishingly heavy cargoes. John Spry, the president of the company, now deceased, had been connected with the lumber business for more than forty years, and had been especially interested in the Chicago wholesale trade. He was a man of large financial resources, and of commanding influence in the community. His sons are active business men, and declare that the Sprys will continue in the lumber trade so long as the pine supply shall last.

A house which is one of the oldest, not in the lumber business alone, but in any branch of industry in the West, is that of C. Mears & Co., which was established in 1838, and lacks but one year of being co-existent with the foundation of Chicago, in the development of whose commerce Mr. Mears has taken a prominent and influential part. For years the house confined itself to lumber largely, in which it also yet deals, with mills at Duck Lake, Lincoln and Mears, Mich. At the same time Mr. Mears was interested in general merchandising and lumber manufacturing. Observing the prevailing tendency in all building operations toward brick, about 1883, the house, being the principal stockholder in the Middlesex Brick & Tile Company, began the manufacture of these staples at Pentwater, Mich., where it owned an unusually fine quality of brickmaking clay, in apparently inexhaustible quantities. Cutting their own lumber and manufacturing brick by the aid of the latest devised machinery, the house was in a position both to fill orders promptly and to quote bottom figures, while they guaranteed both commodities the best obtainable for the money in the city. This concern, now located at 345 Ohio street, gives its attention wholly to the lumber trade.

Nothing in the history of the American commerce has been more extraordinary than the growth of the lumber trade from the smaller traffic, a generation ago, when Chicago was a village, to the present vast and all-pervading trade in hard and soft lumber, of which this great city has become the chief market of the world. John Sheriffs & Son are examples of the thrift of this immense commerce, which stands to-day as the leading interest of Chicago's business. The present firm has handled over fifteen million feet of lumber per annum, and the stock of the firm is never allowed to fall below an investment of four million feet at the yards. The establishment was founded in 1850 by John Sheriffs, the elder member of the present firm, and Mr. Sheppard, who was the senior member. In 1852 the title was Sheppard, Sheriffs & Smith, from which, in 1859, it was changed to Sheriffs & Smith, and to John Sheriffs & Son in 1866. The latter member of the present firm is Walter Sheriffs, son of the founder of the business. He is a young gentleman of intelligence, affable manners and most kindly disposition, while he possesses the Chicago spirit of enterprise in a marked degree, and has the most thorough knowledge of the business in all its details. The elder, Mr. John Sheriffs, has a good financial standing, and the name of John Sheriffs & Son stands high in commercial and financial circles.

The following notice of Addison Ballard, a pioneer, wholesale and retail dealer in lumber, lath, shingles, pickets, etc., with yard and office, 394 Fifth avenue, was published about nine years since: "While our attention is directed to the lumber business of Chicago we do not feel at liberty to evade a cordial recognition of the extensive business of Mr. Addison Ballard, who established himself in 1851, and is in consequence one of the oldest and most thoroughly reliable houses connected with this great, growing interest. Beginning upon a comparatively small scale, the business, during the last thirty-one years, has grown to very extensive proportions, and involves the handling of all kinds of lumber indigenous to this section. Some idea may be gained of the dimensions of the business from the fact that from three to four million feet of lumber is carried in stock, and an annual business of $200,000 is transacted. The yard occupied at the address above indicated, covers an area of eighty thousand square feet, and is admirably arranged in every detail for conducting the business successfully. A force of fifty persons are regularly employed in the several vocations identified with the transactions of this house, which, in its management, manifests unusual system, and a proper care for every detail. The office, two stories in hight, 20x30 feet in dimension, is also located on the premises. The operations of this house embrace both the wholesaling and retailing of lumber, lath, shingles, cedar posts, and all kinds of dressed lumber, flooring, siding, ceiling, shelving, and pickets; rough or dressed, fancy heads, or plain, square or flat. This house is, in many respects, one of the most favorably regarded concerns in the trade; its facilities for procuring supplies are unsurpassed, and dealers, contractors and all others interested, will find it to their interest to cultivate business relations with this establishment." Mr. Ballard is a son of Ohio, but has resided in Chicago for approaching half a century. He is a gentleman of more than ordinary business ability, and by judicious management built up a large and prosperous trade. He has been three times elected as a member of the board of aldermen, filling the position with extreme fidelity, and with entire satisfaction to his constituents. He has retired from active connection with the lumber trade, but is interested in everything concerning it.

William C. Ott has been quite prominent in the lumber trade of Chicago. Mr. Ott, who was born in Maryland fifty years ago, has resided in Chicago since 1857. Thirty-one years ago he established himself in business as a general lumber broker. As a general lumber commission merchant, Mr. Ott handles Georgia pine, car, bridge and building timber, and all kinds of hardwood lumber, by the carload or cargo, and at prices which can not be excelled in the market. Mr. Ott's connection with manufacturers of lumber are of the most satisfactory character, and advantages are conferred on customers equal to those of any other house in the trade. Mr. Ott is a member of the Lumberman's exchange and of the real estate board. With a thorough knowledge of the wants of the trade, gained by so long an experience, and always displaying promptness in the filling of orders, he has built up a prosperous trade, and has won the high esteem of dealers, builders and others who have had commercial dealings with him. His office is at room 913 Tacoma building.

One of the pioneer lumber houses of Chicago was that of A. R. Gray & Co., established in 1860, which had a flourishing career. The grounds occupied by this firm, at the corner of Paulina street and Blue Island avenue, were very large, giving the firm ample room for its immense business. On these grounds was piled a select stock of the choicest lumber, lath, shingles and other materials incidental to a general lumber trade, second to none in the city, and in 1883 of the value of $175,000. This stock was offered at the lowest rates, at wholesale only. In handling this stock the help of ninety men was necessary. Lumber to the value of $500,000 was sold annually to the trade, extending all over the West and South. The business compared favorably with that of any other house in the same line in the city, and grew rapidly, owing to the very aggressive management of the firm. The individual members of the partnership were Messrs. A. R. Gray and E. A. Foster, both of whom were practical lumber merchants, thoroughly familiar with all the details of the trade. Their successful career was the result of ripe experience, wise judgment, untiring energy and unwavering devotion to honesty and duty.

It is an admitted fact that the lumbering interests of the United States form a very important item in the general aggregate of the country's business. The rapid growth and development of the lumber trade in Chicago has been largely brought about through the enterprise and ability of such houses as that of Messrs. Bigelow Bros. This firm has long been an important factor in supplying the great eastern territory with lumber from the pineries of the West. It is one of the oldest and largest establishments engaged in the lumber trade in this city, and one of the best known in the West. The business was founded in 1861 by Messrs. A. A. and C. H. Bigelow, and the name of the firm has always been as at present. In 1875 Mr. Peter Walker became a member, and in 1887 Mr. H. P. Walker was also admitted to the firm. The mills of the firm are at Washburn, Wis., where they employ on an average three hundred and fifty hands in the lumbering business. The lumber is the celebrated pine growth from the shores of Lake Superior, and has no superior in the world for the purposes to which it is applied. This firm handles thirty million feet annually, mostly by cargo lots, and the connections of the house are such that all commissions are promptly filled, all supplies being received direct from the mills and lands owned by the firm, and all kinds of lumber are cut to order at the shortest possible notice. The policy upon which the business is conducted is characterized by liberality and a careful fostering of the interests of all its patrons. The proprietors have gained a reputation in the lumber trade co-extensive with the country, and which places them beyond the requirements of any eulogy at our hands. They are prominent members of the Lumber Exchange of this city, and acknowledged leaders in their important line of enterprise. The members of this firm at this time are Anson A., Charles H. and Nelson P. Bigelow. The office is at 308 Tacoma building.

One of the leading and one of the oldest commission merchants, lumber, shingles, lath, etc., in the city was William Meglade, now retired. Seventy-one years ago he was born in Belfast, Ireland, and in 1848 he came to reside at Chicago. In 1854 he became a lumber inspector in the city, and twenty-nine years since he founded his lumber enterprise. He was a member of the Lumber exchange, and had a neat and well-appointed office at 236 South

Water street. The trade of the house extended to all sections of the country, while a large trade was transacted with local dealers. On commission, Mr. Meglade handled every description of lumber, and also shingles and laths. The specialty of the house was western pine lumber, which was received direct from the mills. Sales were made by the cargo only, in transit or on arrival. The facilities of the house were such that orders were promptly filled with special sizes, dimensions and grades, and bills were sawed to order at lowest market rates.

A successful and representative house in Chicago engaged in the manufacture and sale of heavy timber, railroad material, etc., is that of the Marsh & Bingham Company, whose office was formerly situated at No. 2 Market street. This reliable house was founded twenty-six years ago and the following have been the changes in the style and title of the firm since that date: 1865, George A. Marsh; 1867, Marsh & Goodrich; 1872, George A. Marsh & Co.; 1880, Marsh Bros. & Ransom; 1883, Marsh, Bingham & Ransom. In September, 1883, the business was duly incorporated under the laws of Illinois, with ample capital, the following gentlemen being the officers, viz.: G. A. Marsh, president; A. E. Bingham, treasurer; W. D. Walker, secretary. The mill and yard of the company were formerly at the foot of Illinois street. The officers of the company are now A. E. Bingham, president and treasurer, and Charles A. Marsh, secretary. The mill and yard are at Thirty-seventh and Iron streets; the office is at 502, 169 Jackson street.

That pioneer lumber dealer and worthy citizen of Chicago, Albert Soper, was summoned from his earth-life at the ripe age of seventy-eight years. Mr. Soper was among the older members of the lumber trade in this city, and was familiar with it throughout the period of its rapid development. He became the head of a house whose operations were large and were always conducted in accordance with honorable principles. In this regard he made a record that any man might emulate. His characteristics were urbanity, integrity and straightforward conduct as a business man and citizen—qualities that he has transmitted to the men on whose shoulders the paternal mantle has fallen.

Albert Soper was born in Rome, N. Y., in 1812. He attended common school until sixteen years of age, when he began to learn the carpenter's trade. At the age of twenty-one he embarked in business on his own account. He at length combined the lumber trade with his building enterprises, and thus learned the business in its most practical form that became the pursuit of his after life. In 1850 he built and began the operation of a sash, door and blind factory, and was quite successful in that undertaking. In the financial and commercial depression of 1857 his firm was obliged to make an assignment, but he remained virtually in charge of the business until 1865, when he came to Chicago and entered into partnership with George H. Park, under the firm name of Park & Soper. The firm's yard was at 775 Canal street. Soon after 1880 the firm was changed to Soper Bros. & Co., Mr. Park selling his interest to James and James P. Soper. The business was expanded by the planing mill and box factory plant on Twenty-second street, which have been run in connection with the yard on that thoroughfare for several years. The business was for some time carried on by the Soper & Pond Company, and on the retiring of Mr. Pond the Soper Lumber Company succeeded, that being the present name of the concern. Albert Soper maintained his interest in the house until his death, though for two years he had relinquished any active participation in the business, which has been conducted by his sons, A. C. and James P. Soper. The house has been among the more successful in the city, and as a result Mr. Soper leaves a handsome competence for his surviving family.

John Bagley, treasurer of the Southern Land & Lumber Company, 159 and 161 LaSalle street, is one of the active business men of Chicago. He was born in Quebec in 1852, and in boyhood located in the state of Maine, where he received a common-school education. In 1872 he went to Oconto, Wis., and engaged in the lumber business and later to lake Superior, locating at Hancock, Mich., continuing in the lumber trade. He was engaged also in handling cord wood to the extent of fifty thousand cords per annum from 1882 to 1887. This wood was shipped to the mines of the Lake Superior region. To facilitate this trade, he built eight miles of railway and employed an average of four hundred men, doing a business really of gigantic proportions. During this period of cord-wood cutting he cleared about three thousand acres per annum, stripping it of all its most valuable timber. In 1887 he removed his railway and all his apparatus from Hancock to Menominee, Mich., where he has since followed the lumber business exclusively. Since 1889 he has been the treasurer of the Southern Land & Lumber Company, a position of much responsibility. This company does a general lumber manufacturing business. From May, 1890, to May, 1891, Mr. Bagley, by his own efforts and by means of his railroad, delivered to various lumber companies by contract sixty million feet of lumber. It is difficult to realize the magnitude of these figures but they more clearly than anything else indicate the extensive lumber operations of Mr. Bagley. Unquestionably he is one of the most experienced and widely known lumbermen of the United States. Under his contract of 1886, he was required to furnish at least three hundred and fifty million feet of pine logs to be cut and delivered to several of the companies of this city, and several outside. The lumber taken from the woods by Mr. Bagley has found its way into thousands of buildings of all descriptions in Chicago. Some time ago he acquired an interest in valuable property in the state of Washington, which in March, 1891, he sold at a good profit. While in Michigan Mr. Bagley built the Ingalls, White Rapids & Northern railroad, of which he became president and has continued to be such with several interregnums until the present time. Since 1888 he has resided in Chicago. He is a member of the Builders & Traders' exchange, and in 1877 was made a member of the Masonic order at Calumet, Mich., and later joined Gate of the Temple, chapter No. 30, of Hancock, Mich. He was also a member of Lake Superior commandery, at Marquette, Mich. From this organization he withdrew and became a charter member of Hancock commandery, at Hancock, Mich. He is now a member of St. Bernard commandery, of Chicago, and a member of Covenant lodge and Corinthian chapter of Chicago. He was married in 1874 to Miss M. A. Heaslett, and has two children: Albert W. and Gertrude.

One of the older and more substantial lumber concerns of Chicago is that of T. Wilce & Co. Since 1870 Thomas Wilce has been a prominent figure in the trade of this city. The firm now includes Mr. Wilce, the elder, and his two sons, E. Harvey Wilce and George C. Wilce. The head of the house, though somewhat advanced in years, retains a large degree of bodily vigor, while his mental faculty is as bright and energetic as in his young manhood. Thomas Wilce is a man who is leading a full life, with no intention of laying down its activities and abating its interests while he lives. He purposes to round out a business career to the end, holding that a man is best prepared to die when engaged in the active duties of life. His two sons were bred to business from boyhood, and are never so well content as when wrestling with the cares, competitions and labor of a large and complicated trade. The Wilce plant is situated in the very heart of the Twenty-second street district. The location is on the corner of Throop and Twenty-second streets. The yard extends along Throop street, having a dock front in Gas House slip of eighteen hundred and sixty feet. Tracks connecting with the "Q" system extend the entire length of the yard, affording room for the loading of fifty cars at one time. There is piling space for thirty million feet of lumber. The large planingmill plant occupies nearly all the block bounded by Twenty-second, Twenty-first and Throop streets and Allport avenue. This establishment contains fourteen machines, employed mostly in the manufacture of maple flooring. As a part of the mill outfit there are three dry kilns. T. Wilce & Co. have, in late years, become the most extensive manufacturers of maple flooring in the country. With the view of promoting the sale of such material, they began the boring of their flooring, so that it could be nailed in place without splitting, devising a machine of their own for that purpose. This proved a great success, and the flooring turned out by the firm soon became very popular. For years the maple flooring from the firm of T. Wilce & Co. commanded almost the entire trade of the city and surrounding country; but recently powerful rivals have entered the field. The result, so far as the Wilces are concerned, has been only to spur them to more energetic effort to hold and extend the large trade that they had before. The firm owns and operates three mills in Leelenaw county, Mich. Two are at Empire, and one at Lime lake. The total capacity of these mills is one hundred and twenty thousand feet a day. While maple is a special manufacture, large quantities of basswood, elm, birch, ash and oak are cut. The steam barge, Hattie B. Perue, is owned by the firm, and during the season of navigation brings in hardwood lumber from the mills. T. Wilce & Co. are dealers in both pine and hardwoods, but devote special attention to the last named. At a late date twelve million feet of hardwood alone was piled in the yard, the larger portion being maple strips for flooring. A complete line of oak, ash and other hardwoods is also carried in stock. It is the intention of the firm to hereafter go extensively into the manufacture of oak flooring. Lumber to the amount of four million feet for this purpose has already been contracted for in the Northwest. The yearly business amounts to the handling of about fifty million feet of lumber. Since so much hardwood is included, it represents considerably more value than if the entire stock were pine. The house is backed by ample capital, as all who are familiar with the Chicago lumber business well know. It is one of the comparatively few concerns that is in the business to stay for many years, despite the mutations that inevitably come with the lapse of time. When changes arise that make it necessary to adopt new methods in order to meet the exigencies of trade, T. Wilce & Co. are always equal to the occasion, having the means to stand the expense and the will to continue business in spite of all discouragement. As an evidence of the firm's enterprise, it may be stated that it lately contracted to make and ship to London, England, one million feet of maple flooring, to be used there in the construction of skating rinks.

The rapid growth of Chicago abundantly demonstrates the wisdom of those who early entered the lumber trade, the rise of which, with but a few brief intervals, has been rapid and permanent. In 1870, seeing the advantage of the opening afforded in the lumber trade to energy and perseverance, Mr. John H. Wallace, who for the five years prior had been identified with the dry goods trade at Decatur, Mich., established himself in the lumber trade in Chicago and obtained a constantly increasing patronage, his annual sales exceeding ten million feet in 1887. The yards are provided with every facility and appliance for the economical shipping and handling of lumber. Though pine is largely dealt in, hardwood lumber is the speciality in which the trade can at all times depend on being supplied with promptness and dispatch at the lowest market rates by this concern, which is now known as the John H. Wallace Hardwood Lumber Company, of which John H. Wallace is president and G. C. Wallace secretary and treasurer. The office is at 242 South Water street.

Chicago's splendid geographical position, railroad facilities and other advantages have conduced to the concentration in her midst of the Western lumber trade. A representative and progressive house in the great western metropolis engaged in this important enterprise is that of the widely-known S. K. Martin Lumber Company, whose office, yard and planing-mill are located at the corner of Blue Island avenue and South Lincoln street. This business was established in 1870 by Mr. S. K. Martin, who conducted it till 1884, when it was duly incorporated under the laws of Illinois with a capital stock of $600,000. The following gentlemen, who have had great experience in the trade and are highly esteemed in financial and commercial circles for their business capacity, integrity and energy are the officers, viz: S. K. Martin, president; E. B. Martin, vice president; Edward Hines, secretary and treasurer. The yards are spacious, and have a dock frontage of two thousand two hundred feet, enabling a number of vessels to discharge their cargoes at the same time, while there is track accommodation with the Chicago, Burlington & Quincy railroad. The premises afford ample space for handling and piling and always contain about twenty-two million feet of choice lumber, specially adapted to the wants of the trade and manufacturers. During the year 1886 the S. K. Martin Lumber Company sold sixty million feet of lumber in addition to one hundred and thirteen million shingles, etc. The company makes a specialty of dealing in dry lumber, kiln-dried shingles, lath, sash, doors, blinds, etc., which are offered to customers in cargo or carload lots at the lowest ruling market prices. This responsible and enterprising company has more than fifty branch yards in Illinois, Iowa, Kansas, Nebraska, Missouri, Texas, Michigan, Wisconsin, etc. Four hundred operatives are employed by the company in its planingmill, yards, etc., and its trade extends throughout all sections of the United States.

The company has several large dry kilns in its yards, so that it is enabled to ship the choicest seasoned lumber and shingles, saving freight and insuring the greatest satisfaction to the trade, and are active members of the Lumberman's exchange and of the National association of lumber dealers. Mr. Martin, the president, is a native of New York, and has been a resident of Chicago for the last thirty years. He is a member of the Calumet club, a stockholder of the Union National bank and in every way a progressive citizen. Mr. Hines, the treasurer, is a native of New York.

Among the most prominent and reliable houses engaged in manufacturing lumber, is that of the representative firm of Messrs. Pardee, Cook & Co. The mills of the firm are located at Ludington, Mich. This business was established in 1870 by the present copartners, Messrs. Ario Pardee and John R. Cook, in Michigan. In 1875 the Chicago branch was opened. Both partners brought great practical experience to bear upon their operations, coupled with an intimate knowledge of every detail of the lumber trade, and the requirements of customers. At the mills, which are among the best equipped and managed in the country, three hundred workmen are employed, who turn out annually twenty million feet of lumber. Bills are cut to order, and the resources and facilities of this responsible house are such that the largest commissions are promptly filled. This firm handles only the best grades of lumber, and its patronage is derived from the best classes of the eastern trade as well as from jobbers and large buyers in the West and Northwest. Messrs. Pardee and Cook were both born in Pennsylvania, in which state (at Hazleton) Mr. Pardee is carrying on an extensive coal mining, iron and lumber business. Both partners are highly regarded in commercial circles for their sound business principles, enterprise and integrity. The office of the company is at 523 Chamber of Commerce building.

The late Thomas S. Ruddock was a native of New York, having been born, and having passed his childhood and youth at or in the vicinity of Glens Falls, in that state. As a boy he spent his time as a farm hand and a canal boatman. His career was begun with no means but his hands, a good constitution and a brave heart. In early manhood he married the sister of James Palmeter, and became identified with that gentleman in a series of enterprises that extended through many years. The two men removed to Berlin, Wis., and remained there for some time. He ran trading steamboats on Wolf river for several years, and passed through some strange vicissitudes in that business. One of his boats was destroyed by a boiler explosion, and Mr. Ruddock, who was in command, thus came near losing his life. In another instance a partner swindled him out of his share in the ownership of the boat. In process of time Ruddock and Palmeter became owners of considerable pine land in the vicinity of Winneconne, and got a start in the lumber business by buying and selling such property. Our data is meager as to their career at this period, but eventually they turned their attention to the pine interest on Manistee river, Mich. As a beginning on that stream, they possessed themselves of a small mill, and then negotiated for pine lands. A gentleman by the name of Gifford owned a considerable area of such property, and he was induced to put in his lands against the mill and a yard in this city. A firm was thus formed under the style of Gifford, Ruddock & Co. E. B. Leonard and D. J. Nuttall became members of the firm, Mr. Nuttall superintending the mill at Manistee, and Mr. Palmeter holding the helm in this city. The yard for years was on Laflin street south of Twenty-second street. Eventually Mr. Palmeter sold his interest, and Mr. Gifford also disposed of his lands to the concern, when the firm became Ruddock, Nuttall & Co. About 1884 the yard in this city passed into the hands of Ruddock Brothers & Co., composed of the sons of the elder Ruddock, Charles H. and Fred S., Henry Meyerding and H. A. Gerhardt also becoming partners. Ruddock & Palmeter at one time owned extensive and profitable cranberry marshes in Wisconsin, and it is said made in that way much of the money with which they bought pine lands in Michigan. The Ruddock pine land and mill interests at Manistee prospered all through the seventies and into the eighties, until the house became strong and wealthy. Thomas S. Ruddock does not seem to have been much identified with the details of the firm's operations either in Michigan or here, but he managed his affairs so as to maintain his foothold and amass so much wealth as to be reputed a millionaire. He resided on Ashland avenue, in this city, and was a devoted husband and father, surrounding his home with all that could make life pleasant. He seems never to have coveted public or social display, or such distinction as many seek to secure by means of wealth.

A prominent and prosperous firm in the lumber trade was that of Messrs. Babcock & Wheeler. This business was established in 1866 by W. S. Babcock, Martin & Co.; in 1871 they were succeeded by W. S. Babcock & Bro.; in 1880 Babcock & Park became proprietors, who conducted the business till 1885, when Mr. S. P. Wheeler was admitted, and the firm became known by the style and title of Babcock & Wheeler. The yard had a dock frontage of two hundred and fifty feet, while there was track accommodation with the Chicago & Alton railroad. The yard always contained millions of feet of the choicest lumber, specially adapted to the requirements of contractors, builders and dealers. The sources whence this responsible firm drew this extensive supply of lumber were the finest pine lands of Wisconsin, Michigan and Canada, and their sales average fifteen million feet of lumber annually, besides large quantities of shingles, lath, sash, doors and blinds. The trade of the house extended throughout the middle, western and northwestern states. Messrs. Babcock & Wheeler were both natives of New York, but he resided in Chicago for more than twenty years. During the Civil war Mr. Babcock became colonel of the Twelfth Colored United States heavy artillery, and was present at all the battles engaged in by the Army of the Cumberland. He was noted for his courage and devotion to the cause of the Union, and after the capture of Richmond embarked in the lumber trade. Mr. Wheeler for many years ran stages throughout all sections of the West from Canada to Mexico, and Illinois to the Pacific. Since 1851 he was long proprietor of the Telegraph Stage Company of California, and superintendent and proprietor of the Kansas & Nebraska Stage Company. Mr. Babcock was an active member of the Lumbermen's exchange.

In relation to the Chicago lumber trade, the South Branch Lumber Company has a pedigree that dates far back in its history. It is sufficient to say that it is an outgrowth of

DRAWING FURNISHED BY BURKE & CO.

PAVEMENT FOUND AT POMPEII.

the Beidler interest, which was developed in the sawmill and pine land business of western Michigan, and at length came to be one of wealth, reaching into the millions. The president of the South Branch, as it is familiarly termed, is Jacob Beidler, a man of undoubtedly large pecuniary resources; Francis Beidler, his son, is secretary, and B. F. Ferguson is treasurer; the two younger men are the actual conductors of the business. Two busier and more untiring men are not engaged in the lumber trade in Chicago. Mr. Beidler attends to the yard and sales department, while Mr. Ferguson ships and places in stock more than one hundred million feet of lumber annually. The South Branch began business in 1875, at the corner of Loomis and Twenty-second streets. It also had a yard at its present location on Fisk street. Subsequently the entire business was concentrated on the last-named thoroughfare. It is to be observed in this connection that at one time in the seventies the following named firms had yards on that street: Avery, Murphy & Co., Lowell & Barker, Wheelock, Fauntleroy & Co., R. S. Whitcomb & Co., Dean Brothers, Loomis & Davis, and B. L. Anderson & Co. Now the South Branch occupies the entire street and dock front between Twenty-second street and the river, except that which is held by the H. Witbeck Company. This shows how the large concerns have endured and spread out, while the number of strictly wholesale yards has diminished. The latest acquistion of territory made by the South Branch was the Street, Chatfield & Keep yard, that having been purchased in February, 1890. The dock frontage of the company is about three thousand five hundred feet, lying on Allen and Mason slips. Fisk street passes between, on which are tracks running the length of the yard, and affording room for sixty to seventy-five cars. The yard's piling capacity is about forty million feet. The Chicago yard handles seventy to seventy-five million feet a year. The South Branch is noted for its large business in clears and selects, it having a heavy trade with the sash and door factories in this city and throughout the country. It also carries a general stock for the distributive trade. The yard is probably supplied with a larger miscellaneous product than any other in the city. Its line of specials, rough and manufactured, is extensive. Among these are all kinds of shingles, including California redwood, cypress, Oregon cedar and white cedar. A large stock of dimension and fancy butt shingles is carried. Anything turned out by a planingmill or sash, door and blind factory can be had of the South Branch. Particular attention is paid to pattern lumber, panel stock, car builders' material, etc. Extras are shaped up to suit the trade, and are always ready to ship on short notice. The policy of the South Branch is to expand its resources so as to meet any enlargement or change of demand. In this it is decidedly a progressive institution. For the same reason the company is embarking in the cypress trade. It has a large interest in the Santee Lumber Company, with lands and manufacturing plant in South Carolina. The purpose is to put an ample stock of cypress in the yard here and develop a large trade in that wood. A supply of California redwood is also kept on sale. In fact, whatever kind of lumber is in demand or is likely to be in demand is freely taken hold of by the South Branch Lumber Company. The yard at Tonawanda, N. Y., was established three years ago with a view to better supplying a large local trade. Its capacity is forty million feet annually. The company in a single year handles at its Chicago yard about one hundred and fifteen million feet of lumber, an amount which can be comprehended only by a vast stretch of the imagination, and yet one man buys every foot of it and attends to its concentration and shipment, ranging the country from Georgian bay to Duluth for that purpose.

Its operations, extending through a long series of years, and reaching to all parts of the country and the world, have rendered mention of the firm of S. B. Barker & Co. synonymous with that of the Chicago lumber trade. S. B. Barker & Co. began business on an extensive scale, and have continued it thus until the present day. The firm's policy has always been one of independence. The proprietors have been averse to combinations of any sort that would prevent them from the utmost freedom of action in respect to their trade. Their method has been the carrying on of an immense business, the annual handling of a large quantity of pine lumber, and selling at prices that would keep the stock moving. The pride of the concern has ever been to have a long train of loading cars on track every day in the week, the year round. In order to do this, it has been necessary to make special effort in the accumulation of mill product, and in the sales department. Nothing has been left to go by halves or by default. The members of the firm and the subordinate managers have hustled all the time, and the result has been a business remarkable even in this, the greatest lumber market in the world. The yard of S. B. Barker & Co. is situated on Wood street, near Blue Island avenue, with dock on slip C, having a frontage of two thousand feet. Hence the yard is one of the larger class. It is supplied with track room for seventy-five cars to load at one time, and that number has often been seen in the yard, with lumber going into them, sixty cars having been handled in ten hours. There is dock room for twelve vessels to unload simultaneously. Connected with the yard is a planingmill, containing eleven machines. The drying capacity includes six kilns, through which four million feet of lumber can be run annually. The firm handles seventy-five million feet of lumber, and one hundred and twenty million shingles a year. Besides an enormous shipping business, seventeen teams are constantly employed in the city trade, which has grown rapidly in the past two years. The yard in this city by no means includes all the Barker interests. S. B. Barker is the principal stockholder in the Itasca Lumber Company, of Minneapolis. This corporation owns a large body of pine land in Minnesota, estimated capable of producing seven hundred million to eight hundred million feet of logs. An average cut of thirty-five million feet a year is made on this tract, the company hiring the logs sawed, and distributing the lumber at large. Mr. Barker also owns about four thousand acres of hardwood lands in Charlevoix county, Mich., from which he is cutting logs and sawing lumber. Furthermore, he is interested in several thousand acres of pine lands in Louisiana.

George B. Whitman was for years engaged in the lumber trade in Michigan, and established business in Chicago some fourteen years ago, and developed a trade of such magnitude as to become an important lumber merchant in this great city, the admitted lumber market of the United States. He handled exclusively on commission pine lumber, lath and shingles, and enjoyed an extended connection which enabled him to promptly dispose of the largest consignments, upon which liberal advances were made when desired. Mr. Whitman also handled largely white and yellow pine lands, in which he was prepared to offer such inducements as prudent lumbermen could not afford to ignore. His office was at 16,196 La Salle street.

A representative and progressive house most heavily engaged in the Chicago lumber trade is that of the widely-known Sawyer-Goodman Company, whose main office, yard and dock are eligibly located at No. 500 Lumber street. This company was duly incorporated in 1880. It was organized in 1878 with a capital stock of $500,000, and since its organization at that date has built up an extensive, influential and permanent patronage in all sections of the United States. The yards have an area of ten acres, and their dock frontage is upward of one thousand feet, enabling a number of vessels to discharge their cargoes at the same time, while there is track accommodation in the yards with the Chicago, Burlington & Quincy railroad for the loading of about seventy cars per day. The company's yards afford ample space for handling and piling, and always contain twenty million of the choicest lumber, lath and shingles, specially adapted to the wants of manufacturers and builders. The lumber and shingle mills of the Sawyer-Goodman Company are at Menekaunee, Wis., at the mouth of the Menomonee river. These mills have a capacity of two hundred and twenty-five thousand feet of lumber daily, and give employment to two hundred operatives. In the Chicago yards one hundred and fifty workmen are employed, and the sales in 1886 amounted to fifty-one million feet of lumber, etc. The sources whence the company draws its immense supply of lumber are the choicest pine lands of Wisconsin and Michigan. The characteristics which regulate the business policy of this responsible corporation are such as to entitle it to every consideration, while the extent of its trade has made it a very prominent one in Chicago, and the inducements offered to purchasers are of the most favorable character. The officers are active members of the Lumbermen's exchange. The company's extensive business is admirably conducted, and Chicago is to be congratulated upon having permanently located in her midst such a thoroughly reliable corporation. The career of the Sawyer-Goodman Company has been one of steady development, while the signal success achieved by it is a just tribute to the energy, enterprise and industry of its officers and founders. Like other concerns manufacturing at the mouth of the Menominee river, the Sawyer-Goodman Company has begun to pile a large portion of its lumber at the mill. At present it has a capacity for piling eight million to ten million feet, and it can be increased to any desired extent, there being plenty of room. It is the intention to season the mill output at the mill, and dispose of it by the cargo, in large lots, or through the yard here, as shall be the most profitable. If so much shall be sold at the mill that not enough will be left to stock the yard here, subsidiary supplies will be purchased by the manager of the yard wherever he can secure them profitably. In this particular the Chicago yard will be entirely independent of the mill. The stockholders and officers of the Sawyer-Goodman Company include the following named well-known individuals: The Hon. Philetus Sawyer, president; Edgar P. Sawyer, vice president; James B. Goodman, secretary, and William O. Goodman, treasurer.

The company enjoys the distinction of having a United States senator as president. W. O. Goodman has a more immediate relation to the yard business here than any other member of the company. He has for many years been a conspicuous figure in the wholesale trade at this point, and from time to time has held office in local lumbermen's associations, and as such has exercised much influence. The yard business here has always been conducted in an even-handed, fair manner. Its distinguishing feature has been good value in the quality of lumber sold, and just treatment of customers. The company never employs traveling salesmen, but has succeeded in disposing of its large annual mill output with facility and profit. Though it has a heavy local trade, mainly with the large contractors, it does not secure it by the aid of perigrinating salesmen. The yard for twelve years has been under the immediate management of John A. Nourse. This gentleman was born in Massachusetts, and is characterized by thoroughgoing New England industry and business faculty. He has been identified with the Chicago trade for many years, though he is yet in the prime of manhood. He was for some time in the employ of Mears, Bates & Co., and afterward held an interest in the firm of Soper, Brainerd & Co., that had a yard on Polk street, contiguous to the Chicago & Alton tracks. That relation continued from 1877 to 1879, inclusive. Since then he has been in his present important position, where he expects to remain and handle lumber for years to come.

One of the leading houses engaged in the lumber trade of Chicago was that of Messrs. J. S. Hair & Co., which was established in 1877, and which was conducted with marked success. The business was at first located on Twenty-second street. In 1881 it was transferred to Wood street, and in 1886 it was removed to Paulina street, south of Blue Island avenue. Here the firm occupied a dock 600x250 feet. The premises were connected by a switch with the line of the Chicago, Burlington & Quincy railroad, so that the best of facilities were enjoyed for the receipt and shipment of lumber and the economical handling of stock. Here was constantly stored about four million feet of hard and soft lumber, of which about ten million feet was handled annually. The stock also embraced a very extensive assortment of lath, shingles, sash, doors, blinds, yellow pine, etc. All lumber was received from first hands and manufacturers, and this fact, together with the economical conduct of the business and the nominal expenses of handling, enabled the house to quote the lowest possible prices to the trade or consumer. The firm controlled a very expensive trade, and forty hands were permanently employed in filling the orders of customers, who were located in all parts of the country. Mr. J. S. Hair was born in Virginia forty-four years ago, and he has resided in Chicago since 1865. At this time he was in the real estate business. He was a member of the Lumbermen's exchange and of the National Association of Lumber Dealers. Mr. Hair is also a member of the Union Veteran club, and is a member of the G. A. R. and Millard Avenue Veteran club. At the call to arms in 1861, he entered the Third Indiana volunteer infantry, when but fifteen years old, as a drummer boy, and arose in the rank to staff duty at Nashville, Tenn., and to acting assistant brigade quartermaster, and was five months a prisoner of war at Salisbury, N. C.

A concern which was until recently well known in the lumber trade of Chicago was the Chicago Cedar Post Company, wholesale dealers in cedar posts, telegraph poles, bridge piling, etc., office and yard, Union avenue, south of Twenty-second street. This house was founded in 1878 by Mr. J. P. Towler, who conducted it till 1885, when it was duly incorporated with a paid-up capital of $50,000. The following gentlemen were the officers, viz.: J. P. Towler, president; J. A. Goodman, treasurer; J. J. White, secretary. The yard was eligibly located, and had a dock frontage of one thousand feet, enabling several vessels to discharge their cargoes at the same time, while there was track accommodation in the yard with the Chicago, Burlington & Quincy railroad for the loading of thirty cars. There was a commodious mill on the premises, which was equipped with all the latest improved machinery, operated by a fifty-horse power steam engine. Forty experienced workmen were employed and the trade of the house extended throughout all sections of the country. The company dealt largely in cedar posts, telegraph poles, bridge piling, paving blocks, etc., and, as its supplies were received direct from the forests, this house was enabled to offer unrivaled advantages to patrons in quality and prices. The officers were all born in England, but have been permanent residents of Chicago for many years.

Probably no man in the Chicago wholesale trade is better known than the one who stands at the head of the firm of T. H. Sheppard & Co. He has made a record as a sagacious and reliable dealer, as well as a man of peculiarly social and friendly quality. Tom Sheppard, as he is familiarly called, is a man whose word is as good as his bond, and he has thus secured a reputation that any man might envy. His right-hand man, Charles P. Miller, is an important adjunct to the firm. He has been connected with Mr. Sheppard's business interests for the past nine years, and is nearly always to be found at the yard. In respect to whatever concerns the welfare of the firm, Mr. Miller is identical with it, and what he says or does goes at par with Mr. Sheppard. Perfect confidence exists between the two men, that relation, no doubt, conducing largely to the successful prosecution of the business. Mr. Sheppard was born and reared on a farm in New Jersey, a fact that he glories in to this day. He began his prominent career as a lumberman as a member of Bradley, Sheppard & Smith, in 1879. The head of the house was F. E. Bradley, of Bay City, Mich. The location of the yard was at Sixteenth and Clark streets, with frontage on Clark and dockage on the south branch. In 1876 he formed a partnership with A. R. Gray, buying out H. L. Norton for that purpose. Their yard was at Twenty-second and Throop streets. Afterward it was removed to a position on Paulina street. This relation continued for seven years. In the spring of 1883, Mr. Sheppard withdrew from A. R. Gray & Co., and opened a yard on Paulina street, under the name of T. H. Sheppard & Co. About four years ago the yard was removed to its present position at the corner of Loomis and Twenty-second streets. While he was a member of A. R. Gray & Co., his firm became interested in the Ontonagon Lumber Company, the property consisting of a mill and pine lands. The amount of stumpage owned by the company was estimated at one hundred and forty million feet. The mill had a daily capacity of one hundred and fifty thousand feet, and contained two circulars and a gang. The property was held during 1881 and 1882, and then sold to the Diamond Match Company, the partners realizing handsome profits on the transfer. Mr. Sheppard last year became interested with several Chicago lumbermen in the purchase of a large body of Florida land, and participated in the formation of the Chicago & Tampa Investment Company, with a capital stock of $500,000, he becoming one of the directors. Large deposits of phosphates have been discovered on the company's lands, and the investment promises to result in much profit. T. H. Sheppard & Co. conduct business on independent lines. Buying is done in large blocks. Mr. Sheppard, who is the buyer, prefers to obtain his stock by the log run. He seems to think that in this way, if there is any high grade in the stuff, he will get it. He trusts to his judgment about the percentage of richness there is in a given quantity of logs to be cut. Usually he makes his purchases in the woods, that is, inspects the logs, and buys the lumber to be cut from a given quantity. The firm makes a specialty of good lumber, and for that reason prefers to take the stuff log run. Mr. Sheppard says that he has a poor opinion of low grade, cheap lumber as a source of profit. He attributes his success to a constant endeavor to handle as much high-grade stock, in proportion to the lower grades, as possible. The concern has made a large increase of business during the past three years. In 1889 it handled about forty million feet through the yard, and seven million to ten million outside. This was a splendid record, considering the quality of lumber handled. T. H. Sheppard & Co.'s yard is well situated for business. It is in the heart of the Twenty-second street district, and convenient to planingmills. It has ample dock and track facilities, and one of the finest and most commodious offices in the district.

In 1887 the T. W. Harvey Lumber Company added to its Chicago business a construction department, the object of which was to take contracts for all kinds of buildings throughout the United States, making a specialty of Chicago and its suburbs. They do not restrict themselves to any particular system, but take their contracts through the offices of the leading architects of Chicago. Mr. T. W. Harvey started the business now located at Twenty-second and Morgan streets thirty-five years ago, and it can be truthfully said that there is no firm in this country doing a similar business under similar conditions, owning, as the T. W. Harvey Lumber Company does, its own timber lands, sawmills, vessels, docks, yards, dry kilns, planingmills, and last but not least a factory for getting out the trim and woodwork for its contracts. Many beautiful residences on the north shore have been erected by this concern, as well as many of Kenwood's choicest homes. The company's office and factory are situated at Twenty-second and Morgan streets, and it is well worth the time of any one interested in building to go through their plant and see the system of their construction department.

As a factor in both inland and maritime commerce, the lumber trade is of surpassing importance. In this connection special attention is directed to the enterprise conducted by Messrs. George G. Robinson & Co. This firm deals extensively in lumber, lath and shingles, making a specialty in long joist, scantling and timbers. The business was established in 1880, and has been conducted with marked ability and steadily increasing success. The connections of the house are such that the stock is received direct from the pineries in large quantities and at advantageous rates, enabling the firm to offer inducements to the trade of the most desirable nature. Employment is given to a large force of men. The arrangements for the careful and prompt fulfillment of all orders are of the most perfect character, and every detail of the business is prosecuted under the most favorable auspices. Mr. Robinson is a native of the city of Philadelphia, and came to Chicago in 1856. He is in the early prime of life, a member of the Lumbermen's exchange, and a gentleman of energy, enterprise and business reliability. The office of this firm is at 817 Chamber of Commerce building.

C. R. Hooker, who is with the Shoemaker Lumber Company, has been a resident of Chicago since 1878 and is a wide-awake, pushing and enterprising business man. He was born in De Kalb, Ill., in 1861, a son of Morgan L. Hooker, who was originally a mason contractor but had retired from this calling for several years prior to his death. He was for a number of years a merchant of Cedar Rapids, Iowa, and died in 1887. C. R. Hooker was reared principally in Boone County, Iowa, and there he received his education. In 1878 he came to Chicago, and for two years was in the employ of C. O. Perrine, a manufacturer of syrup, and the following year was with Samuel Harris, a dealer in machinists' supplies. Since 1881 he has been with the Shoemaker Lumber Company, and in their interests he has been active and faithful. He is a member of the Builders & Traders' exchange, the National Union and the Improved Order of Red Men.

The consumption of lumber is annually increasing, notwithstanding the fact that iron and other materials are now so largely used for building purposes, and, as the demand increases, enterprising houses keep pace with the wants of the public by providing the necessary marketing facilities. One of the representative concerns engaged in this line is that of the Lord & Bushnell Company, whose spacious headquarters are located on the Illinois Central, slip C, where they command a dockage of four hundred feet. The business was organized in May, 1883, with a capital stock of $50,000, and since then a large, influential trade has been developed, its tributary area extending to all parts of the West, Northwest, Southwest and the East. A stock of from three million to four million feet is always carried, while the annual sales amount to over twelve million feet. The yard is connected with the Illinois Central railroad by a side track, and every convenience and facility is possessed for the receipt, shipment and general handling of lumber. The company make a specialty of car flooring, siding and roofing. A force of fifty hands is employed by the extensiveness of the trade enjoyed, and the firm are provided with every means for the prompt fulfillment of orders of any magnitude. Edgar A. Lord, president of the company, has for the past twenty-four years been prominently identified with the lumbering interests of this city, and is so well and favorably known to the trade as to require no personal comment at our hands. He was formerly a member of the house of Adams & Lord, and Mr. W. Bushnell, the former secretary and treasurer, was a member of the firms of Reed & Bushnell, Bushnell, Walworth & Reed, and others. The present secretary and treasurer is A. T. Bushnell. Both of the gentlemen in the active management of this concern command a high position in financial and commercial circles, and are universally esteemed for their probity and high personal worth of character.

The yard of the Hamilton & Merryman Company is situated on the corner of Twenty-second and Loomis streets, having a dock frontage on Sampson slip of one thousand feet, and a depth from Loomis street of two hundred and forty feet. It is thus well proportioned for handling lumber from vessels into piles, and thence on cars and wagons at a moderate expense. The great length of wharf front permits several vessels to unload at once, and there is ample space for assorting before the lumber is placed in pile. Tracks connecting with the Q switch system, run the length of the yard, thus affording room for long trains, which are common in the course of the company's large business. Probably twenty million feet can be piled here at one time. The Hamilton & Merryman Company is one of those known in the trade as a Menominee concern. Its yard stock is manufactured from logs that are produced on the Menominee river. The company's mill at Marinette, at the mouth of the Menominee, has a yearly capacity of thirty million feet. Its output for the past sixteen years has mostly been shipped to the yard in Chicago for piling and carload distribution. Previous to that the product for several years was sold by the cargo here and at mining points on Lake Superior; but the collapse of the iron trade in 1873 crippled the demand in the mining regions to such an extent that the company determined to open a yard in this city, which was done May 1, 1875. Since then the yard has been the depository of the Marinette cut; and it has afforded the Illinois, Indiana and Iowa trade a vast amount of richness in the form of lumber. The policy of the managers has always been to give customers good grades and good measure. The proprietors have had an ample supply of stumpage that was purchased when pine lands were cheap. They have mainly desired to work off their lumber so as to obtain a fair price for their stumpage, with such added value from year to year as would naturally come of increased demand and diminishing supply. Thus situated the company has not been obliged to take all of the advantage in the trade, but has been willing to give the buyer a little. Full-up grades have been the rule in this yard. Though many changes have come to the Chicago trade, and the manipulation of sorts and qualities has been reduced to a fine art, the Hamilton & Merryman Company has kept on in the even tenor of its way, and now gives as good value to its customers as when the start was made sixteen years ago. In this way the patronage of the yard has been maintained. Customers who began with it are still on the company's books, and a line of trade is held that gives permanency to the business. The company cuts little stuff over twenty feet long. Its yard stuff is therefore what is called in this market short piece stuff, boards and strips. Its trade is largely with retail country dealers. Until last year the company had shipped its product green to this point, but a change in that respect has been made. Lumber is now piled at the mill and seasoned before shipment. Thus the stock is fitted for any market East or West. Enough to stock the yard will come here as before, but it is probable that in future considerable quantities will be forwarded direct to purchasers from the mill by cargo or carload. This is in accordance with a plan recently adopted by several concerns operating on the

Menominee. The company owns a fleet of three vessels and in the transportation of product from the mill to this point. They are the schooners S. A. Wood, C. J. McGill and Butcher Boy, with a combined capacity of one million one hundred and fifty thousand feet of lumber. The Hamilton & Merryman Company is composed as follows: I. K. Hamilton, president and treasurer; W. C. Hamilton, vice president; A. C. Merryman, secretary.

The corporation known as the Watkins & Fuller Lumber Company began the wholesale yard trade in Chicago in May, 1888, as successor to R. W. English & Co. Really the yard, mainly under the present interest, was founded in 1884. That is to say, W. A. Fuller and V. A. Watkins have been in the enterprise from the beginning. The present stockholders include the gentlemen named, with L. W. Fuller and George B. Whitman. The last two mentioned have the immediate management of the yard. It can be seen that the combination is a strong one. Messrs. Fuller & Watkins are well known sash and door manufacturers of large capital and extensive operations. L. A. Fuller is the son of W. A. Fuller, and George B. Whitman is a lumberman of long and mature experience. Thus much concerning the personnel of the company, which should be a guarantee of the soundness and thoroughgoing character of the business. The yard of the Watkins & Fuller Lumber Company is located on Twenty-second and Throop streets, in the midst of the largest wholesale lumber district in the world. It has one thousand feet of dock frontage, with railroad tracks extending the entire length of the yard, and a special independent track running across the width of the premises on the Twenty-second street end. This gives ample room for shipping or receiving lumber by rail On the dock front there is space for three or four vessels to unload at a time. Nothing better could be asked in the way of handling facilities. The special features of the business under review are the carrying in stock of a high class of lumber, the guarantee of grades, and prompt shipments. In each of these particulars the company has secured an enviable reputation, which it intends to maintain in future dealings. Especially in respect to grades this house has set a standard that is acknowledged the country over. The yard is always supplied with a high class of lumber, boards and strips being specialties. They are cut from selected logs bought by the company and sawed under its supervision. There is also carried in stock a full line of piece stuff, lath and shingles. The Watkins & Fuller Lumber Company confines its trade principally to the country dealers.

W. P. Ketcham, ex-president of the Builders & Traders' exchange, and one of the members of the firm of J. P. Ketcham & Bro., wholesale lumber dealers, with office and yards at Hoyne street and Blue Island avenue, is a native of Philadelphia, born April 16, 1844, a son of Samuel and Rose Ann Ketcham. The father was a prosperous shoe dealer in Philadelphia, and later in Muscatine, Iowa. W. P. Ketcham was reared principally in the West, and educated in the public schools of Muscatine. Upon reaching the age of sixteen years he engaged in the lumber and grain and agricultural implement trade with his brother, J. P. Ketcham, at Marengo, Iowa. They did a successful business together until, in 1861, soon after the breaking out of the war, Mr. Ketcham, although but seventeen years of age, enlisted in Company A, Seventh Iowa infantry, in which organization he served honorably for over a year, when he was detached to serve as a clerk at the headquarters of Generals Grant and Sherman. He participated in the battle of Fort Donelson and at Shiloh; his regiment was located on that part of the line at the Hornet's Nest which was the only one not driven back by the enemy until Sunday evening, April 6, 1862. He was in the movements around Corinth and Holly Springs, and in many other important engagements. At the engagement at Holly Springs he was clerk in the medical purveyor's office, and with about twenty-five others, out of the entire force, succeeded in making his escape. In August, 1864, he returned to Iowa and resumed business, and continued business at Marengo with much success until 1885, when he came to Chicago and assisted in organizing the firm of J. P. Ketcham & Bro., which has since taken high rank. He is also yet concerned in the business at Marengo, Iowa, his interests there having been placed in charge of a manager. He has carried on business at Marengo for over thirty years. The business in Chicago has steadily expanded until the firm now employs about one hundred and twenty-five men. Its lumber interests are very extensive. In 1890 W. P. Ketcham was elected president of the Builders & Traders' exchange, and he is also a director in the Lumbermen's exchange and in the Lumber Dealers' association. He was married in Illinois, in 1866, to Miss Mary J. Parry, and he and his wife are members of the Third Presbyterian church. Mr. Ketcham is a member of the George A. Thomas post, G. A. R.; a member of the Mont Joie commandery, K. T., of the Masonic fraternity, and a director of the World's Columbian exposition.

E. E. Hutchins is the city agent for the Southern Land & Lumber Company, at room 66, 159 La Salle street. Previous to November, 1889, he had devoted four years of faithful service to the Hayden Brothers' Lumber Company. He was born in 1846, and educated in Massachusetts, and came to Chicago in November, 1871. For seven years he has been a lumber salesman of the city. The Southern Land & Lumber Company was organized in 1889, under the name of the Field Lumber Company, but in February, 1891, the name was changed. It is one of the largest lumber organizations in the United States.

The firm of Fick & Oliver, wholesale lumber, Leavitt street and Blue Island avenue, was one of the largest, foremost and most stable and reliable concerns of the kind in Chicago. This enterprise was started in 1885, and the unequivocal success that attended it from the first amply attests the wisdom that inspired the venture. The yards, which possessed excellent transportation facilities both by lake and rail, were very capacious, having a depth of twelve hundred and seventy-five feet and a dock frontage of four hundred feet, and were connected by track with the Chicago, Burlington & Quincy railroad, while from eighty to ninety hands were employed. A large and carefully assorted stock was constantly carried to meet the requirements of the trade, including rough and dressed lumber of every variety, timber, posts, shingles, lath, flooring, pickets, etc.; long timber and joist having been a specialty—about ten million feet, altogether, having been usually kept in stock—and the annual transactions of the firm reached a handsome figure, upward of thirty million feet of lumber having been handled in 1886. The trade, which was of a wholesale character exclusively, was confined principally to the city and environs, with very substantial connections also throughout the entire West. The individual members of the firm were Messrs. L. W. Fick and John Oliver, Jr. They were both popular and respected members of the Lumbermen's exchange. The latter is now a member of the firm of Oliver Brothers, lumber dealers, at Thirty-fifth street bridge.

From its favorable position Chicago naturally is one of the leading lumber markets of the country, and the operations carried on in this line are of the most extensive character. Of the numerous houses engaged in this branch of enterprise that of Joseph Rathborne & Co. is entitled to more than passing recognition, as being not only eminent in the business, but noteworthy as conducting a trade of great magnitude, and one of the largest in the country. Although established not longer ago than 1886, the establishment has built up a trade that has its ramifications in all parts of the United States, and its operations are steadily growing in magnitude. The premises occupied comprise the Illinois Central railroad pier No. 2, foot of Randolph street, which has a dockage of two thousand feet, and is provided with every facility for the receipt, handling, and transportation of lumber, a side track connecting the yards with the Illinois Central railroad. An immense stock is carried to meet the demands of the trade of every description, the sales amount to a large sum yearly, and a large force of men are employed in handling the stock, etc. Every convenience is at command for promptly filling all orders, and a specialty is made of selling the lumber in carload lots, special inducements in terms and prices being given. The proprietor and energetic director of this important enterprise, Mr. Joseph Rathborne, has for twenty-three years been actively connected with the lumber trade, is thoroughly acquainted with all its departments and details, and no one possesses a more comprehensive knowledge of the wants and requirements of the trade than he. He is a prominent member of the Lumbermen's exchange, is noted for his business ability and sterling honor, and possesses the esteem and confidence of the trade and public generally.

The head of the firm of Higbee & Peters, Charles E. Higbee, has for many years been identified with the heavy timber business of this city. He was for a long time with Fitzsimons & Connell, and antedated that concern in experience in the business. When the Marsh & Bingham Company was located on the lake front, at the foot of Illinois street, Mr. Higbee was the yard superintendent. Probably no man in the country has had a longer or more thorough experience in the heavy timber business, with immense dealings in railroad supplies, than Mr. Higbee. In the fall of 1888 he formed a partnership with R. G. Peters, the well-known operator in lands and lumber, of Manistee. This combination was one of great strength, as it was a union of abundant capital and timber resources, with superior ability for the prosecution of the undertaking. A yard was leased on Paulina street, near Twenty-second, with dock on slip A. The wharf is one thousand feet long, and the street and track front is of equal extent. The yard is supplied by two steam derricks, by which timber is easily handled into pile and on to cars. All the appliances of a first-class timber depository are here brought into requisition. The annual yard capacity is fifty million feet. No sooner was the business fairly under way than it became prominent throughout the Northwest. It acquired a heavy trade with the railroads, and the demand from those sources has steadily increased. The firm carries a large stock of all sizes of white and Norway pine timber, procuring supplies mainly in Michigan. Besides its railroad trade, the firm does a large business with the lumber dealers in this city. The yard is furnished with a large stock of special sizes, such as are not usually found in the ordinary wholesale and retail yards. Situated as Higbee & Peters' establishment is, in the midst of the Twenty-second street district, it is convenient to the general trade, and does a large business in furnishing shippers, local dealers and contractors with timber. The stock of large and long timbers is ample and complete as to assortment. A season or two ago the firm had shipped to the yard here a quautity of Oregon fir timber. Some demand has developed for such material, and it is likely to increase in the future. It cau be procured in size and length that would be impossible in the forests of Michigan. It is the purpose of the firm to meet this demand in the future, such as it shall be.

The Byrkit-Hall Sheathing Lath Company first invented their lath in 1884; it was patented March 24, 1885, the proprietors of the rights being the Byrkit-Hall Sheathing Lath Company, organized with Henry Coburn, president, and A. A. Adair, secretary and treasurer. It was slow in coming into popular favor, just as any radical change from old-time methods is slow to take possession of the public, but wherever its advantages were studied its use was decided upon immediately. The lathing and sheathing are made of seven-eighths inch matched flooring, four, six and eight inches wide, and in all lengths. The lath is dressed to an even thickness on the face. This opens up the pores of the wood when the mortar is spread on, as the lumber will swell a little. Lime preserves wood in all cases, and there being a glue substance in it, this penetrates the wood and fills up the pores, thus when it dries out the lumber can not shriuk back so as to even crack the plastering, if the sheathing lath is properly uailed. And it is so made that the action of heat and cold will not affect it. The laths are only one and one-eighth inches wide on the face, with a full half inch space between them, five-sixteenths of an iuch deep, giving the plasterer a chance to work his thick mortar with the hair into the clinches, or dove-tails, and it all cements solidly together. Its advantages are manifold. It tends to rigid, straight construction, it is an economizer of fuel for it is windproof, and it is an economizer of labor and plaster, for it abolishes the lath of our fathers—that most troublesome and wasteful building accompaniment. Notwithstanding its cost is larger than that of lath, the saving in fuel and other advantages make it cheaper in the end, and it is preferable for the reason that it can be nailed in any place and really makes the structure more solid and substantial. The cost is about twenty per cent. more than that of lath, but if necessary saving can be made in studding and joints and building at the same time be stronger, the price is brought down to the cost of lath. By the use of sheathing lath in back plastering twenty-five per cent. can be saved. The Byrkit-Hall sheathing lath sells in Chicago at $12 and $13 per thousand feet, board measure. It can be sold for less at the mills where it is manufactured, in Michigan, Wisconsin and Minnesota, and it is so much lighter than rough lumber that a great saviug in freight is effected. It may be said with truth that he who discovered the existence of this combined sheathing and lathing, after he built his home realized what ignorance is; while, on the other hand, the owner who studied its application in the building arts and used it in his house possesses a joy forever—a something which opposes the tendency to crack in the settlement of a building and which gives a sense of protection to the occupants of the house during a storm. That the exclusive use of this system of sheathing and lathing in frame buildings brings them within the realm of Chicago construction as closely as it may be applied to frame buildings, is a truth worth remembering. This sheathing lath is now a well-known article of commerce throughout the United States, the annual sales amounting to thirty million feet and rapidly increasing every year. Among the larger buildings in which it has been used are the Theological Seminary dormitory, Warren and Ashland avenues, Chicago; Boys' Training school, West Monroe street, Chicago; the Y. M. C. A. building, Indianapolis; The Alma college buildings, Alma, Mich.; the Congregational church, Akron, Ohio; the Soldiers' home, Grand Rapids, Mich.; Plank's grand hotel, Mackinac Island; Hotel Victory, Put-in-Bay, Ohio; Glen Ellen hotel, Prospect Park, Ill.; Methodist Episcopal church, Oakland, Cal.; Chicago Board of Trade, Club house, Fox Lake, Wis.; Ridgewood sanitarium, Reading, Penn.; the Soldiers' & Sailors' Orphans' home, Knightstown, Ind.; St. Margaret's hospital, Kansas City, Kas.; The Algome block (office building), Oshkosh, Wis.; the O'Neil and Dyas block, Akron, Ohio; the Union hotel, Le Mars, Iowa; St. Paul's cathedral, Fond du Lac, Wis.; the hotel, Club house, etc., Mount Yearga Penn.; the Society of Antiquity building, Worcester, Mass., and hundreds of others that can be named, besides thousands of dwellings scattered all through the various states. The Byrkit-Hall sheathing lath is being manufactured in all the principal lumber points (over one hundred and fifty firms now being engaged in making it), and any lumber dealer can supply it just the same as any other kind of lumber. It has been in constant use and has been put into all kinds of buildings for the last six years, and been thoroughly tested by all kinds of heat, and been so often proven to be a success that it is no longer an experiment with any one. It is simple but practical, and an improvement in the building arts long needed to make a warm, strong and comfortable house. A special lath is made for use with adamant, acme or King's cement or any hard plasters, which is the best thing to use because of its solid back and staunchness. It is being used for exterior as well as interior construction, and its use is not confined to any special way, which makes it all the more valuable. Its cheapness and its many advantages ought to commend it to all. Many imitations are on the market, but the Byrkit-Hall Sheathing Lath Company are the sole owners of the patents for sheathing lath. The directors of this company are C. C. Foster, J. H. Murry, B. M. Hair, H. Coburn, A. A. Adair, E. T. Sumwalt and J. T. Hall. The office is in the Gaff building, 230 to 236 La Salle street.

J. C. Deacon & Co. Owing to the phenomenal growth of the city of Chicago during the last decade, the advantages possessed by prominent lumber dealers can hardly be estimated, for the demand for fine building material has been almost unprecedented. The members of the above mentioned firm were with George G. Robinson & Co. until May 1, 1890, when the firm of J. C. Deacon & Co. was organized. They have since been prominently identified with the lumbering interests of the city, and their large transactions give them prominence among the leading business men. The trade of the house has been subject to those influences which have affected the interests of all enterprises and mercantile transactions during the time of its existence, and yet has maintained a gradually increasing business until its present annual transactions entitle it to rank as a prominent establishment in the lumber trade. They do a wholesale and retail business and deal in pine lumber and hardwood flooring, and as each member of the firm was reared to the business, they are practical and experienced men. J. C. Deacon was born in Philadelphia, Penn., in 1850, to J. C. Deacon, Sr., a banker, and came to Chicago in 1873 and became associated in business with McCann, Fitch & Converse (now Fitch Paper Company). In 1875 he became a partner in the firm of R. E. Dewey & Co., manufacturers of galvanized iron cornices, etc. In October, 1878, he became a salesman for George G. Robinson & Co., with whom he remained until entering business on his own responsibility as above stated. He was married in 1876 to Miss Rebecca Rogers, of Chicago, by whom he has three children. He is a republican in his political views, and socially belongs to the Royal League, the National Union and the Royal Arcanum.

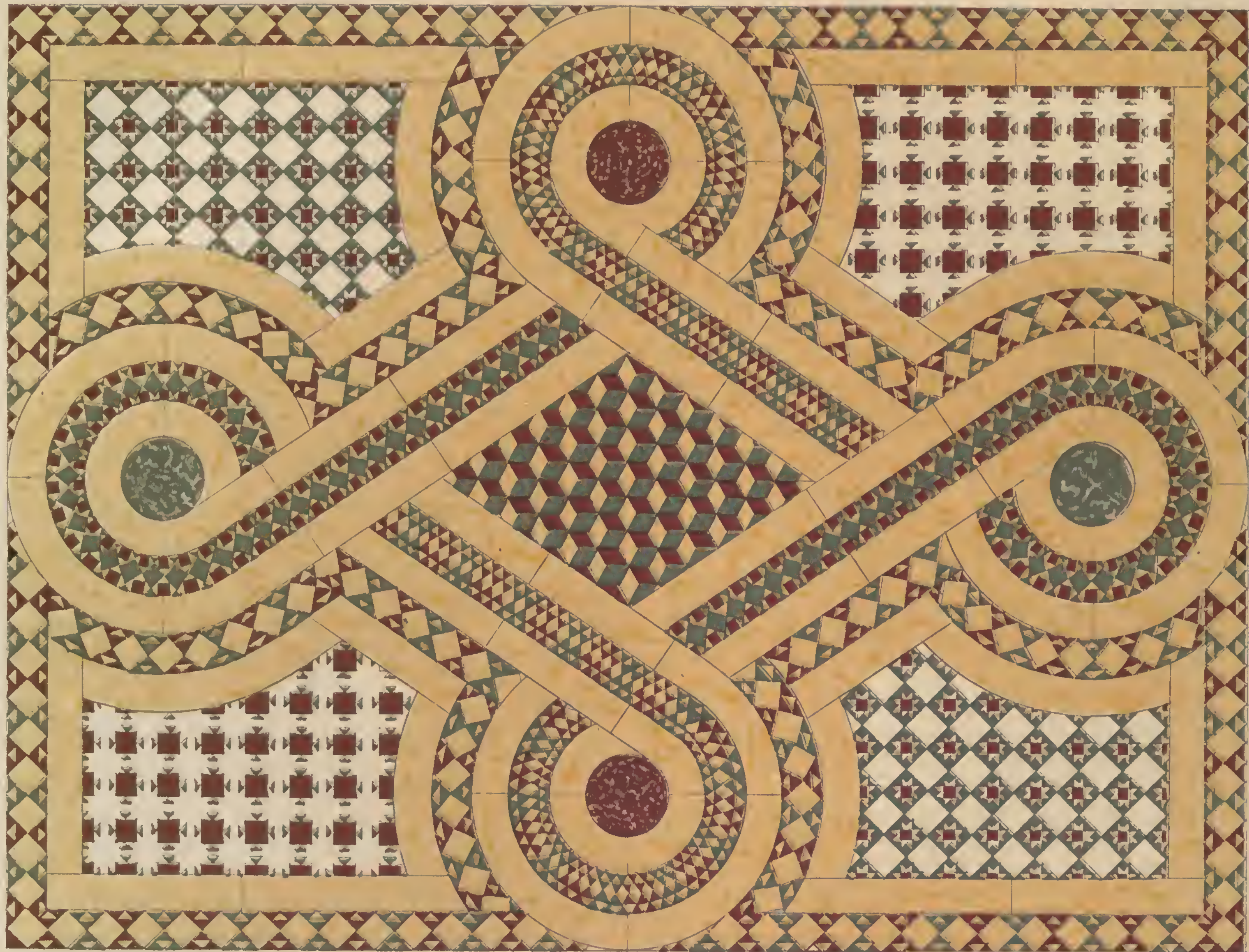
E. A. Osbornson, of this firm, was born in Norway in 1858 to David Osbornson, but in 1865 came to the United States and soon secured employment with Babcock Bros., which firm afterward became Babcock & Park, remaining with them from 1878 to 1882, at the end of which time he became an employe of George G. Robinson & Co., acting the most of the time as bookkeeper and general manager. In 1885 he wedded Miss Grace Bryant, of Chicago. He is a republican, and like Mr. Deacon belongs to the Royal League, the National Union and the Royal Arcanum. Prior to entering the employ of the Babcock Bros., he was with Bradstreet & Co. two years, was with Marshall Field & Co. nine months, and was with F. S. James & Co. two years.

T. G. Richey, of the firm of J. C. Deacon & Co., was born in Malone, N. Y., in 1838, to James Richey, and was given a common-school and an academic education, becoming well fitted for an active business career. In 1846 he went to Council Bluffs, Iowa, where he began clerking in a grocery store, but two years later, becoming attracted by the gold excitement, he pushed westward to California, where he met with fair success as a gold miner. In 1860 he returned to his native state, but the same year went to New York city, being in the employ of the Washington Ice Company until 1869, in which year Chicago became his home. He was foreman for Ludington, Wells & Van Schaak Company until 1880, the two following years being spent with Cross, Austin & Co., lumber dealers. Then he returned to Chicago in 1882, and for three years thereafter was employed by the Soper Lumber Company, becoming thoroughly conversant with every detail of the business. Following this he acted as foreman for George G. Robinson & Co., after which he became a member of the present firm. He was married, in 1866, Miss Sarah E. Verry, of New York city, becoming his wife, by whom he has three children. He is a republican, and belongs to the Royal Arcanum.

The working of wood in Chicago is especially remarkable for the application of labor-saving machinery, by which the most important results are attained from apparently very simple means. All the implements and machinery designed for the speedy and expeditious production of every description of moldings, sash, doors and blinds were employed at the extensive manufactory of the Goss & Phillips Manufacturing Company, on West Twenty-second street, at the corner of Fisk. The abundant supply of lumber in Chicago and the sources of that supply are mentioned at length elsewhere in this work, and it is appropriate in this connection to append a brief sketch of the facilities enjoyed by one of the leading manufacturing establishments, formerly, for many years, engaged in its manufacture into various forms required for building purposes. The firm of Goss & Phillips was established in Chicago in 1848, and they were among the pioneers in their branch of industry. The Goss & Phillips Manufacturing Company was incorporated in 1871, the officers of which were William B. Phillips, president, and Cornelius Curtis, secretary and treasurer, gentlemen of excellent business qualifications, whose efforts were largely instrumental in developing this important branch of industrial enterprise to its present proportions. The premises occupied at the location above designated covered a large area, upon which was a spacious three-story brick structure, 125x150 feet in dimension. Immediately in the rear of this, the company occupied another building, 60x140, as a storehouse. An average force of between five and six hundred skilled and experienced workmen were regularly employed in the manufacturing department, and throughout the entire establishment the greatest system and order prevailed. In addition to the manufacture of every variety of moldings, sash, doors and blinds, which the company could supply of any size required and at as low prices as could be had from any similar concern in the West, they gave special attention to the manufacture of both hard and soft wood interior finish, and invited personal examination of specimens and workmanship at their manufactory of a great variety of unique and original designs of doors, pilasters, mantels, sideboards, bookcases cabinets, hall furniture, paneled wainscoting, etc., which they manufactured in mahogany, cherry, butternut, oak, walnut, maple, yellow and white pine. This company also dealt in lumber, lath and shingles, balusters, newels, stair rails, etc., and were prepared to furnish all kinds of building material ready for use. The trade of this establishment extended to all parts of the United States. This was one of the best houses in this section of the Union, controling a large and constantly increasing business. It was well and favorably known to builders, contractors and others, on account of its enterprise and excellent facilities, which were first-class in every sense of the word.

The lumber trade of Chicago is absolutely immense. Indeed, Chicago justly enjoys the reputation of being the greatest lumber market in the world. Lake navigation affords easy access to the vast and almost inexhaustible lumber regions of Michigan and Wisconsin; while the twenty odd railroad lines which center here stretch out their arms like some great artificial Briareus, into the almost limitless forests of Ohio, Indiana, Illinois, Minnesota, Iowa and other distant quarters, and by cheap and rapid transit, lay at the door of our lumber manufacturers the choicest material that ever tempted the tooth of a saw or invited the whetted edge of a planer. These advantages have attracted the attention and enlisted the abilities of live, energetic, industrial firms, and to-day the lumber trade and correlative branches rank as of the first magnitude. Among the firms occupying position in the first rank, Mr. J. K. Russell, whose extensive planingmill is located at Nos. 82 to 96 Fulton street, deserves special mention. Nearly forty years' successful engagement in the trade in this city entitles Mr. Russell to the respect and confidence he has fairly won, and serves to place his establishment among the oldest and most solid in the city. A resident of Chicago since 1850, Mr. Russell, a Canadian by birth, has been intimately identified with the rise and progress of the metropolis, and has always been noted for his public spirit and liberal business views. His premises are extensive, the planingmill being 60x170 feet, four stories high, with basement, occupying a site 170x170 feet. Employment is given to eighty skilled workers. Steam engines, aggregating an immense horse power, are required to run the complete system of machinery with which the building is replete. The line of business includes moldings, dressed lumber, hardwood flooring, shelving, resawing wide lumber, scroll sawing, brackets, balusters, newel posts, screens, sash, doors and blinds, the manufacture of packing boxes, cases, etc. His facilities for seasoning lumber by an improved kiln-drying process are also unsurpassed. The greater portion of his goods are manufactured to order, and his annual sales as far back as 1883 amounted to $160,000. He supplies to a great extent the best city trade, and has hundreds of regular customers in all leading cities east and west. This business was begun in 1850, under the firm name of Cleveland & Russell, but in 1857 Mr. Cleveland withdrew, since which time Mr. Russell has been sole proprietor. Mr. Russell has always been closely identified with the lumber interests of Chicago, and is one of the representative mill men.

Conspicuous among the lumber interests of this great metropolis and accorded a position of high standing in business circles, attained through individual effort, ability, and a spirit of progression, the extensive establishment of Hillary Dufour, 259 West Twenty-first street, is particularly worthy of mention in a work of this character. No branch of the mechanic's art has been more benefited by the invention of labor-saving machinery than that which is employed by workers in wood, and no manufacturers have been more prompt to seize upon all advantages offered than those in this line. This house was originally established in 1865 by Messrs. Guilert and Dufour Brothers, who were succeeded by Dufour Brothers & Rowe in 1872, they by Dufour Brothers in 1879. Hillary Dufour became sole proprietor at a comparatively recent date. No better evidence could be adduced in their behalf than the fact that they began the business at the bottom of the ladder and rose to an enviable position. The following notice of this concern was published in 1883: "The premises occupied by this firm are of considerable magnitude, covering an ample area of ground surface, on which is erected their factory; the main structure is four stories in hight, having a floor area of sixteen thousand square feet; the planingmill, one story in hight, 150x100 feet in dimension; a very conveniently arranged wareroom 25x80 feet in size, makes complete this model concern, which is thoroughly equipped in all its departments with the most costly machinery that can effect rapid and satisfactory results. Their engine is a splendid piece of machinery of seventy-five horse power, supplied from a fine battery of two boilers. Employment is furnished to seventy operators, selected on account of their experience and dexterous workmanship, who involve



DRAWING FURNISHED BY BURKE & CO.

OPUS ALEXANDRINUM IN THE BASILICA OF
SANTA MARIA MAGGIORE ROME.

upon the firm alone a weekly disbursement of from $700 to $800. Finished work is carried on hand to the value of from $10,000 to $15,000, which aids materially in the prompt filling of orders. The trade, while very large in this city, finds its way to all parts of the United States and attains in its yearly volume fully $100,000. Few firms in the city have equal facilities for the manufacture of sash, doors and blinds, frames, moldings of all kinds, flooring and battens, pickets, etc. The firm make a specialty of the manufacture of pickets, by the aid of their own invention, the Dufour Brothers & Rowe patent picket header; they are enabled to turn out work faster and much more satisfactorily than with any other machine. This ingenious labor-saving machine was patented June 15, 1875; from its start it has always held a very favorable place among those engaged in this busines; its practicability is unquestioned. It is made entirely of iron and steel, has a tight and loose pulley eight inches in diameter by four-inch face, and should run about one thousand revolutions per minute. It not only does more work than any other machine (its capacity, requiring the attention of one man and a boy, being from five to eight thousand pickets per day of ten hours), but it also leaves the corners sharp and smooth, turning out work especially to be desired for its beauty and finish. The firm is composed of Hillary and P. C. Dufour." The latter, now sole proprietor, has resided continuously in this city since 1865, from which year dates the inception of the business.

The firm of John L. Diez & Co., sash, doors and blinds, 530 North Halsted street, was founded in 1866, and through energy, skill and close attention to business on the part of the members of the firm, has been notably successful, and made for itself a prominent position in the industrial circles of Chicago. They formerly did all kinds of carpenter work, building and contracting, and were unsurpassed both in the construction and ornamentation of buildings. Following is an extract from a notice of this firm published in 1883: "They have every facility for their work, and the practical experience of long years. The premises occupied are spacious, and admirably suited to their wants. Their grounds are 164x175 feet, and their factory 60x100 feet in extent. The latter is equipped with one sixty-five-horse-power engine of the best make, which is supplied with steam from a hundred-horse-power boiler. They are well supplied with all the latest and best machinery employed in their line, and can fill all orders with despatch. One hundred skillful carpenters and workmen are kept constantly employed. To these is paid weekly in wages $900. The firm has ample capital, and a stock of material valued at $6,000 is kept on hand. The yearly business of the house amounts, in the aggregate, to $125,000, and is growing with great rapidity." The concern was then located at 282 to 296 Hawthorne avenue. The individual members of the firm are Messrs. John L. Diez, John C. Moninger and J. G. Ottmann. Messrs. Diez & Ottmann were born in Germany, and Mr. Moninger is a native of Chicago. All are stirring, intelligent, wide-awake and honorable gentlemen, fully up with the times, and full of industry and pluck. They have won the admiration of their fellow-citizens and the esteem of the public, and the excellence of their work has made them justly renowned throughout the city.

William F. Peterson is one of the foremost dealers in sash, doors, blinds, etc., in Chicago, and his establishment is a thoroughly representative one. The business was organized, in 1866, by his father, in 1887 the firm taking the name of E. Peterson & Son, which continued in existence until 1890, when William F. became sole proprietor. The warerooms are located at 4914 and 4916 Wentworth avenue, and here a stock of sash, doors, blinds and moldings and all kinds of mill work is carried, and this will bear comparison with any similar establishment in the trade. The grounds include all necessary offices, sheds, outhouses and all other kindred buildings found in such a yard, and the premises are exceptionally well located as to trade. During the years that Mr. Peterson has been in business, he has become well known and appreciated as a man who devotes his entire time and energy to the task of faithfully conducting his business on correct principles. He was born in Chicago, in 1869, to Edward and Margaret Peterson, the former of whom was for many years an extensive lumber and hardware dealer of this city. William F. Peterson was a resident of Chicago until he attained his fifteenth year, at which time he went to Two Rivers, Wis., where he began working with the Hintze & Baker Co., manufacturers of sash, doors and blinds, but after remaining with them for several years he returned to Chicago, and the subsequent year worked at the carpenter's trade. He then embarked in his present business with his father, as above stated, and has since conducted his business affairs in a manner highly satisfactory financially. He was married, December 29, 1889, to Miss Jennie M. Young, their residence being now on Wentworth avenue.

Contractors, builders or private individuals will be interested in some account of the formerly extensive operations of Messrs. C. G. Dixon & Co., manufacturers of moldings, brackets, newel posts, and articles of that character, which enter into the proper construction of buildings, and by their superiority or inferiority, add to or take from the general excellence of a house, no matter how much money may be spent otherwise. The location of this firm was at Nos. 19 to 23 North Jefferson street. It was established in 1869 by Mr. Dixon, a practical mechanic and a resident of Chicago since 1869; O. K. Mitchell later became a partner. In 1875 the firm of C. G. Dixon & Co. was organized by the admission of Mr. Soren M. Peterson as a partner. Mr. Peterson is a Norwegian, but has lived in Chicago since 1864. He, too, is a practical and experienced workman at the business, and brought to the concern acknowledged strength. The capital was increased, the business grew, until in 1883 the firm carried a stock of $10,000, and had an annual trade that amounted to not less than $70,000. Principally confined theretofore to city and suburban work, the firm had been the recipient of some handsome orders from western points and other distant quarters of the country. Their workshops had a floor surface of five thousand six hundred feet; their machinery was new, speedy, and well adapted to economical production and the best results attainable. Their engine was of twenty-horse power, and their corps of workmen regularly employed numbered about twenty. Special attention was paid to the manufacture of the articles above enumerated, including all kinds of builders' moldings, newels, balusters, walnut or cherry rails, stair balusters, pine balusters, and all kinds of turning and band sawing. They were prepared to furnish hardwood moldings of all kinds to builders and cabinet-makers, on short notice. They use none but thoroughly kiln-dried lumber, and their unequaled facilities, both as to quality of material and workmanship, enabled them to offer inducements as to terms, and to fill all orders promptly and successfully. Mr. Mitchell sold out his interest in 1878, and Mr. Peterson bought the interest of Mr. Dixon in 1888. He is at present located at 13 and 15 North Canal street. [See notice elsewhere.]

J. G. Lobstein is located at Twenty-first street, near Loomis, and is manufacturing, extensively, sash, doors, blinds, molding, and does interior work of all descriptions, among which may be mentioned stair rails, brackets, turning and scroll sawing, pilasters, casings, hard-wood flooring, beaded ceiling, etc., all thoroughly kiln dried, and of the very best quality. He furnishes, on short notice, estimates for the interior wood work for all kinds of buildings. The products of his factory are indispensable to the building arts. By long experience and unusual ability Mr. Lobstein has built up a conspicuous trade, and he is one of the leading manufacturers of his class of goods in the city. He is a native of Strasburg, Germany, born in 1844, and possesses the industry and frugality and steady habits, so proverbially belonging to his countrymen. His parents were J. G. and (Neuman) Lobstein. The father was a contractor and builder, and imparted to his son much valuable advice in youth. The son, therefore, liking the trade, concluded to adopt the maxim of the Chinese to "follow your father, my son, and do as your father has done," and accordingly took up the trade of a carpenter. He received a good education, and at the age of fourteen years started to learn this trade. For six years he steadily pursued it, at which time, knowing himself to be thoroughly proficient, he came to this country, and in 1866 located in Chicago. He worked by the day until 1869, when he began contracting on a limited scale, and from that day until this his business has steadily increased and become profitable. In 1880 he began the manufacture of sash, doors and blinds. At first his works occupied but two lots, but now they cover twenty-six lots. One of the notable products of his factory is the excellent class of hardwood he manufactures. He employs about 250 men, and has, at all times, important contracts on hand. The following may be mentioned as among the buildings on which Mr. Lobstein has done work: the hall and pavilion building for George A. Chambers, Thirty-first street and Rhodes avenue; a residence for O. F. Lindman, Forty-eighth street and Ellis avenue; the residence of Mr. Reiman, Forty-third street and Drexel boulevard; the residence of Joseph Beifeld, Thirty-third street and Calumet avenue; the public school buildings of the city of Chicago; a hotel building, Thirty-first and State streets. Mr. Lobstein is doing an annual business of about $200,000, and lives at 103 Hastings street. He was married in 1867, and has three sons and four daughters. He is a member of the Builders & Traders' exchange, is a Mason and Odd Fellow, and belongs to one or two German organizations.

In every city on the American continent those branches of business connected with the lumber trade occupy, by reason of their bearing on other branches of trade, the most prominent positions. In this connection the special branch of the planingmill business, devoted to the manufacture of sash, doors and kindred articles, is most important, entering, as these products necessarily do, into the construction of all classes of buildings. In times not remote these articles were all made by hand, consequently, while they may have been as good and well made as machine work, the process was slow, and the construction of buildings measurably prolonged and tedious; more hands were required, and more economy and less elaboration rendered necessary in the use of these indispensable requisites. The introduction of machinery revolutionized the business. Sash, doors and frames were no longer a part of the carpenter's trade. Steam machinery turned out work too rapidly and with such perfection that hand work could not compete. Among the prominent establishments in Chicago is that of E. A. Hartwell, started in 1869 with but limited capital and circumscribed trade. Supplemented, however, with a large measure of experience and undaunted industry, energy and enterprise, Mr. Hartwell's increase was gradual, but sure; at first entirely local, but increasing demand resulting from the settling of this western country and the merit of his products and square business policy, extended his trade throughout this and neighboring States. His manufacturing facilities were enlarged to meet the increasing demand, and to-day his establishment and trade are the equal of most in this section. His former place of business, on West Lake street, comprised office and warerooms. The building was 44x100 feet, five stories high. The factory, on Fulton street, 60x170 feet in dimensions, was well equipped for the prosecution of the business, being furnished in the most complete manner with the best machinery and appliances; everything, in short, in the line of machinery pertaining to the business. One hundred hands were employed. A steam engine of seventy-five-horse power drove the machinery. The product of his factory had a reputation second to no concern in the city. The annual sales were, as far back as 1883, about $360,000. Mr. Hartwell is practical in the business, having learned his trade in his native State, Massachusetts, in 1850. He has had a continuous experience of forty years in it, understands it perfectly in all of its details and management, about thirty years of which experience he has acquired in Chicago, giving him a thorough knowledge of the requirements of the trade in this locality. As a business man he possesses the confidence of the community in a high degree. This business is now conducted by E. A. Hartwell & Co., 69 North Desplaines street.

Henry Scherer is one of the enterprising German-American citizens of the city of Chicago, and as a shrewd, far-seeing and practical man of business, has not his superior in this which is noted for its able financiers. He inherits many of the sterling qualities of his ancestors, for besides being honest, industrious and thrifty, he is also progressive in his views and to be relied upon on all occasions. He was born in Saxony, Germany, in the city of Lobenstein, in the year 1847, and in his native land acquired a practical education, being an attendant at the public schools from six to fourteen years of age. From that period until he attained his majority, he devoted his time and attention to learning the carpenter's trade, but becoming imbued with the idea that America offered an excellent field for a young man of push and enterprise, to rise in the world, he decided to come to the United States, and the next year, 1868, found him in Chicago which was, even then, a pushing and ambitious town. Here he entered upon a career which was admirably calculated to call forth his most worthy business qualities, and for a few years following his arrival in this city he devoted his attention to contracting. In the year 1870 he erected a mill for the purpose of manufacturing sash, doors and blinds, which was run by horse power, but his business increased so rapidly that by 1880 he was compelled to erect a larger mill, and is now doing an annual business of $175,000 at 414–426 Blue Island avenue. The work which he turns out is strictly first class, as is fully attested by his large annual sales, and of this establishment he is the sole owner. Upon entering this business, he was not blessed with an abundance of means, but to say that he leads in the business in which he is now engaged is but to give him his due, for in the quality and quantity of his work he is unsurpassed. In his first establishment only about six men were employed, but in his establishment of to-day he finds work for from eighty to one hundred men the year round. Having seen the miraculous growth of the city and having lived here for so many years, he has been deeply interested in the progress of Chicago, and owing to the determined stand taken by such enterprising and public-spirited men as himself, it is now the metropolis of the West. Great credit is due Mr. Scherer for the ability and push he has ever displayed in developing this branch of business and carrying it to its present eminently successful position, for it has contributed materially to the reputation of the city, and has, by example, stimulated enterprise. He does no contracting now, but is finisher to other contractors, and also to a large country trade. At the present time he is treasurer of the Veteran Building, Loan & Homestead association of Chicago, being also a member of the Builders & Traders' exchange. He has been a stanch republican all his life, and was a delegate to the national republican convention which nominated Harrison for president in 1888. He is also a member of the Royal League. In the year 1870 he was married to Miss Ernestine Meyer, of Naperville, Ill., and by her is the father of four children: Louis, Birlie, Emma and Ida. His residence is at 443 Ashland boulevard, and in this pleasant and attractive home, a hospitality is displayed that is the delight of the many friends that gather beneath his roof tree. His parents, Henry and Christena Scherer, were native Germans, the former being, as was his father, engaged in the planingmill business.

P. Wohler & Co. (P. Wohler and Charles Wienholz) are carpenter contractors, stairbuilders and manufacturers of sash, doors, blinds, moldings, etc., with place of business at 521 to 529 Twenty-first street, near Blue Island avenue. They also deal in all kinds of hardwood, newel posts, balusters and hand railing, and at all times keep on hand a large supply of their product, with excellent facilities for prompt delivery, and at very reasonable prices. Mr. Wohler is a native of Germany, born in 1844, son of Henry and Margretta Wohler. He received his initiatory training in the schools of his native land, and there also learned the carpenter's trade, at which he served a five-year apprenticeship. At the age of seventeen years he came to Chicago, and until 1866 followed his trade and did quite an extensive contracting business. In 1871 he started a sash, door and blind factory, and a large amount of his product is used annually in the buildings of this city. In 1886 he once more began contracting on a large scale, and some of the leading buildings of Chicago have been erected by him. He is doing a business of $125,000 a year, and employs about one hundred and twenty-five men the year round. He is in every sense of the word a self-made man, for he has achieved his present property, success and reputation by his own exertions. He is a member of the A. O. U. W., the National Turner society, and in his political views is a republican. He was married in 1870 to Miss Mary Ubechel, by whom he has five daughters: Lena, Lucy, Sophia, Emma and Annie. He has a comfortable home at 901 Ashland avenue, and he and his family are members of the Lutheran church.

S. M. Peterson & Co. are extensive manufacturers of interior woodwork, and are also large contractors and builders of porches and stairs. Soren M. Peterson, the senior member and manager of the company, was born in Norway in 1846, and in his youth was given the advantages of a public-school education. When about sixteen years of age he left home and country to seek his fortune in the New World, and April, 15, 1862, settled at Whitewater, Wis., where he devoted two years to the joiner's work. In 1864 he came to Chicago and here learned the machinist's trade of Tobey & Tarris, after which he learned the details of manufacturing sash and doors, while employed in charge of machinery in a sash and door factory. In 1872 he began manufacturing furniture on Indiana street, after which he sold out, and in 1875 engaged in the lumber-milling business with C. G. Dixon and O. K. Mitchell. In 1878 the last named gentleman disposed of his interest, after which the business was continued by Mr. Peterson and Mr. Dixon until 1888, when Mr. Dixon sold out, his partnership with Mr. Peterson having continued for fifteen years. The company has been doing a general line of interior work, and make a specialty of building porches and stairs, their work in this line being highly artistic and ornamental. They furnish mill work for a large number of contractors of this city and have also furnished the Elgin Watch Company with their product, as well as the Follansbee building. They do a business of about $75,000 annually, and employ about thirty men in their mill, which is located at 13 and 15 North Canal street. Mr. Peterson was married in 1875 to Miss Gunderson, a daughter of Capt. Martin Gunderson, of this city, by whom he has seven children: Gertie, Henry, Sewart, Walter, George, Hazel and Leslie.

E. P. Wilce & Co. was first founded by William Stevens eighteen years ago, becoming Stevens, Wilce & Co. eight years later, and eight years since the name was changed to E. P. Wilce & Co. Mr. Wilce died in September, 1889, since which time the business has been conducted by his estate, under the management of A. H. Lowden—A. H Lowden and Thomas Wilce, trustees. Mr. Stevens, who was a very successful and experienced man of business, has been dead about six years. Mr. Wilce was born in 1858, a son of Thomas Wilce, and in early life was reared to the lumber trade by his father, becoming an exceptionally shrewd and successful financier and business man. He was married to Miss Bodley. Mr. Lowden, the manager of the firm of E. P. Wilce & Co., was born in Montreal, Canada, in 1846, to Alex. and Catherine (Corrigall) Lowden, the former of whom was a clergyman of the Presbyterian church. A. H. Lowden was educated in the public schools of Canada, and in the city of Montreal began learning the carpenter's trade at the age of fourteen years. He became foreman of a large concern belonging to A. Holmes, a builder of Montreal, with whom he remained for nearly four years, since which time he has been in business for himself. He removed to Chicago in 1876, and for two years was in the employ of A. T. Steward & Co., as house carpenter, after which he began contracting on his own account, and later was engaged in building and selling dwelling houses. In 1887 a co-partnership was formed by Messrs. Lowden and Wilce, and after the death of Mr. Wilce the business was dropped by Mr. Lowden, who assumed the active management of the house of E. P. Wilce & Co., sash, door, blind and interior finish and general planingmill work. Although their trade is principally local, they have an extensive patronage in Denver and elsewhere. This firm is now doing the interior finishing work for the Wisconsin Central depot of Chicago, their work for other noted buildings of this city being equally meritorious. The business is large and constantly on the increase, involving the investment of much capital and the employment of a large amount of labor. They make a specialty of fine interior finishing, and are conceded to be among the leaders in their line in the city. Besides the above mentioned building, they have done the work for the Forty-first Street Presbyterian church, the Allen flats, and many others in different parts of the city and in the surrounding suburbs. Mr. Lowden was married in Montreal, Canada, in 1870, to Miss Ellen, daughter of Thomas and Margaret (Brown) Jackson, of Montreal, by whom he has four daughters: Helen C., Margaret, Edith and Mabel A. He is a republican, a member of the Presbyterian church, in which he holds the office of elder, and the Builders & Traders' exchange.

Hermann Kirchhoff is a prominent manufacturer of sash, doors and blinds at 1483 and 1485 Milwaukee avenue, with factory and warehouse at 972 to 980 Oakley avenue and 160 to 180 Wilmot avenue. He makes a specialty of wood turning, scroll sawing and stair building, and employs the year round from one hundred and fifty to one hundred and seventy-five men, and uses about three million five hundred thousand feet of lumber for manufacturing purposes annually. He has built in about every district of the three great divisions of the city, and his operations hereabouts have been confined entirely to the city and suburbs; though he has a branch establishment at Denver, Colo., managed by his brother, but it is not so extensive as his business here. He was born at Coethen, Germany, in 1846, and at the age of fourteen began to learn the cabinetmaker's trade. In February, 1871, he came to the United States and located in Sauk county, Wis., where he engaged in farming until 1872, and then came to Chicago. At first he did carpenter work here, but after a few months opened a furniture store on the west side, but this proving unsuccessful he relinquished it and began the carpenter contracting business. This he made highly successful from the start, and it was continued for a period of nine years, when he constructed his planingmill at the corner of Oakley and Milwaukee avenues. In 1874 he married Miss Elizabeth Steinbrecher, daughter of Edward Steinbrecher, and by her has three daughters. He is a member of the Builders & Traders' exchange.

One of the chief divisions of the great lumber trade of Chicago is that department exclusively devoted to the conversion of rough material into dressed and finished lumber; and the manufacture of sash, doors and blinds. The perfect machinery with which inventive genius has provided the workers in wood, has insured such rapid work and reduced the price of prepared lumber to such a minimum figure that contractors, builders and those engaged or interested in the construction of buildings, have almost universally adopted the comparatively modern methods of placing their orders for such material with firms who are specially prepared to do that character of work. This accounts for the vast importance of the sash, door and blind manufactories that have become so numerous and extensive in the country of late years. Among all of the firms in Chicago or throughout the great northwestern country engaged in this particular business, there is not one that has won a higher name or sustained a more honorable record than the Philip Rinn Company, of which Philip Rinn is president, and George P. Rinn is secretary and treasurer, and which now carries on the business formerly of Kaeseberg & Rinn, with planingmills located at the corner of East Division and Crosby streets. This firm was organized and began operations January 1, 1872, only a few months after the great Chicago fire. The great and urgent demands for building lumber of all kinds, taxed their energy and capacity to their full strength, and built up their trade, from a small beginning with limited capital, until, in 1883, it amounted to not less than $125,000 per annum, and necessitated an average stock of finished goods on hand valued at $10,000. Just previous to that time the firm erected a first-class three-story brick mill, 150x125 feet in dimensions, besides which their ample yard room included three choice lots and gave them 150x125 feet additional frontage on Crosby street. Their mill was thoroughly fitted up with improved planers, saws, and woodworking machinery, and they had a first-class engine of one hundred horse power, which was supplied by steam from two boilers. Employment was given to fifty-five skilled and experienced workmen, whose weekly wage-roll amounted to $750. Both of the members of this firm were from Germany. However, Mr. E. Kaeseberg had lived in Chicago thirty years, while Mr. Philip Rinn came here two years earlier, or in 1851, long enough since to be ranked among the pioneers, and to gain for himself honorable position among the most enterprising, liberal and reliable business men. This concern has since added greatly to its facilities, and its business has increased with the great development of the city and the advancement of its building interests.

Jonathan Dunfee & Co., manufacturers and dealers in wood carpets, parquet floors, wainscoting, etc., have a large, well-appointed office and salesroom at 104 and 106 Franklin street, and their factory at Kinzie and Diller streets, with houses in St. Louis, Kansas City, Cleveland, St. Paul and other leading cities of the United States. Their products are used for parlors, diningrooms, bathrooms, sittingrooms, sleepingrooms, halls, kitchens, nurseries, vestibules, offices, banks, hospitals, hotels, drug and other stores, billiardrooms, dancing halls, schoolrooms, etc. They have a large establishment, and send out immense quantities of goods, not only to all parts of the Union, but to Canada and Mexico as well. So great has become their trade that they keep constantly employed a large number of men to prepare and dispose of their goods. Many of their goods are of recent invention, and are designed to keep pace with the extraordinary improvements made in all the building arts within the last decade. A quarter of a century ago a wood carpet was not thought of, but now may be seen on thousands of floors in this city alone. It is not, as many suppose, a temporary floor covering, to be put down or taken up at pleasure, but is a permanent new floor on top of an old one, and is firmly nailed down, and has all the effect of a thick European floor. The designs are elaborate, tasteful and beautiful, colored to harmonize with the walls, wall-paper and woodwork of rooms and offices. As it is manufactured and put down at a less cost than a regular floor, will last fully as long, and can be easily adjusted or removed, it has become so popular that large quantities of it are used by builders in the completion of floors of the best buildings, public and private. This company keeps in stock standard goods, only of the finest quality of all kinds of wood, and sells at the lowest market price possible. The straight carpeting can be rolled up like an oilcloth and can be easily shipped. It weighs about seven pounds to the yard. This carpet, beautifully ornamented and colored, presents the attractive appearance of fine cloth carpet without the latter's disadvantage of accumulating dust. Besides this the parquetry wood floors are more healthy, easier to keep clean, and in the end far more economical. They are prepared to furnish designs to meet the orders of architects. Many of their orders are so beautiful and tasteful in design that they represent, in the highest sense, a striking improvement in artistic decoration. It is impossible to describe them, they must be seen to be appreciated. They also have in stock the Diamond flexible rolling mat. Jonathan Dunfee was born in New Jersey in 1842, and in 1861 enlisted for nine months in the Union army, and after having served his full time he received an honorable discharge, after which he returned home. In 1868 he came to Illinois, and first located in the southern part of the state, where from 1868 to 1873 he was engaged in the building business. Since 1873 he has been connected with his present business. He is a republican, and cast his first presidential vote for Abraham Lincoln. He is a member of the Masonic order and of the G. A. R. He was married in 1865 to Miss Virginia Huff. Of the five children born to them only two are living. Mr. Dunfee is an active, successful and upright business man.

Anthony Holpuch is a large manufacturer of sash, doors and blinds at 653 to 657 Throop street. In early life Mr. Holpuch learned the mason's trade, at which he worked after arriving at mature years, until 1874, when he began contracting and building at that trade, and was thus engaged until 1887. During this period he constructed the masonry of many of the best residences and business buildings of Chicago. In 1887 he founded his present business of manufacturing sash, doors and blinds, and now has a large factory and a successful and lucrative business, and the countenance of the most active and upright business men connected with the building interests. He manufactures moldings of the latest patterns and designs on an extensive scale, and at his factory keeps on hand a large amount of stock in all departments of his line. Woodwork of all descriptions, stairs and interior finishing is turned out by him and kept constantly in stock. He has about thirty-five men in his mill, and does a business of about $60,000 per year. He has an extensive city trade, and his work is in all respects classed among the best of the city. He is married and has six children. He is a democrat and a member of the I. O. O. F. Mr. Holpuch was born in Bohemia in 1851, and in that country was reared and educated. He arrived in Chicago March 18, 1871, and here he has since labored.

One of the foremost concerns in the department of sash, doors and blinds, stair building, etc., is that conducted by Messrs. P. Wohler & Co., at Nos. 521 to 527 West Twenty-first street. This enterprise was started in 1875 by Mr. P. Wohler at Center avenue and Eighteenth street, he making a specialty of stair building. In 1880 the present firm was organized, and in 1883 the firmed moved to the present quarters, adding the following year the other branches of manufacture referred to. Their premises comprise a three-story brick building, 50x125 feet in dimensions, and a frame building of the same size, one story. The mills are completely equipped with new and improved machinery and appurtenances, operated by an eighty-horse-power engine, and employment is furnished to from fifty to one hundred hands. Every facility is at hand for executing all kinds of work in the most expeditious and satisfactory manner, and the products are in heavy and extensive demand, owing to the high standard of excellence that has always been maintained. Hardwood flooring of all kinds, also newel posts, balusters and hand railing are promptly made to order, and the most skillful and painstaking care is given to the execution of all contracts and commissions. No house in the city has better advantages for prompt, successful and satisfactory work, or is more enterprising and progressive in its methods of manufacture. The output is in great favor with builders and contractors in this city, and the fair and reasonable prices that prevail add materially to the popularity of the house. The firm is composed of Messrs. Peter Wohler and Charles Wienholz, both natives of Germany and residents of Chicago for many years.

A leading establishment is the Western Planing & Manufacturing Company, manufacturers of sash, doors, blinds, etc., whose office and factory were formerly at 130 to 134 Fulton street, and of which William Schumacher is president. This business was established by the above company with a moderate capital in 1877, since which period it has been greatly increased. The premises occupied are equipped with all the latest improved facilities as regards tools, wood-working machinery, and appliances known to the trade. A powerful steam engine is utilized, while employment is given in the various departments to a large number of skilled workmen. The Western Planing & Manufacturing Company turns out largely sash, doors, blinds, moldings, turnings, etc. Special attention is given to scroll and band sawing, and also to interior hardwood finish and fine cabinet work. All the productions of this responsible house are unrivaled for quality, workmanship and design, by those of any other first-class house in the trade. The company possesses unsurpassed facilities, and can always quote satisfactory prices in all branches of work, and has furnished its products to many of the finest buildings lately erected in Chicago and its vicinity. The officers of the company are prominent members of the Builders & Traders' exchange. This enterprise is located at 754 to 764 Austin avenue.

Joseph Klicka. The extraordinary strides made in the first few years in the production of manufactured articles by reason of the wonderful improvements made in machinery of all descriptions finds no clearer illustration than in the preparations of moldings used by builders. Work of this nature formerly done by slow and laborious process is now accomplished in a much easier, speedier and more satisfactory manner by skillfully constructed machines. Great art is shown in designing the machines, which are to perform such results. But the skill, dexterity or expertness required to successfully handle these machines is itself an art as well as a science. It requires genius of the highest order to adjust the machines to new, fresh, beautiful, and artistic designs to meet the cultivated taste of an art-loving people. It has come to mean more than custom to find the Chicago palaces full of the refined products to the pliable genius of molders and other art workers. Joseph Klicka, since his youth, has made a special study of the manufacture of room moldings and the art of gilding, and to-day, unquestionably, his house at 114 and 116 South Jefferson street, stands at the head of this business in the United States. It is a revelation to enter his mammoth six-story establishment, crowded with beautiful products, and view the wonderful profusion and variety of artistic molding designs there displayed, but it is still more wonderful to witness the artistic work performed in this great shop. The exceptional skill required, the marvelous perfection of methods, the brainwork necessary to accomplish such elegant results, all border on the phenomenal. Mr. Klicka's present six-story-and-basement-40x70-foot structure was erected in the fall of 1889, and in this building nearly one hundred artisans find constant employment. Three traveling salesmen assist in expanding the large trade to all parts of the world. The consumption of the product of this house is particularly large in the United States and Canada. The extent and permanence of the trade confirm the high and enviable reputation of the house. The most noticeable feature in the life of Mr. Klicka is the fact that he is absolutely self-made. Alone and unaided, except by unceasing perseverance and industry, high native ability and unswerving integrity, he has steadily risen in his calling to the position of chief molder of the United States. He is a native of Bohemia, was born May 28, 1855, and when eleven years of age was brought to America by his parents, who came directly to Chicago. His parents were poor, and at this early age Joseph was thrown largely upon his own resources. His industry, ability and honesty triumphed, as those qualities always will when combined. He worked first at odd jobs as an errand boy and in a crockery store. At the age of fourteen years he engaged with Goodwillie & Co., to learn the gilder's trade, and was started at $3 per week, but so closely did he apply himself, that in less than a year he was receiving $10 per week, and within two years he was a member of the Gilders' union. Later, he followed his trade as a journeyman until 1877, at which date he entered the business for himself as a member of the firm of Fillman & Klicka, gilders and picture-frame manufacturers. In 1880 Mr. Klicka withdrew from the firm, and engaged in business for himself at 41 to 45 South Jefferson street, and in April, 1890, moved into his present commodious and elegant quarters. In 1879 he married Miss Amelia Bernhardt, a native of Bohemia, who was brought to this country when a child. They have four sons. Mr. Klicka is a member of the National Union of Apollo council, and of Humboldt Park lodge of Odd Fellows. He resides at Humboldt park.

One of the largest and most important planingmills in the city a few years ago was that of Messrs. Ware & Co. This firm were widely known as extensive dealers in lumber, lath, shingles, etc., and planingmill work. The business was first established in July, 1878, by J. W. Ware and O. K. Johnson, the above named firm succeeding to the control in May, 1887. The premises occupied comprised a brick building containing two floors, 100x125 feet in dimensions, and a frame building one hundred feet square. The mill was provided with nine planers, having a capacity for planing one hundred and fifty thousand feet of lumber per day. The motor was an engine of two-hundred-and-fifty-horse power. In every department special wood-working machinery was used, and every new and improved device was introduced for the manufacture of building materials of all kinds. The specialty of the business, however, was the manufacture of all kinds of lumber used in building. They gave employment to one hundred and fifty hands, and the output was one of great volume. A heavy stock of builders' lumber, lath and shingles was carried, and inducements were offered as regards economy of prices and guaranteed stock. The firm was composed of Messrs. J. W. Ware, A. H. Kingman and W. E. Burden, natives of New York, and members of the Planing Mill and the Box Makers' associations. Mr. Ware was formerly a banker, and is well known in business circles. This enterprise was located at Twenty-second and Throop streets.

That a trade should be prosperous whose productions are an actual necessity and to be found in universal use, is no wonder, and it will excite no feeling of surprise when it is stated that there are no more flourishing establishments in the country than the branches engaged in manufacturing specialties connected with the great lumber trade. Among these the establishment of Trunkey & Co., in its bearing on other industries and as furnishing needed staples to the community, was formerly important. This business was the furnishing of front-yard fencing; their specialty was moldings for showcases, in pine, walnut, ash and whitewood; parting panel, base, crown, casing, bead wainscoting, band partition, threshold and other moldings, in ash, maple, pine, walnut, etc., to order in any and all styles; balusters, newel posts, in cherry, walnut, etc., and in their work they had no superiors. This business was established in 1877, by Messrs. A. W. Tucker and A. J. Trunkey, in a modest way. To what an extent it grew can be judged from this sketch. Their factory was on West Lake street, at Nos. 337 and 339, in a large and conveniently arranged building, fifty feet front by one hundred deep, two stories high, and was provided with the latest and most improved machinery and appliances used in the business. Here they possessed every facility for transacting an extensive trade. In machinery they were most thoroughly and practically equipped, all selected by and under the personal supervision of Mr. Tucker, who, if we may so term it, was born in the lumber business. An engine of fifty-horse power supplied motive power. In their particular specialty, wood fencing, they were at one time the only firm in the city. They built front-yard and partition fences in all styles, furnishing every part, pickets, posts, gates, hinges, casings, and completed the fence to order by contract, or furnished any of the parts. Their work was neat, durable and well put together. They also dealt in flooring and dressed lumber, window screens, and executed scroll sawing, turning, etc. They carried an average stock of about $6,000 in value, their annual transactions reaching from $60,000 to $70,000. Twenty-five skilled mechanics and artisans were employed. Their trade was largely in the city and suburbs, but extended to Missouri, Kansas, Iowa, etc. Mr. Tucker was a native of Maine, Mr. Trunkey of Ohio. Their great prosperity was due to the skill, enterprise and ability of the members of the firm. As an important factor in the reputation of the city, they won a prominent rank by honest, earnest effort, and they deserve credit for it.

It is truly marvelous to what a high state of perfection and elegance the manufacture of moldings has been brought. The industry, as now carried on by many extensive houses, is the outgrowth of mechanical ingenuity of later years, and is a prolific example of the upward-and-onward tendency of the age. The establishments of Chicago devoted to this branch of industrial art are many, each vying with the other to produce some new design, or enhance the character of their work above their contemporaries. The house of Messrs. Raubold & Lambin, 19 North Ann street, although not so long in the field as some others, has made more rapid advancement. They started in 1879 in a small way, and have since largely increased in the volume of business transacted. The factory of this firm is provided with the various machinery essential for conducting a business of this kind. Numerous skilled mechanics are employed, who are thoroughly proficient in their several vocations. The trade is distributed throughout the surrounding country, as long ago as 1883 approximating nearly $20,000 per annum. The individual members of the firm are John G. Raubold and Fred H. J. Lambin, the former a native of Cincinnati and the latter of Chicago; both are practical mechanics in this business, and merit the success that has attended their efforts.

The Bernritter Manufacturing Company, mill owners and planingmill contractors, South Chicago avenue near Seventy-fifth street, is an incorporated concern, capitalized at $30,000. Its officers and stockholders are Henry Bernritter, president; John Bernritter, treasurer; Frank H. Bernritter, secretary, and Robert Bernritter, superintendent, all of whom are practical mechanics. The factory of this company is supplied with the most improved machinery, and from seventy-five to one hundred men are employed in its manufacturing and building operations.

The business of A. H. Andrews & Co., 215 to 221 Wabash avenue, is that of bank and office fittings and special lines of furniture. The list of the manufactures includes bank counters and railing, office furniture, opera chairs, and school furniture or desks, and all kinds of school merchandise or apparatus. The well-known reputation of this firm appears to have been largely due to a determination, from the very outset, to select the best material for their stock, and never to trust the reports of the country lumber seller who claims that his wood had been so many months or years in seasoning, but do their own kiln-drying by a new process in what is known as the Noyes lumber dryer, which they find very valuable in preparing lumber for their purposes. The bank fittings of the firm are well known, especially throughout the Northwest and the South. To this department they have added the new and stylish brass-work for gates or wickets, which is very superior and of original designs. The improved opera chairs designed by this house have attracted much attention, with their various appliances, both for comfort and reduction of space. Their one hundred varieties of office desks, samples of which have been seen in various expositions, are their own best advertisement. Many lines of railway have also adopted their desks, specially designed for offices and stations of railway companies. In addition to these specialties thus briefly mentioned, the firm have always manufactured that staple article called the public-school desk; also various articles under the head of school merchandise, such as globes in a very large variety, maps, blackboards, etc.

The Central planing and re-sawing mill of Wintermeyer & Dempsey, 546 to 552 South Clark street near Twelfth street, were extensive manufacturers of sash, doors, blinds, moldings and all kinds of packing boxes, and large dealers in dressed lumber. The enterprise was inaugurated in June, 1878, in a small way, with a force of some six hands. It was destroyed by fire in 1880, and larger works were immediately erected, comprising a four-story brick building, 65x122 feet in dimensions, admirably equipped with all the latest improved wood-working machinery, tools and appliances, operated by a seventy-five-horse power steam engine, and furnishing employment to some one hundred and fifty hands. Everything in the line of dimension lumber, flooring, siding, moldings, ornamental hardwood work for banks, churches, theaters, mansions, and all other planing work, was done to order, while every facility was at hand for turning out work promptly and in the best possible manner. Contract work was made a specialty, and among the leading specimens of the skill of this firm to be seen in this city are Maller's building; St. Jarlath's church, at the corner of Jackson street and Hermitage avenue; American Tailor's store, on Clark street, the finest in the city; the interior woodwork on Cook county courthouse; the United States Rolling Stock Company's building; Crane Brothers Manufacturing Company's pipe mill and other public buildings and business structures. The firm was composed of Messrs. J. C. Wintermeyer and L. H. Dempsey. Mr. Wintermeyer, a native of Germany, has been a resident of Chicago since 1867, and served three years in the Army of the West, as a member of the Fourteenth Wisconsin infantry; is a member of the G. A. R., and has been treasurer of the Veteran club. Mr. Dempsey was born in Ireland, and came to this city in 1871. Mr. Wintermeyer is in business at the same place, making a specialty of the manufacture of boxes.

Vincent Dlouhy, in a short space of time in this active city, has built up a successful business and reputable name. He manufactures a first-class line of sash, doors, blinds, frames, molding and stairs, and does a superior line of designing plans for scroll sawing and turning. He is located at 697 to 701 Laflin street, near Twenty-second, and has a branch office at 735 Paulina street, between Forty-seventh and Forty-eighth streets. He is a native of Bohemia, and in 1872 came to Chicago, and here learned the carpenter's trade, working at it until 1881, at which date he began manufacturing sash, doors and blinds, and has steadily extended his trade until he is now well known to the leading builders of the city. He was first located at 653 Throop street, but in May, 1888, removed to his present place of business. He occupies a space of 100x120 feet, two stories high, and employs an average of forty men throughout the year. His trade is large, and may be seen in many of the best buildings here. He does a superior line of interior finishing and stair work, and keeps on hand a full and complete stock of goods in his line. He is absolutely self-made, having been the designer and promoter of his own success. The following are some of the buildings on which his work may be seen: the C. S. P. S., 400 West Eighteenth street; Bohemian National hall, corner Eighteenth street and Center avenue; St. Prokopius Priory's school and parish-house, Eighteenth and Allport streets; St. Mary's church, Division and Humboldt streets; S. P. Norman's block, 1151 to 1153 Western avenue; Nathan's hall, Jefferson and O'Brien streets, and many others. He was married in 1874 to Miss Antonie Schutler, and has five children. He is a member of the I. O. O. F., the I. O. F., and the C. S. P. S.

The firm of L. H. Bourret & Co., manufacturers of and dealers in sash, doors, and blinds, at the corner of Loomis and Hinman streets, is composed of L. H. Bourret, and Edmond Le Clere. The business was established by Mr. Bourret in the fall of 1881, on a small scale, on Henry and Throop streets. It was removed to Twenty-first and Loomis streets in 1883, and to the present location in 1886. The concern made blinds at first for six years, and since then has made sash, doors and blinds, interior finish and general mill work. An annual business of about $125,000 is done, and about seventy-five to one hundred hands are employed. Mr. Bourret was born in Louisville, Canada, August 7, 1842, a son of Maxime and Sophie (Belant) Bourret; attended school until sixteen years old, and learned the carpenter's trade during an apprenticeship of three years, one year at Louisville, and two years at Montreal. He then went to Lake Superior, Mich., and worked at his trade during the next two years. He came to Chicago in 1866, and was employed as a machine hand in a sash, door and blind factory. After working in different places, in 1877–80 he was foreman for Palmer & Fuller, sash, door and blind manufacturers, and then established this business. He was married in 1871 to Miss Hattie Lemoine, of Chicago, and has had seven children, five of whom are living. Mr. LeClerc, a native of Canada, began with Mr. Bourret as an employe, and became his shipping clerk, bookkeeper, and finally his partner. He is twenty-four years old.

It is an undisputed fact that there is not a city in the world more noted for its thrift and enterprise than is Chicago. Its natural advantages and location have much to do with this, but without its energetic, far-seeing business men, Chicago would never have been the city it is to-day. The different lines of business have each a leader, and generally this prominence has been attained by superiority of intellect, or a combination of fortunate circumstances. In the line of manufacturers connected with the building interests, there is no man deserving of more praise than Raymond Ringwald, a German by birth, and the sole owner and proprietor of the sash, door, blind and general milling business, situated at 481 to 493 West Twenty-second street. He was born in the year 1842, the son of Nicholas and Zazilia Ringwald. His parents were agriculturists by occupation, and his early years were passed upon the farm, and in securing a good practical German education. When old enough he was apprenticed to learn the carpenter's trade, which afterward served for his occupation for several years. After coming to this country in 1865, he attended the schools of Chicago for a time, and was first employed at his trade of carpenter in this city. Later he worked at milling, and becoming proficient in this branch of business, he decided to make that his future occupation. By hard work and economy he accumulated sufficient means to embark in the milling business in 1881 in a small way, but this start, small as it was, became the foundation of the extensive work he is now conducting. He first started in a rented mill on Twenty-first street, but later moved to a larger one on Twenty-second and Allport streets, where he did a largely increased trade. The spring of 1890 he erected a large mill on Twenty-second street, where he is now located, and from where he is now furnishing to the building trade first-class mill work for building purposes, his annual transactions now amounting to from $75,000 to $100,000. His work is conducted by about fifty employes, and consists in the manufacture of sash, doors, blinds and a general planingmill business, the product being of the best grade, finding ready purchasers. It is unnecessary to add that Mr. Ringwald has furnished the material for many of the best buildings in the city, a record of which would be superfluous in a work of this kind. Mr. Ringwald began life's battle on his own responsibility, a poor boy, but the cardinal principles of hard work and honesty which have governed his actions have led to the establishment of a large business, and have given him an honored name among honest men. In every sense of the word he is a self-made man. He is a democrat, a member of the I. O. F., the Catholic Knights of America and the Catholic church. His marriage occurred in this country. He is the father of five children, and he resides happily at 772 Loomis street.

With those contemplating building, a very important item is as to where they can procure the necessary goods at the most reasonable prices, and made in the most modern styles and best workmanship. In the line of sash, doors, blinds, moldings, etc., the firm of Messrs. Rossman & Roeder, 845 to 851 Allport street, had a reputation second to none in the city. Their plant was of considerable magnitude, comprising two buildings, respectively 40x60 and 25x60 feet in dimensions, each two stories in hight. These structures were fitted up with the latest approved machinery and appliances, consisting of everything essential and requisite. A superior steam engine and boiler of ample horse power propelled the multifarious machinery, and everywhere effective completeness was apparent. Twenty skilled mechanics, astisans and others were constantly employed and liberally paid. The range of production embraced sash, doors, blinds, moldings, window and door frames, stair work, and scroll sawing. From a limited business at the start, the firm so increased their trade that in 1883 it amounted to at least $30,000 per annum, extending throughout the city and adjacent territory. No similar concern was more thoroughly prepared to execute work in this line in a better manner, or at more reasonable rates, while for promptness in filling orders they had a reputation equal to that of any competitors. Mr. Rossman had then been a resident of Chicago for thirteen years, and had been raised up in the business. He was eminently practical and thoroughly conversant with every detail of the manufacture. Mr. Roeder came to this city during 1882. He was also a skilled mechanic and a valuable addition to the firm. They were gentlemen of enterprise and integrity, and fully merited their liberal patronage.

One of the chief factors of the great and growing lumber trade of Chicago is that division exclusively devoted to the conversion of the rough material into dressed lumber and the manufacture of moldings, sash, doors and blinds. The marvelously perfected machinery with which inventive genius has provided the workers in wood, has insured such rapid work and reduced the price of prepared lumber to such a minimum figure that contractors, builders, and those engaged or interested in the construction of buildings have almost universally adopted the comparatively modern methods of placing their orders for such material with firms who are especially prepared to do that character of work. This accounts for the vast importance of those concerns devoted to the manufacture of moldings, sash, doors and blinds, which have become so numerous and extensive in the country of late years. Among all the firms in Chicago or throughout the great northwestern country, engaged in this particular business, there is not one that has won a higher name or sustained a more honorable record than Messrs. Gauger, Olver & Co. (succeeded by John A. Gauger & Co.), whose extensive factory is located at the corner of Twenty-second and Laflin streets. This firm, although engaging in the trade as recently as 1882, is composed of gentlemen of vast and extended experience in the business, who are abundantly able, both financially and otherwise, to extend the scope of its operations and push it rapidly forward to enlarged success. They carry a large and well-assorted stock of finished work at all times, and can fill orders promptly. The premises occupied by the firm cover a large area, most conveniently located, and in advantageous proximity to shipping facilities by water or rail. Their extensive factory is thoroughly fitted up with all the latest improved planers, molding machines, saws and wood-working machinery, and they have first-class engines aggregating an immense power, which are supplied by steam from a fine battery of boilers. The trade is largely confined to the city, but also extends throughout the North, West, East and South. A specialty is made of the manufacture of moldings in great variety and of good quality. Estimates, price lists and any information in their line will be furnished to the trade upon application by mail or personally. The members of the firm have resided in Chicago long enough to be ranked among the representative business men engaged in this line, and to gain for themselves an honorable position and unblemished reputation for commercial integrity.

The increased attention devoted of late years in this country to the production of fine interior wood work, moldings and kindred articles, has resulted in placing upon the market a very superior and greatly improved class of goods from those prevailing a quarter of a century ago. Among the leading and noteworthy firms engaged in this line in Chicago may be mentioned the enterprising and prosperous firm of S. T. Gunderson & Son, manufacturers of molding, casings, pilaster trims, etc., whose commodious and well-equipped establishment is situated at the corner of Twenty-second and Laflin streets, and whose products are in steady and extensive demand all over the West as far as Kansas City and Denver, also in the eastern and southern states, owing to the uniformly high standard of general excellence at which the work turned out here is maintained, while the business of the firm is very large and grows apace. This flourishing enterprise was started in 1885, and from the inception of the business, the trade of the firm has constantly and materially increased, growing from fifty to one hundred per cent. annually, until now it is very extensive. The factory is a 150x150 frame structure, supplied with heavy steam power (a hundred-and-fifty-horse-power engine being in service), and completely equipped in every respect with the most improved machinery, appliances and general appurtenances, while employment is afforded to numerous hands, the capacity of the mill being upward of seventy-five thousand feet of molding per day. A heavy and A No. 1 stock is constantly carried, including moldings, casings, pilaster trims, interior finish and fancy wood work of every description for dwellings, offices and stores; carload lots being a specialty, and all orders are promptly executed and filled. Severt T. Gunderson, a gentleman of fifty-two, was born in Norway, but has resided in Chicago since 1852, and prior to embarking in his present prosperous venture had been engaged in the lumber commission trade over twenty-five years. He is one of Chicago's stanchest citizens, has served with credit in the board of aldermen, representing the Tenth ward in that body, and is a popular and respected member of the Lumbermen's exchange. His son and partner, George O. Gunderson, was born in Chicago, and is under thirty years of age.

The business conducted by the North Chicago Manufacturing Company embraces, in connection with a finely equipped factory, sash, doors, blinds and the manufacture of builders' finish, etc. The company was organized and incorporated June 1, 1886, with a capital of $5,000. The premises at 51, 53 and 55 Pearson street are 75x100 feet in area, fitted up with the latest and best wood-working machinery driven by steam power, and twenty-five skilled workmen are employed in the different departments engaged in the manufacture of sash, doors and blinds, frames, brackets, balusters and interior finish, a large demand being supplied derived from the builders throughout the city and adjacent sections of the country. The president is Otto Benson; E. Strom, the secretary, who is from Norway, is a practical man at the business. The work turned out by the company is equal to the best in the city.

The firm of Sylvester & Mador is composed of Emil Sylvester and Edward Mador, their office being at 500 and 502 Twenty-first street. The firm was organized in November, 1886, with office at the corner of Fifteenth street and Blue Island avenue, and although they started in a very modest way, with no machinery, and employed only two men, their business has increased to mammoth proportions, and they now do an annual business of $75,000, and employ thirty men. In November, 1889, their establishment at Loomis street and Blue Island avenue, to which they had recently moved and in which they had put machinery, was burned to the ground, after which they removed to the premises of Hair & Ridgway, on Twenty-second street, where they remained until the spring of 1890, when they came to their present location, where they manufacture and deal in stair railings, newel posts, balusters, brackets, and do an extensive business in stair building, turning and band sawing, their plant being valued at about $6,000. Mr. Sylvester was born in West Prussia, Germany, and is twenty-eight years of age. He came to America about 1881, and at once located in Chicago, where he at once began working at the trade of stair builder, which he had previously learned in his native land, continuing this vocation until the organization of the firm of Sylvester & Mador. Mr. Mador was born in Quebec in 1851, and came to Chicago at the age of sixteen years, and here learned the stair-builder's trade, at which he was employed until he and Mr.

Sylvester formed their present partnership. He was married in 1878 to Josephine Parent, of Chicago, by whom he had seven children. Mr. Sylvester, who was married in 1886 to Miss Emma Lantenshlager, of Chambersburg, Penn., has two children. He is a Royal Arch Mason.

The firm of Filip, Raichart & Co. was organized on the 1st of April, 1887. The members composing the firm are Joseph Filip, John Raichart, V. J. Smidl and V. A. Smidl. They were incorporated January 1, 1891, with a capital of $20,000, fully paid up and divided into four equal parts. They are extensive dealers in sash, doors, blinds, frames, moldings, etc., and, besides manufacturing these articles, they also do turning and scroll-sawing, their place of business being at 862 to 870 Allport avenue. They began business with a capital of $2,000, but their trade has increased so rapidly that they now do an annual business of $200,000, and give employment to about fifty-five hands the year round. The mention of this firm in lumber and building circles carries with it, for various reasons, a prestige and confidence seldom enjoyed by any firm, and this is owing to the honorable manner in which they have always conducted their affairs and to their pluck and business capabilities. The men in their employ are experts, and turn out admirable work, and they are prepared to fill any contract and meet any opposition. Joseph Filip was born in Bohemia in 1860, but when a child was brought to America, and at the age of twelve years began learning his trade in Chicago, being employed by other lumbering firms, and having charge of shops for five years, until the above mentioned firm was organized. John Raichart was born on the 29th of May, 1862, in Baltimore, Md., and first worked for Palmer & Fuller, after which he was with different firms until he became foreman for Rossman & Roder, with whom he remained for about four years. V. J. Smidl was born in Chicago in 1863, and about 1883 began learning the details of his present business, being engaged in estimating and keeping books for different firms until the present lumber firm was established. V. A. Smidl was born in Bohemia in 1858, and about 1879 came to America. Having learned the trade of a cabinetmaker while still in his native land, he worked at it for some time, but after coming to this country he identified himself with the firm of Holly, Slama & Co., as a partner in the business, and until the organization of his present business he was associated with them.

Hintze & Weise are engaged in the manufacture of sash, doors, blinds, moldings, hardwood veneered doors, and fine interior finish of all kinds, on a large scale. They are located on the corner of Brown and Twenty-first streets, where they occupy almost the entire block, bounded by Canalport avenue, Brown, Clayton and Johnson streets. Their factory is filled with the latest and most improved machinery, and turns out almost $30,000 worth of manufactured work per month. They employ on an average about two hundred and fifty men, in and around their establishment, and have lately added a large five-story-and-basement brick warehouse, which is completely filled with staple sizes of sash, doors and blinds, which they ship to every part of the United States. In addition to this branch they do a large local business, furnishing fine hardwood interior finish for many of the finest houses in Chicago. Mr. R. A. Hintze, the senior member of the firm, was born in Prussia in 1849 and brought to Chicago by his parents at the age of three years, was educated in the public schools of this city, and in 1866 entered the employ of C. J. L. Meyer as office boy, leaving that gentleman's establishment in 1880, as its manager, in order to start the firm of Hintze & Baker, in the same line of business. In 1887 Mr. Hintze sold out his interest in this firm and at once started the new firm of Hintze & Weise. Mr. Simon Weise, who is also a native of Germany, has grown up in this line of business, and is admirably fitted to attend to the practical part of the business, which, in connection with the lumber yard, is his department and under his sole management; Mr. Hintze taking charge of the finances and all office work incident to the marketing of goods, making prices and securing the business necessary to keep the concern full of work, as the only means of insuring success.

The Columbian Grille Company, 3329 State street, manufacture grilles, fire screens, fret work and cabinet work of all kinds. The members of the firm are W. E. Craig and F. C. Gilbert. The business was established in 1891, and the special product of this concern is grille work. They are prepared to do residence or office work, having now a fine line of grille in the natural wood, and facilities for turning out a large amount of work in their line with great promptness. Although but a short time established, they are getting the cream of the trade in the southern and south-central parts of the city, and have a large and increasing búsiness coming from the west side. The members are first-class mechanics, thoroughly acquainted with every detail of their business, are genial, straightforward business men, and already command a large portion of the building trade of the city. They have furnished grille work for some of the most elegant residences and offices in Chicago, and have sent much work to different cities throughout the West. Their grilles are made from their own original and special designs, which are duplicates of no other manufacturers, so their purchasers may depend upon having the exclusive use of the designs placed in their offices or residences. Mr. Craig, senior member of the company, was born in Lehigh county, Penn., in 1844, a son of A. F. Craig. He learned the cabinetmaker's trade in his youth and is a thoroughly practical wood worker who has had much experience with hardwood. He has a pleasant home at 3329 State street. His wife died in 1890, leaving him with a son and daughter to care for. He is superintendent of the concern, and originates and draws designs for the elegant grille patterns and special work which they execute. F. C. Gilbert was born in Allensville, Essex county, N. Y., in 1863, a son of F. L. Gilbert. He learned the painter's trade, and is an expert finisher of hardwood, which renders his work valuable in finishing the hardword products of this company. He came to Chicago in 1890. He is a married man.

A. Plamondon Manufacturing Company. Integrity, conservativeness and fairness are the distinguishing characteristics of this company, and to these attributes doubtless is due much of their remarkable success. The firm is composed of Ambrose Plamondon and his three sons: C. A., George and A. D. The former is the president of the corporation; C. A., vice president; George, secretary and treasurer, and A. D., superintendent. The machinery manufactured by them is mostly in the line of gearing, pulleys, shafting, etc., much of it

A. Plamondon

suitable for planingmills, sash, door and blind factories, and other wood-working establishments, and finds a ready sale in the North, South and West. The capital stock of the company is $150,000, surplus, $75,000. Two hundred and twenty-five employes are comfortably quartered in a four-story brick building, 150x160 feet. Like a great many others who settled in Chicago in early days, Ambrose Plamondon, the senior partner and founder of the A. Plamondon Manufacturing Company, had a hard struggle at the outset of his career, his only capital being sturdy Canadian pluck and honesty of purpose, combined with mechanical skill. Mr. Plamondon was born in Quebec, Canada, in 1833, and after receiving a liberal education he settled in Oswego, N. Y., and learned his trade of millwright, where he was united in marriage to Miss Cecilia Higgins in 1853. In 1856 he came west and superintended the building of the Ottawa starch works at Ottawa, Ill., and built several flouringmills in the different states. In 1859 a modest shingle swung from a small wooden building on West Water street, bearing the names of Palmer & Plamondon, millwrights. Both members of the firm were young men and practical mechanics, but with a capital not to exceed $1,000. They quickly gained the confidence of the public through their good workmanship and prompt, business-like methods, and soon had all the millwright work they could attend to among the grain elevators and distilleries. As the city grew in population and importance, the young and enterprising firm kept pace with its growth and prosperity, and from millwrighting their field of labor gradually extended to the manufacture of pulleys, gearing and shafting. In 1864 the firm moved into their present commodious quarters, the increase in business having made such a step imperative. In 1868 Mr. Palmer severed his connection with the concern, the style of which was then changed to A. Plamondon & Co., continuing under that title until 1877, when it assumed its present name. During all the years that this company has been engaged in business, there has never been a strike at the works, owing to the liberality of the employers to their employes. Another remarkable circumstance lies in the fact that there has never been a shut-down since the first business venture in 1859. The machinery used in manufacturing is of the latest and most practical pattern. So enormously has the business of the firm grown that another removal in the near future is absolutely necessary. In anticipation of this ten acres at Rockwell and Polk streets have been purchased on account of its superior railroad facilities, on which a two-story brick building, 385x400 feet, will be erected. The buildings will be constructed of pressed brick and will cost in the neighborhood of $150,000. When they are completed five hundred employes will be carried on the pay rolls. The company will make a specialty of gearing and other power-transmitting machinery, and the establishment will be the largest of the kind in the United States. Of late years the senior member has allowed the active duties of the establishment to devolve upon the shoulders of his sons, who have proven themselves every way worthy of the trust reposed in them. Mr. Plamondon is a director of the Fort Dearborn National bank and a member of the La Salle club and also of the American Society of Mechanical Engineers. Besides the three sons mentioned above Mr. Plamondon has two daughters: Mary Emily, wife of John H. Amberg, of Cameron & Amberg, and Charlotte Jeannette, wife of Dr. J. B. Murphy, who is a prominent member of the medical profession.

George Bradford, who is a member of the Builders & Traders' exchange, is a prominent dealer in wood, coke and coal, at 587 to 595 West Twentieth street, and established his business at his present address, December 26, 1876. He began in a small way, with but a limited capital, having at first only one one-horse wagon. He now has a very large trade and the unlimited confidence of his patrons. He has thirteen wagons, and employs from twelve to fifteen men; and has also a large yard on Harrison street. He came to Chicago, October 16, 1870, from England, where he was born March 21, 1848, a son of Michael and Elizabeth E. (Bradford) Bradford. His father and mother died in England, the former in 1877, the latter in 1875. George Bradford was married January 17, 1870, to Miss Hannah Allebone, who is likewise a native of England, born in 1843. They have five children: George W., Frances E., John C., Emma E. and Benjamin A. Mr. Bradford was made a Mason in July, 1874, in Pleiades lodge No. 478, was demitted in June, 1883, and later joined Garden City lodge No. 141; St. Bernard commandery No. 35, and Medina temple. He is also a member of the A. O. U. W. Iron Clad lodge, and is past master workman. He is the present deputy grand master workman of the same order. He is a member of the Episcopal church. In addition to his large regular business, he has lately started a livery stable which is already largely patronized. His eldest son, George W., has charge of the office work. Mr. Bradford is one of the most conscientious, reliable, competent and active business men of Chicago. Wherever he is known his merits are freely acknowledged.

CHAPTER XIV.

DECORATORS, PAINTERS AND PAINT DEALERS.

Peter M. Almini was born in Smoland, Sweden, in 1825, and died in Chicago in 1890. His boyhood was passed in agricultural life. The death of his father left him at a tender age to care for his mother. His limited educational advantages compelled him to rely chiefly on his native intelligence to gather the crumbs of knowledge which fell within reach. That he did this to good purpose, his after life sufficiently proves. At the age of fourteen years he was apprenticed for five years to a painter at Ekesjo, a provincial town of Sweden. He subsequently spent one year at Norrkoping and later removed to Stockholm, where, under the stimulating influences of a wider field, he labored patiently for six years to perfect himself. How well he succeeded is attested by the fact that he was engaged for two years as assistant in the decoration of the palace of the king of Sweden. At the conclusion of his engagement there, somewhat enriched in pocket and greatly in the knowledge of his art, he went to Russia, whence, not finding a satisfactory opening, he embarked for the United States, landing in New York in 1852, at the age of twenty-seven years. Before the close of the same year he was settled for his life work in Chicago, a city of about thirty thousand inhabitants. Eager to exercise the skill he had spent so many years to develop, he soon resolved to establish a business for himself. Accordingly, in connection with Mr. Otto Jevne, he formed the firm of Jevne & Almini, to accomplish a purpose which he had always in mind, that of contributing to the pleasures and cultivation of his adopted city by the establishment of an art gallery. This was soon followed by the publication of *Chicago Illustrated*, a journal devoted to art and architecture. What progress the city had made toward Mr. Almini's standard of home decoration was suddenly checked by the great fire of 1871, and thence for a time houses of any kind which would afford temporary shelter were principally in demand. He now began a new departure alone, and three years later he was again a sufferer by the destructive fire of 1874. Recovering from this shock, instead of embarking in the general business of painting, he decided to devote his time and abilities to the higher grade of fresco work. The wisdom of this resolve has been made manifest by Mr. Almini and his successors in the decoration of a large number of houses and public buildings in different parts of the country. He soon, and for a long time, stood at the head of his profession, a position reached by actual merit and painstaking labor. He did his work well, leaving upon it the impress of his own original mind. He made a profound study of both ancient and modern art, and wisely used the knowledge thus gathered. He was a shrewd observer, and nothing that he could make use of escaped his notice. He enjoyed the respect and esteem of a wide circle of friends and admirers who appreciated his genial manners and sterling integrity and who could rely upon him to do any description of work from the highest to the lowest branches of his business. This success was obtained neither by inheritance nor force of circumstances, but principally through the faithfulness with which he did his work in the early part of his career and his thirst for knowledge and his eagerness to tread the higher walks of his profession. He was enthusiasm, faithfulness, and perseverance personified, and his life is worthy the emulation of all young decorators who are striving to win the honors of their calling.

The Almini Company. Peter M. Almini began business in Chicago about 1856. Later the firm of Jevne & Almini was formed, and it was dissolved in the fall of 1871 and succeeded by the firm of P. M. Almini & Co. R. H. Stewart connected himself with the old firm of Jevne & Almini about the close of the war, and has worked up from the ranks to the position of president of the Almini Company. After gaining a general and thorough knowledge of the business by travel and comparison in all the large cities and throughout the country, he located permanently in Chicago, satisfied that the wonderful future development of this city would afford him the grand business opportunity he sought. Mr. Almini very soon discovered that Mr. Stewart was possessed of the right kind of enterprise and determination, and a warm friendship was early developed between employer and employe, which ended only when Mr. Almini died in Mr. Stewart's arms in 1890. Mr. Stewart was placed in charge of the execution of important contracts, not only in Chicago but in various parts of the country, and was later given the superintendency of the city work of the concern. This embraced all classes of work then being done by houses in this line. The knowledge obtained in former days and by extensive travel was added to by the experience thus gained, and good work and adequate profits were the natural and pleasing results of Mr. Stewart's supervision, and when the firm of P. M. Almini & Co. was dissolved (Mr. Charles A. Bourne, the unnamed partner, retiring) Mr. Stewart was given the entire management of the business of the concern; and when, on the 1st of January, 1887, the Almini Company was incorporated under the state law, Mr. Almini became its president and treasurer and Mr. Stewart its secretary and manager. May 31, 1890, Mr. Almini was compelled to retire on account of rapidly failing health, and as at present organized the company is officered as follows: R. H. Stewart, president and George R. Stewart, secretary, with Paul Schubert as designer and superintendent of decorations. It was claimed by Mr. Almini, the founder of this house, that he did every important piece of decorative work that was executed in Chicago and throughout the Northwest down to about ten years ago, either individually or in connection with his partners, including residences, public buildings, halls, churches, etc. Among his earlier contracts were the old Board of Trade building, the old Tremont House, the old Grand Pacific hotel (all elaborate) and three thousand churches and residences in all parts of the country. He may be said to have controlled the mass of the decorating business of Chicago for fifteen or twenty years. Among his later contracts was that for painting the new Board of Trade ($10,000); that for painting Pullman, Ill., ($50,000); and that for painting the Pennsylvania railroad depot, ($10,000). He decorated the new Chicago Operahouse, the contract for which amounted to $10,000, the Milwaukee Board of Trade, the Mitchell bank building and Masonic Temple of Milwaukee, the Chicago Masonic Temple on Monroe street, theaters, churches, and numberless private residences and single rooms, the most expensive and artistic of their time, all over the country. Among the more recent Chicago contracts of the Almini Company may be mentioned the West Division Masonic Temple, the National Bank of Illinois, the Hyde Park church, the Englewood Congregational church, the Englewood Presbyterian church and the South Park Avenue Methodist Episcopal church. These are only a few among many, however. Conspicuous examples of the company's work outside of the city are the Georgia state house, at Atlanta; the public library building at Muskegon. Mich.; the Louisville hotel, at Louisville, Ky.; the Marshall county (Iowa) courthouse, and the Porter county courthouse at Valparaiso, Ind.

The death of M. J. Sullivan, in 1890. removed from the Painters' exchange, the Builders & Traders' exchange and the National Association of Builders. a most active, popular member, and from the business circle of the city the junior member of a firm, who for about thirty years was prominently connected with it. His work was art work throughout, monuments to which exist to-day in church and business buildings between the two oceans. He was among the first to be impressed with the sanitary qualities of blue glass, and in 1869–70 induced his brother, J. B. Sullivan, to secure control of the blue-glass trade. His funeral was a great public demonstration, the members of the Builders' and of the Painters' exchanges turning out *en masse*, and each body contributing floral pieces of rare design. The Builders' exchange, in special meeting, adopted the following resolution, as presented by George C. Prussing:

"With sorrow and regret we have heard of the sudden death of our friend, Michael J. Sullivan. We feel that a good man, an upright citizen, a true friend and a worthy member of the Builders & Traders' exchange has left us. He was kind and generous, alive to every advancement and progress, of sterling character and unquestioned integrity, and his reputation extended broadly over the land. He was liked by all he met, and made friends of all who were privileged to know him well. We feel his loss deeply and mourn with the bereaved."

Healy & Millet, 225 Wabash avenue, designers and manufacturers of fine stained glass, and artistic frescoers and general decorators, are among the leaders in their department of the building interest, not only in Chicago but in the entire country, and a work of the character of this which did not contain some mention of them and their achievements would be obviously incomplete. George Louis Healy is a son of George P. Healy, the portrait painter, and was born in Paris, France, December 29, 1856. Louis J. Millet, son of E. Millet, a composer and musician, and nephew of Aime Millet, the French sculptor, was born in New York in July, 1855. They both entered the School of Fine Arts, Paris, in 1873. and in 1879, after completing their course as architects and decorators, they came to Chicago, intending to make this city their permanent residence and the scene of their life work. They formed a partnership and embarked in the decorative business in 1880, opening an office in Music Hall building. Their work came into demand at once and it has embraced numerous first-class buildings of all kinds, among the more notable ones having been, besides the great Auditorium building, the buildings of the Calumet and Union League clubs; a number of elegant churches including Grace Episcopal church, Chicago; the Pueblo Operahouse at Pueblo, Cal.; the Metropolitan Operahouse at St. Paul, Minn.; a fine theater at Seattle, Wash.; McVicker's theater; the courthouse at Las Vegas, N. M.; the Central Music hall, Chicago; and the residences of Potter Palmer and others of Chicago's millionaires, besides many other magnificent residences in other cities. A very interesting notice of the decorative features of the Auditorium appears elsewhere in this volume and is well worthy of perusal.

One of the oldest decorative concerns on the west side is that of Louis Lattan, successor to Lattan & Tripp, house and sign painters, decorators, grainers, glaziers and wall-paperers, 123 and 125 West Madison street. Mr. Lattan is a house and sign painter of large experience and established reputation, and is extensively engaged in decorating, graining, glazing and wall-papering. The business was established in 1849 by Messrs. Lewis & Thompson, and in 1854 Mr. Lewis' interest in the business was purchased by Mr. T. Lattan, who became sole proprietor in 1855, admitting his two sons, Louis and Theodore, to partnership in 1862. This firm continued the business until 1872, when Mr. Louis Lattan assumed sole control, remaining as proprietor till 1879, when the firm of Lattan & Tripp was organized. Mr. Lattan employs a goodly number of hands the year round, and executes first-class work of all kinds in his line of trade with promptness, reliability and success. The best workmen only are employed in the different departments of painting and decorating, and the work performed has given the proprietor a fine reputation throughout the city. Louis Lattan is a native of Rome, N. Y., and came to Chicago in 1854.

The firm of Mitchel & Halbach, designers and interior decorators, 264 Michigan avenue, consists of Otto William Mitchel and J. Frederick A. Halbach. Mr. Mitchel was born in Vesbeck, Germany, October 8, 1853; Mr. Halbach in Peru, Ind., December 25, 1856. Mr. Mitchel has been a resident of Chicago since 1873; Mr. Halbach since 1877. As apprentice colleagues and employes in the same decorative establishment, they began an acquaintance resulting in a determination to unite their talents and fight side by side for the victory they have won. Their partnership dates from January, 1885. An opportunity soon presented itself for them to figure on the decoration of the City hall, and the contract was awarded them at one-third of the price of the highest bidder. This was the starting point of their advancement. They did a great amount of labor and sustained much mental strain, but paved the way for an after career of success. The prompt and thorough manner in which they carried out this contract, employing the best workmen and the most direct and efficient methods, attracted such attention to them that they may be said to have bounded into sudden and well-deserved popularity. They decorated the State capitol at Springfield in the fall of 1885, and later did considerable work in Chicago, and soon an opportunity was offered them to enter a competition for the contract for the decoration of the Broadway theater in New York. They made thorough studies for the work and secured the contract, the successful bidders among thirty-six. The decorative features of the Broadway were a novelty, and attracted such attention that during the following year Mitchel & Halbach decorated no less than twelve theaters in the principal cities of the United States. First and last they have decorated a large number of this class of buildings, prominent among which are the following: The Broadway theater, N. Y.; the Tremont theater, Boston, Mass.; Hooley's, the Columbia, Havlin's, the Chicago Operahouse and the Lyceum, Chicago; the Baldwin and Bush Street theaters, San Francisco, Cal.; the Peavey Grand Operahouse, Sioux City, Iowa; the People's theater, Minneapolis, Minn.; the operahouses at Altoona, Penn., and Mansfield, Ohio; the Fuller Operahouse, Madison, Wis.; Havlin's theater, Cincinnati, Ohio; the Timmerman theater, Englewood, Ill.; the Auditorium, Spokane Falls, Wash.; the grand operahouses at St. Paul, Minn., Dubuque, Iowa, Canton, Ohio, and Bloomington, Ill.; the Davidson theater, Milwaukee, Wis.; the Lyceum theater, Memphis, Tenn.; the Broadway theater, Norwich, Conn.; Myers' Operahouse, Janesville, Wis.; the Du Bois Operahouse, Elgin, Ill.; the Duquesne theater, Pittsburgh, Penn.; the Sorg Operahouse, Middletown, Ohio, and many others throughout the country. The Tremont theater, Boston, is considered one of the finest in the United States in point of decorations. Among the most elegant residences are those of Martin A. Ryerson, Conrad Seipp, R. T. Crane, P. D. Armour, Marshall Field, Charles L. Pope and G. T. Smith, Chicago. William H. Crocker, Alvenza Hayward, John F. Merrill and Moses Hopkins, of San Francisco; P. P. Mast, Springfield, Ohio; R. W. Woodbury and Alfred Butters, Denver, Colo.; Charles L. Chapin, Niles, Mich., and J. D. Oliver, South Bend, Ind. Among their hotels are the Baldwin, San Francisco; the Bates house, Indianapolis; the Burnet house, Cincinnati; the Galt house, Louisville; the St. Julien hotel, Englewood, and the Hotel Metropole, Chicago. Their best churches are the First Presbyterian church of Decatur, Ill., and the Presbyterian church of Peoria, Ill. They also decorated, among many other churches, the First Methodist Episcopal church, the First Baptist church and the Congregational church, all of Springfield, Ill., and the First Methodist Episcopal church of Lincoln, Ill. Their latest pieces of work, aside from residences and churches, are Spaulding's jewelry store, at State and Jackson streets, and the Hotel Metropole, at Twenty-third street and Michigan avenue. These, it is believed, will be in some respects the finest examples of decorative painting in the United States. For the diningroom and restaurant of the Metropole, Mitchel & Halbach made the designs for everything, furniture included; also the wood work and stained glass, and furnished the plastic ornamental decorations from their own designs, and the entire decorative work is from their own special designs, the main diningroom being decorated in the style of the first empire, the restaurant in the style of Louis XVI. The first floor of the Spaulding store is decorated in the Louis XVI. style also, with beautiful garlanded frieze; and the plastic ornamentation and decorative designs are original with Mitchel & Halbach, which is true also of the second story, finished in the style of the Renaissance. The residence of Marshall Field, Jr., 1919 Prairie avenue, which will soon be completed, will be one of their most complete pieces of work, as they have made studies for the wood work, gas fixtures and electric lighting, furniture, leather, wood floors, carpet as well as their decorations, plastic ornamentation and stained glass. All the work is executed under their supervision, and when completed this will make one of the most artistic as well as magnificent residences in this city. One of their recent achievements was their rebuilding, in 1890, of the residence 264 Michigan avenue for their own use as offices, receptionrooms and studio. The principal receptionroom, in its important features, is a duplicate of the receptionroom of Mrs. Moses Hopkins, of San Francisco, the decorations of which were designed and executed by them. An important branch of their work is the designing and furnishing of original ornamental stained glass for all classes of buildings. They have the enthusiasm of true artists, and are satisfied with no achievement that does not call for the exercise of all of their skill, taste, judgment and originality. Their motto is, "There is nothing too good for anybody," and they are devoting their best energies and the best years of their lives to a promising attempt to educate the public up to this idea.

Murdock Morrison, who is located at 582 Thirty-seventh street, is probably the oldest painter in the city of Chicago. He was born in Glasgow, Scotland, May 3, 1834, to Murdock, Sr., and Elizabeth (Murray) Morrison, both of whom were born in Scotland, in which country the father learned the painter's trade. In April, 1841, he took passage on the sailing vessel Shakespeare, which was considered the best and swiftest ship on the deep water at that time, and at last reached New York city, the voyage from Liverpool occupying about four weeks. He came to Chicago via the great lakes on the steamer Illinois, reaching this city June 5, 1841, the city at that time comprising a population of about six thousand. He moved to a farm near Dundee, in Kane county, soon after, on which he remained until the summer of 1849, when he moved to Elgin, where he began business at his trade as house painter and continued until 1854, at which time he returned to Chicago with his family, remaining here until his death, which occurred March 22, 1860. He was the father of seven sons and two daughters, seven of which family are still living. Murdock Morrison, the subject of this sketch, is the eldest of the living sons, and was but seven years of age when he came to this country. He was educated in the public schools, was brought up on a farm, and learned the painting trade under the guidance and instruction of his father, his term of apprenticeship beginning in the fall of 1849, and has followed this calling ever since, and since April, 1854, has been one of the leading painters of Chicago. In 1852 he commenced work with the firm of Thompson & Allston, which was then the largest painting firm of the city, remaining with them two years, or until 1854, when he formed a partnership with his father, which continued under the firm name of M. Morrison & Sons until the father's death, when it was changed to M. Morrison & Brother, and as such was in existence until 1881, when it was dissolved. Since that time Mr. Morrison has been alone. He has been awarded the contract for painting many of the finest public and private buildings, the following of which may be specially mentioned. The first contract (and still a west side landmark), at the time considered the best building on the west side, was the building on the northeast corner of Randolph and Canal streets, erected in 1854; the same year the residence of Elliott Anthony (now Judge Anthony), on La Salle avenue; the house built the same year by Sylvester Sexton, on the southwest corner of Twelfth street and Indiana avenue, considered one of Chicago's landmarks; Henry Horner's store on West Randolph street; the residence of Robert H. Foss, on the northwest corner of Monroe and Throop streets; the Peck court and Michigan avenue house built by E. J. Chapin; Hon. Thomas Hoyne's residence, on Michigan avenue; Washington Smith's residence, on Michigan avenue, now owned and occupied by Ex-Alderman Rosenberger; a block of thirteen houses on the northeast corner of Michigan avenue and Thirteenth street; a block of thirteen houses on Indiana avenue and Thirteenth street; the original Grannis block, now the Illinois Bank building; the present Grannis block, on Market street; the Adams block, on Market street; the Keep building, on State street near Van Buren; the S. B. Cobb building, on the southwest corner of Lake street and Michigan avenue; the Hale & Ayer building, on the southeast corner of Lake street and Michigan avenue; E. G. Hall's building and the one adjoining it south; the McCormick building, Lake street and Michigan avenue; B. V. Page's residence, on Dearborn avenue; the Erring Woman's Refuge, on Indiana avenue and Fifty-first street; a block of stores and flats at Prairie avenue and Thirty-first street; all the hardwood finishing in the First Presbyterian church; a block of nine houses on Indiana avenue and Sixteenth street; thirteen houses built by J. Y. Scammon; C. B. Carter's residence, on Vernon avenue; Norman B. Ream's present residence; L. H. Turner's residence, Greenwood avenue, Hyde Park; Henry Warner's residence, Prairie avenue, north of Twenty-ninth street; the Byram residence, on Michigan avenue near Twenty-ninth street; a block of seven houses on Indiana avenue north of Twenty-first street; E. A. Slaughter's residence, on Michigan avenue near Thirty-second street; A. Grannis' residence, on Indiana avenue and Twenty-ninth street. Mr. Morrison was married May 3, 1858, to Miss Mary Blakesley, and on the 19th of March, 1885, took for his second wife Bertha W. Rack, by whom he has three children: James M., born January 26, 1886; Martha E., born July 22, 1887, and Emma, born August 16, 1889. He and his wife are members of the First Baptist church, and he is a member of the Builders & Traders' exchange.

Peter Emmel's Sons, painters, decorators and paperhangers at 500 Wells street, are among the leading business men in their line in the city, pushing, energetic, and accordingly prosperous. The business was established in 1855 by Peter Emmel on the site of the present store, but he retired in 1887 and was succeeded by his sons, Henry G. and Peter O. Mr. Emmel, Sr., was born near Frankfort, Germany, and when young came to America and located in Buffalo, N. Y., where he learned the painter's trade. He first came to Chicago in 1854, and the following year embarked in business for himself, and at the present time is one of the oldest painters in Chicago, his many years of practical experience in his line of work placing him at the topmost round of the ladder. His work has always been strictly first-class, and some of the handsomest and best buildings of the city were finished by him—the Custom-house, Church of the Ascension, St. Anthony's church, Conrad Seipp's residence, besides numerous others. Henry G. and Peter O. Emmel learned the details of painting, decorating, and paperhanging in their father's store and are now admirably fitted to successfully carry on the business so auspiciously inaugurated by him. At this time they rank among the foremost decorators of the city, and do all classes of fine work of a very artistic and tasteful character. Henry G. Emmel was born in Chicago in 1859 and was married in 1885. He is a member of the Apollo Musical club and the Germania club. Peter O. Emmel was born in Chicago in 1863 and is also married. He belongs to Hesperia lodge No. 411, A. F. & A. M., and St. Bernard commandery No. 35, and is a member of the Douglas club. In this popular decorative establishment about one hundred men are employed during the busy season.

The business of C. W. Stephan & Co., interior decorators, whose studio and offices are at 597 Wells street, was established by Mr. C. W. Stephan in 1886, and the firm of C. W. Stephan & Co. was formed by Mr. Stephan and A. H. Thompson in March, 1891. Until the date last mentioned Mr. Stephan did a general decorative business and now, under the management of Mr. Thompson, who is a practical wall-paper man, the firm has extended and brought into great prominence its wall-paper department. Mr. Stephan was born in Boston in 1861, and received his education in that city of good educational institutions. He studied art in Europe, making Turin his headquarters, carefully observing some of the best models in the old world and gaining from an inspection of the products of old masters valuable ideas on decorative work which he could not have obtained otherwise. He is a picture painter of talent, experience and recognized skill, and in a practical way he has been connected with decorative work as a decorative picture painter nearly all his life, and with him the acquisition of the more purely mechanical part of the work was a secondary and later consideration. He successfully combines the principles of the higher art with the finest grade of decorative work, imparting to his products original designs of a high order of merit and such artistic excellence as are generally found only in a good class of picture painting, in many cases combining the execution of really fine oil pictures with more common but scarcely less elegant legitimate decorative work on ceilings and side walls. Some of his residence work will compare favorably with any in America, and sketches in the studio of the firm are of such a character as to arrest the attention of art-lovers and critics. Mr. Stephan came to Chicago only a few years ago, totally unknown and with the way to reputation and fortune all untrodden before him. His work has found favor only on its artistic merits of beauty in design, color and finish. The line along which he has advanced has been indicated above, and it is one available only to such a man as Mr. Stephan, possessing the talent and enthusiasm of the born artist in combination with the skill and confidence of the trained workman and the judgment and energy of the practical man of affairs. Indeed, both members of the firm are business men of much ability, and both have a technical knowledge of decoration in all its relations, which enables them to compete with any house in their line in the city. Mr. Thompson was born in Chicago in 1865, and is a life-long resident of the city. His connection with the wall-paper trade, to which he gives special attention, dates back ten years or earlier.

A house which is one of the oldest in its line in the city is that founded in 1852 by Mr. George Drake, the father of the present proprietor, who purchased the business in 1857, and has for the past thirty-four years conducted it with marked success. He is a native of England, and has resided in Chicago since 1852. The business is a very extensive one, and requires the constant employment of a large number of skilled workmen. The establishment at 217 West Madison street is very thoroughly fitted and furnished for the exhibition of the varied stock. Mr. Drake is a dealer in all materials necessary for ornamentation and painting, comprising paperhangings in all the newest styles and designs, in rich, bright shades and tints of imported and the best American goods, and a full assortment of mixed and dry paints, artists' materials, window shades and fixtures of every description, etc. Mr. Drake is noted for his excellent work in painting and wall decoration. Painting, in all its branches, and papering are executed promptly and with a degree of good taste in keeping with the requirements of Chicago's cultivation and improvement. Estimates are given for all classes of work, and Mr. Drake's patrons are among the best class of the residents of Chicago, and it is their patronage that he solicits.

One of the oldest interior decorators and sign manufacturers in the city is William Edmonds, 199 South Clark street, who is seventy-eight years of age. He is a native of England, and came to the United States nearly sixty years ago. For a quarter of a century he was in business on his own account as a manufacturer and engraver of metal signs, sign painter and interior decorator, in Brooklyn, N. Y., and for upwards of another quarter of a century he has been similarly engaged in Chicago. In 1862 he opened a business establishment on Randolph street, and in the great conflagration of 1871 this was utterly wrecked. He resumed business on Clark street, and eight years ago removed to his present premises at 199 South Clark street. In engraving brass and other metal signs, and in painting ornamental signs, Mr. Edmonds displays skill, judgment, taste and originality. Mr. Edmonds also executes all kinds of metal engraving and attends to interior decorative work of every description. He employs a large staff of competent workmen.

One of the old established and most successful houses engaged in selling and hanging wall-papers, etc., in Chicago, is that of Mr. J. McDermott, 242 Thirty-first street. This gentleman has been established in this business for a period of twenty-four years. He was among the first to introduce tropical painting and decorating on walls, and is a large dealer in paper hangings. His store is spacious and attractive and finely fitted up. Here may be seen the latest novelties in wall-paper, Lincrusta Walton and paper hangings of every kind, from ten cents to $10 per roll. Many of these goods have been imported at great expense from celebrated English and French manufacturing houses, and include gold and highly colored parlor and drawingroom papers, with beautiful dados and friezes to match, rich library paperings in imitation of leather, carved oak and walnut, all at fair and reasonable prices. Mr. McDermott is especially successful in the decoration of interiors, using an embossing process in imitation of carving and papier mache, which is much to be preferred for its cheapness and durability. He undertakes every description of painting, calcimining, frescoing, graining and marbling; employs a large force of skilled and experienced hands, and executes all work with promptness and artistic taste. He decorated the drug store of Mr. William A. Dale, on State street, a very fine piece of work, and his skill is shown in hundreds of instances throughout the city. Designs and estimates for work are promptly furnished on application. Mr. McDermott is a native of Cumberland, Md., and has been a resident of Chicago for the past twenty-four years, and is a member of the orders of Foresters and United Workmen.

R. F. Beckwith is a well-known painter, calciminer and paperhanger of Chicago, and is also an artistic, tasteful and experienced decorator, the neatness and grace of his work indicating that he possesses ability of a high order. He established his business in 1865, and has continued with almost uninterrupted success to the present time, for the people of this progressive age have not been slow to discover that Mr. Beckwith is experienced and competent. His place of business is at 699 Congress street, at the corner of Ogden avenue, where he is prepared to fill all orders with skill and promptness. He was born in Meredith, Delaware county, N. Y., October 10, 1832, and when about two years of age was taken by his parents to Townsend, Huron county, Ohio. He remained with them until the spring of 1848, when he left home and went to Fond du Lac, Wis., where, two years later, he married Miss Lucy A. St. Ores. He afterward removed to Fulton, Ill., and two years later to Oconto, Wis. At this place he engaged in the lumber business, continuing until 1861, when he sold out and enlisted as a private in Company F, Twelfth Wisconsin volunteer infantry, with which regiment he served until the fall of 1863, when he was promoted to the captaincy of Company G, Thirty-eighth Wisconsin volunteer infantry. The war having been terminated, he was mustered out of the service June 28, 1865, and returned to his home with the consciousness of having performed his duty faithfully and well. After remaining at his home in Wisconsin for about two months, he came to Chicago and engaged in the painting business, and has since been a successful business man of this city.

An important business establishment on Blue Island avenue is that of Mr. Henry Bosch, at No. 120, which dates its existenee from 1866, when it was established by the firm of Otto & Valk, and it was continued as such until 1873, when it came under the control of Otto Bros. During the next ten years there were several changes in the conduct of the business, and in 1880 it came under the sole management of Mr. Bosch, who has enlarged the facilities and extended the trade. The premises, embracing store and wareroom, having combined dimensions of 20x120 feet, are well arranged and provided with every facility for business purposes, and a large stock of goods is always carried to meet the demands of the wholesale and retail trade. In this assortment will be found everything in the line of ready-mixed paints, also

DRAWING FURNISHED BY BURKE & CO.

PART OF PAVEMENT FOUND AT CIRENCESTER, ENGLAND, 1849.

those dry and in oil, and painters' supplies and materials generally, together with a large and varied line of new, beautiful wall-papers in all the rich, elegant designs and patterns, from the most distinguished manufacturers in the country, also window shades and fixtures in great profusion and window glass in all sizes, as well as colored glass. Mr. Bosch came to this country from Amsterdam, Holland, in 1866, and was engaged as a practical painter in 1867 with Barry & Cushing, and started in business in 1879 with little capital, and after years of hard and honest labor is recognized as one of the leading men in his line in his part of the city. He has been a citizen of Chicago since 1867.

George W. Manning is a painter and decorator of much ability, and in 1866 established himself in business at 171 Washington street, and after the fire at 55 Clark street, where he did a successful business until two years since, when he located at 4218 Cottage Grove avenue. He is a native of Baton Rouge, La., where he was born in 1841, and his early life was spent in the South. In 1865 he came to Chicago, and the following year established his present business, which has grown to goodly proportions. His work has entered into many of the finest residences and largest business and public buildings of the city. He has a large patronage in all departments of his trade, for his work is strictly first class and gives universal satisfaction. He is one of the oldest painters of the city, and during his long business career he has become well and highly honored, both in a business way and socially. He is a member of the Builders & Traders' and Master Painters' exchanges, and socially is a member of the Masonic fraternity and the I. O. O. F., and has held official positions in both lodges.

Among those engaged in the sale of wall-paper, painting, and calcimining, perhaps none are more favorably known than the Messrs. Tehle Bros., at 205 W. Twelfth street. John and Walter Tehle, who are both natives of Bohemia, have been citizens of Chicago for many years, and established their business in 1867, and from that time onward have met with success and won an enviable reputation as artistic workmen and as honorable, upright business men. The premises occupied are ample, the store is of large dimensions; in the rear is a workshop and a spacious store house. In the store a full and general line of new and beautiful wall-papers in the latest designs and patterns are always kept on sale; also paints, oils, brushes, window glass and painters' supplies generally. Messrs. Tehle Bros. also make contracts and execute work of all kinds as house, sign and ornamental painters, paperhangers and interior decorators, and are considered by property owners, builders and tenants among the best and most careful workmen in the city. The members of the firm possess thorough experience.

A decorator and painter of prominence a few years ago was Henry H. Meech, who is still living. He conducted a fine establishment in the wall-paper, window shade and painting line at 512 and later at 510 north Clark street. Mr. Meech was born in the state of New York in 1837, but has been a resident of Chicago since 1867. He occupied a fine store and basement of ample dimensions, both of which were well fitted up and thoroughly equipped. He displayed in his store a fine and well selected stock of foreign and domestic paperhangings, borders, center pieces, dados, cornices and other goods of that description, also an unsurpassed line of window curtains, etc. He also carried a complete line of paints, mixed and unmixed, white lead and zinc, colors of all kinds, oils, varnishes, brushes, putty, window-glass and other painters' supplies. Mr. Meech was possessed of a wide range of practical experience in all the different branches of paperhanging, fresco painting and artistic decorating, graining, marbling, tinting and calcimining. He employed as many as fifty first-class workmen and artists during the busy seasons.

Otto Schmidt, painter, is located at 3427 State street. He was born in Germany in 1845 to August and Fredericka Schmidt, and in his youth received a good English as well as German education. In 1848 he came to America and settled in Manitowoc, Wis., his parents living there until their death. At the age of seventeen years he went to Aurora, Ill., but shortly after came to Chicago and here finished his apprenticeship at the painter's trade, which he had begun in Wisconsin, under Schmitt & Vaner. He worked for them until 1868, then began business for himself at the corner of Wells street and Fifth avenue, where he remained until after the great fire of 1871, when he was burned out. He soon after located at 329 State street, remaining at that stand until July 14, 1874, when he was again burned out. Nothing daunted by these misfortunes, he immediately located at 490 State street, thence moving to the corner of Harrison and State streets, and in the spring of 1890 came to his present place of business, where he has a large trade and is deservedly prosperous. He does an annual business of from $20,000 to $30,000, making a specialty of residence work, although his services are often required by government architects and by builders. He is well known, and his work will bear the closest inspection. In connection with his business he keeps a fine stock of wall-paper, paints, oils, etc., and is prepared to fill any contract or order given him in the latest and most artistic style. He is a member of the Builders & Traders' exchange, the Master Painters' association, the I. O. O. F., and of Garden City lodge A. F. & A. M., Chicago chapter and St. Bernard commandery. He resides at 5654 Wentworth avenue, Englewood.

John McDermott is a prominent painter and decorator and dealer in wall-paper, etc., at 242 Thirty-third street, Chicago. He was born in the town of Cumberland, Md., in 1839, and is the son of Thomas and Maria (Beemes) McDermott. He grew to manhood in his native state, where he was educated, and later learned his trade in Philadelphia, where he served an apprenticeship. He came to Chicago in 1864 and began working at his trade with Bent & Goward. He thus continued for one year in the service of other people, at the expiration of which time he (1867) he started independently for himself at 244 South Water street, and later at Van Buren and Clark streets, at the present site of the McCoy hotel. Some time later he removed to 110 Monroe street, where the Columbia theater now stands, but left there in 1880 and located at his present stand. Mr. McDermott has done some of the best work in his line in Chicago, notably on Wood's museum and the Academy of Music, but his largest work was done in residences throughout the city. A very beautiful specimen of his work may be seen at the residence of Mr. Shaw, at 2125 Michigan avenue. He is the inventor and the owner of a one half interest in a machine for graining on bare wood, which is claimed to be the only practical graining machine ever devised. Its claims of superiority are based on the fact that the grain of any wood that can be mentioned is done with it in oil on bare wood, and can be removed only by planing, as it will neither wash off nor crack off, and can not be removed by sandpapering, being literally in instead of on the wood. Mr. McDermott was married in this city in 1867, to Miss Theresa F. McLaughlin, and by her has one son, William, who is associated with his father in business. In 1862 Mr. McDermott enlisted in Company G, One Hundred and Twenty-seventh Pennsylvania regiment, and participated in several important battles, among which were Antietam, Port Tobacco, Fredericksburg and others. He was discharged in 1862, but re-enlisted at Fort Leavenworth, Kas., and in that state participated in Price's raid and several other important military movements. He received his final discharge in 1864, when he came to Chicago. He is a member of Lincoln Post, G. A. R., of the Foresters, of the Royal League, of the K. of H., the Master Painters' association, the Builders & Traders' exchange, and is president of the Eagle Loan & Homestead association at 2967 State street. Mr. McDermott is doing a large business, and his work is strictly first class.

Among the old-time house decorators must be classed Charles H Cubbon, of 883 West Madison street and 38 Fifth avenue, who has devoted some twenty years to the various branches of that business in this city. Coming West when the big fire called mechanics from every quarter of the globe, Mr. Cubbon secured his first job from Mr. Potter Palmer, being soon afterward placed in charge of the painting department on that gentleman's tenement property under the superintendency of his brother, Mr. W. D. Palmer. Mr. Cubbon has been in the employ of the most prominent of the older firms in his line, and was engaged also six years with the Chicago & Northwestern Railway Company. In 1880 Mr. Cubbon commenced business for himself, his effort at first being of a modest character; gradually it has grown until his is numbered among the more prominent establishments of the city. He has handled some of the largest contracts of recent years, including the Lindell hotel at St. Louis, the Union Cold Storage & Warehouse Company's building at the corner of Sixteenth and State streets, and the ship Argo for the Argonaut Club. Mr. Cubbon is a thoroughly competent workman with old fashioned ideas about lead and oil, and has little patience with new-fangled notions of cheap materials and lightning workmen, believing that good work needs good materials and time sufficient to do it justice. He also has the reputation of being one of the most expert wall-paper men in the trade, being very successful in the harmonizing of tints. Mr. Cubbon is somewhat prominent in British-American circles, being chairman of the executive council of that organization, belonging also to the Masonic fraternity, Foresters, National Union and American Legion of Honor. He was also a member of the citizens' committee which nominated Mr. Elmer Washburne for mayor of Chicago.

Adolph Muus is a general painter and decorator at 344 Blue Island avenue, and also deals in wall-paper, paints, glass, etc. His business was established at his present location on the 15th of April, 1870, by his father, Adolph Muus. The latter was born in

Germany about 1820, and in 1852 came to Chicago, being one of the city's pioneer citizens. He was a merchant by calling, and became quite well known, for besides being a park commissioner for a number of years, he stood high in political circles. He was married in this city to Miss Albertina Schmeling, and by her reared a family of one son and three daughters: Adolph, Amanda, Alvena and Metha. He was a member of the I. O. O. F., and died on the 6th of January, 1889, his widow passing from life in September, 1890. In this city Adolph Muus, the immediate subject of this sketch, was born in 1865, and here he acquired his education in the public schools. He began taking sole charge of the store in 1882, and from that time carried on a fine painting and decorating business, and is now doing a business of $20,000 per year, in the busy season employing from twelve to twenty men. He keeps a full and select stock of goods, and his work has entered into some of the finest buildings of the city, among which may be mentioned a fine church on Jackson street; the sash, door and blind factory of Henry Sheens; the residence of S. Levi, at 431 Ashland boulevard; a building for S. Klein at the corner of Halsted and Fourteenth streets; the paper decoration of Apollo hall; and numerous others. He is doing a fine line of residence decorating, and has fully carried out the expectations of his patrons, his work being noted for artistic design and for harmony of color. He is a Knight Templar in the Masonic fraternity, is a member of the A. O. U. W., and as a business man is honorable and upright and commands the respect of all with whom he comes in contact.

The W. H. Stubbings Company, painters and interior decorators, 575 West Madison street. There is no better evidence that the days of shoddy have forever passed away than is found in the genuine elegance of our homes. We can all of us remember those days which followed the accumulation of large fortunes in a short time directly after the war, creating a sham aristocracy devoid of culture and refinement. The lack of these qualities was reflected in the tawdry interior decorations and furnishings of the homes of the newly rich, as plainly as in their dress and manners. No wonder Chicago was the subject of ridicule by visitors from the art centers of the old world, for American interiors of fifteen or twenty years ago, with their incongruous decorations and furnishings, must have been painful to the eyes of those familiar with the drawing-rooms and salons of Europe. To-day all this has changed, and on every hand we may see the influence of wealth combined with culture and refinement in our splendid architecture and in the tasteful and elegant ornamentation of American homes. In this connection we can not be unmindful of the conspicuous part which American decorators have taken in educating our people up to a refined standard, for without competent artists in this line, possessed of marked originality, we should still be far behind the old world in these matters. Of the many noteworthy houses whose work has always commanded unqualified admiration, the W. H. Stubbings Company deserves special mention. This house is an old established one, having been founded some time since by its present head, W. H. Stubbings, and during its long career has proved itself to be one of the most progressive in the line of interior decorating in the country, carrying a very comprehensive assortment of wall paper and paper decorations, and an examination of this stock shows the nice discrimination with which it has been selected, and also how great an advance has been made in paper decorating during the past few years in the originality, novelty and variety of designs, and the faultless execution which characterizes present methods of manufacture. The company displays many elegant and exclusive designs in hand-painted hangings, and these are to be especially commended where it is desirable to give a distinctive character to the embellishments of an interior. One of the important departments of the business of this house is devoted to painting, calcimining and fine tinting, fresco and decorative work of all kinds. In this line its work evidences the exercise of masterly skill in its execution and a high order of artistic ability in design. The reputation of the house has long since extended beyond local boundaries, and its handiwork may be seen in many of the finest halls, operahouses, churches and private buildings in the country.

Gordon Meyers was born in Ohio in 1851, and is the son of James Meyers. He received a common-school education in youth, and learned his trade in Richland county, Wis., where he worked for a number of years. In 1864 he enlisted in Company F, Forty-first Wisconsin volunteers, and served about five months, and was in several important actions. He was at Memphis in 1864, when Forrest came through that vicinity. He was honorably discharged in August, 1865, after which he returned to Wisconsin and resumed his trade. Later he located at Three Oaks, Mich., where he remained about eight years, and in 1882 began business for himself. Later he came to Chicago and began working for Henry J. Milligan, but at the expiration of one year he again started out for himself, locating at 202 Washington street, where he remained until he came to his present location. He has a large and handsome salesroom, well stocked with fine wall-paper, window shades, paints, and oils. Associated with him is Mr. E. M. Williams, the firm being known as Meyers & Williams. They give attention to cleaning hardwood, fresco work, painting, decorating, glazing, calcimining, tinting, graining, etc., and all their work is strictly guaranteed to be first class. The office of the firm is at 512 Sixty-third street, Englewood. The firm has a very extensive trade among the residents of Englewood and vicinity. Among the buildings fitted up by Meyers & Williams are those of John Whittlesey at Auburn Park; Mr. McMillar, at Auburn Park; S. J. Campbell, of Eggleston; Mrs. Sue Maple, of Eggleston; Captain Phillips, of Englewood; George Ebersol, Englewood; Mr. Johnson, of Englewood; M. Cowels, of Englewood; J. C. Fortner, of Englewood; the Burnes block, the Murphy block, the Remner & Waite building and many others. The firm is one of the most efficient in its line in Chicago. Mr. Meyers has made a specialty of painting and decorating, and understands thoroughly the details of this interesting art. He was formerly a member of the Master Painters' association, No. 1940. E. M. Williams, of the firm of Meyers & Williams, dealers in wall-paper, etc., at 512 Sixty-third street, Englewood, is a native of Maine, aged about forty-four years, and is a practical painter and decorator, and one of Chicago's well-known business men. He came to Chicago in 1886 and two years later entered into partnership with Mr. Meyers. Before coming to Chicago he had been engaged in the same business successfully at Bangor, Me. Mr. Williams has had thirty years of continual practice in paperhanging, graining and decorating, and, without exaggeration, is an expert in every sense of the word, having never finished an unsuccessful job during his whole career. Among a few of the buildings which he would particularly call attention to are Mrs. Veider's house on Sixty-third street; Mrs. John Foley's, at 636 Chestnut street; Mr. Johnson's, on Sixty-first street, near Wright, and Mr. Thompson's, on Chestnut street, near Wentworth avenue. The firm make a specialty of fine paperhanging and decorating, and give employment to about thirty men, doing an annual business of over $20,000. They exhibit some of the finest artistic decorative work in Chicago. Mr. Williams was married, in 1891, to Miss Nettie Meyers, of Aurora, Ill. He is a member of the Masonic fraternity and I. O. O. F.

E. H. Humphrey, who is located at 80 Van Buren street, is doing a large general painting and decorating business. He was born in North Wales in 1828, and in 1850 came to this country and settled here in 1855. He learned his trade of painting and decorating thoroughly in England before coming to this country, and for a considerable time followed it in London. Upon reaching Chicago, he first secured a position with the Chicago & Milwaukee Railway Company as master painter, and with this company continued until 1861, when he secured a situation with the Galena & Chicago Union, where he remained until that organization and the Chicago & Milwaukee Railway consolidated, and then became painting master of the new road. In 1872 he left that company and branched out for himself at the corner of La Salle and Morgan streets, where he has since done a constantly expanding and profitable business. He does a general line of painting and decorating with the most improved materials and methods, and stands high among Chicago's business men. In June, 1889, he located at his present stand. He now has in his employ from forty to fifty men throughout the year. His artistic work may be seen in the Grand Pacific hotel; the Royal Insurance building; the H. C. Durand building, at the corner of Quincy and Jackson streets; in one of the Studebaker buildings; in the annex to the Art Gallery on Michigan avenue; in the fine finishing and painting of hard-wood in the residence of Peter Hayden, at 3155 Michigan avenue; the inside and outside painting on the residence of E. W. Blatchford, at 375 La Salle avenue; the inside and out-side painting of the Chicago training school building, and in many other buildings. In August, 1890, he did a very fine piece of work in the lectureroom and parlor of the Third Presbyterian church, which alone entitles him to much distinction. Mr. Humphrey was married in 1849 to Miss Harriet Pierce, who has borne him a family of three children. He has taken all the degrees of Masonry except one. He is a member of the Builders & Traders' exchange, and the Master Painters' association. His father lived and died in the old country, but the mother passed from life in New York state. Mr. Humphrey resides at 51 Warren avenue.

William H. Emerson is an extensive dealer in wall-paper, and is a skillful and artistic painter and decorator, at 1904 Wabash avenue, where he has held forth since November, 1890, having built the building which he now occupies in the early part of that year.

He first established himself in business in 1872, soon after the great fire of 1871, at the corner of Thirteenth street and Wabash avenue. He was born in Boston, Mass., October 9, 1827, to Henry and Phœbe (Nichols) Emerson, and upon reaching a suitable age began serving an apprenticeship in his native city with Kimball Gibson, an old painter and decorator of that city. He was for sixteen years a prosperous business man of Boston, and during that time became expert in his line of work. For four years he was member of the common council, representing the Sixth ward of that city. Seeing a fine business opening in this city, he came here in 1872, and has never had cause to regret the step, for he has prospered financially, and has built up a reputation for skill and artistic ability for which he may well feel proud. His line of work has been for the best class of buildings, both private and public, and speaks strongly in his favor.

Karl Arnold is a practical painter at 518 Cleveland avenue, and also makes frescoing a specialty. He was born in Germany, in 1848, to John Arnold, who is also a fresco painter of the old country. Karl learned this business in his nativeland, where he received excellent training, and in 1871, after the great fire, came to Chicago, and the succeeding year started in business for himself, since which time he has done some of the finest work of the city. Some of the most important buildings which have been decorated by him are the Palmer house, the Grand Pacific hotel, the First National bank and the Monroe club house, all of which are finished in fine fresco. Mr. Arnold is an experienced painter and decorator, and in his work shows exquisite taste and judgment. He is prompt in filling his contracts, slights no portion of his work, is the soul of honesty in his dealings, and is moderate in his prices. He is a practical business man, and is well known throughout this city. He is married to Miss Wilhelmina Lehnertt, a native of Hanover, Germany, who became a resident of Chicago in 1871. They have one son, Herman.

J. C. Burket has been a dealer in wall-paper, paints, glass, oils, etc., in this city since 1873, his place of business being at 659 and 661 West Lake street, and is one of the pioneers in his line of business in the portion of Chicago in which he is located. He was born in Cambridge city, Wayne county, Ind., in 1850, a son of Levi and Lucinda (Huddleston) Burket. He was given a common school education, and at the age of twenty years came to Chicago, after the great fire, and here began working as a journeyman painter, having learned the trade in the state of his birth. In the spring of 1873 he opened an establishment of his own, and has since carried a large yet choice stock of goods. His business has gradually increased, until his annual sales now amount to about $20,000. At busy times he employs about wenty-five men, and in connection with his business does a large amount of sign painting and decorating, making a specialty of residence work. He also has a large trade in real estate work, and altogether, his time is fully occupied. He is a member of the I. O. O. F., the Masonic fraternity, the Lake Street Social club, at 681 West Lake street (in which he holds the office of treasurer), and since 1885 has been a member of the Master Painters' exchange. He was married in 1873 to Miss Ellen Bumstead, by whom he has a family of four children. He is a member and one of the trustees of the Fox River Fish & Game association, and as chairman of the game committee of Illinois, with the aid of Alderman John W. Lyke, he drafted the present state game law, later going to Springfield, where he appeared before the committee and was influential in securing the passage of the bill, thus placing the sportsmen of the state under obligations to him for his efficient service in this important matter. He has a pleasant cottage at Fox Lake, and is the owner of the building in which his business is quartered.

George Stevenson is an extensive dealer in wall-paper, paints, oils, brushes, varnishes, glass etc., at 71 Thirty-fifth street, near Cottage Grove avenue, and these articles form an essential in every home, hence this business is one of general interest. This establishment dates its inception back to 1873, having been started that year by Mr. Stevenson at the above mentioned place, and is a most comprehensive one. His large trade has been secured by a system of operations conducted upon the strictest principles of mercantile integrity, and the goods which he offers to the public stand preëminently in the front rank for artistic design, worth and excellence. Mr. Stevenson was born in Scotland, January 1, 1848, but in 1868 emigrated to Canada and located at Port Perry, where he began learning the trade of a painter. In 1870 he came to Chicago, and at the time of the great conflagration here took the first load of provisions down town. For some time thereafter, he worked for Atkinson & Clement, of Chicago, and for other firms elsewhere, but in 1873 returned to his native land on a visit, and after again setting foot on Chicago soil, he embarked in business for himself at the old Atkinson & Clement stand, engaging in general decorative work. He worked on some of the handsomest and most artistic buildings of the city, and was one of the painters of the Exposition building, which was at that time (1883) one of the largest contracts in the United States. He did a like work for some handsome homes in his part of the city; also doing the interior decorations in a very artistic and workmanlike manner, but does not confine himself to one locality, evidences of his handiwork being in all parts of the city. From a small beginning, this business has grown to be of vast proportions, reaching out in every direction and extending over a large section, and as he is one of the oldest and most reliable decorators of that portion of the city in which he lives, he does not have to seek work. He is vice president of the Master Painters' exchange, and was one of its projectors and organizers. He was the first treasurer of the Illinois State Master Painters' association, and is a member of the National Painters' & Decorators' association of the United States. Being enterprising and public-spirited, he has the best interests of the city at heart, and is found ready at all times to further worthy enterprises. He is a large property owner.

William Wilson is a very successful and extensive dealer in wall-paper and painters' supplies, in addition to which he does a very prosperous business in painting, calcimining, paperhanging and general decorating, his taste, excellence of workmanship, and promptitude in fulfilling his contracts, gaining him a large patronage of the better class. Mr. Wilson established this business in 1873, but was originally located on Clybourn avenue near Larrabee street, removing two years later to his present location. He began business on a small scale with a limited capital, first making his own step ladders and tools, but has increased his capital from about $300 to an annual business of about $80,000, with a large South Chicago branch at South Chicago and Commercial avenues. He owns all the property at both locations, and employs from forty to fifty men throughout the year. His business nearly doubles itself each year, and he handles annually in the neighborhood of one hundred and fifty thousand rolls of paper, and other goods in his line in proportion. He does all classes of decorative work on all classes of buildings, and in all parts of the city, and during the year 1890 the business increased to a greater degree than during any preceding year. Of a number who embarked in decorating on the south side, Mr. Wilson is the only one who has made a prominent success. He has fitted up the following residences: That of John Borden, on Lake avenue; Mr. Morris, on Wabash avenue; A. C. Soper, on Ellis avenue; W. J. Jefferson, on Lake avenue; M. C. Mitchell, on Calumet avenue; John R. Bensley, on Ellis and Oakwood avenues; Dr. Wardner, on Drexel boulevard; Dr. Strickland, on Lake avenue, and A. J. Cooper's, on Washington avenue, besides many others. The following are the business buildings he has fitted up: The office of the Chicago Music Company, the building of Thomas Whitfield, the American Desk & Stool Company, the Cambridge flats, and the M. M. Brown building. Mr. Wilson is a native of the North of Ireland, and was born in 1845, son of James and Mary (McNetten) Wilson. In 1867 he came to America and located in Pittsburgh, in which city he partially learned his trade, but in 1870 made his appearance in Chicago, and for some time worked for the Sullivans and other leading decorators. In 1874 he went to California, but after working there a short time returned to Chicago, and here has since had a prosperous business career. He was married in this city in 1872 to Miss Martha Bett. On the 4th of May, 1889, his three-story store on Cottage Grove avenue was burned, but he rebuilt and occupied the establishment in the early part of the following July. Once in every two or three years Mr. Wilson revisits his native land. His career affords an excellent example of what pluck and energy can accomplish under adverse circumstances and against keen competition.

W. H. Miller is an artistic painter and decorator, and is noted for his elegant designing and ornamental work. He commands a very large general business, his work is strictly first-class, and in filling his contracts he brings to bear the widest range of practical experience. His business was established in 1874, at 674 West Madison street, but later he moved to 658 West Lake street, which is now the oldest place of business on that street and of which he is the owner. He carried on business at this stand for eleven years, but in 1889 sold his stock of goods and went to Missouri, where he remained for about a year. In February, 1890, he opened his present establishment, 750 West Lake street, with a fine stock of paints, oils, glass, wall-paper, etc., and he already commands a large and permanent patronage. Mr. Miller was born in Torquay, England, in 1840, son of Charles and Mary A. Miller. He learned his trade in the land of his birth, and in his youth served six years with a practical painter. He was married in Torquay, July 7, 1862, to Miss Annie M. Cole, a daughter of George Cole, a tailor by trade. She was born July 30, 1840. Mr. Miller began business in the town of Red Hill, Surrey, England, in 1869, but in August, 1873, came to Chicago, and here for some time worked at his trade. In 1874 he opened his painting and decorating establishment, which is one of the best equipped in his part of the city, and he has decorated some of the finest residences and public buildings of Chicago, his customers being of the best class of people. During the seventeen years that he has been in business in this city he has gained a reputation as a thoroughly reliable business man. He was made a member of tbe Independent Order of Foresters in his native land, in which order he has ever since taken an interest.

Among the most skilled and reliable house and sign painters, grainers, glaziers, decorators and paperhangers must be classed Mr. A. M. Rofinot, whose place of business is at 4302 State street. He is the successor of Charles Stephens, and in 1874 established himself at 144 Archer avenue, where he was a successful business man for eight years. In 1882 he established a branch store in Hyde Park, his brother, V. F. Rofinot, succeeding him on Archer avenue in 1887, and in 1890 he removed his Hyde Park store to 4302 State street, where he has since done a general line of painting, paperhanging and decorating, also making a specialty of graining and marbling, at which be is an expert, having worked at it in all parts of the country and for most of the leading decorators of Chicago. He was born in this city in 1850, and learned his trade here, his literary education being acquired in the public schools. His family has been identified with the building interests of Cbicago through almost its entire history, and he was a personal friend of "Long John" Wentworth, Joseph Medill and other influential early settlers. He has done the decorating for many handsome homes throughout the city and suburbs, and in 1887 did tbe painting and decorating of eight large flats at the corner of Washington boulevard and Carpenter street for B. F. Jacobs. He also did the painting on the line of the Western Indiana railroad and all of its buildings in this city. He father, P. F. Rofinot, was one of the early settlers of Chicago and was a prominent cut-stone dealer, the pioneers, the elder Gindele and Peter Wolf, being in his employ at one time. He is now residing at 3018 Emerald avenue.

Michael McNulty is a painter and decorator of prominence, who has his office at 182 Wells street. He was born in Ireland in 1844, a son of James and Eliza (Lawlor) McNulty, but in 1871 left home and native land to win fame and fortune for himself in America, and having learned the painter and decorator's trade in his youth (which calling his father followed before him), he entered upon that occupation after coming to Chicago, and in 1875, in this city, started in business for himself at 178 Huron street, afterward moving to his present place of business, which he purchased. He has built up a large business, and does a general line of painting, decorating, graining, frescoing, paperhanging, etc., and in this work has shown much artistic taste and ability. During the busy seasons of the year he gives employment to about twenty men, and his annual sales have amounted to $20,000. In 1880 he was married to Miss Emma Smith, of this city, by whom he has two children, Nicholas and Roseanna. He is a Royal Arch Mason, a democrat in politics and a member of the Catholic church. He has done a large amount of work throughout the city, all strictly first-class, and his services are always in demand.

John A. and George O. Linker, who are fresco painters and art decorators at 258 Thirty-first street, established business in 1875 at 45 Clark street, the firm taking the name of J. A. Linker & Bro. Since 1886 they have been at their present stand, where they are doing a satisfactory business. John A. Linker was born in Boston in 1852, in which city he was educated but learned his trade in Providence, R. I., with E. G. Barton, but afterward returned to his native city where he began working at his trade with sufficient capital to start an ordinary business. He came to Chicago in 1878 and here, by his thorough knowledge of his calling and strict attention to business has built up a patronage among the very best class of people and is prospering. Among the buildings which have been decorated by him is the residence of Mrs. General Webster, of Dearborn avenue; A. G. Spalding, at Kenwood; the Chapin residence, at Thirty-seventh street and Michigan avenue; the C. L. Shattuck residence, at Thirty-fourth street and Michigan avenue; the residence of D. A. Kohn, at Thirty-fourth street and Michigan avenue; the residence of Banker Snydacker, on Michigan avenue; Wood's residence, on Prairie avenue; the residence of Mrs. Ellis, on Prairie avenue; the residence of Dr Byford, besides many more throughout the city and in the surrounding suburbs and country. Mr. Linker's home is at 3121 Prairie avenue, which he also fitted up and decorated. The firm employs about sixty-five men during the busy season and do an annual business of about $50,000, their business being constantly on the increase. They are making a specialty of first-class residence work, and for artistic ability and taste have no superiors in the city. Both are members of the Masonic order.

Richard Letsche bears the reputation of being a thorough, practical and honorable man in his business transactions, and as a leading sign painter, interior decorator and dealer in wall-paper, paints, oils, etc., he ranks among the foremost men in Chicago. The articles in which he deals form an essential in every home, the industry is one of general interest, and the work which he does, and the goods supplied by him, stand preëminently in the front rank for excellence of workmanship and artistic design. His place of business is at 319 North avenue, and the establishment dates its inception back to 1876, having been started in that year by its present proprietor, who first devoted his attention to sign painting and interior decorating, adding wall-paper, paints, oils, etc., in 1879. The large patronage which he now commands has been secured by a system of operations conducted upon the strictest principles of mercantile integrity, and among the many fine buildings that owe their beauty to his skill and artistic ability may be mentioned Hooley's theater and Moody's church. He was born in Detroit, Mich., May 3, 1855, to Isaac and Regina (Peterler) Letsche, the former being a compositor by occupation, and both being natives of Ulm, Wurtemburg, Germany. Isaac Letsche came to America when a young man, about 1853, and spent about three years at the compositor's case in Detroit, in which city he was married about 1856, coming the same year to Chicago, being honorably connected for about twenty years following with the *Staats Zeitung*. He is now living retired from the active duties of life, but is in the enjoyment of fair health and prosperity. His children are Charles, who is a foreman for G. E. Langer, sign painter; Emma, wife of Curt Fisher, of this city, and Richard, who has spent the greater portion of his life in Chicago. At the age of fourteen years he began serving an apprenticeship at the sign painter and decorator's trade, and after becoming thoroughly competent began an independent career, with the result that he is now in affluent circumstances and has a large and constantly increasing trade. He was married in this city to Miss Mary Agatha Merki, a daughter of John and Mary Agatha Merki, both of whom were born in Switzerland. To Mr. Letsche and his estimable wife three sons and three daughters have been born—Evelyn, Richard, Hedwig, Theodore, Louis and Antoinette. Mr. Letsche is a worthy member of the A. O. U. W.

M. Dougherty is an artistic and successful painter and decorator, and an extensive dealer in wall-paper, paints, oils, glass, varnishes, window-shades and brushes, at 3005 State street. This business was established in 1876 at 3227 State street. Mr. Dougherty served an apprenticeship of four years at his trade with Strand & Morrow, and in 1886 began business for himself. He was born in Cedarburgh, Wis., in 1849, a son of Patrick Dougherty, and in 1868 came to Chicago. For about one year following he sailed on the great lakes, at the end of which time he abandoned the life of a sailor and engaged in painting, in which he has since been employed. He has done a large amount of fine private residence work, notable of which may be mentioned the residences of J. H. Swan, at 2625 Michigan avenue; M. Mulveil, at 1356 State street; B. Mahon, on Twenty-second and Dearborn streets; Thomas English, at Forty-first street and Michigan avenue; J. C. McCord, at Thirty-fourth street and Wabash avenue; C. P. Libby, at Thirty-fourth street and Michigan avenue, and E. Manierre, at Twenty-fourth street and Prairie avenue. Of his other work that for the Keeley Brewing Company, at Twenty-eighth street and Lake Park avenue, is noteworthy, and he has painted or decorated St. James' church, at Twenty-ninth street and Wabash avenue; Nativity church, at Thirty-seventh and Dashiel streets, and the Church of the Holy Angels, Oakwood boulevard, and numerous others throughout the city. During the busy season Mr. Dougherty handles large quantities of goods and keeps employed from twenty-five to thirty men, the annual amount of business done by him amounting to $25,000. He is the owner of the residences at 3719 Wentworth avenue and 2960 Dearborn street; and although he started in business without capital or influence he is to-day in good circumstances.

Charles Byron Krieger is a contracting painter and hardwood finisher and dealer in paints, oils, glass, etc., at 556 Ogden avenue. He is exceptionably well posted in his line of work and makes a special study of the true harmony of colors and of mural and ceiling decorating. They produce fine contrasts and combinations to match any manner of furnishing, imitate all kinds of precious wood, do elegant or ordinary sign painting in excellent style, and their designs in decorating are chaste and original. The business was established in 1877 at 992 Harrison street, at which place he continued to conduct his affairs until May, 1888, when he removed to his present place of business. He has done a fine line of interior decorating in churches, theaters, stores and residences in all parts of the city and in the surrounding suburbs, and does an annual business of $10,000. He is a natural artist, and his taste and talent in this direction have been augmented by study and experience, and his manner of decorating is very tasteful and strictly original. His work has entered into a large number of the handsomest buildings of the city, among which the following are worthy of special mention: Hooley's theater, Race Brothers' restaurant, South-Side dime museum, Belvidere hotel, East Chicago saloon, a hardwood-lumber residence for R. Grange, the residence of H. W. King. the Springer flats (on La Salle street), the residence of Henry W. Peter (on Sheffield avenue), and many others. Mr. Krieger employs from ten to fifty skilled mechanics to do his work, and guarantees strictly first-class work. He was born in St. Joseph, Mich., in 1856, to Charles and Bertha (Schmall) Krieger, and received his education in the high school of his native town and finished at Ypsilanti, Mich. Upon commencing the painting and decorating business he learned very readily, owing to the previous knowledge he had acquired of art, and upon coming to this city he was fully prepared to do work of a high class, and has since sustained an enviable reputation. He first began working here for the Almini Company, after leaving which he worked about the Palmer house for three years as painter and decorator, since which time he has been in business for himself. He is a large property owner on the north and west sides, and although he and his family attend the Congregational church, they belong to the Lutheran church. In 1884 Mr. Krieger was married to Miss Amelia Blanrock, daughter of Charles A. Blanrock, one of Chicago's pioneer citizens. Mr. Krieger has a family of two children: Harvey and Ethel.

The paint and decorative house of Asmus F. Krey is located at 168 North avenue. The proprietor of this thriving and reliable house has been a resident of Chicago since 1867. The business was founded originally in 1877, at No. 166, next door to the present location, by Messrs. Krey & Letcher. Subsequently Mr. Letcher withdrew from the firm, and Mr. Krey became sole proprieter. In 1884 the trade had grown to such large proportions that he was obliged to seek more commodious quarters, which he did by erecting the building now occupied. The premises occupied comprise a store and basement, each 25x80 feet in dimensions. The store is very neatly and appropriately appointed, as is also the basement. The stock is very full and complete, and embraces almost everything that can be thought of in connection with interior mural and window decorations. In addition to the fine assortment of paperhangings kept by Mr. Krey, he also deals very extensively in mixed and unmixed paints, foreign and domestic colors, oils, varnishes, glass and other painters' and glaziers' supplies, which are sold to the trade and consumers. He also makes a specialty of making window shades of any size or design to order.

The paint and decorative establishment of George Otto, 98 Blue Island avenue, is well known to the whole community, the proprietor, Mr. George Otto, having been a resident of the city since 1872, and for twelve years engaged in the business he so ably conducts. His store is well stocked with a general line of paints of all kinds, dry and ready-mixed and in oil, and also varnishes and brushes, window glass, etc., supplies and materials for painters of every description, also window shades and fixtures and wall-paper, dados, etc., in the newest and most fashionable designs in figure and floral patterns. In 1886 Mr. Otto opened a branch store at 703 Van Buren street, which was well fitted up, and contained a varied line of goods of the class enumerated above. A special feature of Mr. Otto's business is house and sign painting, calcimining, graining, glazing, etc., and also paperhanging and decorating interiors. He attends personally to, and keeps constantly employed from twenty to thirty-five practical workmen. Mr. Otto is from Holland originally, and is a member of the high board of directors of the Indiana Order of Foresters, and a member of the Ancient Order of United Workmen of the Knights of Honor.

C. Millies is a dealer in paints, oils, glass, varnishes, brushes, wall-paper and window shades, which articles are essentials in the decoration of every home. He does a general line of business, his establishment being at 4312 Wentworth avenue. He is a native German, his birth having occurred in 1854, but in 1871 he came to America and settled in Chicago, and here began working at the trade of painter, grainer and paperhanger. In 1879 he embarked in business on his own responsibility at 175 Archer avenue, at which place he conducted a prosperous trade for three years. Since that time he has been doing business at his present stand, where he is carrying a general stock of goods and is doing well. He employs about twelve men during the busy seasons of the year, all of whom are experienced in their line, and has fitted up some of the handsomest homes in his part of the city, doing a first-class work in all branches of his business. He served an apprenticeship at his trade in his native land as well as in this country, and although he started in business with but little capital, by his practical views and good management he has become well to do, and now owns his place of business at 4312 Wentworth avenue. He was married in 1880 to Miss Mary Hansen, a native of Germany, by whom he has one son.

George W. Antis, wholesale and retail dealer in paperhangings and decorations, paints, oils, glass, putty, etc., also makes a specialty of interior decorating, frescoing and paperhanging, his place of business being at 326 Sixty-third street. He was born in Chambersburg, Penn., in 1834, a son of Rheinhardt Antis, but in his youth his advantages for acquiring an education were limited. In 1856, at White Pigeon, Mich., he was married to Miss Emma J. Knox, by whom he has two children, Harry E. and Ethel J. Mr. Antis is a thoroughly practical business man. He learned the details of his calling in Pennsylvania, his apprenticeship lasting a number of years, the latter part of his term being with a firm at Danville, Penn. In 1856 he established himself in the painting and decorating business at White Pigeon, Mich., which business he carried on until 1880, when he came to Chicago and opened his present establishment at 326 Sixty-third street. He has had a constantly increasing business since that time. He is well known, and has in the last ten years established a reputation for doing a first-class line of work in all the different departments of his business. He carries a stock of goods valued at from $6,000 to $8,000, and does an annual business of about $45,-000. He resides at his place of business, which he owns, and is also the owner of some lots at Morgan Park. The following are some of the buildings which he has fitted up: The Baptist church, of Englewood; the Englewood bank; the residence of Mrs. Ellis, at 7730 Dickery street, Normal Park; the residence of Mr. Badenoch, of Englewood, besides numerous others. While a resident of Michigan, he did a very extensive business in his line in that state and in Indiana. He is a member of the G. A. R., is independent in politics, and is a member of the Baptist church.

George L. Robertson came from Denmark to Chicago in the year 1870. He received his initiatory education in the schools of Denmark, but after arriving in Chicago, received additional schooling in this city. At the early age of thirteen years, he began serving a three-year apprenticeship at the painter's trade, at the expiration of which time, and until he was twenty-four years of age, he worked steadily at his calling for the leading painters of the city. During this long period of steady industry and experience, he so widened his knowledge of the art of decoration and attractive painting in harmonious colors as to place himself unquestionably among the leading representatives of his trade in Chicago and the West. After the age of twenty-four, he founded his present business, and since 1883 has been located at 345 West Randolph street where his present large and lucrative trade is wel-conducted and merited. He is a practical man and a popular contractor for artistic house-painting and decorating, and is a wholesale and retail dealer in wall-paper, glass, paints and oils. He has a large permanent business, with an abundance of hard work before him, but with certain promises of ample returns for labor and energy expended, and he has the satisfaction of knowing that his success in business and his excellent reputation are due solely to his own intelligence, energy and honesty. He is a member of the Master Painters' exchange and of the K. O. T. M. tent, No. 9. He is one of the better class of Chicago citizens of foreign birth. His life here of activity and honesty presents a strong contrast to the lives of so many others of foreign birth who, upon their arrival here, embraced the cause of anarchy, indolence and intemperance, and are now worthless in both means and reputation. He was born in Denmark, June 14, 1859, and is the son of Christian and Bertha Robertson, worthy people of that country. In 1879 he was united in marriage with Miss Caroline Henson, who was born in Sweden and came to Chicago at about the age of twenty years. They have two children, George A., born May 29, 1880, and Bertha A., born July 4, 1882. He is a stanch democrat.

W. E. Toerpe is a painter and decorator of much ability at 439 and 441 Ogden avenue. In 1881 he started in this business with a cash capital of $150, but his ability is so marked and his desire to please his patrons so evident that he now does an annual business of $60,000, his patronage being among the best people of the city. At times he employs about fifty men, and in his establishment he keeps constantly on hand a large stock of wall-paper, paints, oils, etc. He was born in Germany in 1858, a son of William Toerpe, a contractor by occupation, and in 1871 came to this country with his father, obtaining a practical education in his youth, and after obtaining a suitable age he began learning the painter's trade and later started in his present enterprise. Among the buildings for which he has done the painting and decorating are the Indiana Street Methodist Episcopal church; the Marshfield Avenue church; the Garfield Park summer house; the Hayden high school building; the residence of H. H. Barnes, on Ashland avenue; besides many other fine structures. His stock of goods is valued at $9,000, and the pretty home where he lives, at 1284 Wilcox avenue, is his own, the result of his own endeavors. He is married and the father of two children.

Conspicuous among the houses engaged in the paperhanging, window-shade and interior decoration business in their part of the city is that of the Messrs. Anderson Brothers, 245 West Indiana street. The firm, since they established their business in 1881, have developed an excellent patronage. The premises occupied consist of a store and basement, the dimensions of each being 25x60 feet. The attractive salesroom contains a fine stock, which has been purchased direct from the leading sources of manufacture. The assortment of wall-paper is very full and complete, embracing all qualities and shades, from the most exquisite, high-class, gold papers and decorations, down to those of more ordinary quality, while in the line of window shades the stock is unsurpassed for variety of designs, excellence and prices. Dry and mixed paints, colors, oils, varnishes, brushes, glass, etc., are also kept on hand in full variety. Employing a number of expert hands, the firm make a specialty of executing to order sign painting, glazing and paperhanging, performing all work in the most thorough and satisfactory manner, while their prices are on all occasions reasonable. The members of the firm, Messrs. Harold and Carl Anderson, are natives of Norway, but have resided in this city for years.

As a capable and efficient paperhanger and dealer in wall-paper, paints, oils, glass, and all the kindred line of goods belonging thereto, Mr. John E. Koehsel, 328 West Indiana street, has for the last ten years been prominently before the public, and by his expert knowledge and careful attention to details, has won a leading position in this staple line of business. He commenced in 1881 at No. 318 West Indiana street, remaining there until March, 1886, when, his increased business requiring an improved stand, he removed to the store now occupied. In this well-appointed establishment is carried at all times a complete stock of wall-papers of all grades, from the latest and most expensive designs to the plainest and cheapest quality in the market, window shades, and the usual and necessary accessories, ready-mixed paints, oils, glass and glaziers' supplies of all kinds, and a vast miscellaneous kindred assortment. The store is neatly and attractively fitted and furnished with every necessary accommodation for the increasing trade. Mr. Koehsel is a native Chicagoan of the most unquestioned integrity and worth.

A formerly well-known decorator, now an operator in real estate, was J. D. Vail, Jr., house decorator and dealer in wall-paper, etc., at 3636 Cottage Grove avenue. Mr. Vail is a native of New York state, but was raised in Bloomington, in this state, and came to this city in 1880. He founded this establishment in 1882, at the location above mentioned. His store was quite large, finely appointed and fully supplied with everything required in the business. He conducted a large business as a house, sign and fresco painter, and also dealt very extensively in all kinds of wall-papers, dados, friezes, borders, Lincrusta Waltons, window shades, moldings, etc., likewise paints mixed and unmixed, colors, oils, varnishes, window glass, brushes, etc., in fact, everything in the nature of painters', paperhangers' and glaziers' supplies. Mr. Vail gave particular attention to the higher branches of the art of painting, frescoing and gilding, and so well was his skill in these branches known that his services were in constant demand at all seasons of the year. He kept constantly

INGLE NOOK AT AUDITORIUM THEATRE.

DESIGNED BY MESSRS ADLER & SULLIVAN. EXECUTED BY BURKE & Co.

employed from fifteen to forty-five first-class workmen, and was prepared to enter into and execute contracts of any magnitude.

John C. W. Rhode, one of the leading decorators of the city, was born in Denmark, April 8, 1854. He was educated in Germany. At fourteen years of age he began serving a four-year apprenticeship at the painter's trade in the city of Eckenfœrde, Germany. Later he worked at his trade in different European cities, until 1871, when he came to the United States and continued to work at his trade in different towns until 1883, when he began business on his own account, at 339 North Clark street, Chicago. His work is in the line of general painting and decorating. He has done the decorating of the Paris (Kentucky) operahouse; Racine (Wisconsin) operahouse; Baird's operahouse, at Lansing, Mich.; Jacobs' Clark street theater, Chicago; the Masonic temple, at Kalamazoo, Mich., one of the finest masonic temples in the Union, Mr. Rhode's work upon it being of the most artistic quality. Among the other examples of his skill may be mentioned St. Peter's and St. Jacob's chapel, in Elizabeth hospital in the city; John T. Hinton's residence at Paris, Ky.; Buckner Woodford's residence at Paris, Ky.; W. S. Lawrence's residence at Kalamazoo, Mich.; F. W. Dewes', A. A. Engle's, O. Clusen's, A. Hostman's and Phillip Jaeger's residences in Chicago; and he has done work equally creditable in many of the leading cities in the country. The paper-hanging department in this institution is very extensive, and Mr. Rhode does a great deal of decorative work in all departments in Chicago and elsewhere, employing from forty-five to seventy-five mechanics and fifteen to twenty-five artists. In commenting on Mr. Rhode's work, the Chicago *Times* of October 20, 1889, published the following: "H. R. Jacobs' Clark Street Theater is the title which will be emblazoned over the magnificent new temple to Thespis, now nearly completed at the corner of Clark and Kinzie streets. The new theater promises to be one of the most attractive in every point of comfort, elegance and convenience in the city. It is on the ground floor, and is approached by a beautifully decorated corridor, spacious and well furnished with exits. It is furnished with nineteen hundred opera-chairs of the most approved pattern, all elegantly upholstered in colors to match the beautiful decorations. The decorations of the interior of the house by John C. W. Rhode, are novel and beautiful in design, unexcelled in artistic perfection by those of any theater in the United States. The prevailing tints are light, restful to the eye, harmonious and brilliant, and the designs are bold, graceful and unique. The prevalent Romanesque is greatly lightened and modified by the graceful and delicate Parisian style so generally coming into favor in recent years. Twelve beautiful boxes and a pretty proscenium arch, the graceful curve of the well-concealed soundingboard and the gradual rounding off of the front of the auditorium into the side walls are particular instances in which the decorator's artistic instinct is best shown." The Racine (Wis.) *Daily Times* of January 18, 1890, called the new operahouse in that city a thing of beauty, and gave the following description of Mr. Rhode's work of decorating the interior: "To the average citizen who looks at the building on Main and State streets, known as the Belle City operahouse, the thought will occur, 'a very plain building; not much of an ornament to the city.' But the beauty, comfort and elegance of the interior will speak volumes for the wishes and desires of the projectors. As we have before stated, the work of decorating the interior of the operahouse was done by John C. W. Rhode of Chicago, the fresco painter and general interior decorator. The work stamps him as an artist in his line, who stands at the very head of his profession. When the operahouse is opened, we predict that our citizens will be more than pleased with the beautiful interior of our new auditorium. While but a faint idea of its beauty can be obtained from a mere description of it, we are confident that such a description will not be uninteresting and will give to some, at least, an idea how the interior will look on the opening night. The ceiling is treated in Parisian style, with bamboo cross work styles woven through. The cove is treated on blue background with festoons in six distinct panels with birds as relief. The surrounding and cross friezes forming circles around the ventilators artistically decorated in fibroo, with a band pattern cut out in same, of which the body is colored and bronzed in an extreme light terra cotta with gold bands woven through the same. The sounding board, which, in this house is of extraordinarily large dimensions, representing on the center a triumph wagon surrounded by cupids, drawn by white pigeons, surrounded with a wreath of apple blossoms. The entire painted on a bluish ground surrounded by clouds, giving it a perspective effect of the highest character. The walls are treated in two different, distinct kinds of raised fibroo work. The sink panels are plainly raised and the outbills combed in a basket pattern. The coloring of the sink panels is shifted terra cotta from light to dark, bronzed at the highest points. The outbills are old gold colors, also shifted from light to dark and bronzed at the highest points, giving the entire a most beautiful, brilliant effect. The ceiling under the balcony is treated similar as the large ceiling described above. The proscenium above the boxes is decorated with two large and splendid Parisian vases filled with flowers and the slant arch in the proscenium is worked out in Renaissance scrolls with large drop borders on each side. The dado formed between the base board and chair railing extending all around the auditorium and vestibule is marbled in imitation so like real marble that the bare eye can not detect whether it be real black French marble, and Italian sienna. The front of the balcony and boxes represents a beautiful design in raised stucco work, colored in harmony with the other decorations in orange, blue and gold. The columns are in imitation of bronze. The interior wood work is painted in parti colors to correspond with all colorings and decorations. The office, anterooms, ladies' waitingrooms, etc., are tinted in beautiful colorings to match and harmonize with all the balance of the decorations. Taken as a whole, the interior will present a most magnificent sight, especially when, as contemplated, it is lighted by a volume of electric lights. Competent judges have estimated that the Belle City operahouse, when completed, will be superior to all in the state of Wisconsin, and it will be equal to any theater in Chicago. It is original in its design as well as in its coloring." Mr. Rhode is a member of the Builders & Traders' exchange. He was married in 1872 to Miss Martha Larson, and has seven children: Paul J. C., Anna, Jennie, Lillie, Roscoe, John C. W., Jr., and Martha. He became a mason in 1885, in Germania lodge 182, A. F. & A. M., is a member of Lincoln Park chapter 177, R. A. M., Oriental consistory, S. P. R. S., and Medinah temple, A. A.

O. N. M. S. The father of Mr. Rhode was C. J. W. Rhode, who was born in Germany in 1827, and died in Eckemfœrde, Germany, in 1869, and his mother (Anna Nissen) was born in 1826, and now resides with him in this city.

A decorative firm, well known in Chicago, is that of Freund Brothers, dealers and jobbers in wall-paper, paints, oil, glass, varnishes, brushes, etc., No. 2911 Wentworth avenue and 4654 South Ashland avenue. The members of this enterprising firm are Ignatz, Sigismund, Louis and Julius Freund, all of whom were born in Germany and came to Chicago in 1880. Four years afterward they founded this business on Clybourn avenue, subsequently removing to their present location and establishing a branch store. In their stores will be found a full and complete assortment of foreign and domestic wall-papers of the very latest and handsomest designs and of all grades, including all kinds of dados, friezes, Lincrusta Walton, gold and silver wall-papers, center pieces, cornices, etc., from the most celebrated manufacturers. They also carry a heavy stock of paints, oils, glass, varnishes, brushes, window shades, oil paintings, chromos, engravings, picture frames and moldings for interior decorations, also prepared paints ready for use. They are also prepared to do all kinds of artistic paperhanging, glazing, graining, marbling, calcimining and all kinds of housepainting, and make a specialty of signpainting, frescoing, painting, gilding and interior decorating. The firm employs from eight to fifteen skilled and proficient workmen.

W. H. Bucher has his place of business at 601 Lincoln avenue, and as an interior decorator is doing a line of first-class work for leading citizens of this city. He keeps on hand a stock of wall-paper and painters' supplies, chiefly for his own convenience, and in his work he has displayed an extraordinary degree of exquisite taste and artistic ability. He first entered business in this city in 1884, at 596 Lincoln avenue, but since 1890 has been at his present location. His work has entered into many of the fine private residences of the city, besides a large number of business buildings, such as the Portland block, the Maller block and the Exchange building. He learned his trade with Spoor Mackey, and was for some time employed by Sullivan Brothers, and later by S. A. Maxwell & Co.

Among the older painters and decorators may be mentioned M. Murphy & Bro., dealers in fine paperhangings and ceiling decorations, 3317 State street. This business was established in 1884 by Madigan & Murphy. They were succeeded in the spring of 1885 by M. Murphy, and he, in 1889, by M. Murphy & Bro. (M. and John Murphy). M. Murphy was born in Ireland, and came to America in 1850, and located at Rochester, N. Y., where he learned the trade of painter. He came to Chicago before the war, and worked for J. B. Sullivan, and later went to Bloomington, Ill., and worked there until the outbreak of the war. He enlisted in Company H, Ninety-fourth Illinois infantry, in 1862, and served until 1864, participating in the engagements at Prairie Grove and Springfield. Discharged for disability, he returned to Bloomington, and from there came again to Chicago and worked for Heath & Milligan and others. John Murphy was born in Ireland, and came to America in 1848, locating in Brooklyn, N. Y., where he served his time at the carpenter's trade. He came to Chicago in July, 1854. For a time he was a carpenter contractor. He had charge of the office of Calvary cemetery in 1859–70, and later was in the insurance business until 1885. He then returned to New York, and lived there and was engaged in the house-furnishing business until 1889, then came to Chicago and entered his present business.

Roland A. Crandall, painter and decorator, 100 Twenty-second street, has become known throughout the city for the admirable character of his work, the artistic originality of his designs, and his taste and skill in executing them having attracted wide attention. He was born, reared and educated in Cairo, Ill. His first start in life, while yet a mere lad, was as apprentice to the printer's trade; but, upon removing to Chicago, at the age of eighteen years, he took up the calling of a painter. His first business advancement was marked by his establishment for C. E. Langer of the latter's decorative business, at 149 North Clark street, and, as general manager for Mr. Langer, his services were so valuable that, though yet very young, he received a salary of $1,500 per annum. He remained in that responsible position until the spring of 1885, when he began the establishment of his own enterprise, which sprung into such sudden popularity that, during the first year, he did a much larger business than he had reason to expect. His operations are now as considerable as those of the largest decorative establishments of the south side, and require the labor of nearly one hundred men during the busy season. His business includes a full line of decorative work, all of high class and of the greatest original merit. Among the many noted and beautiful buildings of all classes for which he has furnished the interior decorations we may mention the following as especially commending themselves to admirers of elegant work in this line: Four residences for Will H. Moore, and residences for P. F. Raber and T. M. Baxter, all on Grand boulevard, and the Washington Park clubhouse, the Immanuel Baptist church and the Farragut boathouse. Mr. Crandall's success has been exceptional, but it is based on industry, perseverance, natural ability, originality, genial manners, good business capacity, honest methods and characteristic American push, elements which are helpful singly and invincible in combination.

F. W. Wagner is a well-known painter and decorator of Chicago, and is also engaged in graining, glazing, calcimining, paperhanging, etc.; his place of business being at 673 Wells street. Mr. Wagner was born in Chicago in 1862, and in the public schools of this city he obtained his education. He learned his trade of his father, and worked with him for a number of years, but after the latter's retirement from business in this city he went to Peter Emmel's, where he stayed for four years. In 1886 he began business at 546 North Wells street, but in 1889 removed to his present place of business, where he has built up a very large trade, his skill, taste and knowledge of his calling winning for him a large amount of residence work. He has painted the residence of John McEwen on La Salle avenue; Charles Steinbirn; Valentine Ruh; Henry Martin; Charles Martin; W. A. Paulsen; D. F. Crilly, on Warren and Dearborn streets; Mrs. Smidt, on Twenty-fourth street; the Lutheran church, at Franklin and Superior streets, besides numerous others. During the busy portions of the year he employs about fifteen men, who are all experienced and skillful workmen. He was married in 1886 to Miss Anna Mary Heusen, by whom he has two daughters. He is a member of the Arbeiter Unterstructzungs Verein and of the Northern Light club. His father, J. Wagner, came to Chicago at an early day, and for many years was engaged in painting and decorating in this city, but abandoned active business life in 1881 and left the business, which had increased to such admirable proportions under his management, to be carried on by his son. He is now residing at Colehour, Ill.

W. C. Wright is a prominent and successful dealer in wall-paper, etc., at 510 North Clark street. He is also engaged in painting, calcimining, decorating, graining, sign-writing and papercleaning, in first-class style and at moderate prices. He stands among the better class of dealers in his line in the city. He makes a specialty of fine work in residences and offices. He is a native of Lincolnshire, England, born in 1857, the son of William C. and Susan Wright. He received a practical education in his native land, and in 1873 came across the ocean, locating in New York city. There he remained for several months, then he came to Chicago and engaged in the service of Jabez Baystone, his uncle, and one of Chicago's oldest painters, with whom he served five years at the painter's trade, in that time becoming proficient. At the early age of seventeen years he was a foreman in charge of a large number of men, and of his uncle's shops. This trying experience brought out his characteristics of observation, intelligence and energy—qualities which have remained with him until the present. After continuing with his uncle for ten years, he worked at the painter's trade until 1884, after which he was, for a time, a traveling salesman in the same line. Soon afterward he engaged in business on his own account at Seventy-sixth street and Emerald avenue, where he remained for some time, when he was given charge of the painting department of the Western Indiana Railroad Company. In January, 1891, he bought out the trade and supplies of Henry H. Meech, and has since been engaged in a business of unusual success and merit. His work may be seen in many of the best buildings of Chicago, among which are the following: The Timmerman building on Seventy-ninth and Sherman streets, Frank Brothers, the Bonanza and Theobald & Co.'s stores, J. E. Miller's and S. E. Stevens' residences, the J. E. Talbot, Lowell, Callahan, George R. Jennings and W. Reed residences, Auburn Park. He was married in 1880 to Miss Ida A. Kendall, a native of Maple Park, Kane County, Ill., by whom he has two children. He is a member of the Chicago Painters' club and in politics is a republican.

C. H. Tiedt is a wholesale and retail dealer in paints, varnishes, brushes, wall-paper and general painters' supplies, and has been established in business in this city since 1888, his place of business being at 623 Sixty-third street. Mr. Tiedt was born in this city in 1861, son of John C. and Caroline (Boedecker) Tiedt, the former of whom was one of the oldest settlers of Cook county, and is now farming on section six, in Palos township. His father came to this section of the country in 1850, and here has since made his home. C. H. Tiedt spent his youthful days on his father's farm, but at the age of nineteen years came to this city and began working as clerk for H. M. Hooker, remaining with him until he engaged in business for himself. In 1886 he went to Kankakee, Ill., where he opened an establishment of his own, dealing in paints, oils, wall-paper, etc., but two years later returned to Chicago, and has since been established at his present place of business. He keeps a fine general line of goods and is doing a constantly increasing business, although his first year's sales amounted to $15,000. His last year's sales amounted to $25,000. He makes a specialty of residence work, and has fitted up some handsome establishments in this city. In busy times he employs about twenty-one men, and is himself constantly employed the year round, his business being so extensive as to fully occupy his time. The following are some of the residences which he has fitted up: The residence of M. Knight, at 626 Sixty-second street; the fine residence of W. S. Belding, at 6423 Stewart avenue; the residence at 6320 Wright street; the residence of N. T. Curth, at 6458 Wright street, besides numerous others. Mr. Tiedt is a republican in politics.

Aris & Hewitt, house decorators and painting contractors and dealers in wall-paper, window shades, wall moldings, paints, etc., established their business in January, 1889, at Fifty-first and Dearborn streets, but later removed to 5034 State street, where they are at present doing a satisfactory business at general painting and decorating. E. W. Aris was born near Detroit, Mich., in 1858, but learned his trade at Lansing, Mich. In December, 1881, he came to Chicago, and for five years worked with O'Brien Brothers, and from that time until the founding of the establishment of Aris & Hewitt, in 1889, he was with other leading firms in the same line of business. W. L. Hewitt was born in Indiana and learned his trade with his father, who was a practical painter. He came to Chicago about fourteen years ago and until forming his partnership with Mr. Aris, worked at his trade. The company employ about fifty men during the busy season, and are doing a business of about $20,000, their line of wall-paper, window shades, paints, moldings, etc., being very extensive and in the latest style. They are experienced workmen, their establishment is a most comprehensive one, and although they have only been in business but a short time, their house is a thoroughly representative one, their large trade having been secured by a system of operations conducted upon the strictest principles of mercantile integrity.

The firm of Campbell & Lebeau, interior decorators and painters, 1428 Wabash avenue, is composed of Robert Campbell, formerly with R. G. Gledhill, Fifth avenue, New York, and Alexander Lebeau, formerly with C. H. George & Co., Fifth avenue, New York, and has been in existence since 1889. The firm has executed a fine line of decorative work, and its members rank among the artistic decorators of the city. Among their more notable work may be mentioned the Alhambra theater, the residence of Mrs. H. A. Kohn and that of W. W. Clark. All of the latest novelties in decorative materials of both American and foreign production are represented in their work. The firm is prepared to execute every kind of painting and interior decoration, and its work presents numerous fine examples of what can be achieved in the way of magnificence in decorative beauty by master hands. In the extensive operations of the firm, which aggregate about $30,000 per annum, about seventy-five skilled workmen are afforded employment. Mr. Campbell was born in 1859, and is a native of Edinburgh, Scotland, where he was educated and served a six-year apprenticeship to the decorator's trade. His father, Alexander Campbell, who died recently, was a decorator of prominence in the west of Scotland. Mr. Campbell completed his trade in 1880, and after working with leading decorators in England and in New York city for a number of years, part of the time as superintendent, came to Chicago in 1889, and with Mr. Lebeau, organized the firm of Campbell & Lebeau. Alexander Lebeau, a native of Canada, came to Chicago when a young man, with his father, Alexander Lebeau, who was a well-known painter and decorator. He is married and has three children.

The decorating firm of Eckart Brothers was established in 1889, under the title of Shaw, Eckart & Co. On the death of Mr. Shaw, William Eckart became a partner, and hence the present firm name. The senior member, George Eckart, was born at Plauen, Saxony, in 1862. At an early age he was apprenticed to a decorative artist there, under whom he served for five years. Subsequently he devoted four years to travel and work throughout Germany, and to the study of decorative art at Berlin. Coming to Chicago in 1881, he entered the employ of Phillipson & Co., who soon recognized his ability and placed him in charge of their contracts outside the city. Later he was employed by W. L. Prettyman & Co. as superintendent of special work. William Eckart is also a native of Plauen, where he was born in 1867. He came to Chicago with his brother, in 1881, and received that practical education here which enables him to take an active part in the business of the firm as designer as well as manager. The important works of the Eckarts may be seen in the frescoing of William Gillman's residence, 1889, and of Moody's tabernacle; Gossage's store, George J. Titus' residence, and the new Fourth Baptist church on Ashland boulevard. Their attention is devoted almost exclusively to fresco work from original designs.

The firm of William Stevenson & Co. consists of William Stevenson and O. L. Guildenast, who established their general painting and decorating business in January, 1890. They have assuredly attained a high degree of eminence in this most beautiful branch of the building art. Mr. Stevenson is a native of Scotland, where he was born in 1857, being the son of Richard Stevenson, a general merchant of that country. He received a good education in the public schools there, after which he came to the United States and located in Chicago, entering his present line of business with George Stevenson in 1882. Immediately succeeding this he learned the fine art of painting, as a necessary adjunct to his regular business. He was first employed as a foreman by J. A. Linker for a number of years. His studies and natural qualifications and the steadiness with which he prosecuted his business have placed him among the first painters and decorators of the city. In connection with their other business, Stevenson & Co. deal in painters' and artists' materials and fine paperhangings, and in their fresco and art works they go beyond mere mechanical work, carrying the art into special designs of great variety and beauty. They are located at 87 East Forty-third street. Mr. Stevenson is a Mason, a member of the Royal League and is the present master of Kenwood Masonic lodge. Politically he is a republican. He was married in 1882, and has a family of three interesting boys. His residence is at 4630 Langley avenue. Otto G. Guildenast, the junior member of the firm of William Stevenson & Co., is a native of Prussia, and was born in 1858, being the son of Frederick Guildenast, a prominent architect. Otto, during his youth, had the advantages of a superior educational training, and upon reaching more mature years learned his trade thoroughly in the old country, making a special study of art decoration. He completed his art studies at Berlin, Stuttgart and others of the great educational centers of Germany, and in 1884 crossed the Atlantic and came to Chicago, where, for a time, he was employed by J. A. Linker as foreman of fresco painting. He is a practical draughtsman and a complete master of the details of his art. Some of the most beautiful special designs in the city have been prepared by him. Mr. Guildenast was married in 1887 and has one son. He resides at 4427 Evans avenue. The firm are doing a special and extensive work in their line in the finer residences of the suburbs and city proper, prominent in which may be mentioned the decorations of the following buildings: The Oakland club-house and the residences of John R. Bensley, Dr. Nelson, William L. Moss, George C. Watts, A. Strass, Edward Rose and many others, in which may be seen the examples of the most artistic class of fresco painting and interior finishing.

Nieman & Conklin are artistic, experienced and skillful interior decorators, and deal in all kinds of artistic draperies, shades and lace curtains, fine upholstering, furniture made to order, etc., and do all kinds of repairing. Their partnership was formed in 1891, the members of which are Henry J. Nieman and E. B. Conklin, and their place of business is at 3855 Cottage Grove avenue. This firm is doing a fine line of interior decorating, from furnishing the wood and walls to carpeting and furnishing, and has fitted up the fine residences of Mr. Goodrich, 1474 Michigan avenue; Mr. Jaleter; Mr. Nichols, 3630 Grand boulevard; Mr. C. Morrison, 4024 Ellis avenue; Mrs. Hunter, 4665 Lake avenue; D. A. Strickland, 4039 Lake avenue; Mrs. F. N. Gage, 4028 Ellis avenue, and numerous other fine residences, receptionrooms, banquet halls, operahouses, etc., and their services are required in the surrounding cities and suburbs as well as in Chicago proper. H. J. Nieman was born, reared and educated in Germany, his knowledge of his calling being also acquired in his native land. He came to Chicago in 1880, and in this city married, and is the father of a family of three children. He has been connected with the Chicago Carpet Company for the past nine years and is a member of the Lutheran church, and in his political views is a republican. His residence is at 5554 Armour avenue. E. B. Conklin was born at Fox Lake, Wis., in 1851, a son of John W. Conklin, who was for years connected with the building interests of his section, and in the schools of Milwaukee his education was obtained, his knowledge of art decoration being also obtained there. He came to Chicago in 1870 and entered the employ of the Colby Furniture Company, with which he remained one year, then entered the employ of the Chicago Carpet Company. Prior to this, however, while a resident of Milwaukee, he worked for the Matthews Brothers' Furniture Company for twelve years. He is a member of the Independent Order of Foresters. He is married, the father of three children and his home is at 5522 Sangamon street.

John Von Kampen, the successor of Rudolph Perl, deals in paints, oils, glass, etc., at 496 Milwaukee avenue, where he has been established in business since 1890. His stock of goods is very complete, and by his earnest endeavors to supply the wants of his patrons and by his honorable business methods he has built up a large trade that is constantly increasing. He was born in Holstein, Germany, March 22, 1844, and there at the age of thirteen years he began learning the painter's trade, and after becoming thoroughly versed in this business worked at it in his native land for thirteen years, during which time he acquired a thorough and practical experience. In March, 1869, he immigrated to the United States and soon came to Chicago, and here successfully worked at his trade until 1890, when he purchased his present well-equipped establishment. As a painter he has shown much ability, and his work has at all times proved satisfactory. Since coming to this country he has affiliated with the republican party and has interested himself in all worthy enterprises, showing those substantial and worthy traits of character for which the German-American citizen is famous. He was married in 1869 to Miss Katie Mewing, by whom he has three children: Edmund, Hugo and Ida.

The Henry Dibblee Company is one of the best known in Chicago, and has a high reputation for the character of goods placed upon the market, and for its reputable dealings. It is located at 266 and 268 Wabash avenue, and has a very large and lucrative patronage, which it justly merits. The house imports, manufactures and deals in the finest line of mantels, tiles and fireplace appurtenances of every description, of the most beautiful varieties and in immense quantities. It manufactures many of the most beautiful of special designs of mantels now in the market, and in conjunction with the same, artistic sideboards, bookcases, diningroom, hall and library furniture. The house also carries a varied and extensive line of brass and onyx goods. Their enormous sales and large and steadily increasing patronage attest to the reputation of the house. The facilities of the house for handling large contracts and the certainty of always supplying the highest grade of goods, have secured them many fine orders without any competition. One of the best designers in the United States is in their employ, and the trade has extended far beyond Chicago into all portions of the Union. Their factory is located at 194 to 198 South Clinton street, and patrons of the house are at all times welcome thereto for the purpose of seeing the execution of many interesting features of the work. The tile business done by this company is very extensive, and their special productions may be seen in the fireplaces of hundreds of homes and in scores of the best buildings in the city. Large quantities of these goods are imported from Shropshire, England, where they are manufactured by Maw & Co.; in fact, this company imports larger quantities of English tile than any other concern in America. Their goods may be seen in the Pullman building, the Richelièu hotel, the Wellington hotel, the Auditorium building, Kinsley's restaurant, the Dearborn street depot and the Great Western depot. An inspection of the salesrooms of this company will well repay any person wishing goods in their line. The founder of this well-known company began business in Chicago in 1873, and the house still bears the name under which the company was first organized. The business at first was very limited in this market, the demand being small and uncertain, but it has steadily gained in proportions until Chicago alone furnishes an enormous demand for the line of goods handled by this company. The present president and general manager, Mr. Anson S. Hopkins, associated himself with the firm in 1878, and under his excellent management and industry the demand for their line of goods has rapidly increased and has developed into its present large proportions. In 1886 a stock company was formed, at which time Mr. Dibblee retired from active participation in the business. The large acquaintance which Mr. Hopkins has secured among the business men of Chicago and the West enabled him to interest, as stockholders in the company, many of the wealthiest and best known of the local business men, among whom were O. S. A. and A. A. Sprague, of Sprague, Warner & Co.; A. C. Bartlett, of Hibbard, Spencer, Bartlett & Co.; C. H. Morse, of Fairbanks, Morse & Co.; Peter White, president of the First National bank, of Marquette, Mich., and others. With such men as stockholders, and such a man as Mr. Hopkins as manager, the house has secured and holds the largest trade in its line in Chicago and the West. The beauty of the salesrooms, the wonderful fittings, furniture and appurtenances of their establishment. the æsthetic nature of their adornments and interiors, are both a surprise and revelation. A feature of the business of this company, and which many do not realize, is the large amount of fine specially designed work now being executed by them. Many of our best architects with their rapidly increasing business find commission does not compensate them for the time required in preparing designs and details for such parts of the interior as the mantels, sideboards, bookcases and in many cases fine pieces of furniture, and appreciating the effort of this company in employing a designer conversant with the requirements, are very glad to turn over such items to the company to design and execute. In all such cases the general character and feeling of the architect's plans is adhered to, and these designs when adopted are not duplicated for any one else. Notable examples of their productions may be seen in the Tennessee club at Memphis, Tenn., where all the interior furnishings, including even the billiard tables, were designed and supplied by this company; also in the residences of William A. Fuller, of Palmer, Fuller & Co.; T. P., F. W. and George T. Smith, Grand boulevard and Forty-seventh street; George E. Willits, and many others in Chicago; also in the residence of R. B. F. Pierce, Indianapolis, Ind., and in fact in both public and private buildings in most of the territory tributary to Chicago. Like scores of others identified with the well known business interests in Chicago, the president and manager of this company is New-England born, being a native of Vermont.

After attending the regular summer and winter terms of a country district school until he was fourteen years of age, he was compelled to forego further educational advantages, and to take up the task of earning a livelihood for himself. and made a five-month engagement with a farmer in Lyndon, Vt. Some of his associates bantered him as to his probably giving up the position after a few days' trial, and he determined not to leave it until the expiration of his engagement, a determination which he kept. A letter of recommendation from the old farmer for whom he had worked, which he asked for, was willingly given him, and which he keeps to this day as a memento, reads as follows: "I can recommend Anson S. Hopkins as a very good boy and a first rate milker." It is signed, Welcome Bemis, for that was the agriculturist's name. In the following spring he engaged for three years in a general merchandise store in West Concord, Vt. After two years' service, overwork and exposure brought on him that painful disease, inflammatory rheumatism, which incapacitated him for work for three months, and when he recovered his late employer secured for him a position as entry clerk in a store connected with the scale manufactory of E. & T. Fairbanks & Co., at St. Johnsbury, Vt. His services there were so satisfactory that after six months he was promoted to the position of general bookkeeper in charge of the merchandise books, which he retained about three years, relinquishing it only upon his elevation to the position of paymaster for the scale works, in which he served continuously six years, during which period he disbursed to employes of the concern about $40,000 monthly, knowing each individual on the pay-roll by name, and being regarded by all of them in the light of a trusted friend. But the young man was ambitious to rise in the world, and even this desirable position did not satisfy him. Securing a month's leave of absence, in October, 1877, he came west on a prospecting tour. Chicago had long been his ideal city, and when he saw it he was even more favorably impressed with it than he anticipated; and, returning home, he resigned his position, his resignation to take effect at the close of the year, at which time he came directly to Chicago, bearing a letter of recommendation to Marshall Field from a mutual friend. Securing an audience with the merchant prince, he so favorably impressed the latter that Mr. Field recommended him to his brother-in-law, Henry Dibblee, with whom he accepted a position as bookkeeper and general salesman, which, however, was not immediately open to him. He was not one to wait idly, and he took a temporary position in the office of Fairbanks, Morse & Co., who would gladly have retained his services, but, preferring to learn more of general commercial life, he took his place in Mr. Dibblee's establishment in February, 1878, thus beginning his active connection with an enterprise with the development of which he has been ever since helpfully and conspicuously identified, and which is in its line second to no other concern in the country, perhaps to none in the world. When Mr. Hopkins' connection with this great establishment began, the business was largely devoted to iron products, which was not exactly in accord with his wishes as to its scope and opportunities, and under his influence and management this then leading feature was gradually abandoned until, when, in 1886, the Henry Dibblee Company was formed, it was wholly closed out, and the concern has since devoted its entire time, attention and space to the present industry. At the age of only forty years Mr. Hopkins, the once farmer boy among the Vermont hills, is in one of the best and most responsible positions in Chicago's great mercantile and commercial circles. He was married, in 1876, to Miss Martha F. Leath, of Memphis, Tenn., and, with his wife and four children, resides at 5335 Cornell avenue. His career is one which illustrates what may be done by a man of honest ambition, perseverance and good business training and sagacity.

The premises occupied by the Builders' Mantel Company are located at 261 Wabash avenue, and as the spacious showrooms are arranged in a suite, they are admirably adapted for displaying to the best advantage the magnificent stock of grates, tiles and mantels which are kept constantly on hand. Their stock ranges from the simplest in wood, marble and slab to the most elaborate and expensive. The impression left on one visiting their establishment is both pleasing and profitable, illustrating, as it does to the most superficial observer, that Chicago (but a short time since a prairie village) can now, owing to the enterprise and push of her business citizens, bring the excellencies of art to their very doors. Manufacturing enterprises of modern times have embraced many features of practical utility, but none which deserve higher merit or consideration than those which relate to the home, its pleasures and conveniences, and the reputation of the above mentioned company, as designers, makers and dealers in mantels of all descriptions, has become widespread. The firm was organized in June, 1890, under the personal supervision of John M. Dodd, the present courteous and gentlemanly manager, who also occupies the position of designer, and has enjoyed a very prosperous career. Prompt attention is given to all orders, and the contracts which have been filled by them have been highly satisfactory, the work done on houses for Potter Palmer, Frank Alsip, A. F. Shuman, D. E. Corneau, Perry A. Hall, E. C. Coulter and others being particularly commendable. They do a large amount of suburban work, and some of the most palatial residences surrounding the city contain specimens of their handiwork. Included in the business done by this firm is that of tile and mosaic work of all descriptions from their own special designs.

The Decorator's Supply Company have their office and showrooms at 49 East Van Buren street, and of this company S. Strahan is president and R. C. Foster, secretary and treasurer. This establishment is one of the remarkable developments of the application of æsthetic taste and knowledge to special building manufactures of an artistic nature. By study, experience and care they can supply the decorator with every description of ornamental work that he may desire to use in enriching or embellishing with his art any office, residence or public building. They manufacture all kinds of artistic woodwork, such as grille work, fret work, carvings, turnings, scroll work, etc., a cut herein representing some of their grille work in natural wood. In addition to this fine line of goods they also manufacture all kinds of friezes, cornices, ornamental coverings for ceilings and walls. This material is called fibrous plastic work and is composed of paper pulp and canvass with sufficient plastic gypsum and other materials mixed therewith to make a substantial and ornamental covering for walls and ceilings that will not crack and is fireproof. After being placed in position, it can be readily decorated from time to time to suit the taste. Another meritorious and new development of ornamental art is their cement fiber composition for exteriors of buildings, such as gables, friezes, urns, panels, festoons, etc., which will stand exposure to the weather. This work is manufactured of cement and fibrous materials, molded into flexible molds, thereby securing the greatest relief for the work, which is equally as good for the purpose intended as if carved in solid stone. Designs are made to order and to suit any place required, and the work is carried out in the most artistic and praiseworthy manner. A visit to their depository of applied ornamental work is highly recommended as being entertaining, instructive and useful. This is one of the most important advances in superb decorative effects of this wonderfully inventive epoch.

J. Bartolomei & Co., ornamental composition stucco work, center pieces, cornices, etc. Mr. Bartolomei is well known throughout the West as a designer of all kinds of ornamental stucco work, and all the leading theaters of Chicago, as well as public buildings and dwellings, show evidences of his handiwork. Being a native of Italy, the home of art, he learned his business there, after which he began looking for new fields where his talent would be appreciated, and in 1849 became a resident of the United States. He has identified himself with the building interests of Chicago since 1865, but his labors have not been confined to this city alone, as much of the interior work and finishing on the principal operahouses in the following cities was done by him: St. Louis, Kansas City and Sedalia, Mo.; Milwaukee and La Crosse, Wis.; St. Paul, Minneapolis and Duluth, Minn.; Cincinnati, Dayton, Sandusky, Zanesville and Springfield, Ohio; Syracuse, N.Y., and Keokuk and Sioux City, Iowa. The following churches also bear testimony to his skill and artistic talent: St. John the Baptist, St. Anna's, First Baptist, Holy Trinity and Italian Catholic, of Chicago; St. Mary's, at Joliet, Ill., and the new Catholic at Ottawa, Ill. The ornamental stucco work done by him is elaborate, rich and beautiful, and his designs are noticeable, elegant and pleasing. Some of the most elegant and costly homes of the city have been fitted up by him, and the admirable blending of colors and the neatness and grace of his designs indicate that he is possessed of artistic ability of a high order. He has a new invention which, besides being absolutely fireproof, possesses the admirable qualities of intense hardness and susceptibility of readily reuniting upon being cracked or broken. With this composition he has fitted up the establishment of Lansing & McGarigle, the Chicago restaurant (on Adams street), and a nnmber of fashionable saloons, some of his contracts on Monroe street and Ashland avenue figuring very high. He has found it convenient, from time to time, to change his quarters, but is now located at 196 to 200 Washington boulevard. He also has 671 West Van Buren street, where Frank Bartolomei is located, and where they receive all kinds of orders, both great and small. This firm is not only one of the very oldest in its particular line in the city, but in the entire West as well. This branch is known as F. Bartolomei & Co., proprietors of the Lapillo Novi Decorating Company, manufacturers of stereo-relief work and lapillo novi, for interior fireproof wall decorations.

As a manufacturer of plaster decorations, etc., William F. Kellett began business in 1878, upon very limited means, at 49 East Van Buren street. The enterprise had at first a struggle, but soon came bravely to the front, and in 1883 was full of promise. It was devoted exclusively to the manufacture of plaster decorations, centers, brackets, cornice enrichments, etc., and a specialty was made of designing and modeling to order. In all the departments of his business, Mr. Kellett displayed great talent, culture and industry, and was the originator of many designs of surpassing beauty. He issued a catalogue and price list, which was very attractive. Three skillful men were employed and ably seconded the efforts of the proprietor. The fame of the products had spread thus early over the whole Union and Canada, and orders aggregating $10,000 were yearly received from all quarters. The work was all done by hand, and was of superior excellence and beauty. Two basements 18x65 feet in size were occupied, and the business was, in its line, one of the finest in America. Mr. Kellett came to Chicago from San Francisco, where he acquired his calling, in 1879.

George W. Pitkin & Co. are among the most extensive manufacturers of liquid and paste paints and white lead and colors in oil in Chicago, and are located at 277 and 279 South Clinton street. The merits of their products are recegnized by all builders and house-owners who have used them. The superiority of their white vessel paint is universally recognized by all vessel-owners on the lake, who have used it. The present house, George W. Pitkin & Co., was established in April, 1868, by George W. Pitkin, who was the first to introduce mixed paint in this city. The company's plant is very extensive and affords facilities for the manufacture of large quantities of the best paints known to commerce. Like so many others of the best business men connected with the building trades here, Mr. Pitkin is a native of the East. He was born in Manchester, Conn., in 1827, the son of the distinguished Deacon, Richard Pitkin, whose family consisted of six children. He was reared and educated in his native town, and started in life by first clerking in a drug store, succeeding which he traveled, selling notions in the country towns. In 1854, after having followed a variety of pursuits and having traveled quite extensively throughout the country, he came to Chicago and engaged in the wholesele grocery business, and in 1868 first turned his attention to the sale of mixed paints, which occupation from the start proved successful. His first plant was established at 19 Dearborn street. He was one of the stockholders of the Averill Chemical Paint Company, of Cleveland, Ohio, for which he was sole agent in the West for a period of eight years. In 1876 he associated with him in his business Edward C. Sherman, a nephew, as a partner, and commenced the extensive manufacture of paints at 85 and 87 Market street, where they remained until 1882. They then removed to their present place of business. The capacity of the present plant is 2,000 gallons of paint products per day. The company employs about thirty men. Its trade is almost entirely with the country merchants direct, the firm having always declined doing business with jobbing houses, and its sales have extended into all the states from Indiana to the Rockies, and from Canada to Mexico. January 1, 1890, Mr. Pitkin bought Mr. Sherman's interest in the business, and with his son, Harry E., proceeded to drag the enterprise out of the stagnant state into which it had grown. That their efforts have been successful is evidenced by the business of the year 1891, which bids fair to almost if not quite equal the famous year of 1882. Mr. Pitkin is a member of the Illinois club and of the Bon Ami Camping club, of which he has been, for five or six years, secretary and treasurer. His wife was formerly Miss Eliza A. Swope. They have three children, Harry E., Roger S. and Gertrude. Harry E. was born in 1863. He was educated in this city, graduating at Morgan Park Military academy in 1881 and later entering Beloit college, Beloit, Wis. For the past year he has been the efficient and active assistant manager of this company. Roger S., the younger son, has returned from Yale college and taken the superintendency of the manufacturing department.

Schmidt Brothers' Drug Company, Seventy-first street and Cottage Grove avenue, is composed of F. Joseph Schmidt, president; F. William Schmidt, vice president, and F. Charles Schmidt, secretary and treasurer, and deals in drugs, paints, glass, oil, etc., besides manufacturing a well-known line of proprietary medicines. This company handles a large amount of paints and oils, and is excellently equipped to supply the trade of contractors.

H. W. Wollin is the efficient and trustworthy manager of the Northwestern Lead & Oil works, at 84 to 96 Pratt street. He was born at Oconomowoc, Wis., March 4, 1861, to Frederick and Louisa (Zander) Wollin, who were born near Berlin, Germany, the former in 1826 and the latter in 1836. They immigrated to the United States in 1855 and settled in Wisconsin. The father, who was formerly a successful mason contractor, is keeping a saloon and farmers' home (hotel) in Wisconsin. H. W. Wollin is the eldest of seven children and was reared and educated in his native state. At the age of sixteen and a half years he began learning the miller's trade, and to this calling he devoted his attention for about five years, at the end of which time he came to Chicago and entered the employ of Joseph Schlitz, the brewer, the following year and a half being spent as a traveling salesman on commission. The year of 1885 was spent in the employ of his uncle, C. H. Plautz, who was serving in the capacity of city clerk, but for the past five years he has been engaged in his present business, first filling the position of bookkeeper, then secretary, and for the past year has been manager of this extensive business. He has proved himself very competent, honorable and active, and although he is still young in years he has shown business ability of a high order, and gives promise of becoming a first-class financier and a leading man of business of this city. He was married in 1887 to Miss Pauline Lausten, a native of Chicago, by whom he has one son: Andrew A.

Chapter XV.

PLUMBERS, HEATERS AND VENTILATORS.

Ludwig Wolff has long been widely known as a leading manufacturer of plumbers' supplies. He was born in Mechlenburg, Germany, March 11, 1836, a son of John and Christiana (Sivert) Wolff. Mr. Wolff's father was born in Schwaan, Germany, in 1806, a son of John Wolff, millwright (who died at Schwaan, Germany, in 1809), and was by trade a wagonmaker. Accompanied by his family, he came to the United States in 1854, by the sailing vessel North America, the voyage consuming thirty-three days from Liverpool to New York, where his wife (born in Bentwisch, Germany, in 1818) and two sons, brothers of Ludwig Wolff died. There had been nine hundred passengers on board the North America. Of these, four hundred had died en route, of Asiatic cholera, and fifty died at Staten Island, so that only one-half of the original number may be said to have reached their journey's end alive. The father and the surviving members of the family came to Chicago soon after this distressing bereavement, and had scarcely got settled in the town after a journey of six days by water and by rail from New York, when Mr. Wolff died, July 3, 1854, at the hospital of the Sisters of Mercy, on Michigan avenue. A few days later a son died, and there were then five children left, of whom Ludwig Wolff, then eighteen years old, was the eldest. This youth had now taken upon himself the burden of the family, and bravely he assumed the responsibility. Like most German boys, he had considerable education. He had attended the public schools of Schwaan from the age of five to the age of fourteen years. Besides, he had served a four-year apprenticeship to a coppersmith in the city of Rostock, and during that time had attended night school. So equipped, it will be seen that he was by no means helpless, even in a strange land, whose tongue he did not understand. He first sought work at his trade, which he found with Thomas George & Co., 201 Lake street. Having succeeded thus far, he rented a large room on State street, opposite Taylor street, of Mrs. Andrew Schaffer (now Mrs. Koch, one of the few remaining early settlers of Chicago), in which he domiciled his dependent family, paying Mrs. Schaffer for their board all the money he earned. He next inserted an advertisement in the Illinois *Staats Zeitung*, offering some of the children for adoption, and a few months later had the satisfaction of seeing his brothers and sisters well cared for in good families. Mr. Wolff worked with George & Co. until the fall of 1854, receiving nine shillings per day as his earnings, and then started South, looking for better fortune. He traveled until he spent all of his money except fifty cents, and found himself in St. Louis. The remaining half dollar he spent in crossing the river. Later he was at Alton, and from that town he walked to Plainview station, where he found employment with a farmer at $2 per month and his board and washing. He remained there three months, the farmer instructing him in the English language meanwhile, and at the end of that time had $6, which he spent in getting back to Chicago. On the trip he and his fellow-passengers were snowed in four days and nights. Arriving again in Chicago, he secured employment at his trade, at $2 per day. June 17, 1855, he formed a partnership with a plumber named Torrence McGuire, already established in a small way, and the two opened a plumbing and coppersmithing business in the rear of 75 Lake street, in which they continued together eleven years. At the end of that time the firm of Wolff, Barry & Co. was formed. The partners were Mr. Wolff, a coppersmith, William Barry, a brass finisher, and Edward Boss, a capitalist. A year later Mr. Wolff purchased his partner's interest. In 1876 the L. Wolff Manufacturing Company was incorporated, Mr. Wolff owning all the stock. He built his old plant at 109 and 111 West Lake street in 1866, and has added to it since at different times, until it covers the space from 93 to 117 inclusive on the same street. In 1887 he built on Carroll and Hoyne avenues a plant, which is the largest in the city, covering four hundred and seventy-five feet on Carroll and two hundred and fifty feet on Fulton, which includes a large foundry, a boiler shop, a galvanizing department and enameling works. He employs about one thousand men, and his pay-roll aggregates $9,000 weekly. The output of his concern in 1890 was upward of a million and a half dollars' worth of products. This business of Mr. Wolff's has grown up entirely under his personal supervision and management. His manufacturing establishment is the most complete of the kind in all its branches in the United States. His business consists chiefly in manufacturing all kinds of plumbers' materials and tools and sanitary appliances, all brass and plated goods and porcelain-lined cast-iron work used in plumbing. His trade extends to all parts of the country. In brass-work, the concern is a leader in all branches appertaining to plumbing, and in copper-lined goods, including bathtubs, showers, etc., all the latest improved water-closets and appliances of the same, it is an originator in all improvements, having experts experimenting in this line all the time. It turns out also all marble, slate and soapstone work for bathrooms, kitchens, etc., for all kinds of structures, from dwellinghouses up to the largest public and office buildings, and gets up special designs for fine bathrooms and closets for Pullman cars, residences, hotels and office buildings, manufacturing everything required in the plumbing of any structure, however large, having a department for fine cabinet woodwork for bathrooms, closets, etc. The company employs several artists and designers, whose sole duties are devoted to finest specialties in the plumbing lines, and employ their own artists and engravers for making wood cuts descriptive of their products used in their finely illustrated catalogues. The company is now composed of L. Wolff, president; John F. Wolff, vice president; John Clifford, secretary, and C. J. Wolff, manager of the Carroll avenue plant. Starting so inauspiciously and with such disadvantages as have been spoken of, Mr. Wolff has yet been a very successful man. Nor has his success been unbroken since it began. He has at times been singularly unfortunate in his over-confidence in men, and he has lost much by fire. He became a Mason in 1857, joining William B. Warner lodge No. 209, and he is a life member of Apollo commandery No. 1, and a member of the Oriental consistory and Medina temple.

Robert Griffith is the popular president of the National Association of Master Plumbers of the United States, a position for which he is eminently fitted; for he is a man of recognized influence and ability, and by his systematic, careful and thorough manner of work has attained to a success which is justly deserved. He was born in County Monaghan, in the North of Ireland, March 3, 1848, to John and Mary (Brown) Griffith, both of whom were born in the Emerald Isle, but were of Scotch descent. When Mr. Griffith was quite young, his parents removed to Scotland, and in that country he was reared and educated. His mother died in Glasgow, Scotland, in 1863; his father in Chicago, at the age of seventy-four years. Robert Griffith, as a young man, possessed an original and active mind, at all times thinking for himself, and as he was ambitious, he decided that the new world offered a better field for his talents than the old country, and hither he came in 1867. He reached Chicago on the 27th of April, and during the same year began an apprenticeship at the plumber's trade in the shop of Lothian & Griffith, where he remained for some time, and then served three years in the employ of the Chicago Steam Boiler Manufacturing Company, then returned to the plumbing trade and for some time was in the employ of Watson Griffith, a prosperous plumber, perfecting himself in his trade, until 1876. He then began the plumbing business for himself at 427 North Clark street, and has since continued independently, meeting with most flattering success, his business having increased from year to year, and some of his first customers still favoring him with their patronage. He first began to make his presence known in this city upon his entrance into the Master Plumbers' association of Chicago, and as a member, he has been an active, enthusiastic, conscientious worker and a steadfast believer in the principles upon which the organization is founded. For five years he was chairman of the warehouse committee of the Chicago Master Plumbers' association, and in 1887 was president of the association, proving a competent and faithful official, well liked by the members of the organization. He has also filled the position of president of the National Association of Master Plumbers, being elected in June, 1890, and served until June, 1891, and for his thorough competency, his faithfulness to the discharge of every duty, and his interest in the welfare of his brother workmen, he won encomiums from all. In June, 1875, he married Miss Lizzie Redmond, who was born on Sigel street, Chicago, February 6, 1858, a daughter of James and Katie (Redmond) Redmond, and by her has become the father of the following children: William H., Mabel S., Robert Roy, Chester A. and Bessie M. In politics Mr. Griffith is absolutely independent, always supporting those whom he considers the best men, and in nearly all cases the men to whom he has given his support have proved competent and incorruptible officials. He is a member of Lincoln Park lodge No. 611, of the A. F. & A. M., also Lincoln Park chapter No. 177, R. A. M., of Ætna lodge No. 159, of the A. O. U. W., and of Lincoln

Park council of the Royal Arcanum. He and his wife are prominent members of Lake View Congregational church, and for several years he has been superintendent of its Sabbath school. Although Mr. Griffith is unassuming in manner, he has a sufficient amount of self appreciation to make him at ease in any society, and this, with his unswerving energy and enterprise that does not flag, has made him a prosperous business man and brought him a host of warm personal friends, who are his earnest well wishers. He is impulsive and frank, despises hypocrisy and meanness, and his career thus far has been strictly honorable. As a plumber, he has won both a local and national reputation, and in every respect deserves the respect and esteem which are accorded him.

David Whiteford, president of the Chicago Master Plumbers' association, was born in Dalry, Ayrshire, Scotland, December 27, 1843. Leaving school at the age of ten he went with his parents to Johnstone, a manufacturing city in Renfrewshire. He began work in a cottonmill as a piecer, but having a desire to learn a trade was sent to Largs, a sea-bathing place and a summer resort for the people of Glasgow. At the age of twelve he was apprenticed to J. & J. Wylie, plumbers, etc., and served a term of six years, working from six in the morning until seven at night. While learning the trade he joined the Fourth Ayrshire volunteer artillery company, and was a member at the time of his departure to his adopted home in this country. He arrived in Chicago in 1861, and in a few days went to work with W. S. Verity, who had a tin store, and did repair work in plumbing at 215 West Randolph street. At that time there was no practical plumber in the business west of Halsted street. After a few months' work with Mr. Verity, he left and worked with Thomas George. Being desirous to add to the stock of knowledge he already had, he entered the employ of John Hughes, at that time carrying on the most extensive plumbing business in Chicago, and in the West. Later he engaged with Barnett & Murray, plumbers, and for them in 1862 and 1863 had charge of the plumbing work at Camp Douglas. In the winter of 1864 he left Barnett & Murray, and took charge of the business of William S. Verity until the latter recovered from a severe attack of sickness, and in February, 1864, being twenty-one years of age, he entered into partnership in the plumbing business with Mr. Verity, which partnership continued until 1873, when it was dissolved. Mr. Whiteford left for Europe in search of rest and health, visiting the principal cities in England, Ireland and Scotland, returning from his trip fully restored to health in the fall of 1873. In the spring of 1874 he opened a place of business at 346 West Randolph street, where he has continued uninterruptedly for the past seventeen years, and is now engaged in the business at 372 West Randolph street. Mr. Whiteford was elected to the presidency of the Chicago Master Plumbers' association, Thursday evening, January 8, 1891. In matters pertaining to the advancement of the trade, he has always been an earnest and sincere worker. Since the organization of the Chicago Master Plumbers' association he has devoted both time and money to furthering the interests of all engaged in the trade. He has served on almost all the important committees of the organization, steadily refusing to accept office of any kind, and it was with considerable hesitation that he finally decided to accept the position to which he has recently been elected. He has also been a conspicuous figure in the national association, not as a speaker but rather as one exceedingly wise in counsel. He has been sent as a delegate to almost every convention, and filled the position with both credit to himself and to the association which sent him there. He occupied the important position of state vice president for Illinois in the National Association of Master Plumbers in 1890, and has been chairman of the essay committee of the National association. As a writer he has contributed many valuable papers on sanitary topics which have been widely published both in this country and abroad. With an integrity that never deviates a shade, unswerving in honor, and with the principles of right and justice firmly fixed, he will add additional luster to the organization which has just honored him with its presidency.

John J. Hamblin, of the well-known plumbing firm of J. J. Hamblin & Co., is a native of New Jersey, his birth occurring at Newark, July 5, 1835. His parents were John and Susannah (Ross) Hamblin, both natives of England and both of Anglo Saxon stock, the most adventurous, enterprising and successful branch of the Caucasian race. The father was born October 1, 1800, and lived to be forty-five years old, dying in New York city. The mother died at Newark, N. J., in 1836. Of their family of four children, three are living, of whom John J. Hamblin is the youngest. After reaching a suitable age, he attended the public schools of New York city, but later entered San Harbor college, an institution of more than local repute. His studies were pursued steadily until 1849, when, on March 11, of that year, he began serving an apprenticeship at his present business with J. P. Quinn; later he was with the firm of Philbin & Quinn five years, and then for two years served under Thomas Carter, receiving thus seven years of continuous instruction in the complex duties of his chosen occupation. In 1856, having attained his majority, he came to Chicago and began work for James Brown, continuing to his employer's satisfaction for one year, and then for a few months accepted a position with Many & Fitzpatrick. Immediately succeeding this, in November, 1857, Mr. Hamblin formed a partnership with James McDonald, and together they bought out the firm of Many & Fitzpatrick, and carried on the business successfully until the spring of 1860, when they dissolved partnership. In August, 1862, the country being then involved in a gigantic civil war, Mr. Hamblin enlisted in the Chicago Mercantile battery, and served faithfully until July, 1865, when he was honorably discharged as corporal. In the autumn of 1865 he formed a partnership with Joseph A. McCartney, to resume the old business, and continued until 1876, when he located where he now is; but one year later went to Kansas, though in 1881 he returned to Chicago and again located at his present place of business, where he has continued uninterruptedly. The present firm of J. J. Hamblin & Co. was formed in 1882. Mr. Hamblin has filled a number of official positions of great responsibility and trust. He was a charter member of the Chicago Master Plumbers' association, established in 1882, and since its organization in 1883 has been a member of the National Association of Master Plumbers of which, in 1888, he was treasurer. He is now the financial secretary of the National association and treasurer of the local organization. In 1871 he became a member of Dearborn lodge No. 310, A. F. & A. M. He is the oldest master plumber now in the city. His life is a splendid example of what perseverence, pluck and honesty can accomplish.

Hugh Watt, the oldest gentleman engaged in the plumbing business here, was educated in Cousland, Scotland, in the parish schools, and as early as October 20, 1842, he began learning the details of the plumber's trade in Edinburgh, with the firm of Hay & Addis, and with them served an apprenticeship of six years. At the conclusion of this service he commenced work at his trade as a journeyman and continued until the spring of 1850, when he came to the United States, and for two years followed the plumbing business in the city of New York. In February, 1865, he came to Chicago and established his plumbing shop on Monroe street, where he continued to do business until the great fire of 1871. He is now located at 300 Dearborn street, and for twenty-six years has been engaged in the plumbing business in this city, and is one of the most popular, efficient and capable of the local plumbers. His jobbing is very extensive, and his elaborate and conscientious work may be seen in some of the finest structures here, among them the Grand Pacific hotel, the Board of Trade, the old Chamber of Commerce; the fine residence of George M. Pullman, and in scores of others of the best buildings in Chicago. He carries a full line of plumber's supplies and is prepared to do any work in his line, no matter how extensive or important. He is well known to all builders and to property owners and has a steady trade from old patrons who have learned from experience of his honesty and strictest adherence to the best business principles. He is president of the Chicago Master Plumbers' association, and is a member of the National Plumbers' association and of St. Andrew's society, and he and his wife are members of the Jefferson Park Presbyterian church. In politics he is a republican. In 1851 he married Miss Catherine Wilson, a native of Scotland; who died in 1860, leaving five children, three of whom (John F., Robert G. and Agnes E.) are now living. In 1861 he took for his second wife Miss Anna McGowan, also a native of Scotland, and to this union seven children have been born: James M., Archibald M., Frederick H., William H., Anna I. and Janet M. (twins), and Harriet M. Mr. Watt was born January 25, 1826, a son of John and Catherine (Dewar) Watt, both the parents being natives of Scotland. The father was born in 1788 and died in his native land in 1842, having been for thirty years the efficient manager of the celebrated lime works located at Cousland, Scotland, nine miles from Edinburgh. The mother was born in 1790 and died in 1840. Mr. Watt was the youngest of seven children, of whom three are living.

P. Nacey. No part of the plan of public building or private residence is more carefully scrutinized than are its sanitary provisions. One of the best posted men on the subject is P. Nacey, of 339 Wabash avenue. He has built up a large business by reason of his careful and faithful attention to the details of sanitary plumbing. Mr. Nacey is a native of Kingston, Ontario, Canada, and was born June 26, 1843. It was there he began learning the trade of plumbing, which he completed in Chicago with one of the leading houses in that line. He has been a resident here since 1862, and has been in business on his own account since 1866. He has been at his present location since 1889. The work he has accomplished has been large in volume, and much of it important in character. Anything like a mention in detail of his various contracts is impossible in the space of a sketch like this. He has for some time done the bulk of the plumbing of the public school buildings for the Chicago board of education and numerous structures of all classes, including the Owings building, the Mallers building and the Stock Exchange building; and some of the finest residences in the city owe their plumbing, gasfitting and sanitary appliances to him. He also furnished the plumbing for the main floor of the Tremont house, and remodeled the plumbing of the George Armour estate building; and he did the work of the finest residence in San Diego, Cal., one of the most costly and elegant on the Pacific coast, and has recently completed the plumbing of the new Fair building, now in course of erection. One of the great changes for the better which have taken place in the past five years in Chicago is the improved work in plumbing and ventilation that is exacted by builders and owners, who at the same time expect to pay for this better class of work. This new condition of things in building circles has produced the effect of making plumbers in this city rank with the best equipped and most skillful workmen in the world, and none are better equipped or more skillful than Mr. Nacey, nor is there one who has always kept farther in advance of the times, nor who has earlier advocated practical innovations. The plumbing firms who are to-day doing the greater part of the work in Chicago, in public and private buildings, are among the men who prophesied the new order of things many years ago. It has been more than ten years since Mr. Nacey began to insist that all plumbing fixtures should not be encased, but should be open to view; that each trap should be ventilated, as well as all soil and sewer pipes, and that the drainage or sewer pipe should be of iron and be tested after being placed in position. His views on these questions then are in universal use now, and it is a source of gratification to him to know that, although he had a long and hard fight to carry his ideas into practice, the increase of better ventilation and better plumbing in the homes of Chicago has led directly to a noticeable decrease in the death rate of the city. Mr. Nacey gives particular attention to remodeling defective plumbing and drainage systems, and will undertake no contract where anything less than first-class work is demanded.

Valentine Ruh, plumber and gasfitter, 548 Wells street, was born in Germany, and came to Chicago in 1852, and began to learn the plumbing business with Wilson & Hughes, then located on Lake street near Fifth avenue. He was a volunteer fireman of the old Red Jacket Fire Company No. 4, and a member of the common council during the administration of Mayors Rice and Sherman; and he was one of the aldermen who made the memorable trip through the tunnel to the crib before the water was let into the city water works. He began business in 1872, and was active until 1889, since when his establishment has been in charge of his son, Frank E. Ruh. During his forty years' residence in Chicago, Valentine Ruh has been well and favorably known, is recognized as a sterling business man, and at one time was quite influential in local politics. Some of the work done by this house includes Lincoln Turner hall, Diversey street and Sheffield avenue; the remodeling of North Side Turner hall; the German American school, 621 and 623 Wells street; the Park Avenue

Methodist Episcopal church; the Chicago Polyclinic; the George P. Braun block, Chicago avenue and Wells street; the Henry Hochbaum block, Wells and Division streets, Henry Piper's building, 609 to 619 Wells street; the Sheridan apartment building, 580 and 582 La Salle avenue; the Western Wheel works and the following elegant private residences: F. W. Stanley's, State street and Burton place; Francis Lackner's, Dearborn avenue and Burton place; Adolph Schoeinger's, Melrose street; George P. Braun's, 674 La Salle avenue: Charles Ehman's, Garfield avenue and Lane place; A. F. Portman's, Argyle; and these all on Fullerton avenue: F. Brodt's, No. 640; Fred Guhl's, No. 644; Leo Austrian's, No. 648; L. O. Kohtz's, No. 650; L. Wolff's, No. 652; E. Lipkau's, No. 654; L. Shaffner's, No. 656, and O. Paulson's, No. 661.

Daniel J. Rock, plumber and gasfitter, has his office at No. 86 North Clark street, and is one of Chicago's most substantial, progressive and reliable business men. He has been a resident of Chicago since 1846 and his entrance into business circles dates from 1854, at which time he began learning the plumber's trade with Alexander Raffen, who was then established in business at the corner of Monroe street and what is now Fifth avenue. Later he was with the firm of Wilson & Hughes, whose shop was in the rear of the Sherman house. Here Mr. Rock completed his knowledge of his trade, and in 1860 started as a plumber on his own responsibility, continuing until August, 1862, when his sympathies became warmly enlisted in behalf of the government and he joined the Irish legion of the Ninetieth Illinois infantry. At the battle of Missionary Ridge, November 25, 1863, he received two severe wounds in the right leg, and on September 4, 1864, was discharged on account of physical disability, and returning home, worked for some time thereafter for James Irons. In 1866 he once more embarked in business, this time in company with James H. Lane, a partnership that was harmonious and profitable up to October, 1870, when it was dissolved. After the great fire of 1871 he began business at 74 Clark street, whence he removed in 1876 to his present stand. He is one of the oldest plumbers of the city, his work having been principally confined to residences, and he is now engaged in doing the plumbing for two fine residences on Diversey avenue east of Clark street, for McGinnis & Boyle. He is a rapid and thorough workman and has always been very reasonable in his charges, and in consequence his time has been fully and profitably employed at times when business has been very dull with others. He was the first president of the Chicago Master Plumbers' association. He has brought to bear upon his business many years of experience and unimpeachable honor combined with the most exemplary habits, and has made his house one of the most substantial and reliable in the city. He is a model citizen, energetic, enterprising and public-spirited. He was one of seventeen plumbers to join the Builders & Traders' exchange, and has been a member of that organization for the past five years. In connection with his business Mr. Rock is the agent for the Reliance beer pump, everything pertaining to which he keeps constantly on hand. He is a member of the G. A. R., and in 1890 was commander of Washington post No. 573, of which he was a charter member. He has a fine residence at 1219 Lill avenue, and in this beautiful and comfortable home he and his wife dispense a generous hospitality. He was married in 1868 to Miss Catherine Berrigan, who was born in Illinois in 1844, their union resulting in the birth of six children: Daniel J. Jr., Richard, John, Mary, Marciedas and Bessie. Mr. Rock inherits many of the sterling principles of his Scotch ancesters, chief among which may be mentioned honesty industry and perseverance. He was born in Glasgow, Scotland, July 6, 1835, the oldest of seven children of Joseph and Ellen (Mellon) Rock, (who were born in Ireland in 1801 and 1809, respectively, and died, the one in Tennessee in 1877, and the other at Davenport, Iowa., in 1866), and came with them to the United States in 1838, settling in Buffalo, N. Y., from which city he came to Chicago in 1846.

A thoroughly practical plumber, of twenty-eight years' experience, who makes a specialty of sanitary engineering, sewer building, and making sewer connections, is J. M. Bell, 80 Thirty-fifth street, who occupies spacious and commodious premises, comprising a store and workshop. The latter is thoroughly equipped and supplied with all the necessary tools and appliances, and a number of competent and experienced workmen are given constant employment. The store is stocked with a full and complete assortment of all kinds of plumbers' supplies, such as bathtubs, washbasins, water-closets, terra cotta, wrought and cast iron and lead pipe of all required sizes, also force and lift pumps, etc. Mr. Bell is prepared to furnish estimates and enter into contracts for all classes of work pertaining to his business, and execute the same promptly. He exercises the utmost vigilance over all work entrusted to his care. Mr. Bell was born in Ireland in 1850, but came to this country when but thirteen years old, and has been a resident of Chicago ever since. He is a member of the Master Plumbers' association, also a member of the Order of Chosen Friends, and of the Ancient Order of United Workmen.

The plumbing establishment of Young, Gatzert & Co., 965 West Madison street, presented a good representation of business improvements and scientific progress. Mr. Andrew Young founded this business in a small way in 1866, which steadily advanced to its later large patronage. A few years ago he received as partners Milton Gatzert and Charles Cavanna, two practical and experienced plumbers and gasfitters, who had spent a lifetime at this business, working for years at the large establishment of E. Baggot. Mr. Young has a national reputation as a thorough sanitary engineer and plumber. He has held the offices of president and vice president of the National Plumbers' association at various times, and was twice elected president of the local association, and was appointed on the committee on sanitary appliances to the World's exposition at New Orleans in 1885. He believes in state legislation, and that examinations should be as rigidly made as for applications to any government position. Mr. Young is the inventor of an automatic attachment for unhitching horses, which is just being placed upon the market. It is found to work a revolution in getting horses from barns and stables during a fire. This firm made and executed contracts for the complete fitting up of buildings of all kinds, and in sanitary plumbing, which was their specialty, Mr. Young has more recently operated alone.

Among the foremost exponents of the art of plumbing in or around Hyde Park may be named Marshall Horne, plumber and gasfitter, 5329 Lake avenue. None engaged in this line thereabouts maintains a higher reputation for skill and reliability, while his patronage is of a very flattering character. Mr. Horne, who is a native of England, but a resident of Chicago since 1869, is a practical and expert workmen, with many years' experience in the exercise of his art, of which he is a thorough master in all its branches. He occupies a good-sized store and carries constantly on hand a full and fine assortment of gas fixtures of every description —plumbing materials, lead pipe, gas pipe, traps, cocks, marble basins, fittings, etc., while several skilled hands are employed. Plumbing and gasfitting work and jobbing of all kinds are executed in the most superior and expeditious manner.

The business of M. Ryan & Brother, plumbers, No. 421 Milwaukee avenue, was estab-tablished by Mr. M. Ryan in 1870, at No. 462 Milwaukee avenue, where it was continued until 1884, when the premises now occupied were secured. In 1871 Mr. Thomas Ryan was admitted to an interest, and from that time it has been continued under the present firm name. They are thorough practical men, and have wonderful skill and success in arranging drainage and ventilation and setting bathtubs, sinks, closets, etc., and also introducing gas into buildings, and furnish all the fittings and pipings required. A number of skilled workmen are kept constantly employed and the workshop of the firm is fully equipped to do all work promptly and make repairs and general jobbing. The premises occupied are 25x60 feet in extent and are well stocked with everything that is required in the business of the plumber and gas-fitter. Both these gentlemen are from Ireland originally, and have been in Chicago many years. Mr. M. Ryan for eight years was an influential member of the board of aldermen, and takes an active interest in municipal affairs.

Frederick Neustadt, plumber, was thoroughly drilled in the details of his calling in the city of Dresden, Germany, and since 1870 has followed this calling in America, the most of which time has been spent in the city of Chicago. He was here during the great conflagration of 1871, and although all his worldly possessions were swept away at that time, he afterward started anew, and his services as a plumber were soon in requisition. He made money rapidly, and in 1878 formed a partnership with Robert Hauslein, and with him opened an establishment at 137 North Clark street, their partnership lasting quite harmoniously for two years. Mr. Neustadt then sold out to his partner, and opened a like establishment at 295 North avenue, which place has since been his headquarters. Among the many buildings which he has fitted up with plumbing appliances, the following are the most worthy of mention: The Germania training school, on Belden place; the residence of Gustav Wilkie, at Wrightwood avenue and Sidney court; the store and flats belonging to W. John Rich, at the corner of Wells and Whiting streets; the store and flat belonging to John Haufmeyer, at the corner of Lincoln and Racine avenues, the others being too numerous to mention. He is a most skillful, exact and painstaking workman, and the contracts which he has filled have always resulted satisfactorily to all concerned. He is a member of the Master Plumbers' association, being one of the very oldest members, and he also belongs to the Fidelia singing society, the Blue lodge of the A. F. & A. M., a select knight in the A. O. U. W., the United Order of Red Men, and is a charter member and was an active organizer of the Ogden Building & Loan association. He was born at Dresden, Saxony, Germany, December 25, 1846, to Frederick and Kate (Nix) Neustadt, the former of whom was a builder by occupation, and was quite prominently connected in Dresden. He worked at his trade for many years, and in 1870 came with his family, which consisted of himself, his wife, a son and two daughters, to America, and in this country he breathed his last in 1876. The names of his daughters are: Elizabeth, widow of Frank Bendel, of Chicago; and Othelia, wife of Herman Van Zandt, also of this city, both she and her sister Elizabeth being mothers. Frederick Neustadt was married in Dresden to Miss Linda Mizner, who died in that city, leaving him with a son, Albert, whom he has now associated with him in business. Mr. Neustadt's second marriage was celebrated in this city, the maiden name of his wife being Mary Ryman, who was born and reared here, a daughter of Frederick Ryman, a native of Mecklenberg, Germany.

James H. Roche, plumber, gasfitter and sewerbuilder, was born in Philadelphia, August 16, 1851, and is a son of James and Theresa (Kavanaugh) Roche. In 1861 his parents removed to Springfield, Ill., where James H. attended a Catholic school until 1867, when he went with A. J. Babcock to learn the plumber's trade, and was thus employed four years. He came to Chicago in 1871, and was employed by Daniels & Brown for two years, by Thomas McKinney for one year, and by Harper & Skinner for two years. In 1873 he succeeded Harper & Skinner, and in 1878 formed a partnership with D. & J. Hardin, under the firm name of Roche & Hardin. They remained together two years, when the firm was dissolved, since which time Mr. Roche has carried on the business by himself. His place of business is at 210 Thirty-first street. Mr. Roche was one of the first plumbers to get a sewer-builder's license in connection with plumbing, and has, by perseverance and strict attention to the requirements of his calling, built up a large and prosperous trade, and has fitted up many of the best and finest residences and other buildings in the city and its suburbs, among which may be mentioned the residences of Mr. Trego, Lake avenue and Forty-ninth street; W. A. Fuller, 2913 Michigan avenue; B. R. Wells, Forty-eighth street and Lake avenue; Colonel Sellers, 3440 Michigan avenue; Dr. Frank Carey, Twenty-ninth street and Indiana avenue; Dr. P. S. McDonald, 2878 Indiana avenue; H. B. Chase, Thirty-fourth street and Michigan avenue; B. F. Head, State and Bank streets; J. R. Page, Forty-eighth street and Kimbark avenue; George Ward, Forty-seventh street and Kimbark avenue; and St. James' parochial house and school (the Holy Rosary church), Pullman, Ill.; Father Gill's school, Twelfth and Cypress streets, and the Webster and Grant free schools.

The formerly well-known house of L. F. Daly & Co., 170 Ogden avenue, combined two most important branches of trade—those of roofing and plumbing; the latter having been established by Mr. Daly in 1873, and the former in 1879. In both of these staple lines a large and desirable trade was carried on, the patronage being drawn from the most influential building firms, capitalists, property owners and managers of real estate in the city. Mr. Daly did all kinds of plumbing, gas and steamfitting and work connected therewith, in accordance with approved sanitary science, and, also, in the roofing department, the house executed all work connected with felt, gravel and composition roofing, both in the line of new work and repairing, and dealt extensively in coal tar, pitch and roofing material generally. The premises occupied by the business were ample in every respect, suitable and convenient. They comprised a spacious yard and commodious office and store, and at both places every necessary facility was at hand. A full staff of competent workmen were employed in both trades, numbering together about twenty-five. Mr. Daly, a Canadian by birth, had in 1887 been for nearly twenty years a highly respected resident of Chicago.

Martin Moylan was at all times a marked figure in the master plumbers' associations, both local and national. In 1884–85 he served as a member of the executive committee of the national association and at the convention held in St. Louis in the latter year he presented one of the ablest papers ever read before that organization. He chose for his subject at that time a question which attracted widespread attention, the rights of manufacturer and dealer. In association affairs he was aggressive, but with a spirit of fairness which won the esteem of all. He contributed many valuable papers to the trade press in former years, but recently his business had grown so that it demanded all his time and attention. Mr. Moylan's good humor was unfailing. When asked one time by the writer how he decided on the plumbing trade as the business of his life, he replied: "I thought that the trade about which I had heard so much, whose members sported the largest diamonds, occupied the palatial residences, enjoyed a sojourn every year in Europe, were the courted and petted members of society, and whose names were synonymous with honor and wealth, was certainly good enough for me—in fact, it was something for which I was looking." Mr. Moylan was born November 11, 1848, at Gibbet Hill, near Nenagh, Ireland, where he resided until his eighteenth year, when he came to this country and located in New York city. He learned the plumbing trade with Nunneny & Ford in that city, and in 1874 came to Chicago and entered the shop of A. R. Wilson, on Twenty-second street, with whom he remained one year, after which he opened an establishment at 101 Twenty-second street, the present location of Moylan & Alcock. The panic of the previous year, which was being felt with crushing effect, caused him to feel that the opportunity was one for testing his staying qualities and he invested his wealth in one month's rent and launched out in his enterprise with as much pride, energy and ambition as if he had, as he once said, the First National bank at his command. During the years which followed he built up a first-class trade and enjoyed, best of all, an enviable reputation as an honest and upright business man. In January, 1889, a partnership was formed by Mr. Moylan with Joseph R. Alcock, a young man of many sterling qualities, who had also established a successful business at 121 Twenty-second street, and the firm of Moylan & Alcock was formed, which is still in existence. He died December 16, 1890. Mr. Moylan was married to Miss Mary E. Campion, of Newark, N. J., July 24, 1879, who with a family of seven children mourn his death. At a special meeting of the Master Plumbers' association, held December 19, 1890, called for the purpose of taking action on the death of this member, the following resolutions were unanimously adopted: "It is indeed with feelings of sorrow and deep grief that we congregate to do honor to the memory of our departed friend and associate. The sterling qualities of Martin Moylan are so well known that to rehearse them seems almost superfluous; but, pursuant to the time-honored custom, we desire to make a formal record, and testify to our appreciation of his virtues and our affliction at his loss. He had endeared himself to us by his warm friendship, genial manners, strict uprightness and ready sympathy for those in trouble. This association has lost a most valuable member. From its very birth there have been few, if any, who have felt a deeper interest in or labored harder toward its success. He had the courage to follow his convictions, but was quick to acknowledge an error. To his bereaved wife and children we tender our heartfelt sympathy in their irreparable loss of a kind husband and a loving father, while we mingle our tears with theirs, realizing that by the death of Martin Moylan the Creator has taken from our midst one of nature's noblemen, and we lose in him the most loyal, the truest and best of friends. Resolved, that a copy of these resolutions be spread upon the records of our association and the secretary be instructed to transmit an engrossed copy to the family of the deceased associate." This was signed by the following members of the committee on resolutions: M. Ryan, E. Baggot, J. H. Roche, J. J. Wade, T. C. Boyd. The following memorial poem, by A. W. Murray, was presented at this meeting:

The voice of love and wisdom, a defender of the right,
That counseled well the erring, and pointed out false pride,
Is hushed at half life's voyage, in the zenith of its life,
A sad loss to our council and his own dear fireside.

The honest hands we firmly held in truest friendship's grasp
Are passed beyond this vale of tears, forever are at rest;
And moistened hy our tears, have ceased their labors now,
We lay our memory's chaplet upon his manly hrow.

The kindly eye will ne'er again a loving kindred's greet,
Its joyous light or friendly glance, our own will never meet,
For the heart has ceased its heating, and life's warm hlood is stayed,
And the smile that lit his features is now in death arrayed.

The hell is softly tolling, his soul is gone hefore,
Of him whose life and faith were manly, strong and true;
The loved ones of his home will miss him ever more,
As well the hrethren of his craft, whose weal he had in view.

Excelsior was his motto, of sturdy aim and thought,
His fertile mind and cunning hand great aid to brethren wrought;
And as a just employer, his memory e'er will live,
To comfort those he leaves hehind, whose errors he forgave.

Children of a nohle sire, we also grieve with ye,
Unto his stricken widow, we lend our sympathy,
And to his aged mother, in the "Isle across the sea,"
We loved thy son, our brother, and sympathize with thee.

The president in his annual address, speaking on the subject, said: "Death has invaded our ranks during the year. Two of our members have passed away from among us; they have passed the bourne from whence no traveler ever returns. Peace to their ashes. Mr. Esch, though not an active member, was with the fraternity in matters of progression. The Auditorium building was plumbed by him, and stands as a monument to his venture and enterprise as a plumber. We regret his loss. Martin Moylan, so well known among the plumbers, has left a record that can not be effaced from our memory. Quick as a flash was he in defense of his opinion, and as quick to retract an error. His seat in our gatherings who can fill? His characteristics were his alone. We will miss him."

A. F. Irons is one of the energetic and prominent plumbers of Chicago, where he was born March 25, 1857. He was educated partly in the public schools, and partly in the college at Racine, Wis. He thoroughly learned the plumber's trade under his father's instructions, and after his father's death he formed a partnership with his father's brother, John Irons. The firm was then known as A. F. & J. Irons, and they continued in business until 1882, when John Irons died, and the style of the firm was changed to A. F. Irons & Co. (Mr. Irons' brother James being his partner), and thus continued until 1885. In 1887 the business was reëstablished by the Irons' Plumbing Co., with A. F. Irons as president, under whose management the enterprise is very extensive and of the best character, with a full line of the most modern appliances connected with the trade. Mr. Irons is a member of the local plumbing association, of which he was secretary in 1890. He was married in 1879 to Miss Emma Bohanon, by whom he has one son — George B. Mr. Irons' father, James Irons, who was born in Scotland in 1826, was a plumber of more than ordinary prominence. He learned his trade in his native land, and first exhibited his excellent business qualities there. He sailed for America in his youth, going first to New York, but a little later he went to Australia, then back to Scotland and elsewhere; but again came to America, locating in Chicago in 1852, where he worked as a journeyman for a number of years, finally establishing the business in which he was succeeded by his son, as stated above, after his death in 1877.

One of those plumbers who has proved his claim to a representative position in his vocation is Bartlett Ryan, practical plumber, steam and gasfitter, No. 290 Dearborn street, who is prominent as a sanitary plumber and expert steam and gasfitter. Mr. Ryan founded his business here in 1875. Among the most notable houses in which he has exercised his skill are the Madison hotel, Clifton house, the Langham, the Leland, J. E. Otis' block, the Fisher flats, H. C. Walker's business block, and many others. He has had twenty-eight years' active experience in this branch of industrial activity, and understands perfectly its every department. He has a natural, inherited ability for his business, as his father, under whose valuable tuition he acquired his first training in the trade, was also a skilled plumber, steam and gasfitter. The premises occupied are large and commodious, and are fully stocked with all kinds of plumbers' requisites, steam and gasfitters' supplies, gas fixtures, lead pipe, castings, water backs for stoves of various patterns, wrought-iron pipe coiling, pipe railing, etc., all of the most reliable character. Employing an adequate force of hands, Mr. Ryan is at all times fully prepared to enter upon contracts of any magnitude for work in his line, and those securing his services will be perfectly satisfied with the thoroughness with which all work will be performed. Mr. Ryan is a native of New York city, has resided in Chicago since 1860, and his wide-awake, sterling business qualifications have made him popular and respected throughout the community, and he is personally esteemed by all those with whom he comes in contact.

The plumbing enterprise of George J. Stokes was begun in the centennial year at No. 158 North Halsted street, and removed to 132 West Lake street, then to 220 West Randolph street, and to the present larger and improved quarters, at 232 West Randolph street, in May, 1886. These premises are well equipped, and probably nowhere is there a more complete assortment of goods and fittings. It embraces a plentiful supply of iron, lead and other pipe, valves and faucets, pumps of all sizes and descriptions, fire-clay chimney pipe and chimney linings, all sorts of gas fixtures all of the newest style and pattern. Orders for house and sanitary plumbing are promptly attended to by perfectly competent workmen, whether in town or country. Mr. Stokes is also a qualified sewer builder, and holds a license from the city for the carrying on of sewer building and tapping, and is known as an expert in this direction. He is a member of the Chicago Master Plumbers' association.

An old establishment connected with local building interests is that of E. Hennessy & Co., sanitary plumbing, gas and steamfitting, 3251 State street. This firm is composed of gentlemen of large experience and established reputation in their line of business, and enjoys a first-class and influential patronage. The business was founded some fourteen years ago by Mr. E. Hennessy, the present firm being of later organization. The store is well stocked at all times with a splendid line of plumbing material, gas and steamfitters' supplies, chandeliers, gas fixtures, and globes, all of the latest designs and most durable patterns, which are offered at the very lowest prices. The proprietors are firm advocates of the adoption of every improvement and method that will facilitate the work in hand or add to the value of the service rendered. They give constant employment to many skilled and experienced workmen. Designs and estimates for all kinds of sanitary plumbing and engineering are promptly furnished, and popular prices invariably prevail. The members of this reliable firm are Edward and Patrick Hennessy, John O'Toole, and John J. and Edward C. Dooley, the older of whom have had twenty-five years' experience in their business. This firm was formerly known as Hennessy & Co., and its members were E. Hennessy, P. R. Brown, H. McDermitt, J. O'Toole, P. Hennessy and E. Dooley, and their place of business was at 3247 State street and 3509 Cottage Grove avenue.

The vocation of a plumber, has, of late years, become, in view of its great importance in relation to sanitary science, more a profession than a trade, and its value to the community is constantly increasing. Among the prominent exponents of this leading branch of activity in Chicago, a very conspicuous place is held by Mr. A. H. Watson, whose place of business is eligibly located at No. 426 Milwaukee avenue. The house was established in 1878 by Brinkwater & Watson, the firm continuing until 1880, when Mr. Brinkwater retired, since which time the business has been conducted by Mr. Watson alone. He is a thoroughly experienced and skillful plumber and sanitary engineer and gasfitter, having been apprenticed to the trade, and worked at it from his youth. All the various branches of plumbing, gasfitting, steamfitting etc., are attended to promptly and efficiently, his specialty being contract work for new buildings, in which line he enjoys a most generous patronage among the construction and building interests of the city, as well as real estate owners, agents and capitalists. The patronage of the house embraces the whole of Chicago, and most of the chief surrounding districts, and a very large and valuable trade is carried on. An extensive stock of gasfixtures and fittings, and steam and gasfitters' supplies is kept always on hand. Mr. Watson is a native of Scotland, but has resided in this city from early childhood, and within two blocks of Milwaukee avenue since 1855. He is a prompt, reliable and energetic man of business, and the fullest confidence is felt, both in the trade and through the community, in his skill and integrity.

John F. Mathews is a conscientious, practical and highly successful plumber at 3241 Cottage Grove avenue, and the work which he has done, in this line, in his city is characterized by thoroughness and superior execution. For neatness and despatch he is unexcelled, and the durability of his work is also attested to by his numerous patrons. He was born in Uniontown, Penn., December 31, 1854, to Charles H. and Elizabeth (Hannan) Mathews, the former of whom was born in Pennsylvania in 1832, and is now a resident of California. The mother's birth occurred in 1830 and her death May 20, 1889. The family removed from their eastern home in 1856 to Galesburg, Ill., and in that city John F. Mathews, who was the fifth of six children born to his parents, was educated. From 1871 until 1874 he resided in the town of his birth in Pennsylvania, but at the latter date came to Chicago, and for the three months following worked for Cotter Bros., plumbers, and then with T. C. Boyd, with whom he learned the plumbing trade and remained three years. He associated himself in this business with L. F. Daly in 1878, and their partnership lasted until 1886, the firm name being Daly & Mathews. Since that time Mr. Mathews has been in business alone, and has fitted up a great number of buildings and residences mostly on the south side, where he aims to confine his efforts. He also does a good business in hot-water heating, as his numerous customers can certify. When he came to Chicago he possessed only $5, but by persistent endeavor he is now worth over $20,000, all the result of his own earnest toil. He has carved out his own career, and is in every sense of the word a self-made man. He has a comfortable and handsome home at 4613 Champlain avenue, which was erected in 1882 (the same year of his marriage), June 20, of that year his nuptials with Miss Carrie L. Boyd being celebrated. She was born at Galesburg, Ill., and has borne her busband two children: John F., Jr., and George Harold. He is a member of the Chicago Master Plumbers' association, the National association and the American Protective association. His brother, T. P. Mathews, in his bookkeeper.

M. J. Roughan is a practical plumber, and has his office at 25 Quincy street. He began learning the details of the plumbing business in 1879, but since 1888 has been in business for himself. His work gives general satisfaction.

Charles M. Foskett, of the well-known and reliable firm of Foskett & Brown, 215 Fifth avenue, has had eighteen years of practical experience in and is conversant with all the details of plumbing, justly meriting the flattering success which has attended his business career. He was born in Wyoming county, N. Y., October 8, 1856, a son of Daniel and Lois (Heath) Foskett, both of whom died in York state in 1875, the paternal grandmother also dying in that state at the advanced age of one hundred years. Charles M. Foskett was educated at Warsaw academy, in his native state, and at Palatine school, in Cook county, Ill., whither he came in 1872, the following year taking up his abode in the city of Chicago. He immediately began learning the plumber's trade with J. S. Bassett & Co., with whom he remained about six months, the following six years being spent in the employ of James, A. F. and J. Irons. Since 1880 he has been a worthy member of the firm of Foskett & Brown, the members of which are acknowledged to be among the leading plumbers of the city. The following are some of the principal buildings which they have fitted up: The Calumet building, the Douglas school building, the Gaff building, the Hampshire block and the theological seminary building, at the corner of Ashland and Warren avenues. The members of this firm hold high reputations as sanitary plumbers, are very practical, yet enterprising, in their methods, and the business which they have built up speaks volumes for the excellence of the work done and the public's appreciation of the same. Mr. Foskett was married in 1882 to Miss Marcina Tapper, a daughter of George Tapper [see sketch] and a native of Chicago, by whom he has three children: Roy, George and Elmer.

Mr. Foskett is a member of the Chicago Master Plumbers' association and belongs to Cleveland lodge No. 211 of the A. F. & A. M., Washington chapter No. 438 and St. Bernard commandery No. 35.

Elias C. Brown, of the firm of Foskett & Brown, plumbers, 217 Fifth avenue, is a competent and reliable plumber, and a thoroughly practical mechanic and engineer in every department of his business. His birth occurred in Glencoe, Ill., February 15, 1861, and he is a son of Elias C. and Mary A. (Mortimer) Brown, both of whom were born in England, the former in Hampshire and the latter in Devonshire. The father was a contracting plasterer by occupation, and was well up in his calling. He came to the United States about 1850, and died in 1885, at about the age of sixty years, his wife's death occurring in Glencoe, Ill., in 1881, when forty-five years of age. They had eight children, all of whom are living. Elias C. Brown is their eldest son. He remained in Glencoe, Ill., until thirteen years of age, receiving the advantages of the common schools, but at that age came to Chicago and began serving an apprenticeship at the plumber's trade with James Irons, continuing with him for five years. A short time thereafter he spent in the service of John Lavery, on Cottage Grove avenue, remaining there until April, 1880, when he formed a partnership with Charles M. Foskett, under the firm name of Foskett & Brown. They have gained the confidence of all for whom they have fulfilled orders, and have executed the plumbing and sanitary arrangements of some of the leading building and private houses of the World's Fair city. Among the most prominent may be mentioned the Boylston building, the Kinzie flats, the new Daily News building, Frank Alsip's residence, the Gaff and Calumet buildings, J. P. Ketcham & Bro.'s residences and many others. In this line they are a recognized leading and representative house, and builders and others may safely rely upon the excellence of their work. Mr. Brown was married, January 15, 1890, to Miss Anna L. Hubbel, a native of Baltimore, Md. In politics he is an uncompromising republican, and as a business man has had large experience, and is thoroughly conversant with every detail of his calling.

DRAWING FURNISHED BY BURKE & CO.

CEILING AT CHAMBER OF COMMERCE BUILDING.

DESIGNED AND EXECUTED BY MESSRS. BURKE & Co.

Charles Conrad Breyer, plumber. It is about eleven years since Mr. Breyer started in the business in which he is now engaged, and during this time, owing to thorough business habits and knowledge of his occupation he has made his house one of the most substantial and reliable in the city. In this progressive age, much attention is being bestowed on the interior of mansions, public buildings and stores, and Mr. Breyer has done the plumbing for many of the finest buildings in Chicago. He was born in this city on January 15, 1859, and being possessed of a fine intellect and retentive memory he made rapid progress in his studies, and although he left school at the age of thirteen years to take up the trade of plumbing, he was a better scholar that the average youth of his age. He began serving an apprenticeship under his father, and after becoming the master of the trade, he, in 1880, associated himself with his father and at the death of the latter, carried on the business with precision, faithfulness and success. He did the plumbing, gasfitting and sewering for the residences of Mr. Burchmeyer, John Grosse and W. E. Hatterman, as well as numerous others, and has also fitted up the Emerick and Spitz blocks. His father, Charles Breyer, was born in Hanover, Germany, and about 1835, when in his early manhood, came to America and located in Chicago. Having completed a thorough apprenticeship at the gasfitter's trade, he began following it in this city, continuing for about twenty-seven years, a portion of the time being associated with his brother Ernest, their partnership being dissolved after the great conflagration of 1871. Mr. Breyer then carried on business alone until about a year before his death, which occurred February 12, 1883. He had married, in Chicago, Miss Eva Ruh, a native of Alsace, France, who bore him two sons and three daughters. His second marriage was to Miss Saloma Ruh, a sister of his first wife, by whom he had a son and a daughter. He was one of the substantial German-American citizens of the city and encouraged the development of all praiseworthy concerns. He assisted materially in the establishment of the first German singing society in Chicago, and was active in that connection throughout his life, being, at the time of his death, a member of the Tentonia Maennerchor Orpheus Singing society, and was buried with the honors of this society in his forty-seventh year. In this city Charles Conrad Breyer was married to Miss Annie Schaub, daughter of Conrad and Annie Schaub, and to their union one son and two daughters have been born. He is a member of the A. F. & A. M., the I. O. O. F. and the Master Plumbers' association of Chicago. He was one of the organizers of the Ariel Yachting club, is consequently a charter member, and has served as its treasurer. He also assisted in organizing the Chicago Master Plumbers' association, of which he is a charter member, and has served as an honored official, being the present chairman of the auditing committee of that association. He has served as a delegate by election to three different conventions of the National association, and is a member of the Royal League and Iron Hall, both benevolent associations, contributing liberally of his means to worthy interests, social, professional and general.

J. F. Alles & Bro. The following are some of the handsome buildings that have been fitted up by this firm, the members of which are practical plumbers: The Rounseville building, on State street; the Fourteenth street pumping station; Crilly block, Eugenie and

Wells streets, etc. This firm, which was organized in 1880, is composed of John F. and Joseph W. Alles, who are practical and experienced plumbers, and owing to the majestic growth of the metropolis of the west their business has been a most important and prosperous one. The manner in which the above mentioned buildings have been fitted up has added much prestige to their originally enviable reputation, and has tended to place them among the leading business men of the city. John F. Alles was born in Chicago, May 6, 1859, to Frank and Catherine (Brosel) Alles, who were born in Germany in 1826 and 1828, respectively, the former being a farmer and contractor by occupation. To them the following children were born: George Alles, Margaret Alles, John F. Alles, Joseph W. Alles, Frank Alles and Mary Alles. John F. Alles began serving an apprenticeship at the plumber's trade in a shop belonging to his brother George at the age of twelve years, and after becoming thoroughly familiar with the details of the business he worked as a journeyman for a few years, entering business for himself in 1880, as above stated. He was married in this city to Miss Appellona Goelz, who was born in Hesse-Darmstadt, Germany, to John and Katherine (Hillinger) Goelz, who came to America in 1865, locating in Chicago, Mr. Goelz following the occupation of signhanging. Mr. Alles and his wife have a family of four children: Catherine, Gertie, Josephine and John F., Jr. Mr. Alles is an active member of the Master Plumbers' association of Chicago, in which he has held official positions and of which he was one of the organizers; belongs to the Royal Arcanum, the Independent Order of Foresters, the Mystic Circle, is a member and was one of the organizers of the Star Loan & Building association, and also assisted in organizing and is a member of the directory of the Record Printing & Publishing Company of Lake View.

Stephen Klein, plumber, steam and gasfitter. On no branch of trade are householders more dependent for their domestic comforts, as well as for necessary sanitary arrangements, than on that which comes under the heading of general plumbing and steamfitting. Many are engaged in this enterprise, but all are not competent and reliable. However, amongst those who come within the category of reliability and competency must be ranked Stephen Klein, who has followed this calling for nearly a quarter of a century. He is a native of Germany, and March 1, 1879, when about twenty-six years of age, he came to Chicago, and worked as a journeyman from that time until November, 1881, when he established himself in business, and has built up a good reputation as a reliable plumber. He learned his trade during a two-year apprenticeship at Bonn, on the Rhine, and in his native land worked as journeyman for about ten years in different cities of good size, besides working in France and Belgium in the cities of Paris, Cologne and Ostend. Among the many buildings in which he has been interested as workman or superintendent are the Polish orphan asylum, on Division street; St. Stanislaus hall and school building, on Bradley street; William Bruge's block, at Franklin street and Tell court; Henry Giesecke's building, on Paulina and Kinzie streets, besides many fine residences and office buildings. Mr. Klein was born in Adenau, Rhine Province, Germany, November 18, 1853, son of Frank and Bertha (Kaspar) Klein, the former of whom was a technical engineer by profession. Stephen is their only son, and prior to his fifteenth year he was given excellent educational advantages. June 29, 1880, he was married in Chicago to Miss Bertha Hoerdt, who was born in Weinheim, Baden, May 17, 1856, a daughter of Henry and Eva Hoerdt, the former a farmer and winegrower by occupation. Mrs. Klein died May 15, 1891, and was buried in Forest Home cemetery. Mr. and Mrs. Klein were the parents of two sons and four daughters: Bertha, Eva, Emma, Katie, and Frank Henry, who died April 14, 1891, and Stephen, who died July 11, 1888. Mr. Klein is a member of the Chicago Master Plumbers' association. He has passed through all the chairs of Odd-fellowship, and has attained to the Blue lodge in Masonry, and is a select knight in the A. O. U. W., and has represented his lodge (Arion No. 267), in the Grand lodge of the state of Illinois. In addition to this he is a member of the German Order of Druids, and the North American Turner society.

David F. Dewar. For a period of eight years, he whose name heads this biography has been a resident of Chicago, and during that time he has enjoyed a reputation as an honorable, upright citizen, and a solid, substantial and thoroughly reliable business man. The history of his life has not been unlike that of other business men, for it is marked by ups and downs, but there has been an individuality about Mr. Dewar that has gained him many friends. He was born in Edinburgh, Scotland, September 1, 1863, to John F. and Jessie (Forest) Dewar, also natives of Scotland, where the mother died and the father is still living, his home being in Edinburgh. David F. Dewar obtained his first schooling in Dr. Bell's academy, Edinburgh, but finished his education in the Murray House normal school, of the same city, from which he graduated. He immediately began learning the plumbing business and served a five-year apprenticeship under R. P. Beaty, in his native city, at the end of which time (in 1882), he came to the United States, and almost immediately to Chicago, of which city he has since been an honorable resident. He was first in the employ of Hugh Watt, but in 1885 left him to establish an independent business in Englewood, and although he has only resided here a short time and is yet young in years, he has, by personal worth, arisen to his present prominence, for the public has not been slow to recognize his intelligence and ability. He is the oldest and leading plumber in the city, south of Fifty-fifth street, and he and his partner have built up a business that averages from $75,000 to $100,000 per annum. They have done the plumbing for some of the finest buildings in the city, and among the many may be mentioned the residences of Curtis and J. B. Mullett, of Eggleston; R. E. Brownell, of Morgan Park; J. J. Badenoch, at the corner of Sixty-third street and Yale; W. O. Budd, at Sixty-first and Wright streets; the Drake building at Sixty-third street and Wentworth avenue; the Burkey building at Sixty-first and State streets; the Englewood bank at Sixty-third and Yale streets; the Rich flats at Sixty-fifth street and Stewart avenue; the Masonic and Assembly hall at Auburn Park; the new Julien hotel and opera house at Sixty-third street and Stewart avenue; the Tansy flats, the Ingram block, the Baptist, Methodist, Episcopal, Presbyterian and Congregational churches, the residence of P. S. Hudson on Howard street, and many others. The style of the firm is D. F. Dewar & Co., and their place of business is at 6312 Wentworth avenue. They do a general plumbing, gas and steamfitting and an iron and earthen drainage business, and their annual earnings are a good proof of the perfection of their work and the satisfaction with which it is received. Mr. Dewar is a member of the Chicago Master Plumbers' association, and in 1887 was a delegate to the national convention, and in 1889 to the convention held at Denver, Colo. In all his ideas and tendencies, he is progressive and enterprising, a useful member of society, popular personally and in business circles. In disposition he is genial and liberal, distributing his means with an unstinted hand wherever it is essential to the welfare or happiness of his family or those around him, and as a result, he commands the esteem of all with whom he comes in contact. He married in October, 1885, Miss Lizzie Webster, of Edinburgh, Scotland, by whom he has two children: John and Margaret. He has been a stanch republican in politics, since his arrival in this country, and has shown his approval of secret organizations by becoming a member of the Masonic, the K. of P., and the A. O. U. F. fraternities.

Charles Redieske, plumber and licensed sewer builder. This gentleman is an energetic business man, abundantly worthy the success that he has achieved, and as a plumber and sewer builder, has had vast experience. This calling is a most important one, for upon it the health, and frequently the life, of one depends, and the importance of honorable, intelligent and conscientious men making it their calling will be readily understood. Mr. Redieske is admirably fitted for this business, for he possesses these essential qualities and is acknowledged, by those who are intelligently posted on the matter, to be the thorough master of the plumbing business. On May 26, 1867, he sailed from his native land for America, to seek a home for himself and family in the New World, and came direct to Chicago, here learning the trade of a plumber with Williams Bros., with which firm he remained for several years. Having acquired a thorough knowledge of the trade during this time, he, on June 1, 1882, started in business for himself, which he has continued with success ever since. The buildings which he has fitted up are: Judge Altgeld's residence, Eckhard & Swan's building on Market street, and numerous others of equal importance, his work giving the best satisfaction. He was born in Belgarde, Prussia, July 24, 1838, to John and Anna (Kaking) Redieske, the former of whom was a coachman by occupation. Charles grew to manhood in the land of his birth, and upon attaining a suitable age became a member of the German army, in which he served for four years, or until he was twenty-five years of age. When the Austro-Prussian war came up he enlisted in the service, remaining on active duty until the close of the war. For bravery on the field of Konigratz, he was presented with a gold medal on July 3, 1866, and to-day, with pardonable pride, wears it as a watch charm. He was married in his native land in 1863 to Miss Augusta Behling, a daughter of Christian Behling, by whom he has two sons and one daughter living: Paul, Anna and William. Paul is married to Antonia Rosz, daughter of Charles Rosz, a native of Baden, and by his wife is the father of two daughters: Lillie and Alma. Charles Redieske is a member of the Chicago Master Plumbers' association, in which order his son Paul is sergeant-at-arms and a zealous and faithful official. The family are members and supporters of the Lutheran church, Mr. Redieske is an official in it, and of that church is also one of the school directors.

A reliable plumber is Samuel Good, 2409 Cottage Grove avenue. Mr. Good was born in Pittsburgh, Penn., in 1858, and has been a resident of this city since 1883, when he established himself in business. His store contains a full and complete stock of plumbers' and gasfitters' supplies and fixtures. Everything in the line of plumbing, ventilating, steam and gasfitting is executed. Estimates are furnished, contracts are entered into and the complete fitting up of all kinds of buildings is satisfactorily accomplished. In sanitary engineering and sewerage ventilation, which is a specialty with this house, the long practical experience of Mr. Good is a sufficient guarantee that all work entrusted to his care will be done in the best manner. He is also prepared to do all kinds of general jobbing upon short notice. He employs only the most skillful workmen and devotes his close personal attention to every department of his concern. He is an active and prominent member of the Master Plumbers' association.

A well-known establishment, now nearly ten years old, is the Whittaker Supply Company, Charles Whittaker president, and John M. Beeler, secretary, manufacturers and dealers in plumbers' supplies, 151 Washington street, which is the successor of the Charles Whittaker Manufacturing Company, formerly at 237 East Lake street, of which Charles Whittaker was president also. The great variety of specialties embraced under the heading of plumbers' brass goods, and the varied application of this valuable composition metal to the manufacture of articles of mechanical and household use present an interesting study. In this connection special reference is made to this widely known and reliable concern, at whose office and salesrooms is kept constantly in stock a full line of plumbers' supplies. This business was established in 1882 by Charles Whittaker, who conducted it till February, 1886, when it was duly incorporated with a capital stock of $100,000. The company's works are admirably equipped with all the latest improved automatic machinery, tools and appliances, necessary for the systematic conduct of the business. A strong force of able and experienced workmen are employed, and the machinery is driven by a powerful steam engine. The company manufactures largely all kinds of brass plumbing goods, including the Whittaker's noiseless bibb, basin and bathcocks, also Whittaker's graduated bibb, basin and bathcocks. These inventions and specialties, which have been duly patented, have everywhere given great satisfaction, as their large sale abundantly attests. Whittaker's graduating basincock is of neat and elegant design. It occupies less space and does the work of two, leaving the opening of the sink or basin practically clear, while all temperatures of water are under the control of one handle, and are graduated to any degree between hot and cold. Faithful attention is given to the manufacture of all of Whittaker's specialties, while the greatest care is taken in the selection of proper qualities of metal, as the greatest accuracy, soundness and finish are required in these articles. Mr. Whittaker was born in Scotland, and came with his parents to the United States when nine years old. He entered the University of Michigan, and remained there till the commencement of the Civil war, when he went to New York and enlisted in Company C, Fifth New York volunteer artillery. Mr. Whittaker served for three years and was present at several of the most important battles, being noted for his courage and devotion to the Union cause, and justly merits the signal success achieved in this useful and valuable industry. Frank Seals was secretary and treasurer of the company as at first organized.

No business requires a more thorough knowledge of details than that of the plumber and gasfitter, and among those who have had a good experience in it there are none better qualified to perform the work belonging thereto than Mr. Charles Walter, who is familiar with the science of sanitary plumbing and ventilation, and as a practical expert gives to it his whole personal attention. He fits up bathtubs, water-closets, wash-bowls, etc., and introduces water and gas into buildings and dwellings; makes sewer connections, and lays drains and attends promptly to all orders for work in this line of business. Repairing and general jobbing are attended to, and a number of skilled workmen kept constantly employed, who are under the immediate direction of Mr. Walter, who personally oversees all branches of his business. The premises occupied, consisting of store and basement, are well adapted to business purposes, and a large stock of piping, fittings, etc., is always to be found on hand, or will be furnished to order as may be required. Mr. Walter, who is a native of the city, was brought up to the business he is engaged in, and was formerly located at 195 Blue Island avenue, but in May, 1887, he moved to the very desirable premises now occupied at 403 on that same thoroughfare. He is a man of enterprise, push and vim, and his reputation as a practical plumber and gasfitter is of the very highest character.

Charles S. Lawrence, plumber, 1315 West Madison street, is the successor of the firm of Lawrence & O'Loughlin, plumbers and gasfitters and dealers in gasfixtures, etc. This firm was organized in March, 1887, the co-partners being Charles S. Lawrence and M. J. O'Loughlin, both of them practical plumbers of adequate experience. Mr. Lawrence was born in Pittsburgh twenty-eight years ago, and has resided in Chicago for the past eleven years. He occupies a store 25x60 feet in dimensions, and carries a large stock of plumbing, gasfitting and steam-heating materials, and has a full equipment of tools and other appliances for the successful prosecution of his business. Sanitary plumbing forms a specialty with the house. No work is permitted to be done that may not be considered first class in every respect.

Harry A. Black is the efficient and popular secretary of the Chicago Master Plumbers' association, having been elected to this office in January, 1891. Although still young, he is one of the practical, experienced and successful plumbers of this city, and has fitted up some of the largest, handsomest and most substantial buildings. In speaking of this work, special mention may be made of the plumbing for the Kadish estate; the Natatorium building, between Twenty-third and Twenty-fourth streets on Wabash avenue; his work for Furst & Rudolph, the architects; the Turner building, on Forty-seventh street; some of the finest school buildings of the city, and many fine residences. He is efficient and thoroughly experienced, and throughout the year employs ten competent workmen. He has carved out his own career, and his labors have prospered, for besides being in comfortable circumstances, he has built up an excellent reputation for thoroughness, and is looked upon with respect and esteem by his brother workmen. He was born in the city of New York August

22, 1865, a son of John H. and Julia Bunce Black, the former of whom was a sea captain and vessel owner, and died in Chicago in 1884. The mother still lives in this city. Harry A. Black was educated at a private school in his native city, and in 1880 began learning his trade in the employ of E. Baggot, with whom he remained until 1888, after which he engaged in the business of plumbing, on his own account, on State street near Harrison. In May, 1891, he removed to his present place of business, where he has since been successfully engaged, winning many new patrons, in addition to retaining his old ones. He was married in 1888 to Miss Ella M. Smith, who was born in the city of New York, and by her has one child, Harry J. Mr. Black is a member of the Red Men and the Royal Arcanum.

Molter & Kretschmer are practical plumbers and gasfitters, and are also engaged in the manufacture of gas fixtures at 426 East Division street, at which place they have been engaged in business since the firm was organized on February 28, 1888. They have contributed in no small degree to the quantity and quality of work in their line throughout the city, and in many of the magnificent structures for which Chicago is famous the plumbing was done by them, and in every instance to their credit. Among the many buildings which they have fitted the following are eminently worthy of mention: The residence of Thomas L. Forest, on Center street; of F. Gray, president of the Hide & Leather National bank; F. H. Brammer's residence, South Evanston; a residence block for W. H. Colvin, Jr., Hyde Park; William Schmidt's, on Deming court; Charles Siebert's, at the corner of North Clark street and Dewey court; A. F. Stevenson's flats, on Clark street; the Merchants' National bank, on La Salle street; a block of flats for William Walk and Henry Portwright, on North Halsted street; flats for F. L. Shellenberg, at Webster avenue and Edward street; flats for Charles Hoffman, on Rush street; buildings of Mrs. Nellie Schneider, of York place; flats for John G. Frick, on Oak street; and a great deal of remodeling work for Judge Lambert Tree, besides many buildings consisting of business blocks, flats and residences. Nicholas Peter Molter, of this firm, is a native Chicagoan, born October 17, 1859, to Peter and Annie Mary (Simon) Molter, who were natives of Berfeld, Trier, Germany. In 1845 they came to America, and after spending a year in New Orleans they came to Chicago, and here made a permanent home for themselves and reared their children, the surviving members being as follows: Nicholas Peter; Annie, wife of Peter Suerth; Mary, wife of Henry Schoenemann, and Katie, unmarried. In 1874 Peter Molter was called from life in the sixty-first year of his age, at which time he was a communicant of the Roman Catholic church, of which he had always been an upright member, his widow still surviving him. Nicholas P. Molter assisted his father in the foundry and machine shop until fourteen years of age, then began serving an apprenticeship at the plumber's trade, and after becoming familiar with its details he continued to follow the calling until forming his present partnership. He was married in Warsau, Wis., to Miss Bertha Hett, a daughter of Henry Hett, Esq., a native of Germany, who came to America in 1846. Mrs. Molter is a lady of fine attainments, and before joining in marital alliance with Mr. Molter was engaged in the very laudable employment of school teaching. She has borne her husband three sons, Harry, Benjamin, and Frankie (deceased).

Mr. and Mrs. Molter reside at 107 Sheldon street, Lake View, Chicago. They are members of the Roman Catholic church, and Mr. Molter is a member of the order of Foresters, Court Mt. Carmel No. 76, and of the Royal League, Star Council No. 31. He is an active and enterprising citizen, is liberal with his means and has won respect from all who know him. Conrad Michael Kretschmer, of this firm, was born in Germany, his ancestors belonging to an old and worthy line of artisans in Saxony, although members of the family have been found to be honorably connected with mercantile pursuits, the professions, agriculture, wine-growing, etc. Mr. Kretschmer's birth occurred in Passau, Saxony, February 24, 1857, his parents being Francis Edward and Johanna (Hadlich) Kretschmer, who, with their children, came to America in 1869 and made a home in the Garden city of the West. The father was a dyer by occupation, a calling he followed until his death in 1886, his career proving a useful and happy one. He died in the faith of the Lutheran church, leaving, besides his wife, a family of three sons and three daughters to mourn his loss. Of the sons, Rudolph D. is a stone contractor of Chicago, Martin C. is in the retail candy business, and Conrad M. is a plumber. Of the daughters, Pauline married Conrad Stoltze, Helena married John Weppner, and Laura is yet unmarried. Conrad M. Kretschmer began learning the brush making business at the age of twelve years, but as the encouragements offered for that business were not sufficiently encouraging and the prospects for future success were far distant, he sought a better field and began working at his present business at the age of seventeen years. He has succeeded admirably in his efforts and to-day is an honored member of a firm whose reputation is first-class, not only in a practical way, but also financially. Mr. Kretschmer was united in marriage in Chicago to Miss Mary A. Miller, daughter of Henry Miller, a native of Hesse Darmstadt, who came to America about 1870. To this union two sons and a daughter have been born: Ida, Raymond R., and Arthur. Mr. Kretschmer and his wife are esteemed members of the Lutheran church, and he belongs to the A. O. U. W. and the Saennefelder Liederkranz. He is devoted to his business, and bids fair to take a front rank in the future march of progress in this busy city.

William Bowden, Jr., has had great experience as a plumber, and has developed his large trade solely on the basis of merit. His office is at 158 Fifth avenue, and in his work he introduces all the latest sanitary appliances, effectually preventing the escape of sewer gas and providing for the supply of water, and removal of sewage. His trade was learned of his father, who is also in the business, but since 1889 he has been in business for himself, and after holding forth at 81 Dearborn street, one of the old plumbing stands of the city for some time, he, in May, 1890, moved to his present headquarters, and is ever ready, both with men and materials, to contract for the most extensive undertakings, his work in plumbing, gasfitting and ventilating being remarkably satisfactory. He is one of the enterprising young plumbers of the city, and is a member of Western Electrical council No. 365 of the National union.

F. J. Fischer. The degree of skill required in plumbing is but little understood. Not only must one be an expert mechanic to attain first rank, but he must also have a creative fancy little short of genius. Those who have been observant enough to note the really elaborate work of the plumber on some difficult piece of show plumbing, such as applies to kitchen range or perhaps even office work, will all the more readily apprehend the full force of this assertion. Among this class who have creative fancy and practical skill is F. J. Fischer, a plumber and gasfitter at 7446 Cottage Grove avenue, who bears an enviable reputation. His trade was learned of D. T. Jack, the well-known Lake street plumber. He soon showed an aptitude for the business that caused his rapid advancement in his chosen work. Since 1889 he has been in business for himself, and so well has he done his work that business seeks the man rather than man the business. Some of the finest residences in the southern division of the city are examples of his painstaking skill, and in every instance his work has stood the most severe tests. Among scores of residences fitted up by him may be mentioned three on Drexel avenue and in Windsor Park—one for C. E. Macey, one for Flo Middaugh and one for Attorney Morgan. Within the short space of one year he has taken plumbing contracts for nearly one hundred residences, and during last summer had, in addition to this, a large number of important contracts both in plumbing and sewer laying.

Ignas J. Geiss is a successful and practical plumber and gasfitter, and is prepared to do, in a satisfactory manner, all jobs in his line. He is located at 1199 Milwaukee avenue. He began learning the plumber's trade about eleven years ago, and for one and one-half years was engaged with the firm of Geiss & Prietsch, at the corner of Southport and Webster avenues. Since July, 1890, he has conducted his business alone at 1199 Milwaukee avenue, which place was formerly Ryan's old stand. Mr. Geiss is well qualified to do every kind of sanitary plumbing, and keeps on hand an excellent line of the most modern plumber's supplies. He is a member of the Chicago Master Plumbers' association, and is essentially a self-made man. He is one of the best plumbers of the city, and can always be relied upon to give satisfaction. He was born in Chicago, December 25, 1865, and is the son of Ignas J. Geiss, formerly one of Chicago's volunteer firemen, who was killed on South Water street by a falling wall at a fire in the early part of 1865.

John W. Wittich, plumber and gasfitter. Some of the buildings in this city which have been fitted up by this gentleman with fine plumbing appliances are: Four stone residences for Dr. S. C. Smith, Forty-first street and Ellis avenue; fifteen flats for E. D. Murray, in Brookline; a block of stores and flats for Jacob Wolf, One Hundred and Fifteenth and Front streets, Kensington, and numerous other structures in Grand Crossing and vicinity. The plumbing industry has at all times been of great importance, and in recent years it has been rendered more so by the additional branches of steam and hot-air furnaces, demanding much mechanical skill and ingenuity. Mr. Wittich has been in business for himself since February 8, 1890, and although this has been only a short time, he has proved himself a competent and skilled mechanic, a thorough man of business, and is most favorably quoted among the followers of his occupation. He has done his work in such a thorough and workmanlike manner that he has built up a flourishing trade, which will compare most favorably with that of any young man of his age engaged in a similar business. He learned his trade under those practical workmen, Martin Moylan and R. M. Millar, and may with truth be said to have done credit to his instructors, for, besides being a competent and experienced workmen, he employs none but those skilled in the craft. He was born in Chicago in 1864, and since he attained his eleventh year has been interested in mechanical arts. His father, Bernhardt Wittich, was born in Germany and afterward became a noted dealer in cattle in Chicago, dying here in 1884; six of the eight children born to himself and wife (whose maiden name was Lena Williams and who is still living), are dead. Those living are John W. and B. W.

E. D. Connor, whose place of business is at 2465 Archer avenue, has been interested in the plumbing business in this city since he was thirteen years old. He began serving an apprenticeship at that time and afterward worked as a journeyman plumber until January, 1891, when he established himself in business at his present location. As a mechanic Mr. Connor ranks among the best in Chicago. Ever since his apprenticeship days he has taken a deep interest in labor problems, and after the great trade depressions of 1876 to 1879, he was one of the seven men who organized the Chicago journeyman plumbers into a closed union. It was he who wrote its constitution and by-laws and was made chairman of the first mass meeting held by them. The result of this meeting was that all those employed in Chicago as plumbers secured an advance of fifty cents a day, without a strike. At the time of the great eight-hour agitation in 1886, he was made chairman of the journeyman plumbers' arbitration committee to meet employers and arbitrate the eight-hour question. The two committees failed to agree, but through Mr. Connor's efforts the journeyman plumbers and the subordinate organization of junior plumbers were so well organized and made so well acquainted with the plan of attack formulated by him, that the demand of the plumbers for eight hours per day, with ten per cent. reduction of wages, and seven hours' work on Saturdays, was acceded to by the employers between seven and eight o'clock A. M., May 1, 1886. It was the journeymen and junior journeymen plumbers of Chicago that inaugurated the eight-hour per day rule by working seven hours as a day's work. This was one of the most successful strikes in the history of industrial Chicago, and, perhaps, in the eight-hour movement. Mr. Connor, at different times, has held almost every important position in the Chicago Journeymen Plumbers' association, and at one time was president of the International Association of Journeymen Plumbers, Steamfitters and Gasfitters. In the spring of 1887 he was elected to the city council from the Fifth ward on the labor ticket. During the same year he was made chairman of the first public meeting called to protest against the hanging of the condemned anarchists, held at Battery D, where thirty-five hundred people assembled, and had to enter the hall between two rows of police. Mr. Connor as chairman preserved the most remarkable good order throughout the meeting, and at its conclusion dismissed the immense gathering without any crowding or disorder of any kind on the part of the people. While a member of the council he introduced and had passed the first practical eight-hour law ever enacted by any legislative body in the country. This ordinance compelled the commissioner of public works to insert a clause in every contract for the erection of a public building, viaduct or bridge to which Chicago was a party, requiring the contractor to employ his workmen at the place where such construction was in progress and limiting the workmen to eight hours' time between the hours of six A. M. and six o'clock P. M. per day, under penalty of forfeiting to the city $50 per day for each and every day that he permitted his men to work over the stipulated time. This ordinance is now generally known as the Connor ordinance among the building trades. Mr. Connor also took an active part against the further extension of franchises, and the granting of new ones, to corporations or syndicates, for the reason that he desired to substitute ownership by the whole people for the benefit of the public in the place of private ownership and individual profit. Mr. Connor was born in Coldspring, N. Y., in August, 1853, and in 1857 came to Chicago with his parents, who died here, his father having been a stonecutter by trade. He was married to Miss Annie L. McGovern, in 1880, and is the father of six children: Annie, Daniel, Edward, Marcella, Thomas and John.

Robert Gordon is a successful and prominent contractor for steam and hot-water heating apparatus at 33 West Monroe street, which business was established in 1886, and although this has only been a short time, he has already built up an excellent trade and reputation. The business was conducted under the firm name of Ahern & Gordon until May, 1889, since which time Mr. Gordon has been alone. He has put up the entire line of heating apparatus in St. Patrick's church and two parochial schools on Desplaines and Adams streets; the Cathedral of the Holy Name, residence and parochial school; the convent of the Ladies of the Sacred Heart, on Superior and State streets; St. Gabriel's church, at Forty-fifth and Wallace streets; St. Bernard's church, at Sixty-fifth street and Stewart avenue; the high school building, in the Town of Lake; the Farrar school building, at Fifty-first street and Wabash avenue; the Coleman school, at Forty-seventh and Dearborn streets; the Church of the Holy Angels on Oakwood boulevard and Vincennes avenue, also the parochial residence at that place; the residence of Rev. D. J. Riordan; the residence of the late John Maddock, at Forty-eighth street and Michigan avenue; the St. James' parochial school and residence, at Twenty-ninth street and Wabash avenue; the residence of Rev. Dr. Hirsch, on Grand boulevard; the Church of the Sacred Heart, at the corner of Nineteenth and Johnson streets; the Sacred Heart convent, on Eighteenth and Johnson streets; the convent of Our Ladies of the Sacred Heart, on Taylor and Lytle streets; the St. Jarlath parochial school and residence, on West Jackson and Hermitage avenue; a part of the plant in the County hospital; St. Joseph hospital; the Illinois Central round houses at Cairo, Ill.; the McBride Brothers' block, at Elgin, Ill.; the Northwestern academy at Elgin, Ill.; St. Mary's and St. James' churches and parochial schools at Rockford, Ill.; the Woodstock public school building; Syron hall, at Notre Dame, Ind., besides fitting up a large number of the finest buildings in the business portion of Chicago. Mr. Gordon is a native of New Jersey, born in Newark in 1860. He remained there attending public school until he was fourteen years of age, then went to Albany, N. Y., and worked in a manufactory for two years, after which he returned to his native city and worked as an engineer in the manufacturing establishment of D. Ripley & Son, where he spent two years. In 1878 he went South and for some time was superintendent of a sugar plantation near New Orleans. In 1880 he came to Chicago, and during the next three years he was traveling through the Northwest. He returned to Chicago in 1883 and worked with John Davis, who was in the steam-heating business, and there he acquired the skill that has since been a prominent characteristic of his work. Mr. Gordon began to make his own way in the world when but a lad, and his success has been solely due to his own pluck and energy. He was formerly a member of the Masters' Steam & Hot Water association of the United States. He is a member of the Royal League. He was married in this city May 12, 1885, to Miss Lena Adamson, and resides at 43 Florimond street. Mr. Gordon is of Scotch extraction.

This is undoubtedly an age of progress, and in no branch has greater perfection been attained than in the production of steam and hot-water heating apparatus for warming and ventilating public buildings, private residences and greenhouses, the desideratum being to secure a pure as well as a warm atmosphere, at a reasonable outlay of expense. To this important branch Mr. Albert Galloway long devoted his entire attention, having established his business in Chicago nearly twenty-five years ago, and become, by reason of his practical experience, able to determine upon inspection what system would prove to be most serviceable and economical in any given case, many elements being necessary to be taken into consideration in addition to the architectural features of a building, its exposure, and the sizo and number of rooms to be heated. His business has passed to the Albert Galloway Company, 17 River street, of which Thomas E. Rushbrook is president, and E. T. Brainerd secretary. A large assortment of heating and ventilating apparatus is carried in stock, and experienced workmen are employed, thus enabling the concern to promptly execute all contracts, however large, many of the most pretentious buildings in the city having been equipped through this house, than which few in its line occupy a higher position in the commercial world. To its patrons this company secures, at a reasonable cost, that perfect warmth and ventilation so essential to health in this rigorous and variable climate.

The following notice of a prominent establishment dovoted to heating and ventilating was published in 1887: "Mr. William Haythorn, of 200 East Washington street, for the past twenty years has been carrying on business as a contractor for steam-heating and ventilating apparatus, and has, during the intervening period, executed some very important work. Among other buildings which he has fitted out in this line are the Chicago Tribune building, Davis block on Market street, the Second regiment armory I. N. G., and many others, chief among whom Mr. Haythorn has permission to refer to the following: R. R. Cable, Esq., president Chicago, Rock Island & Pacific railway; F. A. Marsh, Esq., purchasing agent Chicago, Rock Island & Pacific railway; Joseph Medill, Esq., Chicago Tribune Company; O. B. Green, Esq., Green's Dredging Company; Messrs. Steele & Price, perfumes, essences, etc.; Messrs. Grey, Clark & Co., No. 201 Lake street; board of public works, Chicago; Calumet dock company, Chicago. He also heats railway cars with hot air from a locomotive by a patent of his own. The business premises occupied have an area of 30x100 feet, are fitted up with every convenience. Mr. Haythorn is a general dealer in steam engines, boilers, steam-fitting supplies and hydraulic and steam pumps of every description, and at all times has a large stock on hand, which he furnishes on the most favorable terms. Employing a staff of skilled workmen, he undertakes contracts of any magnitude for steam heating and ventilating work, making a specialty of iron pipe fitting in all its branches. Mr. Haythorn is a native of England, born in 1835, and has long resided in this city. He is a member of the Independent Order of Engineers." This business is now carried on by William Sooy Haythorn & Co., 94 Franklin street.

Among the merchants and manufacturers of Chicago the firm of J. M. Hatch & Co. holds a deservedly high position. This firm was widely known as dealers in stoves, ranges, furnaces, housekeeping goods, and kitchen utensils, and as manufacturers, wholesale and retail dealers in Western Empire furnaces, Fisher's ice-box handles and tap-hole protectors. The business was established in 1871 by Messrs. Hatch & Breeze, who were succeeded by the present firm in 1886. The premises formerly occupied at 50 State street, comprised a large four-story building, 30x80 feet in size, with basement, and unsurpassed facilities for conducting the business in a thoroughly systematic and successful manner. The stock carried at the present commodious location, 131 Lake street, is very extensive and elaborate in all departments, embracing a full line of stoves, ranges and furnaces, embodying all the improvements made for both cooking and heating, and house-furnishing goods in such great variety and of so useful a character as to command universal attention and general patronage. The firm also manufacture ice-box handles, numerous articles of tinware which find a large sale, and do repairing of all kinds. A goodly number of hands are employed in the business, and the trade is large and influential throughout the city and vicinity. Mr. Hatch is a native of Maine, a resident of Chicago since 1845, and an experienced, enterprising, and successful business man. The Western Empire Gas Burner furnace, manufactured by this house, for durability, economy, uniformity of heat, and easy management is said to equal any furnace in the market. It possesses many features that are easily recognized as being superior, and that will give the greatest heat from the least fuel.

A high place must be awarded to Powell's improved hot-air furnace, which embraces economy of fuel, tastefulness of design, excellent workmanship and general efficiency. This furnace is the invention of Mr. W. T. Powell, and is patented. This gentleman is a native of Saratoga county, N. Y., born in 1831, who has resided in Chicago since 1867. In 1872 he established his business here, and has built up a first-class trade. His extensive premises on West Lake street are fitted up in the most approved manner, and every facility is at hand for the prosecution of business, and employment is afforded to from eight to twenty hands. Mr. Powell conducts a general business as a manufacturer of his hot-air furnaces, and also of hot-air pipes, registers and register borders. Either hard or soft coal can be used with the furnace, and it is guaranteed to give the utmost satisfaction. Among other places where they are in operation, Mr. Powell refers to the following: Presbyterian church, of Clinton, Iowa; Methodist Episcopal church and Congregational church, of Oak Park, Ill.; Methodist Episcopal church, of Geneva, Ill., and Baptist church, of Ottawa, Ill.

The widely known inventor and manufacturer of Reynolds' steel plate warm-air heater is Benjamin F. Reynolds, and his enterprise was inaugurated in November, 1885, and during the period intervening a large business has been developed, its operations extending to all portions of the United States. This heater is the only one made that is absolutely gas and dust proof, and remains so, and for economy, durability, delightful and healthy air it has few equals. It is made of the best quality of steel in the most subtantial manner by skilled workmen, and combines the latest improved methods in its construction. It has no joints, consequently there is no putty, sand or cement used, as the boilermaker's methods are followed in the manufacture. The Reynolds heater is set in brick or portable form, has double the radiating surface of any heater in existence, and produces a large volume of pure, warm air, instead of hot air as furnished by the ordinary hot-air furnace, or impure air by steam apparatus. The Chicago & Wisconsin Railroad Company are among the many who have sent testimonials as to the excellency of this furnace. Estimates are given on private and public buildings, and all contracts undertaken are executed without loss of time. Mr. Reynolds is a native of Chicago. The office of B. H. Reynolds & Co. is at 69 Dearborn street.

The admirable position of Chicago as a distributing center, controlling the trade of the vast Northwest, early led to the establishing here of branch houses of many of the leading manufacturing establishments of the East. Among those who early conceived the grand possibilities of this now great metropolis were Messrs. Baker, Smith & Co., manufacturers of steam and water heating and ventilating apparatus, whose extensive manufactory is located at Nos. 149 and 151 Greene street, New York city, which firm has been succeeded by the Baker & Smith Company. Having established an extensive demand for their special line of goods in the West, it became a necessity, in order to speedily fill all orders entrusted to them, to establish a branch at the most desirable point; in looking about for this location, they came to Chicago, in 1865, and have since maintained one of the largest and most complete houses in this branch of trade in the Northwest. At present, the business is under the management of Mr. P. S. Hudson, vice president and treasurer, and C. C. Turner, secretary. Mr. Hudson is a man of wide and extended experience, who has, by his prompt and conservative management of its requirements, largely increased its volume, and extended the boundary lines of its trade relations. The premises occupied by the firm, at Nos. 81 and 83 Jackson street, include the entire four stories of the building, which is suitably and systematically arranged for conducting the business. Here is displayed a large and extensive assortment of the latest improved steam and water heating and ventilating apparatus, such as the advanced age demands, and especially adapted for the special purposes for which they are designed. The Baker & Smith Company is one of the largest, and most thoroughly reliable houses in the line; they have unsurpassed facilities, and are prepared to supply the trade throughout this section with the best goods in the market, and at prices uniformly reasonable, and in every instance satisfactory. One of the grandest achievements attained by this firm in their long list of valuable improvements, and one which has given them a high and honored position among those who have added greatly to the safety and comfort of the public, is their apparatus for heating railroad cars. Great loss of life and much suffering have been caused by the use of the ordinary stoves for heating purposes; with them in use, in case of accident, collisions, etc., was impossible to obviate the frightful results which were formerly of frequent occurrence. In the use of the Baker & Smith Company's patent in drawingroom cars, sleeping cars, and the like, the stove is usually hidden from sight with a closet lined with metal, with an iron fret-work door, and beyond the reach of passengers. This apparatus consists of a simple fireproof stove, occupying only two feet diameter of floor space in one corner of the car; a dull fire, that consumes but about one peck of coal in twelve hours, warms the water, which circulates through the pipes run under each seat entirely around the car, giving each passenger the most agreeable foot-warmer of hot water, the heat of which is evenly maintained against all currents of air, and is absolutely unaffected by the motion of the car. By this plan, nearly the entire heat of the fire, instead of concentrating at the stove, is taken up and distributed at the very points where heat is required. The heat of the stove actually goes to every passenger, instead of every passenger going to the stove for warmth. This is the only apparatus that actually radiates and holds the heat at the floor, and at the same time allows ventilation in the region of the head—the upper space of the interior of the car. The water in the pipes is rendered frost-proof by being fully saturated with pure salt. All air from inside the pipes is positively excluded, which must be accomplished to allow the water to circulate; hence, the pipes can not rust on the inside, as the presence of air, required to form rust, does not exist. The apparatus being air tight, no evaporation of the water occurs, and the whole remains as permanent as the car itself. As the water contains no more salt than it can hold in solution, there can be no deposit in the pipes. This invention, in public use for the past twenty years, has attained a world-wide notoriety for merit with railroad managers and the traveling public. This firm issues a large and elegantly illustrated catalogue devoted entirely to the explanation of this system of steam heating. It contains, besides a full review of heating by indirect and direct radiation, explanatory particulars on ventilation, healthy heat, fuel saving, etc. It is impossible to give a list of the buildings fitted up with Baker, Smith & Co's. apparatus in view of the fact that they number more than 3,500. The house was duly incorporated under the laws of Illinois in 1876, with a paid-up capital of $150,000. The following named gentlemen were the officers at that time: J. J. Smith, president; P. S. Hudson, vice president; J. H. Davis, secretary.

In connection with heating, mention should be made of the Instantaneous Water Heating Company, which has been in operation since July, 1886. The company manufactures the Douglas patent water heater, for baths, office and domestic purposes, the construction of the apparatus being such that makes it the most durable, safe and economical water heater yet invented. The heater is made in two sizes, in nickel-plated, copper and japanned in any color. With these heaters water is made hot at the rate of a gallon per minute with the No. 1 heater, and three gallons per minute with the No. 2 heater. The prices range from $22 to $48. The small consumption of gas is another great advantage the heater possesses over any other, the water heating as it passes through; the consumption is only while using. The officers of the company are M. Cohen, president; Samuel Bernstein, secretary. The office is at 141 Ontario street.

CHAPTER XVI.

ROOFERS, GALVANIZED IRON WORKERS, BRASS AND IRON FURNISHERS, GLASS DEALERS, ETC.

Charles F. Knorr is a successful cornicemaker of this city, and since 1887 has been associated in business with Frank Campe, although he first gave his attention to that work here in 1864. He was born in Germany in 1847 to Henry and Caroline Knorr, and at the age of fifteen years, in 1862, came to America and settled in Chicago, where he learned the tinner's trade and began acting as foreman in a cornice factory at the age of twenty-two years. He has been remarkably successful in this work, employs about fifteen men annually and has been located at his present stand since 1880. The following are some of the buildings for which he has done the cornice work: The Grand Pacific hotel, the old Palmer house, Marshall Field's building, the Lakeside building, the Masonic building, at the corner of Randolph and Halsted streets; the State insane asylum of Iowa, the Palmer house, C. Seipp's residence, Perry H. Smith's residence, besides numerous other buildings of all classes. The work of this establishment is not confined here, but has extended throughout the suburbs and surrounding cities. The sales are very large annually, and are continually increasing, which is a good indication of the esteem and confidence in which this firm is held by the builders and contractors of this city. They do also all kinds of sheet-iron jobbing work. Mr. Knorr is married and the father of four children. He is a member of the A. O. U. W. and the I. O. F. Frank Campe, of this firm, is also a native German, and inherits many of the sterling characteristics of that people. He immigrated to the United States in 1865, and in 1871 started in the cornice business with a Mr. Edbrook, on Clark street, with whom he remained for some time. Mr. Campe is a married man and is the father of three children. Both Mr. Campe and Mr. Knorr are practical business men, honorable in their methods and successful in their enterprise.

Christian Eskilson is the president of the Standard Roofing Company, the office of which is situated at 294 North Halsted street. This business has proved, for the gentlemen composing the firm, a very profitable one, for they are ideal business men—progressive, practical and enterprising. Mr. Eskilson has been a resident of America since 1870, and up to 1875 he worked in a meat market in Omaha, Neb., but since that time has been a resident of Chicago. In 1877 he began learning the roofing business, and in 1882 began contracting in the business; in partnership with others, the firm being known as Eskilson & Co. This company became dissolved in 1888 by Mr. Eskilson selling his interest to the Standard Roofing Company, of which Mr. Eskilson is president and John J. Wheeler, secretary and treasurer. Some of the fine buildings which have been roofed by them are the West Division Car Company's buildings, the Armory building on Michigan avenue, the Scandinavian hall, at the corner of Ohio and Peoria streets, many of the public school buildings, among which may be mentioned the Longfellow and Foster schools and the Clark school. The gentlemen composing this firm are thorough workmen, thoroughly understand their business, and are prompt in filling their contracts. Mr. Eskilson is a member of the Gravel Roofers' exchange, also the Builders & Traders' exchange, and belongs to the Oriental consistory in the Masonic fraternity, the encampment in the I. O. O. F. and the Danish Brotherhood of America, being a charter member of Lodge No. 18. Mr. Eskilson has made a thorough study and gives the closest attention to the details of his business, and the company of which he is a member conduct their affairs on the principles of enterprise, prudence, liberality, courtesy and foresight, and any one entering into relations with them receives prompt and courteous attention. Mr. Eskilson was born in Denmark, April 27, 1845, at Jutland, his father, Eskil Jansen, being a lumber merchant and farmer by occupation. Christian Eskilson spent the greater part of his life on the ocean, after he had attained his fourteenth year, and during the eight years that he followed the life of a sailor, he became familiar with the Atlantic ocean and Mediterranean sea, being in the merchant marine and on war vessels. Although he has no family of his own, he has two adopted daughters: Thyra and Alice Baden, whom he is rearing and educating.

John J. Wheeler is the secretary and treasurer of the Standard Roofing Company at 290 and 294 North Halsted street, their business forming a most important and profitable branch of the building interests of Chicago. The enterprise was established by William Wheeler, the father of John J., in 1865, and continued by him until 1883, when death put an end to his labors. John J., his second son, continued the business after the death of his father, under the same firm name until 1889, when the style was changed to the Standard Roofing Company, and has continued such to the present time, the members composing this firm being John J. Wheeler and C. Eskilson.

That branch of industrial activity known as roofing has a worthy exponent in the city of Chicago in the person of Mr. G. W. Getchell, of the firm of G. W. Getchell & Co., felt, composition and gravel roofers, and dealers in roofing materials, office, No. 158 La Salle street, who is extensively engaged in felt, composition and gravel roofing, and is a well-known dealer in roofing materials. Having been established in the roofing business here since 1862, he can conscientiously guarantee satisfaction in every case where his services are brought into requisition. He occupies a large and well-equipped shop at the corner of Wabash avenue and Harrison street, and gives employment to from sixty to seventy hands. The roofing applied by Mr. Getchell to stores, houses and public buildings is found to be remarkably durable and entirely fireproof. The high favor in which his work is held in this city is fully attested by the demands made upon him, and by reference to the leading contractors, builders, architects and real estate agents of the city, as well as many citizens and property owners in the suburbs who have employed his service much to their satisfaction. His services are always promptly rendered, and his work well and faithfully performed. Mr. Getchell is a native of Maine, and has been a resident of Chicago since 1862.

T. E. Conner, felt, composition and gravel roofer, with office at 4531 State street, and yards at 4527 to 4529 State street, is one of the successful business men of Chicago connected with the construction of buildings. He is a native of Maryland, born in 1856, the son of Levi and Mary (Wiley) Conner, also natives of Maryland, the father born in 1809 and dying at the age of eighty years. The father, for some thirty-six years, was a mail contractor in the state of Maryland. T. E. Conner is the seventh of eleven children, of whom eight are now living. He was reared and educated in Maryland, and upon reaching mature years was also a mail carrier in the service of the government. He came to Chicago in 1877, and for ten succeeding years worked at the roofer's trade in the employ of others, but in 1887 began this business independently where he is now located. He has done an extensive and successful work, and merits the patronage of the citizens and the countenance of good builders and architects. He employs ten to fifteen men and a suitable number of wagons. The company, of which he is the senior member, was organized in May, 1888. Among the buildings to which they have furnished roofs are the following: A granite block belonging to Josephine Krick, at Fifty-fifth street and Ridgewood court, which cost $60,000; a large building for W. H. Moore, at 117 and 119 Forty-seventh street; a block of seven houses for Mr. Earl, built of Bedford stone, at Fifty-fourth street and Monroe avenue; an operahouse for Mr. Ashford, at Seventy-fifth street and Ellis avenue; a block at Forty-third street and Indiana avenue, costing $40,000; two fine flats at Forty-ninth and Michigan avenue, for Mr. Clarkson, costing $19,000; the Glass Bending works at Fifty-ninth and Wallace streets; the Chicago Smelting & Refining Company's building at the corner of Fortieth and Clark streets; ten houses at Forty-first and Lake streets; two hundred squares on the Ft. Wayne railroad freighthouse; one hundred squares on a building for P. J. Flynn; two hundred squares on a building for the Chicago, Rock Island & Pacific Railroad company; eight brick buildings for E. L. Burchard, at Forty-second street and Lake avenue; several buildings for Mr. Lant; fifty squares for Mr. Underwood, at Brainard, Ill., and many others throughout the city. The following letter from the Chicago & Aurora Smelting & Refining Company, dated June 30, 1891, and signed by F. B. F. Rhodes, superintendent, speaks for itself: "This is to certify that Messrs. T. E. Conner & Co. have been doing our gravel roofing during the past two years, and have always done their work promptly and according to agreement." Mr. Conner was married in Chicago, in 1886, to Mary Hayes, a native of Oswego, N. Y.

The inception of the Wheeler & Thomas Roofing Company occurred in 1875, when the house was founded by Mr. John Wheeler, Mr. W. K. Thomas becoming a copartner in 1876.

The business has been carried on at the present address, 169 and 171 North Wells street, since 1878. The firm are general dealers in felt, resin, pitch, tar, gravel and building paper, carpet felt, etc., and carry a large stock constantly on hand to meet all demands that may be made upon their resources. They make a specialty of their roofing department and of executing contract work on new buildings, and their men for the repairing of old roofs are the most experienced that can be had. The Wheeler & Thomas Excelsior Roof is recognized as one of the cheapest and best roofs made, and is warmly recommended by all who have used it. From thirty to fifty hands are employed, and a first-class, influential patronage is enjoyed.

A prominent and reliable house in Chicago, engaged in taking contracts for roofing of every description, is that of Augustus Burke, 15 West Superior street, with a branch office at 106 Chicago avenue. This business was established in 1880 by Messrs. A. and J. Burke, under the firm name of Burke Bros. In 1884 J. Burke retired and Augustus Burke became sole proprietor. His warehouse is commodious and is fully stocked with a superior assortment of roofing materials, which are offered to the trade and customers at extremely low prices. Mr. Burke contracts for all kinds of roofing, including felt, composition and gravel, and deals extensively in roofing materials. His work is highly endorsed by builders, architects and property owners.

Among those who have established an excellent reputation for skill and reliability in their line may be named the pushing and popular firm of Renaud & Coghlan, felt, composition and gravel roofers, 181 East Jackson street, who are in all respects among the best equipped and leading roofers. This flourishing business was established in 1883 by the present proprietors. Felt, gravel and composition roofing of all kind is executed in the most superior and expeditious manner, and a large and firstclass stock of general roofing material is always carried on hand in the warehouse of the firm, while from ten to twenty expert workmen are regularly employed, the roofing of the Chicago clubhouse and numerous private dwellings having been done by this concern, and altogether a flourishing business is carried on. Messrs. Felix D. Renaud and Simon Coghlan, who compose the firm, are natives respectively of Canada and Ireland, but have been residents of this city many years. They have won by their reliable business methods many friends and patrons.

In order to have roofs put on properly and skylights constructed substantially, it is necessary to engage the services of those who have had long experience in the business and can be depended on to do the work in a first-class manner. Of those engaged in this business in Chicago, there is no one more capable and competent than F. W. Binder, contractor and manufacturer of galvanized iron cornices, tin and slate roofing, metal skylights, etc., 441 West Division street, formerly at 1093 Milwaukee avenue, who has obtained an excellent reputation and is highly endorsed by builders, property owners and architects, owing to the superiority, finish and workmanship of his various kinds of roofing. This business was established at No. 684 Milwaukee avenue, by Peter & Binder. In March, 1887, Mr. Binder withdrew and formed the firm of F. W. Binder & Co., which was subsequently changed to the present style, Mr. F. W. Binder becoming sole proprietor.

I. N. Price, manufacturer of galvanized iron cornices, slate and tin roofing, etc., was born in Carbondale, Penn., in 1847, son of Reese and Jane (Jones) Price, both worthy people of Wales. His boyhood days were spent in his native town, in the public schools of which he obtained a practical education. When fifteen years of age he began to learn the tinner's trade, which he followed for four years, and in 1868 came to Chicago, and from that time until the great fire of 1871 he was with Thomas McFarland, cornicemaker, of whom he learned the trade. Immediately thereafter he became a partner of the firm, which took the name of McFarland, Price & Co., afterward McFarland & Price, and this partnership continued until 1879. They did an extensive business in general cornice work, and their connection was prospered. In 1879 Mr. Price became a member of the firm of Price & Kauffman, which existed until the death of Mr. Kauffman in 1889, since which time Mr. Price has conducted the business personally. He furnished the cornice work for the residences of Marshall Hewitt, D. R. Lewis and W. G. Wadsker, and also for the Grant school building other school buildings and numerous apartment buildings, his work in all cases proving very satisfactory. Mr. Price has been in this business in Chicago for the past twenty-two years, and thoroughly understands every detail of his calling. He is experienced and progressive, and is now well to do. He was married in Pennsylvania to Miss Mary A. Cornish, a native of Pennsylvania, but of English parentage, and has borne her husband a son and daughter. Mr. Price is a member of the Royal League and the I. O. O. F.

R. E. Dewey & Co., manufacturers of galvanized iron cornices, iron skylights, slate, tin and corrugated iron roofing, 90 and 92 West Van Buren street, give employment to about twenty men. This is one of the oldest concerns of its kind in the city. It turned out the cornice work for the Exposition building, the Tremont house, the front on the Brevoort house, St. Cecilia's church, many other churches and hundreds of residences and business buildings, besides work for other parts of the country, as far west as Salt Lake city, and including that on Litt's theater, Milwaukee, Wis. Mr. Dewey was born in Sandusky, Ohio, and came to Chicago in 1869 and became a member of the firm of Dewey, Jones & Co., which was located on the west side and was burned out in the great fire. The business was immediately reëstablished by Mr. Dewey, who has since been at its head. Washington Dewey, his father, is a native of Middlebury, Vt., and came to Sandusky, Ohio, when a lad. When sixteen years of age he became an apprentice to learn the tinner's trade in Sandusky and served four years. Later he worked as a journeyman, and finally established himself in business and put up the first galvanized iron cornice in that city, which was put on the high school building in 1868, and is still standing. In March, 1869, he established himself in business here and was one of the very early cornice manufacturers in Chicago, and one of the first iron cornice jobs put up here was that done by Mr. Dewey on the large building at the corner of Washington street and Wabash avenue, owned by J. V. Farwell & Co. and John B. Drake. This pioneer retired in 1875.

Edward Kirk, Jr., is a cornice manufacturer at 3945 to 3951 Wentworth avenue, and is also an extensive dealer in tin, copper and sheet-iron work, and slate and metal roofing.

The product of his manufactory has been extensively used throughout the city, and the extensive patronage which he commands speaks in an admirable manner for the high quality of his work. The present age is one of the greatest progress, and in every article manufactured perfection is rapidly approaching. Nowhere is this more forcibly illustrated than in the establishment of which Mr. Kirk is the proprietor. He founded his house in 1875, and he has spared no expense in fitting it up with the latest improved tools and machinery, and every necessary facility and convenience is provided for the successful manufacture of his product. Special attention is given to cornices, a branch in which Mr. Kirk has no superior, for his work is unsurpassed for beauty of design, quality of material and excellence of finish. He employs from fifty to sixty skilled workmen the year round, and is prepared to fill all orders with neatness and despatch. Mr. Kirk was born in 1837, was educated in the common schools of New York city, and, at the age of sixteen years began an apprenticeship of four years at the tinner's trade, a calling which he followed until he attained his majority. He then established himself in New York, but in 1873 came to Chicago, the two subsequent years acting as foreman in the cornice works of the late J. W. Atkinson, at the end of which time he embarked in business for himself. He was a member of the Twelfth New York national guards before the war, and in April, 1861, after the Rebellion had opened, went with his company to the scene of action, holding the rank of corporal in the Army of the Potomac. He took part in the engagements at Bull Run, Gettysburg and others, and in 1863 was commissioned first lieutenant, which position he held until the close of the war. He was mustered out of service in 1864, and, returning home, resumed his business operations in New York. He is a member of the G. A. R., and was the commander of George G. Mead post, No. 444, at Englewood, in 1889 and 1890, and was the first eminent commander of Englewood commandery No. 59, Knights Templar, in both of which orders he is an active member. He resides at Normal Park. His father, Edward Kirk, Sr., was for many years a successful merchant of New York, and is now a resident of that city.

Robert Hughes, manufacturer of cornices and slate roofing, established himself in this business in Chicago in 1878, his office being at 175 West Adams street. He was born in England in 1849, and at the age of eight years was brought to America and located at Granville, N. Y. He received a public-school education and worked in a slate quarry, and at the age of fourteen years began learning the tinner's trade, going to New York city, and there serving an apprenticeship of three years at the slate and metal-roofing trade. He worked as a journeyman in Baltimore, Philadelphia, Boston and other cities, and in 1868 established himself in the roofing business at Hartford, Conn., from which place, in 1878, he came to Chicago, of which city he has since been one of the active business men. He furnished materials in his line for McCoy's hotel; the training school at Feehanville; St. Anne's church, at Fifty-fifth street and Wentworth avenue; All Saints' church, Twenty-sixth and Wallace streets; St. Joseph's church, on the north side; the Jesuit church, Twelfth and May streets; St. Mary's church, on Wabash avenue; Holy Name cathedral, on Superior and State streets; the Studebaker building, on Michigan avenue; the Fort Sheridan water tower for the government, one of the most difficult and finest pieces of copper roofing in the United States, and numerous other noted buildings. Mr. Hughes is one of the originators and a charter member of the Builders & Traders' exchange, and for some years has had charge of the roofing and repairs of the County hospital and also many schoolhouses, the most prominent of which is the beautiful Marquette school building, on Harrison and Wood streets. His business has been always energetically conducted, and in spite of many obstacles he has succeeded in building up a large trade, that fairly entitles him to rank among the largest and best firms in the city.

A. J. Welin, manufacturer of galvanized iron and copper cornices, came to Chicago in 1872. He established his business on State street in 1880, and moved to 2829 Fifth avenue in 1891.

The business of Thomas Allen, metal and slate roofing, cornices, metal skylights, finials, etc., 424 West Randolph street, was established in 1882 by the present proprietor, who built his works in 1886. The workshops are fully supplied with all modern appliances and machinery necessary for the successful prosecution of the business. A requisite number of experienced and skillful workmen are employed, and the trade of the house extends throughout all sections of Chicago and its vicinity. Mr. Allen attends carefully to all kinds of metal and slate roofing, and manufactures cornices, metal skylights, finials, etc. He has roofed a large number of factories, churches and other buildings throughout the city and state. He is likewise a practical expert in tin, gravel and other roofing, and gives personal attention to all work entrusted to him. Mr. Allen was born in Philadelphia, but has resided in Chicago for the past eleven years.

One of the largest and best appointed cornice manufactories in Chicago is that of W. H. Vallas, located at No. 1381 West Lake street. Here is a shop that has facilities for turning out galvanized iron and copper cornices second to none in the city. Mr. Vallas takes contracts in all parts of the country for slate, tin and iron roofing, skylights and cornice work of all descriptions, and keeps a force of men employed sufficient at all times to do work in the best possible manner and shortest time. He can point with pride to many of Chicago's fine buildings which show his handiwork. He was born in London, England, June 9, 1856, where he learned his trade. In 1879 he married Miss Annie Smith, who has borne him one child. He came to this country in 1880, and to Chicago in 1882. In March, 1890, he opened the place he now occupies, and is doing a very successful business by reason of his eminent qualifications and wide experience gathered in different parts of this country and England. He is a thoroughly practical man, and if good work, business integrity and energy are any indications of prosperity, his future is an assured success. He is a member of Garfield lodge No. 686, A. F. & A. M., and resides at No. 593 Park avenue.

The galvanized iron and copper cornice business of Louis Biegler, at 379 North Clark street, was established by Mr. Biegler in 1882, and was then located on Clybourn avenue, but his business increased so rapidly that he was forced to enlarge his facilities, which he accomplished by removing to his present location in the fall of 1886. His place is light and well ventilated and thoroughly equipped with the latest improved appliances and machinery of his line of goods, and his operations necessitate the employment of many skilled metal workers. He manufactures galvanized iron and copper cornices, metal skylights, which he produces in large quantities, and originates many new styles that are beautiful specimens of chaste and ornamental workmanship. He also does all kinds of slate, tin and corrugated iron roofing and jobbing of all descriptions, and is prepared at all times to make estimates and enter into contracts for supplying goods in his line, which he has all the facilities for executing promptly. His trade extends throughout the city and state, and as his work is unsurpassed for excellence and his prices low, it is rapidly growing in volume and extent. He is a native of this city.

Charles V. Kuder. Not many years ago in this country dealers in builders' supplies usually found little trouble in handling products for all branches of the building interests, but the enormous advances made in the building arts, the enormous increase in the variety and quantity of all building specialties, have rendered this at the present day impracticable. As a consequence, in the building interests, as in all other interests, at present, men are compelled to take up and handle specialties. This has caused great perfection in special departments of business, and it affords a greater degree of completeness and finish. One of the most important of the special interests connected with the construction of buildings is the production of cornices, slate roofs, skylights, tin roofs, etc. One of the most active houses in this line in Chicago is that of Charles V. Kuder, at 5315 Wentworth avenue, where he has been actively engaged since May, 1886. The excellence and prominence of his work may be seen at the following buildings: The store and apartment structure at Forty-sixth street and Cottage Grove avenue; the splendid and solid iron front of the store and flat building of J. R. Trenton, at Normal Park; the fine store and flat building at Thirty-third street and Cottage Grove avenue; a class of very fine, artistic and durable work on the southwest corner of Forty-fifth street and Greenwood avenue, and many of the fine residences of the south side. His work possesses great durability, perfect finish, artistic completion, and is in large and constantly increasing demand. He is one of the most successful roofers of the city, and is well known to all interests connected with the building trade. He first began business on a small scale on Cottage Grove avenue, but his trade had so increased by February, 1890, that he sought his present quarters, which he built to suit his business. He employs from eight to fifteen men, and does an annual business of $15,000. He is a native of Philadelphia, his birth occurring there in 1857, and is a son of John Y. Kuder, who for many years was a hardware jobber of that city. Charles V. grew to manhood in his native city, and at the age of sixteen years began learning the trade of a tinner. In 1877 he came to Chicago, and entered Rush Medical college, but after remaining in that institution for four years he was compelled to leave on account of ill health. In May, 1886, he established his present business, and, owing to his push and determination, enjoys a liberal patronage. He is a member of Gauntlet lodge No. 4, of the K. of P., being also a member of the Royal Society of Goodfellows. He was married in this city, in 1884, to Miss Anna Schroeder, a native of Chicago, and by her has two daughters.

A firm noted as manufacturers of patent vault and sidewalk lights is the Dauchy Iron works, George K. Dauchy, president, and Samuel O. Dauchy, secretary, 84 Illinois street. Its premises are well arranged and fitted with all the appliances and conveniences necessary for this business. Besides a variety of vault and coal-hole covers, the company put in a great number of forms and shapes of roof and floor lights, and with different colors make very handsome and ornamental work for both ceilings and floors. They use Ross' patent light for vaults, a great improvement in vault light work, whereby they are able to greatly increase the light, and thus make deep basements more valuable. The plate is cast with shoulders in the hole where the glass is inserted, whereby the glass, with corresponding shoulders, can be inserted from below, and then being partly turned around is thereby fastened in so secure a manner when cemented that it can not be got out without breaking it to pieces, nor can it be jarred loose.

One of the most interesting industrial enterprises in the Union, and one often visited by a delightful public, is that of the bronze foundry at Grand Crossing. One never wearies in gazing upon the works of art and rare mechanical skill within its walls, and one leaves it with almost a sigh of regret. The formation of the American Bronze Company is the outgrowth of that spirit of progress, patriotism and commercial enterprise in general for which Chicago is distinguishably notable. Whether or not Chicago could compete with New York or Paris in strictly first-class figure casting in bronze, was a question not easily answered. Artists, draughtsmen, molders or finishers of bronze statuary were rare indeed, and those who were competent, as a rule, were either employed as master workmen or in supervising the casting in famous bronze establishments. Such was the status of affairs in 1885, when Joseph Berchem, a celebrated artist, sculptor and designer in bronze from Paris, landed in Chicago. He at once sought out the men now at the head of the American Bronze Company, men of wealth, experience and ideas not confined within narrow limits, to whom he explained that bronze figure casting could be done in Chicago by either the wax process or sand as cheaply and as well as in New York city, Paris or Munich. Mr. Berchem explained, and had documentary evidence to show that he had but just completed a coarse of studies in France on wax molding for bronze casting, and that twenty years of his life had been devoted to art. His profession he had learned at Boye-Roland, France, a renowned establishment for the casting of bronze statuary, and subsequently he had perfected his work at Thiebault-Freres, France, and in the city of New York. Mr. Berchem's claims were inquired into, and everywhere his skill was so favorably commented upon, as well as his tact in drawing about him the best class of workmen, that it was decided by several prominent and successful Chicagoans to establish in this city a bronze-casting establishment that should brook no rival. Accordingly, after careful consultation and deliberation, it was finally decided by an organized company, incorporated at Springfield and capitalized well up in the thousands, to locate such works at Grand Crossing, as there the railroad facilities would be unexcelled, and casting could be accomplished more successfully than in the more crowded districts of Chicago.

The enormous capital invested and the number of workmen employed in the metal trade of Chicago have combined to render it a branch of industry of the first magnitude. A representative house in this line of business is that of Messrs. George P. Harris & Bro., of Nos. 62 and 64 West Lake street, manufacturers of copper, brass, tin and sheet-iron goods. They make a specialty of distillery, brewery and steamboat work and engineers' supplies, and special attention is called to their kettle and column. The combination is apparent to all distillers at a glance. Heavy bronze and brass castings and brass finishing of all descriptions for builders and other patrons are done. Their large and well-equipped factory occupies two floors, and is fitted up with all the latest improved machinery. Their principal customers are among the distillers and the brewers, and they ship their goods to every part of the States and Canada. They have been at their present factory for two years. Messrs. George and Arthur Harris are Englishmen, and came to this country about thirty-five years ago. They use the best of material, and all the work passes under the master's supervising eye, and in this way they have succeeded in acquiring the confidence of the public.

The hum of industry nowhere in Chicago plays a livelier tune than proceeded from the workshops of E. F. Angell & Co., 87 and 89 Franklin street. The long lines of shaftings, revolving pulleys and flying belts kept in motion the varied machinery, which, under the control of able mechanics, transformed the large rolls of brass, long lengths of tubing, and the rough, unpolished iron and steel into graceful and artistic patterns of fenders, frames, grates, brass tables, brass easels, office railings, wickets, grilles and every conceivable article the firm's patrons demanded in ornamental brass, bronze and iron work. The many unique and original designs in fireplace trimmings, furniture trimmings, office fittings and ornamental metal work of all descriptions manufactured by this concern, elicited the admiration of the visitor, and satisfied the various tastes of the most critical buyers. With years of practical experience, and their facilities for production, this firm held unchallenged its place among the manufacturers of fine metal work.

The well-known copper and brass works of E. Smeeth, manufacturer of alcohol and spirit apparatus, etc., Nos. 28 and 30 North Desplaines street, was established in 1853, by Mr. E. Smeeth, who conducted it until 1882, when he died after a long, honorable and successful career. He was succeeded by his son, Mr. E. Smeeth, Jr., who is a thoroughly practical coppersmith, etc., fully conversant with every detail of the business and the requirements of patrons. The premises occupied embrace a substantial five-story building with basement 40x60 feet in dimensions. The workshops are fully supplied with all modern machinery, tools and appliances known to the trade. Forty experienced workmen are employed, and the machinery is operated by a powerful steam engine. Mr. Smeeth manufactures to order or otherwise the latest improved alcohol and spirit apparatus, also highwine distillery, vinegar and brewery work. He makes a specialty of heavy bronze and brass castings, genuine babbitt metal, spelter, solder, etc., while all jobbing in copper, tin, sheet iron and galvanized iron work is promptly and carefully attended to. Faithful attention is given to whatever may be desired in copper or brass, while great care is taken in the selection of proper qualities of metals, and in the delicate processes of casting, especially where soundness and the greatest accuracy are required in the finished articles. The trade of this house extends throughout Chicago and the West. Mr. Smeeth was born in Chicago and is highly regarded for his mechanical skill.

The well-known concern known as Thomas Brothers Manufacturing Company, Horatio Thomas, president, 521, 246 Washington street, succeeded the firm of H. Thomas & Brothers, brass founders, manufacturers of brass goods, Nos. 86 and 88 Market street, and is a successful and reliable house engaged in the manufacture of brass goods of every description. This business was established in 1869 by P. E. Mahew, who was succeeded in 1877 by H. Thomas & Brothers. In 1883 the firm of H. Thomas & Brothers was organized, the copartners being H., L. & M. Thomas, all of whom are practical brass founders. The foundry and work shops are fully supplied with every appliance, tools and machinery requisite for the successful prosecution of the business. A large number of hands and skilled mechanics of different kinds are employed, and the machinery is driven by steam power. The company manufactures all kinds of light and fancy castings in brass, box metal, dipping metal, white metal, bronze, bell and gun metal, etc., and makes all descriptions of metal patterns. A specialty is made of show case trimmings and philosophical goods. All orders are promptly and carefully attended to at the lowest possible prices, and the trade of the firm is by no means confined to Chicago, but extends throughout the adjacent cities. Messrs. H., L. & M. Thomas were all born in Virginia. They are all members of the Knights of Pythias, and H. Thomas is the inventor and patentee of several improvements in package and cask carriers.

The former firm of Massey & Donne, electro-bronzing, gold, silver and nickel plating, antique and oxidized, architectural brass work, etc., 67 and 69 Lake street, stood high in this city in the manufacture of architectural brass work. The business of this house was first established in 1883 by Mr. J. E. Robinson, who was succeeded in November, 1886, by Mr. A. W. Massey, and in January, 1887, the firm above named was organized. Their manufacturing premises were admirably equipped with the latest improved machinery, tools and appliances known to the trade; the machinery was operated by steam power, and a force of twenty-five skilled hands was constantly employed. This firm were extensively engaged in electro-bronzing, gold, silver and nickel plating, antique and oxidized, and manufactured fireplace frames, fenders and andirons, fire sets and screens, railings, wickets, brass tables, furniture trimmings, etc. The trade of the house extended throughout the entire West. The firm was composed of Messrs. A. W. Massey and L. Donne. Mr. Massey is a native of the city of Baltimore, and began in this line in 1876. Mr. Donne is a native of France, a resident of this country since 1862, and had a practical experience in his business dating from 1865.

In the department of brass building appliances a prominent want is supplied by the Union Brass Architectural works, 77 North Clinton street, A. N. Bort president, and Max Schneider general manager, which was a few years ago located at 91 and 93 Ohio street. John Alex. Cooper was then proprietor and J. D. Duffy, superintendent. The Union Brass Architectural works are the successors to the architectural department of the Union Brass

Manufacturing Company of this city. The latter company was founded in 1884, and of this Mr. John Alex. Cooper was the secretary. In January, 1887, Mr. Cooper secured control of that company's architectural department, which had been founded and under the superintendence of Mr. J. D. Duffy, and he established the present Union Brass Architectural works on Ohio street. The subsequent change in the management is indicated above.

Among the various extensive and growing commercial interests of Chicago which exert an important influence on our general trade and bear the marks of continued increase and prosperity, none, perhaps, occupies a more useful position than the trade in building specialties which was so satisfactorily represented by Messrs. Richard Robins and Edward N. Kirk Talcott. These gentlemen were so prominent in the building fraternity that from the very beginning of their enterprise, in 1886, the success of their house was great. The firm represented the Hecla Architectural Bronze & Iron works of New York and Brooklyn, the Magneso Calcite Fireproofing Company, Boston Terra Cotta works of Boston, and several stone producers; and they successfully covered the entire field of ornamental iron work, terra cotta, granite, marble, sandstone and fireproofing, orders for which they were prepared to fill promptly. Their trade, from the first of great magnitude, steadily increased and reached out rapidly into the far West. Architects and builders, as well as owners and those needing representation in the West, fully appreciated the advantages to be derived through this house, the office of which was at 11, 115 Monroe street.

Oswald Lockett was born in Manchester, England, August 1, 1843. His parents were James Garnett and Sarah Lockett, who with their family came to this country in 1854, and located in Boston, Mass., where several of his brothers and sisters still reside. After leaving school, he started to learn the boot and shoe business in Boston, but, owing to ill health, was compelled to relinquish this design and, on the advice of the family physician, concluded to try the rough out-door life of a farmer, and in 1860 we find him on a small farm near Kingston, Canada. With returning health, he soon grew tired of this kind of life and in 1863 came to Chicago, bringing with him letters of introduction to some of the best families in the city; but soon learning that it was not wise to rely on them to find or make a business opening for him, and that if he ever was to succeed in anything, he must learn to rely on his own exertions, he began to search diligently for something to do, going from store to store, enquiring if there was any vacancy which he could hope to fill. After many a weary day of fruitless travel, he called at the old hardware house of Botsford & Kimball, then at 109 Lake street. Here he met Mr. Mark Kimball, from whom he learned that the firm needed someone, but he feared the position would not suit, as the work was rough and hard and the pay small, only $25 a month. Nothing daunted, and being determined to get a footing, he secured the place and immediately entered upon his duties, which he found had not been misrepresented as, in those days, sidewalk elevators were unknown, and the old-fashioned sling and hand-over-hand hoist was the only means of raising and lowering goods. In the spring of 1865, he entered the employ of Edward Hunt, then one of the oldest and largest wholesale and retail hardware dealers in the city, located at 84 Lake street. He remained with this house until after the great fire of 1871, and in January, 1872, entered in partnership with E. Hamilton Hunt, under the firm name of Hunt & Lockett, doing business in a wooden shanty erected amid the ruins of 75 Lake street. The two men were not congenial, however, and in April the firm was dissolved. About this time Mr. Lockett met Frank B. Orr, who had moved here from Mansfield, Ohio, and on the 27th day of May, 1872, the firm of Orr & Lockett began its career at 129 West Randolph street. They passed through the dark days of the panic, when so many of the oldest and best firms in the country were forced to the wall, and by close application, and what now seems almost superhuman effort and endurance, succeeded in pulling through and finally establishing a reputation, and building up a business of which they may justly feel proud. In 1876 he was married to Anna M. Wood of Galesburg, Ill. Early in his business career, Mr. Lockett became convinced that the hardware used in our fine buildings was not in keeping with the times, or the other work and ornamentation of the structures, and that so important a feature ought to be made a matter of careful study, and combine artistic merit with utility. He determined to devote his life and energies to the advancement of this much-neglected branch of the building business. He has lived to see a wonderful change for the better, but contends that the art is still in its infancy, and that in the near future people erecting fine buildings will demand a higher grade of builders' hardware, and a more intelligent handling of this branch of the business than has thus far been obtainable. He has been closely identified with the rebuilding of Chicago, having been entrusted with the hardware contracts for most of the large buildings here, among them the First National bank building, the Home Insurance building, the Phœnix Insurance building, the Union League club building, the Rookery, the Pullman building, the Grand Trunk depot and offices, the Chicago, Burlington & Quincy offices, the Grand Central passenger station, the new Herald building, the Daily News building, the new Board of Trade building, the Monadnock and Kearsarge office buildings, and the Auditorium. From the small beginning described, Mr. Lockett has made his way in the world with a boldness and certainty that mark him as one of the ablest and most successful business men of modern Chicago, he being not only one of the two heads of one of the largest general hardware establishments in the country, but, what is more important to the interest treated in this work, the originator of and the leader in the great transformation in the builders' hardware trade that has advanced it from the most primitive commercial position to a veritable art.

George B. Carpenter & Co., 202 to 208 South Water street, handle mill, railway and vessel supplies, marine hardware, wire rope, blocks, twines, cordage, etc. The business of this house was established by George A. Robb, in 1840, only three years after the incorporation of Chicago as a city. In 1845 Mr. Payson was admitted to the firm, and the name was changed to Payson & Robb. Mr. Payson retired in 1850, and Gilbert Hubbard entered the firm, the style of which was then made Hubbard & Robb. After the death of Mr. Robb, in 1857, George B. Carpenter became a partner in the firm. Mr. Carpenter is a son of Benjamin Carpenter, a native of Ohio, who was the first president of the board of public works of Chicago. Gilbert Hubbard & Co. succeeded, and during twenty-four years, to the time of Mr. Hubbard's death, in 1881, the house advanced to its present position in the trade, and the name became a familiar one throughout the West. January 1, 1882, following the death of Mr. Hubbard, the business passed into the hands of the present firm, who had been his associates for a quarter of a century, and George B. Carpenter & Co. have since cared for the trade, upon the same principles which characterized the management of the old establishment. From 1859 until the great fire of 1871, the concern occupied the large iron front building at Nos. 205 and 207 South Water street, immediately opposite their present location. It was burned to the ground on the night of October 9 of that memorable year, but before the ruins were yet cold a tent was erected, and Gilbert Hubbard & Co. resumed business. The tent answered the purpose until more commodious quarters were fitted up from the ruins of an old grain warehouse at 14 and 16 Market street, which was occupied in November following the fire. The new establishment was considered a great curiosity at the time, fully one half of the rude structure being below the level of the sidewalk. In April, 1872, the concern removed to the then capacious three-story building, 226 to 232 South Water street. In 1874, the erection of the present building at Fifth avenue and South Water street was begun, and a year later it was completed and occupied. In 1887 a six-story warehouse, 50x100 feet, was added, and the firm to-day hold a position in the trade second to none in the country.

H. C. Hanson deals in wood and wire lathing, and has his office in the Builders & Traders' exchange, his residence being at 777 North Leavitt street. He was born in Norway, March 6, 1855, and in 1861 was brought to the United States by his parents, both of whom are dead. The father, Hans Hanson, was a native of Norway and died in this city March 25, 1889. The mother, Carrie Hanson, died ten years previous, and was also a native of Norway. Upon coming to the United States the family located in Chicago and this has been the home of H. C. Hanson since. In 1866 he began working at the lathing business, and in 1872 commenced upon his own responsibility. His business has increased so greatly that he is now obliged to give steady employment to thirty-five men, and his services have been utilized by builders and owners in all parts of the city. He did the wire work on the Auditorium building and on the top story of the Tacoma building, and has done extensive work in his line in Pullman. He has been a member of the Builders & Traders' exchange since its organization, and is also a member of the I. O. F., court Chicago No. 17. He was married January 12, 1884, to Miss Jennie H. Nelson, who was born in Chicago in 1861 and has presented him with four children: George H., Mabel C., Arthur M. and Gracie L.

Frederick Voss, wire-cloth manufacturer, established himself in business in Chicago in 1873, and in his factory, which is at 67 and 69 West Monroe street, 40x160 feet, and three stories in hight, he employs on an average fifty-five hands throughout the year. He manufactures sufficient of his product for home use, and the buildings of this city which he has furnished with his manufacture are as follows: The Gaff building, the Northwest Insurance building, the Insurance Exchange building, the entire furnishing of the wire lath and elevator guards in the Farwell building, Auditorium building, L. J. McCormick's buildings, Martin Ryerson's building, Chicago Telephone building, J. H. Walker's retail store, N. K.

Fairbank's building, P. C. Hanford's building, Counselman's building, J. B. Maller's buildings and many others. In 1872 he came to Chicago, and the following year engaged in the manufacture of wire cloth, in connection with Mr. Kiely, the firm taking the name of Kiely & Voss. This continued until the death of Mr. Kiely, in 1884, since which time the business has been very successfully conducted by Mr. Voss. He became one of the first members of the Builders & Traders' exchange, and also belongs to the A. F. & A. M.

In a vast city like Chicago one can always find something new to amuse and instruct the mind, and no better remedy could be prescribed for the blues than a lengthy stroll over the great thoroughfares, made particularly prominent by the multifarious manufactures conducted thereon. Some fresh and attractive feature is to be seen at every step one takes, and articles of common, every-day life, which hitherto, perhaps, have given the average mind but little or no concern as to how, or where, or by whom it was created, when observed under these circumstances, suddenly arouses in the sightseer a sense of the neglected objects of importance in this wonderful world of ours, and the interest felt is at once manifested in the ardor of the spectator to know all about it. In the establishment of John Booth, successor to Jones & Booth, manufacturer of green wire cloth, etc., No. 110 Lake street, there is much to be found that will awaken into life the enthusiastic curiosity born of that thirst for knowledge which is inherent in human nature. This manufactory is one of Chicago's old time industrial expositions, having been established nearly forty years ago by the firm of Jones & Booth. Located, as it was, upon a sound financial basis, and conducted continuously since with a strict regard to the business honor and integrity, the firm has grown up with Chicago. Mr. Booth stands high in his line of manufactures, controlling one of the largest concerns of the kind west of New York city. The factory is amply large for turning out, in any quantities, the various goods in which he deals, and being fully stocked with the latest improved machinery for making the several lines of wares, not only speedily, but in the most superior manner, aided by the intelligent skill of about one hundred employes, the products have earned for him well-deserved honor and enviable distinction in the commercial world. Furthermore, being possessed of mechanical genius (as the large number of patents granted him for various useful inventions testify), and long practical experience, he is continually alive to the importance of this progressive age, and endeavors to anticipate the demands, by introducing quite frequently such improved wares as in his sound judgment will best benefit the trade, and being backed by a large working capital, he succeeds. His trade is not confined to any specific locality, but extends over the entire country, as its goods can not be excelled by those of any other manufactory in the land, and the immense business transacted gives evidence of its popular standing at home and abroad. Chicago points with just pride to the gentleman at the head of this firm, as prominent among her worthiest citizens and representative business men.

George F. Kimball, a leader among the glass manufacturers and jobbers of the United States, is a native of Boston, where he was born in 1839. His parents, Alvah and Rebecca (Woodbury) Kimball, were natives of New England, where the first representatives of the family in the United States, settled in the early days of the republic. Alvah Kimball established the first print-calico mill or factory in Massachusetts near Boston, and was interested in this new industry for the greater part of his life. After receiving a superior education at Andover, Mass., George F. Kimball left home in 1856, and going to Louisville, Ky., entered a dry-goods store there. Three years later the large dry-goods house of Johnson & Kimball was formed and the partners were singularly fortunate. Civil war came to disturb all this, and in 1861 Mr. Kimball sold his interests in the house to his partner, Johnson, and, entering the United States army, was commissioned paymaster. He served in that department of the army to the close of the war. Subsequently he engaged in soliciting consignments in New York and other north Atlantic states, for the large southern auction and commission house of Thomas Anderson & Co., and continued in that position until 1868, when he moved westward to Chicago. Here he was appointed resident agent for the glass importing house of Platt & Boyd, of New York city, serving until 1874, when the firm of Marrenner & Kimball was organized. In 1882 Mr. Kimball purchased his partner's interests in the house and widened the trade field until it covers everything connected with house furnishing in glass. He handles more window glass than any other house in the United States, and is the heaviest manufacturer in fine-art glass. His force of workers in this special department has increased from five men to three hundred men in the last half decade, among the employes being a number of European artists of acknowledged ability. He takes by far the greater part of the Crystal Plate Glass Company's product, manufactured at Crystal City, Mo., from pure silica, the finest sand in the world, which does not require washing before melting. The glass for the Auditorium, the Chamber of Commerce, the mammoth Fair building, the Monadnock, the Art Institute, the Studebaker, the Pontiac, the Pennsylvania railroad Union depot, the Leiter, and many other great modern buildings, was supplied by him with polished glass. In the Leiter building it is used in every light, and, when the statement is made that the contract for supply was the largest ever entered into in the United States for plate glass for a single house, a look at the great commercial structure on State and Van Buren streets will leave no room for doubt. To Mr. Kimball must be credited, in a large measure, the extraordinary development of the fine art and plate-glass business in the West. He was among the very first to establish a great house so far south of the old business center as Wabash avenue and Congress street, and displayed greater courage in later days when he opposed the glass trust. As a citizen, he is a most useful one in every particular, while as a part of the social fabric of Chicago his membership in the Washington Park and Union League clubs points out the genial social side of his character.

John Scott, glass stainer, comes of a prominent English family of that name, which at an early day began the manufacture of stained glass of various improved plans, and has continued in this business down to the present time. Mr. Scott began in the manufacturing department of this celebrated house in 1849, and consequently has an extensive experience over a wide range of years. He soon secured a large patronage from patrons of the highest social and professional class. So excellent, indeed, was the character of his work that in 1867 he took an important medal from the French government. The character of his patrons, their artistic taste and culture, prove the unusual merit of the work and product turned out by Mr. Scott. He is the oldest practical stained-glass man in America. He is capable of performing the work in any one of the several processes employed in the manufacture. He has made a specialty of church and cathedral decorative glass work. In this department of his business alone he has attained the highest grade of artistic work. Before coming to this city many of the grandest arched gothic windows of the cathedrals of England were decorated by him. This is also true of many fine church buildings, Protestant and Catholic, in the United States, and all branches and departments of the work are done at his factory. He is the owner of an important patent in the United States for the process of bending glass. The very superior character of his work in all its details, his faithfulness to his contracts, and the merit in general of his products makes him a credit, not only to Chicago, but to the country.

One of the oldest businesses in stained glass in Chicago is that of J. F. Carse, of 1192 Fulton street, formerly located at 19 to 21 South Canal street, which was founded about thirty-five years ago by Robert Carse, father of the present proprietor. Every description of stained glass for use in private houses, churches, public buildings, halls, stairways, etc., is manufactured. Mr. Carse makes a specialty of stained glass work for ecclesiastical purposes, and many of his designs are very elaborate and give evidence of great artistic merit. His business pluck, combined with the excellence of the work he produces, established for him a large and increasing trade. Original designs are furnished on application, and prompt attention is given to all orders.

The growth of Chicago as a business center has not only been very rapid, but its history is one of advanced strides toward the position it now so creditably occupies. Every department of commerce has kept pace with this marvelous growth, and to-day are to be seen the colossal results of the ability and energy of her citizens, in which the glass trade forms a most important branch, one of the leading representatives being the James H. Rice Company. The business was established just after the fire in 1871, by James H. Rice, with a capital of $50,000, and conducted with eminent success, the result of which is the present stock company, which was organized January 1, 1884, with a paid-up cash capital of $100,000, and whose officers are: James H. Rice, president; Edward Flanigan, secretary. The company do an extensive wholesale and retail business, importing direct every grade of polished, rough and crystal plate glass, and handling large quantities of English, French and American window glass, also French plate and German mirrors, colored, embossed and enameled glass. To accommodate the immense stock carried, a removal was effected, early in 1891, from their former location on Quincy street, to their present spacious premises, 34, 36, 38 and 40 South Water street. The stock carried embraces the choicest goods in the market, and the resources of the company are such that the largest orders can be executed promptly and on reasonable terms. From its inception this business has been an unprecedented success, each year largely increasing the volume of trade. Mr. Rice has lived in Chicago since 1854, and he conducts this important business on a sound and liberal basis, its great extent speaking most impress-

LANDING AUDITORIUM HOTEL.

DESIGNED BY MESSRS ADLER & SULLIVAN. EXECUTED BY BURKE & Co.

ively of the confidence with which he is so widely and justly regarded. The trade of the company extends throughout the middle, western and northwestern states and is steadily increasing, owing to the superior quality of its plate and window glass.

The stained-glass house of George A. Misch, 217 Washington street, was established before the great fire and was then burned out. Immediately afterward Mr. Misch began again and enjoys a largely increased capital and a business which, in 1883, reached $75,000 yearly. This business extends from New York to San Francisco, being largely in the West, and is growing constantly and rapidly. The premises occupied by this industry are equipped with a powerful engine, and all the most approved machinery for the purpose of the enterprise, and employment is found for a large number of workmen of the best skill and experience. This establishment, which is one of the largest of its kind in the Northwest, is conducted upon the strictest system, and shows everywhere evidences of the practical and life-long experience of its proprietor. Among those works which stand as monuments of his taste, skill and efficiency, may be mentioned the memorial work in the Presbyterian church at Detroit; St. John's Catholic church, Chicago; the cathedral of St. Francis De Sales, Cincinnati, and numerous private residences, including that of Mr. C. Watrous, Chicago, and many other buildings of all kinds. This house possesses the facilities to execute, in the ablest manner, all work entrusted to it, be it severely simple or highly elaborate, and the integrity of the house and its well-known character for fair dealing, is an assurance that everything will be as represented.

A leading branch of commercial industry, and one that is fast assuming prominence in this city, is that technically known as glass beveling and silvering, a branch of trade ably represented by J. D. Roberts & Co., of 79 and 81 West Van Buren street. Since establishing his business in December, 1885, it has developed into most prosperous proportions. Mr. Roberts is a native of Rutland county, Vt., and has been a resident of Chicago for nearly forty years, having been engaged in the business of house and sign painting for some eighteen years prior to embarking in his present undertaking. At the outbreak of the great Civil war, Mr. Roberts at once went to the front as a member of McAllister's battery, achieving a gallant record at the various engagements in which it participated, being assigned to Bolton's battery, after receiving his commission as second lieutenant for meritorious conduct in the face of the enemy. After three years' constant service, sickness finally necessited his discharge, upon which he returned to this city. His three brothers also served through the war, one in Colonel Brackett's regiment, Ninth Illinois cavalry, most remarkably passing through one hundred and sixty of the great battles and skirmishes of the war without receiving a scratch. In commercial life Mr. Roberts has been as successful as he was gallant as a soldier.

A progressive west side concern is Suess' Ornamental Glass Company, whose office and factory are at 590 West Taylor street, near Laflin, manufacturers of art, ecclesiastical, beveled, sand blast, chipped or crystallized and embossed glass, for vestibule doors, transoms, bank and office counters, etc., and advertising glass signs. Of this concern Max Suess is general manager. The business was established in 1886 at 216 East Lake street, and removed to its present quarters in 1889. About twelve men are employed, and the annual business aggregates $30,000. Mr. Suess was born in Germany in 1854, a son of Joseph and Anna Suess. He was educated there and came to America in 1881, and settled in Chicago, and learned his trade in this city. He is a practical draughtsman and designer of much ability. He studied in Italy a year, and attended an art school in Germany. He was married in 1882 and has three children: Walter, Anna and Max. He is a man who has made his own way, and has been successful in the career he has chosen.

That well-known establishment, the Linden Glass Company, was established by Frank L. Linden, in 1882, at 333 Wabash avenue, and has done a high-grade trade in stained and decorative glass.

Among the flourishing and noteworthy mercantile establishments that have sprung into prominence and prosperity during recent years in Chicago may be mentioned the well-stocked and commodious concern of Tyler & Hippach, 151 Michigan avenue, wholesale dealers in imported and American plate and window glass, ornamental glass and mirror plates, and which, although not one of the oldest firms, has attained a name and standing in the trade that place it among the leading houses devoted to this important branch of commercial activity in the city, while the transactions of the house, which extend all over the western states, are of a very substantial and gratifying character. This enterprising and prosperous firm was established on January 1, 1887, and from the inception of the business has steadily pushed its way to public favor and confidence, building up in a short while an extensive and flattering patronage. Handling only the most reliable brands of glass from the leading factories, upright and honorable in all their dealings, and being withal both men of energy, judicious enterprise and thoroughly conversant with the trade, it is only in the nature of things that they should have attained the large measure of success that has attended their well-directed efforts from the start. They occupy for business purposes four 26x150-foot floors and basement, and carry constantly on hand a heavy and A No. 1 stock, including imported and domestic plate and window glass of every description, also ornamental glass and mirror plates of all kinds. They are western agents for Belcher's patent mosaic glass for churches and house decorations, such as windows, doors, transoms, skylights, hall lamps, fire screens, etc. The unlimited variety of designs and magnificent color effects that can be produced by this process, and its moderate cost, recommend it strongly over some other methods of producing ornamental glass. Messrs. Albert S. Tyler and Louis A. Hippach are gentlemen of sterling qualities, and prior to embarking in business on their own account, had held the most responsible positions for years in the well-known glass house of G. F. Kimball of this city.

George W. Trent & Co., manufacturers of stained glass, sand blast, embossed, chipped and ornamental glass for churches, vestibule doors, transoms, bank and office counters, steamboats, etc., and dealers in French and American plate and window glass, command an extensive and paying patronage throughout the city of Chicago and her suburbs. Their office and factory is at 28 and 30 West Washington street, and as their honorable business methods have become universally known and the quality of their goods is unsurpassed, their time is fully occupied in supplying orders and in looking after the various details of such an establishment. George W. Trent was born in Boston, Mass., but at an early age was brought by his parents to Chicago, with whose interests he has identified himself. In 1883 he began working in the ornamental-glass business with one of the largest and most important firms of the West, with which he remained until embarking in business for himself. He is making a high grade of art stained glass and has a process of his own for making ornamental sand blast glass, which is said to be much superior in finish to anything yet produced in that line. Mr. Trent started out in business for himself in 1889, and although he has been only a short time thus occupied, it has been sufficiently long to establish his reputation as an artistic glass-worker and to demonstrate the fact that he is a man of practical business views, sound judgment and honorable principles.

Of all the gorgeous decorations devised to ornament homes and public buildings nothing exceeds the brilliant effects of artistic cut-glass in its different forms, such as cut and ground door, transom and office lights, plain and fancy beveled glass, etc. No other form of glass ornamentation can compare with this class of work. The firm of B. J. Schreiber & Annas, of 13 and 15 South Canal street, devoted their sole attention to artistic glass cutting in its highest perfection, in all its branches. This concentration of their abilities made it possible for them to furnish perfect work of the most difficult description, such as making jewels of any size to pattern or drawing, glass engraving, hammered, beaded, mitred, scored and fancy beveled glass. They introduced many new and effective ideas in this line and established an extensive business, being both ambitious and determined that no eastern concern should lead Chicago in turning out artistic glass work. This concern was succeeded by B. J. Schreiber, whose business is carried on at the old location.

CHAPTER XVII.

OFFICIALS, BUILDING PROMOTERS, ELECTRICIANS, HOUSE MOVERS AND ELEVATOR DEALERS.

Louis O'Neill is the present commissioner of buildings of Chicago, and one of the most active, practical and experienced of its business men. He is a native of Newark, N. J., born in 1837, the son of Michael and Mary (Sterling) O'Neill. The parents were both natives of the Emerald Isle, who, as early as 1830, crossed the Atlantic and settled in New Jersey, where they lived about two years, then removed to New Philadelphia, Ohio. Subsequently they removed to Pittsburgh, then to Mount Pleasant, Penn., but in May, 1866, came to Chicago, where, in October of that year, the father died of cholera. He was a man of high character, broad mind, ripe and extensive learning, and of more than ordinary worth. He had, at the age of eighteen years, graduated with distinction from Queens college, Dublin, Ireland, and throughout life was a close observer and a hard student. His wife died in Chicago in March, 1881. Louis O'Neill is a self-educated and self-made man. Like so many others of the best citizens here, he was compelled to battle with adversity and to surmount difficult obstacles almost from childhood. This constant contact with trying conditions has fitted him in an eminent degree for the responsibilities of his present high position. Naturally possessed with a keen intellect, with unusual depth of mind, and strong powers of observation, he has, by this combination of qualities, succeeded in a marked degree. From October, 1866, when he located in Chicago, until about 1881, he was engaged in the lumber and building business. His mill and factory, at the corner of Franklin and Ohio streets, was destroyed by the fire of 1871, and was rebuilt the same fall. In 1883 Mr. O'Neill was elected superintendent of construction of the Cook county hospital, and August 29, 1891, he was appointed commissioner of buildings of Chicago, by Mayor Washburne. Previous to his appointment to his present position, he contracted and put up many of the best buildings of the city. Mr. O'Neill has also for the past two years been in the commission business at 27 and 29 Michigan avenue, and for seven years has been a member of the firm of J. W. Kepler & Co., who have large cooling and freezing rooms at 368 to 372 East Indiana street. He has been a life-long republican, and for twenty-six years has taken an active part in politics, but has never been an office seeker. His ability fits him to be, as he is, one of the principal lead-

John M Dunphy

ers of his party in local politics. He was married in 1857 to Miss Mary F. Bechville, of Mount Pleasant, Penn. They have one daughter, now Mrs. B. F. Bush.

John M. Dunphy, ex-commissioner of buildings of Chicago, is one of the most popular and efficient of the local business men. The high character, ability and strict integrity led to his appointment in 1889 as commissioner of buildings of the city by Mayor Cregier. For many years prior to that he had been one of the most active, useful and prominent mason contractors here. The extent of his operations has made him familiar with the construction of buildings of all kinds in all portions of the city, and this fact, coupled with his splendid reputation and well-known ability, led to his appointment. He was born in Utica, N. Y., October 2, 1834, and is the son of Martin and Mary (Hickey) Dunphy, both of whom were natives of Ireland, born in 1804, the former dying in Carthage, N. Y., and the latter in Utica of the same state. They came to the United States in 1834 and settled at Utica, where Mr. Dunphy became a prominent brick and stone mason. John M. Dunphy was the fourth of seven children, of whom four only are now living. He was educated in the schools of Utica, and in 1850 began serving an apprenticeship at the bricklayer and plasterer's trade. After four years he commenced doing journey work at his trade, and in 1855 came West, at the suggestion of Horace Greeley and located in Chicago, where, until 1863 he worked steadily at his trade at journey work. From that date until the present he is doing a general contracting business. In politics he is a strong democrat. He was married in 1859 to Miss Mary Doyle, a native of Ireland; they have one child, John J. Mr. Dunphy, by reason of his recognized ability, has been awarded several responsible positions in the political world. He was town collector in 1879 and four years later was elected to the very responsible office of city treasurer. No man connected with the building interests stands higher here than Mr. Dunphy.

Charles C. P. Holden, ex-secretary building department, the son of Phineas and Betsey (Parker) Holden, was born in Groton, N. H., August 9, 1827. His father's ancestry runs back to Richard Holden, who settled in Massachusetts in 1634. His grandfather on his mother's side was Levi Parker, a lieutenant in the Continental army, who was at Bunker Hill and with Washington's army on the Hudson at the time of the treachery of Benedict Arnold, and was in charge of the guards at the execution of Major Andre. Mr. Holden's parents removed from Groton to West Hartford, Vt., in 1630, and to Illinois in 1836, arriving in Chicago on the steamboat New York, Capt. R. C. Bristol, June 30, 1836. They stopped at the Green Tree house, then on the northeast corner of Lake and Canal streets. With two ox teams, procured for the purpose, the family embarked for the prairie July 1. They were the first to settle in the edge of Will county, thirty miles south of Chicago, and the Indians' wigwams were still there. It was a lovely grove of the better kinds of timber, one mile square. The famous Sauk trail ran along its southern boundary, past the Holden homestead. Mr. Holden built for his family a snug log house, 18x27 feet, and made other necessary improvements. Their nearest neighbor was three, their nearest postoffice (Joliet) fourteen, and the nearest schoolhouse three miles distant, where the subject of this sketch attended, winters, in a rude log house, about twenty feet square, with rough slab writing desks and stools. During the summer of 1837, though only ten years old, he drove a breaking team of five yoke of oxen while his father held the plow. He remained on his father's farm, working a part of the time for Robert A. Kinzie, a neighbor, for two shillings per day, until 1842, when his father procured a clerkship for him in Charley Sweet's grocery store in Chicago, which stood on the north side of North Water street, about one hundred and fifty feet east of Wolcott street (now North State). From the grocery he went into the book store of W. W. Barlow, 123 Lake street, in 1845, and in the spring of 1847 enlisted in Company F, Fifth Illinois volunteers, Col. E. W. B. Newby, for the war in Mexico, where he served until October 17, 1848, at which date he was mustered out of the United States service with his regiment, at Alton, Ill., just in time to vote for his favorite old commander, Gen. Zachary Taylor, for president of the United States. Mr. Holden, after visiting his father's family, went into the employment of A. H. & C. Burley, booksellers, 122 Lake street, and remained with that firm until March 18, 1850, at which time, with seven others, he went overland to California, leaving the Missouri river at old Fort Kearney on April 26 of that year, and arriving in Hang Town, Cal., July 12. He at once went to mining and followed that business both in the dry and river diggings until October, 1851, when he went to the Napa valley, where he engaged in stock and hog raising, in which he continued until late in November, 1853. December 1, of that year, he left San Francisco on the steamship Winfield Scott, Captain Blunt, for home, but the second night out, when off Santa Barbara, and in a dense fog, the steamer ran on the rocks of Anna Capa island. It was at midnight; the confusion and terror of many of the passengers cannot be described. However, with the life and the other boats, all the passengers (some three hundred) were safely landed on the rocks, where they awaited relief. The steamer was a total wreck; the mails and all baggage were lost. The morning of the eighth day the passengers were rescued by the steamer California, Captain Leroy, and in due time were landed at Panama, reaching New York early in January, 1854. Visiting New England, where he had many relatives, and Mount Holly, N. J., where his sister, Mrs. J. M. Brown, was living, he reached Chicago, March 19, 1854, having been absent four years and one day. The changes that had taken place in those four years were wonderful. Chicago had begun to grow in dead earnest. Seven railroads had then entered the city over their own or leased tracts.

During the season of 1854 Mr. Holden held forth over George Smith's bank, at No. 59 South Clark street. The office was occupied by the late John and Allen C. Lewis and C. N. Holden. He entered considerable government land in various parts of the Chicago land districts. The Lewises were large investors in wild lands, and Allen C., at his death, left a legacy for mechanical purposes. February 20, 1855, Mr. Holden entered the service of the Illinois Central Railroad Company, in its land department, and remained with it until February 4, 1873. In 1858 he was chosen a member of the republican state convention, which assembled at Springfield June 16, of that year. This was the year Lincoln was made famous by his debates with Stephen A. Douglas. The evening of the day of the convention, when all business pertaining to the convention had been transacted, upon invitation, Mr. Lincoln appeared before that body and delivered his historic speech in which he used this language: "A house divided against itself can not stand. I believe this government can not endure permanently half slave and half free. I do not expect the Union to be dissolved; I do not expect the house to fall, but I do expect it to cease to be divided. It will become all one thing or all the other." Mr. Holden's membership of the convention was among his first political acts, though from the foundation of the republican party, in 1854, he had identified himself closely with it. He was in at the birth and kept the faith until 1872, when he affiliated with the Greeley party, and from that day to this has been a democrat. He was a member of the Greeley state convention that sent delegates to Cincinnati, where Greeley was placed in nomination for the presidency, and was one of the Greeley state electors for that year. In 1876 Mr. Holden went to New Orleans to form his opinion on the ground as to the justice of the democratic claims that Florida, South Carolina and Louisiana had been carried for Tilden. He was elected to the city council in May, 1861, and remained in that body continuously until December 1, 1872. He was president of the common council at the time of the great fire, and had much to do in furnishing the first nucleus for relief. He was the marshal of the council to receive the remains of Abraham Lincoln. He was chairman of the committee of the council to receive General Grant at the time of the great soldiers' fair held in Dearborn park, June 19, 1865. He was elected a county commissioner in November, 1874, for the term of three years, during which time the county hospital was projected and built and the courthouse was got well under way. As president of the county board he laid the corner-stone of the courthouse July 4, 1877. But his greatest pride seems to be in his having been instrumental in bringing about the construction of the second lake tunnel and its extension to the corner of Ashland avenue and Twenty-second street and Blue Island avenue. He was at the breaking of the ground for the first lake tunnel, March 17, 1864, and placed in the first wheelbarrow a shovel of earth toward the inception of the work. He was chairman of the committee that went before the legislature February 16, 1865, and had the bill passed by that body for cutting down the summit level and deepening the canal. The improvement cost the city $2,955,340. In 1862 Mr. Holden raised Company E, Eighty-eighth Illinois volunteers, named the Holden guards, in his honor. The regiment was attached to the Army of the Cumberland, and the company suffered great loss during the war. Late in 1864 the Tenth Ward association was organized, with Mr. Holden as president, and raised $51,912 to clear the ward of its quota and obviate necessity for a draft therein. In the meantime Mr. Holden put three veterans in the field as representatives for his family. He had two brothers in the war. David L. Holden was commanding sergeant of the Fifty-third Illinois volunteers, and Levi P. was major of the Eighty-eighth Illinois volunteers. His wife also had two brothers in the service—Gen. George S. Reynolds, of the Sixty-fourth Illinois volunteers, and Henry J., of Company E, Eighty-eighth Illinois volunteers, who died just after the battle of Stone river, in the hospital at Nashville, Tenn. Mr. Holden was appointed a park commissioner for West Chicago in 1869, and served nine years. The board had the laying out and purchasing of the ground for the whole west side park system. After the great fire of 1871 the two political parties in regular convention nominated him for the office of mayor. A citizens' movement met and nominated what was called a fire-proof ticket, with Joseph Medill for mayor. Medill was elected. Mr. Holden married Miss Sarah J. Reynolds, of New Lenox, Will county, Ill., September 17, 1855. She died July 26, 1873. She was a lovely and most devoted woman, and to her encouragement and sympathy Mr. Holden credits his great success during those years. Mr. Holden's mother died September 24, 1869. His father died February 23, 1872, of old age, hastened by a severe cold. His sister, Mrs. Mary E. Freer, wife of Joseph Freer, died in November, 1845, and his sister Sarah Ann C. died February 13, 1847.

Ellis Sylvester Chesbrough, born at Baltimore, Md., July 6, 1813, died at Chicago, Ill., August 19, 1886. In his youth he was chainman during the survey of the Baltimore & Ohio railroad. At the age of fifteen years he accompanied an exploratory party beyond the mountains, and was engaged in the surveys of railroads in Pennsylvania, and in 1837 (the same year in which he married Miss Elizabeth Ann Freyer), in South Carolina. In 1846 he was appointed engineer of the western division of the Boston waterworks, and planned the buildings there, as well as the Brookline reservoir. Four years later he was appointed commissioner in the Boston waterworks. In 1851 he was chosen city engineer in charge of waterworks, streets and harbor improvements, and held that position until 1855, when he was elected engineer of the Chicago board of sewerage commissioners, and planned the original sewerage system of the city. When the board of public works was organized, he was elected chief engineer, and in 1858 published his report on the sewerage systems of Paris, London and Liverpool. It was he who planned the tunnels at La Salle and Washington streets. He served as chief engineer during the existence of the board of public works, and in 1879 was appointed commissioner of public works, an office created that year. His knowledge of the details of his profession, and particularly of the branches of it relating to water supply, sewerage and tunneling, added to his fame, and called upon him to fill the position of consulting engineer on many great works east of the Mississippi.

James John, secretary of the Builders & Traders' exchange of Chicago since 1887, has been a resident of the city for nearly forty years, and is a skilled mechanic who did long service at his trade. He is widely known to the building fraternity of the country at large, and otherwise has an extensive acquaintance through his very prominent connection with the Masonic order. He was made a Mason about 1865 in Garden City lodge No. 141, A. F. & A. M., and is one of its most honored worshipful masters and life members, and also a member of Oriental consistory, thirty-second degree. From the fact of his proficiency in Masonic work, Grand Master John C. Smith appointed him one of the grand examiners for the state of Illinois, and in that capacity he has demonstrated the fact that the appointment was worthily bestowed. With Worshipful Brothers Flannery, Ockerby and others, he united in organizing the Standard team, which has performed excellent work in various lodges, and tended, in a great measure, to perfect those lodges in the ritual. A new team was organized later by Mr. John, selected from the young and efficient workers in eleven Masonic lodges in this city, who have been made thoroughly conversant with the work. Mr. John is widely known as a presiding officer of long experience and great ability, a fact which has been conspicuously recognized recently by his election as the presiding officer of Chicago council No. 3, Commercial Pilgrims of America, and his appointment as supreme deputy of the same order for Cook county. A genial and courteous gentleman of many good qualities, Mr. John is esteemed almost universally, and in his long incumbency of the secretaryship of the Builders & Traders' exchange he has discharged the duties of his office in the most acceptable manner.

Edgar Isbell, doorkeeper of the Builders & Traders' exchange, and a successful builder of this city before the Civil war, is a native of New Berlin, Chenango county, N. Y., born July 15, 1832, son of Samuel and Frances (Bentley) Isbell, natives of Massachusetts. The father was a tanner and currier by trade, and about 1859 removed with his family to Barrington, Ill., but breathed his last in the state of Iowa. He was the father of three sons and four daughters. Edgar, the eldest son, was educated in Otsego county, N. Y., being an attendant of the public schools, but learned the trade of carpenter and builder also in his native state, entering upon his apprenticeship at the age of nineteen years. In 1857 he came West and located in Chicago, working by the day until 1859, when he went to Peoria, Ill., thence to Pekin, Ill., where he enlisted in Company F, Eighth Illinois regiment and served three months. At the end of this time he returned to Pekin and reënlisted in the service, becoming a member of the Forty-seventh Ill. regiment, in which he became orderly sergeant of Company E, and served until 1862, when he was promoted to second lieutenant, in which capacity he was serving when wounded in May, 1863, at the battle of Vicksburg, Miss. The following November he was honorably discharged on account of disability and returned to Barrington, Ill., where he engaged in the building business as soon as he had sufficiently recovered from his wound. The following year he was appointed postal clerk on the Chicago & Alton railroad, running between Chicago and St. Louis for thirteen years, at the end of which time he went into the internal revenue service, in which he served four years. The two following years he was in the Chicago city waterworks department, and in February, 1888, he accepted his present position as doorkeeper of the Builders & Traders' exchange, and has filled the same with credit to himself and to the satisfaction of all concerned. He is past master of Lounsbury lodge No. 715, of Barrington, Ill.; Ashler lodge No. 208, of Chicago; member Washington chapter No. 43, and St. Bernard commandery No. 35, of the A. F. & A. M. He is also a member of Custer post of the G. A. R. He was married in 1852 to Miss Mary E. Coy, by whom he has four children: Charles E. (an architect) and three daughters. Mr. Isbell was quite an extensive and successful builder in this city prior to the Civil war.

Eggleston, Mallette & Brownell. The firms of J. P. Mallette & Co. (James P. Mallette and Ralph E. Brownell), and R. E. Brownell & Co. (Ralph E. Brownell and James P. Mallette), were formed in 1885. In 1889 they were merged into the firm of Eggleston, Mallette & Brownell, Charles B. Eggleston being the added partner. This firm, besides being one of the leading real estate houses in the city, is also among the largest contractors of public improvements. They own large stone quarries at Thornton, Ill., which were opened in 1885 and from which they have taken the material for many of the longest cable railway lines in the city, and from which has been furnished the crushed stone for many miles of the beautiful drives and streets for which the south end of the city is famous. The capacity of their plant is two thousand cubic yards of crushed stone per day. They own the most complete outfit of steam and horse rollers, and other machines for making roads. During the season they give regular employment to from four hundred to five hundred men. Their business in this department may be summed up by the statement that they are contractors for all kinds of public improvements, sewers, water mains, etc., and macadam streets, drives and boulevards. They make a specialty also of subdividing and improving vacant property, and own Eggleston and Auburn Park subdivisions, the finest improved suburban property in the south part of the city. Recognizing the value of the location, they bought the ground upon which Eggleston now stands and began to improve it. Soon afterward, George M. Pullman and C. M. Henderson, at their suggestion, laid out Auburn Park. Well understanding that no locality can be uniformly improved except under one control, Eggleston, Mallette & Brownell bought Auburn Park. Their property extends from Seventy-first street to Seventy-ninth street, and is bounded on the east by State street and has Wallace street for a western boundary, being one mile long by three-quarters of a mile wide. The accessibility of this property is well known. Its main transit line is the Rock Island railroad; the Chicago & Eastern Illinois railway is close at hand, and the Wentworth avenue street car line extends through the property to its southern limit. The firm have recently subdivided, for one of their eastern clients, the triangle of ground extending from Vincennes road to Stewart boulevard and from Seventy-seventh street to Seventy-ninth street. This subdivision is within three minutes' walk of the depots of the Rock Island and Eastern Illinois railroads. May 1, 1891, this company placed under contract the entire frontage, aggregating two thousand two hundred and sixty-two feet, of the famous Good-luck fourteen corner ten-acre strip, extending from State street to Stewart avenue, at an average price of $70 per front foot; this price includes all street improvements, which are to be put in by the seller, the same to be equal in character to those in Auburn Park and Eggleston. The transaction involves a much larger amount of money than simply the price of the ground, one of the conditions of the sale being that the purchaser, Richard Peck, of Chicago, shall improve each of the seventy-one lots in the piece with a residence or business building, to be of brick or stone, and to cost from $7,500 to $10,000 each; the total amount involved being, therefore, fully $750,000. The fronts are of different designs, and are constructed of the celebrated Bloomington-Bedford stone, with bays and attractive carvings and ornamentations. The interiors are each divided into nine rooms, besides reception hall, bath and laundry rooms, and are finished in hardwood and bronze and heated by furnace. There have been constructed by them, or by actual purchasers from them and upon their own property, over three hundred and fifty houses, ranging in price from $3,500 to $18,000 each. This is one of the few old established Chicago real

J. P. Mallette

estate firms of whom it can be truthfully said, that there has never been a customer of theirs who has not made money on property purchased through them—a striking tribute alike to their sterling integrity, good judgment and excellent knowledge of real estate values. The offices of this enterprising firm are at 207 Tacoma building and 600 Royal Insurance building.

Norman T. Gassette. Strictly speaking this gentleman did not belong to the building fraternity. His prominent connection with the erection of the Masonic temple, one of the greatest of Chicago's structures, however, entitles him to just recognition for his labors. Mr. Gassette was born at Townsend, Vt., April 21, 1839, and came with his parents, Silas B. and Susanna P. Gassette, to Chicago in 1849. Here he attended the Garden City institute and later was a pupil in Professor Hathaway's academy. He afterward received instruction from Prof. Alonzo J. Sawyer and in his seventeenth year entered Shurtleff college at Alton, Ill. One year later he went to the Atwater institute at Rochester, N. Y., and completed his education by taking the entire curriculum at Harvard university under private tutors. At the opening of the war, Mr. Gassette responded promptly to his country's call. June 17, 1861, he was mustered into service as a private of Company A, Nineteenth Illinois volunteer infantry, and left with his regiment for the field in July. In 1862 he was promoted to the rank of first lieutenant and to the position of aid-de-camp. For gallantry in action at Chickamauga he was recommended for the brevet rank of lieutenant-colonel by his brigade, division and corps commanders. He was mustered out of the service in October, 1864. His political life was a notable one. After his return from the war he found employment in a law office, studying during the day and working part of the night in the postoffice to secure the means for his subsistence, until he graduated from the Chicago university's law department and entered upon the practice of his profession. For three or four years prior to 1868 he was deputy county clerk under Gen. Edward S. Salomon. In the latter year he was given the republican nomination for the office and elected by an overwhelming majority and served until 1872. After 1872 he never held public office, but was for several years chairman of the republican executive committee and was otherwise prominent politically. Mr. Gazette was made a master Mason in 1864 in Blair lodge No. 393, from which he received a demit and then affiliated with Home lodge No. 508, of which he was a member at the time of his death. He was a member of La Fayette chapter No. 2, R. A. M., and his connection with Apollo commandery No. 1, K. T., dated back to 1869. He was also a member of Oriental consistory, thirty-second degree, S. R. P. S. In the Masonic order he was as highly honored as any man in the West. He held nearly every office in the gift of the Masonic fraternity of the state and had taken every degree in Masonry, the thirty-third degree of the Scottish rite, the highest degree in the order, having been conferred upon him in 1889. The great Masonic temple in Chicago, which will be one of the most notable buildings in the world when completed, may be said to have had its inception in him, and he was president of the board of directors of the Masonic Fraternity temple association at the time of his death. The Masonic temple, with its eighteen stories of granite and steel, will remain for ages the grandest monument Mr. Gassette can have.

Paul Cornell. As fair a sample of the generous Chicagoan as we could possibly select is Paul Cornell, the original founder of the thriving suburbs of Hyde Park, Cornell, Grand Crossing and Brookline, and who was, at one time, one of the most popular and energetic workers among the South park commissioners. He is a lawyer by profession, although not actively engaged as such at present, but in reality is a maker of towns. Coming to Chicago without means, but amply endowed with what proved to be serviceable Chicago pluck, he gradually pushed his way into the front rank of the legal profession, and subsequently into the foreground frequented by men of energy, public spirit and wealth, where we find him to-day. Mr. Cornell was born at White Creek, Washington county, N. Y., August 5, 1822. His father was Hiram K. Cornell, whose wife was Eliza Hopkins, of Swanton, Vt. The great-grandfather of Eliza Hopkins was Samuel Robinson, one of the famous Bennington Robinsons, who distinguished themselves during the troublous years in the early history of Vermont, before her admission into the Union. While the subject of this sketch was yet a child, his father died, his mother, several years afterward, uniting her fortunes with those of Dr. Barry, which proved almost as happy a union as the first. When Paul was in his ninth year the family moved to Ohio, and five years later to Adams county, Ill. Here Dr. Barry was for many years a successful practicing physician. Paul was eager to try the paths of knowledge, and in order to save money for school expenses he hired out as a field hand to farmers during the summer months, and after passing through several terms at a select school he became a school-teacher, and studied law in his spare moments. He became a most studious law student, and finally entered the law office of Hon. W. A. Richardson, at Rushville, Schuyler county, Ill. In 1845 he came to Chicago, and was favorably impressed with the growing town, but not being able to enter upon the practice of law at that time, he went to Joliet, Ill., where he entered the law office of Wilson & Henderson, the former, Hon. John M., afterward becoming chief justice of the Superior court of Chicago. After two years' study he was permitted to practice. June 1, 1847, he took passage on board of one of Frink & Walker's stages to Chicago, as there was neither railroad nor canal at that time, and landed in Chicago with a small bundle of clothing, wearing a rusty suit of clothes, and with $1.50 in his pocket. He also had a few plain cards inscribed thus: "Paul Cornell, attorney at law, Chicago." Mr. Cornell, however, nothing daunted by his poverty, hunted up Hon. John M. Wilson, who had removed to Chicago, and was the senior member of Wilson & Freer, lawyers, and subsequently entered their office as a duly fledged attorney. The first suit he ever tried was before Justice Home, whose office was on Dearborn street, and this suit he won, although Hon. H. B. Judd was on the other side. Afterward he entered the office of James H. Collins, and subsequently that of Skinner & Hoyne. While thus associated Mr. Cornell was appointed probate judge clerk. In 1851 he became associated in the law business with the Hon. William T. Barron. Their clientage augmented so rapidly that soon five clerks became a necessity. In 1856 Mr. Cornell became the senior member of the law firm of Cornell, Jameson & Bass. Mr. Bass retired from the firm upon receiving an appointment as the United States district attorney, H. N. Hibbard, then United States register of bankruptcy, taking his place.

While making his record as a lawyer, however, Mr. Cornell was shrewd enough to invest in real estate, and it gave him ample returns for his foresight. Several miles down on the lake shore south he saw his opportunity. He bought three hundred acres, had it surveyed, and afterward sold sixty acres to the Illinois Central Railroad Company, one of the conditions being that the company should run a train to Hyde Park, a town in embryo. He at once laid out the town and erected the Hyde Park house, and pushed the venture to a success. Afterward he accomplished the same thing for Grand Crossing and Brookline. This was the beginning of the idea of founding suburban towns, which has since been acted upon by other real estate dealers of Chicago. Mr. Cornell, jointly with other public-spirited men, agitated the question of pleasure grounds for Chicago. He spent the entire winter of 1867 at Springfield laboring for the passage of the Park bill, and in spite of stubborn opposition secured its passage. Soon afterward, although bitterly opposed by rings and cliques, he was appointed by the governor a park commissioner. Another of Mr. Cornell's enterprises is that of founding Cornell, south of Hyde Park. He purchased a section and a half of land about the crossing, paying from $7 to $30 per acre for the same. One of the first substantial improvements was a watch factory, which was known as the Cornell watch factory. It was successfully operated up to the fall of 1874, and in 1875 was sold to William C. Ralston, of San Francisco, Cal. In 1856 Mr. Cornell married Miss Helen M. Gray, of Bowdoinham, Me. He and Mrs. Cornell are active in all matters of benevolence, and are worthy members of the First Presbyterian church of Hyde Park. Although uncommonly shrewd at a bargain, and having passed through some trying ordeals, no one could accuse Mr. Cornell of any intentional wrong or injustice. On the whole, his life has been successful far beyond his expectations, and now, in the sixty-eighth year of his age, he is blessed with plenty, and has the proud satisfaction of knowing that he has kept shoulder to shoulder with his fellow-citizens in the march of progress that led to the development of Chicago. He is still in active business life, and as vice president of the American Bronze Company, one of the most notable industrial enterprises of Chicago, and as a real estate dealer, he still finds vent for that vigorous, forceful energy that distinguished his youth. The substantial fireproof hotel known as the Hyde Park was built by Mr. Cornell in 1888–9, at an estimated cost of $350,000. At this writing it is the fourth in size in Chicago, containing over three hundred rooms, and is successfully managed by Winter & Milligan, who furnished it at a cost of about $60,000, and opened it August 1, 1889. It has been a complete success from the first.

E. T. Paul. It is exceedingly gratifying to the publishers to point to a real estate firm, closely allied to the building interests, that has won its way to the front ranks by the most honorable methods. E. T. Paul, at 116 La Salle street, is the builder and real estate operator referred to, who in twenty-four years, as a real estate dealer, has won golden encomiums from all with whom he has had business transactions. Since that day, twenty-four years ago, when he closed his first lot sale, Mr. Paul has had an abiding faith in north shore property, and has never had reason to lose confidence in his faith, for, with little exception, the property has proved a paying investment to both buyer and seller. Sales of lots aggregating $400,000 one year is a record that has never been equaled by other dealers in north shore property. Quite recently Mr. Paul has been purchasing acre property and subdividing it. Lots at Evanston he holds at $25 to $150 a foot; those in Wilmette from $10 to $30 a foot. In addition to his extensive real estate operations, Mr. Paul has erected more residences of a good class than any other real estate dealer on the north shore. These residences are sold for cash or on the installment plan, at from $2,000 to $5,000 each, to men who are usually employed on a liberal salary or employers of labor. The following, as showing to some extent Mr. Paul's transactions in this direction, will indicate the class of people who settle on the north shore: Eight houses, ranging in price from $1,800 to $4,000, are now going up at Wilmette, under Paul & Co.'s personal supervision, and will be occupied by railroad officials, cashiers and bookkeepers; a residence for L. S. Breese, Lake Shore & Michigan Southern railway; Richard Bodinghouse, of the Title Guarantee & Trust Company; E. C. Heveran; Robert N. Ward, teller of the Merchants' Saving, Loan & Trust Company; M. O. Miller, of Miller Bros., printers; Small & Bishop, architects; W. E. Crane, manager of the Baldwin Furniture Company; Frank M. Paul, of the Mitchell-Vance Company, of New York; Mortimer Powers, who is in the cloak department of J. V. Farwell & Co.; Charles S. Musson, traveling agent for the Nickel Plate road; Warren W. Tolman, of Tolman & Simons, attorneys; George A. Colton, of the Munger & Colton Manufacturing Company; Edward P. Fach, of the Standard Accident association; Charles A. Bruce, with Franklin Mac Veagh & Co.; Ad. Kammerdiener, with the Jewett Stove Company; Milton P. Ghee, with the German-American Fire Insurance Company; Ernest E. Perrin, in the freight auditor's office of the Chicago & Northwestern railroad; Alex. Scrimger, journalist; Samuel Stennett, contractor; Alfred C. Sagert, with the Western Leather Manufacturing Company; William B. Ketchum, of the Adams & Westlake Manufacturing Company; Charles M. Olson, of Olson & Stoltz, engravers; William B. Morley, in the county clerk's office, and numerous others. Mr. Paul was born in Canada, graduated from the Toronto university, and in his early youth first turned his attention to law; but on a pleasure trip to Chicago, away back in the sixties, saw the possibilities of this now great city, and, to use his own words, "sent for his trunk, pulled off his coat, and went to work," and, like all typical Chicagoans, he is still working.

That prominent corporation connected with the use of electricity, the Thomson-Houston Electric Company, was incorporated no longer ago than 1880, but its progress since has never been paralleled in corporate business history. Its original capital was $125,000—it is now $5,500,000. Its first factory at New Britain, Conn., was comprised within a modest three-story frame building—its present works, at Lynn, Mass., cover fifty acres of ground and include numerous mammoth brick structures. A few hands sufficed for its earliest needs, and it now employs an army of over five thousand workmen. The company has manufactures of electrical apparatus, of dynamos for arc and incandescent lighting, of stationary and railway motors and electrical supplies. They purchased, in 1888, the railway patents of Charles J. Van Depoele, the Chicago inventor of the first successful electric railway, and have since greatly added to the efficiency of that system by needed improvements, and there are now over thirty railways in operation, or in course of construction, using the Van Depoele or the improved Thomson-Houston system of railways. The company has recently further extended its facilities by the purchase of the patents, franchises, plant and business of the Brush Electric Company of Cleveland, Ohio. In electric lighting this company has made remarkable progress. In motors for the electrical transmission of power the machines manufactured by this company have no equals, and they are in use in a large and increasing number of mills, factories, newspaper and other printing establishments, etc., throughout the country, as well as being extensively used for operating pumps, elevators, etc. The principal office of the company is at Boston, while other offices are maintained in many of the larger cities of the world. The western office at Chicago, one of the most important, at 148 Michigan avenue, is in charge of B. E. Sunny, as manager. Prior to accepting this responsible position he was president of the Chicago Arc-Light & Power Company, and previous to that was connected with telephone and telegraph interests.

One of the foremost electricians and manufacturers of electrical supplies is Foree Bain, senior member of the Bain Electrical Manufacturing Company, at 47 South Jefferson street, which is capitalized at $250,000. Under the above name the company was organized in February, 1891. Its officers are: Foree Bain, president and general manager; M. F. Allen, secretary and treasurer. The company have an entirely new plant on Jefferson street, and are among the largest electrical manufacturers in the West. While many connected with the establishment are well-known electricians, Mr. Bain has a national, if not an international, reputation. He was born at La Grange, Oldham county, Ky., February 1, 1853, where he passed his boyhood and attended the common schools. Quite early in life he displayed a taste for scientific subjects, and at sixteen years of age he was a railway telegraph operator between Indianapolis and Louisville. Subsequently he served in the same capacity on the Louisville, Cincinnati & Lexington railway, with headquarters at Newport, Ky. His career as a telegraph operator was simply a step to perfect himself to some extent in electricity. In the fall of 1878 he attracted the attention of Post & Co., a Cincinnati firm, who offered him the position of electrical engineer and superintendent, which he accepted, doing excellent service until 1881. To him is due the credit of building up the enterprise from an insignificant affair to one of the most successful plants for telephone calls and telephone supplies in the country. At this time Mr. Bain was experimenting on an electric light system, radically different from those of his competitors. In 1881 he went to Minneapolis, Minn., where his experiments were pursued for nearly two years, and so successfully, that on coming to Chicago, the modern Mecca for inventors, he soon succeeded in arousing an interest among men of science and capital, among whom was Capt. A. E. Goodrich, owner of the Goodrich Transportation Company. With Captain Goodrich arrangements were made for one of the most important electric light manufacturing establishments in the country. Unfortunately Captain Goodrich sickened and died, and without capital, other than undaunted perseverance and a reputation for honesty, the young man was left where he had started. Not a whit discouraged at the prospect before him, he set resolutely to work, like the true inventor that he was, and soon enlisted other capitalists in his cause. Many are the inventions of Professor Bain since he came to Chicago, and to his credit be it said that he has never yet invented a device without merit. Among his more important patents and appliances are an electric system of mine machinery for transporting silver, copper and iron ore from one lode to another, and an equally meritorious invention for cutting and drilling coal, which saves both time and money. The cost of these coal cutting and drilling machines is from $6,000 upward, and they are largely in use at the Shawnee iron and coal mines, Shawnee, Ohio; by the Thurman, West Virginia, Coal Company, and by others of equal prominence. A micrometer invented by him is also largely in use, while an electric galvanometer of his invention is used by the government in standardizing all testing machines in use by the government. Patents have also been procured by him on all kinds of dynamos and motors and a number of different appliances to be used in the construction of circuits and the operation of dynamos and motors, such as insulators, indicators, lightning arresters, storage batteries, etc. Despite heavy contracts to fill for various interests, Professor Bain has had a constant demand made upon his services as an electrical expert, and has given testimony in many important litigations growing out of electrical disputes. A year ago he was appointed to the enviable position of consulting electrical engineer for the St. Paul & Minnesota electric street railways. Under his efficient management the roadway was started in April, 1890, and has just been completed. This road is among the most noteworthy of electrical railways in the world, with sixty-five miles of double track laid in Minneapolis and forty in St. Paul. Trains are now running between the two cities, and the road and equipment may be said to be an unqualified success. The road has much to commend it over other electric railways, for among its peculiar features it may be well to note that while overhead wires are used, sub-feeders are placed under ground, the first innovation of the kind in this country and one highly gratifying to the stockholders. The cost of the roads in both cities was $5,000,000. The success of Professor Bain in all his enterprises has led to numerous offers for his services throughout the country. He is now at work on a house dynamo for household use where a large or small amount of light may be required.

George Cutter is one of the successful electricians of this country, and is probably the greatest traveler in his profession. Born in Boston, Mass., in 1853, he received a liberal education in the Boston high school. His first entree into business life was in the city department of civil engineering of Boston, where he remained two years. Prior to and during this time, however, he conducted many interesting experiments in electricity. Receiving a flattering offer from Johnson & Whitamore, who were manufacturing telegraph improvements, he accepted it, and was for several years in their employ. It was there that his genius for invention first came into play and revealed itself conspicuously in the production of an oscillating engine with an automatic cut-off. Severing his pleasant relations with Johnson & Whitamore, the young electrician and inventor became a valued employe of Charles Williams, Jr., a manufacturer of and dealer in telephone supplies in Boston. It was at this time Professor Bell invented his telephone, and had his experimental work done in Mr. Williams' shop. In 1881 Mr. Cutter was engaged by the Bell Telephone Company, who had large contracts in Russia, to take charge of their interests there, and while in that country he planned the telephone stations at Riga and Warsaw, which occupied his time for nearly a year. The planning of stations involved hundreds of miles of travel through a somewhat unfriendly country, and was not without its trials, especially as the government itself, at that time, was distrustful of the new agent for communication. On his return to America he entered the employ of the Thomson-Houston Electric Company, taking charge of their testing department. While serving in that capacity he invented several important electric light appliances, among them being a switch-board for connecting dynamos to circuits, which are shown by cuts in the Thomson-Houston Company's catalogues. The switch-board has had, and still has, an extraordinary sale. Besides, he has invented porcelain cut-outs, combination shades, a lamp-supporting pulley, a globe-holder and a street-hood; and he is an extensive dealer in the Morris swivel-pole pulley, the Morris oil-cup, the Morris trolley hangers, the Morris pole-top, the Lewis attachment, the Simplex tree insulator, and many other fine electrical appliances. His connection with the Thomson-Houston Electric Company extended over a period of six years, during two and a half years of which period he was chief engineer in charge of its European business. While in Europe (his second expedition across the ocean) he traveled seventy thousand miles in planning stations, making estimates, contracts, etc. His work in Europe was successful far beyond his most sanguine expectations, resulting in the Thomson-Houston electric light plants and appliances being looked upon with universal favor. In 1889 Mr. Cutter went into business for himself as a dealer in electrical supplies, a business that has brought him international fame and a comfortable fortune. Within the past three years he has, aside from his base of supplies, been very actively engaged in the invention of important appliances, as named above. Some idea of his electrical supply business, largely augmented by these inventions, may be inferred when it is known that his trade reached a round quarter of a million the first year. Inasmuch as the business is constantly expanding, it would be difficult to estimate the growth a year hence. In order to meet all demands, Mr. Cutter has been compelled to establish a manufacturing plant in the Springer building, on the west side.

In 1857 the firm of Brown & Hollingsworth was established in Chicago, they being well-known contractors for raising and moving brick, stone and iron buildings. The senior member of the firm, Mr. Brown, came here from Boston. In 1860 the firm of Hollingsworth & Coughlans was organized, and has existed continuously to the present time, notwithstanding the death, in January, 1889, of Mr. Hollingsworth. The present members are John, Thomas and T. E. Coughlan. John Coughlan came to this city in 1857 with Mr. Brown, for whom he was foreman from 1845 until 1860. In 1860, Mr. Brown retiring, the firm became Hollingsworth & Coughlans, and remained so until Mr. Hollingsworth's death, in 1889. Thomas Coughlan, brother of John, came here in 1858, and until 1860 was also in the employ of Mr. Brown, for whom he had worked in Boston. Not until the death of Mr. Hollingsworth did

T. E. Coughlan become a member of the firm. He is a son of John Coughlan above referred to. The firm is one of the strongest in their line in the West, and does a large business in raising and removing all kinds of structures, whether of brick, stone or iron. The firm is known as the pioneer contractors in this line of work. It has had thirty-three years' experience in Chicago, and during that period has done an enormous amount of successful work. Its business is not confined to Chicago, but has extended from the Atlantic ocean to the Rocky mountains, and from the great lakes to the gulf. In 1860 the firm removed the Marine Bank block from La Salle to Clark street; the Tremont house in 1861; in 1871 the Briggs house and Armory building, the latter, while yet standing on the screws, being destroyed in the great fire; the Robbins block, at the corner of Fifth avenue and Water street; St. Patrick's church, at Adams and Desplaines streets; the Episcopal church, at the corner of Washington and Peoria streets; the McCormick building, which was one of the most difficult jobs ever undertaken, and was raised nearly six feet, it being a six-story building 100x125 feet; the old Board of Trade building, under which a new foundation was put; besides many buildings raised in Washington, D. C., and the St. Joseph church, Charity hospital and many other structures of immense size and weight in New Orleans, La. From 1857 to 1871 the firm did the principal business in its line in Chicago, and it can with truth be said that there is no uncertainty about its work, nothing in connection with it being dependent upon chance. Most minute calculations, made beforehand, are based upon principles that never change. In raising, lowering and moving from one place to another buildings of brick, stone and iron, these men have made a record for themselves of which they may well feel proud. During the many years spent in continuously handling the heaviest and most costly structures, no property has ever been damaged, and they have never had a mishap that deserved the name of accident. It may with truth be said that they are among the very foremost of the house movers of Chicago and have no superiors in their line anywhere. They are thoroughly reliable and trustworthy business men and may be said to have had a lifetime's experience in this industry. This firm has assisted ably in the improvements being made in the young and thriving city of East St. Louis, Ill., where they are emulating Chicago in raising their town to a grade that insures good drainage second to none in the country. The principal streets have already been graded and paved, and Hollingsworth & Coughlans have raised hundreds of their buildings with satisfaction to every one with whom they have had dealings.

H. Sheeler was born in Canada in 1842. He came to the United States at the age of eight years and located in Lee county, Ill. At fourteen years he began a four-year apprenticeship to the carpenter's trade. He later became a farmer, but came to Chicago in 1871, immediately after the great fire of this city, and soon found himself profitably running teams to draw sand for building purposes. In 1872 he engaged in the house-moving branch of the building trade, in which he at once became and has since been conspicuous. His office, now at 108 and 110 Dearborn street, has been on that street, at or near its present location, during the past ten years. He has yards in Chicago, South Chicago, East St. Louis, and Indianapolis. During the past five years he has conducted an extensive contracting and building business in connection with his older specialty. During his long career here as a mover of buildings he has done as much as any one man to develop house-moving from its former crude condition to its present standard, on what may be termed most fitly a scientific plan. It would be unprofitable if not impossible to give an exhaustive account of Mr. Sheeler's extensive operations in house-moving during the past twenty years, but it may be of interest to note some important items. He did all the house-moving occasioned by the construction of the Western Indiana railway into Chicago, his operations extending from Polk street to Eighty-third street. He moved the Wisconsin Central freighthouse, a brick building 40x400 feet in size, forty feet east, then two hundred and eighty-six feet south, then forty-six feet east and lowered it two feet and a half. He held up the east wall of the eight-story Smith building on twenty-inch heavy steel beams of thirty-two feet span, so that a twenty-seven feet and six-inch party foundation could be put in partially under the same, at the time of the erection of the new Rand-McNally building adjoining, the buildings being supported by screws which were elevated as pressure increased from the gradually growing wall of the building under construction. He has done similar work in connection with the Post and Herald buildings on both sides of each. He held up a building at the northeast corner of Randolph and Dearborn streets while new foundations were put under it; also the east wall of the structure now known as the Illinois National bank building at the time the Gossage store addition was built, as well as the front of Marshall Field's retail store while new beams and new columns were placed. Another large building which he raised is located at the northeast corner of State and Washington streets. He also held up the Crilley building at the northeast corner of Dearborn and Monroe streets, along its entire front, and took out the old piers and put in new iron work throughout the whole structure. He did similar work on the buildings at the northeast and northwest corners of Madison and Halsted streets. A part of his work for the Western Indiana Railway Company was the removal of two double-brick three-story-and-basement buildings, 50x60 feet in size, turned from an east front to a west front, a distance of six hundred feet, and he moved about one hundred and fifty similar brick buildings for the same corporation. He does work of this description in any part of the United States where material can be shipped. His operations have extended to Colorado and other western points, and have embraced work at East St. Louis, Indianapolis, Three Rivers, Mich.; Marshalltown, Iowa; Van Wert, Ind.; Whiting, Ind., and other points north and south.

E. A. Thomas, manufacturer and dealer in material elevators, has his factory at 113 South Hoyne avenue. Since 1881 he has been connected with the building interests of this city in this capacity. The business has been slowly evolved from a small beginning, until at present it is large and lucrative. At first he had a few machines, but now he has over one hundred in actual use in Chicago, and is selling them in the principal cities throughout the Union. In this city he leases his elevators, but outside of Chicago sells them. He employs from twenty-five to fifty men. The idea of material elevators is the product, mainly, of the present building epoch, and is due to the extraordinary hight of the present buildings. Mr. Thomas has brought these elevators quickly to a high degree of perfection, and can accommodate any building, no matter how high it may be. The saving to a builder in using these machines is great; in fact, their use, if the building be high, is absolutely indispensable, especially where competition is so active as in Chicago. Mr. Thomas was born in Delavan, Wis., March 19, 1851, and was educated in the public schools of that state. He came to Chicago in the spring of 1871, and since 1881 has been connected with the building interests here. He became a member of the Builders & Traders' exchange in 1884, and from 1885 until 1890 was a director of that organization.

The business of the Crane Brothers Manufacturing Company, now the Crane Company, was established in 1855 by R. T. and C. S. Crane, in a very modest way. Selecting important specialties bearing directly on numerous other branches, their success was steady and assured from the start, and rapidly increasing demands necessitated enlarged facilities for production, which have always been provided with judgment and prudence, the first prime requisite for maintaining favor being never neglected—that of making first-class work out of the best obtainable quality of materials, constructed on true mechanical principles. In 1865 articles of incorporation were taken out. Pursuing their business with the same determination and honesty of purpose which actuated them at the start, success begat success. To-day, in their specialties, which include lap-welded wrought-iron pipe and boiler tubes, steam and gasfittings, and steam and hydraulic passenger and freight elevators, they are the largest manufacturers in the Northwest—probably in the country. It would be superfluous to enter into detailed reference to their different articles of manufacture; some of them, most intimately connected with buildings, factories, etc., it is necessary, however, to briefly allude to. They manufacture wrought-iron pipe, both plain and galvanized, for gas, steam or water—proved by hydraulic pressure of from 300 to 500 pounds to the square inch—of all standard dimensions and sizes, and extra or double extra in quality; lap-welded charcoal iron boiler tubes; cast-iron, malleable iron and galvanized iron fittings; valves of all kinds, including Crane's patent valve with Frink patent disc; gas and steam-fitters' tools; steam engine trimmings; coupling and pulleys for line shafting; boiler fronts; radiators; coils and screws; steam pumps—of which they make a specialty, manufacturing a large variety and giving them the closest possible attention and best mechanical skill in construction. They also manufacture patent frost-proof hydrants, lamp posts complete, turgese irons, babbitt metal, hoisting machinery, with positive safety appliances, for mines, blast furnaces, buildings, etc. In this most important branch of their business they excel. Not only are their appliances constructed of the best material, but the great point, safety, is assured by devices which render slipping or falling from parting cables an impossibility. In steam and hydraulic elevators for passengers and freight, for hotels, factories, warehouses, stores and public buildings, they have few rivals, and many large buildings in the city are fitted with their elevators. The county courthouse, in the construction of which only the best machinery and appliances were accepted, is equipped with five of Crane's Victorious hydraulic passenger elevators. Taking popularity and the large patronage of architects and builders as a test, the merits of their elevators are simply incontestable. The trade of this company extends all over the country, from Maine to California, and to Australia, New Zealand, etc. The buildings, as long ago as 1883, were five in number—the Jefferson street, 154x200 feet, four stories high; another on same street, 90x43 feet, five stories high; Desplaines street building, 130x168 feet, five stories high; one pipe mill, 400x200 feet; another 150x200 feet, giving them 300,000 square feet of floor surface. The buildings are massive structures specially designed and constructed for their purposes, thoroughly equipped with a complement of special machinery, complete in details, conveniences and appliances. Motive power is furnished by several engines, aggregating an immense horse power. Stock in material to the value of $350,000 to $500,000 is carried. The officers of the Crane Brothers Manufacturing Company were: R. T. Crane, president; C. R. Crane, vice president; S. W. Adams, secretary; J. W. Skinkle, treasurer. Those of the Crane Company are: R. T. Crane, president; A. M. Gilbert, vice president; H. P. Crane, second vice president; J. B. Murphy, secretary; W. S. McCrea, treasurer. The company's office address is 10 North Jefferson street.

C. H. Mitchell & Co., builders exclusively of the patent center lift improved safety elevators, passenger and freight, hydraulic, steam, gas and hand power, 363 and 365 South Clinton street. The business now conducted here originated in 1875 under the same name now used, with limited capital and under humbler circumstances, but Mr. Mitchell had had three years' experience in the elevator business prior to that time in charge of the manufacturing department of another concern, and on that and his energy he relied. The business has increased steadily from year to year, until it has now become fully established and the company builds as many elevators in a month as it did formerly in a year. The building now owned and occupied by the company at 363 and 365 South Clinton street, was completed and occupied in the spring of 1890, and is 50x100 feet square and five stories high and is complete in design and equipment, containing all the most modern machinery for the manufacture of elevators. The elevators of this concern are built under seven or eight of the company's own patents, are run by steam, water, gas, electricity and hand power, and are in all sizes and for all purposes, but they pay special attention to large freight elevators for manufacturing houses. Their elevators are used in a very large number of buildings in the city, approximating closely to a thousand altogether, and their trade outside the city is very much larger and extends to the extreme limits of the United States in every direction as well as to Mexico. In all this wide trade they have never made an elevator that failed to suit the party for whom it was constructed, and the satisfaction of the purchaser is a part of their contract in every case. The elevator business has developed more rapidly in Chicago than anywhere else, not even excepting New York, and Mr. Mitchell conceives it to be still in its infancy here, although Chicago is the leading city of the world in this line. The months of July and August are ordinarily regarded as the dullest for business of any in the year, but the month of August, 1891, was the busiest month in Mr. Mitchell's experience;

and from this fact he considers the outlook to be very encouraging at the present time. Since Mr. Mitchell's beginning in business others have undertaken the same enterprise here and failed. Mr. Mitchell's success is owing to his steady and persistent work and personal supervision over every department of his business, to which he has devoted his entire time, and the most absorbing study and attention, and his is another example of the truth of the age that keeping everlastingly at it brings success. In regard to the benefits resulting from the use of elevators and their effect in making sky scrapers possible and profitable, Mr. Mitchell is of the opinion that in any building much of the value of the second and third stories and all the practical value of any story above the third, for ordinary business purposes, depends upon the use of the elevators, and to the elevators is therefore due by far the greater part of the utility of the best business houses and office buildings.

The Standard Elevator Company, manufacturers of passenger and freight elevators and hoisting machinery, was incorporated in January, 1891, with a capital stock of $200,000. Its officers are H. A. Beidler, president; G. L. Forman, vice president; and W. H. Wells, Jr., general manager. Its works are on Fifteenth street, from Laflin street to Ashland avenue, and its general offices are at 320 Dearborn street. Mr. Beidler, the president, has been engaged in the manufacture of elevators since 1884 with the Ellithorpe Air Brake Company, of which he was vice president during the entire period of his association with that company, and is a native of this city. Mr. G. L. Forman was the secretary of the Crane Brothers Manufacturing Company, later the Crane Company, and resigned that position to aid in the formation of this company. Mr. Wells, manager of this company, was general manager of the Crane Elevator Company until a year ago and has had about eight years' experience in the elevator business. The Standard Elevator Company works under its own patents, and has associated with the concern as chief engineer Mr. George H. Reynolds, one of the most eminent engineers in this country. This company is now building twenty-two elevators for the cold storage warehouses, between Randolph and Lake streets, Canal street and the river, all to be operated by compressed air; they are novel in design and constitute the only plant of the kind in existence. One of the improvements introduced by this company is the use of aluminium bronze for the cross or carrying beams. One of these beams was recently subjected to a test and sustained a weight of sixty-five tons. Its ordinary load is about one thousand pounds, thus giving a factor for safety of about one hundred and thirty. In the Monadnock-Kearsarge building, for which this company has the elevator contract, they are putting in ten cars to be made of aluminium, thus securing the least weight combined with greatest strength known, and the highest ornamental effect. In these two buildings all the ornamental work usually of iron will be executed in aluminium. This company is also furnishing the elevators for the Manhattan building, which is one of the finest finished buildings in the city, and for the Unity, which is now so conspicuous on Dearborn street. These are all sixteen-story buildings. The company uses five different safety appliances, and puts them all on every machine. These are the standard automatic governor which controls the movement of the car, and is so adjusted that when an unsafe degree of speed is reached the platform is instantly locked to the guides, rendering it impossible for the car to fall, either from the breaking of the cables or from a failure in any part of the machinery; an independent attachment for cables, by which each cable is independently anchored to the machine, and is provided with an adjustable draw-bar, so that any slack may be at once taken up, the combined strength of all cables being thus used at all times, each sustaining its proportion of the load; an automatic button stop, by which the car is stopped at the upper and the lower landings independent of the operator; the iron buffer, to arrest the car at the upper and lower landings independent of the valves and water connections, same being cushioned with heavy rubber rings to prevent any shock or jar to the machine, and anchored back to the closed end of the machine by four steel rods, having a combined total strength of four hundred thousand pounds; a siphon relief valve, to stop the machine in case the car shall meet with any obstruction in descending, and prevent any unwinding or slackening of the cables, as the piston always stops when the platform does. This company manufactures elevators operated by hydraulic power, steam, electricity and compressed air, all being made of various sizes, corresponding to the work required, from the largest to the smallest. The amount of value added to the city by the use of elevators is enormous. It has been said that the land costs nothing after going above the sixth floor, which in the case of the Unity and all buildings above enumerated, gives ten stories without ground rent, and it is estimated that the average value of the heart of the city for business purposes is increased fourfold by the use of elevators, while in many cases the increase will far exceed that estimate. All the members of this company are natives of Chicago, about thirty-two years of age, and active business men of wide experience, such as Chicago only can produce. Their factory is located on the lines of the Wisconsin Central and Chicago, Burlington & Quincy railroads, with which the company has connecting tracks, and is said to be the best for the purpose to be found anywhere. The equipment is of the newest and best that money can buy, and includes the first traveling crane operated by electricity that has ever been erected in Chicago, and runs the entire length of their shop. The works have a capacity sufficient to turn out about $1,000,000 worth of work per annum. The output of the company is now going into all the principal cities of the country.

GLOSSARY OF ARCHITECTURAL AND BUILDING TERMS.

A.

Abaciscus (Lat.). An angular tile used in paving.

Abaculus (Lat.). A small tile of marble, stone or glass, colored and otherwise ornamented, used in mosaics.

Abacus (Lat.). The top member of the capital of a column, or that next to the architrave; an ornamental panel in mosaics.

Abbey. The same as monastery.

Abutment. That portion of a wall, pier, etc., used to sustain a lateral thrust, as of an arch, roof, etc.

Acanthus. An imitation of the acanthus leaf employed in the ornamentation of the Corinthian or Composite bell.

Acrolith. A statue of combined wood and stone.

Acroterium. A small pedestal at the angles of a pediment; a roof balustrade or the gables of gothic structures used to support statues or other sculptured designs.

Adobe. A sun-burned brick used in Mexico and several of the territories; a building made of these bricks.

Ægicrania. A classical sculpture of rams' heads.

Aisle. A side division of churches or similar structures, separated from the nave by columns or piers, which mark the side of the clearstory.

Alcazar. A military structure or a palace of royalty.

Alcove. A recess in a wall or room; a small room connected with another; a small ornamental building for parks, etc.

Alhambra. The beautiful palace of the Moors, at Granada.

Alhambresque. A style of rich ornamentation patterned after that in the Alhambra, and a characteristic feature of Moorish and Saracenic architecture.

Alley. A narrow passage between rows of pews in a church or seats in a hall.

Altar. A raised structure in a church where Christians celebrate the sacrament; also the pedestal where the ancients offered sacrifices.

Altarrail. A railing used to exclude the altar.

Altarscreen. A partition in the rear of an altar to protect it.

Alto-relievo. Sculptured work in strong relief.

Amphiprostyle. Having columns at the ends only; the structure built thus.

Amphitheater. A large circular building about an open court, the structure being wide enough to contain many terraced rows of seats.

Anaglyph. Any ornamental carving or embossing in low relief.

Anchor. A strong tie used to hold adjacent building members together; part of the molding called egg and anchor.

Andro-sphinx. One with a lion's body and a man's head.

Annex. A secondary attachment to a main building.

Anta. Antes. A pier or pilaster with capital and base formed as a part of, and at the extremity of, a wall.

Ante-temple. The portico or vestibule of an ancient church or temple.

Ante-room. A room to be entered first.

Apophyge. The curve of expansion at the top and bottom of the shaft of a column.

Apothesis. The shelving on the south side of the chancel in ancient churches, for books, religious paraphernalia, etc.; a private dressingroom for public bathers.

Apse. Apsis. Abses. Similar to chancel; the seat reserved for the bishop in ancient churches.

Arabesque. A low relief ornamentation composed of foliage, fruit, animal figures, including the human form, fanciful creations, etc., woven into a general pattern or design, used often by the Romans, and particularly by the Moors, who carried it to great perfection, but excluded the animal figures. (See Alhambresque.)

Aræostyle. Aræosystyle. Systyle. (See Intercolumniation.)

Apartment. A single room; a suite of rooms in an apartment house.

Arcade. A series of columniated arches with the necessary adjacent parts, generally open and used to give entrance or light, but sometimes mimic, diminutive or false for decorative effect; the building composed of a series of arches; an archway.

Arch. A curved structure of any materials, usually wedge-shaped, employed to bridge an open space. A method of diverting the force of gravitation to the extremities of a semicircular structure used to cover the space between uprights.

Archbrick. A wedge-shaped brick used in arch building.

Arch, flat. A member not curved, which takes the place of an arch and is supported by the angular shape of the voussoirs.

Architect. A person proficient in the building arts; one who makes the art of building his profession.

Architectonic. Architectural science.

Architecture. The process of building under definite æsthetical and mechanical principles.

Architecture, civil. That branch of architecture concerned in the structures of civil life.

Architecture, military. The application of building rules to military structures.

Architecture, naval. The art of ship-building.

Architrave. The lower of the three general members of an entablature, or the building member resting directly on the capital; the collection of moldings at the top and the sides of a window, door, or other usually square opening.

Archivolt. The collective member upon the wall face of an arch, corresponding to the architrave of a square opening.

Archstone. Same as voussoir; one of the wedge-shaped stones composing an arch, the joint between any two forming part of the radius of the circle of which the arch curvature is a segment.

Archway. A course under an arch or arches.

Areostyle. Areosystyle. Aræostyle. (See Intercolumniation.)

Arras-wise. Arris-wise. Ridge-wise. The process of laying rectangular tiling, etc., so as to show the upper surface and two sides by placing an angle in front.

Art of architecture. Art of building. The systematic application of fixed mechanical and geometrical principles and æsthetic forms and details to the union of the parts of structures generally known as buildings.

Ashlar. Ashler. Dressed and squared stone; a wall of these stones; a slab used to face a wall of bricks, etc.; the side studs of a garret.

Ashlaring. Ashlering. The process of casing a wall with ashlars, or of laying ashlars in cement or mortar.

Astel. A ceiling in a mine.

Astragal. A half-round molding.

Astylar. Said of a building that has neither columns nor pilasters.

Atheneum. Athenæum. A celebrated temple at Athens; a room or building devoted to study, recreation and art.

Atlantes. (See Caryatids.)

Atrium. (See Court.)

Attic. The apartment or group of apartments next to, or next under, the roof.

Atticbase. A special form of base to a column or pilaster used by the Romans and the architects of the Renaissance.

Atticstory. The crowning order of the elevation of classical architecture, and usually a low story, partly enveloped by the roof.

Auditorium. Auditory. A large apartment where audiences may hear lectures, dramas, sermons, etc.; a building in Chicago containing such an apartment; the nave in an ancient church; the receptionroom in an abbey.

Axis of the Ionic capital. The imaginary vertical line passing through the eye of the volute.

Axis, spiral. One that is thus drawn to exhibit the spirals of a twisted column.

Aztec architecture. That style practiced by the Aztec tribes in America before the discovery of the western continent.

B.

Back. The convex face of a bent timber.

Backfilling. Material used as a filling between walls or between faces of the same wall.

Backjoint. A recess, groove or rabbet left in masonry for the insertion of a block, slab or other filling.

Baguet. Baguette. A molding similar to an astragal, but smaller.

Balcony. A projecting stage or platform on the side of a wall, supported by consoles or pillars, and fenced on the edge by a balustrade; an extensive gallery in theaters and similar auditoriums. (See Gallery.)

Baldachin. A special form of canopy on the side of a wall.

Ballflower. An ornamental flower which has a ball-shaped projection in its center.

Baluster. One of the small carved or turned uprights used to support the handrail of a staircase, veranda, balcony, gallery, bridge, etc.; the plural of this term is often used to designate the entire balustrade; the small column or pilaster of an open parapet.

Balustrade. A series of balusters braced on top by a rail, and serving to guard the edge of a balcony, staircase, roof, etc. (See Parapet.)

Band. A projecting strip, of greater or less width, encircling a pillar or column; a lengthy strip or group of ornamental terra cotta designs, woodwork, etc., used to decorate a wall surface; a collection of moldings on pillars and shafts.

Banded architrave. Banded pier. Banded shaft. Banded column. One which has projecting bands extending across it, usually at right angles.

Banister. Same as Baluster.

Banker. A stone worktable or bench used by masons.

Banquette. A narrow winding seat or shelf.

Baptistry. Baptistery. In ancient times a building where the ceremony of baptism was performed; now that part of a religious edifice containing the baptismal font; the font itself.

Bar. A small strip of wood or metal separating and supporting the glass in a window or door.

Bartracery. Projections in stone resembling iron bars.

Barbaresque. Referring to a barbaric style of ornamentation or architecture.

Barbatine. A plastic paste used in relief decorations of pottery.

Bare. That portion of shingles, tiles, etc., exposed to the weather on roofs.

Bargecourse. That portion of the roof tiles which projects over the principal rafters and covers the gable.

Bartizan. An overhanging lookout at the angle of a defensive structure.

Bascule. An arrangement like a balance.

Bascule bridge. A draw-bridge on the principle of the balance, one end falling while the other is rising.

Base. The lower portion of any distinct building member, such as wall, column, pier, house, story, decoration, etc.

Basecourse. The lower series of material of a base; the building member marking the separation of the basement from the first story wall; the lower layer of stone, iron or concrete in a foundation.

Baseboard. The special wood work extending round a wall of a room next to the floor.

Basement. The lower story of a building if wholly or partly underground; a wall of this underground story.

Basil. The angle which the plane of the cutting edge of a tool makes with the axis.

Basilica. A public building of the Romans, with courtrooms attached; an early Christian church fashioned after the Roman basilica.

Basket. Improperly applied to the bell of the Corinthian capital.

Basrelief. Bassrelief. Basso-relievo. Sculptured or molded figures of ornament slightly projecting from the surface.

Bastard ashlar. Ashlars roughly dressed or shaped before shipping.

Bastile. Bastille. A tall strong structure used as a defense to a fortification.

Batten. A long thin strip of wood, used to cover joints between boards, etc.; a kind of long timber sawed ready for use, about 2x6 inches.

Battendoor. One made of boards which extend its entire length and are held in place by battens nailed crosswise.

Battening. Furring obtained with small pieces of wood fastened to the wall.

Batter. The face of a wall which slopes to the rear.

Batterrule. An instrument to determine and regulate the batter of a wall.

Battlement. One of the uprights of a parapet; the collective uprights of a parapet and the spaces between them; a kind of parapet; a structure of this kind used as a decorative feature in churches and other buildings.

Bay. A special and distinct division of a structure; a main compartment formed by piers, vaults, walls, roofs, etc., as a part of a building, or thus formed of the whole building.

Baywindow. A window projecting outward from the wall of a room, thus forming a recess within, and of any external shape.

Bead. A small rounded molding, embossed or continuous.

Beading. A molding cut into beads.

Beak. An expanding projection which ends in a fillet.

Beakiron. A peculiar anvil with a long point or beak.

Beam. A long heavy pieee of iron or wood; a strong, main, horizontal support in a building.

Bearing. That part of a structure resting directly on supports; that part of the support next against the object supported.

Bed. The final resting place in a wall or building of a stone, a brick, etc.; the horizontal surfaces of a building stone.

Bedmolding. The special molding next underneath the eorona in a cornice.

Belfry. A tower for bells; a room in a building where the bell is hung; any special portion of a building devoted wholly to the bell. (See Campanile.)

Bell. The solid body of a capital extending from the neek molding to the abacus, and upon whieh the volutes, foliage, acanthus leaves, etc., are placed. (See Vase, Tambour.)

Bellarch. An arch shaped like a bell. (See Ogee.)

Bellcage. Bell carriage. A frame to hold and ring a large bell.

Bellcot. A secondary structure, often supported by a eorbel and attached to a wall, used to contain a bell or bells.

Belldeck. The ceiling of a room made to serve as the floor of a belfry.

Bellgable. A small structure like a gable, fitted to hold bells.

Bellroof. One whose section is shaped generally like a bell.

Belly. The concaved surface of a bent timber.

Belt. Same as band.

Belvedere. A small open building used in landseape gardening.

Bema. A reservation in an ancient church for the clergy.

Beneh. A long tabular structure upon which mechanies do their work.

Benchplane. A special plane for making level surfaces.

Benehtable. A heavy course of masonry or wood at the base of a wall, pier, pillar, etc., often used as a seat.

Bent. A transverse frame in a framed structure.

Berliniron. A soft, easily-fused kind of cast iron used in the manufacture of delicate figures, articles, etc.

Bessemer steel. Steel made directly from cast iron, during which process much of the carbon and other impurities are eliminated by the application of pure air forced through the molten mass.

Bethlehem. A small church annex, where bread for the eucharist is made.

Bevel. To form an angle on wood or metal different from a right angle; a device with two projeetions which can be set at any angle.

Billet. An ornamental molding in Norman architecture, square or round, resembling a billet of wood.

Biscuit. Porcelain of light color, upon the unglazed surface of which miniature animals, flowers, vases, etc., can be grouped.

Bisque. Unglazed white porcelain.

Bit. A small tool upon the principle of the augur, used with a brace in boring.

Bitstock. Same as Braee.

Bivaulted. Consisting of two vaults.

Blaekplate. Sheetiron before the tin is added.

Blaek tin. Tin ore in the form of fine sand ready for smelting.

Blade. The several principal rafters of a roof.

Blank door. Blank window. A structural arrangement in a wall so that later a door or window may be cut; an imitation of a door or window used in a wall for effect.

Block. A row of houses of any kind, a single long building composed of several houses attached; a tract of land divided into lots.

Blockingcourse. The top course in a wall above the cornice or architrave.

Bloom. A quantity of wrought iron freed from alloy, impurity, etc.; an ingot of steel after being rolled or hammered out into a large bar.

Bloomery. The place where blooms of wrought iron are made.

Board. A piece of wood of considerable length and some width, but usually about an inch thick.

Board rule. A systematic method of finding at once the square feet in a board or in many boards.

Boarding. The act of enveloping with boards.

Boast. To shape in outline ready for finer work.

Boaster. A strong broad chisel used by a stone mason.

Bocca. An opening in a glass furnace to permit withdrawing the melted glass.

Body of a church. (See Nave, Choir.)

Bogore. A variety of iron ore found in bogs or swamps; limonite.

Bohemian glass. A very fine variety of glass made in Bohemia of silica, potash, lime and soda.

Boiler. A large, very strong wrought-iron vessel, made of separate plates riveted together, in which steam is generated to be used as a motor.

Barrel of a boiler. The cylinder containing the flues.

Boilerplate. Boileriron. Rolled iron of great tensile strength used in the construction of boilers.

Cylinder boiler. One having only a single boiler.

Flue boilers. Those containing a few large flues which carry the heat away from the fire or back to the chimney.

Boiler, sectional. One having several connected sections, usually small.

Boiler, tubular. One the tubes of which are the flues and are immersed in the boiler water.

Bois dur ci. A composition of hardwood sawdust and blood compressed until very hard and then polished.

Bolster. The circular rolls at the ends or sides of the Ionic capital.

Bolster work. A convex member for special uses, as the bulging friezes of several classical styles.

Bolt. The sliding catch of a door; a strong pin of iron or wood used as a fastener.

Bolt auger. A special one of large size.

Bolt and nut. A steel or iron pin with a head at one end and threads on the other on which a nut can be screwed.

Bond. The means by which timbers, stones, bricks, etc., of a wall are held together.

Bond, cross. A class of English bond, where the joints of the second stretcher line alternate or break with those of the first.

Bond, combined cross and English. This term is used where the front face of a wall is laid according to one method and the rear face by the other.

Bond, English. This consists of laying one course of bricks with their ends out, and the next course with their side out and so on, the first being called headers and the last stretchers.

Bond, Flemish. Where the alternate bricks are headers and the others stretchers, care being used to break joints.

Bondtimber. Wood so worked into a wall of masonry as to strengthen it lengthwise and furnish support for the interior structure.

Bond (or lap) of a slate. In roofing, that surface which is covered by three thicknesses of slate.

Boom. A long line of logs connected at the ends and used to enclose and keep from floating away a raft of sawlogs, lumber, etc.

Bosh. The lower portion of a blast furnace, where it slopes.

Boss. An ornament fastened to the crossings of the ribs of a ceiling; a special vessel to hold mortar, used by masons while tiling, etc.; the superintendent or director of a gang of workmen.

Bossage. Stone the face of which is left rough until laid in the wall, when carvings are made thereon; a kind of rustic work where the central portions of the stones project beyond the joints.

Boultel. Boultin. A quarter-ronnd molding; a torus; an ovolo, seen under the abacus of the Roman, Doric and Tuscan orders; one of the members of a clustered column.

Bowstring bridge. One shaped like a bow and string, the former representing the steel or iron arch and the latter the tie which is a chord of the arch.

Bowstring girder. A beam forming the segment of a circle, having the two ends connected by a strong tie.

Boxbeam. Boxgirder. A beam made of steel or wronght-iron plates transversely riveted together, and thus forming a section resembling a double cross or a modification of it.

Boxdrain. One with vertical sides and horizontal top and bottom.

Box. To roughly enclose with boards, laths, etc., in order to outline and confine.

Boxing. The framework used to shape or ontline any structure.

Brace. An instrument with an elbow, used to bore with a bit; a long piece of metal or wood used to sustain a side thrust; one of the struts in the triangular snpports of a truss.

Brace, boiler. A tie connecting the head of the boiler with the shell, and placed diagonally.

Bracket. A member, usually right-angled, the hypothenuse being often curved and ornamented, used to sustain projecting weight; one seeming to perform this office.

Bracketing. A row, series or group of brackets.

Brass. An alloy usually of zinc and copper, but sometimes tin and other metals. The usual combination is one part of zinc and two of copper.

Brassfoil. Brassleaf. Dutch gold. Thin sheets of brass.

Brattishing. A term used to designate the open work of a parapet or battlement.

Brazil wood. A reddish wood imported from the tropics, notably Brazil, nsed in cabinetwork.

Break joints. To lay any structure made up of smaller parts so that the joints of one series will not occur directly under those of the one above.

Break. A change or modification in the course of any piece of work, as the change of direction in a wall; the new face formed by a recessed portion, etc; the act of severing an electrical circnit.

Break-circuit. An apparatus to break an electrical circuit.

Breastrail. The top horizontal member of a balcony railing, parapet, etc.

Breastsummer. A long lintel or girder laid in the face of a wall and usually extending entirely around it.

Breeze. A mixture of cinders, ashes, etc., nsed in the manufacture of bricks.

Brick. Common clay that has been rendered plastic for working by the use of water, molded into solid masses of uniform size and then baked in a furnace or kiln.

Brickclay. Brickearth. Earth, the principal constituent of which is the metal aluminium, used to make bricks.

Brickdust. The dust formed when bricks are crushed.

Brickkiln. A special furnace, suitable for the purpose, in which bricks are baked or burned; the term is also applied to the mass of green bricks before the burning.

Bricklayer. One who makes the laying of bricks in walls, etc., his occupation.

Bricklaying. The art of building with bricks.

Brickmaker. One whose business is to manufacture bricks.

Bricknogging. A filling of rough brickwork between walls.

Brick, pressed. Bricks made in the usual manner, but subjected to an enormous pressure to make them denser and free them from water, air, etc., before being burned.

Bricktrimmer. An arch of bricks under a hearth to prevent fire from communicating with the woodwork.

Brickwork. Any structure made of bricks, mortar, etc.

Brickyard. An inclosure or open space where bricks are kept in stock for sale; the entire outfit for the manufacture and storage of bricks.

Bridgewall. A perpendicular partition in a furnace chamber to change the direction of the ascending flame.

Bridge, truss. Bridge, girder. A bridge having trusses or girders resting directly on the piers.

Bridge, Wheatstone's. An apparatus to measure electrical resistance.

Bridgeboard. The notched board placed at a vertical angle to which are fastened the risers and treads of a staircase.

Bridging. A system of bracing to distribute weight.

Bridleiron. A piece of iron so bent and used that it will support a timber end having no other rest. (See Stirrup and Hanger.)

Broach. A broad chisel; a spire.

Broadax. A special ax having a broad edge often bent to one side, for hewing timbers.

Brob. A special spike used against abutting beams, etc., to prevent their slipping.

Bronze. Copper and tin melted and mixed to form an alloy.

Bronzing. The art of giving the appearance of bronze to other substances.

Browning. A brown finish to a coat of plaster.

Brownstone. A valuable kind of sandstone.

Browpost. A beam extending through a building.

Brush. An instrument with bristles used by painters; a bundle of wires or plates used to carry electricity to and from a dynamo; a current of electricity shaped like a brush.

Bucranium. A sculpture of an ox skull carrying wreaths.

Buffet. A sideboard; a set of shelves answering as such.

Build. To construct any variety of edifice.

Building. The object built; the art of construction.

Builder. One who practices building.

Bulge. The convex section of a wall.

Bulldog. An infusible substance.

Bundle pillar. A collection of small columns.

Bur. Burr. A small circular saw; an angled chisel.

Burden. The measure of ore, etc., in a blast furnace compared with the fuel.

Bushhammer. A hammer having a cross-botched face, used in dressing stone.

Butment. A side support for an arch; the heavy masonry used in bridging to sustain the arches.

Butmentcheek. That portion of a piece of timber surrounding a mortise.

Butt. The heavier end of a piece of timber; a hinge used in hanging doors.

Buttingjoint. The joint between two pieces of timber, etc.; it may be right-angled or oblique.

Buttress. A mass of masonry projecting from a wall, used to sustain a lateral thrust, as of an arch; or sometimes used merely for ornament, or to strengthen a high, thin wall. (See Pier.)

Buzzsaw. One with the teeth on the edge of a circular disc.

Byzantine architecture. A style evolved by the Byzantines, the characteristic features of which are the dome, round arch, pillars, cross, etc. St. Sophia Mosque, at Constantinople, is the best example.

C.

Cabinet. A room devoted to the exhibition of art works; a cupboard of drawers.

Cabinetmaker. A specialist in artistic woodwork.

Cabinetwork. The art of making cabinets and other fine woodwork.

Cable. Any building member shaped to represent a cable.

Cablemolding. A molding made to represent a rope or cable.

Cabling. The ornamentation of a column, shaft, cornice, etc., with reedings or roundings placed in the hollows of the moldings.

Caisson. Sunk paneling on soffits or ceilings.

Cam. A turning instrument so shaped as to communicate irregular motion to another object.

Camwheel. One having cams which impart eccentric motion.

Camber. The concave soffit of a beam, lintel, girder or straight arch. (See Hogback.)

Camberarch. A straight arch, the intrado or soffit of which is slightly concave.

Camberbeam. One that is cambered.

Camerate. To vault or arch over; to separate into sections or chambers.

Campaign. The length of time a blast furnace is run continuously.

Campana. (See Gutta.)

Campanile. A bell tower, usually erected apart from a church.

Candlepower. The intensity of the light of a common candle; the unit used to measure the degree of illumination.

Candle, electric. Candle, Jablochkoff. That varied form of the arc lamp which shows the carbons placed side to side, instead of end to end, and at such a distance as to furnish the arc at the end.

Canopy. A roof-like structure over a door, window, niche, altar, statue, fountain, font, etc.

Canted column. A polygonal column.

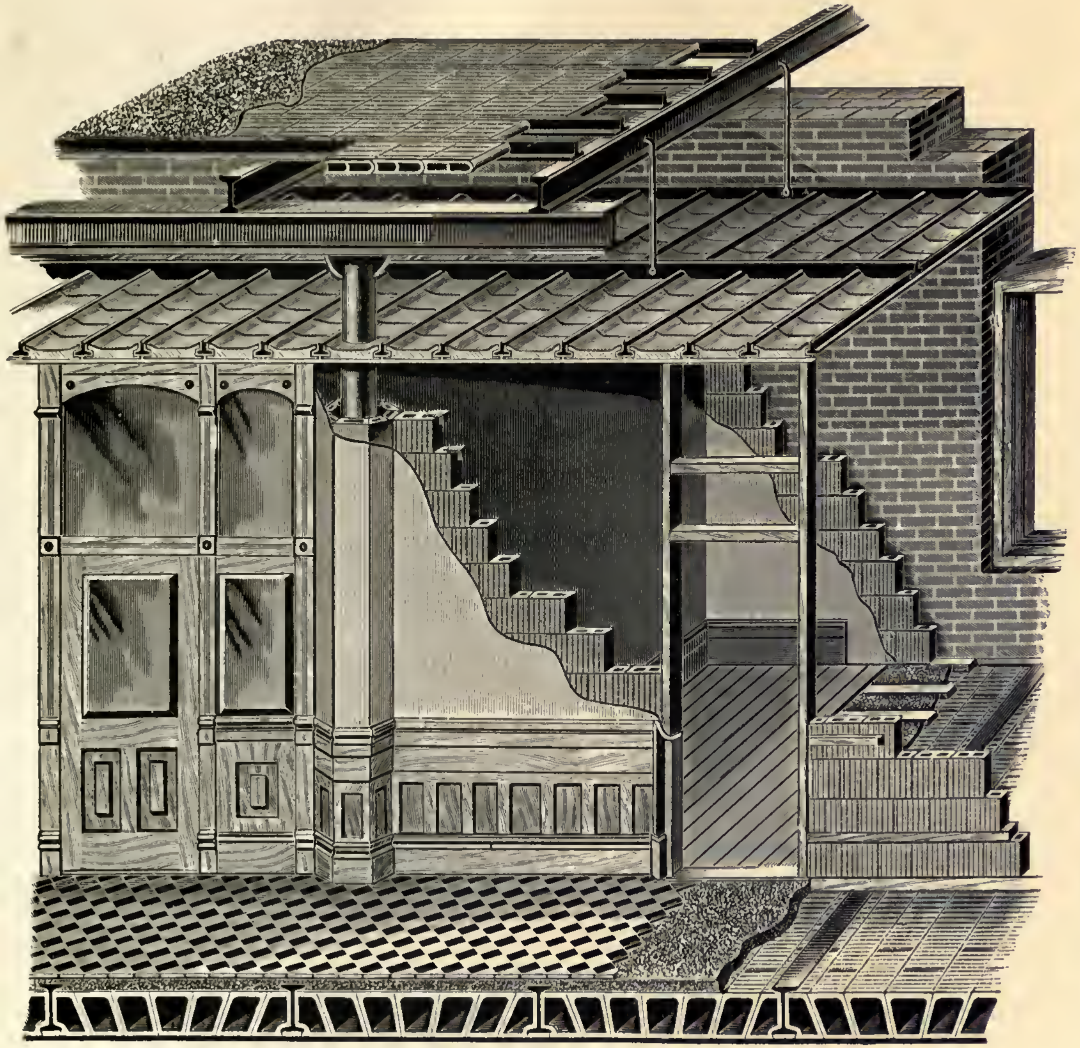
Canted window. An angular one.

Canted bolt head. One having angles.

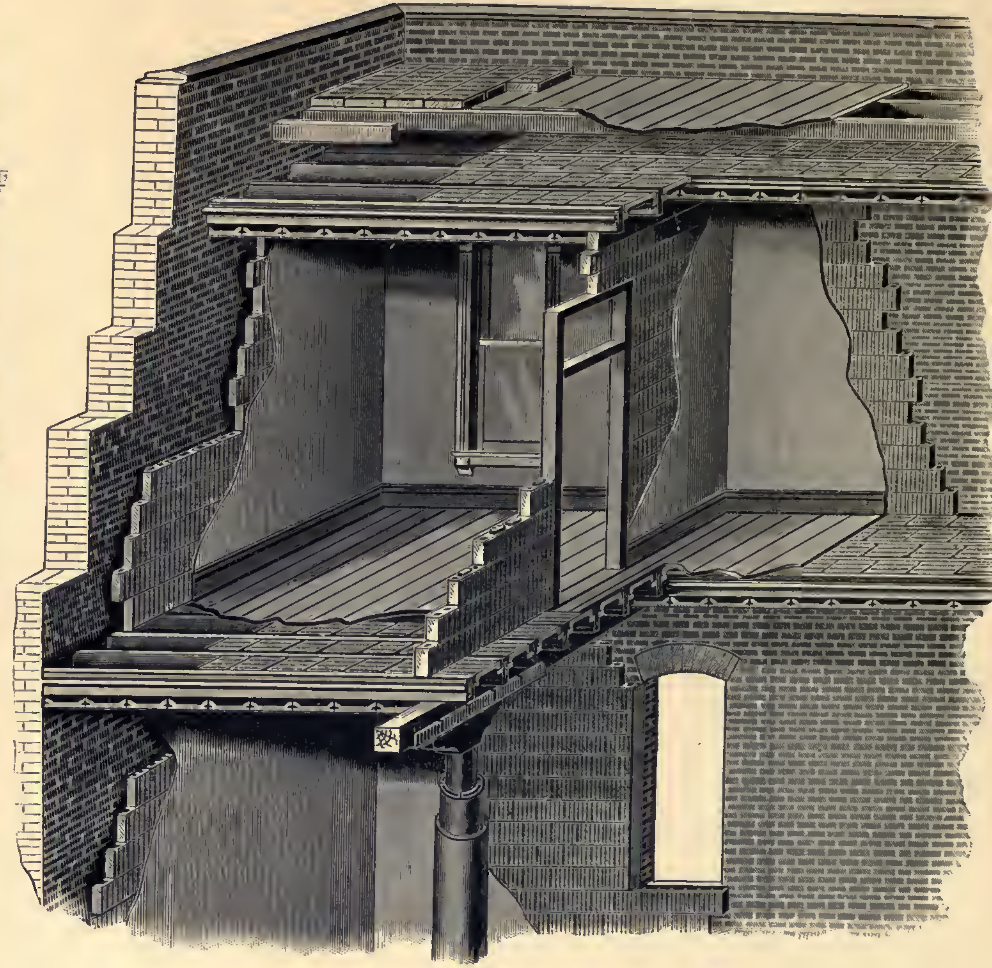
Cantoned. That feature of a building member which shows its angles decorated with moldings or small shafts.

Cap. The crowning piece of any building member, such as a cornice, coping, capital, plate, etc.

Capital. The top member of a column, pilaster, etc., usually composed of abacus, bell and neck, with their ornamentation.



INTERIOR VIEW OF FIREPROOF BUILDING.



INTERIOR VIEW OF FIREPROOFING APPLIED TO WOODEN CONSTRUCTION.

Caracole. A spiral staircase.
Carbonlight. The electric light obtained by the touching of two carbon points.
Carbonpoint. That union of two carbon ends which is maintained by clockwork.
Carpenter. One skilled in working in timber or in building houses.
Carpentry. The art of building houses of wood, or of preparing timber for house construction.
Carriageporch. A canopy over the entrance leading from the driveway to the house.
Cartouch. A console, corbel, cantalever, bracket, modillion, etc., shaped like a scroll of paper; a tablet in this form.
Carve. The art of cutting decorations in wood or stone.
Caryatid. A statue of a draped female occupying the position of a column or pilaster.
Case. A frame used to inclose, as a window case, door case, etc.
Casebay. The expanse between two girders.
Casehardening. The process of giving iron a steel finish. (See Cementation.)
Casemate. A molding of concave outline often seen in cornices.
Casement. A window which has sashes opening on hinges.
Casino. A room or building devoted to social gatherings.
Cast. An impression of any form taken.
Casting. The act of taking an impression; the object of which an impression is taken; the warping of lumber.
Castiron. Iron that is rich in carbon, besides containing sulphur, phosphorus, silica, etc.
Castle. A fortified house or residence; a fortress.
Castellated. Provided with battlements, turrets, etc., and otherwise built like a castle.
Catchbasin. A depression in a sewer where the street flow is received, to catch large articles not likely to pass through the sewer.
Catharine wheel. (See Rose window).
Cavo relievo. Sculpture in relief but on a section sunk so low that none of the carving projects beyond the general surface. (See Hollow relief.)
Cedar. A valuable wood having a reddish color and a fragrant odor.
Ceiling. The surface of a room overhead; the material used to form such a surface.
Ceilingboard. A special board used to ceil with.
Cell. That section of a vault between the ribs; a vessel, or section of a vessel, containing the liquids and materials used to induce electricity.
Cella. The walled inclosure of an ancient temple. The wall was usually surrounded by a peristyle.
Cellar. A story of a building, usually underground.
Cement. A substance used to cause bodies to adhere, lime, clay and water being the principal ingredients.
Cementation. The process of changing the physical properties of a body by chemical combination with another substance. Iron thus associated with charcoal becomes steel, and ordinary glass associated with sand becomes porcelain.
Center. A temporary frame upon which an arch is built.
Centerpiece. An ornamental design placed in the center of the ceiling of a room.
Chainmolding. A Norman molding shaped like a chain.
Chaintimber. (See Bondtimber.)
Chamfer. An oblique surface formed by cutting off the arris or angle made by the meeting of two surfaces.

Chamfret. A small groove, gutter or channel.

Chancel. A certain part of a church reserved for the ministers, usually that part beyond the transept intersection.

Chancelaisle. The one communicating with the chancel.

Chancelarch. The great arch of the entrance to the chancel.

Chancelcasement. The main chancel window.

Chanceltable. (See Communion table.)

Channelbar. Channel iron. A bar having the profile of a flat gutter.

Chapel. A small subordinate church, or a recess in a room used to contain an altar.

Chaplet. A molding of beads, pearls, etc.; a piece of metal used to hold a core to its place in the mold.

Charcoaliron. The furnace iron produced by the use of charcoal as a fuel.

Cheeks. The solid material surrounding a mortise.

Cherry. A wood of much value to cabinetmakers.

Chevron. A peculiar, distinguishing molding in Norman architecture.

Chill. A system of cooling cast iron so suddenly as to assist its crystallization and improve its temper.

Chimney. A tall, narrow brick, stone or metal structure, running up through a building, used to carry off smoke, gases, etc., from a grate or furnace and to increase the draft.

Chimneyboard. A screen for a fireplace.

Chimneycap. A chimney covering so devised that the smoke always escapes to leeward.

Chimneycorner. The space between the fire and the sides.

Chimneypot. A metal or earthenware chimney top of cylindrical pattern.

Chimneyshaft. That part which springs above the roof.

Chimneybreast. A horizontal projection in a chimney beyond the wall.

Chimneypiece. An ornamental fixture around a fireplace.

Chisel. A tool with a handle at one end and a sharp edge at the other, driven by a mallet, and used to cut or dress wood, stone, etc.

Choir. That part of a church devoted to the use of the singers and organ; the same as chancel.

Choirscreen. Choir wall. The screen or wall which separates the aisles from the choir or chancel.

Chord. The expanse between the bases of an arch; the right line extending between the bases.

Chump. A heavy piece of short, thick wood.

Church. A building used by Christian people for devotional purposes.

Cinque-cento. An Italian style of architecture which came into use after the year 1500.

Cinquefoil. An ornament of five points, called cusps, used as a foliation of panels, windows, etc.

Circle, dress. A low gallery on the lower floor of a theater, usually separated from the parquet by a railing.

Circuit, voltaic or galvanic. A continuous union of positive and negative electricity through the two poles of a battery; an uninterrupted current of electricity through the battery poles.

Clamp. A piece of wood bound to another to strengthen it; a heap of bricks ready for burning.

Clapboard. A narrow weatherboard used on houses, having the lower edge thicker than the other.

Classical architecture. The styles used by the Greeks and Romans, and afterward adopted as classical during the Renaissance.

Clawhammer. A hammer of metal having one end of the head forked for drawing nails.

Clay. The hydrous silicate of the metal aluminium, often containing lime, oxide of iron, etc., as impurities; it is formed by the decomposition of rocks containing these minerals.

Clay, brick. That clay which contains sufficient iron to render the bricks red when burned.

Clayironstone. An iron ore composed of clay, sand and oxide or carbonate of iron.

Claymarl. A gray, chalky clay.

Clay, fatty. That clay which contains water, silica and alumina, and has an oily feeling.

Clay, fire. A pure infusible clay used for making fireproof bricks and tiles.

Clearstuff. Lumber of all kinds wholly or nearly free from knots; the space bounded by walls.

Clearstory. That portion of a church between and above the aisles and aisle-roofs; the second story of the nave.

Cleat. A transverse strip fastened to an object to prevent warping, etc.

Cleft. A long narrow portion of wood obtained by splitting.

Clinker. Several bricks fused together by the action of fire; also a kind of brick.

Cloakroom. A room usually in a public resort, where outer clothing is temporarily left.

Cloister. A narrow covered passage, or several such passages, communicating with the buildings of a monastery, usually at the sides of the court; the buildings of a monastery.

Cloister garth. The open space or court, often a garden, inclosed by the cloisters.

Closer. A piece of brick or a small stone used to finish a horizontal course of masonry.

Closet. A small private apartment or recess.

Clubhouse. A building in which a club assembles.

Clump. The dense clay found under or between the coal strata.

Clustered column. A combination of real or apparent columns into a single one.

Coak. A pin or tooth of wood or iron uniting one piece of wood to another.

Cob. A mortar made of clay and straw, used by the poor in England, in chinking their rude houses.

Cobblestone. A small rounded stone much used in paving streets.

Cobwork. Relating to the style of building log houses by dovetailing the ends of the logs that are laid above each other horizontally.

Cocklestairs. Those that are spiral or winding.

Coffer. A panel deeply sunk and used as a decoration for a ceiling of any kind. (See Caisson.)

Cofferwork. Rough stone masonry faced with dressed or ornamental stone.

Cog. A projection called a tenon, left at the end of a joist to fit flush into the bearing timber.

Coil. (See Electricity.)

Coldchisel. A chisel, wholly of metal and of superior temper, used in cutting cold iron, etc.

Coldsheet. The partial union of two pieces of metal too cold for proper welding.

Coliseum. Colosseum. The Vespasian amphitheater at Rome.

Collar. A ring, or annular fillet, or cincture, near the end of a column.

Collarbeam. A beam extending horizontally from one rafter to another opposite and used to keep them in place.

Colonnade. That portion of a building consisting of a row of columns surmounted by entablatures, roof, etc. (See Portico and Peristyle.)

Color. Any hue, not black or white; a material used to furnish color.
Complementary color. Any color which, united with another, will produce white.
Color blindness. Inability to distinguish certain colors.
Coloring. The act of giving color to an object; the material which produces color.
Colorist. One who gives color to objects.
Colorman. One who keeps paints for sale.
Column. An upright pillar, circular or angular, ordinarily consisting of three principal parts—base, shaft and capital, and used to support parts of a building above it. (See Clustered column.)
Communion table. The table used in the celebration of the Lord's supper.
Compartment in buildings. One of the spaces into which a given compass is divided by partitions.
Compass. The limit or space inclosed by an encircling wall.
Compassplane. A plane the under surface of which, including the knife, is convex, used to dress concave surfaces.
Compasssaw. A saw with a blade so narrow that a curve may be cut in wood. (See Fret saw, Keyhole saw.)
Compasswindow. (See Bay window, Oriel window.)
Compasses. An instrument with two legs which are hinged at one end and pointed at the other, used by mechanics to describe circles, measure distances, etc. (See Dividers, Calipers, Bow compasses, Triangular compasses, etc.)
Composite architecture. A highly ornamental order of architecture, originated by the Romans from the four older orders, principally the Corinthian, but with many important Ionic and other features added. (See Roman or Italic order.)
Compound pier. (See Clustered column.)
Compound engine. One with two cylinders—high pressure and low pressure—where the steam, after use in the first, is also used in the second.
Concave. (See Arched vault, Recess.)
Conch. (See Concha.)
Concha. A term applied to the under concave face of a vault, dome or cupola.
Conciator. An individual who prepares the materials to be made into glass.
Concrete. A mass of gravel or small stones mixed with any kind of cement and used to pave streets, etc.
Condensing engine. One which condenses the steam after using it.
Condenser. An instrument which accumulates electrical force by induction through the use of a non-conductor; an apparatus for liquefying steam.
Conductivity. The capacity to receive and power to transmit electricity, heat, etc.
Conductor. Any substance possessing conductivity; the trough or pipe used to convey water from a roof to a cistern. (See Leader.)
Conductor, prime. A conductor used to accumulate electricity.
Conduit. A more or less closed way for the passage of water.
Congé. (See Apophyge.)
Console. A kind of small bracket. (See Bracket.)
Consoletable. A table the legs of which are consoles.
Construct. To put building materials in orderly relation; to build.
Construction. The art of putting building materials into useful, ornamental and scientific relation.

Constructor. One who builds.

Contractor. An experienced operator who performs certain constructive work for another; specifically, one who assumes the task, responsibility and oversight of doing any definite work connected with the erection or completion of buildings, as building contractor, mason contractor, excavating contractor, plumbing contractor, etc.

Converting furnace. One where, by the process of cementation, steel is made from wrought iron. (See Cementation.)

Converter. A retort used in a converting furnace.

Cop. (See Merlon.)

Cope. Specifically, the arch of a door, roof of a house, etc., to represent an extension over a person.

Copechisel. One shaped for the purpose and used to cut grooves.

Copestone. A dressed stone used in coping.

Coping. In masonry, the last course at the top of wall, used as a protection from the weather and usually made heavier and ornamental.

Copper. A reddish metal of great hardness; ductile, malleable and tenacious; of high conductive power, and therefore invaluable among electricians; of important use as an alloy in brass and bronze. (See Brass and Bronze.)

Corbel. A sort of bracket, often plain, employed in Gothic architecture to support a projecting weight. (To corbel a course is to project the bricks or stones out over the next course below.)

Corbeltable. A horizontal course of corbels and the intermediate panels.

Corbiestep. One of the steps of a Tudor gable.

Corinthian architecture. A Greek order of architecture of great beauty, adopted and carried to great perfection by the Romans.

Corkscrew stairs. A spiral screw-like staircase rising around a strong supporting upright.

Corner. The line where two walls meet; the point where two or more walls meet.

Cornerstone. The stones used at the point where two or more walls meet; specifically, a large stone laid at the corner of an edifice, often with great ceremony.

Cornice. A group of moldings extending along the side of a wall, door, window, house, etc., at the top, as a decorative finish; the upper member of the entablature.

Corona. A projecting member of the cornice in classical architecture.

Corridor. A narrow passage or hall connecting the apartments of a house; a gallery.

Corrugated iron. Sheet iron forced into parallel wrinkles to increase its strength.

Cottage. A small hut, house or cot.

Coulisse. A grooved piece of timber.

Counterbrace. A brace of opposite strains.

Countergauge. A gauge with double points, easily adjustable, used to compare dimensions.

Counter-sink. A special increase in the size of an opening in wood or metal, to depress the head of a nail, bolt or screw, below the surface.

Coupleclose. A pair of rafters having their bases tied with a collar beam or otherwise.

Course. A horizontal layer of brick, tile or stone.

Coussinet. The stone placed between the base of an arch and the impost of a wall, pier or pillar; a member of the capital of the Ionic order.

Cove. An architectural member with a concave surface or section; it may be a molding, ceiling, roof, etc.

Coved vault. The reverse of a groined vault.

Cradle. Special ribs fastened to vaults, arches or coves, for the purpose of holding the lath and plaster.

Cradling. Same as Cradle.

Cramp. A strong wood or metal clasp used by masons and carpenters, to hold stones or timbers together temporarily.

Crane. An important machine much used in building, consisting of a long arm, so fitted with a windlass, ropes and pulleys that great weights can be raised and lowered and the arm revolved.

Cranny. An instrument used by glassmakers to form the necks of bottles.

Crayon. The term given to the stick of carbon upon the end of which an electric light is produced.

Creeper. (See Crockets.)

Crenelated. A notched molding used principally in Norman architecture.

Crenelle. A piece of notched ornamental woodwork.

Crest. A more or less ornamental finish to the ridge of a roof, top of a wall, etc., and also often extended to other terminal points.

Crest tile. A tile with two wings to fit the ridge of a roof and prevent leakage.

Cresting. Same as Crest.

Cricket. An alteration in a roof to protect a chimney from the rain, which would otherwise accumulate above it.

Crippling. Timbers set slanting against the side of a wall or house to prevent it from falling.

Crocket. A foliated ornament employed to finish gable and spire edges.

Crocketing. Crocket ornamentation or finish.

Cromlech. A special rude stone monumental architecture, practiced by the ancient Celts.

Cross. A public monument in the form of a cross.

Crossaisle. Same as Transept.

Crossbond. A method of bricklaying where the joints of the second stretcher course come under the middle of the bricks of the first, and so on.

Crossfile. A double convex file.

Crosshandle. One attached to a tool at right angles to its axis.

Crossbanded. A method of veneering to ornament and to change the direction of the grain in wainscoting, paneling, etc.

Crossbar. A strong bar usually placed against back doors as a protection from burglars.

Crossbeam. Same as Girder.

Crosscut saw. A long saw furnished with two transverse handles and propelled by two persons, one at each end.

Crossette. A return curve in the extremities of the architrave of a window, door, etc.; also applied to the angle of a joggled keystone. Called also ancon.

Crosspringer. Same as Crossbeam.

Crossvaulting. A system of crossing simple vaults in groined ceiling or vault work.

Crowbar. An iron lever.

Crown. The uppermost portion of an arch.

Crownglass. (See Glass.)

Crownpost. Same as King post.

Crow's foot. A notch cut across a piece of timber in which the end or edge of another is to be inserted. Called also Bird's mouth.

Crowstep. (See Corbiestep.)

Crowstone. The top stone of a gable or similar wall.

Crucible. The reservoir for melted metal at the base of a furnace.

Crypt. A subterranean vault usually under a church; sometimes applied to church basements.

Crystal. (See Glass.)

Cupola. A dome on a small scale. It is sometimes used to surmount a dome and is then often called a lantern.

Cupola furnace. In foundries an upright furnace for holding large quantities of molten metal.

Curb. The wood, stone or metal framework enveloping and fixing permanently an opening.

Curbplate. A plate used to take the place of a curb.

Curbroof. One having two descending planes on each side of the ridge.

Curtain. A designation applied to the wall separating double buildings, pavilions, etc.

Cushion capital. A short capital fashioned like a cushion, used much in the Romanesque style.

Cusp. A finished projection from the inner curve of an arch, curve of tracery, etc.

Cyclo-stylar. Said of a circular row of columns.

Cylindrical vaults. (See Vault.)

Cyma. A cornice molding, shaped like an open letter S. (See Ogee.) There are two kinds—c. recta and c. reversa.

D.

Dado. The plain part of a pedestal between the base and surbase; that part of an apartment wall next above the base; that part of a general wall foundation between the base and base course.

Dam. The front of the hearth of a blast furnace, usually of stone or brick.

Deadwood. Wood from trees which died while standing; useless wood.

Deafening. The act of filling a floor, wall or partition with material to deaden sounds; the material itself. (See Pugging).

Deal. A board usually six or eight feet long and about half a foot wide; often extended to any plank or board sawed in two; a short deal is called deal end and a narrow deal a batten.

Decastyle. Relating to a portico or colonnade having ten pillars or columns.

Deck. That portion of a mansard roof near the ridge; the upper flat plane of a curb roof.

Deckcurb. In roof building, a curb constructed to support a deck.

Deckfloor. A combined floor and roof, as on a balcony.

Deckmolding. The finish at the junction of the deck and the lower plane of the roof.

Deckroof. A roof almost flat and without parapets.

Decorated style. A term usually applied to the perfected Gothic.

Decorator. One who makes a business of dressing artistically the interior walls of any building.

Degarnish. To strip a house of its furniture and ornaments.

Demi-rilievo. Relief work in sculpture where the figures project one-half their diameters.

Derrick. A tall frame or mast held upright by stays and provided with tackle for lifting heavy weights.

Derrick crane. An upright mast or frame to which is attached at the foot a diagonal spar adjustable at any angle and capable of being revolved, used in lifting, carrying and depositing stone, iron and other material.

Design. An outline drawn upon paper of the principal features of a building.

Dial lock. A lock having one or more plates, lettered or numbered, which, being properly arranged, permits the lock to be used.

Diameter. The horizontal distance through the lower part of a columnar shaft, used as a unit of architectural measurement. (See Module.)

Diamond. A small four-sided and pointed ornamental projection used in line or band decoration.

Diamond drill. A rod drill, pointed with block diamonds, used in piercing stone, slate, etc.

Diamond groove. A groove having an acute angle in a roll in iron working.

Diamond point tool. One whose cutting edge is diamond shaped.

Diaper. Diapering. A surface decoration of figures or designs repeated at regular intervals.

Die. To merge gradually into a different surface; the flat surface of a pedestal between the base and the pedestal cornice (see Dado); a metal form or block so shaped and used as to transfer its form to other objects usually by a blow; a block having a small hole which is used to receive a punch after it has been driven through an object; a small frame used to cut metal with a screw spiral; a thin steel frame, either circular or angular, with a sharpened edge, used to cut out smaller definite shapes from a larger article.

Diestock. A frame used to hold a die in cutting screw spirals.

Differential pulley. A hoisting apparatus whose motion is obtained by differential gearing.

Differential windlass. One having different adjacent diameters from one of which the rope holding the pulley unwinds while it winds up on the other.

Dimension lumber. Lumber which is cut in large quantities to sizes mostly in demand.

Dimension stone. Stone put in a partially dressed state to be used for any purpose.

Diminished column. One the upper diameter of whose shaft is less than the lower diameter.

Diminishing. A long rule with a concave edge for establishing the degree or entasis or curvature of a column or shaft.

Diminishing stile. One not of the same, or of a uniform width.

Discharging arch. An arch placed over a door, window, or other opening, to distribute the downward pressure of the superstructure.

Discharging piece or strut. A strong piece so set as to convey pressure to a sufficient support.

Distyle. Having a front of two columns.

Distyle in antis. Having two columns in line between two antæ.

Divider. An instrument used by draughtsmen to describe circles, etc.

Dogear. Same as Acroterium.

Doglegged. A term applied to a stairway which has two or more straight flights with intervening platforms instead of wellholes.

Dogtooth. An ornamental molding devised by Gothic architects and consisting of a series of pointed projections resembling a dog's teeth.

Dome. Usually, a large curved superstructure rising above and covering a bay, intersection or termination (see Cupola); applied to any object shaped like a cupola or dome.

Donjon. A large, strong tower attached to ancient and mediæval castles. (See Keep.)

Door. The opening by which entrance is gained into a room or through a wall, etc.; the light, upright object swinging on hinges used to close such opening.

Doorcase. The frame surrounding the opening constituting the door.

Doorcheek. Same as Jamb.

Doornail. The metal projection on which the knocker struck on ancient doors.

Doorpost. Same as Jamb.

Doorsill. The strip at the foot of a door.

Doorstep. The step next before the door.

Doorstone. The stone forming the sill.

Doorstop. A strip used to stop the closing of a door as soon as the lock has caught.

Doorway. The opening by means of which entrance is gained through a wall. (See Door.)

Doric order. A building member perfected by the Greeks, but used in a simple, rugged form by the Egyptians, from whom it was obtained. As evolved by the Greeks, it consisted of a column composed of a shaft and capital, and of an entablature composed of an architrave, fricze and cornice.

Dormer. Dormer window. A vertical window or its gablet set in a slanting roof.

Double floor. One having the ceiling and flooring joists supported by intervening binding joists.

Double-framed floor. One in which the binding joists are framed into the girders.

Double window. One having two sets of sashes separated by a pier or air space.

Dovetail. A tenon which has a less diameter at the base than at the extremity; a method of uniting timbers by means of dovetail tenons whereby the pieces are interlocked so that they can not be drawn apart.

Dovetail molding. A convex molding of zigzag pattern supposed to resemble a line of dovetails.

Dowel. A piece of wood built in a wall to which other pieces may be fastened; a pin projecting from the side of a piece of wood, so arranged as to fit into a hole of an abutting piece and keep the two from sliding on each other.

Doweljoint. One formed by the use of dowels.

Down draught. That result in a chimney, shaft, etc., whereby the movement of the air, smoke, etc., is downward instead of upward.

Downcourse. The shaft which carries the combustible gases of a blast furnace back to be consumed.

Draft. (See Draught.)

Draftsman. Draughtsman. One skilled in drawing according to mechanical and artistic principles the plans and specifications used by builders.

Drag. An instrument used to finish the dressing of soft stone surfaces.

Draught. Same as draft. A current of air moving up a chimney or through a room; the plan or outline of a building drawn for guidance or inspection; a border on a dressed stone different from the face; a temporary border on a stone to serve as a guide in dressing.

Drawbore. An irregular hole so bored through a tenon and the checks that, when a pin is driven through, the tenon will be drawn tighter into the mortise.

Drill. A tool with a cutting end driven by revolutions and used to pierce metals, woods, etc.

Drillpin. The small pin in a lock over which the key fits.

Drillstock. An arrangement used to hold and revolve a drill.

Drip. That special projecting molding of a band-course, cornice, base, etc., used to deflect the rain.

Dripstone. A drip of stone.

Drop. Any small pendent member used as an ornament. Same as Gutta.

Dross. The refuse matter thrown off from the ore in smelting.

Drovechisel. A broad flat chisel used in dressing stone surfaces.

Drovework. The stone surface prepared with a drove.

Dry area. A space left outside an underground wall to keep it from becoming damp.
Dry-stone walls. Those in which no cement or mortar is used.
Dub. To dress smooth, as stone, timber, etc.
Dub out. To fill out hollows with mortar and thus make a level surface.
Dutch door. An ordinary door divided horizontally into two, so that either may be closed while the other is open.
Dwarf wall. One usually surrounding a court or garden and not over four or five feet high.
Dwelling. A house used as a residence.

E.

Earthtable. Same as Ground table.
Easement. A curvature instead of an angle given to a small building member.
Eaves. The lower edge of a roof overhanging the wall, and used to throw off the rain.
Eaves board. A board with a narrow edge, fastened on the ends of the rafters so as to raise the lower course of slates or shingles.
Eaves molding. That just below the eaves.
Edge. The thin sharp angle of a tool used in cutting.
Edgejoint. A joint made by the union of two edges which form an angle.
Edgemolding. One made by two curved moldings meeting so as to form an angle.
Edgeplane. One used to dress the edges of boards, etc.
Edgetool. One designed to be kept on edge for cutting.
Edifice. Any building, structure or house.
Egg and anchor. An enrichment of convex moldings, consisting of alternating egg and anchor carvings.
Elbow. That part of a wall bent like an elbow; a sharp angle in any woodwork; applied generally to anything shaped like an elbow.
Elevation. Used in the same sense as facade or front.
Elevator. A huge building of modern times, usually an adaptation of the clearstory plan, and used to contain or store grain.
Embattlement. A serrated parapet.
Embrasure. An opening with slanting sides, in a wall. (See Splay.)
Emplecton. Masonry, the faces of which are ashlared, while the space between is filled with rough fragmental stone and mortar.
Enamel. A kind of glass used as a covering for brick, tile, terra cotta, etc. It was known to the ancient Egyptians and to the Assyrians, who possessed the art of thus covering whole buildings of brick after they were erected.
Endiaper. (See Diaper.)
Engaged column. Same as Attached column.
English bond. (See Bond.)
Entablature. The horizontal member, consisting of architrave, frieze and cornice, which rests directly upon the capital.
Entablament. Same as Entablature.
Entasis. A slight convexity in the outline of the shaft of a column, first used by the Greeks.
Entresol. A low subordinate story between two regular stories, usually between the first and second floors. (See Mezzanine.)
Entry. A passage leading to a room. (See Vestibule.)
Epistyle. Same as Architrave.

Escape. Same as Apophyge.

Escutcheon. A small thin plate of metal used to protect wood where it is liable to wear away rapidly.

Etruscan architecture. Those styles practiced by the Etruscans.

Eustyle. (See Intercolumniation.)

Exedra. A building extension or projection of a curved form.

Extrados. The outer curved surface of the voussoirs of an arch taken collectively. (See Intrados.)

Eye of the volute. The curved center of the Ionic volute.

F.

Facade. The principal front of a building taken as a whole, and generally exhibiting the style of architecture employed.

Face. The plane formed by any surface, such as of a wall, timber, facade, etc.

Faceguard. A mask to protect the face of a workman from heat, sparks, or flying particles.

Facemold. The pattern used by carpenters to cut out similar forms from wood, metal, etc.

Facet. The fillet or long plane surface separating the flutes of a column.

Facing. The coating finish given to a wall or other surface.

False arch. A member which is an arch in appearance only.

False attic. A structure having the appearance of an attic, but having no windows or rooms and used as an ornament (generally to complete the skyline) to conceal the roof.

False bearing. Any bearing which is not sustained by a vertical support; thus, an arch, a bay or a column, resting on a bracket or corbel, has a false bearing.

False door. False window. One made to resemble a door or window for architectural effect or to be pierced for use in the future.

False roof. The space between the real roof and the ceiling of the upper story.

Fanlight. Specifically, a semicircular window over an arched door, having radiating sashes resembling the ribs of a fan; also applied to any window over a door.

Fantracery. The elaborate and intricate tracery in Gothic architecture over the intrados of the vault.

Fanvaulting. That method of vaulting by which many ribs, centering on a column or pier, spring in great number on divergent lines over the vault expanse in Gothic cathedrals. It is one of the distinguishing features of the English Gothic.

Fancy woods. Those that are rare and very valuable, such as mahogany, rosewood, satinwood, etc.

Fascia. Generally a flat band or member like a wide fillet; the flat surfaces constituting the architrave of the Ionic order.

Feather. A thin strip projecting from an object and used to prevent its turning when inserted in the groove of another object. (See Spline.)

Featheredge. Said of a board which has one edge thinner than the other.

Feathering. Same as Foliation.

Feedhead. A surplus of molten metal which by its force or head serves to make a casting complete or perfect.

Femalescrew. A spiral cavity into which another screw called male is fitted.

Fenestella. A small opening like a window or recess.

Fenestral. A window sash, casement or similar opening closed with paper, cloth, etc.

Fenestration. That which relates to the proper arrangement, proportion and ornamentation of window and door openings.

Festoon. A sculptured ornament of flowers and fruit tied with a ribbon and hung in loops.

Fettle. To line with cinders and slag.

Fid. A bar or pin used to steady or support anything.

File. A steel instrument with cutting ridges.

Filigree. Ornamental work after arabesque patterns.

Fillet. A narrow flat and usually long projection, the type of which appears between the flutings of a shaft.

Filleting. In wall or batter work the projection of a joint by means of cement or mortar.

Finial. An ornamental representation of a bunch of flowers, leaves, etc., used to top the pointed extremities of members in Gothic architecture; also the entire pinnacle.

Finish. The fine joiner or carpenter work used to complete the interior of a building; also the last touches of any of the building arts.

Finisher. The workman skilled in finishing.

Finishing coat. The last thin coat of plaster applied to walls; the last coat of paint.

Firebrick. An infusible brick made from clay and a cementing substance and used to line fire boxes, etc.

Fireescape. An arrangement to assist persons in escaping from burning buildings otherwise than by the usual mode of egress.

Fireboard. A chimney screen used to close a fireplace when not in use.

Firedog. The support upon which wood is placed in a fireplace.

Fireplace. A recess in a wall where fire is built.

Fireproofing. The incombustible materials used in building.

Fishjoint. A joint formed by two plates fastened upon the meeting ends or edges.

Fishplate. One of the strips used to fasten the ends together, thus forming a fish joint.

Fix. The act of lining a puddling furnace hearth with felting.

Flagging. A number of flagstones.

Flagstone. Any kind of stone that will split into layers, used for pavements, etc.

Flamboyant architecture. That French Gothic style where the tracery of windows, etc., is wavelike or flamelike.

Flange. A ridge or rim used to strengthen objects, arches, beams, etc.

Flank. The side of a building.

Flaptile. A tile bent to turn a corner or throw off rain.

Flashing. The metallic covering to ridges and roof hips; metal built into walls so as to flap over edges, ridges, etc.; the metal covering of roof valleys; the protection of breaks in walls by the use of water-proof materials; the reheating of glass to restore its malleable condition; the art of covering white glass with a layer of colored glass.

Flat. A story or floor of a building with all the necessary rooms and appliances for a complete residence.

Flintglass. A dense brilliant glass made essentially from silicate of lead and potassium.

Flitch. One of the pieces which, when united and nailed together, form a beam or girder.

Float. A trowel used by plasterers to level the floated coat.

Floatstone. A porous siliceous stone used to secure smooth surfaces by rubbing.

Floating screed A section of plastering first prepared to determine the thickness of the coat.

Floating. The second of three coats of plastering.

Floor. That portion of a room upon which persons, tables, chairs, etc., stand.

Floorcramp. A tool used to tighten flooring boards before they are nailed down.

Floorlight. The window-like frame containing glass in a floor.

Floorplan. A horizontal section of a building showing the location and thickness of walls, partitions, etc.

Flooring. The material used in building floors.

Florentine mosaic. A beautiful mosaic of valuable stones with a background of white or black marble.

Flush. Having an even surface.

Flute. A groove or channel having a rounding profile.

Fluted column. One the shaft of which is ornamented with flutes.

Flyer. One of a series of parallel steps.

Flying buttress. A diagonal bridge-like structure used to receive a thrust which can not be sustained by an ordinary buttress.

Foil. The small arch between the cusps in a Gothic ornament; an ornament resembling leaves in windows. Trefoil, quatrefoil, quinquefoil, refer to the number of small arches in a single member.

Folding door. One of two or more doors used to fill the same opening, and swinging on hinges.

Foliated. A member ornamented with foils.

Foliation. An ornamentation by the use of foils, usually applied to an opening thus embellished.

Footing. A thickened part of a wall near its base.

Footingcourse. A course of masonry in the wall near its foot, wider than the rest of the wall.

Footingbeam. One used to tie the members of a roof.

Footstall. A term applied to the plinth of a pillar.

Formeret. A half rib in a ribbed vault.

Fornicate. Fornicated. Arched or vaulted.

Foundation. The lowest member of a building used as a support for all above.

Foundation course. Same as Base course.

Foxwedge. One used to spread the end of a bolt by being driven into a split made for that purpose.

Frame. The structural parts of a building which, united, form the skeleton.

Frame building. One of which the structural parts are framed timbers.

Framelevel. One used by and made for a mason.

Framing. A series or system of framework.

Franking. The process of jointing window sash by removing only enough wood to show the miter.

French casement. (See French window under Window.)

French roof. One like a mansard, but having the upper slope nearly flat.

Fresco. A painting on plaster which is either green or dried.

Fret. An ornament, the figure of which is a system of fillets departing at regular intervals at right angles, thus repeating *ad infinitum* the figure.

Fretsaw. (See Scroll law.)

Fretwork. A system of ornament consisting of frets.

Frieze. One of the three principal members of an entablature, which is between the other two, and which has a flat surface to be enriched with triglyphs, sculptured figures, flowers, etc.; any rich horizontal band in a building.

Front. A term used with the same meaning as facade.

Frontage. The space covered by the front of a building.

Frontal. A small gable or pediment used to crown a door or window.

Frontispiece. The principal front or facade or elevation of a building (rare).

Fronton. Fr. Same as Frontal.

Frustum. One of the circular sections which compose the shaft of a column.

Fumerell. Same as Femerell.

Fur. To fill up and make level with strips a surface for boarding or plastering, or for protection against moisture.

Furniture. Builders' hardware, such as locks, bolts, catches, etc.

Furring. The making level of a surface for lathing, boarding or air space.

Fusarole. A kind of molding usually found under the echinus in the capitals of the Doric, Ionic and Corinthian orders.

Fust. Same as shaft of a column or trunk of a pilaster.

G.

Gable. The upright triangular portion of the end wall of a building, above a horizontal line joining the eaves; a similar portion when it is not triangular in shape; sometimes applied to the entire end wall of a building; also often applied to other surfaces, as the triangular space over doorways in Gothic architecture.

Gableroof. A roof descending from the ridge in two straight slopes and forming at the end of the building a triangular gable.

Gablewindow. Any window in a gable.

Gablet. A small gable over a recess containing statuary, etc.

Gain. The notch in a girder, etc., in which the floorbeam rests.

Galilee. A term sometimes applied to a church porch.

Galvanized iron. Iron which has been given a coating of zinc, by immersion in a bath of that metal.

Gambrelroof. One which descends from the ridge on both sides straight for some distance, and then suddenly both planes change to a more abrupt pitch, and thus descend to the eaves. The gable is thus made pentagonal. (See Curb roof.)

Gang. A group of workmen under one boss or foreman.

Gangsaw. One of a group of saws hung on the same frame, and all moving together at set intervals apart.

Gangue. The dross and earthy matter found associated with metallic ore.

Gargoyle. A grotesque spout to a roof, valley or gutter, often made to represent an ill-shaped human being.

Garret. That portion of the interior of a house next underneath or between the roofs. Same as Attic.

Garreting. Small pieces of stone used to fill up the joints between larger stones in masonry.

Gas. An inflammable mixture produced by the distillation of bituminous coal and consisting of marsh gas $CH4$, olefiant gas $C2\ H4$ and hydrogen H.

Gasfitter. One whose business is to lay and unite the pipes which convey gas to the consumer.

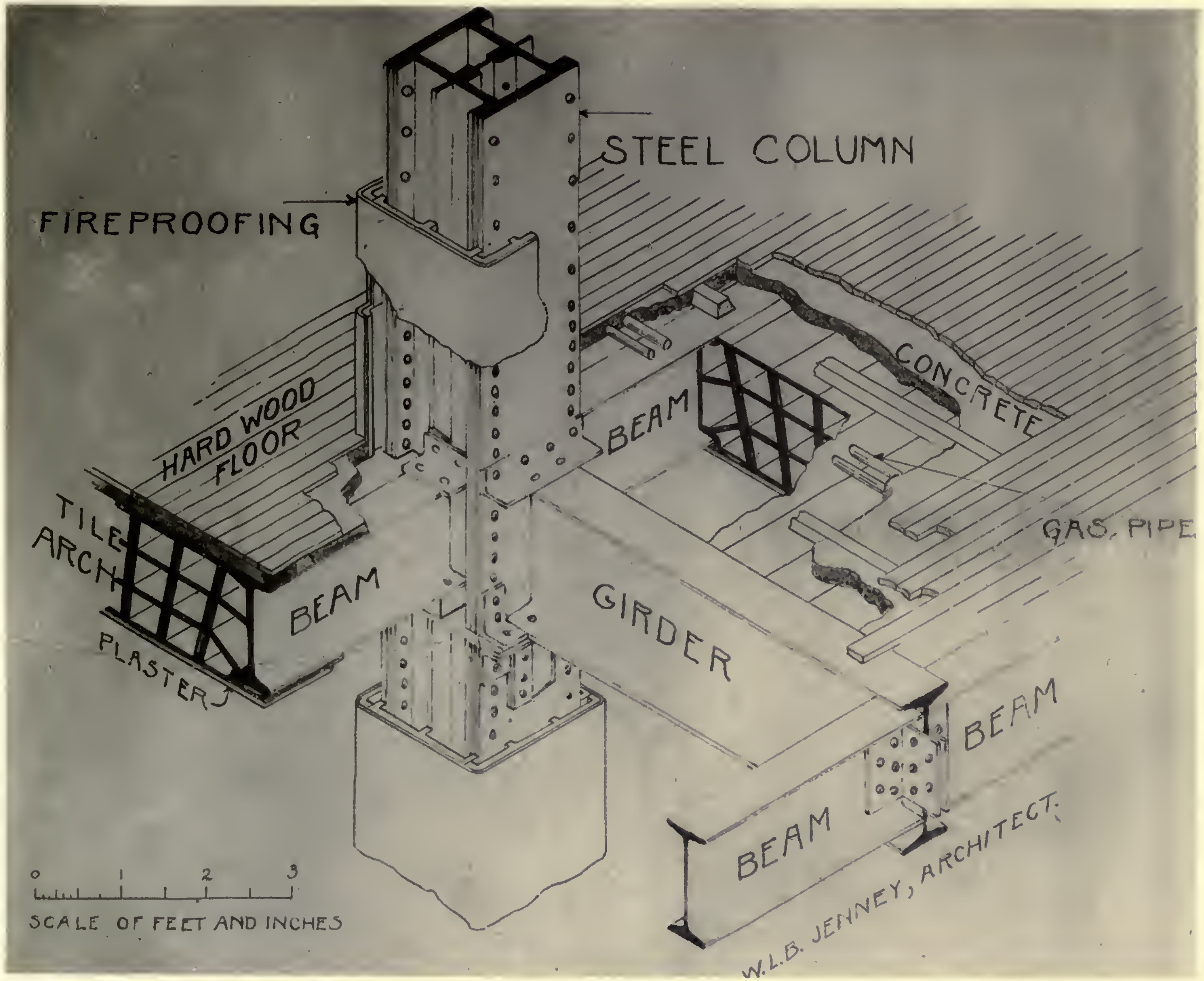
Gasfixture. The piping which serves as a conductor for gas.

Gasjet. A single flame of gas.
Gasmeter. An arrangement which measures the quantity of gas used by the consumer.
Gasworks. The manufactory where gas is made.
Gasburner. The small tip where the gas escapes and is lighted.
Gaslight. Light obtained by the combustion of illuminating gas.
Gasometer. A large vessel at gasworks where gas is stored ready for distribution to the consumer.
Gasoscope. An instrument whose use is to determine the presence of small quantities of gas.
Gate. The opening through which molten metal is poured into the mold.
Gather. To bring closer together, as masonry is often diminished from the bottom to the top.
Gather. The soffits of masonry which is gathered.
Gauge. A certain amount of plaster of paris used to set common plaster. Wire-gauge. An instrument for measuring the thickness of sheet metal, wire, etc.
Gaugestuff. A plastic plaster used as a model in making moldings, etc. Also called gauged mortar.
Gauged brick. One that is made of an exact size for special use in arches, recesses, etc.
Gigsaw. Same as Jigsaw.
Girder. A straight, horizontal beam, used to span an opening and to carry weight.
Glass. A hard, brittle substance, usually transparent, made by the fusion of sand with potash, soda, oxide of lead, etc. It is variously colored by the metallic oxides.
Glasscutter. A cutter or polisher of glass.
Glasscutting. The act of cutting or polishing glass.
Glassmetal. The fused mass from which glass is evolved.
Glasspainting. Colored decorative work on glass.
Glassworks. A manufactory where glass is made.
Glassmaker. One who manufactures glass.
Glaze. To provide the windows, doors, etc., of a house with glass; to cover brick or porcelain with a thin glass-like coating; to apply a transparent paint in order to modify a former coat of paint.
Glazer. One who gives a glass-like surface to anything.
Glazier. One whose business is to set glass.
Glazing. The art of setting and polishing glass; modifying paints applied to reduce the effect of others
Gloryhole. An opening showing the strong white light on the interior of a glass furnace.
Gorge. A molding with a concave section. Same as Cavetto.
Gorgerin. The small portion of the capital between the top of the shaft and the small flat fillets under the echinus. In some columns there is no such space. (See Neck.)
Gothic architecture. A style which flourished in western Europe from about 1200 to 1475 A. D., and characterized by pointed arches and gables, vertical members, large windows, clustered columns, pinnacles, cusps, crockets, bosses, finials, systematic proportion of interior spaces, rib-vaulting, window tracery, etc.
Gradine. Any building member which rises like a step above others; thus the tiers of seats in a theater.
Gradino. A raised step or shelf.
Grafting. To form a scarf joint of the ends of two timbers.
Grain. The direction of the fibers of wood.
Grained. Painted to imitate the grain of wood.

Graining. Painting in imitation of wood or marble grain.
Groin. The curved projecting angle formed by the crossing of two vaulting surfaces.
Groin. To provide with groins.
Groove. A term applied to a hollow molding or other similar building member.
Grotesque. A term applied to irregular figures in architecture.
Ground. The surface upon which painting or decoration is laid.
Grounds. The pieces of wood inserted in the walls and made flush with the surface of the plastering and to which moldings or bands are attached.
Groundplan. A horizontal section of the lowest story of a building, showing the location of walls, columns, staircases, doors, windows, etc.
Groundplate. One of the strong, heavy timbers laid horizontally on or near the ground into which the uprights of a building are mortised. Same as Groundsill.
Groundtable. (See Earthtable.)
Grouped columns. A group of three or more columns resting upon the same pedestal.
Grozingiron. A tool used to smooth the joints of lead pipes which have been soldered.
Guilloche. A scroll-like ornament formed of two or more lines woven together and furnishing a continuous series with circular openings between.
Gula. A molding used as a cap or crown. Same as Cymatium.
Gutta. A small ornament placed under the triglyphs and the mutules of the Doric order and shaped like the frustum of a cone. Same as Campana and Drop.
Gutter. A long hollow trough at the eaves of a house for carrying off the rain water.
Gutter member. A gutter that has been ornamented and otherwise made a distinct and notable building feature.
Gutterplane. A plane with a convex bottom used to dress gutter bottoms.
Gypsum. The hydrous sulphate of lime. Some of its forms are plaster of paris, selenite and alabaster.

H.

Hagioscope. Same as Squint.
Halfround. A molding, the curved section of which is a half circle.
Half timbered. A building, the frame of which is timber but the wall spaces of which are of brick or other masonry.
Hall. Usually the first room to be entered from the outside after passing through the vestibule; a vestibule or entrance room itself; an entry or passage way.
Halve. A method of joining timber by cutting away half the ends of two pieces so that the remainder will fit together and form a continuous member of the two.
Hammer. An instrument usually of steel, having a handle and used to drive nails, etc.
Hammerbeam. A braced, projecting truss used in roofing to take the place of, or abolish, the tiebeam. It is used chiefly in Gothic architecture in vaulting.
Hangingrail. The rail to which the hinges of a door, etc., are fastened.
Hangingstile. The frame or stile of a door upon which it is hinged and hung; also the frame of the window upon which the hinges are fastened and the window is swung.
Hanse. That part of an elliptical arch nearest the impost.
Hardfinish. A hard, smooth, thin coat used by plasterers to finish their walls.
Haunch. That portion of an arch nearest the impost consisting of about two-thirds of the half-arch.



ISOMETRIC VIEW OF AN INTERIOR COLUMN, FAIR BUILDING.

Header. A stone or brick so laid that its shorter face is flush with the wall; a short piece of timber which carries the tailpieces, but is in turn carried by the trimmers.

Heading. The end of a brick, stone, etc., which is laid flush with the wall.

Headingcourse. One in which the shorter ends of all the stones or bricks are laid flush with the wall.

Headingjoint. One formed at right angles to the grain of the wood; a joint formed by two voussoirs in the same course.

Headway. Sufficient space over the upper step of a stairway, or under an arch or beam, to allow upright and easy passage.

Heartbond. One where the two header stones or bricks are laid side to side or end to end and are held by another laid like a header.

Hearth. The floor of a fireplace.

Heater. One whose business consists in furnishing buildings with suitable heating apparatus.

Heel. The lower end of a timber standing upright; a cyma reversa.

Heelpost. The post upon which a door is hung.

Helix. The small volute between the larger ones on the capital of a Corinthian column.

Hemiglyph. The half groove at the sides of the Doric triglyph.

Hexastyle. Having six columns to the front portico.

Hickory. A wood famous for its density, strength and elasticity.

Hinge. A flexible joint consisting of one or more upright rods over which an equal number of small cylinders fit, the rods and the cylinders, respectively, being connected with plates that are screwed fast to the door frame and the door.

Hip. The outer angle formed by the junction of two roof planes extending in different directions.

Hipknob. An upright ornament or finial at the end of a roof ridge.

Hipmolding. A molding running up the hip of the roof and concealing that joint.

Hiprafter. The rafter extending from the corner of the wall plate to the end of the ridge.

Hiproof. A roof with sloping sides and sloping gables.

Hiptile. One made specially for the hip of a roof.

Hogback. A sharp upward curve or angle of any horizontal member. (See Camber.)

Hollow newel. The opening around which a circular staircase ascends; the circular handrail which guards such opening.

Holly. A fine-grained, heavy, white wood, useful to cabinetmakers.

Hood. A chimneycrown or top which turns with the wind, and thus insures a constant draft; the chimney projection over a fireplace.

Hoodmolding. A molding which extends along the outmost edge of the archivolt and projects beyond its face. It may be seen on thousands of buildings in Chicago.

Horn. A term sometimes applied to the Ionic volute; a projection on the front end of a carpenter's plane.

Hotbed. A place in a rollingmill where hot bars are left to cool.

House. A structure intended as a habitation, either for man or the lower animals, and having some dignity of appearance.

Housing. A space or notch cut in the end of one timber in which a tenon of another is to be inserted; a recess provided for a statue.

Hue. The most noticeable shade in a mixture of colors.

Hypostyle. Standing upon columns or formed of columns.

I.

Imperfect arch. (See Skew arch.)

Impluvium. A tank in the peristyle of Roman houses to receive the rainwater from the roof.

Impost. The capital of a pier, pillar, wall or post, which sustains the arch.

Continuous impost. One where the moldings of the arch extend without interruption down the jamb, pillar or pier.

In antis. An arrangement where two columns are placed in line between two antæ which form the corners of the porch or building.

Incrustation. A layer or revetment of mosaics attached in mass to walls, etc.

Inlay. The insertion of small pieces of rich wood on a ground of some other material, thus forming a decorative or ornamental surface.

Inside finish. Any work upon the interior of a building designed to complete it.

Intercolumniation. The space between the bottom of the shafts of any two adjacent columns. (Pycnostyle, systyle, enstyle, diastyle, aræostyle, aræosystyle.)

Interlacing arches. A series of arches resting on columns so close together that all arches spring to every alternate column, and thus cross each other or interlace.

Intermodillion. The distance or space between any two modillions.

Intermural. The space between walls, as windows, doors, etc.

Interpenetrating molding. An arrangement of moldings in Gothic architecture, whereby they seem to pass through each other or through other members, as pillars, ribs, etc.

Intrados. The under surface of the entire expanse of an arch.

Inverted arch. One where the curvature is downward instead of upward. It is used principally in foundations.

Ionic order. One of the three great orders employed by the Greeks and characterized by the spiral volutes on its capital.

Iron. A very useful metal, the color of which is usually brown from oxidation. It oxidizes easily, has strong magnetic properties and is usually found in nature as an oxide. Its specific gravity is 7.86, and atomic weight 55.9. It is both malleable and ductile. Cast iron, wrought iron, steel, etc., are varieties of it.

Iron furnace. An arrangement where iron ore can be subjected to great heat, and thus be reduced to a molten mass, freed from impurities and subjected to use.

Iron ore. Any form of iron as it is found in nature, such as hematite, limonite, magnetite, siderite, turgite, gothite, bogiron, clayiron, etc.

Italic order. A term sometimes applied to the Composite order.

J.

Jack. Same as sawhorse and sawbuck; a small screw-like machine used to lift buildings and other great weights, and worked with a lever.

Jackarch. One having the thickness of a single brick.

Jackplane. A plane used by carpenters for rough work.

Jackrafter. Any subordinate rafter in a building.

Jacktimber. Any piece of timber shorter than its fellow-pieces.

Jacktruss. A short truss in a hiproof.

Jackscrew. Same as Jack.

Jamb. The side of a doorway or window-opening; any narrow upright surface on the side, as distinguished from the face.

Jerkinhead. A roof hip the upper portion of which ends in a truncated gable.

Jessewindow. One upon which is represented the tree of Jesse.

Jetty. That portion of a building made to project over a lower portion.

Jibdoor. One that is hung even with the surface of the wall, neither projecting nor receding.

Jigsaw. See scrollsaw and gigsaw.

Jobbing. Uncertain work undertaken as a whole.

Joggle. A notch or flange in any material made to fit a similar reversed one in other material, the object being to prevent the sliding or slipping of the pieces when fastened together.

Joggle. To use joggles in uniting timbers, masonry, etc.

Jogglejoint. Any joint formed in building where joggles are employed.

Joint. The line of union of any two or more surfaces of building material which are fastened together.

Jointer. A long plane for smoothing the surface over joints; a bent piece of iron fastened in a wall of masonry to make firm the joints; a peculiar trowel for dressing the mortar between joints.

Jointingrule. A long rule used by bricklayers to secure straight wall faces, etc.

Joist. Horizontal structural timbers in a building upon which flooring or furring strips are fastened.

Jube. A screen in front of a chancel; a small gallery which formerly surmounted such screen.

Jump. An abrupt change of level or face in brickwork or stonework.

Jutting. Applied to small members like corbels, brackets, cornices, etc., which project.

Jutty. Any projection in a building, usually applied to small members.

K.

Keep. Same as Donjon.

Kerf. A small notch or channel made by a saw in a timber.

Kevel. A hammer made specially for and used by a stonemason. (See Cavil.)

Key. A small instrument by which the concealed lock of a door is thrown either out or in; a small wedge; the last board of a floor laid down; so much of the plastering as, when put on green, is forced through between the lath forming a back, when hardened, that holds the plaster to the wall.

Keyup. The act of driving in a keystone and thus forcing up the whole curved line of an arch.

Keyhole. The opening in the lock into which the key is inserted to work the bolt.

Keyhole saw. A long, narrow saw used to cut keyholes.

Keystone. The central stone, block or voussoir of an arch.

Kick. A small projection in the mold, the imprint of which is to appear on the bricks.

Killesse. A small gutter or channel; any kind of a hiproof.

Kingpost. A vertical truss or support extending from the upper joint of the rafters, or the roof ridge, to the tiebeam, and used primarily to keep the latter from sinking. (See Crownpost.)

Kingtruss. A diagonal truss used with a kingpost.

Kneetimber. A piece containing angles.

Knob. A circular projection on the lock of a door used as a handle.

Knoblatch. One which can be worked by the knob alone.

Knocker. A kind of swinging contrivance used to make a noise on the outside of a door.

Knop. Any sculptured ornament of strong projection, like a finial.

Knosp. Same as Knop.

L.

Label. A projecting molding over the top and partly down the sides of a doorway or window opening, in Gothic architecture.

Labyrinth. An intricate pattern or design usually inlaid on floors.

Lade. To convey molten glass from the melting pot to the forming table.

Laminated arch. One made of layers of bent planks fastened together with long wooden pins.

Lancet arch. The narrow, pointed arch of Early Gothic architecture.

Lancet architecture. A term often applied to the Early Gothic.

Landing. The floor space which connects two flights of stairs or is at the extremity of either.

Lantern. A small cupola upon a roof or upon a larger cupola; a more or less open structure upon a roof to admit light and air; a smaller dome or tower opening into a larger one and generally richly ornamented.

Lap. The distance which one course of shingles, or slates, extends over the second one below.

Lapjoint. A joint where one part extends over or partly over another.

Lath. A thin, narrow piece of wood which is nailed to the studding of a house to serve as a ground for the plaster; anything—wire, metal strip, etc.—answering the same purpose.

Latten. Any metal made into thin sheets.

Lattice. A framework of wood or metal strips laid crosswise, thus forming a net-work.

Lattice girder. One whose interior section is composed of diagonal strips formed and fastened into a lattice.

Lead. A dull, heavy metal, whose specific gravity is 11.37 and atomic weight is 206.4. It is malleable and ductile, and is the principal ingredient of solder used by plumbers.

Leader. A pipe which carries rain water from a roof to a cistern.

Leanto. A small structure placed against the side of a house, and having a single pitched roof of the same plane.

Ledger. A horizontal piece of timber which serves as a support to flooring, staircases, etc.

Ledgment. A horizontal band of moldings, such as a stringcourse, basecourse, etc.

Level. An instrument for ascertaining and establishing the horizontality of a line or a plane, usually determined by a bubble in a glass tube nearly full of alcohol; another consists in fixing a horizontal line by placing it at right angles to a plumb line.

Linen scroll. An ornament representing paper, cloth, etc., rolled and used to decorate panels and other mural spaces. It is also called Linen pattern.

Lintel. The straight beam or member used to cover an opening and sustain the superincumbent weight. It is often assisted by a Discharging arch.

List. A small molding of square section; a fillet; often called listel; a narrow strip of wood taken from the edge of a board or plank.

Listel. (See List.)

Listing. A small strip, usually sapwood, taken from the edge of a board.

Lithic architecture. That composed wholly of stone.

Loam. A mixture of sand, clay, etc., used in making molds for castings.

Lockrail. The rail nearest the lock in a paneled door.

Lockrand. A range of bondstone.

Loggia. An open gallery, roofed, usually richly ornamented, but not projecting from the wall. It is more like an external room, with the outer wall removed and replaced with columns. (See Veranda.)

Lotus. An ornament in Egyptian architecture supposed to have originated from the leaf of the water lily of the river Nile.

Louvreboards. The sloping slats or boards in belfry windows and elsewhere, designed tc throw off rain water; also a small lantern.

Low relief. See Bas-relief.

Low side window. A narrow window of uncertain location piercing the walls of mediæval churches.

Lozenge molding. A Norman ornamental molding, upon which are lozenge-shaped figures.

Lucarne. Same as Dormer window.

Lumber. Timber that has been formed into boards, planks, beams, studs, rafters, joists, etc.

Lunette. A segmental or semicircular surface of any kind.

Lunette window. A window which pierces a lunette.

Lute. A piece of wood having a straight edge, and used to cut off clay which clings to the mold in brickmaking.

Luthern. Same as Dormer window.

Lychnoscope. Same as Low side window.

Lying panel. One where the grain of the wood runs horizontally.

M.

M roof. An ordinary gabled roof, doubled at the side and united so that the section of the two is shaped like the letter M.

Machicolation. An opening between brackets in a parapet, through which shots or missiles can be fired.

Main couple. The roof truss subjected to the greatest strain.

Malleable iron. Cast iron strongly decarbonized, and thus made so soft and tenacious as to be readily shaped under the hammer.

Mansard roof. A roof with two slopes on all sides, the lower one being steeper, and often, though not always, concave, and the upper one often nearly flat or horizontal. Dormer windows often pierce the lower slope.

Mantel. An ornamental finish around a fireplace, across the chimneybreast and usually down the sides.

Mantelpiece. The shelf of the mantel.

Manteltree. The principal piece of timber which spans the fireplace, or the lintel which supports the chimneybreast.

Margin draft. The straight, smooth margin on ashlar work next to the joints.

Margin of a course. That portion of a course of slate or shingles which is left uncovered to the weather.

Marquetry. An inlay of colored stones, woods, shells, etc.

Mask. A whimsical or grotesque face, partly fanciful, employed to ornament corbels, keystones and sometimes panels.

Mason. One who makes a business of building with stones, bricks, etc.

Match-boarding. The process of fitting together two or more boards with tongue and groove.

Matchplane. Either of the two planes employed to prepare the edges in match-boarding.
Mauresque. (See Moresque.)
Meander. Same as Fretwork.
Member. Any distinct building form, as pier, lintel, corbel, bay, molding, arch, etc.
Merlon. One of the uprights of a battlemented parapet.
Metoche. The small space between two triglyphs or two dentils.
Metope. The space between two triglyphs of the frieze of the Doric order. On the metopes of the Parthenon are heroes and centaurs, in high relief, engaged in combat.
Mezzanine. A shorter story not on the same level as either of the main stories between which it occurs. (See Entresol.)
Mezzo rilievo. A kind of relief midway between high and low.
Middlepost. Same as Kingpost.
Mill. A system of machinery which transforms crude material into definite products.
Milling. The process of shaping and dressing lumber, iron and other products from crude material; the product which results.
Minaret. Mineret. A tall, narrow tower with or without balconies, attached to any building, especially a mosque.
Mindra. A cell.
Minster. The church attached to a monastery.
Minsterhouse. The official residence of the canons of a cathedral.
Minster gallery. (Ancient.) A place occupied by singers.
Mirrorplate. Flat glass for mirror or an unframed mirror.
Miserere. A hinged aisle seat.
Miterbox. Mitrebox. Mitrabox. A wooden or metal trough with slits in its sides to guide the saw in making miter joints.
Miterdovetail. A dovetail for a miter joint having only one joint line visible, and that at an angle.
Mitergauge. An instrument for determining the angle of a miter.
Miterjoint. A joint of wood or metal at beveled ends, at a right or other angle; hence miter arch.
Moat. A quite deep canal-like ditch surrounding a castle, etc.
Model. An example for measurement or imitation. A working model is a small machine made in imitation of a large one and doing the same kind of work.
Modillion. A carved or otherwise ornamented block or bracket such as is used at regular distances under cornices of the Corinthian and Composite entablatures, sometimes plainer in the Ionic and other styles.
Module. An architectural measure of distance.
Mold. Mould. The matrix in which a metallic or plaster article is formed.
Molding. Moulding. A narrow surface, plane or curved, sunk or projecting, in which decorative effects are produced by lights and shades upon it. Varying greatly in pattern, some of the most common are known as the astragal, apophyges, band, cavetto, cymatium, casement or scotia, ogee, ovolo or quarter round, reeding and torus moldings.
Mole. A pier; a sea wall; a Roman mausoleum.
Molinet. Mouline. Moulinet. A diminutive mill for grinding; a drum in a crane or capstan upon which the rope is wound.
Monastery. A house of seclusion for monks.
Monochrome. Relating to decorating in one color.

Monitortop. A raised portion in the center, or a clearstory on a roof with low side windows, as on a car roof.

Monolith. Monostyle. A shaft, usually large, as a statue, pillar or monument, formed of only one stone.

Monopteral. Monopteron. Monoptral. Consisting of one circle of pillars or columns to bear a roof.

Monotriglyph. An intercolumniation in an entablature in which there are a single triglyph and two metopes.

Moosewood. Also called leatherwood and wicopy; a small branching shrub characterized by soft white wood and tough leathery bark; the striped maple.

Moathall. A public meeting place, as a townhall.

Moresque. Mauresque. That style of architecture or decoration practiced by the Moors.

Morion. A dark, smoky quartz.

Mortise. A place cut out of the side of a piece of timber, large or small, to receive a tenon or projection on the end of another piece to join the two by a mortise joint.

Mosaic work. Ornamental work in the form of pictures or fanciful designs formed of small pieces of marble, stone, glass, etc., each cut and colored to fill its proper place in producing the desired effect.

Mosque. Musjid. A Mohammedan church.

Mudsill. In a building the lowest sill lying partially in the earth; in a bridge a sill at the bottom of the stream.

Mullions. Munnions. Bars in windows and screens of artistic design corresponding in use to ordinary sash bars; sometimes applied to upright divisions in wainscoting.

Mural. An architectural decoration on the face of a wall.

Muntin. An upright piece of framing.

Muskwood. A fragrant West Indian and Australian mahogany.

Mutule. A projecting block under the corona of a Doric cornice, often sloping downward toward the most prominent portion, corresponding to the modillion in Corinthian and Composite architecture.

Mynchery. Convent.

N.

Nailhead molding. A Norman molding apparently studded with nail heads.

Naos. The interior portion of a temple.

Nave. That part of a church between the transepts and the principal entrances, or between the choir and the principal entrance, exclusive of the aisles; in conventual churches separated from the choir by a screen.

Nattes. A molding made in imitation of straw plaiting or matting.

Needle. A horizontal timber support.

Nerves. Nervures. The moldings of the ribs in groined masonry, notably in the Flamboyant style.

Net masonry. That in which a diamond pattern is used.

Neck. That part at the bottom of a capital between the moldings and the top of the shaft, the moldings in Gothic architecture being often referred to as "neck moldings."

Newel. Neul. The central post about which are built the steps of a spiral staircase; the principal posts at the foot of a staircase; the posts at the various landings. In some buildings the newel post extends above the last step to the vaulted roof, and supports curved roof-supporting ribs which radiate from it.

Niche. A cavity or recess in a wall for a statue, bust, vase or other ornament placed perpendicularly.

Nidged Ashlar. Nigged Ashlar. Stone pick or hammer-dressed, instead of being cut with a chisel.

Nogs. Wood blocks imbedded in walls to which finishing work may be attached.

Norman style. This style of architecture arose in the tenth century. Its distinguishing characteristics are massiveness, simplicity and strength, the semicircular arch, heavy round columns, and many peculiarities of ornamentation, among which those of zigzag or apparently twisted, ropy designs were most noticeable.

Nosing. The projecting molding on the edge of a step, or other prominent edge of molding.

Nulledwork. Wood or metal turned to represent beads strung on a rod.

Nut. A head with internal screw for a bolt.

O.

Oak. A valuable timber tree of the genus Quercus.

Obelisks. Quadrangular shafts of stone erected as monuments.

Oblique arches. Angular arches.

Octostyle. A portico with eight front columns.

Oculus. A small, circular window.

Odeum. A rehearsal or music room.

Offset. A horizontal ledge on the face of a wall caused by a decrease of its thickness, or by the weathering or upper surface of a portion projecting from it. Set-off is used in the same sense. Offset is applied also to an abrupt bend in a rod or other object by which a portion is brought nearly parallel with the rest.

Ogee. O. G. A term applied to a molding, one part of which is round, another part hollow, the face bearing resemblance to the letter S, or to any similar ornamental device used for any purpose.

Ogee arch. A pointed arch with an ogee curve on each side.

Ogival. A French term meaning Gothic.

Ogives. Diagonal arches in groined ceilings.

Olivewood. A name given in Australia to the wood of trees and to trees of the genus Eleaodendron. This wood is hard and white.

Omanderwood. An ebony found in Ceylon.

Omnibus. A thin iron cover used in glass manufacture to protect articles from drafts while being annealed.

Oölitic limestone. A variety composed of small globular grains resembling the roe or egg of a fish.

Openwork. Anything of wood, metal, or other material so constructed that it has openings between its parts or through its substance.

Opisthodomus. An enclosed space in the rear of a cell in a Grecian temple.

Oratory. A small private chapel devoted to orisons, or prayer.

Orchestra. The space railed off in a theater for the musicians.

Orb. A blank panel or window.

Order. A general term applied to special architectural designs. The arrangement of a column and its parts and the entablature supported by it, in classical architecture. There are five orders, as they are usually recognized by Renaissance writers on architecture: the Doric, Ionic, Corinthian, Composite and Tuscan, though the Tuscan and Composite, by some called the Roman orders, are practically modifications of the Doric and Corinthian.

Organ. This term was originally applied to almost any musical instrument used in churches, but has now come to be applied architecturally only to large modern stationary organs, though formerly each of the pipes of an organ was called an organ.

Orgue. Each of a series of long, heavy, pointed, and iron-shod pieces of timber suspended each by a separate rope over a gateway, to be lowered at times of assault.

Oriel. A bay or other projecting window, or any projecting part of a room forming a recess inside, was formerly called an oriole, the original meaning of which was a little place of prayer, and the term oriel is now applied more especially to such projecting windows as are small, either round or polygonal, and rest upon corbels instead of the ground.

Orillon. A name given to semicircular projections at the shoulders of bastions found in old fortresses and intended to cover the retired flank.

Orthostyle. A directilinear arrangement of columns.

Oundy moldings. Moldings of a wavy pattern.

Outbuilding. Outhouse. A structure separate from, yet auxiliary to, a larger one.

Outfall. Outlet. A drain's mouth; a pipe's mouth.

Out of winding. Straight and flat; not crooked or twisted.

Out to out. Distance from side to side or end to end.

Overshot wheel. A water-wheel provided with buckets around its circumference and placed underneath a fall of water, which, exerting its force on the buckets, causes the wheel to revolve.

Overistory. Overstory. The upper or clearstory of a building.

Ovolo. A convex molding composed of some part of a circle; in the Roman order one-fourth of a circle being thus employed; in the Grecian it being flatter with the top bent or quirked inward. It was not much utilized in middle-age architecture, and is seldom found in any except the Decorated style, and not often in that.

P.

Pace. A dais.

Pagoda. Tower-like buildings erected by the Hindoos and Buddhists of India, and commonly though not invariably devoted to the worship of idols, are designated pagodas by Europeans.

Palace. The residence of a sovereign and the quarters of high officers of state; or the official residence of a bishop. The term is also popularly applied to any house of surpassing magnificence.

Palæstra. A portion of a Grecian gymnasium.

Pale. A pointed stake, slat or pole, driven into the ground or erected after the manner of picket fencing; a pallet is a small pale: any fixed series of pales is known collectively as paling.

Palisades. A substantial fence or inclosure.

Palm. An ancient measuring unit based on the width of the hand; four inches.

Palladian. Referring to the Italian school of architecture originated by Andrea Palladio.

Pampre. A device composed of bunches of grapes and vine leaves employed in the ornamentation of spiral columns.

Pan. A shallow cavity or recess to receive the leaf of a hinge.

Pancarpe. Carvings representing fruits, flowers and garlands.

Pane. An old term applied to a flat space or to a compartment of a surface; to the sides of a spire, tower or turret, usually built with four to eight sides or panes; to the separate glass spaces of windows when glazed, and to the glass cut for such use.

Panel. A depressed surface with elevated margins molded or otherwise, of which examples are afforded in doors, ceilings and wainscotings; in masonry one of the hewn faces of a cut stone; a portion of a framed structure separated from others by posts or struts is so called.

Pantile. A roof-tile in curved form.

Pantograph. An ingenious instrument for copying plans, drawings or maps, etc., of the same size as the original, or larger or smaller.

Pantry. A room devoted to the storage of culinary articles.

Paperhanger. An artisan who hangs wallpaper.

Paperhangings. Wall paper in all its qualities and designs.

Papier mâché. A substance made from paper pulp combined with size or glue, etc., and molded and used quite extensively in certain classes of interior decorations.

Parabola. A curved geometrical line.

Paraclose. Parclose. A screen in cathedrals between side chapels and the body of the church.

Paradise. The cloister of a monastery; the burial places within monasteries.

Parallelcoping. A coping equally thick throughout and laid on inclined surfaces, such as gables, etc.

Parapet. A wall to protect the edge of a roof, bridge or similar structure; a low wall.

Parascenium. One of two rooms adjoining the stage of an ancient Roman theater, said to have served as dressingrooms.

Parget. Gypsum or plaster stone, or plaster.

Pargeting. Plastering the inside of flues, chimneys, etc.; decorative plaster work in raised figures formerly used in the interior and on the outside of houses.

Pargework. Ornamental patterns employed in wall decorations.

Parlor. Parlour. The chief, usually the most, elegant room of a modern house.

Parpeyn. A projecting buttress or pier attached to a wall.

Parquet. Parquette. The lower and front portion of a theater's auditorium, corresponding to the pit.

Parquetry. A kind of wood mosaic for floor-covering.

Parsonage. The residence of the clergyman in charge of a church.

Parthenon. A temple of ancient Athens, of the Doric order.

Partingbead. Partingstrip. A strip in a pulley stile to separate the sashes; a thin piece between the weights in a window box.

Partition. The dividing structure between the different rooms of a building; an interior wall.

Partywall. A wall between two buildings, its center standing usually on the dividing line between the lots upon which they are erected. According to a decision (1891) of the Supreme court of Illinois, one of the provisions of the ordinary party wall contract makes it necessary for an adjoining property owner, if he uses any part of the wall, to pay for half the construction of the whole wall. Much property upon which party walls rest has been trausferred without any mention of the walls, and it is possible for the owners who originally built such walls to recover the amount of their cost from those who are now using them. To all intents and purposes partywalls are an incumbrance on property, a contract to sell not being binding unless it is made subject to the party-wall agreement, provided always that some part of such a wall rests upon some part of the property.

Parvis. Parvise. The porch to a church.

Parvisturret. The turret or tower over a flight of steps leading to the parvis.

Passage. An avenue to and upon which open different rooms of a building.

Pastophoria. A room in a Greek temple.

Patband. The baseplate of a screen or partition.

Pate. A usually oval parapeted platform to cover a gate of a fort.

Paternoster. A molding having beaded ornamentation.

Pavement. A floor, passage, walk or street, the surface of which is brick, stone, asphalt, cement, wood, or other hard substance.

Pavilion. A building under one roof, usually isolated from others. Pavilions are for the most part of simple and not very permanent structure.

Pavilion roof. A hiproof.

Pax. A tablet bearing a representation of Christ, the Virgin, a saint or other holy object; or a panel so decorated.

Peckings. Soft or common bricks.

Pecky. The condition of timber just beginning to decay.

Pedestal. The base or lowermost portion of a column, statue, etc. A pedestal has three parts—the base, the dado or die, and the cornice.

Pedestalcoil. Several connected straight pipes parallel and one above another, as in some radiators.

Pedimentarch. A miterarch; a triangular termination over porticoes, etc., in classical architecture, corresponding to the gable of a later period.

Pelasgiac. Pelasgian. Sometimes applied to cyclopean styles.

Pelletmolding. A narrow, flat strip or band on which are raised and flattened round discs.

Pele. Pele tower. Pile tower. A term peculiar to the north of England, signifying a small donjon or fortified church or dwelling.

Pendant. A hanging ornament much used in Gothic architecture of the later styles, in which it is of stone and a notable part of the structure. Mere decorations have been made in imitation, of plaster, wood, etc.

Pendantpost. A short post in a mediæval roof truss. The lower end rests on a corbel, the upper end is attached to the tiebeam, and the post is placed against the wall. Such a post forms the starting of a truss in a Gothic roof.

Pendentive. A portion of a groined vault supported by and springing from a single pier or corbel; that portion of a vault by means of which the square, central space in the building is brought to a circle or octagon to make place for a cupola.

Penitentiary. A prison building, usually a state prison.

Pentacle. A six-pointed star formed of two equilateral triangles, intersecting each other in such a manner that the apex of each extends an equal distance beyond the center of the base of the other.

Pentadoron. A brick five palms long. This term is of ancient date.

Pentagon. A five-angled, five-sided geometrical figure.

Penthouse. A shed or lean-to attached to the main wall of a building.

Pentastyle. A structure with five front columns to its portico.

Pentrale. That part of a Roman temple regarded as most holy and sacred.

Pentroof. A roof sloping on one side only.

Perbend. Also called perpender, perpendstone and perpentstone. A stone reaching through a wall, a smooth end of it appearing on either side.

Perbendwall. A pier or buttress projecting from a wall.

Peribolos. A court surrounding a temple surrounded by an enclosure.

Peridrome. Space between the surrounding columns of a temple and the cell walls.

Periptere. Peripteral. A temple surrounded by a range of insulated columns.

Peristyle. A Roman court, square or cloister surrounded by a colonnade; the colonnade surrounding a building or square. Also written peristylium, peristylon.

Peritherides. Perethyrides. A bracket to a cornice.

Perpendicular style. Derived from the predominance of vertical lines in the last stage of Gothic architecture, and applied to that period.

Perron. An exterior stairway with landing on the main floor.

Persian architecture. An ancient style in vogue with the Persians; also called Persepolitan architecture.

Pew. A seat in a church.

Piazza. A portico or roofed walk supported by arches or columns; an open square surrounded by buildings. Also called peache.

Piedroit. A pier or square pillar having neither base nor capital, partly within a wall.

Piend. A square corner; a hip or an angle.

Pier. That part of the wall of a building between doors, windows and other openings; masses of masonry for supporting arches of bridges; a structure projecting into the sea to serve as a breakwater or a landing place.

Pilaster. A square column or pillar, sometimes insulated, but generally attached to a wall and projecting only a fourth or a fifth of its breadth. The component parts of pilasters are like those of columns. The shaft is called trunk. Sometimes called a pillage.

Pile. An immense building or mass of buildings; a piece of timber sharpened and forced into the earth, to serve as part of a foundation or as the partial support of a foundation or superstructure.

Pillar. A strong, vertical, independent support for a superstructure, of any form or proportion. In the Norman style most pillars are massive, many of them circular, some of them fluted, with capitals either round or square, and clustered or compound pillars are numerous. Plain circular or octagonal shafts are frequently used in the Early Gothic style, but more complicated ones are employed, an example being a large central shaft, surrounded by several smaller ones. In the Decorated style the cluster form takes a lozenge-shaped arrangement, or gives place to that of a square placed diagonally, though there are many other varieties. The plain octagon is often seen in the Perpendicular style, though not so frequently as at earlier periods, its sides being sometimes slightly hollowed.

Pin. A piece of wood, usually a trifle larger in places than the hole it is intended to fit, which is driven forcibly into, often through, a boring in two or more pieces of timber, to hold them firmly together.

Pinnacle. A slender turret, round, square or octagonal, which forms the apex of a tower, buttress or parapet. Decorated pinnacles are numerous, their shafts being sometimes paneled, sometimes formed into niches. Pinnacles are often the most striking features of fine Perpendicular Gothic towers.

Piscina. A vessel or font for holding water used by Christian churches.

Pise. An earth or clay wall of a certain kind.

Pit. A parquette.

Pitch of a roof. Its slope or inclination.

Pitch of an arch. The elevation of the interior curve above the spring or commencement.

Pix. Pyx. The box in which the consecrated host of the Roman Catholic church is kept.

Plan. A sketch, design, delineation or representation drawn on a plane; a draught of a horizontal section of a building or machine. Also called a plat.

Planceer. Plancher. A soffit or under side of a cornice.

Plane. A flat surface.

Plank. Thick boards, usually two to four inches thick and quite wide.

Platband. A flat band or molding whose breadth exceeds its projection; sometimes applied to the lintel of a door.

Plate. The piece of timber in a wood-framed structure which supports the rafters or joists; a piece of architectural iron or steel.

Plateglass. The best thick, heavy, polished window and mirror glass. French and American plateglass are manufactured in France and the United States respectively.

Platetracery. A form of Gothic tracery which, though solid, has the appearance of having been formed by perforating a plane surface in ornamental patterns. It was much used in Early English work.

Plateresque. A term applied to certain architectural ornaments having some resemblance to silver plate.

Platform. A portion of the floor space of an apartment elevated above the principal floor, as a dais or stage; independently of a room a floored space built at an elevation above the ground, as a husting or scaffold.

Plinth. A square, vertical member constituting the lowest division of the base of a column; the projecting base of any portion of a wall.

Plow. A groove extending the entire length of a piece of joiner's work.

Plugs. Pins or wedges of wood driven or imbedded in masonry to which to attach wood finishing.

Pocket. A recess into which a sliding door or window slides.

Podium. A continuous pedestal or basement.

Pointal. The central or kingpost of a truss.

Point. To fill the joints of masonry with mortar.

Points. Three-cornered pieces of tin used in glazing.

Pointedarch. An arch, the crown of which is angular or pointed.

Pointed architecture. A term applied to Gothic architecture in general.

Poleplate. A small wallplate secured at the lower ends of a set of roof trusses to receive the feet of the rafters.

Polychrome. A term applied to the coloring of walls and architectural ornaments.

Pomel. The topmost ornament of a dome, turret, etc.; a boss, knot, or knob.

Poppie. Poppy. Poppy head. An elevated ornament on the top of the upright end of a church pew.

Porch. An outside structure covering the entrance to a building. Some stone porches of the Decorated and Perpendicular styles, have rooms over them; and there are one-story wooden porches in both periods; while some porches of the Decorated style are built as many stories high as the houses to which they are attached, and are termed porch towers. Many porches of all ages are decorated.

Porchtower. (See Porch.)

Portcullis. A heavy iron-armed gate anciently used as a defense to gateways.

Portico. Originally a colonnaded or covered walk; in modern sense a covered space at the entrance of a building protected by a range of columns; a structure larger than a porch and serving the same purpose.

Post. An upright support of any kind, not elaborated as a column or pillar. Vertical timbers in wood structures and like devices are so termed.

Postern. A rear or side entrance; a private or concealed doorway at the rear of or outside of a castle, monastery, town, etc.; a subterranean passage inside of or into a fort.

Postern. Posticum. The rear wall or portion of a classic temple.

Poyntell. A pavement of diamond-shaped stones or tiles, or of square ones laid diagonally.

Preceptory. An establishment of the ancient Knights Templar under the government of a preceptor.

Presbytery. That portion of a church edifice devoted to the uses of officiating priests.

Pricking up coats. The coat of plaster next to the lath.

Prickpost. Queenpost. Suspended posts of a roof truss whose functions are those of a kingpost.

Principal. A term usually applied to a truss rafter, though it may mean a main beam or other important timber.

Principal brace. The chief brace under a principal.

Print. A cast of a flat ornament taken in plaster.

Priory. A religious house under the government of a prior or prioress.

Pronaos. A portico or vestibule before the cell of a temple.

Propyleum. Propylon. A court, vestibule or portico in front of the gates of a building.

Proscenium. The part of the stage of a theater between the footlights and the drop curtain.

Proscenium arch. The arch over the stage of a theater which is in some sense a frame to the drop-curtain and the scenery beyond it.

Prostyle. A portico with a range of columns standing free from the wall to which it is attached.

Pseudodipteral. A dipteral temple with the inner range of columns omitted.

Pseudoperipteral. A temple imperfectly peripteral or with a portion of its columns attached to a wall.

Ptera. A colonnade surrounding a cella of a Grecian temple.

Pteroma. The space between the walls of the cella of a Grecian temple and the columns of the peristyle.

Pteromata. The Greek name for side walls.

Puddling. Backing a wall with clay.

Pugging. Same as Deafening.

Pulpit. A desk elevated on a dais or platform from which sermons are delivered. Formerly pulpits were highly ornamented, often canopied; the tendency of modern times is in the direction of simplicity, however.

Pulvinated. The enlargement or swelling of any portion of an order, as in some friezes.

Puncheon. A short, vertical piece of timber in framing, as a brace, stud or quarter; one-half of a log split centrally, its flat side smoothed.

Purfled-work. Delicate tracery on stone.

Purlin. Purline. A beam extending the entire length of a roof or building to serve as a central support to the rafters.

Puteal. A wellcurb.

Putlogs. Short logs or timbers to support the flooring of scaffolds, so called from the fact that one end is put in a hole left in the masonry to receive it (called a putlog hole), the other resting on the ledger or ligger of the scaffold, a piece of timber fastened at right angles to the upright standards.

Pycnostyle. A colonnade in which only one column diameter and a half is allowed to each intercolumniation.

Pylon. A word applied to the massive front walls of temples of the Egyptians.

Pyramid. Large structures of stone masonry bounded by several triangles, with bases all on the same plane and having a common vertex, usually three or four-sided. A small pyramid terminating the top of a shaft or obelisk is called a pyramidion.

Q.

Quadra. A square frame or rail to a panel, basrelief, etc.; a band of the Ionic base; the plinth of a continuous pedestal.

Quadræ. Small squares flanking the hollow molding of an Ionic base.

Quadrangle. An equisided court surrounded by buildings; an arc of ninety degrees.

Quadrel. A square block of artificial stone.

Quadrifores. A door constructed on such a plan that one-half of the upper half, or one-half of the lower half may be opened, or two or more of the quarters at once.

Quadriporticus. A portico in quadrangular form.

Quarrel. Quarry. A term applied to diamond-shaped slates, tiles, stones or panes of glass, or to square ones set diagonally; a small piercing in the tracery of a window.

Quarrybed. Quarrybond. The place or pit from which stone is quarried.

Quarters. Quarterings. Quarter partitions. Quarter timbers. Square panels; two to four-inch studding.

Quarterpace. A stair landing; sometimes called quarter-landing.

Quarter-round molding. A molding made by quartering a round piece of wood in the direction of its length, or slitting it in halves lengthwise, and then slitting each of the halves in halves.

Quarter-sawed lumber. Rift-sawed lumber. Logs quartered, as described in the definition of Quarter-round molding, at right angles with the circles of growth.

Quatrefoil. An opening pierced by four foils.

Queen. A roofing slate of a certain size.

Queenpost. A suspended post of a roof-truss, useful in the manner of a Kingpost. (See Kingpost.)

Quier. Quire. Choir. Sometimes applied to the chancel of a church; usually to that part occupied by the organ and the singers.

Quirk. A small sharply defined groove in moldings.

Quoin. An external angle to a building; formerly the term was applied to vertical angular projections formed for ornament on the plane of a wall.

R.

Rabbet. Rebate. Rebbate. A square groove or channel in a piece of joiner's or carpenter's lumber.

Rabbetjoint. A joint formed by the device before mentioned.

Raffleleaf. An imitation of a leaf in decoration.

Rafters. The immediate supports of the roof boards or sheathing in roof construction.

Ragwork. Ragstone. A certain style of rough masonry, more particularly a sort of rubblework of ragstones about as thick as bricks.

Rail. Railing. Horizontal pieces of timber, iron, brass, bronze or other material extending from one post or support to another; as over and under balconies; between the panels of ceilings; between doors, windows, etc.; called toprails, bottomrails, handrails, etc. The vertical pieces of frame work in which rails are principals are termed styles. Iron and steel rails (railroad iron properly speaking) are employed in foundation work, and otherwise in the erection of large buildings.

Raisers. Risers. The upright frontage between the steps of stairs.

Raising. Erecting the frame work of a timber structure.

Raisingplate. A longitudinal timber or plate on which a roof is raised and rests.

Rake. Raking. Rake moldings. A roof's incline; its edge; its overhanging moldings.

Ramp. The slope or concavity in the upper member of inclined joinery, as in stair railings; an inclined pathway between different levels of a fortress.

Rampart arch or tunnel. An arch or tunnel one of whose abutments or sides is higher than the other.

Rampart. The substructure of a permanent fortification; a parapet or the passage behind one; the walls of a fort or tower.

Random-range work. Stone masonry with courses of various thickness.

Range. A part of a structure built in regular order; a series of buildings; the rung of a ladder.

Range work. Stone masonry with courses of equal thickness or in the same line.

Rayonant. A term applied by the French to radiating lines in Gothic architecture; from *rayon*, a ray or beam of light.

Rearvault. A small vault between the glass of a window and the inner surface of a wall.

Recessedarch. One of two or more arches receding one behind the other.

Rectilinear period. Applied to the Perpendicular period.

Rectory. The dwelling of a clergyman.

Redan. A small fortification having two faces; a projection against a wall on uneven ground, to make it level.

Redoubt. Redoubte. Redout. An inclosed work of any number of sides devoid of reëntering angles; an outwork within another.

Refectory. The dininghall of a convent, college, etc.

Reglet. Riglet. A flat, narrow molding separating panels, etc.

Regrating. (Sometimes called skinning.) Cutting off the surface of old and discolored stone work, to give it an appearance of newness.

Regula. A fascia, square molding, continuous tablets or series of ornaments in an architrave of the Doric style.

Reigner work. Inlaying.

Reins of a vault. Its sustaining walls.

Rejointing. Filling with mortar old joints in stone masonry.

Relievingarch. One built in a wall to bear part of the weight thereof.

Relievo. Relief. The projection of carved or molded work.

Reliquary. A box, chest, casket or other depository of relics.

Renaissance. A designation for the revival of classical details in French Gothic styles, contemporary with the Italian, Elizabethan and Jacobean styles, and involving a style of decorative art freer than the Antique, from which it resulted.

Rendering. Plastering on walls of masonry.

Reredos. Reredosse. A screen or wall at the rear of an altar, seat, etc., usually paneled; sometimes applied to large, open fireplaces.

Ressaunt. A technical term, now seldom used, formerly applied to moldings and other architectural members of the ogee outline.

Respond. A half pillar or buttress, in Gothic architecture, often built against a wall to support an arch, etc.

Retain wall. Retaining wall. A strongly implanted wall to prevent the downsliding of an embankment, or stand against a lateral pressure of another kind.

Reticulated work. Masonry composed of diamond-shaped stones or square stones set diagonally, resembling network.

Reveal. Revels. The side of a window opening or doorway between the framework and the exterior face of the wall.

Rib. A projecting molding on a vault or ceiling, sometimes inscribed with carved ornaments.

Ridge. Riggen. The highest point of a gable roof.

Ridgepole. Ridge beam. The beam at the ridge of a gable roof extending from end to end of the building and supporting the rafters at their greatest altitude.

Ridgetile. Convex tile for covering roof-ridges.

Riprap. A foundation or parapet of stone built loosely and without mortar, sometimes in the water or in soft ground, without order.

Rock face work. Rough stone work. Masonry of undressed stone, regularly arranged but presenting a rough, rocky appearance.

Rococo. A term used to denote the fantastic in decorative art, applied more particularly to a florid ornamentation which prevailed in France about a hundred years ago, and has since been designated as a distinct style of architecture.

Roll and Fillet. Rollmolding. The term roll molding is often applied to round molding, and has been given in a general way to a molding used freely in Decorated and late Early English work, particularly noticeable in strings and dripstones. The varieties are many. Some resemble a roll of parchment. When the square fillet is conspicuous it is called roll and fillet and roll and fillet molding.

Rolled beams. Beams of iron and steel for building and bridge construction rolled between rollers, not cast.

Roman architecture. Roman order. Prior to the conquest of Greece, the Romans had advanced considerably in the development of an order quite distinctively their own. The Roman order, so called, was adopted after the conquest, when the influence of the superior civilization of the Grecians predominated; though the present Roman style embraces not only the Grecian, but the Tuscan and Composite styles, which were unknown to the Greeks. Many of the great structures of the Romans were erected under the personal oversight of emperors who flourished from about 400 B. C.

Romanesque style. A general term applied to the debased styles of architecture developed from imitations of the Roman, which were in vogue from the downfall of Rome until the popularization of the Gothic order.

Rood. A cruciform decoration employed in architecture; a term applied to large crosses in churches over the entrance to the chancel or choir.

Roodarch. An arch between the nave and chancel of a church.

Roodbeam. A beam above a chancel entrance in a church.

Roodloft. A gallery formed of the roodbeam and roodscreen, upon which the rood was set up in a church.

Roodscreen. An altar screen between the nave and chancel of a church over which the rood was erected.

Roodtower. Roodsteeple. A tower built above the intersection of a cruciform church.

Roof. Roofing. The covering of the top of a building, of whatever materials or construction.

Rose. Rosette. An ornament on the face of the abacus in Corinthian capitals, which led to the use of the rosette. The full rose, a badge of the Tudors, was often carved on buildings during their reigns in conjunction with the portcullis.

Rose window. A circular window with mullions diverging from the center to surrounding cusps.

Rostrum. A scaffold or platform.

Rotunda. A round structure, or a circular portion of a building.

Roughcast. Coarse exterior plastering; also used in panels of framed structures.

Rough setter. A rough mason; one who constructed coarse walling. (An old term.)

Round Tower at Newport, R. I. This mystifying structure is supposed to have been built by Northmen. Professor Rafn, secretary of the Royal Society of Antiquarians, at Copenhagen, who has given more study to early Norse discoveries than any other man, has shown by drawings that the plan of this tower was almost identical with that of certain baptisteries built in Europe in mediæval times, some of which are still standing. On the other hand, Dr. Palfrey proves, with apparent conclusiveness, that the tower was not built by the Vikings, but by men of peace, for a mill, and gives a picture of a stone windmill in Charleston, England, so much like this tower in construction that the latter might possibly have been modeled from it. There is abundant proof in Icelandic documents that the first discovery of America was made by Viking voyagers, but no convincing evidence that they left in the new world traces of their occupation. The first historical mention of the tower bears date 1678, when Gov. Benedict Arnold referred to it as "my stone-built windmill."

Rubbedwork. Stonework rubbed smooth.

Rubble. Rubblework. Coarse walling. A coarse walling of rough, thick, irregularly shaped, many-sized stone.

Ruderation. A pavement of cement and pebbles or gravel.

Rustic. Any architectural work in affected imitation of nature or of roughly constructed structures or adornments; produced in masonry by giving a rough, unfinished effect to the stones.

Rusticjoints. A V-shaped joint in stone work.

Rusticorder. Masonry in which rustic joints, quoins, etc, are conspicuous.

Rusticwork. Ashlar masonry in which all or part of the joints are rendered conspicuous by being grooved or channeled.

S.

Sacelum. A small monumental or ornamental chapel within a church; a small space or court, roofless but enclosed.

Sacrarium. A sanctuary or sacred room in a Roman house.

Sacristy. Vestry. A small apartment, either included within the main walls of a Catholic or Episcopal church, or attached to it, in which the sacred vessels, vestments, etc., are kept, and which the priest uses as a robingroom.

Saddle. A doorsill or threshold.

Saddlebars. Small iron bars to which lead panels are secured in glazing.

Saddle-back coping. Stone coping elevated in the center, roof-like, to carry off the water.

Saddleroof. Pack-saddle roof. Saddle-back roof. A two-gabled roof, usually on a tower or other small elevated structure.

Sag. Sagging. The bending of a beam supported at the ends, under pressure of its own weight or of weight placed upon it.

Sagitta. A keystone (rarely used).

Salient. The projection of a molding.

Sally. To notch a rafter or other piece of building timber.

Sallyport. A private gate or subterranean passage from the inner to the outer works of a defense.

Salon. Saloon. A receptionroom; a spacious and elegant apartment; a hall for public entertainments and public uses.

Sancte-bell. Sanctus-bell. Saints-bell. Mass-bell. Sacring-bell. Saunce-bell. A small bell used in the service of the Catholic church to call attention to the solemn parts of the mass.

Sancte-bell cot. A small bell-tower at the east end of the nave of a church, either Catholic or Episcopalian.

Sanctuary. The part of a church in which the altar is located.

Saracenic architecture. That style also known as Arabian, Moorish, Moresque and Mohammedan.

Sarcophagus. A tomb.

Sarking. Thin board lining for roofs, etc.

Sarraime. A portcullis.

Sash. The frames of windows.

Sashlines. Sashcords. The lines connecting the sash with the sash weights.

Sashlock. A metallic device to fasten a sash down or up.

Sashpulley. A pulley over which the sashcord runs.

Sashrail. The upper and lower cross-piece of a sashframe.

Saxon architecture. The style in vogue in England previous to the Norman conquest, or in the eleventh century.

Scabbling. Scapple. Scappling. Squaring and evening the surface of stone work.

Scabellum. The pedestal of a bust, often employed in Roman buildings in ancient times.

Scaffold. A temporary platform either supported by uprights or suspended; sometimes a church gallery is so called.

Scagliola. A plaster work in imitation of marble..

Scallage. A term applied in Hertfordshire, England, to a detached covered porch or gate at a church entrance.

Scamilli impares. Second plinths below the bases of columns of the Corinthian and Ionic orders. Scamillus is a term incorrectly applied in lieu of the one here used.

Scandulae. An early Roman term applied to shingles.

Scantle. A gauge for measuring slate.

Scantling. A general term applied to pieces of timber less than five inches square; used also with reference to the size of stone.

Scape. Scapus. The shaft of a column; the apophyges of a shaft.

Scarcement. A plain, flat set-off in a wall (almost obsolete).

Scarf. Scarfing. A method of joining the ends of two pieces of timber by cutting away portions and securing the remaining portions together.

Scheme. The crown of an arch.

Scheme arch. An arch the curvature of which is the segment of a circle.

Scoinson. Escoinson. The interior edge of the jamb or side of a window.

Sconce. Squinch. A small stone arch across the angle of a tower.

Scalloped moldings. A kind of molding much employed in the Norman style.

Sconcheon. The jamb between the back of a reveal and the inside of a wall.

Scotia. Casement. The hollow molding used in the bases of columns in Classical and Gothic architecture.

Scratchwork. The first, or rough coat, of three coats of plastering.

Screed. A term applied to a means of forming perfect surfaces by plastering.

Screen. A low wall, sometimes fixed, sometimes movable, which separates a portion of a room from the remainder.

Screw. One of the primary mechanical powers, exerted by the revolution of a cylinder having a spiral thread or head which fits into corresponding depressions in a nut attached in some manner to the object to be moved; a device to secure pieces of wood together by being forced or bored through them, its thread being embedded in the wood.

Scribing. The close joining of pieces of joinery work.

Scroll. A curved or spiral ornamentation used in turning, carving and other decorations, the general character of which resembles a band arranged in convolutions or undulations; the volute of the Ionic or Corinthian capital.

Scrollmolding. A molding so called from its resemblance to a roll of parchment, the last fold overlapping.

Sculpture. The art of cutting images of animate and inanimate objects in wood or stone, especially the art of carving statues.

Scutcheon. Escutcheon. A shield with armorial bearings, sometimes employed in architecture as a memorial.

Section. A representation of the vertical division of a building showing its interior; a molding or other architectural member cut so as to reveal its profile.

Sedile. Sedilia. Seats in the sanctuary or near the altar of a church.

See. A seat, particularly a seat of dignity.

Segment. A portion of the arc of a circle; a part cut off.

Segmental arch. One whose extent of curvature is less than half of a circle.

Segmental window. A window of segmental form.

Sell. A sill.

Semicircular arches. Arches whose outlines are semicircular.

Sept. A railing.

Sepulcher. A tomb; an architectural memorial design. A representation of the entombment of Jesus set up in a church at Easter is called an Easter sepulcher.

Set-off. Off-set. The part of a wall, pier or buttress exposed horizontally when the portion above it is built thinner than the portion below it.

Setting. The placing of a stone in a wall with mortar.

Settingcoat. The last coat of ordinary mortar.
Setwork. Plastering done in two coats.
Severey. Severy. A division, as a bay, of a vaulted ceiling; a room; a section of a scaffolding.
Sextry. Synonymous with Sacristy.
Shaft. That part of a column or pillar between the capital and base.
Shafted impost. A banded column.
Shaft of a chimney. That portion comprising the flue.
Shaft of a kingpost. That portion of the post between the notches or joggles.
Shake. A split or defect in a piece of timber.
Sham door. Paneling in imitation of a door where no door exists.
Shank. A space between the channels of triglyphs in a Doric frieze.
Shingle. A wooden roof-tile; loose gravel, pebbles or roundish stone.
Shoe. An iron socket in a truss to receive the thrust of rafters.
Shoar. Shore. A temporary brace or post to hold up a tottering building or a portion of a new structure while work is in progress.
Shouldering. Shouldering pieces. Thin supports underneath the upper ends of slate in roofing, to close the laps.
Shrine. A repository for relics fixed or stationary; the tomb of an uncanonized person.
Shrouds. A church's crypt.
Sideposts. Posts in pairs equidistant from the center of a roof truss; similar to queenposts.
Sill. The horizontal timber or stone at the foot of a door, hence a threshold; the plate at the bottom of a wooden partition; the piece of timber in a wooden building which lies on the foundation.
Sima. (See Cima or Cyma.)
Single hung. Hung with one window or sash only.
Sink. A small, stationary water receptacle.
Skewarch. An arch built out of right angles with a building to which it is attached.
Skew back. A part of an arch extending beyond the opening in a wall in connection with which it is built.
Skewtable. A stone tablet at the eave of a gable to support the coping above.
Skirtings. Baseboards.
Skirts of a roof. Those portions which project beyond the walls to protect the eaves.
Skylight. A window in a roof.
Slates. Thin plates of stone used in roofing.
Sleepers. Joists resting on the ground; joists laid flat.
Slope of a roof. Its pitch.
Slushed up. A term applied to the filling of openings in masonry.
Smithery. Uniting several lumps of iron into one mass and fashioning that mass into any desired shape, as in foundry work.
Snocket. A provincial term applied to a door fastening.
Socle. Zocle. A square member less in hight than in horizontal dimension; a plinth forming a low pedestal and having neither base nor cornice. If continued around a structure it is called a continued socle. The term is used only when classical architecture is referred to.
Soffit. Soffita. Soffite. Applied generally to under surfaces in architecture, as a ceiling, the lower surface of an arch, a window, a beam or a vault.
Soils. A term sometimes applied to principal rafters.

Solar. Sollar. A name sometimes given to a loft or attic chamber.

Sommer. Formerly a main beam or girder in a floor.

Sommering. Summering. A term applied to beds of stone when used in arching, as ring stones or key stones.

Soudlets. Sowdels. Crossbars in sash.

Soundingboards. Wooden projections or canopies over pulpits, etc., to reflect the sounds of the speaker's voice and render his words distinguishable in all parts of the auditorium.

Soundboarding. Boards placed between joists to which mortar may be attached to serve as deafening.

Spalls. Chips or bits of broken stone.

Span of an arch. The breadth from springing to springing.

Spandrel. Spandral. An irregular triangle bounded by the extrados of an arch of a doorway; a horizontal line from its apex and a perpendicular line from its springing.

Spanpiece. Sparpiece. A name applied in some localities to the collar beam of a roof.

Spanroof. A roof with two inclined sides.

Spanish architecture. The styles embraced in this school were those introduced by ancient Romans, the Moors, by mediæval practitioners of France and Germany, and by Italian masters brought into the country.

Spars. Spers. Spurs. Rafters, quarters, wooden bars for securing doors, etc.

Specifications. A detailed description of the materials and workmanship which are to enter into the erection of a building.

Speke house. The parlor or reception room connected with a convent.

Spere. A screen across the end of a hall.

Spherical bracketing. Spheroidal bracketing. Bracketing so formed as to provide foundation for plastering which, when done, is spherical in form.

Spiral. Pointed like a steeple; a direct curve one or more times round a fixed point which does not return to itself.

Spire. In ancient architecture this name was applied to the base of a column, sometimes to the astragal or torus; in modern architecture it is applied to an acutely pointed termination to towers and turrets, forming the roof and usually carried up to a considerable hight. The term spira was used formerly to denote the base of a column.

Spital. A term applied to a hospital.

Spline. (See Feather.)

Splayed. Splay. The expansion imparted to openings, such as windows and doorways, by slanting the sides or jambs.

Spring bevel of a rail. A term applied by stairbuilders to "an angle made by the top of the plank with a vertical plane touching the ends of the rail piece, which terminates the concave side."—Gwilt.

Springed. Spring. Roof boards set together with beveled joints to shed the water; beveling work in joinery.

Springer. The point of juncture between an arch and its support, or the top of the impost.

Springingcourse. The top layer of stone in the springer.

Spur. A bracket.

Square staff. Staff bead. Angle bead. A bead of wood fixed to the angle of stud partitions to secure the angle and allow a good finish for the papering.

Squaring handrails. So shaping them that all vertical sections are at right angles.

Squinch. (See Sconce.)

Squint. An oblique or beveled opening between apartments.
Stage. A large elevated platform at the end or side of a room.
Staircase. Stairway. All that part of a building containing the stairs.
Stairs. A series of steps ranged one above or beyond another.
Stalk. An ornament in a Corinthian capital which resembles the stalk of a plant, and from which spring the volutes or helices.
Stall. A seat fixed to the floor and wholly or partially inclosed at the sides and rear; a division in a stable.
Stanchion. A prop, post or support; a vertical bar in a window.
Standard. A support for shelving.
Staple. A U-shaped piece of iron or other metal passing through a hasp and receiving the bar of a lock, or used otherwise.
Starmold. A Norman molding with star-like decorations.
Starlings. Sterlings. Stilts. A term applied in bridge work to piles driven around a pier or piers.
Staved. Staves. Any piece of work made of pieces of wood resembling staves and having a barrellike form. The largest cask extant is the historic Great Tun of Heidelberg, which was built in 1751, and has a capacity of forty-nine thousand gallons.
Stay. Stay-bar. A brace of any material.
Steening. Brickwork dry-laid.
Steeple. Steepul. A church tower or spire, including any superstructure.
Stenchtrap. A mechanical device used in plumbing to prevent the rise of sewer gas.
Step. The distance to which a man may lift his foot without inconvenience in ascending or descending; hence the hight of the step in stairs.
Stereobate. Stereobale. The base of a wall; a pedestal.
Stile. Stiles. The vertical part of a piece of framing, the side piece of a door being an example.
Stilted arch. One in which the springing begins from a vertical piece of masonry resting on the imposts, and not directly from the imposts.
Stoa. A porch or portico.
Stockboards. Boards of an equal or standard width.
Stockbrick. Brick of a standard quality.
Stool. The interior sill of a window frame.
Stootings. Stoothing. Terms applied to battens.
Stopping. A term synonymous with pointing in reference to masonry work.
Story. Storey. A space between contiguous floors, entablatures or other architectural lines indicating divisions of a building in a vertical direction.
Straight arch. A lintel formed of separate pieces on an arch-like principle.
Strain. The force exerted on building materials tending to their breakage or disarrangement.
Straining piece. Strutting piece. A piece that keeps two others from being forced nearer each other, thus counteracting a strain in the direction of its length. A piece which keeps two others from being forced apart is called a tie.
String. Stringcourse. A projecting horizontal line of molding or moldings in a building.
Stringpiece. Stringcase. A strip around the well hole of a stair.
Strix. A fluting in a column.
Struck. Struckjoint. A designation given to the work of smoothing or pointing up the joints in masonry.

Strut. A brace.

Struttingbeam. Struttingpiece. A collar beam or straining piece. When a struttingpiece serves as a sill it is called a straining sill. The pieces of timber in naked flooring fixed in between the joists by mortise and tenon are called struttingpieces when their ends project against the sides of the joists.

Substruction. The foundation walls or underbuilding.

Substructure. The part of a building below street level.

Stucco. Cements calcareous in character and of various descriptions.

Studs. Intermediate posts in woodwork partitions; also called uprights and quarters.

Stump tracery. Tracery in which the ribs are made to pass through each other and are then cut off abruptly.

Styles. (See Stile.)

Stylobate. The band or pavement or coped wall on which a colonnade is supported; the lowest horizontal member of a base; the sub-base.

Sub-plinth. A plinth under a principal plinth in a column or pedestal.

Summer. A door or window lintel; a beam tenoned into a girder to support joist ends; a girder; a large stone laid over columns and pilasters in the beginning of a cross vault; a beam placed breastwise to support a superincumbent wall.

Sunkcoak. A term applied to mortises.

Sunklight. A sky or transom light.

Super altare. Super altar. A term erroneously, though often applied to a shelf or second altar over the main altar of a cathedral; properly a small, portable stone altar.

Supercilium. A door lintel.

Surbase. Subbase. The upper cornice moldings of a pedestal.

Substory. An attic story.

Superstructure. That portion of a building above the foundation.

Supporters. Posts, braces, or any other supports.

Surbased arch. An arch, dome or vault whose hight is less than half its span.

Surmounted arch. A stilted arch.

Swelled columns. A term applied to the diminution of columns as by the ancien

Symbolical columns. Columns bearing symbolical emblems and raised to commemorate important events.

Sypper-joint. A lap-joint.

Systyle. A classic building in which the columns are set at a distance equal to twice the diameter of the shaft immediately above the apophyge.

T.

Tabern. An underground apartment for cellarage.

Tabernacle. An architectural structure on the altar, in Roman Catholic churches, wherein the sacred vessels and host are deposited, sometimes applied to the Jewish synagogue. A niche in churches where a painting of a sacred subject or sacred relics are placed.

Table. A band of stone used as an offset, a stringcourse, a water table; that part of a machine on which the work is placed; also bench in carpentry; the perspective plane.

Tablet. An inscribed stone set in a wall. When projecting it is a raised table; when horizontal, a raking table; and when the ground is hammered or chiseled, a rusticated table.

Tabling. Coping of common walls. Sometimes used by Scotch immigrants.

Tablinium. A continuation of the vestibule within the atrium.

Tabulatum. The Roman term for interior wood work, as wainscoting, floors and ceilings.

Tack. A little nail.

Tænia. The band between the Doric frieze and architrave.

Tail. The stirrup or bearing piece in a wall on which rests the end of a beam of timber or a girder. Same as housing in carpentry. Tailing is applied to projecting stone or brick on which rest joist or heavy beams. Tailpiece, a timber which tails into a header in floor framing. Tailbay, a joist with one end resting on the wall and the other on a girder. Tail-trimmer, the timber round a chimney in which the ends of joists are inserted.

Tailloir. The French for abacus; the upper part of a capital under the architrave.

Talon. A molding convex at top, concave at bottom, or ogee molding.

Tambour. The wall of a circular building, outside of which are columns; the back of a peristyle; the drum or stalk of a Corinthian or Composite capital into which the acanthus leaves and volutes are cut or to which they are attached.

Tangent. That portion of a straight line, tangent to the extremity of the diameter of a circle. Tangential force, and tangential stress are mechanical terms differing from normal force and normal stress.

Tank. A wood or iron reservoir placed on the roof or upper floor of high buildings for the purposes of water supply.

Tap. A tool for forming a screw in a pipe or nut. An important word associated with ferrule in the vernacular of the Chicago water department; a water-main tap; literally, to open the pockets of the taxpayers.

Tapeline. A cotton or linen tape showing inches and feet; a steel tapeline.

Taper. To narrow toward one end as a cone or pyramid.

Tapestry. To decorate with carpet or tapestry hangings.

Tapis. To cover with tapestry figures.

Tar. A product of the distillation of wood, used in roof-covering in connection with gravel.

Target. In civil engineering the sliding crosspiece on a leveling staff.

Tarras. A strong hydraulic cement; also written trass.

Tassal. A tail or plate of timber on which rests the end of a beam.

Tasimeter. An instrument for measuring the expansion or movement of solid bodies.

Task. Imposed labor, the quantity and quality of which is defined by the employer.

Taxis. The Vitruvian rule of proportion in architecture.

Teagle. A hoist, an elevator.

Teamster. A driver of a lumber, stone, or clay wagon.

Tease-tenon. A tenon on top of a post for supporting two timbers at right angles.

Technic. Artistic execution opposed to common work.

Technology. A dependent science teaching systematically a knowledge of the industrial arts. If considered as an industral science, it is independent.

Tectonics. The science of building or construction; architecture.

Tectorium opus. Plaster work of ancient Romans.

Tedge. The opening in a mold through which molten metal is poured.

Telamones. Atlantes, caryatids showing male figures.

Telephone. An instrument for reproducing articulate speech; used in all leading offices and homes in Chicago.

Telpher road. An electric road where locomotives receive power from the line.

Temper. The quality of hardness in metal, brick, cement, etc.

Tempera. Early Italian painting; tempera painting.

Temperscrew. An adjusting screw connected with the walking-beam in well-boring machinery.

Temple. A great church. It is in antis, when pilasters are in front of the walls, around the cells, with two columns between the antæ. The prostylos, the amphiprostylos, the peripteral, monopteral, the pseudodipteral, the hypœthral, the octostyle, the eustyle, and the hexastyle, are definite forms of the orders in temples.

Templet. An end guide or face-tryer in setting masonry and brickwork. Also a timber, iron, or stone plate, laid on the brick plate to secure a girder. Written sometimes template.

Tenia. (See Tænia.)

Tenons. Rectangular projections at end of joist or scantling inserted in a well or mortise of the same form and size. A thin-bladed saw with a stiff brass or steel back is used for cutting tenons.

Tenpenny. The name given to a size of nails.

Tensile. Tensible or ductile.

Tensile strength. The degree of ductility.

Tension. The resistance to strain of a body. The limit of the ductility of a body. The power of a body equal to carry the weight of another body; thus the ultimate resistance to tension of seasoned American ash is from 11,000 to 14,000 pounds per square inch, and of copper wire, 60,000 pounds. The tension brace or rod-strengtheners are introduced where greater weights have to be borne.

Tescalli. An Aztec temple in Mexico, Central America and Yucatan. That at Cholulu is 1,440 feet square and 177 feet high. That at Palenque appears to have been the greatest piece of ancient American architecture.

Tepidarium. An apartment in a Roman bathhouse.

Teram. The scroll work on the side of a stairs or at the end of a step.

Tercento. A style of architecture in the fourteenth century, as Cinque-cento was in the fifteenth and sixteenth century.

Term. A pillar or block or inverted obelisk, carrying the bust of a male or female figure, and the figure of a man and goat as a satyr; an ancient landmark, mile or boundary stone.

Terminate. To complete a building, painting or figure.

Terra cotta. A kind of baked clay, very hard, used to face walls, piers and iron structures, and to decorate in architecture.

Terrace. A row of attached houses, approached by steps, generally with a grassplot in front. Opposed to Crescent in having a straight building line. In the eastern nations, the roof. A grass-covered raised space with broad turf steps leading to its plateau.

Tessellated. Laid out in minute squares as mosaic work, or parquetry or tessera.

Testudo. An arch or vaulted house or room.

Tetradoron. A brick about sixteen inches long.

Tetragon. A plane having four sides and angles. Tetrahedron, a solid bounded by four triangles.

Tetrastyle. Four columns forming a portico.

Thatch. Straw, rush or reed laid on a roof and pinned down by willow rods.

Tewel. A chimney.

Theater. A house of amusement or operahouse, generally well decorated in the interior.

Theodolite. An instrument for the measurement of horizontal angles.

Thermodynamics. The science of the actions or relations of heat.

Threshold. The sill of a door in wood, stone or iron.

Throughstone. A bondstone.

Throughbolt. A bolt running through all layers.

Thrust. The pressure of one part of a building upon another part; a horizontal or diagonal pressure, as that of an arch on impost, or of rafters on side walls.

Tie. An iron rod or beam; a brace; a beam or rod used to give rigidity to a building or hold its parts together, or prevent tension. The tigna of the ancients.

Tiercepoint. The intersection at the top of the two arcs of a circle.

Tile. Baked clay, either hollow or solid, used in Chicago construction, in coping, in roofing and flooring, and in decorative work. A tiling fillet is used in coping and roofing.

Timber. A name applied by builders to heavy lumber, as posts, sills, beams and girders.

Timbered, half. A house of timber and masonry, the two materials shown in the exterior.

Timekeeper. A person employed to record the working hours of employes.

Tinning. The process of coating with tin or tinfoil.

Tip. Rubbish cast out of a quarry; to turn a wheelbarrow half over.

Tolmen. A cromlech stone; a holed stone.

Tomb. A walled sepulcher, with stone or iron door.

Tongue. A groove.

Tools. Chisels, planes, hammers, etc., used by artisans, as carpenters' tools, plumbers' tools, etc.

Tool rest. Tool stock. The section of a tool rest where the cutting tool is clamped.

Tooth. A member of the tenon class, fitted into a sunk mortise rather than a through mortise; the steel point of a gauge which marks the material to be worked; a toothing plane.

Toothing. Brick left projecting alternately at end of wall, preparatory to continuing the building.

Tooth ornament. Same as Dogtooth.

Top. The crowning member of any distinct building form.

Toprail. The molding above wainscoting or framework.

Tope. A Buddhist monument over the dead; an architectural structure within a pagan temple, where relics of Buddha are kept.

Toreumatology. The art of toreumatography; the description of sculpture, particularly of metal bas-reliefs.

Torsion. The twisting strain on a wire or rod, as shown on a wire spring which, after torsion, returns to its state of rest.

Torus. A large molding, with semicircular profile, on the base of a column; same in form as astragal, but much larger.

Touch-up. To repair, to paint, to improve a house.

Tout ensemble. The general effect of the interior or exterior of a building taken as a whole.

Tower. A high detached structure, round, as in the ancient round towers of Ireland; a square, or round, or polygonal structure, attached to a castle or bastion; a shot tower, a water tower.

Trabeation. An entablature.

Tracery. The decorated head of a Gothic window, whether cut through a solid flagstone as platetracery, or formed by the bars of the mullions as bartracery. Fantracery, stumptracery, vaulttracery, and tracery in wood, metal and glass, are other forms. Tracingpaper and tracingcloth are transparent materials used in copying drawings.

Tracings. A copy of original drawings; fac-similes by photographic process.

Tralatitious style. A national style of architecture handed down from the beginning of a nation.

Trammel. An instrument for drawing ellipses.

Transcalent. Permitting the passage of heat.

Transept. The transversal division of a church, crossing the nave and aisles at right angles outside the chancel; the extension of the transept beyond the line of the exterior walls of the aisles are the arms of the transept.

Transit. An instrument resembling the theodolite.

Transition. In art, the period of engrafting new forms on old styles.

Translucent. Permitting the passage of light; partially transparent.

Transom. The horizontal bar between the upper light of a door or window. Opposed to mullion and to clearstory window.

Trap. A sanitary appliance to hold a waterseal in plumbing.

Trapdoor. A door or floor in a roof, with a sliding, hinged or removable covering.

Transtra. Horizontal timbers in Roman roofs.

Transverse. Lying athwart, or across, rather than longitudinally.

Transverse strain. The side force acting on a timber or other solid.

Traverse. Same as transverse. In architecture, a gallery communicating with the sides of a church.

Traverse. To plane across the grain of the wood.

Travertine stone. The rock found at Tivoli, near Rome.

Tread. The horizontal board in a stair on which the foot is placed.

Trefoil. The three cusps, or foils, in the circle of the foliated Gothic window.

Trellis. Finer lattice work than the treillage used for training vines.

Treenail. A wooden pin, cylindrical in form, used in roofing and framing.

Trestle. The movable support for scaffolding, a sawhorse.

Trestleboard. A draughtsman's table.

Triangle. A draughtsman's square in the form of a right-angled triangle.

Tribune. The apse or platform.

Triclinium. The receptionroom in a Roman house, with large window looking out upon the garden, and floor elevated twelve inches above the peristyle, furnished with couches for the guests; later, a diningroom with a couch extending round three sides of the table.

Trifasciated. Surrounded by three bands or fasciæ.

Triforium. The open space between the nave arches and the windows of the clearstory of a church, or the gallery between the vaulting and the roof of the aisles looking into the nave.

Triglyph. A rectangular tablet or relief work, in the frieze of a Doric trabeation, divided by two vertical glyphs or channels into femur and meros, with half glyphs at each vertical edge. The metope appears in the intervening recessed space between the triglyphs. A ditriglyph equals two triglyphs in the frieze between those over the columns; tritriglyphs equal three triglyphs.

Trilithon. Two vertical rocks supporting a lintel. A Celtic doorway.

Trim. To dress lumber; to fit timbers.

Trimmer. The beam into which the headers of joists are inserted; where a well has to be made for a stair or chimney or shaft; the joists are called trimmer joist.

Triptych. An altar piece or painting in three parts capable of being folded; three times the size of a diptych.

Triumphal arch. A single or triple arch in the Roman style of architecture, as the Arc de Triomphe, Arc de l'Etoile and the arch at Ancona.

Trochilus. A scotia or molding between the tori at the base of a column, annulated and concave.

Trophy. A representation in metal or wood of arms, armor and battle flags set in the trunk or stump of a tree.

Trough-gutter. The V or semicircular pipe below the eaves of a roof to receive and carry off rainwater.

Truncated. Cut off short, as the upper part of a cone or pyramid, leaving the frustum.

Trunk. The shaft of a pilaster; the drum of a capital.

Truss. A rod or tie rod which opposes tension in beams or girders; an arrangement of wood or iron beams, comprising kingpost, tiebeam, struts and rafters, supported under ends of tiebeam so as to transmit vertical pressure to those points and abolish horizontal strain. In the open wood work of Gothic buildings the truss is subjected to the duty of carrying ornamental molding and grilles. Truss partition, trussed beam, and trussing piece are all adaptations of the truss.

Tube. A cylinder hollowed for the conveyance of water, oil, air or gas; a large pipe.

Tuck-pointing. Lining brick work at the joints in black, red or yellow cement.

Tudor architecture. The four-pointed or flat four-centered arch style of Perpendicular Gothic architecture, moldings and panels introduced into England in 1460, ended there in 1537, when the convents and churches were confiscated to the king.

Tumuli. The burial mounds of the ancients; also applied to works of the Moundbuilders, Aztecs, Chickasaws, Choctaws, Natchez and other aborigines.

Turner. A worker in wood, who directs the lathe to give it form and molding; an artisan when compared with the wood-carver or engraver.

Turningpiece. A board for turning a brick-arch upon.

Turpentine. Distilled juice of the pine tree, used in paints.

Turret. A small tower at the corner of a building, springing from a corbel and surmounted by a coneroof or bellroof with finial; a corner bay.

Tuscan order. The fifth of the five Roman orders.

Tusk. A bevel shoulder inserted in a girder above a tenon to give strength to the latter.

Tympanum. The triangular space in a pediment, recessed between the main and angular cornices; the panel of a door; the die of a pedestal; the space between arch and lintel.

Type. The foundation of style. The canopy of a pulpit.

Tyrian. A style of architecture in Tyre; a purple color or die.

Tyrociny. An apprentice.

U.

Umber. A reddish-brown pigment, obtained from clays colored by the oxides of iron and manganese, is called raw umber. When roasted it is known as burnt umber, and becomes a bright reddish brown rather than its original olive-brown color.

Underbuilder. An assistant builder.

Undercroft. A vaulted room under a church.

Underhung. As a door running on an iron rail set in the floor. Opposed to overhung, as the modern doors.

Underway. In a condition to make progress.

Underpin. To place masonry under masonry or under a sill; to support by masonry.

Underpitch. To pack underneath, as underpitch groin.

Ungula. A part of cylinder or other solid such as a cone, cut off by a plane oblique to the base; the segment of a circle which is part of the base and another plane.

Upher. A split fir pole like a fence rail, but much lighter, used in cabin roofs; a light tapering pole used by builders in Europe for scaffolding.

Upholsterer. One who covers furniture or decorates a room with cloth or cloth hangings.

Uranium, Yellow oxide of. Used in glass manufacture to give a delicate greenish-yellow tint. A purer oxide than uran-ocher.

Uranium, Black oxide of. A pigment used in painting porcelain.

Urilla. The sixteen volutes below the abacus of a Corinthian capital, two at each angle, and two meeting beneath the center of the abacus, branching out of the caulicoli.

Urn. A work in stone, iron or terra cotta, resembling a vase; used to cap the pedestal of a balustrade; the pillars of an entrance or a monument in some cemeteries.

V.

Vacancy. A gap in a block of buildings.

Vaccary. A shed to shelter cows; a dairy.

Vagina. The lowest part of a terminal out of which a bust or statue appears to rise.

Vaimure. The exterior wall.

Vakeel. A local attorney for an architect or contractor.

Valley. The re-entrant angle where the slopes of two or more sections of a roof meet; the lead or tin-covered valley rafter or sleeper which receives the rafters of the inclined sides.

Valve. A lid or cover, a screw or slide to prevent or permit the flow of liquid. The modern automatic valve, such as the "air," "ball," "check," "double-beat," equilibrium, etc., are all common appliances in the modern Chicago house.

Valvule. A little valve.

Vane. A wind indicator placed on the apex of gable, cupola, bartizan or spire to show the direction of the wind. The four arms with the letters N. E. S. W. are stationary, but the indicator is movable.

Vandal. A defacer of art or literary works; one who ignores the laws of taste in architecture.

Vandyke brown. A deep-brown pigment, supposed to be that used in the brown colors favored by Vandyke.

Vanishing line. The intersection of the parallel of any original plane and the picture or one of the lines converging to the point where all parallel lines in that plane tend, known as the vanishing point.

Vaporburner. A burner for vaporized hydrocarbon.

Vaporarium. A Roman bathroom, vaulted and comparatively air-tight, heated by hot water or hot air, and used to produce perspiration; a Turkish bathroom.

Variable exhaust. A blast-pipe with an adjustable opening.

Variation of curvature. That change in a curve which renders it flatter in its various parts.

Variation of color. Varying light and shade.

Varnish. Spirit, turpentine or oil varnish is a clear liquid made by the introduction of resinous stuff into the oils named, which dries quickly, leaving the resin to form a smooth, glossy surface.

Vase. The tambour of a Roman, Corinthian or Composite capital; a vase in a stone or terra cotta placed on a balustrade or in a garden. In ancient times the name was applied to vessels placed under the seats in theaters to carry the vocal or instrumental sounds.

Vault. A cylindrical, coved, groined and ribbed, arched structure of masonry, originally below the street surface, but in early Christian days an arch-ceiled church auditorium or room. A vault with two parallel abutments and the same profile at all points may be classed as cylindrical, or one with its two abutments resting on an inclined plane, i. e., one not parallel to the horizon, such as the ceiling of a stairway may be classed as a rampant. A coved vault is the reverse of a groined vault in having its four coves meeting at a common center, while the groined vault shows its cylindrical surfaces intersecting one another. In the ribbed or Gothic vault, curved ridgepoles or ribs meet or cross and carry the vault, dividing it into triangular spaces approaching fan-vaulting in design. In the fan vault the ribs diverge like the ribs of a fan and carry tracery.

Vauntmure. A false wall in front of the main wall.

Vaulted-ceiling. An arched ceiling constructed of cubes of rock, burnt clay or wood.

Vault-reins. The sides or walls which carry the arch.

Vaulting shaft. A column, pillar or boultel from which spring the ribs in the groined vault.

Vein. A wave or streak of color in marbles, woods or metals.

Velarium. The great awning described on page 632.

Vellar cupola. The square cupola on a dome or rising above a groined vault.

Veneer. The ornamental vaimure of an interior wall; a system of ornamental wainscoting where a thin leaf of mahogany or fine wood is used as a face for common wood in doors, window frames, sashes, blinds, casings or furniture. Veneering, as now known. was introduced about 1824.

Venetian door. A door having an arched transom, and a narrow rectangular sidelight each side. It varies from the Venetian window only in the fact that the side windows in the latter extend from the sill to the level of the spring line of the central arch.

Venetian style. The architectural forms adopted by the Venetian architects early in the fifteenth century, and followed by them in the sixteenth and seventeenth centuries. San Micheli, Tatti, Palladio and Scamozzi may be called the fathers of the style in Italy. Carried into England, it lost some of its grandeur. After the Chicago fire it was introduced here in the Honoré and other buildings, with some show of attention to original details; but the central arched and rectangular side windows which are common to it in the smaller city house were not introduced. The study of Venetian style is interesting from the point of view of artist and historian. Venetian blind, Venetian glass, Venetian red are familiar terms in the language of carpenters and painters.

Vent. The funnel or flue of a chimney; a vent in plumbing apparatus; a ventiduct or live-air passage.

Ventilation. The science of venting. The methods of supplying live air and removing foul air without creating air-currents or drafts.

Ventilator. One whose business it is to replace foul air with fresh air in buildings.

Veranda. An open gallery, with light roof, attached to a house rather than a part of it, thus differing from a loggia. It may be converted into a conservatory in winter, by the use of windows or glass-filled frames. An ordinance prohibiting the inclosure of verandas is one of the written laws of Chicago.

Verge. A diminutive ornamental pillar or shaft; the large course or projection of the tile coping over the gable; inclined boards at the angle of a gable which hide the horizontal timbers of the roof, generally called bargeboards. In Chicago the board or grille suspended from the ends of the horizontal boards of the roof show some of the fifteenth century ornament.

Vermiculated. Used to describe stone work in buildings where the stonecutter expressed wavy lines as if made in sand by worms. It is common in the great houses erected in Chicago in 1872–3, and may be seen in the First National bank building of 1882–3. It is sometimes called rusticwork, owing to the fact that it resembles the engravings made by worms on rustic chairs and fences.

Vermilion. A glaring red pigment used in paint; a warm color.

Vernier. A scale to slide along the limb of a sextant or other graduated instrument to denote parts of a division. Such is the calipher, or the gauge or the compass or the transit, fitted with Vernier's invention.

Vertex. The apex or uppermost part; the finial. Seldom used in the United States.

Vertical. In architecture, the antonym of horizontal; upright; perpendicular to the plane of the horizon; plumb. The pier or pilaster compressing two or more stories into one, conveys the idea of the vertical. The band or entablature defining each story conveys that of the horizontal.

Vesica piscis. In ecclesiastical art an oval-shaped aureole composed of two arcs produced to give two lines at right angles with one another.

Vestibule. A detached apartment connected with the early Roman house. Later, an enclosed space or porch attached to the house leading to the atrium or covered court. Still later, the space between the outer and inner doors of a church or dwelling. In a church, the narthex.

Vestry. A sacristy. A revestiary. An apartment in rear of the chancel or at the side, where vestments, vexiliums and the sacred vessels are kept; the robingroom.

Viatecture The art of road and bridge construction.

Vibration The short motion forward and backward of a building where elasticity opposes rigidness. Oscillation is sometimes used, although the motion is produced by gravity and is slower than a vibratory motion. Vibratiuncle is the diminutive of vibration.

Viceman. A blacksmith who works at the vise rather than at the anvil. Also viseman.

Victorean. A new name for a newer and more grotesque Queen Anne form of building.

Villa. A wholly detached cottage of architectural pretensions in a suburb or by the lake or sea shore; a summer residence. The Romans knew three classes of villa: *villa urbana*, a *rus in urbe* residence; *villa rustica*, a plantation or farm house, and *villa fructuaria*, the great storehouse of the plantation or farm.

Vimaria. The auditorium of the Hindoo temple.

Vinatico. A dark-colored Madeira mahogany.

Vise. An iron implement with screw power. The carpenter's vise is made of wooden jaws and screw on the principle of the iron vise.

Visorium. The tiers of seats in a circus or amphitheater.

Visual. Used in the architectural phrases, visual angle, visual plane, visual cone, and visual point. The visual angle is one formed by two straight lines drawn from the extreme point of an object to the center of the eye. The visual cone is one the vertex of which is at the eye. The visual plane is one passing through the visual cone; and the visual point is one in the horizontal line in which the visual rays unite.

Vital air. Oxygen gas; live air.

Vitrified pipe. Burnt clay glazed by heat and fusion in the manner described in the pages devoted to brick and sewer-pipe manufacture.

Vitruvian scroll. A scroll work of convolved undulations used in classical architecture.
Vitruvius. A Roman architect and author and an authority on classical architecture and engineering and the historian of the buildings of Pompeii.
Vivo. The shaft of a column.
Volt. The unit of electric motive force, producing an ampere on a circuit of one ohm's resistance. It has about one-tenth the force of a Daniel's sulphate of copper cell.
Volute. The spiral scroll of the Ionic column, smaller in the Composite column and smallest in the Corinthian column.
Vomitorium. The principal exit from a circus or amphitheater. Vomitory in the United States.
Voussoir. The wedge-like stones of an arch each side of the keystone or center voussoir, extending to the coussinet.

W.

Wad. A tuft of grass used in log-cabin days, for window openings to keep out the rain and cold.
Wage. Compensation for labor. Pay, however, is the American word.
Wagon vault. A barrel vault or ceiling.
Wainscot or Wainscoting. The interior board lining of a house arranged in panels. The words may be applied to the material or used as verbs. The local vernacular must influence the choice.
Wair. A plank seventy-two inches long and twelve inches wide.
Walings. Supports or props; shorings.
Wall. A work in stone, brick or wood, intended as an enclosure for a house or for partitions within a house.
Wall. To construct a wall.
Wall-cased. An old wall veneered with new material.
Waller. A builder of walls.
Walnut. An ornamental wood used in doors, casings, wainscotings, etc.
Wallpaper. A paper plain or pictured attached to walls with paste. Paper-hangings is the term applied in the United States.
Wallplate. Timber placed horizontally at story level to receive the joists.
Wallrock. A limestone used in building walls.
Ward. A projecting metal in a lock which opposes a key not belonging to such lock. A room in a hospital; an open court in a castle.
Warm. Applied to colors, based on red or yellow, opposed to cold colors, such as blue.
Wash. A thin coat of water-color; a thin coat of metal applied as ornament.
Washer. An iron guard between head and nut of screw to prevent compression of timber. A removable drainer in sink to facilitate its cleaning.
Wasting. Reducing rough-faced stone to a plain surface.
Wastepipe. A conveyor of wastewater.
Watercloset. A privy supplied with sanitary apparatus.
Watercolor. A color the vehicle of which is water.
Watergas. A gas obtained by passing steam over lighted carbon.
Waterglass. Soluble glass.
Waterhammer. Water unimpeded by air striking the sides of piping and making a hammering noise.
Waterjoint. A joint between stones in paving to prevent the lodgment of water.

Waterjoint hinge. A hinge with a loop near the turning part to prevent rusting.
Waterlevel. Same as spirit-level used in fixing horizontal line.
Waterline. Hydraulic line producing an insolnble silicate of alumina.
Watermeter. An apparatus which records supply or evaporation.
Waterproof. To make impervious to water, as waterproof roof, floor, etc.
Watertable. A molding or band at first floor level to cast off the water.
Watertower. An iron extension pipe in sections used as a standpipe.
Weatherboard. Clapboard or siding.
Weathercock. Vane, in the language of the United States.
Weathermolding. The watertable over an arch; a stringcourse.
Weatherslating. The slate siding of a wall.
Weathertiling. The tile siding of a wall.
Wedge. One of the five elementary machines.
Weights. The sash balance to facilitate raising or lowering sash.
Welchgroin. An underpitch groin, formed by the intersection of two cylindrical vaults.
Weld. A fusion of metals; to fuse metals.
Well. The opening in a circular or square stairway; a hatchway; a water reservoir; the lower part of a furnace; a plumber's well.
Wellhole. The vertical open space through a building, in which a staircase is built; the clear space at the ends of the steps.
Weepers. Statues, representing mourners, placed in the niches of mortuary chapels.
Wheel. An elementary machine which has a capacity of power to overcome another power, as a lever; a potter's wheel.
Wheelbarrow. A one-wheeled vehicle, which enables a man to push or draw a load far greater than he could carry on his back or shoulders or in his arms. The weight being divided between the human motor and the axle, the laws of cause and effect are illustrated.
Whetstone. A fine-grained stone on which edged tools are sharpened.
Whitelead. A mineral forming the basis of good paints. The process of manufacturing white lead in twelve hours belongs to 1891, when G. G. Coleman, of Chicago, satisfied a number of practical paint men that this basis of all paints could be produced in a half day. The Dutch process now observed requires over three months and results in waste of valuable constituent parts, which the new process will save by converting the pig lead into white lead without the use of deleterious acids.
White-limed. Washed or plastered with lime.
Whitewash. A wash made from lime.
Whitewood. The wood of the tulip tree used in interior house-work.
Whittlings. Shavings produced by whittling a piece of wood.
Wicket. A gate within a gate; a small door in a large door.
Widmanstatten figures. Figures on etched meteoric iron.
Wigwam. A natural style of architecture; poles arranged in conical form, covered with furs, hides or mats.
Windbeam. A horizontal timber connecting two rafters, now known as collarbeam.
Winder. A step in a circular or winding stair, one end being a point, widening at the exterior or farther end from the center.
Windguard. A guard to protect chimneys from down draft.
Windingstair. A circular stairway in wood, iron or stone. An inartistic form of it is

seen in the tower of the north side waterworks where the steps wind round the great stand pipe.

Window. An important architectural opening in a building. In classical forms they are rectangular, showing the architrave or arch. The Venetian, the Norman, the Gothic, and the Wyatt or Irish are names bestowed on definite classes of windows. In Saxon architecture the window was simply a round or rectangular hole in the wall; but in the church buildings of the Saxon age of civilization some ornament was introduced. Windore is an ancient form. Glass, since its invention, has been used to fill the openings.

Windowtracery. Ornamental stone work in early Gothic windows. The evolution of the dripstone into geometrical circles on the head of the window arose from the grouping of three lancets under one label, and the desire of the architect to fill in the space above the heads with circles, trefoils, ogival forms and the forms of the flamboyant or ogee style.

Wind-tight. Capable of preventing the entrance of wind.

Wings. The divisions of a building each side of the central facade; attached divisions of a building running back from the main building.

Wire-lathing. Woven wire with loop iron attachments, affixed to the walls by means of staples, to receive plaster. It is, of course, more expensive than ordinary wooden lath; but it renders wooden walls, partitions and ceilings practically fireproof.

Wirecloth. Wire woven in the form of mosquito netting, used in screen doors and blinds. Wiregauze is finer and wirenetting coarser than wirecloth.

Withes. The partitions between flues in a chimney stack.

Wood. Called lumber by builders; the hard substance of the tree, sawn into boards or scantling. It is also called timber, but this last name is applied to beams, lintels and sills.

Woodbrick. A block of wood, the size of a brick, inserted in a stone or brick wall, instead of laths or scantling. to receive the interior woodwork.

Woodhouse. A shed or house where lumber or firewood is stored.

Woodrock. A variety of asbestus resembling compact wood.

Woodscrew. A metal screw for insertion in wood.

Wood-terra-cotta. A porous hollow tile to which lumber, marble or iron may be attached by screws or nails.

Wool, mineral. A deadener, filler and fireproofer made from slag.

Working day. The number of hours established by custom or law constituting a day's work; each of the six days of the week exclusive of Sunday.

Working-drawing. A representation of a building or part thereof, showing details and scale. It is the guide for contractor and workmen.

Workman-like. A word used in building contracts to convey the idea of substantial and well finished work.

Wrench. An elementary machine which exerts a twisting strain. The bar wrench and the adjustable hammer wrench are as well known as they are useful.

Wreathed-column. A column or pillar, twisted, curled or round, on which forms in relief are entwined.

Wreathed-string. A name applied to the circular stair-string where a hollow newel is used.

Wroughtiron. A pure iron having the property of welding. It is also known as malleable iron.

Wyatt-window. The Irish window, which suggested the Venetian triple window. Each of its three parts corresponds in size with the central light, and therein it differs from the narrow side-lights of the Venetian window. The present name was given in honor of James Wyatt, an architect who revived the style.

Wynn. A vehicle for the conveyance of lumber.

X.

Xenodochium. The receptionroom of an ancient monastery where strangers, pilgrims and paupers were entertained.

Xylography. The art of cutting figures of natural objects in wood.

Xystus. The long portico, with polished floor, of a Greek dwelling or temple—roofed or open. Also written xystos.

Y.

Yaccawood. A pale-brown wood, streaked with hazel-brown, found in Jamaica. A favorite with workers in ornamental woods.

Yard. A piece of timber as a scantling or joist; a measure thirty-six inches in length; a paved space in rear of a house; an inclosed space where lumber is stored or stone or brick manufactured.

Yellow. A color pigment, such as chrome yellow.

Yellowpine. A hard pine coming into favor for floors and wainscoting instead of maple, oak and ash.

Yle. Early English for aisle.

Z.

Zaccho. A name given to the lowest part of a pedestal; but is only properly applied when speaking of a Greek or Roman column. Written also zaccolo, zacco, zocco and zoccolo.

Zaphara. An impure oxide of cobalt, which produces a blue tint in pottery. The word is spelled zaffar, zaffir and zaffre.

Zax. A knife used in cutting slate.

Zebrawood. A timber found in South America which is striped in brown, black and white like the zebra. It is a favorite wood with cabinetmakers.

Zechstein. A magnesian limestone belonging to the Permian age.

Zeta. A parlor or diningroom. Also zeticula.

Zigzag molding. A molding used by the Norman architects for labels, archivolts, and other ornamental work.

Zinc. A metal of a white color, malleable when heated; used instead of tin or copper in building.

Zincwhite. A mineral used as pigment.

Zophoric column. A support for the figure of an animal.

Zophorus. A part of the entablature between the architrave and cornice, always en riched with figures of animals. Same as frieze.

Zotheca. An alcove.

INDEX.

L PAGE.

PAGE.

M

L