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CONTENTS

WE must confess that we never hear "Labor Day" or "Labor's Holiday" mentioned without a feeling of contempt and disgust for the impudent demagogism on one side, and cowardly servility on the other, which have brought the descendants of those who prepared and defended the Declaration of Independence down to the embodiment in legislation of the idea that, instead of all men being born free and equal, there are two sorts of men in this Republic, one consisting of the members of certain organizations, and the other including the miscellaneous persons who do not belong to these organizations, and that those who do belong to them are entitled to favor and recognition from the Government which is not accorded to other people. In a community whose whole public system is founded upon the idea that there should be no class legislation, it is certainly curious to find, of late years, statute after statute enacted at the demand of the crafty and ambitious foreigners who control the forces of "organized labor." For several years, "organized labor" has, or would have had, but for internal squabbles, things pretty much its own way in the legislatures, but just now, circumstances which neither legislatures nor walking-delegates can control have given a very large number of citizens more leisure than usual for thinking, and there are indications that a good many of them are reflecting whether, after all, they might not be as well off in the simple capacity of "free and equal" citizens of the Republic as they are now in that of abject slaves of a foreign tyranny which dictates to them when, how, with whom and at what price they shall work, which prevents them from teaching their own business to their own children, and which forces them to sit idle and see their families suffer, when work is plenty, for the sake of "sympathizing" with some other people, of whom they never heard, and whose relations to them consists solely in a concerted scheme of their respective leaders for their private advantage.

THERE is no doubt that, with the stagnation and uncertainty of nearly every kind of business, salaries, whether paid by the year, month or week, and whether amounting to ten or ten hundred dollars a week, must be reduced, for the simple reason that there will be several applicants for nearly every employment, and the employer, whose salary, if he is in his turn employed, or whose income, if he depends on the custom of salaried people, has been also reduced, will hire the one who will give him the service he wants for the least money. Under these circumstances, the fetters of trades-unionism, by which men who wish to work must lie still and see others, who are not bound by rules or oaths as to what price they will take for their labor, get the employment they want, will seem oppressive, as they never have before, and, although the tyrants will probably make a savage struggle to keep their control where they think they have any chance of doing so, there is some prospect that "organized labor" will for a time fall into the background, and that ordinary citizens will be given something like a fair chance in earning and regulating their living. Meanwhile, it will be interesting to call attention again to the matter which is most vital of all in considering the question of wages, but which is totally ignored, much to the advantage of the labor tyrants, in nearly all published statistics; that is, the total annual income of men in the organized trades. We are constantly told that the organization of labor has advanced wages, and are confronted with comparative tables of the wages per day demanded by union workmen ten or twenty years ago and now; but we seldom find any reference to the fact that, although the rate of wages has advanced in the organized trades, the proportion of employed to unemployed time has, in this country, fallen off, so that the average union carpenter or mason, in the course of a year, earns less now than he formerly did, while, as other "organized" people have imitated him in demanding higher wages for their work, he has to pay more for his house, more for his shoes and more for everything else that he consumes, into the cost of which "organized labor" enters, and has less money to do it with. It will be remembered that, according to the official statistics collected by the State of Wisconsin, the average income of carpenters in the great and rapidly-growing city of Milwaukee was, two years ago, about five hundred dollars a year. Wages were nominally high, and the most savage penalties attended any attempt on the part of a union carpenter to take less; but there was little demand for such high-priced labor, and the carpenter who could eke out his living by cultivating a garden-patch or going off lumbering in winter considered himself fortunate. Meanwhile, supposing the cost of labor in the house occupied by the Milwaukee carpenter to have been half the entire cost, and the artificial standard of wages under which it was built to have been twenty-five per cent above the natural one fixed by the law of supply and demand, he, with a yearly income about equal to that of an Italian day-laborer, is obliged to pay one-eighth more rent than he would have had to pay if the unions had not artificially increased the cost of his house. It does not require a great mind to see that the Milwaukee carpenter would be much better off, at lower wages, if he could be employed all the time, and it is equally obvious that if the cost of houses were not artificially enhanced by the union leaders, more people could afford to have new ones, and there would be more of them built, so that the carpenter's labor would be in more constant demand, and his yearly income larger, while his house-rent and many other expenses would be less. Certainly, a long argument ought not to be necessary to convince a man that, to earn seven hundred and fifty dollars a year, at two dollars and a half a day, and have only four hundred and fifty to pay out for expenses, is more profitable than to earn five hundred dollars a year by working occasionally at three dollars a day, and have to pay out the whole five hundred for expenses; yet any person in this country who ventures to suggest that the reduction of the artificial standard of wages could be advantageous to all persons concerned is denounced as an enemy of the human race; and the union tariffs are held up to the admiration of mankind as an evidence of the prosperity of the country and the blessed condition of American workmen at the very time that the same workmen are emigrating to Germany, Holland, France and England, finding that, in many cases, they can earn actually more money in a year there than here, while the cost of living there is a fraction of what it is in the United States.

A BRIDGE is in process of erection in Chicago on what is by no means a new plan, although we believe that it has not been applied before in this country. The bridge is to span the Chicago River, and is designed on what is known as the "lift" principle, by which, instead of turning half around, or receding in some other way at its original level, to give passage to vessels, as in ordinary draw-spans, the middle part of the bridge rises vertically to a height sufficient to allow vessels to pass underneath. Theoretically, this is a better plan than the old one, as the ends of the draw-span are firmly held, instead of overhanging vacancy, and the lifting can be effected more rapidly than turning. Practically, however, we suppose that such bridges are exposed to all the accidents that beset elevators, and these are many. In the Chicago bridge, which has a span of one hundred feet, the normal height above the water is fifteen feet, which gives room enough for tugs to pass under; but, to admit the passage of vessels with high masts, the draw-span can be raised one hundred and forty feet higher, giving room for the loftiest masts. For craft with short masts, the bridge need not be raised so high, which will, apparently, economize the time and power needed for the operation. The towers are of steel framing, and the whole affair, which appears to be of the most substantial design, will be very interesting to scientific visitors.

AMONG the numerous plans for laying out the new quarter of Munich is one by Professor Hauberisser, one of the best known architects in Germany, which presents some interesting points. While the great thoroughfares of the present city are extended into the new region, most of the new streets are curved, in a manner which would give picturesque effects, but would, we think, be terribly confusing to a stranger. Unfortunately, Professor Hauberisser only sent a single general plan, at a small scale, instead of the thirty-one sheets of drawings, at various scales, required by the programme, so that his design was excluded from the award of prizes, although it received honorable mention from the judges, and was purchased by the city. The *Deutsche Bauzeitung*, which has devoted much space to an admirable discussion of the various designs, prefers, however, that of Professor Henrici, which we have already described. It is true that the Henrici design embodies so many novel and startling theories of street-planning as to excite a certain alarm in the average mind, but that it would produce a wonderfully picturesque effect cannot be denied, and the *Deutsche Bauzeitung*, which, notwithstanding its high rank as a scientific and technical journal, is thoroughly artistic in its sympathies, has done much by its discussion of Professor Henrici's innovations, to prepare the public mind for seeing his plan carried into execution, as we sincerely hope it may be. Professor Henrici himself seems to have been quite aware of the astonishment and suspicion with which his views would be received, for he accompanied his elaborate and beautiful set of competition drawings with a "description" which, instead of the usual bald and tedious memorandum, consisted of an imaginary dialogue between "Realist," the name used as his motto, and "*Stimme der Zeit*," or, as we might translate it, the common idea, representing the preconceived notions which have, ever since the time of Baron Haussman, ruled over the laying out of new streets.

AS shown in this dialogue, the starting-point of Henrici's plan was the beautiful group of irregular and picturesque streets which radiates from the Marienplatz, the business centre of the city. It was evident that this central point must be more and more frequented as the city increased in population, and that the increasing traffic must be accommodated; but, instead of spoiling the picturesqueness of the present principal streets, which are already tolerably wide, by widening them still farther, it seemed to him best to relieve them by widening and connecting certain insignificant streets and alleys which run nearly parallel with them, and at a short distance. Thus, instead of widening, at great expense, the Thal, the Kaufingerstrasse and the Neuhauserstrasse, which run east and west from the Marienplatz, and on which stand some of the finest buildings in the town, he would widen and connect the Frauenstrasse, the Rosenthal, the Färbergraben, the Althammereck and the Herzogspitalstrasse, which run in the same direction, one or two hundred yards away. A new north and south street, nearly parallel to the present Theatiner and Surdlingerstrasse, would be managed in the same way; and the removal of the old Schrannen-Halle would open a wide street, or rather avenue, planted with trees, directly from the Thal, near the Marienplatz, to the gate of the great park of the Theresienwiese. The idea of relieving the traffic of principal streets, not by widening them, but by forming new ones, nearly parallel with them, out of the neglected slums and alleys which usually exist at a little distance from them, is practically new, but it cannot be denied that it has great advantages. For improving the outlying regions of the city, Professor Henrici divides the territory into seven parts, corresponding with the present natural divisions. Reasoning that these districts will continue to be, as they are now, and as similar districts are in all towns, to a certain extent distinct, carrying on an active local traffic, and requiring ready communication with the central part of the city, but not exchanging much traffic directly with each other, he treats each district separately, laying out its streets to suit local topography and other peculiarities, arranging ample communication with the general centre, and sufficient, but not excessive, communication with the neighboring districts. Although this idea is also new to the rule-and-compass school of street-designers, it is supported by experience, which shows that the tendency of traffic between points in a suburban ring is to pass from one point of the circumference to the centre, and thence to another part of the circumference, in preference to taking the shorter route around the circumference. In laying-out all his streets, Professor Henrici has, apparently, avoided nearly all the favorite practises of the ordinary street-planner. The starlike points where half-a-dozen principal streets intersect, which ornament so many maps, are absent from his. As "Realist" says, the concentration of the traffic of several streets upon a main avenue obstructs that avenue, and should be avoided. As, however, it is advantageous to have theatres, music-halls, schools, churches and other places of public resort placed at the focus of several radiating lines of streets, such foci should be provided, but they should be kept a little away from the great avenues, where they will be conveniently accessible, but will not form an obstruction. It would take much too long to mention all the novel ideas which "Realist" propounds and embodies in his plan, but one or two are well worth remembering. One of these is that streets which are slightly curved are less liable to stoppages and blockades, with a given amount of traffic, than straight ones; and another, which seems to have excited a certain amount of disapprobation, is that the present system of laying-out streets and regulating street-lines is arranged altogether too much after the dictation of street-railway directors. The principles of street-railway traffic, as mathematically deduced from certain postulates, are, Professor Henrici thinks, pure assumptions, which leave out of account the most important factor in the problem, namely, the people, who have something else to do besides mere travelling to and fro; yet so accustomed has the public become to the old system of improving towns by driving straight avenues in all directions through them, that he despairs of ever making it understood how much more beauty, comfort and convenience can be obtained by a different system.

THE annual competition for the Prize of Rome took place at the Paris School of Fine Arts last month, with ten competitors, and the grand prize was awarded to M. Chaussemiche, a pupil of André and Laloux, who took the "second second" grand prize in 1891. The "first second" grand prize was awarded to M. Paul Dusart, also a pupil of André and Laloux, and the "second second" prize to M. Recoura, pupil of M. Pascal. The subject of the competition was a "Palace for the Learned Societies." It was required to provide accommodations for eighty societies, of unequal importance, divided into two groups, one comprising the societies interested in physical science, and the other those cultivating literature, history and the arts; and one of the conditions was that the societies should have accommodations independent of each other, yet communicating in such a way as to allow various societies to join with or assist each other on occasion. It would not be easy to devise a more difficult problem, but the unrivalled skill in planning which the School of Fine Arts manages to impart to its pupils makes light of such difficulties.

THERE is rather an interesting novelty about the Trenton Battle Monument, which will soon be ready for unveiling. The monument consists of a colossal statue of Washington, standing on top of a column, but the peculiarity of the statue is that while it represents Washington, with the right arm extended, in the act of ordering Captain Alexander Hamilton's battery of New York artillery into action, it stands over the very spot where Washington gave that order, as if he had been at the moment turned into bronze. The spot is said to be well identified, the details of the battle being familiar. The figure was modelled by W. R. O'Donovan, and cast at the National Fine Art Foundry, in New York.

MAIN STAIR-CASE: EQUITABLE INSURANCE BUILDING, DENVER, COLO

ANDREWS, JAQUES & RANTOUL, Architects.

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OFFICE-HELP FOR ARCHITECTS.[1]—XVIII.

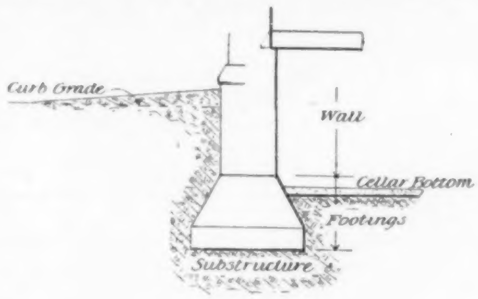


Fig. 74.

CHAPTER VII. — FOUNDATIONS.

§ 250. Definitions: — In what follows, the several parts of the walls or piers below the line of the curb opposite centre of building, in the case of a city building, or the portions below the plane of the water-table will be called "foundations" and divided into "the wall," "the footings" and "the substructure." (Fig. 74.)

§ 251. Weights: — To properly proportion a foundation, it is necessary to know approximately the weights imposed by the building on each lineal foot of wall; for this purpose Table XXVII is given.

Assumptions: — Weights are from top of footings.

Height of stories 12′ 6″, finished floor to finished floor.

Walls: — Brick, at 120 pounds per cubic foot. Sizes conforming to New York Building Laws for walls.

TABLE XXVII.

WEIGHT OF BRICK WALLS IN TONS PER LINEAL FOOT.

			BRICK AND FRAME.		FIREPROOF.				WAREHOUSES.		
					DWELLINGS.		OFFICE-BUILDINGS.				
Stories.	Height.	Frame.	Bearing.	Not B.	Bearing.	Not B.	Bearing.	Not B.	Bearing.	Not B.	Skeleton.
16	200.0				27.20	23.20	30.00	26.40	30.00	26.00	18.00
15	187.5				24.45	20.70	27.25	23.50	27.25	23.50	16.50
14	175.0				21.95	18.45	24.50	21.00	24.50	21.00	15.00
13	162.5				19.45	16.00	22.00	18.75	22.00	18.75	13.50
12	150.0				17.20	14.20	19.50	16.50	19.50	16.50	12.00
11	137.5				14.95	12.20	17.25	14.50	17.25	14.50	10.75
10	125.0				12.95	10.70	15.00	12.50	15.00	12.50	9.50
9	112.5				10.95	8.95	13.00	11.75	13.00	11.75	8.25
8	100.0				10.20	8.70	11.00	9.00	11.00	9.00	7.00
7	87.5[1]		6.70	5.8	6.70	6.70	8.40	6.65	8.40	6.65	6.00
6	75.0		5.00	5.00	5.00	5.00	6.50	5.00	6.50	5.00	5.00
5	62.5		3.96	3.96	3.96	3.96	4.40	3.75	4.40	3.75	4.00
4	50.0		3.00	3.00	3.00	3.00	3.50	3.00	3.50	3.00	3.00
3	37.5	0.21	1.72	1.50	1.72	1.50	2.25	2.25	2.25	2.25	2.25
2	25.0	0.14	0.56	0.56	0.56	0.56	1.50	1.50	1.50	1.50	1.50
1	12.5	0.07	0.48	0.48	0.48	0.48	0.75	0.75	0.75	0.75	0.75

[1] In New York the limit of height of a wall for non-fireproof construction is 85′ 0″. For a change in thickness of wall of 4″, multiply by 0.02 to obtain tons per lineal foot.

TABLE XXVIII.

FLOOR LOADS, DEAD AND LIVE, PER SQUARE FOOT.

For ordinary frame dwellings, churches, etc.	100 lbs.
" " brick " not fireproof	110 "
" " " office-buildings, not fireproof	125 "
" " " " " fireproof	175 "
" " " buildings for light manufacturing purposes, not fireproof	225 "
" " " buildings for light manufacturing purposes, fireproof, armories, gymnasiums and stores	275 "
" " " warehouses, not fireproof	300 "
" " " " "	400 "

[1] By George Hill, Consulting Engineer. Continued from No. 923, page 141.

ABBREVIATIONS AND SYMBOLS.

= equal to.
|| parallel to.
÷ divided by.
× multiplied by.
+ added to.
a^2 a multiplied by itself.
$a > b$: — a greater than b.
$a < b$: — a less than b.
$\frac{a}{b}$: — a divided by b.
∴ therefore.
□′ square feet.
□″ square inches.
8# read 8 pounds per lineal foot.
[channel bar.
I I-beam.
T T-iron.
L angle iron.
⊥ deck beam.
● round section.

TO DETERMINE LOAD ON FOOTINGS FROM FLOOR-LOADS.

Up to five stories:

$$\text{Total per foot in tons} = \frac{\text{Number of stories} \times L \times l}{4{,}000} \qquad (49)$$

For five to seven stories:

$$\text{Total per foot in tons} = \frac{\text{Number of stories} \times L \times l}{5{,}000} \qquad (50)$$

Above seven stories:

$$\text{Total per foot in tons} = \frac{\text{Number of stories} \times L \times l}{6{,}000} \qquad (51)$$

In a building up to five stories, all floors may be loaded with very near the maximum live load at times. Above five stories, this becomes increasingly improbable. In the West, a reduction is made of 5% per story in the live load for tall buildings with good results. This is probably because any soil will resist for a short time an overload that would cause sinkage into it, if left for a considerable time.

$$\left\{ \begin{array}{l} \text{Weight of wall (Table XXVII)} + \\ \text{weight due to floors (Table XXVIII)} \end{array} \right\} = \begin{array}{l} L \text{ on footings} \\ \text{per lineal foot.} \end{array} \qquad (52)$$

$$L \text{ on substructure} = \text{Wall} + \text{Floor} + \text{Footings}. \qquad (53)$$

Wind loads should not be figured as adding to the loads on the footings.

SECTION I. — SOILS:

§ 252. Remarks: — All soils on which it is intended to erect a structure should be studied and explored to a depth which will be sufficient, in the character of material passed through, to sustain a load at least 25% greater than that contemplated, or until some incompressible stratum is reached.

Procedure as follows:

First. — Ascertain, as far as possible, the original topographical features and original level of the ground at and near the site.

Second. — Ascertain what changes have taken place in the way of levelling, filling, draining, etc.

I ton = 2,000 pounds as this is the conventional ton, the legal ton is 2,240 pounds, but is rarely used.
l = the length between supports of any beam or girder or height of any column, always in feet.
b = breadth of any beam or girder, always in inches.
d = depth of any beam or girder, or the least transverse dimension of any column, always in inches.
L = total load uniformly distributed coming on any piece in pounds.
$L^{\square\prime}$ = " " " " per square foot in pounds.
W = concentrated load on any piece in pounds.
s = span of any arch or truss between centres of end pins in feet, or spread of footing courses.
A = area of any section in square inches.
M = maximum bending-moment in inch pounds.
n = distance of centre of gravity of section from either top or bottom edge in inches.
I = moment of inertia, neutral axis through centre of gravity.
R = moment of resistance of section.
r = radius of gyration, in inches.
Sc = safe compressive strain in pounds per square inch.
St = " tensile " " " " " "
Ss = " shearing " " " " " "
S = strain per square inch in extreme fibre.
P_e = upward reaction of support at left-hand end of beam.
P_f = " " " " " right " " " "
e = distance of centre of gravity of load from left hand of beam.
f = " " " " " " " " right " " "

Third. — Have tests made by some fully competent engineer to ascertain the exact character of the soil.

§ 253. Testing: *When $L =$ or < 6 tons:* — Have test-pits dug at intervals of 10′ 0″ around the foundations to proposed depth of footings, then sink holes with 1¼″ auger to an additional depth of 10′ 0″, one in each pit.

In clay or compact earth, the hole will stay; in sand or gravel, drive in a 1½″ pipe, using a wooden maul, keeping the pipe always in advance of the auger. The auger will bring up samples of the soil. In case the geology of the section has been studied, an examination of the outcrops of the strata will give a good indication of the soil, which should be verified with at least one boring when, if this agrees with the diagnosis, the remaining borings may be omitted.

When $L = 6$ to 15 tons: — Proceed as above, but make all of the borings, unless gravel, sand or rock is known to exist for a depth of at least 30′ 0″. If the soil is homogeneous clay, or soft earth, make the borings at least 25′ 0″ deep, and if the soil gets softer as the depth increases, make the borings at least 35′ 0″ deep.

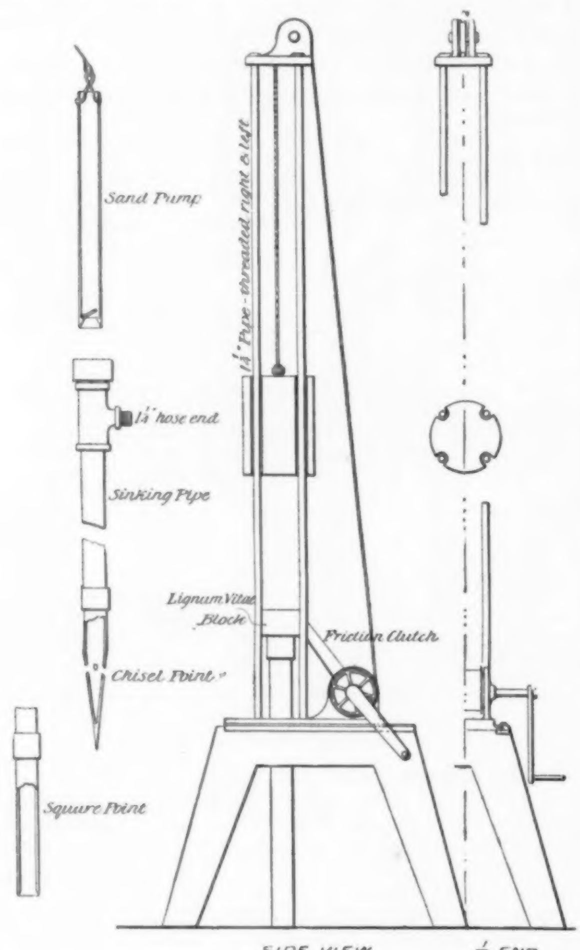


Fig. 75.

When $L > 15$ tons: — Make the borings at least 60′ 0″ deep, or to rock, spacing them so as to be equidistant, and one for each 900 square feet of area covered by the building.

Should any bore fail to reach the average depth of the others, additional ones should be driven around it, until the average depth is reached; in this way the obstacle will be outlined. If they should show a lack of uniformity, additional bores must be made.

§ 254. Methods: — For all test bores up to 30′ 0″ in ordinary soils, a 1½″ auger mounted on 1″ gas-pipe with several 5′ 0″ lengths, and one 1′ 0″ long with an eye to insert the handles, three lengths of 1½″ gas-pipe 12′ 0″ long, with maul, couplings and tongs for jointing, are all that are necessary.

For test bores under other conditions use:

(*a*) A light pile-driving frame as shown on Figure 75, with the runs arranged to slide back. (Type devised by Prof. Charles B. Brush.) Lengths of 3″ pipe, 5′ 0″, 10′ 0″, and 12′ 0″ long, with couplings, tongs and a cap to screw on.

(*b*) An oak or lignum vitæ block 8″ diameter, 12″ long, strapped with iron.

(*c*) A 1½″ auger, with 1¼″ jointing rods 5′ 0″ and 10′ 0″ long. Several chisel-shaped points to use in place of the auger in going through hard material, some perforated and some solid.

(*d*) A sand pump, *i. e.*, a 5′ 0″ length of 1½″ pipe with a ring in top end, and the bottom chisel-shaped, with an ordinary clack-valve in it. (Fig. 75.)

(*e*) A 1″ force-pump with 20′ 0″ of 1½″ suction-hose, and 60′ 0″ of 1″ delivery-hose attached to a coupling at the end of a 1½″ pipe. On the end of the pipe the various points are fitted.

The operation is as follows: The pile-driver is mounted over the place it is desired to test, and one of the shorter lengths of 3″ pipe driven in, then the auger is started down to a depth of two or three feet below the bottom of the 3″ pipe, and the samples brought up and saved. Then the pipe is lengthened, driven down again, and the auger used again, and the cycle repeated, until the auger can be used no more; then the chisel on the end of the 1½″ pipe is put on and a stream of water started down the pipe. This soon fills the hole and muddy water flows out; if this is caught in a pail, the sediment will show the character of the soil. Samples should be taken constantly, and at every change in character a portion should be placed in a wooden box 3′ 0″ long, 4″ wide and 1″ deep, divided by longitudinal partitions into a number of parts, with transverse divisions placed at each point where the samples change character, and the depth of the change-point below the surface noted on the box. The distinguishing number or letter of the bore should be placed at the top of the compartment.

The box should be made to some scale and the samples put in to that scale, so that their relations to one another can be seen at a glance.

A note-book should also be kept, giving minutely the character of the soils passed through, veins of water, rate of progress, etc., on one page, and on the other a sketch showing a vertical section. The rate of progress should be particularly noted, as it indicates in a general way the hardness and the amount of water in the soil.

Bores of 20′ 0″ or over, should always be made by experienced men, and the results judged by one familiar with the methods employed, as it gives more reliable results, and is much more economical.

Should rock be encountered near the surface, of at all doubtful character, or should there be limestone in the vicinity abounding in fissures, the rock should be explored with a diamond or other drill for at least 30′ 0″ in depth, and in at least two places, so as to eliminate all doubt as to its soundness.

The safe plan would be to consult a geologist to determine whether or not there are probably any fissures of 2′ 0″ or more in size, and their probable general direction.

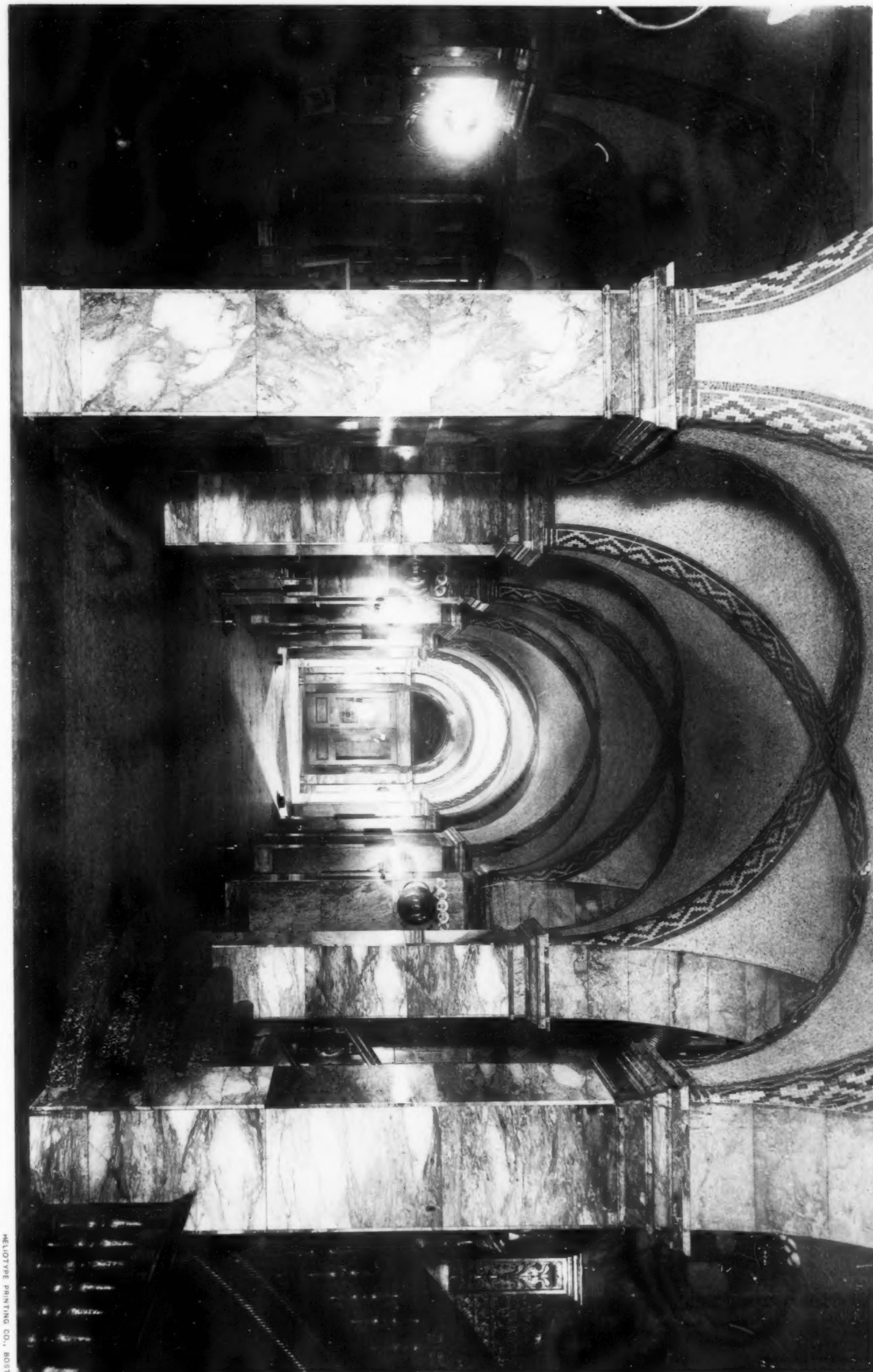
Soft Soils: — These should be tested by driving long spruce piles with a 1,200-pound hammer, until their penetration is $< 3''$ under a 20′ 0″ fall. Rate of penetration and behavior should be carefully noted. (See § 270.)

§ 255. Bearing Value: *Soils, Data:* — Value given per square foot is for a minimum area covered of 20 square feet. Results are from various sources, many have been tested by the writer, and all are believed to be safe.

TABLE XXIX.

BEARING-VALUE OF VARIOUS SOILS, *B.*

Character of soil.	Safe loads per square foot in tons.
Ordinary earth (red sandstone)	2
" " (primary)	2
" dry clay (tertiary)	3
" wet " (not homogeneous)	1½
" " "	2
" gravel and small boulders (tertiary)	5
" sand, gravel and small boulders, water-packed	5
" " water-packed	5
" " very fine and micaceous	3½
Old fills of doubtful character	¾
Mud	½
Silt	¼



CORRIDOR: EQUITABLE INSURANCE BUILDING, DENVER, COLO.

ANDREWS, JAQUES & RANTOUL, Architects.

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Rock, will bear all that the walls will.

Piles, Data: — Bearing-value based on the minimum length of spruce pile and average penetration as given for last five blows of a 1,200-pound hammer falling 15′ 0″. Piles left sound. Dimensions as follows:

TABLE XXX.

DIMENSIONS OF SPRUCE PILES.

Length.	Diameter of butt.	Diameter of point.	Remarks.
20′ 0″	8″	5″	Sizes for oak may be ½″ smaller; for all other timber, may be same as spruce.
25′ 0″	8½″	5½″	
30′ 0″	9″	6″	
35′ 0″	10″	6″	
40′ 0″	11″	6″	
45′ 0″	12″	6″	
50′ 0″	13″	7″	
55′ 0″	14″	7″	
60′ 0″	15″	7″	

Note: Butts to be cut square, points cut on four sides, leaving the point 1½″ square, and 8″ to 12″ long. For very soft soils, make as much thicker as they can be procured.

TABLE XXXI.

BEARING-VALUE OF PILES.

Soil.	Pile lengths.	Penetration.	Load tons.
Silt	40′	6″	5
Mud	30′	2″	8
Soft earth with boulders or logs	30′	1½″	9
Moderately firm earth or clay, with boulders or logs	30′	1″	12
Soft earth or clay	30′	1″	12
Quicksand	30′	½″	17
Firm earth	30′	½″	17
" " into gravel	20′	½″	17
" " " " or rock	20′	0″	20
" homogeneous earth	30′	½″	20
Sand	20′	0″	20
Gravel	15′	0″	20

§ 256. Treatment: *Soils, Earths:* — Should have excavation carried below frost line. Excavation should be carefully levelled and rammed with a wood ram. Masonwork should follow the ramming closely. Should be drained (See Drainage, Chapter XII).

Clay: — When dry, should be treated as earth; when wet, lay ½″ × 4″ boards down, and ram on them. Drain by laying drains 2′ 0″ away from, and 1′ 6″ below bottom of footings, for weight up to 10 tons; beyond that, place the drains farther away and deeper. Great care must be exercised to make the soil absolutely dry at all times, and to provide means to carry off the water freely. If drainage is impossible, fill with sand or gravel in layers and ram. If for a heavy, important structure, consult an engineer of experience.

Sand: — If dry, level off, spread 2″ of concrete over, well rammed, and immediately start masonry. Sloping beds of clay, especially when some little distance from the top of the slope, are dangerous as the building is always liable to slip down the slope.

If footings are above the level of the sewer, or above the average depth, so as to make it possible for the footings to be undermined, protect them by driving 2″ × 10″ × 8′ 0″ creosoted sheet-piling on both sides of the footings.

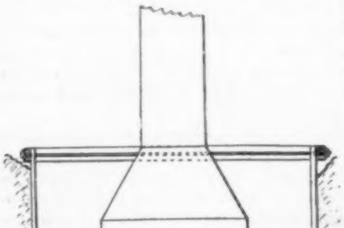

Fig. 76.

If the sand is wet, and the footings so deep as to be free from all danger of undermining, proceed as for dry sand; otherwise, sheet-pile as above.

Gravel: — Level off, and spread 2″ of concrete over to start masonry on.

Quick-Sand: — Pile or drive in the longest sheet-piles practicable on both sides of footings, put wales 8″ × 8″ along outside, and hold together with 1″ bolts 4′ 0″, *c* to *c*, with large washers (See Fig. 76). Spread 1′ 0″ of concrete over to hold sand in place, then start footings. Until weight comes on, the wales will need to be shoved apart.

Fills: — For light buildings consolidate, use a very wide spread to footings. For medium and heavy buildings, pile or use a crib supporting the walls on steel shapes or girders, and connecting opposite walls by means of I-beams of sufficient strength to act in manner similar to a floor, distributing the entire weight of the building over the entire area of the lot occupied. The total weight of the building divided by the area gives the load per square foot, from which the beams must be proportioned, and the weight per lineal foot *L* giving the uniform load per lineal foot on the girder.

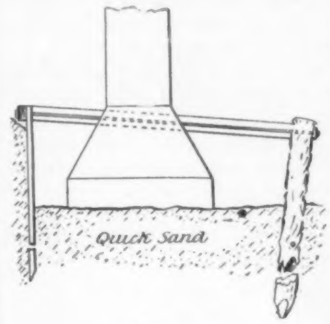

Fig. 77.

Thin Strata: — Ascertain the proper spread for the footings for a soil of the bearing-value of the soil given; then, if the thickness of the strata is three times the breadth of the footings, there will be no trouble. If the thickness is less, then the spread must be determined as for the under or softer strata, adding to the load from the footings the load from the upper strata; then, from the exterior lines so obtained, carry up lines at angles of 30° from the vertical through the harder strata to its top; the breadth between the lines will be the proper spread for the footings. If the hard strata is 2′ 0″ or less in thickness, then it should be disregarded.

Composite Soils: — Usually met with as rock over part of the site, and soft ground over the balance. If masonry walls are proposed, then the only safe course is to pile the soft portions, using the values for piles in Table XXXI. The piles must be very carefully driven to a firm bearing, and every part of the footings must rest either on the rock or on piles. If piles are too expensive, or require too much time, then the building must be carried on columns and the skeleton type of construction used. The loads must be spread over the soil by some of the means described where it is soft, and the column bases where the rock is must rest in boxes of metal thoroughly asphalted and filled with sand. The box should be made 12″ deep, and of the spread required for a firm sand; it must be firmly bedded in a thin bed of neat Portland cement, and in the centre must have a channel through which a 2″ pipe can run from the centre of the box to the outside. Then the erection may proceed as though there were no trouble, putting up the skeleton, filling-in the floor-arches, and loading the material for the fronts on the floors where needed. As the erection proceeds, careful levels must be taken and the settlement noted. Just before beginning the erection of the front, all columns resting on the rock must be brought to the level of the others by filling the sand-boxes with water and letting the sand flow slowly out through the 2″ tube. This must be done very slowly, and the level kept constantly in use. After all is level the front should be built. If the entire material for the front has been stacked where it was to be used, there will probably be no further settlement; if there is, it can be corrected by means of the sand, and will cause but little damage any way. During building the turn-buckles in the wind-bracing must be worked so as to avoid undue strains in these members in case of settlement.

Mud: — (*a*) Sheet-piles 5′ 0″ from footing-courses, held by wales, with the tie-rods 4′ 0″ *c* to *c*, held by piles driven on the inside of the footing-courses (Fig. 77); then concrete as above described; make spread as per Table XXIX.

(*b*) Sheet-pile as under (*a*), then fill with four or five feet of sand or gravel well compacted; cover with a layer of concrete 2′ 0″ thick, and start footings, or

(*c*) Preferably pile. In (*a*) and (*b*), make design such that a settlement of 2′ 0″ will do no damage.

Silt: — (*a*) Put sheet-piles 10′ 0″ from footing-course, and make provision in design such that a settlement of 2′ 0″ or 3′ 0″ will do no harm.

(*b*) Pile.

Rock: — When founding on rock, all loose, weather-worn or rotten rock must be cleaned off, and, if necessary, the rock cut into horizontal steps; all cracks less in width than the footings are high should be filled with concrete of a thickness equal to twice the width of the crack.

If the crack is 3′ 0″ wide or more, it should be arched-over with hard brick in cement, four rowlocks thick for 3′ 0″ span, and one rowlock added for each increase in span of 3′ 0″. This arch should spring from skew-backs cut in the rock.

Should springs or streams be encountered, they should be led off in glazed earthenware pipes jointed with Portland cement, and of ample capacity.

When the rock has been dressed off ready for the foundation, it should be washed thoroughly with a hose stream, and then a layer of strong cement-mortar spread over it to start the masonry on.

Note: — For details regarding the substructures advised above, see "Substructure," Section IV.

(To be continued.)

ON ARCHITECTURAL PRACTICE OF THE UNITED STATES GOVERNMENT.[1]

THE details of the administration of the United States Government under an admirable constitution have been gradually but slowly developed from rude beginnings. Architecture and the other fine arts had long to wait their turn in a young agricultural and commercial country, and, as was the case in ancient Rome, had to depend for their development almost entirely on foreign genius and talent.

It was fortunate that during the early decades of this country, men of broad views, superior education and strict integrity, were called to the presidency and surrounded themselves with their peers in cabinet.

The first happy venture of the young republic in the realm of art was with a landscape-architect, Charles P. L'Enfant, an eccentric French major of General Washington's staff, who was intrusted with the design of the City of Washington and the location of the sites for public buildings.

After a long period of decadency in the fine arts a new era of classicism dawned upon Europe under the reign and impulse of the first Napoleon. It was reflected in this country, the Federal Government leading in the movement.

Congress providing the means, the selection of architects and methods of carrying on the works was largely left to the Executive.

Architects of acknowledged superior ability were applied to for designs, in competition or by special invitation. They received compensation and were retained at what were then considered liberal salaries.

The Capitol at Washington is a prototype of the architecture of that early day. In the year 1791 a premium of five hundred dollars ($500) and a building-lot in Washington were offered for the best design for the United States Capitol, and in 1792 the plans of S. L. Hallet, a French architect, were accepted. As the author of the plans, he was employed to start the work, but he retired before long. After many unfortunate vicissitudes, Benjamin H. Latrobe, a native of Yorkshire, England, was called from Philadelphia, and from the year 1803 to 1817 he reconstructed the work, freely developed, matured and executed the plans so that his name deserves to be recorded along with that of the author.

Shortly after the competition for the Capitol, a competition was started for designs for the President's house. Mr. James Hoban, a native of Dublin, Ireland, then a resident architect of Charleston, South Carolina, and a highly esteemed competitor on the Capitol des[illegible], was successful. The work being intrusted to him, he had it sufficiently advanced for occupancy in the year 1799. The completed building was burned by the British, but was subsequently rebuilt by Hoban, and in this shape it stands to-day.

The first building for the Treasury Department was intrusted to George Hatfield, an English architect, who after Hallet's retirement had been called to this country to take charge of the work on the Capitol, but found it impossible to get along with the amateur commissioners of the District of Columbia. He finished the building in 1799. In 1801 a fire consumed part of it, and in 1814 the whole building was burned by the British. It was recommenced in 1817, finished in 1823, and again destroyed by fire on March 29, 1833.

In the second quarter of the century the above and other severe lessons led to the adoption, by the Government, of fireproof construction, but in design the slow progress consisted mostly of better adaptation of antique styles to modern requirements, in which, however, its designs were fully equal to the best class of work in the older States.

At the middle of the century the wants of a progressive nation had outgrown the size of the original Capitol, and plans for its extension were invited by a committee of Congress. A premium of five hundred dollars ($500) was offered to the successful author and the right was reserved to Government to combine the merits of various plans.

[1] A paper by Jeremiah O'Rourke, Supervising Architect of the Treasury Department, prepared for the Annual Convention A. I. A., but read before the World's Congress of Architects, at Chicago.

The successful competitor was Mr. Charles Frederick Anderson, an eminent architect of the City of Cork, Ireland, then recently settled in the United States. He was awarded the premium, which was paid, under President Fillmore's administration, from the Contingent Fund of the Senate.

Subsequently Mr. Thomas U. Walter, architect, of Philadelphia, and for years President of the American Institute of Architects, was intrusted with the work, under radical changes in the premiated design, and after many years of heated discussion, Mr. Anderson, by a Special Act of Congress, received additional compensation for the use of his, so far, underpaid plans.

While acting as Architect of the Capitol, Mr. Walter was intrusted with the designs of the extension and completion of the Treasury Department and Patent-office buildings, as well as of the picturesquely grouped buildings of the popular Soldiers' Home, since remodelled and extended by Mr. William M. Poindexter, the well-known architect, of Washington, D. C.

Before this time the Government did not erect many public buildings outside of Washington. It had been held that no public buildings besides those necessary for the custom-house service, mint, etc., could be lawfully erected under the constitution of the United States. Incidentally, however, a few marine-hospitals for the care of disabled sailors had been erected, and now a more liberal construction of existing laws began to prevail. It was held that where a custom-house was necessary space might be provided in the building for court-house and post-office purposes, those essential branches of the public service, and this tendency has steadily grown so that there are no more constitutional scruples about the erection of independent post-office buildings, and the "Government Supervising Architect" is intrusted, within the limitations enacted by the last Congress, with the erection and with the repair and preservation of all post-offices, court-houses, buildings for the customs service, mints, marine-hospitals, and such other buildings as may, by special legislation, be placed under his charge; numbering at the present time 297 buildings completed at a total cost of $99,000,000, and 95 in various stages of preparation or erection at a total cost, when finished, of $23,000,000.

ORGANIZATION OF THE SUPERVISING ARCHITECT'S OFFICE.

At the beginning of the administration of President Franklin Pierce, in 1853, the Government owned 23 completed and occupied buildings, and appropriation had been made for 15 new buildings. The construction of these buildings was intrusted to the Treasury Department, wellnigh everything, except the amount of appropriation, being left to the discretion of the then Secretary of the Treasury, Mr. Guthrie of Kentucky, who was in full accord with the new movement. No method or system had been devised nor means provided for the performance of the duties. Architect A. B. Young had just satisfactorily completed the erection of the Boston Custom-house and, with a view to develop the growing branch, Mr. Guthrie tendered him, all he could, a $1,500 clerkship in his Department. Simultaneously, with a view to an efficient management, he obtained from the Secretary of War the detail of Captain A. H. Bowman of the United States Engineers, and placed him in charge of the construction of these buildings. Though Captain Bowman was nominally Mr. Young's superior, both acted for eight years as colleagues and in full harmony — a duarchy at the head of a bureau existing without authority of law, but strong as the offspring of necessity. Carefully compiled regulations for the design and construction and the repair and preservation of all public buildings under the Department were draughted, accepted by the Secretary, and promulgated. These rules were gradually perfected so as to form the foundation of the complicated, but strong and efficient organization of the Supervising Architect's Office as it exists to-day.

The extent of the business of the Supervising Architect's Office will be appreciated when it is stated that during the last fiscal year ending June 30, 1893, there was expended for sites, construction and repair of buildings $6,741,286.11, and that the contract obligations amounted at the end of the year to $2,834,308.02.

In the transaction of the business there are employed at the central office 145 persons (50 of whom are females), and 180 persons as superintendents, clerks, foremen, etc., on the various buildings in course of erection throughout the country, from Alaska to Florida and from the Atlantic to the Pacific Ocean.

A large volume of administrative work is charged upon the office by reason of its facilities as a distinctive part of the machinery of the Treasury Department. Permanent and complete records are necessary, the detail of the variety of work must be systematically executed in accordance with well considered rules, in order to maintain correct and harmonious business relations with the other executive offices of the Government.

The office force is organized in ten (10) divisions, with a chief at the head of each, all reporting direct to the Supervising Architect, or to his Assistant and Chief Clerk, who acts as Supervising Architect during his absence. These divisions are:

1. Engineering and Draughting Division.
2. Law and Contract Division.
3. Construction Division.
4. Computing Division.
5. Repairs and Preservation of Public Buildings Division.
6. Accounts Division.

7. Tracing Division.
8. Records and Files Division.
9. Copyists' Division.
10. Photograph Division.

The titles of the divisions indicate generally the character and range of their duties, and but few explanations are required.

The Engineering and Draughting Division is charged with the making of all designs, plans and detail-drawings required for all the buildings erected, and with the correspondence relating thereto.

It usually employs the services of fifty (50) to sixty (60) expert draughtsmen, including specialists for steel and iron construction, heating and ventilating, and elevator and machinery work.

The draughtsmen are classified and arranged according to their special qualifications, so as to obtain the best results. The draughting-room, which is of large dimensions and well lighted, is supplied with all the best appliances required for a complete architectural and constructive-engineering office.

The salaries range from three to eight dollars per day. The office-hours are from nine to four, with time for lunch. Each draughtsman is allowed, in common with all the employés of the office, thirty days' vacation, with pay, and, in case of sickness, sixty days each year.

The other nine divisions work in harmony with the Draughting and Engineering Division, each through its chief reporting direct to the Supervising Architect, the whole forming probably the largest and best-equipped architectural office in the United States, perhaps in the world.

METHOD OF PROCEDURE IN PREPARING PLANS AND AWARDING CONTRACTS.

Before any money can be expended on a new public building, the Supervising Architect is required by law to make sketch-plans and estimates of cost, both of which must have the approval of the Secretary of the Treasury, the Postmaster-general and the Secretary of the Interior. The estimates of cost must be, in each case, within the limit of the appropriation made by Congress.

The approval having been obtained, the sketch-plans are returned to the Draughting Division for the preparation of scale working-drawings, which are made to show in full and minute detail all parts of the construction and finish of the building, both external and internal. These are passed through the Tracers' Division to the photographer for copying, and simultaneously to the Computers' Division for detail office-estimates of cost and advertisement for bids, thirty days being the usual time allowed to bidders.

An unusually large number of plans and copies of the plans and specifications of each building are required for circulation among prospective bidders, to whom, on application, they are sent by mail.

It is found that the number of scale-drawings required for each building ranges from thirty (30) to two hundred and twenty-five (225) sheets, and the average number of sets of scale-drawings required for estimates on each building is thirty (30) sets, exclusive of complete, full-sized working-drawings, which are always furnished after the contracts are awarded.

At the appointed time, the obtained proposals are publicly opened by the Supervising Architect, his assistant and chief clerk, and the chief of the Computing Division. A full record of the bids is kept and transmitted to the Secretary of the Treasury, with a recommendation to award the contract to the lowest responsible bidder.

On the approval of the Secretary, the successful bidder is notified, the contracts and bonds (five sets) are prepared in the Law and Contract Division and transmitted to the contractor. The contract having been signed, bond executed and vouched for by one of the designated Government officials, is returned to the Department, examined and passed upon by the Solicitor of the Treasury, and, unless there is some irregularity, work is started.

The contract contains generally a clause stating the time agreed upon for completing the work, and a *per diem* forfeit for failure to complete within the specified time.

METHOD OF PROCEDURE IN THE ERECTION OF BUILDINGS.

On the award of the contract, a "Superintendent of Construction" is appointed, and, according to the size and importance of the building, he is allowed a clerk and one or more foremen and watchmen to assist him in the performance of his duties.

The soil under the foundation has generally been previously tested by excavation, boring or other reliable method, and, unless unexpected impediments are encountered, the work progresses regularly, the "Superintendent of Construction" reporting by mail or telegraph to the Supervising Architect, monthly and whenever necessary, up to the time of completion.

At intervals during erection and before final acceptance, each building is visited, examined, controlled and reported upon by "Inspectors of Public Buildings," all working under specific written instructions from the Supervising Architect's Office, and reporting thereto in writing and in detail up to the completion of the contracts.

Payments on account, based on quantities and value of the work actually incorporated into the building, are made monthly, retaining ten per centum of the estimated value until completion and final acceptance of the work.

It may be stated in conclusion, and in justice to the Supervising Architect's Office, that while it may be admitted that the work turned out by this office might, and doubtless will, be improved, still a just comparison and analysis would seem to indicate that, all things considered, it will compare favorably in design, arrangement, construction and cost with similar works erected by either States, municipalities or private enterprise.

It may be proper also to state, with reference to the amount paid by the Government for the professional services rendered by the Supervising Architect's Office, that the records of the office show that the amount paid for said services never exceeds five per cent on the cost of the buildings erected, although the usual proportion of such services are of a character which usually commands, in private practice, a much higher professional fee.

The Supervising Architect himself, for professional services which, in private practice, would easily net $100,000 a year, receives the munificent salary of $4,500, with strictly limited travelling expenses.

THE CONSTRUCTION OF THE WORLD'S FAIR BUILDINGS, BRIDGES, PIERS AND DOCKS.[1]

WHEN Mr. Burnham, in March, 1891, ordered the constructional plans of the Exposition buildings to be made, the nature of the soil of Jackson Park, as regards its bearing-capacity, was practically an unknown quantity. The first step, therefore, was to determine by borings and loading-tests the nature and capacity of the soil.

Over two hundred borings were made on the site of the main Exhibition buildings, and the soil was found to be as follows:

	Fill.	Black soil.	Sand.	Soft sand.	Clay.	Hard pan.
Art Building......		0.5	1.0	13.0	15.5	27.0
Fisheries.........		3.7		12.0		14.5
Government......		1.9	1.6	13.0	16.0	28.0
Manufactures North half......	1.0	1.0	1.2	13.0	13.0	25.2
Manufactures South half......	1.4	2.7	1.3	10.4	11.0	22.8
Agricultural Northeast half..	1.5	2.1	2.0	5.0	23.0	28.0
Agricultural Southwest half..	2.2	3.1	1.1	12.6	13.5	27.0
Machinery Hall...	2.2	1.0	1.8	10.0	16.0	27.2
Administration ...			3.0	12.0	9.0	20.0
Electricity and Mines		0.5	5.5	11.0	13.0	25.2
Transportation....		0.5	4.5	11.0	8.5	17.5
Woman's Building.		3.0	0.5	13.5	3.0	12.0

Or, to put it concisely, this was an average of 1 foot of black soil, 2 feet of sand, 11 feet of what was called in the reports quicksand, but which is not a true quicksand, but simply sand saturated or partly saturated, 13 feet of clay, generally soft, and then hard-pan at an average depth of 27 feet.

Loading-tests were made to determine how much it was safe to put upon the soil per square foot; also whether the soil would squeeze out under pressure, as most of the large buildings were designed to stand close to the lagoons.

Under a load of 1 ton per foot for 48 to 64 hours, the settlement was found to be from $\frac{1}{8}''$ to $1\frac{1}{4}''$ everywhere, except in the swale spoken of below.

A test was made 12 feet from the lagoon at what is now the northeast corner of Electricity Building. A platform 4 f[illegible] square was laid on natural ground, simply levelled off. On this platform 22 tons were placed, a load of 2,750 pounds per square foot. It remained 15 days, with a settlement in that time of $\frac{1}{4}''$. On the fifteenth day a trench 4 feet away from the platform was dug 3 feet wide and down to the soft sand. In 48 hours the platform went down $\frac{1}{8}''$, but no further settlement was detected after that.

Loading-tests, which were made later in the summer, showed as follows: At the north end of Manufactures Building, under a test of 17 tons on 9 square feet, the first 48 hours the ground settled $\frac{3}{8}''$, in 72 hours $\frac{1}{2}''$; no change after this.

The soil at the south end of Manufactures Building, in the swale spoken of below, with 3,161 pounds per square foot, on a base 3' x 3'-1'', showed a settlement of 8'' while loading, and in 90 hours had settled 38''. It was still settling, but the test was stopped at this point.

In the Agricultural Building, in this same swale, with approximately the same load per square foot, a settlement of 14'' in 144 hours was found.

At south end of Stock Pavilion, the settlement in 144 hours was 8''.

In the south end of Transportation Building, in 120 hours, with the same load per square foot, the greatest settlement was $2\frac{1}{4}''$.

At the south end of Government Building, with a load of 3,700 pounds per square foot, the settlement in 24 hours was $\frac{1}{2}''$. Load was kept on 90 hours, but no further settlement occurred.

[1] A paper prepared for the Annual Convention, A. I. A., but read before the World's Congress of Architects, at Chicago.

It was considered safe, from this showing, to use spread foundations, which made a saving of about $6,000 per acre over using piles. These spread foundations were made of a crib-work of timber resting on plank and supporting the posts of the building.

A crescent-shaped swale of muck, spoken of above, probably the bed of an old creek, was found, with one arm extending from the east centre of the Manufactures Building, running southwest and crossing the present basin a little in front of the McMonnies Fountain, then turning southeast and running through the northeast portion of the Agricultural Building. This made it necessary to pile practically the south half of the Manufactures Building and the northeast portion of the Agricultural Building.

When the trusses over the court in the Manufactures and Liberal Arts Building were designed, their foundations were made of piles with a timber grillage on top. These pile foundations were designed to take care of the extra thrust of the arches due to wind, the tie-rods between the feet of the arches being designed to only take care of the thrust from dead load.

The foundations of the Art Building were made of concrete. All the other foundations of the buildings, including Machinery Hall, were made spread.

It was understood that the architects furnishing plans of the buildings should not be made responsible for the construction, and should not be called upon to make any constructional plans; accordingly, all the construction, both in wood and iron, was designed in Mr. Burnham's office. The only exception was in the Mines Building, where Mr. Beman showed the cantilever trusses, and they were built in compliance with his desire. They are interesting as adding another type to the variety of trusses in the Park, although they are not at all economical.

The object sought in the construction of the buildings was the greatest economy consistent with perfect safety. To this end the buildings, as at first designed, were almost entirely wood. The trusses, with the exception of the Mines Building, were wood or combination.

The domes in the Manufactures Building, as then designed; in the Horticultural and Administration Buildings were steel from the ground up, and in the Agricultural and Fisheries were steel tops, the lower portion being of wood. Later it became evident that true economy demanded the use of more iron in the construction, and when, from the desire to get more space, and for other reasons, it was determined to roof over the court in the Manufactures Building, thus doing away with the dome first talked of, it was decided to make this of one span. The court of the Electricity Building was also roofed over with steel trusses. The trusses and domes of Machinery Hall, the construction plans of which were begun about this time, were also made of steel.

The very different buildings of necessity brought out a great variety of trusses, and a multitude of new details.

Some of the trusses while theoretically correct were found to be practically bad. For instance the bow-string trusses in the curtain of the Horticultural Building were designed with the upper chord made of boards nailed together. The drawings called for them to be extra nailed, and the contractor claimed he took extra precautions, but when he came to adjust them it was found that the boards would slip past each other, and the chord flatted under the pull of each rod.

In the Forestry Building the trusses were all made of wood, wooden pins being used instead of nails.

In many cases it was found impossible to properly brace against wind-pressure without making use of the sheathing on which the staff was to be nailed. It was, therefore, laid diagonally. This was notably the case in the towers of the Electricity Building, where 2″ sheathing was laid diagonally, and the number of nails in the ends of each plank was specified.

The maximum load placed on the soil in all the buildings throughout the Park was 2,500 pounds per square foot. This included live and dead load, and the vertical component of the wind-pressure. When piles were used, the load per pile was from ten to fifteen tons; the latter being the maximum used. The contractors were not required to put foundations below frost line, but simply to remove whatever black soil or fill there might be, and get a level bed on the sand.

The main floors of all the buildings, except Machinery Hall and Mines Building, and those parts of the roofs used for gardens or restaurants, were figured for 100 pounds per square foot, live and dead. Machinery Hall floor was figured for 250 pounds per square foot, and Mines Building for 150 pounds.

The galleries of all the buildings were figured for 80 pounds per square foot. Roofs were figured for 40 pounds per horizontal square foot, or 25 pounds vertical load, and 20 to 30 pounds wind-pressure, depending on the exposure of the building. The method giving the greatest result was used. Purlins and jack-rafters 30 pounds per square foot.

The bridge-builders' standard specifications were used for all the iron-work, except the Manufactures' trusses. At first 1,500 to 1,800 pounds fibre-strain was used for white pine, tension up to 2,000; bearing, perpendicular to fibre, up to 800 pounds.

It was decided during the progress of the work that these strains were all too high, inasmuch as they called for a quality and an inspection of lumber which could not be obtained.

The matter was gone into exhaustively, and a careful study made of the recent tests on timber made by the United States Government at Watertown; also those made by Professor Lanza, of the Massachusetts Institute of Technology, and the following unit strains were adopted for white pine, yellow pine and oak, being allowed 33 to 50 per cent more:

Fibre-strain, 1,200 pounds; this not to be exceeded in any case. Bearing perpendicular to fibre, 300 pounds; shear, with grain, 100 pounds; bearing on end of timber, 800 pounds; compression, when ratio of length to least side of cross-section did not exceed 10, 800 pounds; 10 to 35, 600 pounds; over 35, 400 pounds.

Experience has proved that these strains are not too low. In the case of the large tanks of the Sewage Cleansing Works, the Assistant Engineer who figured out the sizes of timber to be used disregarded the standard unit strains, and allowed a pressure of nearly 500 pounds on the 8″ x 10″ white-pine ring supporting the whole weight of the tank. This 8″ x 10″ has crushed-in over ¾ of an inch. In two cases in Machinery Hall foundations, the wood was indented about ¼ of an inch under a load of less than 300 pounds. These are the only instances which have been noted.

The arches over the Court of the Manufactures and Liberal Arts Building were figured for a vertical load of 42 pounds, made up as follows: iron 20, roof 10, snow 12. A recalculation made after the roof was completed, taking shipped weight of iron, showed weight of iron on straight part of roof to be 22½ pounds; roof 8 pounds, leaving 11½ pounds for snow. The arches were also figured to withstand a wind-pressure of 30 pounds per square foot, acting horizontally against the wooden structure which surrounds the court, concentrated at that point of the arch where the combination truss is connected to it. It amounted to 90,000 pounds at this point, 76 feet above the bottom pin. In addition to this a wind-pressure of 30 pounds per square foot was taken, acting at an angle of 20 degrees with the horizon, extending over the whole roof. For the combined strain from wind, dead and snow loads, the unit strain was taken at 30,000 pounds per square inch. The connections, however, were made 50 per cent stronger than this.

The specifications sent to bidders on these arches called for either Bessemer or open-hearth steel, not to contain over .08 of 1 per cent of phosporous; to have an ultimate strength of not less than 66,000, nor more than 74,000 pounds, with an elastic limit of not less than 37,000 pounds; an elongation of not less than 16 per cent in 8 inches, and a reduction of not less than 25 per cent at point of fracture.

Over 3,500 tests of this material were made by Messrs. Estrada, Kenyon & Gray, the inspectors, with the following average results:

Elastic limit, 40,000 pounds; elongation in 8 inches, 27 per cent; reduction at point of fracture, 57 per cent. The unit strain of 30,000 pounds is higher than has been used before, and it was severely criticised in the early stages of the construction; however, it was put at that figure after a thorough study of all the conditions involved, and as it represented a saving of $75,000 to $80,000 over the strains used heretofore, the writer feels that he was justified in adopting it.

The only difficulty found in designing the bridges was the fact that the fire-boat had to go under, and the fire-engines, and in two cases a railroad track, over them. The clearance demanded for the fire-boat and launches made the floors steeper than they otherwise would have been. The three canal bridges — that is, the ones at the northeast and southeast corners of the Electricity Building, and the one from Machinery Hall to Agricultural Building — are plate-girder cantilevers, with three openings, central opening 54 feet, and two side openings 31 feet. This system was made necessary by the shallow depth allowed for the ironwork and the floor. Each bridge is 60 feet wide, and is made of seven plate girders, connected by bracing, having the joists resting on shelf angles just below the top flange of each girder. The two south bridges carry railroad tracks, and the two plate girders under each track were made heavier, and ties used instead of joists. The two bridges at the Peristyle are wood: all the balance are iron, made of three or four (depending on width of bridge) curved lattice-girders. The floor was constructed similarly to the canal bridges.

The docking around the interior waterways was made, where the banks were high, of a row of piles faced with a sheet-piling made of two thicknesses of 2-inch plank. This row of piles was tied back by iron rods to a row of anchor piles. The piles and lumber used in this docking, as well as the piers, were all soft wood, the only requirements in the piling specifications being that the piles should be 10 inches in diameter at centre, and be able to withstand the blows of the hammer.

The first pier built at Jackson Park was a T-shaped pier, with a breakwater some distance away on the north and east, on the site of the present Casino Pier. This was afterwards taken out, and the present pier, 2,400 feet long and 250 feet wide, built. The breakwater of this pier was made part of the pier, extending along north side and east end. The breakwater was made of two rows of closely driven piles, held together with iron rods and filled with stone, increasing in width with the depth of water. The balance of the pier was made of piles, 14 to 16 feet centres each way, capped with 12″ x 12″ timber; these caps carrying the joists and floor. Mooring-piles are placed about 3 feet inside from the edge of pier, securely braced, but not carrying caps or joists.

The 59th Street Pier is similar in all respects to the Casino Pier; as is the Van Buren Street one, with the exception that the latter has no stone breakwater.

The cost of the arches over the court of the Manufactures and Liberal Arts Building was $1.10 per square foot of ground covered. The cost per square foot of the whole building, including decoration, was $1.39. Transportation Building, including sculpture and decoration, $1.08; Electricity Building, $1.69; Machinery Hall, $2.12; Agricultural, $1.44; Administration, $9.18; Van Buren Street Pier, $.21; Casino Pier, $21; Breakwater, Casino Pier, $1.80; Horticultural, $1.41; Mines & Mining, $1.04; Fisheries, $2.35; Forestry, $.75.

As one of Mr. Burnham's staff I cannot close this paper without paying a tribute to our Chief.

You all know of the personal sacrifices he has made for this work; of his untiring energy, and his constant devotion to the interests of the Exposition, and you also know of his masterly executive ability. But you may not recognize what a tower of strength he has been to those who have been associated with him as members of his staff. His grand courage has always been an inspiration to us. If we had doubts; if we were discouraged; if, as often happens in any great enterprise, we felt like throwing up the sponge, we had only to turn our eyes to him and gain new strength and new encouragement from his undaunted spirit. He always led as a true leader should. If he asked us to work until two in the morning he was sure to be at work with us, and worked longer and harder.

His loyalty to his staff was so consistent and so unchanging that each of us felt he had the perfect trust and confidence of the Chief. This loyalty has been our greatest stimulus and our greatest support at all times and in all difficulties.

He is indeed the man who built the Fair.

E. C. SHANKLAND,
Chief Engineer, World's Columbian Exposition.

THE UTILIZATION OF GARBAGE.[1]

THE immortal Justus Liebig, the founder of agricultural chemistry, and, indirectly, by his teachings, the creator of the industry of artificial fertilizers, combined in himself the qualifications of a most eminent chemist and a far-sighted national economist.

He transformed the chemical doctrines of plant nutrition at once to available figures for the farmer to show him, in clear and indubitable sentences, the laws of nature which compel him to restore to the soil what he has taken from it in the form of the products of the field.

His classical "*Chemical Letters*" are a monument he has erected for himself which will endure as long as the conditions of this globe remain the same as they now are. As long as the human race lives, the fundamental laws requiring the restitution to the soil in available form of the constituents of the plants as laid down by Germany's most eminent agricultural chemist will be written in golden letters in the history of all civilized nations.

In centuries to come the classical works of Liebig will be revered as the revelation of science respecting the practice of agriculture.

In his forty-seventh letter, Liebig refers especially to the relation of the consumption of the great cities to the products of our farms. From each hectare of wheat-field, the farmer, from the return of an average harvest, transports from his farm to the consumers, 4,000 pounds of grain containing seventy pounds of mineral substances, mainly phosphoric acid and potash.

The refuse of a city of 1,000,000 inhabitants will amount, in dried form, per annum, to 45,000,000 pounds.

The constituents of this powdered material are 10,300,000 pounds of mineral substances, mostly the mineral parts of breadstuffs and meat, which contain no less than 4,580,000 of phosphatic salts.

The removal of this precious material (at the rate above named) from the fields has been going on for centuries and only a small portion of it finds its way back to the fields. It is folly to think that the loss of this material has had no detrimental influence upon the fertility of the soil. . . .

For the sake of convenience we pollute our rivers and choose rather to suffer the consequences of drinking polluted water than to adopt rational measures to save, for the enrichment of our fields, the products which the law of nature has provided for the very purpose.

Our antipodeans, the much-despised Chinese, are much better practical economists than their civilized brethren. In China, nothing is allowed to go to waste that is useful to the soil. The Chinaman's house is without the improved devices of the modern plumber, and his scent for nuisances may not be so highly cultivated as ours, but by his system of the strictest economy, he manages to keep up the fertility of his soil to so high a degree, that the vast empire, notwithstanding that it possesses the densest population on the face of the earth, is entirely independent of all other nations, not only for the breadstuffs and other food supplies required for the sustenance of its people, but also for the fertilizing materials needed for its soil. The Chinese, with the instinct of self-preservation, have been doing for centuries what Liebig and his followers taught the civilized nations of the world in the beginning and middle of the present century.

To-day we have fleets engaged in transporting phosphoretic and nitrogeneous materials from continent to continent; the services of the miner and the skill of the chemist are required to supply this food-material to our exhausted fields. The nitrate mines of Chile, the phosphate beds of South Carolina and Florida, of Belgium and Russia, the mountains of apatite rock of Estremadura and the deposits of the same material in Canada, the potash salts of Germany and Hungary, are drawn into the service of agriculture. One of the most gigantic branches of the chemical industry has been built up in order to balance the debit and credit page of the rational farmer in the records of his culture.

But in seeking for remedies that will preserve the fertility of our fields, it is a remarkable fact that a vast amount of waste material which lies right at our feet, is not given a thought. It is true that all the more valuable waste materials, such as bones, tankage, cracklings, cotton-seed meal, leather, hoofs, horns, etc., have a stable market. But the poorer and much more abundant materials have been, and are now, almost entirely neglected.

We will to-night direct our attention to the question of the possibility of utilizing the garbage of our city, which, at the present writing, is the subject of much discussion.

Until recently the garbage collected in this city has been used mainly as a feeding material for the fattening of pigs in the outskirts. For sanitary reasons, the Board of Health has banished the piggeries outside the limits of the County of Philadelphia. This is very commendable to free the city of a nuisance, which at the best was a very crude method of disposing of the material, and which, by the carelessness of those who make a business of it, certainly created a health-endangering nuisance; but the decision of the Board of Health made the disposal of the material very much more difficult than before.

The City of Philadelphia is divided into five districts for the collection of garbage. During the summer months, from June to September, the accumulation of a single district runs to 100 tons per day, while in the other months of the year the daily output varies, and in the middle of the winter falls to twenty-five tons per day. A general average for the whole year is about 250 tons per day for the whole city. This estimate we can safely use for calculation of returns but not as a basis for the construction of a plant, for which the maximum figures will have to be taken. For the first district, comprising all that part of the city south from South Street, from river to river, a furnace for the cremation of garbage has been erected, situated on Washington Avenue and Twentieth Street.

Unquestionably cremation is the most complete system for destroying all organic substances, and doubtless to the extreme sanitarian the only method that should be adopted.

But what about the economical results? The daily operation of the furnace requires labor and fuel, the product of a cremator is a small quantity of ashes and worthless at that. Four or five per cent of ashes is all that remains of the garbage when incinerated.

The American Incinerating Company, with headquarters at Washington Avenue and Twentieth Street, has offered its product to the fertilizer trade. I have here a sample of these ashes which were sent to us. Our analysis yielded us:

Total phosphoric acid = 15.32 per cent (= 33.88 per cent phosphate of lime), potash 0.25 per cent, soluble in water.

I was astonished to find so little potash, but the intense heat in the furnace has driven off a part of the alkalies as chloride vapors, otherwise the analysis should show at least four times as much. This ash, even with fifteen per cent phosphoric acid, has a very low market value because natural phosphates in bags, and ground to the finest powder, can be laid down at our doors at $5 per ton.

The phosphoric acid of such low percentage is valueless for dissolving purposes because it will only yield practically a powder containing five to six per cent of available phosphoric acid. This low product cannot be used for mixing fertilizers and it cannot be offered to the market when acid rocks containing thirteen to fourteen per cent of available phosphoric acid are offered as low as $10 to $12 per ton.

The products of the cremating process, therefore, will never become a commercial article. The question then arises: Can the same sanitary requirements be reached in another way? Without doubt they can, and, at the same time, the valuable constituents of the garbage destroyed in the furnace can be saved.

The city garbage, embracing all the refuse from the table and kitchen, changes its qualities considerably with the season. Just now we are in the vegetable period and the results of my experiments represent about the lowest results obtainable.

The experiments I have made are not laboratory experiments, but practical manufacturing experiments, handling at a time from six to twelve tons of material. I have been in the fortunate situation of being able to utilize, at intervals, apparatus designed for other purposes but very well adapted for the purpose of these experiments.

There is no secrecy about the principle of rationally utilizing garbage, and there are no new processes involved for which enormous patent fees will have to be paid. The process is divided in two main operations:

(1) The separation of the grease by extraction.

(2) The drying of the remainder to form directly a salable product.

The results I have obtained yielded me about seventeen per cent, on an average, of dry product from garbage tankage, a sample of which you have before you. This dry tankage is a very excellent fertilizing material. Its composition is:

[1] Extracts from a paper by Dr. Bruno Terne, read at the meeting of the Chemical Section of the Franklin Institute, held June 20, 1893, and printed in the *Journal* of the Society.

	Per cent.
Moisture	4.41
Organic matter (including 4.3 per cent NH_3)	73.34
Mineral matter	22.25
	100.00

On a smaller scale than that which could profitably be carried on in Philadelphia, garbage is utilized successfully in this way in several places. I have received from Detroit samples of fertilizer made from garbage with as high as 5.37 per cent ammonia, 6.08 phosphoric acid; and, at another time, 3.76 per cent ammonia, 3.36 phosphoric acid.

A specimen from Providence contained 3.55 ammonia, 3.38 phosphoric acid; from other places, 3.86 ammonia, 3.51 phosphoric acid.

A fair average analysis, showing the minimum and maximum of what we may export, is as follows:

	Per cent.	Per cent.
Ammonia	3.50	4.50
Phosphoric acid (corresponding to phosphate of lime, 6.54, 13.28.)	3.	6.
Water soluble potash	0.25	0.50

At the present market price the unit of ammonia is sold at 2.60. This would give, for the low grade, a market value of $9.10 per ton; for the high grade, $11.10 per ton.

It is safe to say that at the present market these products will realize $10 per ton. I leave phosphoric acid and potash out of the calculation to give you the practical valuation. This material is a most excellent fertilizer, not only chemically but also physically, and its usefulness in the manufacture of fertilizers is without limit.

The amount of garbage tankage produced from a ton of material as gathered up from the houses, placed at the lowest percentage (viz, about fifteen per cent), amounts to 300 pounds per ton. One hundred tons per day will give 30,000 pounds or fifteen tons daily.

Taking the daily average of one district, we will average seven and one-half tons, or 2,250 tons per year; and for the five districts, 11,250 tons, having a market value of $112,500.

Now, let us see what we restore to the fields in this amount of products.

The ammonia taken at four per cent in one ton of the tankage contains eighty pounds of this important plant food, and 112,500 tons, or the amount of production from the garbage of this city should be equivalent to a saving of 9,000,000 pounds of ammonia, 9,000,000 pounds of phosphoric acid, and 500,000 pounds of potash.

All of this has been taken from our fields, and, if wasted or destroyed, represents so much loss to the community at large, but if this amount be regained and restored in proper form to the farm and garden, it means so much saving. All of this amount must be restored from other sources in some way. If any waste material is worth saving it is surely the garbage of the cities, as I have endeavored to show.

There is another feature connected with this waste, viz, the regaining of the grease contained in garbage.

City garbage, at a low estimate, will yield three per cent of a black grease, which you see in the samples before you. Even for this black grease, there exists a limited market at low figures for lubricating purposes (for car wheels). This black grease rarely contains much free fatty acid, but it is by no means free from it. I have had samples containing over six per cent.

If the regular production should rise to such quantities as the garbage of the whole city will permit of producing, other uses must be found for this product, which in the crude state has but a limited field of usefulness. There are ways and means known to the chemist, however, to improve this raw product, and the refined material made from it will readily find a market in competition with other greases.

The result of a chemical artifice of this kind, I take pleasure in introducing to your notice in the sample before you. The method employed by me in this work is absolutely practical in respect of quick action, cheapness and positive results.

The grease stock so produced is very oily at 60° F. It yields about seventy to seventy-five per cent of this very fine oil which will find a ready sale. This oil will prove a puzzle to the best expert in the analysis of oils, for it contains traces of all oils and greases which enter the kitchen. It will challenge the reliability of all the color tests, the iodine numbers, etc., but in spite of its evasion of the methods of a Mailliau and Benedikt, it will find an excellent market. The refined grease is a very fine soap-stock, and a very crude product of a test in that direction I have with me. This soap is made solely from the same grease you have before you.

The rational mode of disposing of the city garbage is as simple as anything can be.

First, to gain all the grease, we must apply practical methods of extraction by known solvents; then, to save the fertilizer materials, we must employ the most rapid and economical methods to expel tl eighty per cent of water contained in the material.

Small amounts are easily handled; the difficulty arises when such enormous quantities stare one in the face. It is not, therefore, so much the chemical processes employed as the proper disposition of the plant, which must be well understood.

The stock delivered at the works must disappear in the process, on its arrival, and must never be permitted to rest for a moment until, after forty-eight hours, it is ready to be filled into bags for shipment in the form you see before you in this sample. It is no more difficult to handle the enormous quantities of garbage than it is to handle the animal refuse of our city.

My experience of many years in handling materials of this kind in enormous quantities, first in Chicago, and since 1877 in this city, as the chemical manager of the largest works of its kind, permits me to speak advisedly on this subject, and I am prepared to stake my reputation as a technical chemist on the assertion that the utilization of our city garbage can be carried on as a financially successful operation for the saving of the valuable materials contained therein. How important the solution of this question is for the City of Philadelphia is well illustrated by the constant discussion of the subject in the daily papers.

Cremation, as I have shown, produces, at considerable expense, a valueless product. The rational chemical process yields, at no more cost, products which make a large figure in the housekeeping of a community.

Should we cast aside the warnings of an economist like Carey? Shall the teachings of Liebig and of all the prominent agricultural chemists of all nations have been in vain? I trust not, and believe not.

In this century of progress, with our knowledge of chemistry, and with the most complete machinery at our disposal, it seems to me like a lapse into barbarism to destroy this most valuable material simply for the purpose of getting rid of it, while at the same time, we are eager to obtain these very same materials for our fields by purchase from other sources.

There is no doubt in my mind that this question of the disposal of our garbage can be solved by careful consideration of all points, by practical business men, to the advantage of the city authorities and the contractors for this work, to the fullest satisfaction of the health authorities, and to the benefit of the farmer.

Capital intelligently invested should be productive, not destructive. Instead of spending thousands of dollars for the erection of crematories to destroy, let us erect sanitary chemical-works to preserve, this valuable material. There can be no danger to the public health in the conduct of a rational system for the utilization of garbage. All microbic carriers of contagious sicknesses are destroyed by a temperature of 212° F., and this dry product you have before you is as harmless to the public health as the flour in the barrel.

My desire and expectation to-night, in making this presentation of an important industrial and sanitary problem, is to receive the endorsement of the Section, and later on, that of the Institute, to have you condemn the destruction of these valuable waste products, and approve, as the only right solution of this question, the preservation of these products displayed before you by a rational process of manufacture such as that indicated above.

THE DUODECIMAL *VS.* THE DECIMAL SYSTEM.

Mr. JESSE A. STOTT, of Manchester, Eng., addresses to *Engineering* the following very reasonable suggestion as to the advantages of a duodecimal over the decimal system and the propriety of reducing all English measures to a uniform system with twelve for a base:

The facility of multiplying and dividing by 10 with our present or Arabic notation has invested that number with a mystical virtue in the minds of many people. I had that same reverence for 10 until a year or two ago, when owing to Mr. Kesselmeyer, of Altrincham, advocating a change in the basis of our notation from the number 10 to the number 12, I began to think on the subject. It is merely because in the Arabic notation the change from numbers represented by one digit to those represented by two digits occurs at 10, that the facility of calculating in that number happens, and if any other number be chosen as the one at which that change is made, it acquires the property appertaining to 10 in the Arabic notation. For instance, let there be only seven digits and a nought, then the signs 10 would represent not a 10 but an 8, and 100 would represent 8 by 8 or 64 in the Arabic notation. Now 8 is a better number than 10, because it can be divided into halves and quarters without going into fractions, which is more useful than halves and fifths; multiplying and dividing by merely adding or cutting off a nought will apply to 8 if it is made the first double number, just as it now does to 10, whilst 4 will obtain the facility at present applying to 5, with the advantage of being halved without going into fractions. I therefore hold that 8 would be a better number for the basis of a notation than our present 10.

Mr. Kesselmeyer, however, has the boldness to advocate the change of our notation from a basis of 10 to a basis of 12. Twelve is the first number divisible, without fractions, by four other numbers; none of the lower numbers being divisible by more than two numbers, omitting the unit in both cases, and Mr. Kesselmeyer maintains that [illegible] natural basis for calculation. It is divisible without fractions [illegible]es, thirds, quarters, and sixths, and this is why we find our foot of 12 inches and our shilling of 12*d.* so convenient, and why so many articles are sold not by the ten and hundred, but by the dozen and the gross. If our system of notation were made to correspond with our natural systems of calculation, Mr. Kesselmeyer maintains that we should have a much better system than the metric; we should require two more digits to represent our present 10 and 11, and then the signs 10 would represent 12, 100 12 times 12 or one gross, 1000 twelve gross, and so on, and the facility of multiplying and dividing by 10 and 5 under the Arabic notation would apply to 12 and 6 under the new notation.

Mr. Kesselmeyer points out that a gold coin of 12*s*., which he proposes to call a Victoria, might easily be brought into use, and for convenience a 24*s*. gold-piece Victoria 2.0 (new notation).

Our present foot divided into 12 inches appears to me a more serviceable unit than a metre. The inch could be conveniently divided into twelve parts as in duodecimals, which would then be the natural decimals, and these again into twelfths, easily readable on a draughtsman's ivory scale, or in spaces of three-twelfths each on a rougher scale.

The present inconvenient method of measuring a building estate by chains and links, and selling the land by the square yard, would cease, as 72 feet (60, new notation) would make as handy a surveyor's chain as 66 feet, two chains making 100 feet (new notation), that is, one gross or 144 feet Arabic notation.

Our measurements and our money would then be quite as symmetrical as under the metric system, and very much more natural and practical.

The day is already divided into twenty-four hours or two twelves, but probably twelve hours divided into twelve spaces, and the latter each into twelve smaller spaces, which would be five-sixths of our present minute, would be better.

I am afraid our system, or rather want of system, of weights and measures (except of length) is so bad that nothing can be made of it except complete revision; this could be based on the dozen instead of the ten.

After having thought the matter over for some time, I agree with Mr. Kesselmeyer that a system of notation based on the dozen or twelve, with systems of weights, measures, money and time to correspond, would have great advantages over the metric system, which is based on a notation that has adopted not the best number (twelve), nor the next best(eight), but only the third best, namely, ten.

Whether it is practicable to introduce a new notation is a question that would require grave consideration, as I do not see that we could afford to throw this generation into confusion for the benefit of posterity, but before we commit ourselves to the metric system, I think the idea is worth discussion. I expect to be told that the idea is old as the hills, but never having read or heard of it, and finding others in the same ignorance, I venture to ask for space in your valued periodical to call attention to it.

If a new notation is not practicable, I am strongly in favor of the metric system, and I believe the people would get into the way of it with little difficulty. The first time my firm made drawings for buildings, including constructional ironwork for the Continent, our assistants worked to the metric system, with which they were previously unacquainted in practice, without the slightest difficulty and without error.

THE ILLUSTRATIONS

[*Contributors of drawings are requested to send also plans and a full and adequate description of the buildings, including a statement of cost.*]

THE EQUITABLE LIFE INSURANCE BUILDING, DENVER, COL. MESSRS. ANDREWS, JAQUES & RANTOUL, ARCHITECTS, BOSTON, MASS.

[Gelatine Print, issued with the International and Imperial Editions only.]

SPIRE OF ST. MARY'S CHURCH, OXFORD, ENG. SKETCHED BY MR. T. MACLAREN, LATE PUGIN TRAVELLING-SCHOLAR.

[Issued with the International and Imperial Editions only.]

THIS sketch is interesting in view of the proposed restoration which has been mentioned several times of late in this journal.

A VENETIAN DOORWAY. AFTER A WATER-COLOR DRAWING BY MR. W. M. MACCAFFERTY, BROOKLYN, N. Y., *American Architect* TRAVELLING-SCHOLAR FOR 1892.

[Issued with the International and Imperial Editions only.]

DESIGN FOR A CAFÉ FOR A WORLD'S FAIR. SUBMITTED IN A COMPETITION OF THE ROCHESTER SKETCH-CLUB BY MR. W. H. ORCHARD, ROCHESTER, N. Y.

[Issued with the International and Imperial Editions only.]

To this design was awarded the first place.

TWO HOUSES AT OVERBROOK, PA., FOR MESSRS. WENDE[illegible] SMITH. MESSRS. BOYD & BOYD, ARCHITECTS, PHILADEL[illegible] PA.

HOUSE AT OVERBROOK, PA., FOR MESSRS. WENDELL & SMITH. MR. HORACE TRUMBAUER, ARCHITECT, PHILADELPHIA, PA.

PASSENGER-STATION AT DUBOIS, PA. MESSRS. GORDON BRAGDON & ORCHARD, ARCHITECTS, ROCHESTER, PA.

PASSENGER-STATION AT BRADFORD, PA. MESSRS. GORDON BRAGDON & ORCHARD, ARCHITECTS, ROCHESTER, PA.

STATION AT STOCKBRIDGE, MASS. MR. FRANK WALLER, ARCHITECT, NEW YORK, N. Y.

THE residents of the town contributed $2,000 to aid the railroad in substituting for the wooden building destroyed by lightning last summer the present stone structure.

HOUSE FOR PAUL TUCKERMAN, ESQ., TUXEDO PARK, N. Y. MR. JAMES BROWN LORD, ARCHITECT, NEW YORK, N. Y.

[Additional Illustrations in the International Edition.]

MAIN STAIRCASE: EQUITABLE LIFE INSURANCE BUILDING, DENVER, COL. MESSRS. ANDREWS, JAQUES & RANTOUL, ARCHITECTS, BOSTON, MASS.

[Gelatine Print.]

CORRIDOR: EQUITABLE LIFE INSURANCE BUILDING, DENVER, COL. MESSRS. ANDREWS, JAQUES & RANTOUL, ARCHITECTS, BOSTON, MASS.

[Gelatine Print.]

STANMORE HALL. — LOWER STAIRCASE.

PLAS MADOC, NEAR LLANRWST, NORTH WALES.

PLAS MADOC (the residence of Colonel John Higson), which is being altered and added to from designs prepared by Messrs. Dawes & Hoyland, of Manchester, is now approaching completion so far as the structural work is concerned. The decorative features internally are in course of preparation and it is expected will shortly be completed. The arrangement of rooms is shown on the plans. That arrangement has naturally been governed by the constructive lines of the old building which, as far as possible, have been utilized. A comparison of the elevation of the old house with the new will clearly convey the improvements that have been made. The finishings of the dining-room are in oak, the drawing-room in American walnut, the library, morning-room, billiard-room and staircase-hall of pitch-pine. These rooms have open-timbered ceilings with moulded ribs and sunk panels. The dining-room walls are panelled in oak, and like the other entertaining rooms have ornamental wood chimney-pieces and overmantels in harmonious combination with tiles and marble. Between the large and smaller drawing-rooms there is a highly ornamental screen in American walnut, and round the fireplace other ornamental screenwork forming an ingle-nook with settees tastefully upholstered. The small divisions in the upper part of the windows in the principal elevations are filled with delicately-tinted lead lights. The glazing of the entrance-doors, internal screens, staircase-hall windows and other portions are entirely filled with richly-tinted glass in leaded patterns. The main roofs and roof of the veranda extending round three sides of the house are covered with red tiles, which, in combination with the half-timbered work and lattice-work on walls and in window-shutters, form a pleasing effect of color in the midst of the rich foliage around the house. Throughout the building quaint features meet the eye, from the redstone and half-timbered porch to the mullioned windows of the attics, which command one of the finest views in North Wales, embracing the village of Trefriew and the picturesque gorge leading far away into the lofty mountains beyond.

FAILSWORTH CONSERVATIVE CLUB, MANCHESTER, ENG. MR. CHARLES T. TAYLOR, A. R. I. B. A., ARCHITECT, OLDHAM, ENG.

THE new club at Failsworth, Manchester, occupies a frontage of sixty-two feet six inches, the principal entrance facing the main road, the various rooms being situated on each side. On passing through the vestibule and entrance-hall the billiard-room stands on the left, and has windows both on the front and towards Princess Street. This room is thirty feet long and twenty-five feet six inches wide, and is capable of holding two tables. The bar adjoins the billiard-room and card-room, and is also separated from the entrance-hall by glazed sliding sashes; the lavatories are adjacent to the billiard-room. The reading-room, which is a well-lighted room, stands on the right of the entrance. Leading from the entrance-hall there is a members' staircase for access to assembly-hall upstairs, which extends the whole width of frontage. There is also a public entrance to the assembly-hall in Princess Street, which would [illegible] that room to be used for public meetings, entertainments, assemblies, etc., without interfering with other parts of the club. Close to the landing of public staircase are two committee-rooms which, when the assembly-hall is in use, would serve as retiring-rooms — one for ladies and one for gentlemen, the former having lavatory accommodation. There is also on this floor a larger committee-room which could be used for serving refreshments. From Princess Street access is gained to the caretaker's house, which consists of kitchen and scullery on ground-floor, which are both in direct communication with bar; two bedrooms are on the second floor. By means of a private staircase the caretaker has access to any portion of the premises. The basement contains heating-chamber, fuel-cellar and ample accommodation for storage of refreshments. The building is faced with Accrington bricks on two principal elevations, and is freely interspersed with stone and red Ruabon terra-cotta dressings. The principal inside doors and assembly-room roof principals are of varnished pitch-pine, the remaining joiner's work being of St. John's pine stained and varnished. The lavatory and entrance floors are tiled. Stained lead lights are freely used in a portion of the windows, bar front, lavatory and vestibule screens, etc.

DOCTOR'S HOUSE, OLDHAM, ENG. MR. CHARLES T. TAYLOR, A. R. I. B. A., ARCHITECT, OLDHAM, ENG.

The accommodation provided on ground-floor of the building illustrated consists of vestibule, entrance-hall, drawing and dining rooms, kitchen and pantry, also waiting-room, consulting-room and dispensary *en suite*, the latter being fitted with special fittings as required by medical gentlemen; all the three latter rooms are entirely separated from remaining parts of house, there being also a separate entrance to the waiting-room from front street for use of patients. From the hall the staircase gives access to upper floor, which consists of six bedrooms, linen-closet, bath-room and water-closet. In basement there is extensive cellaring consisting of wash-house, fuel-store, larder and general stores, etc., the former having a separate entrance into back garden; the usual outbuildings are provided. The front is faced with red Ruabon bricks finished with red terra-cotta and stone dressings; upper portion of front gable is formed of half-timber framing with cusped panels, the latter being filled-in with cement and finished cream color.

NOTES AND CLIPPINGS

Smokeless Coal. — John B. Clements of the Christy Fire-clay Company has secured an option on 6,000 acres of coal land in the Ouchita River district in Arkansas, which may go far toward solving the smoke question. It is what is known as smokeless coal. It can be burned on the floor in a parlor without giving off any smoke. Mr. Clements has been after the property for some time, and has had the coal tested at the Christy works, the Crystal Plate-glass Works, the Belleville Gas-Works, and other places. A shipment of it is to be received at the St. Louis Sanitary Company's works, to be tested there. The coal is found in a large deposit, the vein being forty-two inches wide. It contains 20 per cent of oil, which has been found to be very valuable in making paint. A bar of iron painted with it has been placed in a fire and submitted to an intense heat without disturbing the paint. It is also claimed that one ton of this coal will produce as much steam as ten tons of that used here. It is also claimed that it is much better for gas than Pittsburgh coal, which is used here entirely. The only question is said to be the expense in placing the coal on the market here. As far as can now be seen it can be mined and placed on the barge at 50 cents a ton, and can be landed here at $3 50 at a good profit. If this proves to be true, it is said Mr. Clements has something better than a gold mine, as the deposit is in inexhaustible supply. — *St. Louis Globe-Democrat.*

The Brass-grinders' Work. — "I've seen a man grind brass with the blood dripping from his nose all day long," said one of Portland's brass and iron dealers the other day. Perhaps no occupation is more injurious to the workingman's health than grinding brass. The air is filled with particles of the emery-wheel and the brass, and they are of course inhaled by the workmen. The result with a novice, and with a veteran when beginning work, is bleeding at the nose and lungs for several days. Then the bleeding stops, the respiratory passages having become apparently cauterized. Whether the flow of blood is simply the result of the irritation of the physical contact of the metallic particles, or whether the brass acts as a poison, we do not know. But certain it is that these brass-grinders are a very short-lived class of men, averaging less than forty years. In the larger cities they are now wearing a protector over the mouth and nose, but those in Portland do not, for no other reason than disinclination to bother with it and disregard of consequences. But why do men engage in this dangerous work? Because they have good wages. They work by the piece, and with plenty to do they can make sometimes $40 a week. It should be added that sometimes the particles of brass pass into the stomach and bowels and cause hemorrhages. — *Portland Transcript.*

The Old Assembly House at Chester, Pa. — Workmen who are tearing down the old Assembly House in Chester, Pa., found the corner-stone of the building in which the first Colonial Assembly of the Province of Pennsylvania met December 4, 1682. William Penn presided a part of that session. The foundations were in a good state of preservation, and showed that the building was 42½ by 50 feet, with an addition 14 by 34 feet. The house was built for a tavern by the Sandeland family prior to 1675. The old house fell down nearly a century ago, and the foundations were forgotten until they were uncovered last week — *New York Times.*

Monument to Louis Favre. — Few of those who travel now in comfort through the long St. Gothard Tunnel give one thought to men whose lives were unselfishly sacrificed in that great effort of engineering skill whose result is that tunnel. Recently we were reminded of him to whose persistence under the most awful difficulties, the convenience and comfort of modern Italian tourists is due. At Chêne-Bourg, in the Canton of Geneva, the monument of Louis Favre was unveiled in the presence of President Schenk and other leaders of the Swiss people. He has been dead but fourteen years, so that his memory still survived among all the speakers who unanimously eulogized him there. Louis de Favre started as a common workingman, but by his enterprise, resolution and skill raised himself to such a high position. He lost in his great undertaking, not only his fortune, but his life, dying in the tunnel his fame was made in, in the execution of his duty. The characteristic of the observance was, as M. Didier said, "homage paid to work, energy and perseverance." — *Berne Correspondence, London Standard.*

Dead Men for a New Bridge. — At Brazcka, in Bosnia, an old superstition has come to life again which resembles the fables of Jewish ritual murders. In Bosnia the people have believed at all times that a bridge could not be firm and lasting unless a human being was walled up in it. Thus there is a legend connected with the handsome Roman bridge at Mostar, which says that the fine arch across the Narenta could not be finished until the architect walled up in it a bridal pair. Now that a solid bridge is being built across the Save at Brazcka, this superstition is revived. It is rumored everywhere that gipsies are stealing children to sell them to the contractors, who wall one up in each pillar. A few days ago there was a regular pursuit of some unlucky gipsies, of whom it had been said that they were raiding for children. — *London Daily News.*

A Flag to summon to Church. — In the rooms of the Connecticut Historical Society is exhibited a piece of a bell showing the date of casting, 1729. This fragment, which is in two parts, is a portion of the bell which formerly hung for more than a century in the old Centre Church. The old bell having broken in 1725, the society, on December 19, 1726, voted "that Mr. John Edwards, at the charge of the Society, purchase some Suitable Red bunting for a flagg to be Set on the State House to direct for meeting upon the publick Worship of God." The old bell was sent to England at the expense of both the First and Second Societies, where it was recast in 1729, and continued in use here from that time until 1841, when it broke, and a new bell was ordered. — *Hartford Courant.*

The Shot-drill. — In the shot process of drilling through rock, steel shot are poured inside the drill pipe into a ring or channel made in the rock by a few revolutions of the pipe. The pipe bears on this ring of shot, and when it is revolved it causes the shot to revolve also and cut the channel in the rock deeper. As boring large holes through hard rock by means of diamonds (which are now costing from three to four times as much as they did a few years ago) is very expensive work, the new process of drilling by means of steel-shot will, it is expected, be used in many cases instead of the diamond-drill. A test boring eight inches in diameter and 390 feet deep, was recently put down by the National Boring and Drilling Company, which owns this process. — *Invention.*

The Reclamation of the Mojave Desert. — The reclamation of 200,000 acres of the Mojave desert is one of the most stupendous enterprises ever undertaken in Southern California, and from the indications the project will go through. The plan is to irrigate the large acreage near the mining town of Victor, in San Bernardino County, this side of the Needles. The company having the project under consideration is the Victor Irrigation Company. Some of the best engineers of the State have reported upon the enterprise as a most favorable one and very feasible. It is understood that the lands thus irrigated will be colonized, when that part of the desert may be expected to blossom as the rose. — *Los Angeles Herald.*

The Antiquity of Canned Fruit. — *The American Druggist* says that we are indebted to Pompeii for the great industry of canned fruit. Years ago, when the excavations were just beginning, a party of Cincinnatians found in what had been the pantry of the house many jars of preserved figs. One was opened and they were found to be fresh and good. Investigation showed that the figs had been put into jars in a heated state, an aperture left for the steam to escape, and then sealed with wax. The hint was taken, and the next year fruit canning was introduced into the United States, the process being identical with that in vogue at Pompeii twenty centuries ago.

Bridge across the Bosphorus. — The building of a gigantic bridge at Constantinople has long been under contemplation, with the view of connecting European Turkey with Asia Minor by rail. The latest scheme is that the structure should span the Bosphorus a little to the east of the metropolis, approximately midway between the Golden Horn and the western extremity of the Black Sea. At this point the strait narrows considerably, but even there the passageway would require to be some 2,660 metres in length, or nearly as long as the Forth Bridge. — *Invention.*

A Foundation Pier built over a Well. — Workmen about to build a brick pier for a new building in Lewiston, Me., dug down four feet into the ground and came upon a large flat stone. It pleased them to discover what they believed would be a fine foundation for their pier, and they went to work building upon it. They built the pier to a height of twelve feet, and then were astonished to see it sink into the earth. Investigation showed that their flat foundation stone covered the top of an old well 30 feet deep. — *New York Times.*

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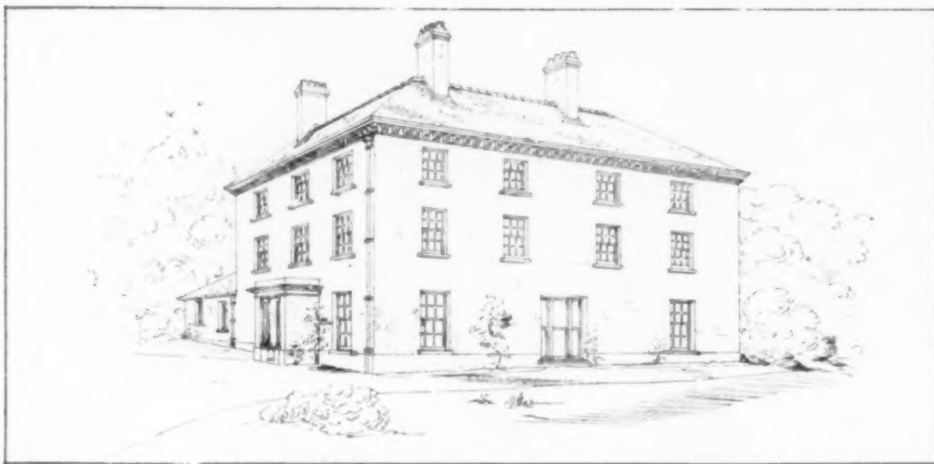
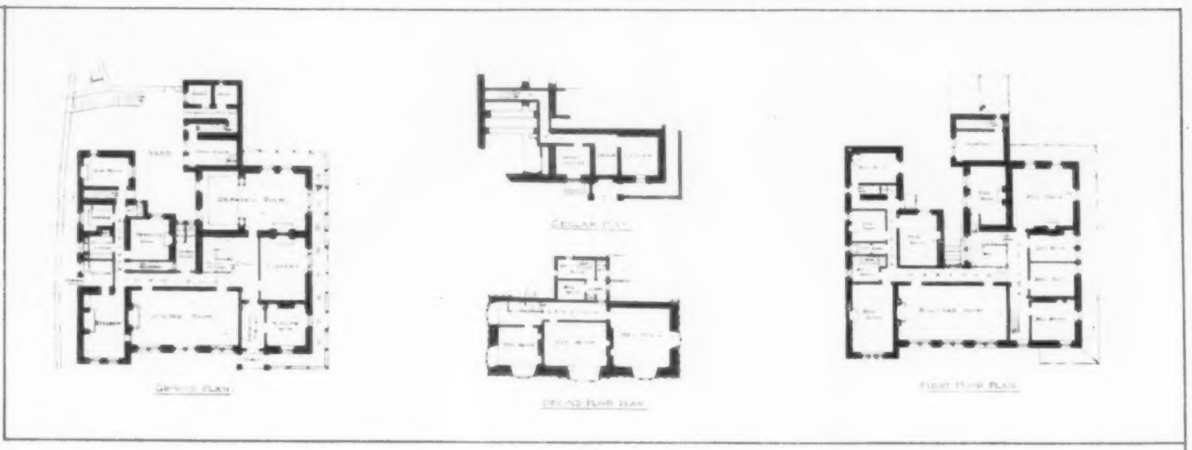
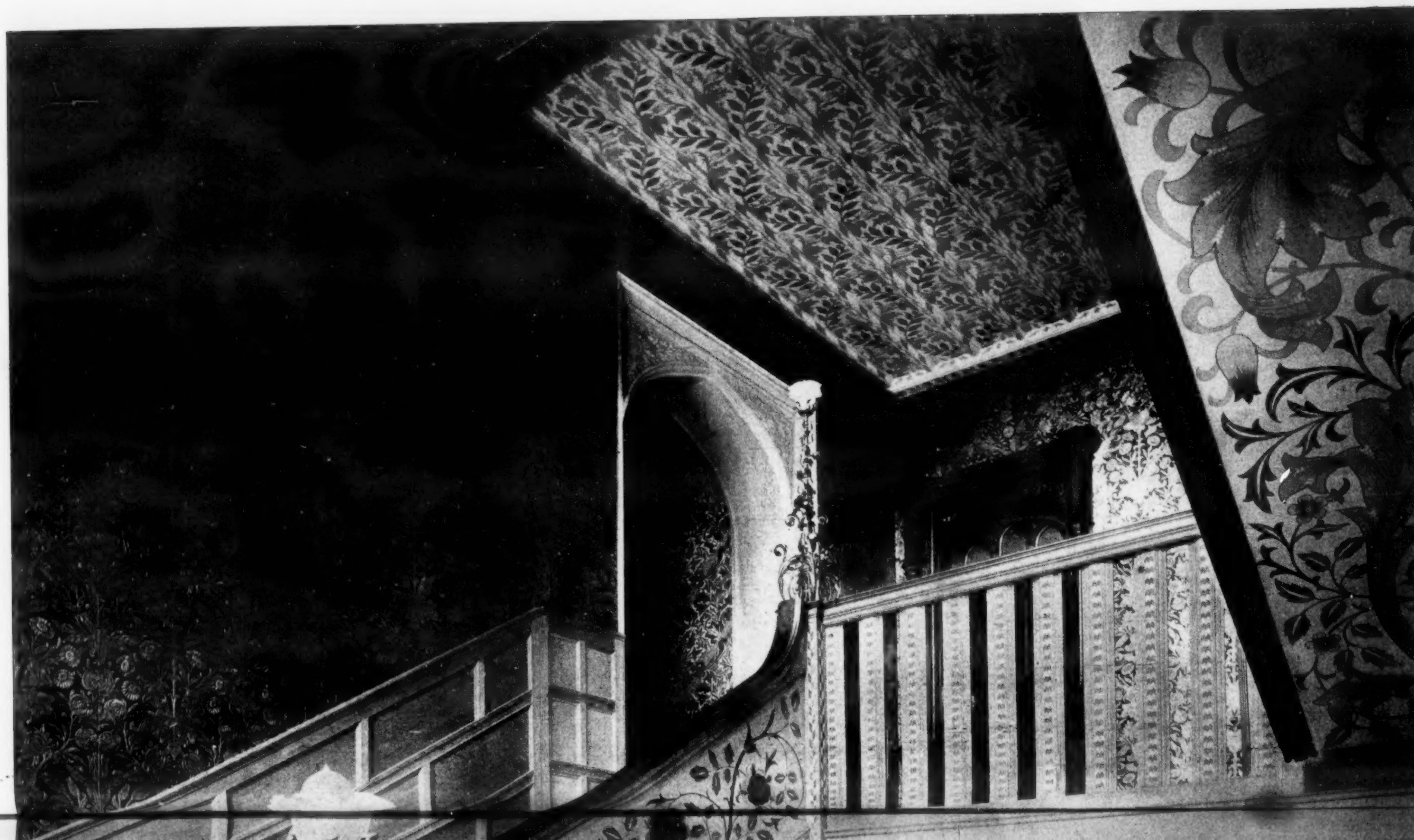


PLAS MADOC NEAR LLANRWST NORTH WAL



WALES THE RESIDENCE OF COL: JOHN HIGSON



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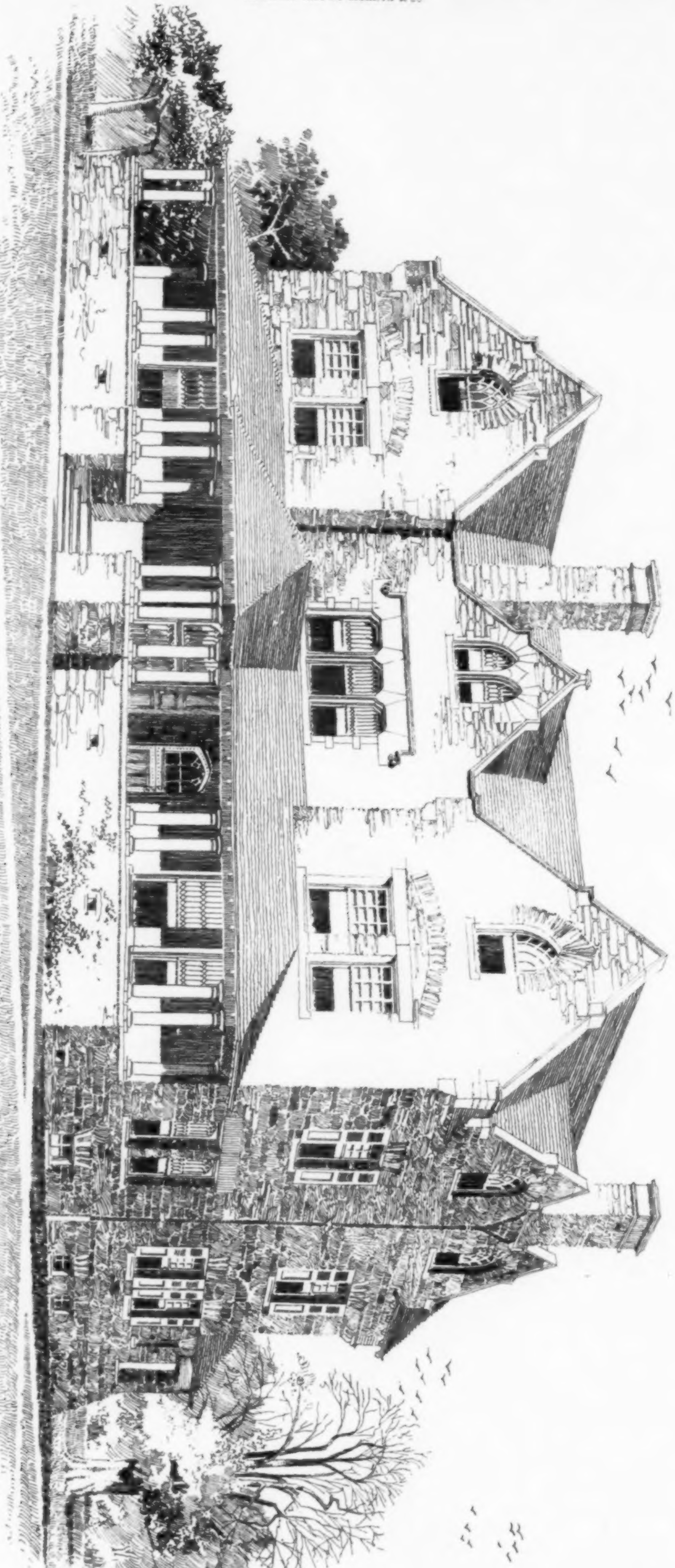
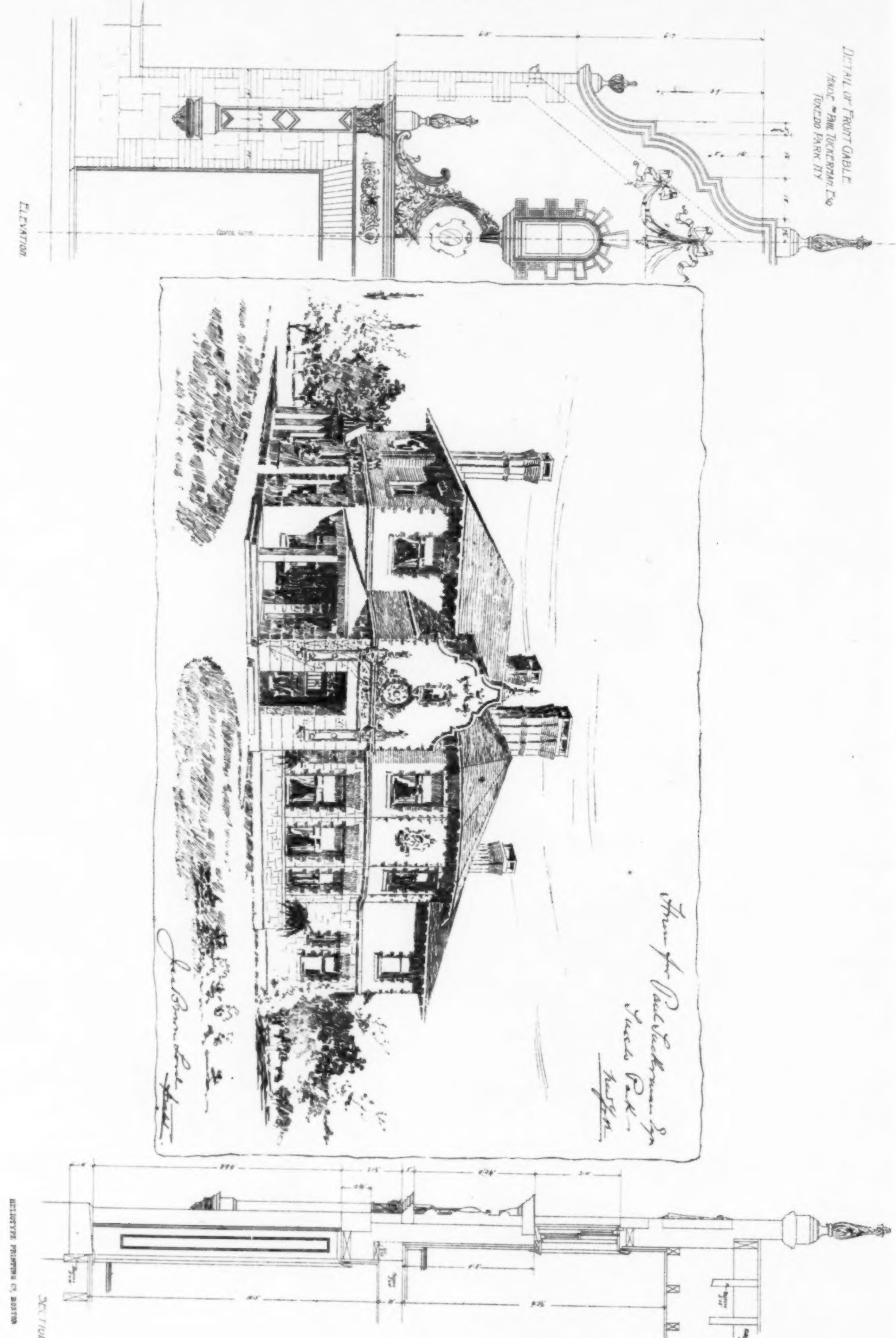
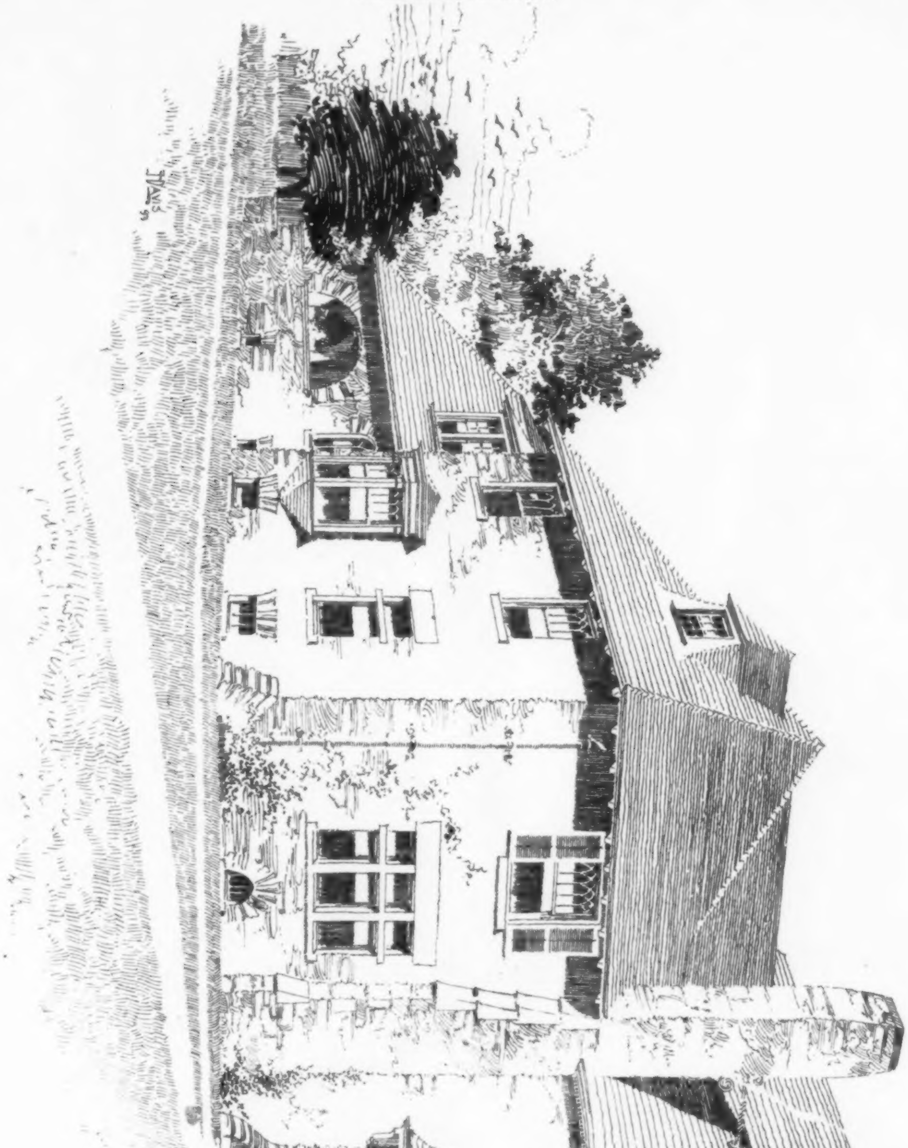
STANMORE HALL: LOWER STAIRCASE.
BRIGHTWEN BINYON, Architect.



House
at Overbrook, Pa.
for Messrs. Wendell and Smith

Boyd and Boyd
Architects
238 So. 3rd St. Phila.


DETAIL OF FRONT GABLE
HOUSE OF PAUL TUCKERMAN, ESQ
TUXEDO PARK, N.Y.
ELEVATION
SECTION



·HOVSE·FOR·

·MESSRS·WENDELL·&·SMITH·

·AT·OVERBROOK·PA·

·HORACE·TRVMBAVER·

·ARCHITECT·

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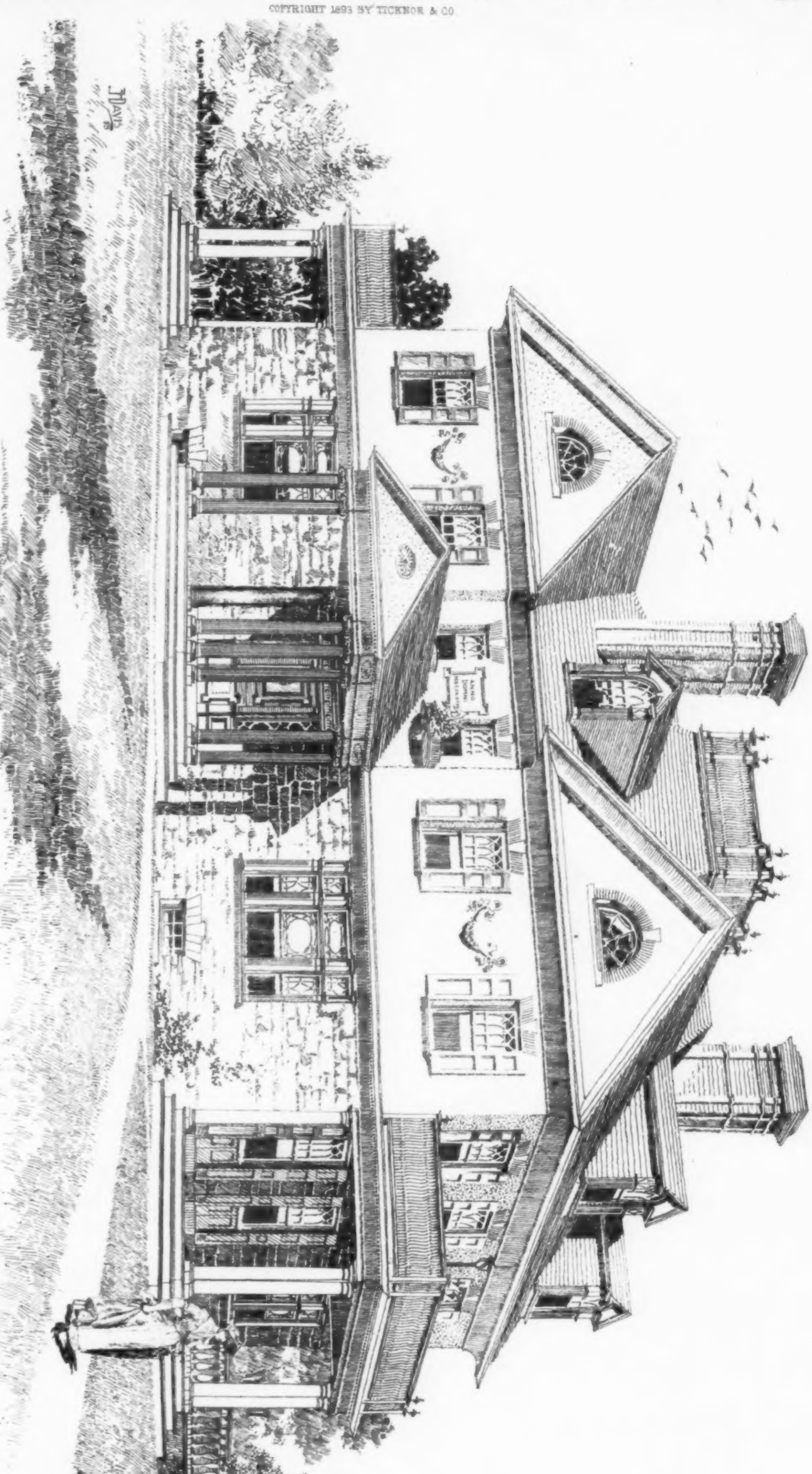

HOUSE AT OVERBROOK PA.
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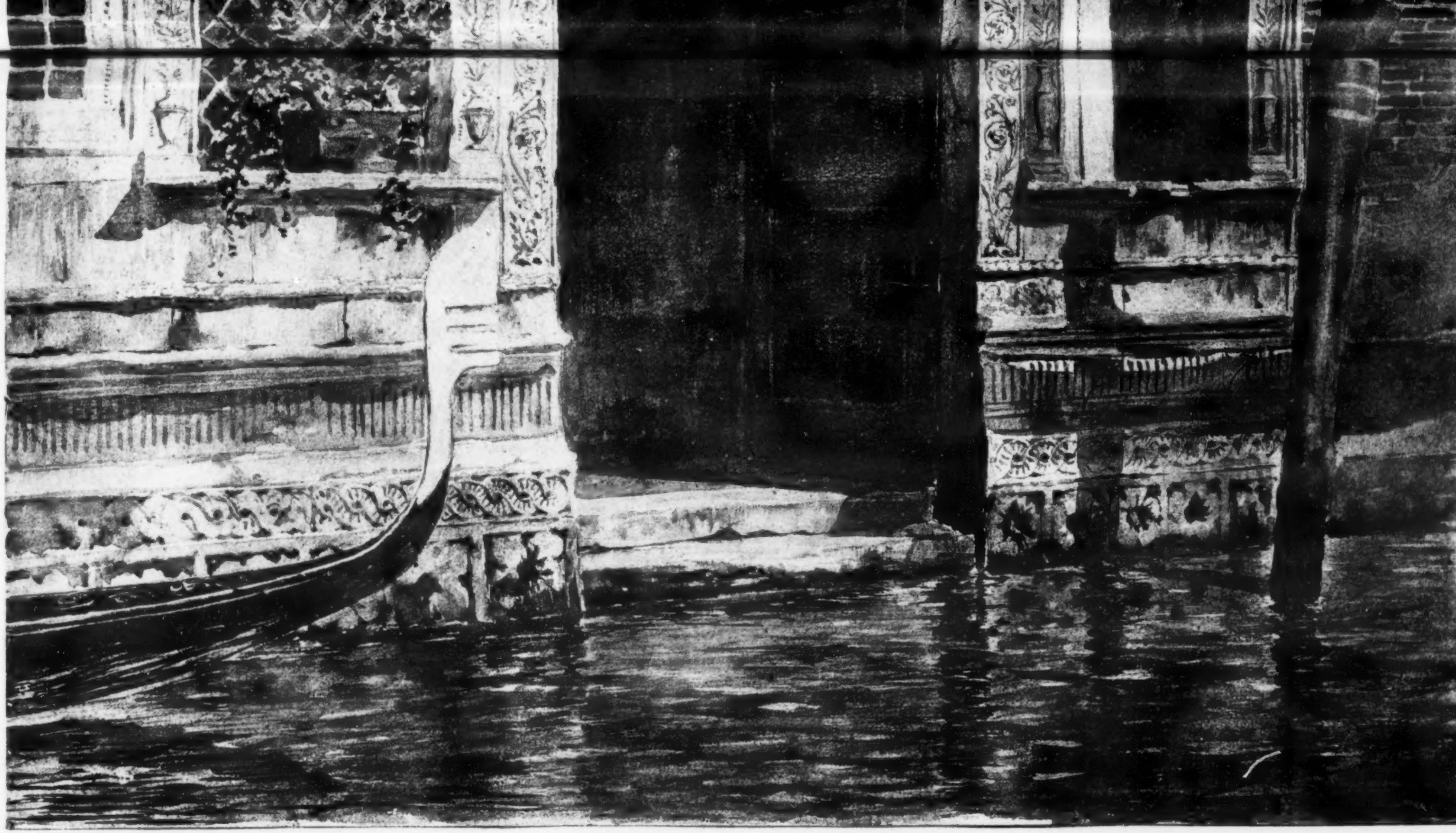

A VENETIAN DOORWAY, AFTER A WATER COLOR BY W. M. MACCAFFERTY,
AMERICAN ARCHITECT TRAVELLING SCHOLOR FOR 1892.

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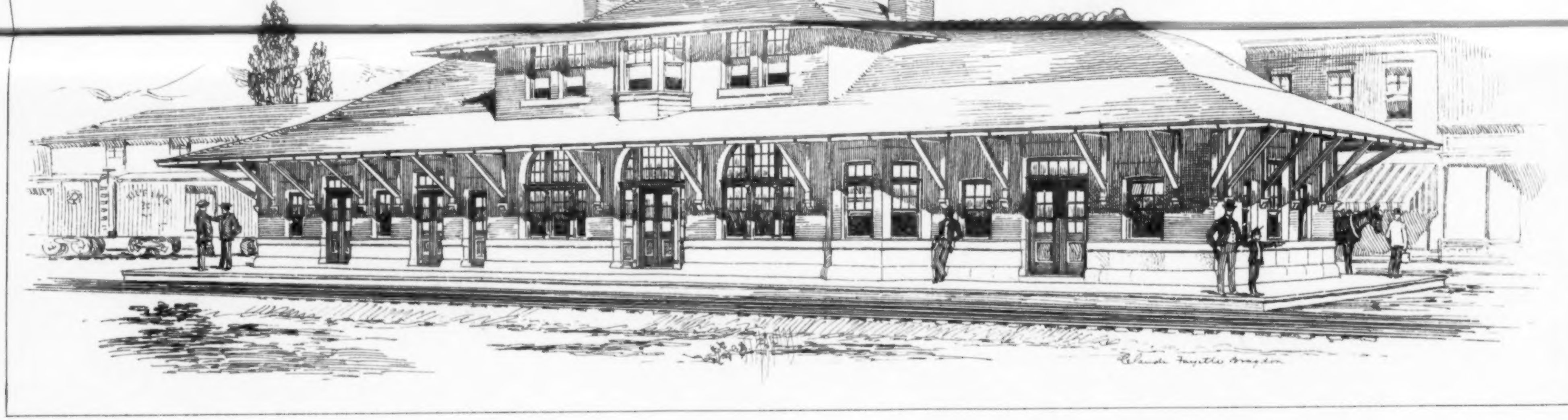

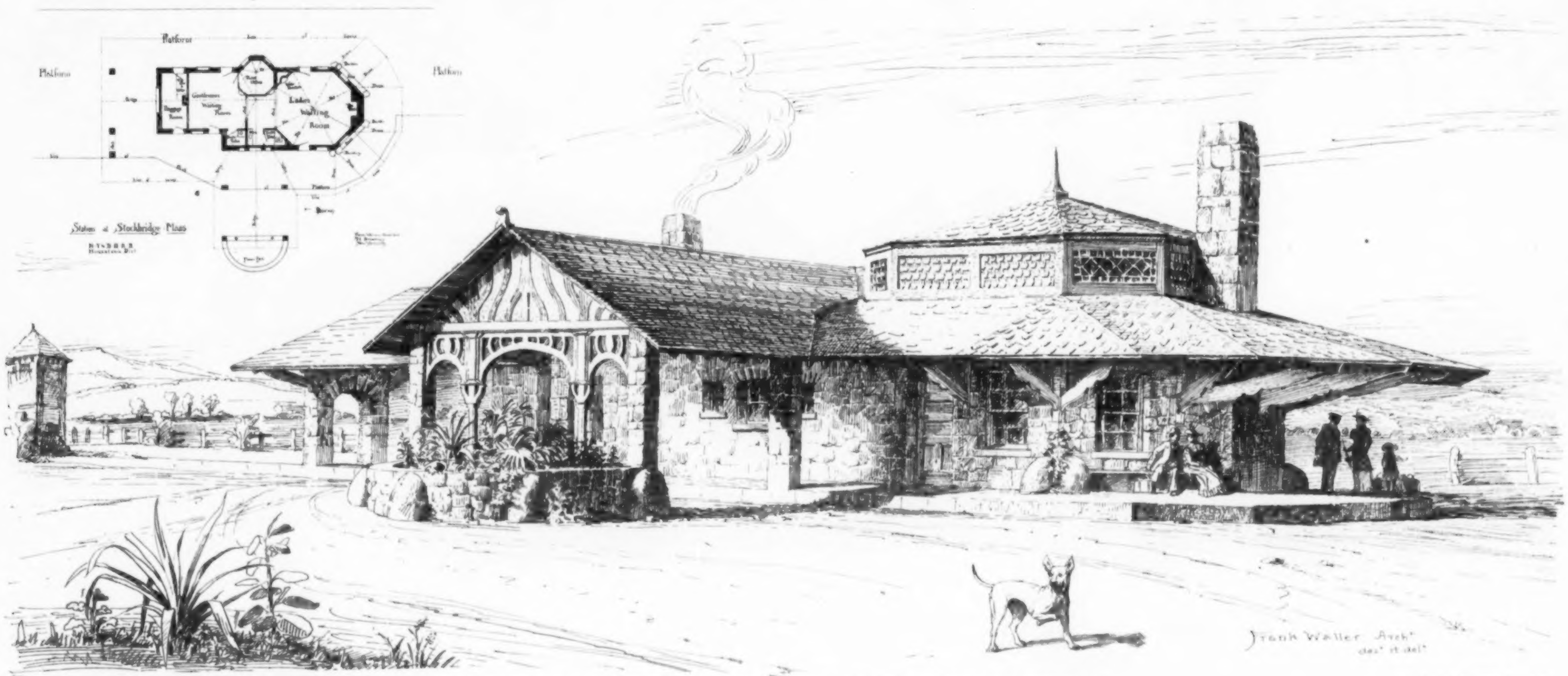

STATION AT STOCKBRIDGE MASS. HOUSATONIC RAILROAD.

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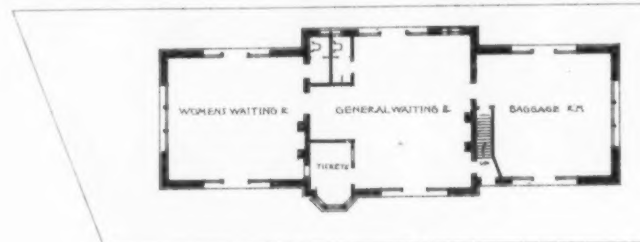
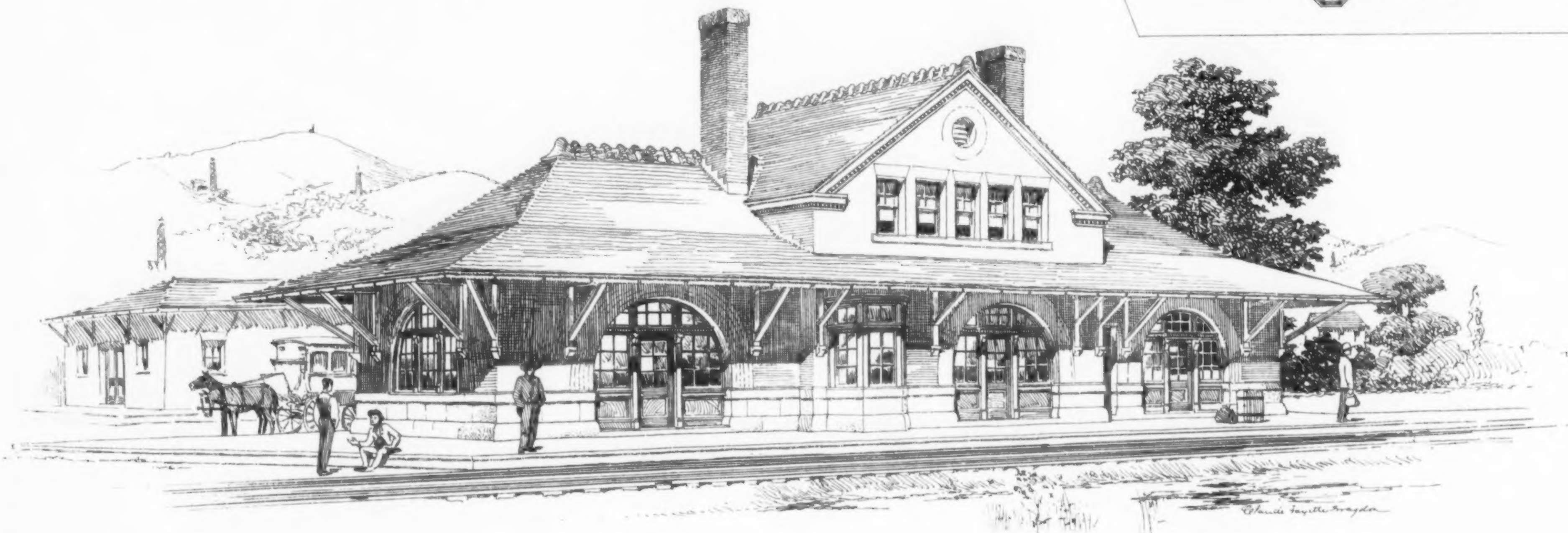
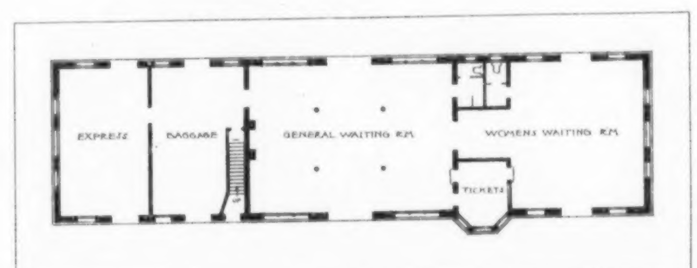
PASSENGER STATION AT BRADFORD, PA. FOR THE BUFFALO, ROCHESTER & PITTSBURGH RAILROAD. GORDON, BRAGDON & ORCHARD ARCHTS ROCHESTER.





PASSENGER STATION AT DUBOIS, PA. FOR THE BUFFALO, ROCHESTER & PITTSBURGH RAILROAD. GORDON, BRAGDON & ORCHARD, ARCHTS ROCHESTER.



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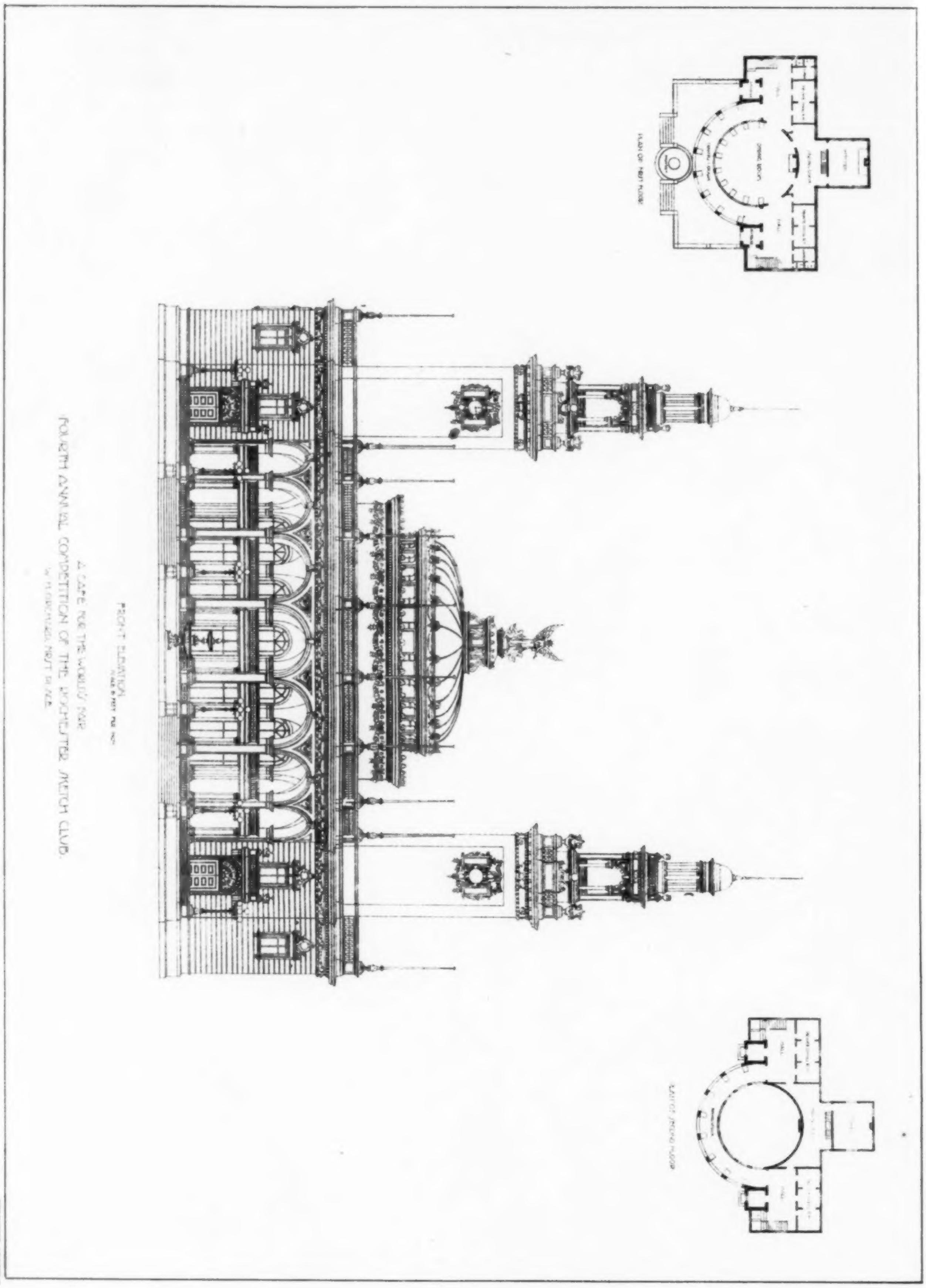
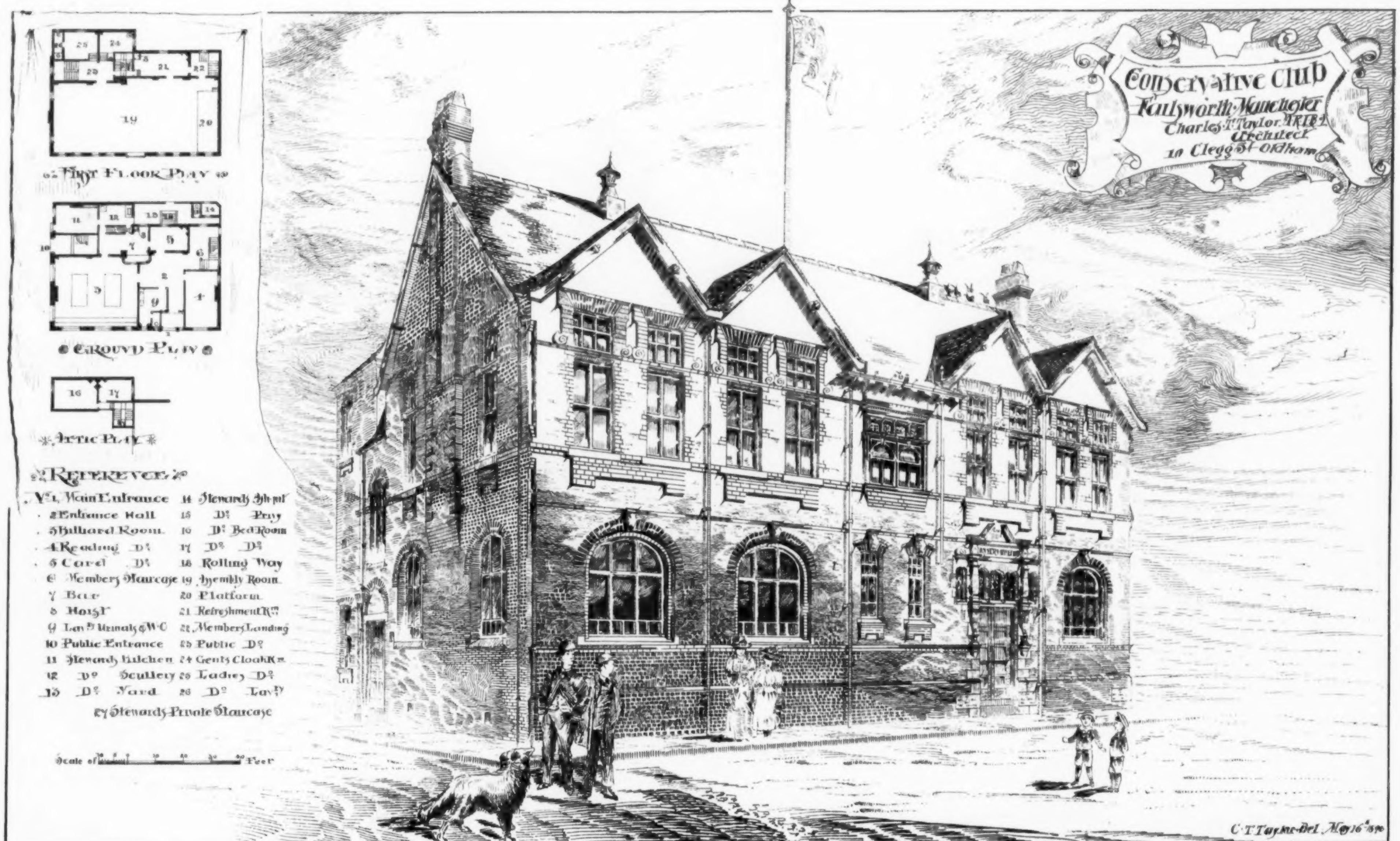
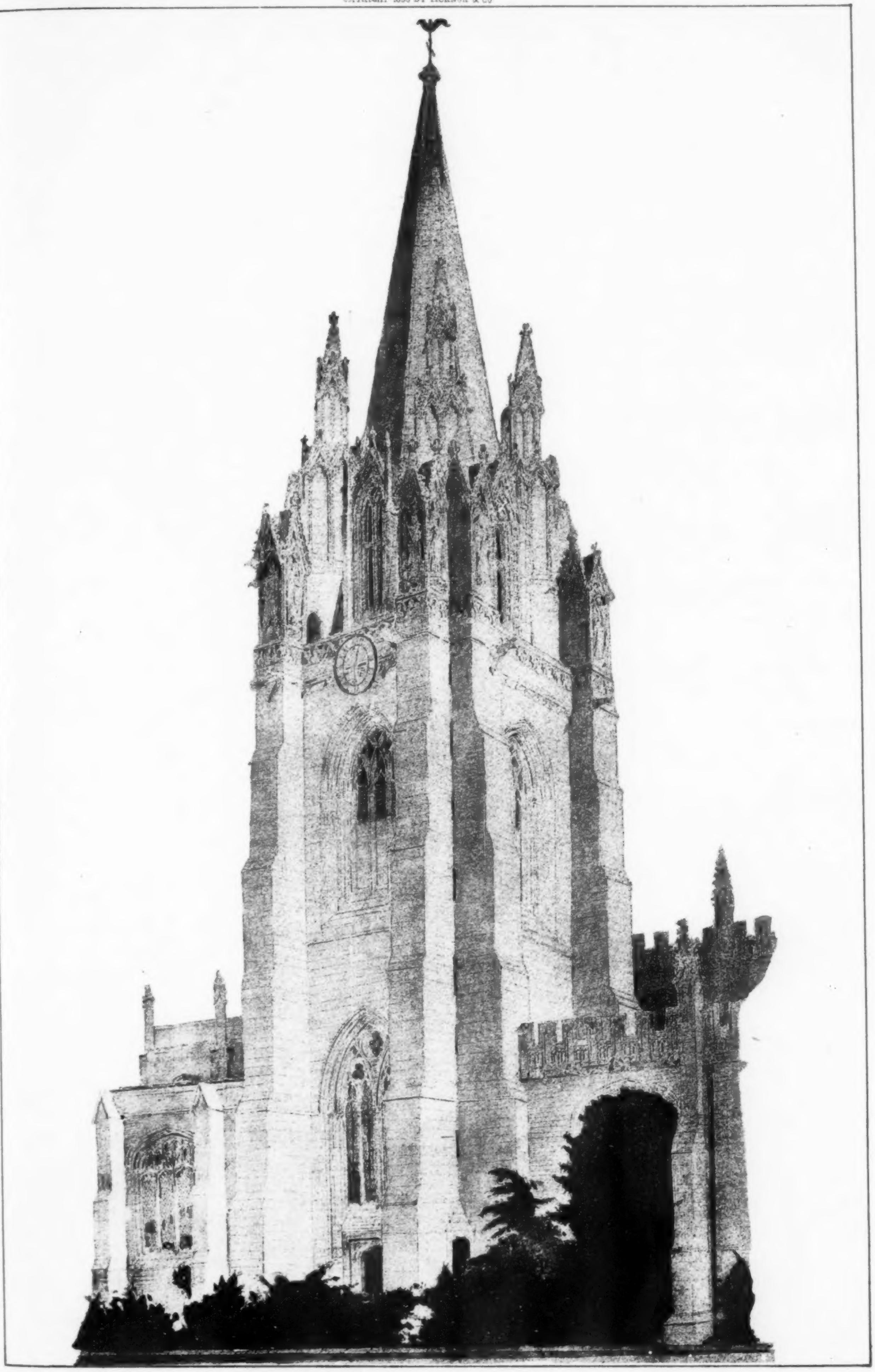



Conservative Club
Failsworth Manchester
Charles T. Taylor. ARIBA
Architect
10 Clegg St. Oldham
First Floor Plan
Ground Plan
Attic Plan
Reference
No. 1 Main Entrance
2 Entrance Hall
3 Billiard Room
4 Reading Do.
5 Card Do.
6 Members Staircase
7 Bar
8 Hoist
9 Lavs. Urinals & W.C.
10 Public Entrance
11 Stewards Kitchen
12 Do. Scullery
13 Do. Yard
14 Stewards Ash pit
15 Do. Privy
16 Do. Bed Room
17 Do. Do.
18 Rolling Way
19 Assembly Room
20 Platform
21 Refreshment Rm.
22 Members Landing
23 Public Do.
24 Gents Cloak Rm.
25 Ladies Do.
26 Do. Lavy.
27 Stewards Private Staircase
Scale of Feet
C. T. Taylor Del. May 16th 1890


House Built in Oldham
For
Paul Bowes Esq. M.D.
Charles T Taylor A.R.I.B.A.
Architect
10 Clegg Street Oldham
Charles T Taylor. Del
May 3rd 1893



SPIRE OF ST. MARY'S CHURCH, OXFORD, ENGLAND.
SKETCHED BY T. MAC LAREN.

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