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THE latest experiment in model tenement-houses is described in the New York *Evening Post* of the 5th inst. It seems to embody the features which by experience have been found essential to success in such enterprises; it is not a charitable undertaking, but a business-like investment of property, from which the owners expect to realize a safe and regular income, — the only foundation upon which any results really affecting the well-being of society can be raised. The practical points aimed at are abundance of air and light in every room, reasonable safety from fire, security from uncleanness, thoroughness in construction, and a decent regard for the natural desire of mankind to live orderly lives. The architects, Messrs. Field & Son, of New York, propose to realize these essential conditions by isolating the staircase in a brick tower, projecting four feet from the centre of one façade, and communicating with the apartments only by a series of slate and iron exterior balconies, by which the occupants are to gain access to the corridors upon which the various suites are to open; by having no living-rooms or bed-rooms without exterior light; by avoiding furred walls; by having washrooms in separate towers, so contrived that the hose may be turned on floors and walls alike; by providing ample shuttes for dust and ashes; by having a separate straight flue for each room, and a flat roof protected by a railing, adapted for the out-of-door uses of the tenants and as a safe and ample play-ground for their children, with an open *loggia*, apparently, in the upper story of a corner tower, where the occupants may sit and enjoy the luxury of cool breezes under cover in the hot weather. The most significant and most encouraging fact in connection with this enterprise is that it is a direct result of the recent agitation of this most important subject, and, if it proves a good investment, it will be followed by others in various parts of the city. The poor we have always with us; to make these a source of wealth instead of an object of charity is a primary condition of civilized life. We are entirely persuaded that if capital will continue in this manner to provide improved and improving homes for the "dangerous classes," they will no longer be dangerous, but, in returning to capital an honest percentage of profit, will increase in self-reliance and self-respect and constitute the strong foundation of the commonwealth. In forwarding such uses of capital by every means in our power, we conceive that we shall perform our highest duty as a journal devoted to the interests of building.

On the 6th inst., the scaffolding of the dome of the new music hall in Chicago, overweighted by a heavy iron bearing-plate weighing five or six hundred pounds, which the workmen were putting in place in the dome, fell to the ground, a distance of sixty feet, and severely injured four of the workmen who were employed upon this insecure footing. This seems to be still another instance of the recklessness with which temporary stagings are too often constructed in this country. A scaffolding of four-inch studs, eight or ten feet apart, spliced end for end with splinters of boards, and braced more or less securely with other boards, with foot-planks tilting upon bearings of ledger-boards on edge secured to the tops of these shaky poles, the whole depending upon the capacity of tenpenny nails to bear cross strains, — all this, however light and airy, is found so capable of bearing distributed weights in the ordinary processes of building, and gangs of masons, carpenters, iron men, plas-

ters, and painters, successively occupy its perilous heights with such impunity, that if the vigilance of the foreman is now and then put to sleep and the whole rickety construction collapses under a concentrated weight, like the iron plate in this Chicago work, perhaps we must blame rather the system than the man. The evidence of the newspapers as to the character of this especial staging is of course extremely various, and we must await the verdict of the coroner's jury. It is worthy of inquiry whether there is not a virtue of greater security in binding together the different members of such a staging with ropes at the intersections, as practised on the continent of Europe, instead of with two or three tenpenny nails, to which we have so long committed the lives of our workmen. Our whole system of scaffolding, with its ledger-boards and putlogs, especially when spread over a wide interior for the purpose of enabling workmen to gain access to every part of a roof, needs something more than the mere following of a convention in the construction; it needs constant watchfulness in the maintenance, and a jealous scrutiny, that irresponsible people, for the greater convenience of their work, may not knock away the most essential members. In the present case the verdict of the inquest should be in such form as to serve as a warning and as a safeguard for the future. Such accidents have become far too frequent.

CLEOPATRA'S needle, the famous standing obelisk at Alexandria, whose prostrate brother has been reërected after such various fortunes upon the banks of the Thames, was formally presented to the city of New York by the late Khedive, as we mentioned a short time ago, and, a citizen having furnished the means to defray the expenses incident to its removal, an officer of our navy has been granted six months' leave of absence for the purpose of visiting Egypt and constructing the appliances necessary for transporting the curious shaft to these strange, modern scenes. He is now, we believe, engaged in examining vessels in Philadelphia with a view to selecting and preparing one for this especial service. This obelisk is several feet longer than the one on the Thames embankment, and is said to be in fair condition. The hope is entertained of delivering the shaft safely in December, and thus placing New York on an equality with Rome, Paris, London, and Florence as an obelisk-bearing city before the close of the year. If the sedentary habits of this ancient monument have not undergone a change since the time when *Rameses II.* laid hands upon it more than three thousand years ago and moved it from Heliopolis, where it had already stood a century, to the borders of the Mediterranean, it must feel a stirring of indignant shame through all its hieroglyphics at this disrespectful Yankee haste. When the New World stands in the presence of this monument of thirty-three centuries, let us hope that our people will at length become conscious of the real significance attached to the shape and details of this venerable monolith, and will understand that our attempt to parody it with a bare pile of stones built up to an enormous height is a mere piece of barbarism, — an empty boast, conveying no thought and satisfying no rational desire of civilization. If our one hundred years of activity have been more fruitful in the experiences which advance civilization than the thirty-three hundred through which this pictured shaft has slept, certainly with our resources of art and money we should build in the memory of Washington a monument more significant and worthy than an imitation of this record of the pious exploits of *Thothmes III.*

THE Chicago *Inter-Ocean* has taken the lead in a discussion, which has extended to other papers, on the proper construction of lightning-rods, in the course of which some valuable suggestions have been made. The unanimous testimony of those who profess to know the facts is that glass insulators are worse than useless, and the best practice seems to be to connect all gas and water pipes, gutters, flashings, and other metal-work in buildings directly with the rods. These should be of thick iron or copper: the idea that the conducting capacity of a rod depends upon its surface has long been exploded, and the probability is that the transmission of atmospheric, like voltaic electricity, is in proportion to the mass, not the surface, of the conductor. Certain late experiments have tended to show, however, that the superiority of copper over iron is not so marked in the transmission of atmospheric as of voltaic currents. All the observers

agree as to the extreme importance of a good connection with moist earth: the principal difference seems to be in regard to the proper number and spacing of points. The old idea that a rod protected a circular area the radius of which was twice its own height has frequently been shown to be erroneous, and to meet the sudden and rapid discharges caused by high winds or violent electrical disturbance probably three or four vertical branches are advisable on a building of moderate size. It is often noticed that lightning strikes the prominent portions of a structure toward the wind, and this suggests the guarding of the gables or other exposed points to meet currents approaching from all quarters. The utility of the secondary points or tridents with which many houses bristle is seriously questioned. One writer asserts that the object of the point at the top of the rod is to increase the tension at that part, and thus aid the silent escape of the electricity from the ground and the connected building into the cloud, or *vice versa*, which may easily be understood by any one who has seen the quiet discharge of the conductor of an ordinary electrical machine by a point either attached to it or presented toward it, and he contends that every additional point divides and diminishes the tension, and lessens the efficacy of the rod. This subject may be easily and profitably studied by any one who has access to a good plate or cylinder electrical machine, and we hope for more light upon it. Meanwhile it is gratifying to see the general accord of the most intelligent writers against insulation, and in favor of connection of all the metal-work of buildings with the rods. If this system, under which it is asserted that the ships of the British navy have been so well protected that there has not been the slightest damage from lightning on board one of them for thirty years, were to be popularly understood and accepted, we should have less reason for the common saying that the devices of the rod peddler are more dangerous than the lightning itself.

A SUGGESTION is made for improving the city of Washington, which is not likely to be soon acted upon, but has some good points. Mr. Private-Secretary Rogers proposes that the offensive flats south and west of the Capitol should be filled in, and a sea-wall built, so as to obtain an outfall for the sewers in a swift current; the land south of the Capitol to be condemned, the shanties which now occupy it removed, and the whole to be laid out in a series of parks. He would also extend the present Mall and Botanical Garden up to the south side of Pennsylvania Avenue, clearing that side of buildings the whole distance from the Capitol to the Treasury. Most people would say, we fancy, that there were already too many parks in Washington, and too little building, and what building there is seems inclined to desert the Capitol, while the Capitol turns its back upon it in return. It would be in many respects a serious misfortune to lose the view of the south front, the most picturesquely lighted of all the sides of the Capitol, in the shrubbery of a park, and if the drainage of the southern district were so far improved as would seem practicable under Mr. Rogers's scheme, the space between the Capitol hill and the river would be an excellent district for the best residences of the city, well situated for receiving the cool breezes from the river in summer, and sheltered by the hill from the winter winds, convenient at once to the Capitol and the government offices, to both the railroads, and the Virginia shore, while the margin of the Potomac itself could be formed into a magnificent street, far surpassing the Thames Embankment, the Riva degli Schiavoni at Venice, or the Nevskoi Prospekt at St. Petersburg. Some of these days, when the contrast between the map of Washington and the reality grows less painful, we think it very probable that the tendency may be in this direction.

We think it useful to give due publicity to the enterprise of Messrs. Raeder & Ramsey, architects, of St. Louis (or of Mr. Charles K. Ramsey, who seems to have succeeded this firm). These practitioners have adopted an advertising expedient not without ingenuity in its conception and doubtless satisfactory in its pecuniary results. They have published an "Architectural Guide" for gratuitous circulation, containing illustrations and descriptions of such of their works as they thought would best set forth their capacities to serve the public of St. Louis and of its neighborhood; these alternate with advertisements of various building materials and appliances which are recommended by the architects in question, and serve as a sort of side-show. We conceive that the circulation of this book was intended to be confined to the far West, because among the illustrations we

discover over the unblushing legend, "Raeder & Ramsey, architects," the design of the Shillaber Building on Court Street in Boston, published in this journal August 19, 1876. We do not suppose that Messrs. Cummings & Sears, the architects of this building, will be inclined to take any action with regard to this, but in the interest of common decency and honor in the practice of the profession, we cannot suffer it to pass by without an appreciative notice, which we trust may reach the neighborhood where it will do the most good.

THE OPEN FIRE-PLACE. XIV.

TABLE VII. shows the heating power of the Jackson Fire-Place. Before lighting the fire the anemometer at the register was motionless, showing that the air was stagnant, and the ventilation nothing, or at least imperceptible, inasmuch as the doors and windows were tightly closed.

The moment the fire was kindled a current of fresh air set in, and in a few moments became powerful enough to blow out the light of a candle held in it, and warm enough to melt the wax. As will be seen by the table it poured into the room at the rate of one hundred and thirty-eight meters a minute, heated nearly to the boiling point of water. Indeed, so great was the heat that the metallic part of the anemometer held in the current soon became too hot to touch, and showed that where hot fires are needed the mantel-shelf used over these fire-places should be constructed of terra-cotta, marble, or some incombustible material, in order to avoid danger of destruction by the heat.

In order to render the tests more reliable, a wooden box or flue was built around the fresh-air inlet register, to collect the air and conduct it outwards and upwards so that the thermometer placed in the current would be protected from radiation from the fire-place and other external sources. The air thus collected entered the room, of course, in a stronger current than it would otherwise have done.

TABLE VII.

Time: Evening of July 10, 1879.	Temperature of the Fresh-Air Current.	Velocity of the Air in Meters per Minute.	Cubic Meters of Air entering the Room.	Difference of Temperature between Outer Air, and Air entering the Room.	Equivalent in Cubic Meters raised 1°.	Weight in Kilograms.	Remarks.
1	2	3	4	5	6	7	8.
6.30	25.0	0	0	0.0	0		
.40	26	21	.4	1	4.3	4.3	Fire lighted.
.45	24	45	.8	9	11.3	13.6	Full blaze.
.50	46	63	1.1	21	99.5	109	2d kilo. put on.
.55	62	63	1.1	37	180.4	198	
7.	85	75	1.1	60	259.6	290	3d kilo. put on.
.5	90	117	2.1	65	501.9	500	
.10	95	138	2.5	70	757.6	757	
.15	97	138	2.5	72	836.8	840	Fire declines.
.20	94	130	2.2	69	783.3	783	Fire out.
.25	86	123	2.0	61	670	730	
.30	80	120	2.0	55	602	660	
.35	75	110	1.7	50	425		
.40	71	95	1.7	46	391		
.45	65	94	1.7	40	357	1972	
.50	60	93	1.7	35	323		
.55	56	93	1.7	31	297		
8.	54	92	1.7	29	272		
.5	52	91	1.7	27	240		
.10	50	90	1.6	25	200	1184	
.15	49	87	1.6	24	190		
.20	47	85	1.6	22	175		
.25	45	80	1.6	20	160		
.30	44	77	1.6	19	140		
.35	42	75	1.5	17	120	698	
.40	40	72	1.5	15	110		
.45	39	70	1.4	13	100		
.50	38	68	1.3	12	85		
.55	37	66	1.2	12	70		
9.	37	64	1.2	12	65	896	
.5	36	63	1.2	11	60		
.10	35	62	1.2	11	50		
.15	35	61	1.1	10	48		
.20	35	61	1.1	10	45		
.25	34	60	1.1	9	40	256	
.30	34	60	1.1	9	38		
.35	33	59	1.1	8	30		
.40	33	59	1.0	8	35		
.45	32	58	1.0	7	30		
.50	32	58	1.0	7	28	171	
.55	31	57	0.9	6	25		
10.	30	56	0.8	5	23		
.10	29	55	0.8	4	18		
.20	29	54	0.7	4	13		
.30	28	53	0.7	3	10		
.40	28	52	0.6	3	8		
.50	27	51	0.6	2	6	144	
.11.	26	50	0.6	1	4		
.10	26	49	0.5	1	4		
.20	26	48	0.5	1	0		
						9671	

By the combustion of 3 kilograms of wood enough heat was saved to raise the temperature of 9,671 kilograms of air 1° Centigrade (supposing the air at 0°, 20°, 40°, 60°, 100°, weighed respectively 1.3,

1.2, 1.1, 1, and 0.9 kilograms per cubic meter). This is equivalent to 2,321 units. The wood used in the experiment contained 9 per cent, by weight, of water. Allowing for perfectly dry wood 4,000 units, our wood would yield $.91 \times 4,000 = 3,640$ units per kilogram, and for 3 kilograms 10,920 units. But to evaporate the .09 of water contained in the wood would render latent $(531 + 75) \times 3 \times .09 = 164$ units of the heat generated. This should therefore be deducted from the 10,920 units, giving an available power of 10,756. In the above equation 531 represents, according to Despretz, the number of units rendered latent in transforming 1 kilogram of water 100° Centigrade to vapor under ordinary atmospheric pressure, and 75 represents the number of units required to raise to the boiling point the temperature of 1 kilogram of water from 25° Centigrade, which was the temperature of the outer air and of our fuel at the beginning of the experiment. The amount saved, 2,321 units, was therefore $\frac{2,321}{10,756} = 21$ per cent of the total available heat generated. Add 6 per cent for that obtained for direct radiation, and we have 27 per cent utilized. Adding, as before, 5 per cent where the upright iron flue is added, and we have a grand total of 32 per cent obtained by the Jackson Fire-Place.

Few persons realize the extent to which kiln-dried wood reabsorbs the moisture expelled by the drying. The wood used in the experiment had been kiln-dried, but had again absorbed from the atmosphere 9 per cent of water. A portion of that used was cut up into small pieces and weighed. It was then redried and weighed again. The drying was conducted in an air bath maintained at a temperature of 150° Centigrade. Before drying the sample weighed 36.155 grams, and after drying only 33.169 grams, showing a loss of 2.986 grams, or nearly nine per cent of the whole; or, in other words, that the kiln-dried wood used in our experiment had reabsorbed 9 per cent of water from the atmosphere.

In testing the wood used in the experiments on the Dimmick and Fire-Place Heaters, the sample, weighing 22.683 grams, lost, after drying for twenty minutes in air heated to 150° , 3.097 grams, or thirteen per cent of its weight. A further exposure for three hours to the drying heat reduced its weight only twenty-two ten thousandths of a gram, so that the wood might then be considered as practically dry. The sample was then exposed for a week to the air of the house, and again weighed. It was found to have regained the greater part of the water expelled by the drying. It weighed 21.33+ grams, showing a gain of 1.774+ grams, or seven per cent of its weight. The rapidity with which kiln-dried wood, when fresh from the kiln and very dry, absorbs moisture from the air was shown in the process of weighing our samples. When placed on the scales immediately after drying it was found to gain two or three ten thousandths of a gram per minute. These experiments on the dryness of wood show how much the calorific power of the material is affected, not only by the method of preparing it, but also by the time it has stood exposed to the air after drying, and even with the condition of the atmosphere at the time of its use. The kiln-dried wood tested showed a variation of 8 per cent in the amount of moisture it contained after drying. In other words, its available calorific power varied between 4,000 and about 3,600. Hence the importance of knowing the hygrometric condition of our wood before making our experiments. Hence, also, the economy of seeing that the wood we buy for fuel is perfectly dry.

These experiments were made in the laboratory of Mr. W. E. C. Eustis, whose liberality in offering me the free use of a set of scales of unusual delicacy, and other apparatus needed, I take this occasion gratefully to acknowledge.

In another experiment made on the Jackson Fire-Place quite a strong breeze was blowing into the fresh-air duct from the outside, so that the anemometer recorded an entering current of 70 meters per minute before the fire was lighted. This outside pressure of course increased the effectiveness of the heater, and the saving amounted to about four per cent more than when the air outside was still. This test was made on the very warm evening of June 25, from nine to twelve o'clock, the thermometer outside standing at 25° C. (77° F.). In winter, when the difference between the outer air and that of the flue is lower, a greater saving of heat is realized from any of these heaters, but the experiments lose in accuracy, partly on account of the difficulty of measuring the temperature of the inflowing fresh-air current at the beginning and end of the experiment. The thermometer is influenced by radiation from the surrounding objects in the room, from which it is, of course, impossible to protect it absolutely. If it were possible it would indicate a temperature of over a hundred degrees below the freezing point of water, the temperature of celestial space being, according to Pouillet, as low as -150° C. Only an approximate degree of accuracy can, therefore, be expected, and it is greatest when the temperature of the room is nearest that of the inflowing air currents, as is the case in summer.

The Jackson Fire-Place is at present manufactured in two sizes only. The price of the smaller size, 32½ inches high, and 30 inches wide, requiring a fire-place opening in the brickwork 32 inches high, 28 inches wide, and 15 inches deep, is \$60, all nickel plated, or \$50, bronzed, or \$45, black, with polished basket. The larger size was originally made for rooms 35 by 50 feet. They measure 43 inches high, 38 inches wide (outside of frame), and require a fire-place 40 by 33 by 15 inches. They are to be obtained of William H. Jackson & Co., Union Square, New York.

THE HOTEL DE VILLE, PARIS. — At one time last May no fewer than 1,098 men were engaged on this building.

CORRESPONDENCE.

THE NEW CITY-HALL INVESTIGATION CONTINUED. — FALL OF A SCAFFOLDING. — POPULAR AGITATION OF THE SEWER-GAS QUESTION.

CHICAGO, August 6, 1879.

BEFORE continuing the account of the city-hall investigation, it is well to describe the present condition of the city-hall and that of the county building adjoining.

The city of Chicago once rejoiced in a public square of about 350 feet in each dimension. In the early days of the city, — that is to say, about twenty years ago, — this spot of ground sufficed for a county court-house, one half of which was used as a city-hall, and a grass plot surrounding it. Two wings were subsequently built, and were supposed to be fire-proof, — one on the east side for the county and the other on the west side for the city. These wings, with the old building, covered the central portion of the square running east and west and from street to street. Two small parks, or court-yards, were left on the north and south sides. But the fire burned up everything contained in these buildings, and utterly destroyed the original structure and one of the wings. The partnership arrangement between Cook County and the city of Chicago, which is of long standing, still exists, so that when it became necessary to build a new court-house and a city hall it was decided by an agreement between the city and county to place them exactly as before. It was also necessary to cover the whole square, and after the two governments had failed to agree upon any plan for a uniform building, the county commenced its own building on its own half of the ground. This compelled the city government to erect a similar building on its half, which it is now doing; and this building is the bone of contention between two rival factions of stone contractors.

Meanwhile the two governments have agreed to erect a connecting building or rotunda between the two, and this is about to be commenced, instead of the immensely tall dome which was designed by the county architects.

The county building is now a basement and four stories high, and some of the work has already been carried up nearly 100 feet above the street grade. It is built of white Lemont limestone and polished Maine granite. It has required more polished granite than any other building ever erected in America, at a cost of nearly \$300,000. For the benefit of your Eastern readers I will add that the white limestone, after it has been a short time exposed to the weather, has much the appearance of the limestone of Caen, France, but is very much harder.

The city-hall is being built of a very light gray limestone from Indiana, known as Bedford stone, while the portions which are of polished granite in the county building are of a darker gray limestone, affording a very slight contrast. The Lemont stone is a stratified and laminated stone, but is from a quarry which yields stones three feet in thickness. The Bedford stone is what the stone-cutters call "liver rock;" that is to say, it is not laminated, but the stone of each layer in the quarry is almost homogeneous. The Bedford stone is oolitic, and the Lemont is a shell limestone.

The Bedford stone is very uniform in color and texture, and may be quarried in any size desired. The only defect in it which is general is that an occasional shell or calcareous insect entering into its formation is soft, and after cutting develops what the stone-cutters call "sand-pockets." These would hardly be considered as defects in large pieces, except for the fact that stone-cutters are in the habit of stopping them with cement, which draws attention to them. The Lemont stone contains dark blue or black lines, which with one year's exposure become of the consistency of dry clay. Besides these it contains fine seams, which only an expert can detect in the quarried stone, but which become painfully evident often when a stone has been half cut.

The city-hall is now built up to the top of the main story, which (counting the basement, which is entirely above the street grade, as a story) makes it two stories high. The outline is the same as that of the county building, and the stone-work is of similar design, with the omission of some elaborate work on the rusticated stones of the main piers, and a reduction in the projection of these rusticated stones.

In my last letter I brought the description of the city-hall imbroglio down to the presentation of the supplementary report of the experts. The private report of Mr. Kirkland, the present superintendent of buildings and acting architect, which preceded the report of the experts, was not made public until Monday, August 4, the mayor having retained it until the experts had made their supplementary report. His call for this seems to have been inspired by Mr. Kirkland's report. As was intimated before, the main point made by Mr. Kirkland was in relation to the hollow piers; he also advised that the piers which did not contain bond-stones be taken down in the first and basement stories. These comprise the narrowest piers on La Salle Street and on the opposite side, towards the court between the city and county buildings. These are not such piers as are used under business buildings, and are not isolated. They are piers between windows and are composed on the outside of blocks of rusticated ashlar. On each side of these are the stone window-jamb pieces, and behind them is the brick backing. The piers have an area of about eight superficial feet, and their height is equal to the height of the windows. On the court side they stand singly

and between much larger piers, whose strength is not questioned except in two places, where there are two intermediate piers so that there may be three openings in a bay. About half of the horizontal areas of the piers are of stone. Gilmore's tests made for the State-House Commissioners of Indiana show that this is one of the strongest magnesian limestones. From these rough data the reader may be able to realize what one of the chief points of dispute is.

Mr. Kirkland's opinion on the hollow spaces in the large exterior buttresses is based on the assumption that the foundations were calculated to sustain the weights of solid buttresses, and that hollow spaces not only weaken the piers but reduce the weights which will be necessary to make all the piers settle evenly, the estimated pressure being three tons per superficial foot at the bottom of the concrete. If these buttresses are solid they will be masses of masonry of about ten feet in dimension each way, and there are about ten of this kind in the building.

It is the opinion of good judges that the lighter intermediate piers are not likely to settle away from the heavier ones, in such a building as this, by reason of exerting a greater pressure per superficial foot of foundation. The horizontal pieces of walls, or transoms of heavy masonry which connect all the piers of such a building as this on every story, have a great sustaining power as masonry beams; and when there is the least tendency of small piers to settle away from larger ones the extra weight is immediately transferred to the large piers by these rigid transoms. If, on the contrary, the larger piers should have a tendency to settle unduly, their weights would be transferred to the small ones, and the tendency would be to bring upon them more weight than they would naturally carry in a building which settles evenly. In view of the fact that these small piers are the very ones whose strength is questioned, it would seem that the lightening of the larger ones was just what was needed to make their reconstruction unnecessary.

The question as to the utility of bonding composite piers, or those composed partly of stone and partly of brick, has been pretty freely discussed by a number of experts who have been giving testimony this week before the Committee on Public Buildings, to whom the experts' report has been referred. Opinions vary. Some contend that the bond-stones were necessary, in addition to anchors, to give homogeneity to the piers, while others hold to the opinion that they are of no use, for the reason that the brickwork will contract and settle more than the stone-work, and consequently that the bond-stones will ultimately have little bearing on the bricks. They even go so far as to say that bond-stones in such piers are liable to be broken.

The committee has thus far taken a great mass of testimony, and is still engaged at it. Most of the stone-cutters who estimated in competition for the work have been called, and with the exception of Walker, the contractor for Lemont stone on the county building, they agree that but one set of plans was estimated upon, and that the building is being built substantially according to those plans. One of them, Patrick Fanning, flatly contradicts one of the expert committee, who testified that Fanning had told him he could not get access to the plans that the successful bidder figured on. This same expert also admitted that he had consented to his name being used as a candidate for Mr. Cleveland's place. In fact, four of the experts admitted that they had been candidates.

The witnesses thus far called have been mainly contracting stone-cutters and masons, while all of the experts have been examined. In their testimony they agree that only five of the stones in the building should be removed. The concurrent testimony of most of the witnesses goes to show that the brickwork is much worse than the stone-work, and that the grade of bricks specified has not been used; also that many long anchors have been omitted; but the opinions differ as to the utility of these anchors.

The experts in their testimony adhere to the opinion that all the small piers without bond-stones should be taken down. But up to the present time no witness has offered any calculation of the weights to be imposed on these piers, or of their actual present strength, and no one has been asked for any. One of the experts admits that he never made any, yet he says the piers ought to be rebuilt. From these facts it can be seen how little intelligent research has entered into this investigation, and how barren it is likely to be in valuable results.

Still the daily papers are hammering out editorials about it, based upon scraps of testimony which give plausible advantage to one side or the other, and to-day the *Times* shows up the political animus in the whole thing by charging the party now out of power with the responsibility for all the faults that have been committed.

To-day the whole city was shocked by the announcement that a part of the staging in the interior of the new Music Hall had fallen, and four men had been either mutilated or killed, with a probability that all would die. The walls had reached the proper height for placing the wrought-iron trusses. Six men were on the scaffold, which was as high as the top of the wall, and were moving a cast-iron bed-plate weighing five hundred pounds, when the whole thing fell. Two of the men clung to the top of the wall, and were saved. No investigation has yet taken place.

The Chicago *Times* has for some time been agitating the question of house-drainage, and calling attention to the dangers to be apprehended from sewer-gas. A large space is given to the subject every day, and the articles are many of them sensational and alarming. But they cannot fail to call the attention of many who could not

otherwise be reached, to the importance of observing sanitary laws in house-drainage. Some of the articles are ably written, but they are mainly a *résumé* of what has often appeared in the columns of the *American Architect* and the *Plumber*.

The *Times* reporter and the sanitary inspector caught one of our oldest architects introducing drain pipes under the air-chambers of hot-air furnaces in a row of new houses now being constructed. They were branches from a sewer, furnished with running traps and having openings and iron grates in the pits under the furnaces. They were introduced to prevent the pits, which were below the cellar floor, from becoming flooded.

THE ILLUSTRATIONS.

DESIGN FOR A COLLEGE BUILDING. MESSRS. WARE & VAN BRUNT, ARCHITECTS, BOSTON, MASS.

ST. PAUL'S LUTHERAN CHURCH, SPRING GROVE, PA. MR. J. A. DEMPWOLF, ARCHITECT, YORK, PA.

This church, now building, is located on the line of the Frederick Division of the Pennsylvania Railroad. The base of the building is blue limestone, and the superstructure of native brick with string-courses of Ohio-stone. The interior is finished in butternut, and the ceiling ribbed, the panels being plaster. The choir gallery, with robing room under, is arranged in the rear and separated from the chancel by a screen backed with red cloth. The building, including Sunday-school room, will accommodate four hundred and fifty people, and will cost, complete, \$10,000.

THE HYPÆTHRAL QUESTION.

TO THE EDITOR OF THE AMERICAN ARCHITECT:

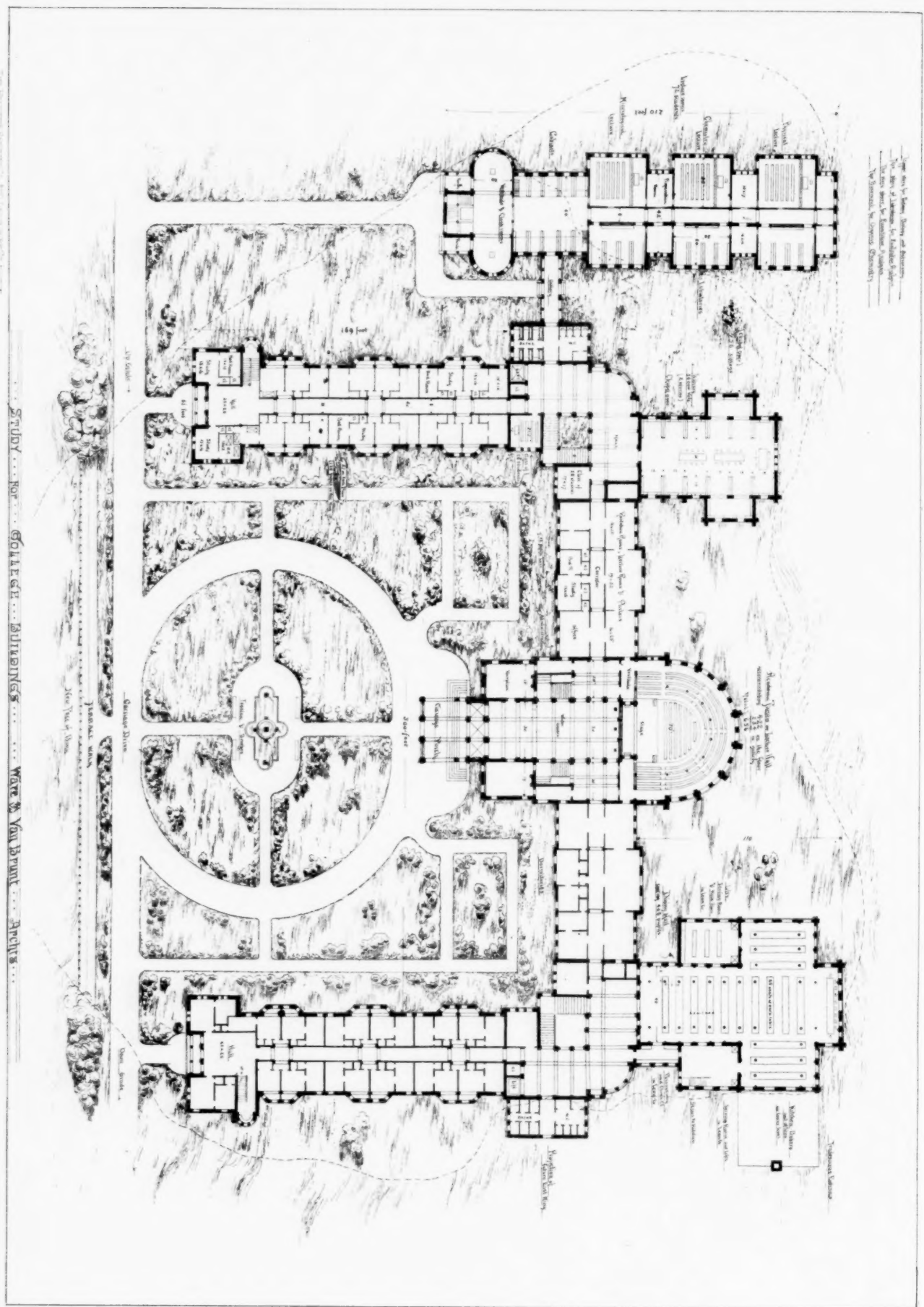
Dear Sir,—Since you have made Mr. Clarke's essay on the Hypæthral Question *publici juris*, by reprinting it in your journal, there is, I suppose, no reason why I should not subject it to a little criticism. I am very sorry that that criticism must be unfavorable; but I must say at once that I cannot regard the essay as in any way a valuable addition to the literature of the subject. It does not bring forward a single new fact or testimony, or help us by any new argument to interpret those already known. On the contrary, the author sets out with an assumption selected, apparently, because it is opposed to opinions generally held by those most competent to deal with the subject, and then endeavors to maintain it at all hazards.

In truth, Mr. Clarke has no clear notion of what the Hypæthral Question is, or, at all events, he has not been able to state it. Although he tells us that "the hinge upon which the entire matter has turned is a notoriously obscure passage" in Vitruvius, he, from the first, loses sight of what is asserted in that passage, namely, that certain decastyle, dipteral temples had in the interior "*columnas in altitudine duplices*" (two ranges of columns, one above the other), and that the middle portion, enclosed within these, was open to the sky; so that instead of asking whether this is or is not true, he puts the entirely different and general question: In what manner were the temples of the Greeks lighted? The irrelevancy of this question will be felt when it is remembered that there was but one decastyle, dipteral temple in all Greece, and that it was not a Greek but a Roman temple, virtually built by a Roman architect, and dedicated by a Roman emperor. That no general answer can be given to the general question Mr. Clarke shows by meeting it with a particular one. "I believe," he says, "all the light in the interior of the larger Greek temples to have been artificial," thus answering the question: How were the larger Greek temples lighted. On the question, as thus stated, the passage from Vitruvius has no bearing; nevertheless Mr. Clarke, supposing that it has, proceeds to undermine the Roman architect's authority, and by arguments which are entirely unfair. He tells us that the passage in question is "notoriously obscure," that its author "wrote more than four centuries after the decline of Greek architecture" about things he had never seen, and that he treats them in so bungling a way that "it has been possible to argue with no little force that Vitruvius did not write during the reign of Augustus, as is generally assumed, but, on the contrary, that he did not live in antiquity at all, but was a monkish compiler of the Middle Ages."

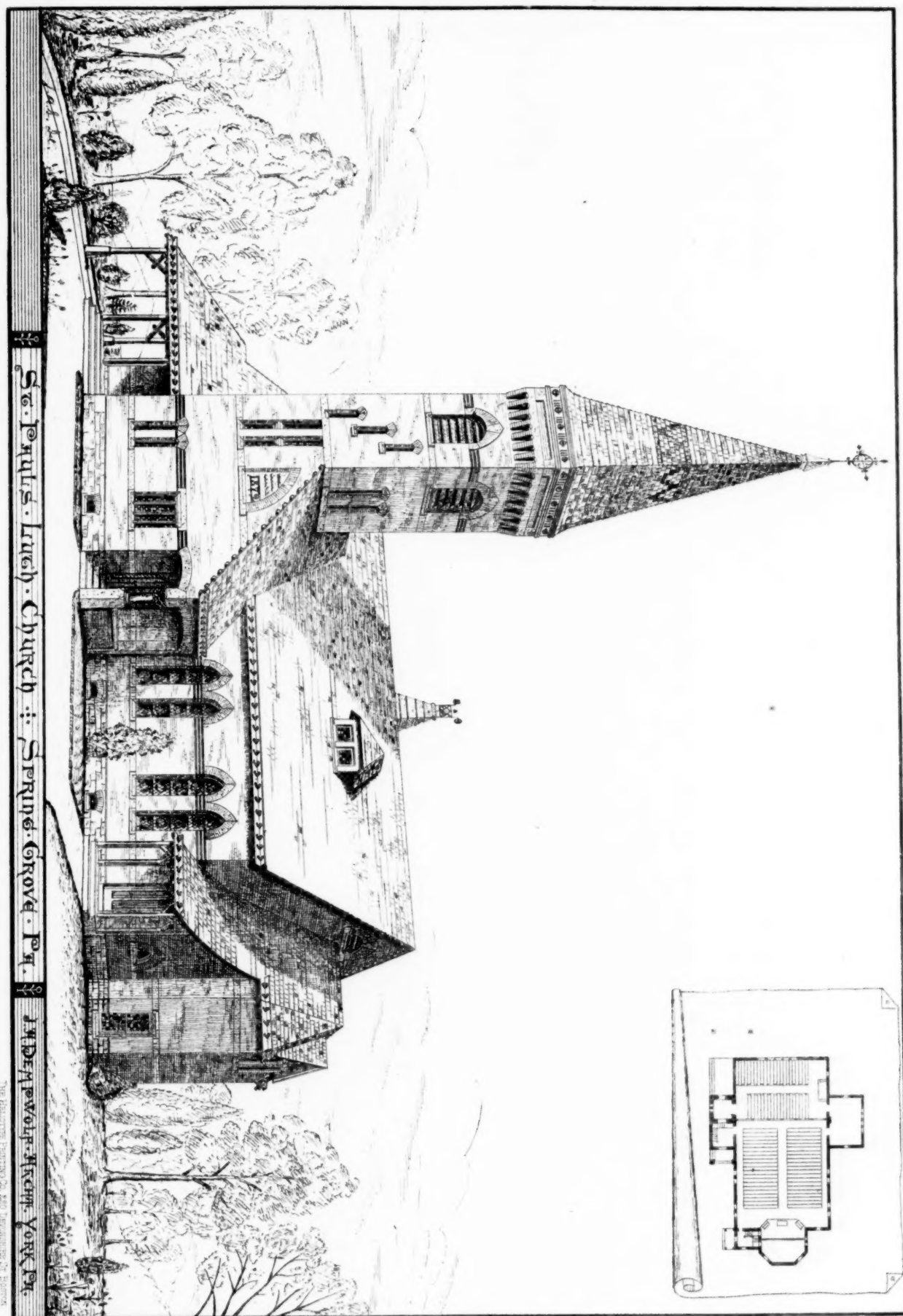
Now, it is not true in any sense that the passage from Vitruvius, in so far as it relates to the point at issue, is obscure.¹ It is perfectly explicit, clear, and unequivocal. The only difficulty (and, as I shall try to show, it is not an insurmountable one) is in the last sentence, in which he undertakes to cite an example of an hypæthral temple answering his definition. That Vitruvius wrote more than four hundred years after the decline of Greek architecture is so far from true that he wrote less than four hundred years after its period

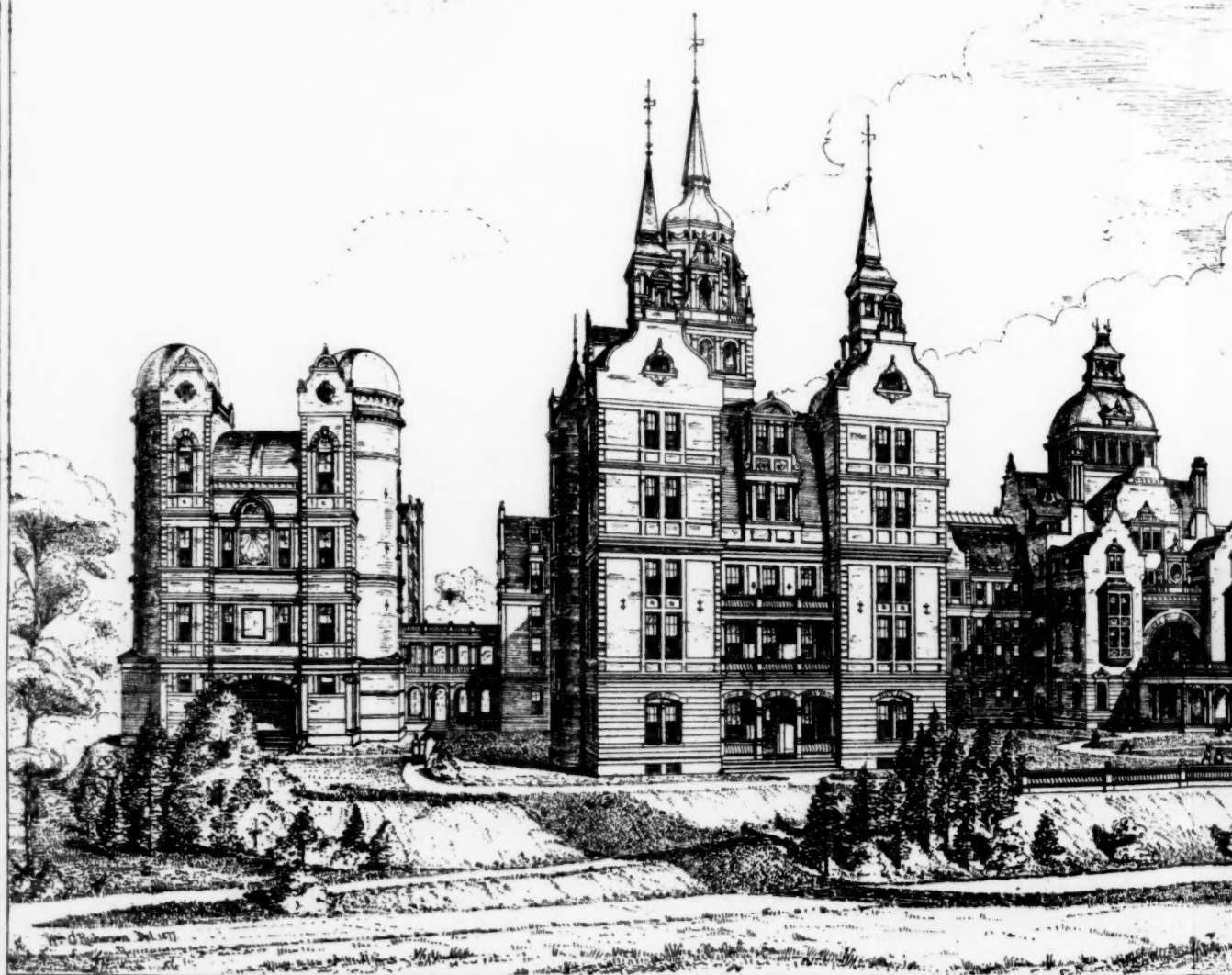
¹ This surely overshoots the mark. That even in the largest temples some light would enter through the doorway is certain. No one doubts that the smaller temples, like that of Themis at Rhamnus, of Apollo Pythius at Sikinos, or of Athena Niké at Athens, received their light through the entrance. It would be interesting to know what dimensions were deemed necessary for a "larger" temple and the entire exclusion of sunlight. This is but one example of the vagueness that characterizes the whole essay.

² The whole passage, with the exception of the last and only difficult sentence, is evidently a literal translation from the Greek. This is shown most plainly by the use of *vero* or *autem* = *δέ*, in every sentence. It may, in the original, have read thus: "ὁ δὲ ὑπαίθριος δεκάστυλος μὲν κατὰ τὴν πρῶτην καὶ τὴν δευτέραν ἰσοστάθην ἔστιν, τὰ δὲ λοιπὰ ἔχει πάντα ὅμοια τῇ δευτέρῃ, ἀλλ' ἔτιδον κίονας διπλοῦς τῷ ὕψος, ἀπὸ τῶν τοιγὰν ἐπιστατηκότων εἰς περικταὶν ὡστερ αἱ στοαὶ αἱ τῶν περιστάλων. τὸ δὲ μέσον ἐν ὑπαίθρῳ τῶν, οὐκ ἔχον ὀροφὴν, θυρίων δὲ εἰσοδοῦς ἀποφωτισθῆν κατὰ τὴν πρῶτην καὶ τὴν δευτέραν." The *porticus peristylorum* finds its explanation in a passage of Pausanias, VI. 25, 1, where he speaks of a temple, στοᾶς ἐν κύκλῳ περιστύλου.



STUDY FOR COLLEGE BUILDINGS... WARE & VAN BRUNT ARCHTS.





STUDY FOR NEW COLLEGE BUILDINGS • I



I · WARE AND VAN BRUNT · ARCHITECTS · BOSTON ·

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of highest development, at a time when nearly all the great buildings of that epoch could still be studied as well as on the day they were finished. That Vitruvius had not visited Greece and seen its famous temples is a pure assumption, resting on no authority whatever, and certainly not countenanced either by what he tells us of his education and means (Bk. VI., pref.), or by his evident familiarity with Greek and Greek authors. That Herr Schultz has found it possible to argue that Vitruvius was a monkish compiler only proves what utterly wild theses a German is capable of maintaining. The value of his arguments may be estimated from the fact that there are extant manuscripts of Vitruvius's work, older than either of the dates assigned to him by Herr Schultz, and that he is referred to more than once by Pliny the Elder, who was almost his contemporary. Mr. Clarke's remark on the possibility of error in the manuscripts of Vitruvius is very amusing.

Notwithstanding the "notorious obscurity" of the last sentence in the famous passage from Vitruvius, Mr. Clarke sees that it *may* refer to the temple of Olympian Jove in Athens, and is at pains to show how the author might have been led into falsely supposing it hypæthral. He says: "The Athenian temple of Olympian Zeus happens to have been without a roof in the time of Augustus." This is another baseless assumption. We know nothing about the matter, and, in any case, if the temple had been entirely roofless, it would not have been an example of an hypæthral temple in Vitruvius's sense.¹

Mr. Clarke having disposed of Vitruvius, and what he supposes to be testimony of his in favor of the hypæthral lighting of the "larger" Greek temples, attacks two other testimonies from ancient authors. Justin relates that the priests at Delphi affirmed "that they had seen the god leaping down into the temple through the *culminis aperta fastigia*." Mr. Clarke's only reply to this is: "It is more natural to suppose that the roof seemed to open to admit the god than that it always stood open." We can only ask why? And what would Justin have said had he wished to convey the other meaning? Mr. Clarke must have a strange notion of what is "natural." That a roof should seem to open to admit a god is surely not more natural than that the god should enter by an opening already made. At all events, if Justin had meant that the temple-roof opened to receive the god he would certainly have said so. The passage does not compel us to suppose that the *culminis fastigia* always stood open.

The other passage, which is from Pausanias (V. 11, 4), is more obstinate still, and, in order to be got rid of, requires more reckless treatment. It runs thus: "When the statue [of Jupiter, at Olympia] was at last completed, Pheidias prayed that the god would give some intimation if the work were to his mind, and instantly a thunderbolt struck the floor on the spot where the brazen water-pot with the lid stood down to my time." That the mark on the floor was "near the statue," Pausanias does not say. The whole force of this passage, of course, consists in the fact that Pausanias was shown, on the floor of the great temple at Olympia, what purported to be a mark made by a thunderbolt after the temple was finished, and found no difficulty in believing it. The truth of the legend, and even the genuineness of the mark, are questions of entire indifference. Yet Mr. Clarke thinks he disposes of the passage by saying: "Such miracles do not need, and should not receive, any materialistic explanation;" which is true, but entirely irrelevant, as is the rest of his argument.

Having destroyed, as he supposes, the testimony of Vitruvius, Justin, and Pausanias, Mr. Clarke remarks: "As far as can be judged from the few and scattered remarks of the ancient writers, which touch upon the subject, the idea of the temple interior was connected with that of a complete roof," an assertion which, if correct, would settle the whole question at once. Of these "few and scattered remarks," however, the specimen selected by Mr. Clarke, and therefore presumably the most favorable to his argument, gives us room for grave doubt. It occurs in Strabo, VIII. 3, 30, and runs thus: "The largest of these is the ivory statue of Jupiter made by Pheidias, the son of Charmides, which is so tall that, notwithstanding the enormous dimensions of the temple, the artist would seem to have transgressed the laws of proportion, in giving it a sitting posture, and making it almost touch the roof with the top of its head, so that it gives the impression that, if it were to stand up erect, it would unroof the temple." Now there is not in this passage a shadow of evidence to show that the temple at Olympia had a complete roof. Even the strongest maintainers of the existence of the hypæthral opening never supposed that the chryselephantine statues of the gods were placed under it. It is only fair to Mr. Clarke's intelligence to assume that he did not understand the statements of Strabo, and indeed there is excellent ground for this assumption. The words which mean "almost touching the roof with the top of its head," Mr. Clarke paraphrases: "Appeared almost to touch the uppermost ceiling in contradistinction to that of the lower aisles, the hypæroön gallery." Evidently he thinks that the verb *ἀπικούει* may be followed by a dative, and that *κορυφή τῆς ὑποφύλης* may mean "the uppermost ceiling," thereby betraying an ignorance of Greek surprising in one who undertakes to discuss most difficult questions in Greek archaeology.² But a person with a gift of inter-

pretation uncontrolled by grammar or lexicon has one advantage: he finds grounds and evidences for theories in places where no one else could, and so Mr. Clarke finds in this passage confirmation for a theory that "Hyperoön galleries existed in all the Greek temples which are now assumed to have been lighted from above." Now, when it is remembered that we have no proof that there were galleries (Why use such a barbarous and superfluous word as "hyperoön"?) in any Greek temple save one, and that existing remains rather discourage than countenance the notion of their having been at all common, this seems a good deal of an assumption. It is true that Pausanias speaks of *στοαὶ ὑπεροῖ* in the temple of Jupiter at Olympia; but it is very remarkable and rather unfavorable to Mr. Clarke's theory, that that temple is the only one which Pausanias tells us was furnished with a permanent means of getting on the roof (*ἀνοδος σκολιά*). It seems a pertinent question to ask, If the temple roof was entirely closed, and there were no sky-lights in it to attend to, what was the use of the stair? If there were galleries in the Parthenon, for example, it is strange that Pausanias should not have mentioned them. The fact that they are specially noticed in only one temple would tend to show that they were not ordinary features. It is one of the evils of "restorations" in which, of course, all doubtful questions must be arbitrarily settled in some way, that they cause many difficulties to be generally regarded as settled, which are still very far from being so.³

After his efforts with the testimonies of ancient writers, Mr. Clarke gives us a number of circumstantial arguments against the "hypæthral theory." The gist of them is, that, if the weather had been admitted into temples through an opening in the roof, it would have been highly injurious to the interior and its valuable contents, especially chryselephantine statues, and that such a large opening as must have existed, if any did, could not have been closed without much trouble. Throughout the whole, Mr. Clarke confounds the question of an hypæthral opening as described by Vitruvius with the more general and different question of the illumination of ordinary large temples from the middle of the roof. All these arguments have as little cogency as the one originally suggested by Ross, that, if temples had been hypæthral, they would have been easily robbed! Are we left to suppose that the Greek temples had no guards or watchmen?

The only positive ground of any seeming weight, adduced by Mr. Clarke in favor of his view, is connected with the Parthenon. "It must not be forgotten," he says, "that the most perfect monument of the Doric style, a temple which is always held to have been a representative of the hypæthral arrangement, and to which the works of Vitruvius are directly applied, was only two hundred years ago architecturally intact, and had suffered but few alterations. There is no reason to suppose that at the time of the fatal explosion, the roof covering of the Parthenon was otherwise arranged than it was when first planned." I must beg Mr. Clarke's pardon. Not only are there reasons for supposing, but there is direct evidence to show, that the roof covering of the Parthenon was arranged very differently in the seventeenth century after Christ from what it was in the fifth century before Him. However intact architecturally it may have been, and however few alterations it may have suffered, these alterations affected radically the very part with which the question under consideration is concerned. In the *Mittheilungen des deutschen archäologischen Institutes in Athen*, II. 1 (1877), there is published a drawing of the Akropolis made in the year 1670, a few years before the "fatal explosion." In this it plainly appears that the only portion of the roof that had not been altered was that of the posticum and opisthodomos, which had probably been entirely of marble from the first. The roof of the pronaos had been removed to make way for the Byzantine *κόγχη* or apse, while that of the main part of the cella had been considerably heightened. Again, Father Babin, who was in the Parthenon about 1672, tells us, "*On y voit trois rangs de voûtes, soutenues de fort hautes colonnes de marbre, savoir la nef et les deux ailes*." No doubt, it was covered with the original tiles, but neither that fact nor any argument drawn from the state of the Parthenon in the seventeenth century has any bearing upon the question of the lighting of Greek temples.

In trying to undermine the force of the argument in favor of the lighting of temples from above drawn from the Roman Pantheon, Mr. Clarke is singularly unsuccessful, and it is certainly unfortunate for his theory that the only two ancient temples now standing with their roofs on — the Pantheon in Rome, and the small, very old temple, possibly of Hera, near Karystos — both have openings to the sky. Of the existence of the latter Mr. Clarke seems not to be aware.

I cannot stop to refute *seriatim* the whole of the arguments advanced by Mr. Clarke to show that the "larger" Greek temples were lighted artificially, but I cannot refrain from quoting one passage in illustration.

"The poetical Greek architect did not prepare without purpose such a transition from the crude and harsh exterior light [O Helios!] as was afforded by the veil of shade given by the pteroma, — a change, a modulation from one kind of light to another [What other?]. The darkness of the pronaos [When was ever a pronaos dark, and if so, where was the modulation?] was the preparatory dissonance which intervened between the common and varying light without, and the soft and rich artificial illumination within. One

² Mr. Wood has restored the Ephesian temple of Diana, giving it galleries, and placing the Niobe group in one of the pediments. This is restoring, with a vengeance!

¹ That the temple was not finished is certain; but, as we know, a Greek temple was hardly half finished when every stone and beam was in its place.

² This worse than school-boy blunder is not the only one Mr. Clarke makes in his essay. He writes *ὑπεροῖ* for *ὑπεροῖ*, thinks *ἐκ σκοτίων μυχῶν* may mean *out of dark temples*, uses the utterly impossible word *epinaos*, and follows bad authority in writing *octastyle* for *octastyle*.

cannot believe [Why not?] that he who had traversed the wildest part of the Attic landscape to offer vows to Nemesis [Who ever did? One need not traverse much wild landscape to reach Rhamnüs], who had wound his way through dense Arcadian forests to supplicate at the mountain seat of the healing Apollo [The dense forests exist only in Mr. Clarke's imagination; there is no proof that pilgrimages were ever made to Bassæ, and Apollo Epikourios is not the "Healing Apollo"], found himself in an enclosed court [Who ever supposed so?] lighted by the passing mood of the day, whose heat may have oppressed, whose gloominess have saddened the traveller [In a temple 4,000 feet above the sea-level! How Christians in their churches must suffer!]; but rather at a shrine illuminated by tranquilly burning flames, separated from all outer influence, whither no excessive wind [Wind does not generally blow excessively through a vertical opening] or heat, no rain or other baneful effect of nature [When were wind, heat, and rain baneful effects?] could penetrate, where no harsh sound of passing bird or beast, no disturbance of the outer world could interrupt the sacred peace."¹ (How morbidly sensitive the Greeks must have been, and how easily jarred by the outer world!) "In larger temples the case was otherwise, and a brilliant and splendid illumination was often necessary." (Was not the temple at Bassæ one of the "larger" temples?)²

This is simply a specimen of the subjective method—the worst of all methods—of dealing with questions of fact belonging to remote ages. A theory that needs such arguments to support it must be very helpless indeed, and the fact that they are needed furnishes an argument by no means weak in favor of a different conclusion. The truth is, Mr. Clarke, without any very considerable acquaintance with Greek or original authorities, has arbitrarily adopted an unpopular theory, and striven to maintain it by subjective arguments, and notions borrowed from German guessers, than whom there are no more untrustworthy guides. His mistake was in taking up the subject at all; for we ought at once to admit that we have not sufficient grounds for any theory whatever on the lighting of the large Doric and Ionic temples of Greece, or even for saying that they were in every case lighted at all, otherwise than through the doorway. At the same time it is true that what little evidence we have goes against the notion of an "hypæthron," such as Vitruvius assigns to certain decastyle, dipteral temples, and yet in favor of lighting from above.

I will enumerate a few facts, which, if steadily borne in mind, may help to render future discussions of this subject easier.

1. The famous passage of Vitruvius (III. 1) has no bearing upon the question of the lighting of Doric and Ionic temples in Greece.³
2. Temples open to the sky, particularly temples of Jupiter, were not uncommon in Greece, or even in Italy. See note to 1.
3. Temples of the size of those of Jupiter at Athens and Selinus, it would have been next to impossible to roof over, and we have the express testimony of Strabo that the temple of Apollo at Branchidæ remained without a roof on account of its size (*διέμεινε χωρίς ὀροφῆς διὰ τὸ μέγεθος*. XIV., p. 634.)
4. The great Eleusinian temple (*τελεστήριον*) of the Chthonian deity Demeter, in which the mysteries were performed, and from which, if from anywhere, we should expect light to have been excluded, had an opening in the roof (*ὀραῖον*), according to the express testimony of Plutarch (Periklēs, XIII. 5).
5. The Doric temple of Jupiter Capitolinus⁴ at Rome had an open-

¹ We compare this with another passage in which Mr. Clarke says of the "hypæthron" of the Roman Pantheon: "Its retention was natural, and in many respects satisfactory. It gave a sufficient and comparatively unvarying light to the dome by omitting a part of the vault, the incumbent weight was diminished, while the supporting and enclosing walls were left unpierced, thus retaining their ideal character of securing entire separation and isolation from the world without." So it seems the light was not unvarying, and the outer world more easily excluded amid the bustle of imperial Rome than on the lonely heights of the Arcadian mountains!

² It is curious that of this very temple a fragment was found which seemed to belong to the cornice of an opening in the roof. The roof, we know, was of marble.

³ On the strength of the last "notoriously obscure" sentence of this passage it has been attempted to extend the Vitruvian "hypæthron" to such octastyle peripteral temples as the Parthenon. For this there is no good ground; for, whatever the sentence may mean, an octastyle peripteral temple can never be adduced as an example of a decastyle dipteral one. There is an explanation of this difficult passage, which, as far as I can discover, has not struck any scholar, and which, nevertheless, would, I think, make it at once consistent with what goes before, and give an intelligible meaning. The sentence reads thus: "Hujus autem exemplar Romæ non est, sed Athenis octastylus et in templo Jovis Olympii," with a various reading of *est* for *et*. If now we bear in mind that the word *ὑπαῖθος* was not used in Greek till long after the time of Vitruvius as an adjective, but always as a substantive, we shall see how it might have come to be used as an architectural term to designate an open-air shrine, such as those which undoubtedly existed in Greece, most of them sacred to Jupiter. Vitruvius himself (I. 2, 5) tells us that conventionally "Jovis Fulguri et Cælo et Soli et Lunæ ædificia sub divo hypæthraque constituntur" (Mr. Clarke has not ventured to attack this testimony); and we hardly need the assurance of Maximus Tyrius, *Dissert.* VIII. 1, to prove to us that Jupiter, the god of the sunlit sky, was originally worshipped under the open vault of heaven. Pausanias not only mentions a temple of Zeus that had no entrance, and whose contents could, nevertheless, be seen from without (*περίβολος δὲ ἔστιν ἐν ταύτῃ [τῇ ἀγορᾷ] λίθων, καὶ ἱερὸν Ἀγκάίου Διὸς ἑσθλὸς δ' ἐς αὐτὸ οὐκ ἔστι· τὰ γὰρ ἐντὸς ἔστι δι' ὀνορῶντα*), but of all the temples which he mentions as roofless (*οὐκ ἔχον ὀροφὴν*—seemingly his expression for "hypæthral"), without stating that the roof had been destroyed or had decayed, there is, I believe, only one which is not a temple of Jupiter, and it is a Metroön. (Cf. I. 40, 5; II. 24, 4; VIII. 44, 3.) It seems moreover capable of proof that the shrines and altars of Zeus *ὑπαῖθος* and Zeus *ὕψιστος* were always open to the sky. Suppose now that it was an established rule, a θεματικὸς, as Vitruvius would say, that this should be so, that the shrine or *ἱερὸν* of Zeus *ὑπαῖθος* should be an *hypæthros*, and suppose that his worshippers, nevertheless, in return for some special favor, wished to show their gratitude by dedicating to him a permanent temple; what could they do other than erect an edifice round the *hypæthros*. But the *hypæthros* would still remain the *ἱερὸν*, and the *ὑψος* would be merely a splendid enclosure for it, a kind of double porch running all the way round it. And this corresponds exactly with the description given by Vitruvius. If now we give *hypæthros* this its proper meaning, and read *est* for *et*, the passage becomes perfectly clear, and the meaning is: Of this (*hypæthros*) there is no example at Rome, but there is one with eight columns at both ends in the temple of Olympian Jove at Athens. I put this forward merely as a conjecture. Whether there is any proof that the "hypæthros" of the temple referred to was octastyle, I do not know.

⁴ There is no need to suppose that this temple was "hypæthral," and indeed we have

ing in the roof over the statue of Terminus (see Beulé, *Histoire de l'Art Grec avant Périclès*, p. 294, and references there given), and other temples of Jupiter must have had similar openings, if we may trust the testimony of Varro.⁵

6. The smoke and heat of numerous lamps, burning in a temple with a closed roof, would have done as much damage to pictures and chryselephantine statues as an occasional shower of rain. Ancient wall-paintings were almost weather-proof.

7. The presence of burning lamps in temples does not prove that they were used for illumination.

8. People who could rear a Parthenon must have been able to provide for opening and closing large orifices in its roof.

9. No arguments based upon modern æsthetic notions are of any weight in determining the appearance or arrangement of an ancient temple-roof.⁶

10. In the Pandroseion, or western part of the Erechtheion, there grew an olive tree,⁷ which would hardly have been possible in a temple from which the sun was excluded. Artificial lighting does not answer well for trees.

There are other facts which might be adduced in favor of the view that Greek temples were, in many cases, lighted from above; but these will perhaps suffice, when it is remembered that not one fact can be brought forward in favor of artificial lighting.

I am, dear sir, truly yours,

THOMAS DAVIDSON.

SLOW-BURNING CONSTRUCTION.

TO THE EDITOR OF THE AMERICAN ARCHITECT:

Sir,—In answer to your request I will make some comments on E. A.'s letter to you, published July 12. First, however, I must be allowed to disclaim utterly the idea that there is any "issue" or controversy between him and me as to the principles which he advocates. On the contrary, there is no one who would take greater pleasure than myself in seeing those principles generally followed, and it is solely with the hope of promoting that end that I remark upon points wherein my experience, or that of others, differs from his, so that when, through the efforts of underwriters I hope, the public shall have been so far brought to realize the enormous losses it suffers through its present penny-wise and pound-foolish habits of building as to call upon architects for more durable constructions, the latter shall, so far as my suggestions go, have their attention called to the difficulties as well as to the advantages of the improved methods, and thus be saved from bringing discredit upon a valuable reform, and perhaps heavy loss upon themselves or their clients, by too hasty inductions from facts which need to be considered with relation to every part of the complex modern structures. I have a vivid recollection of a certain sanitary reform, which, carried away by the description in the writings of some English engineer, I introduced in a house built under my care. The improved arrangement accomplished, perhaps, all that was claimed for it, but there turned out to be incident to it also some objectionable features, about which nothing was said in the description, and these grew to be so serious that within a few months I had the plumbing rearranged on the old system at my own expense, and it is to save others from similar mishaps that I consider it necessary to call in question assertions and theories which seem to me to be doubtful.

E. A. asks what authority there is for supposing that enclosing timber in plastering causes dry-rot, and says that he has not found that to be the case. He thinks that there may be a porosity in plaster which admits a certain quantity of air to the wood and preserves it from the effects which are well known to follow from enclosing it with an impervious covering.

In answer to the question I only cite those authorities which I have immediately under my hand.

The late R. G. Hatfield, one of the best constructors of our time, says, in a paper read before the Eleventh Convention of the American Institute of Architects:—

"This defect" (the combustibility of ordinary flooring) "in the construction of wooden floors has led to various devices, one of which is the use of plaster or gypsum, which is thickly spread upon the lathing at the bottom of the opening between the beams, and also extended up on each side. This forms

the express testimony of Vitruvius that there were no hypæthral temples at Rome in his time.

⁵ Why Mr. Clarke, who promises not to omit "to consider any argument or testimony in favor of the hypæthron on which weight has been laid by its advocates," has taken no notice of the testimonies referred to in 2, 3, 4, and 5, I do not understand. He has given the weaker testimonies and omitted the stronger. Was he unacquainted with the latter? How true it is that modern æsthetic notions are no guides in questions of Greek art is shown by the fact that until recently critics scouted the idea that the Greeks should have had painted temples or statues; yet now no one can doubt the fact. Mr. Clarke, however, is surely wrong when he says (p. 26) that æsthetic considerations have prevented most "hypæthral restorers" from clearly showing "their intention by adequate illustrations." The "hypæthron" is an extremely common feature in restorations.

⁷ I make this assertion in full consciousness of the theories of K. O. Müller, A. Michaelis, and others. Müller places the olive in the open porch of the Caryatides, which is plainly wrong, since that porch is merely a covering for a stair, a *Treppenhause*, as the Germans say. Michaelis, in defiance of the evidence, places the tree outside the building altogether. To the direct statement of Herodotus that the olive and the sea were in the temple (*ὄρος, ἐν τῷ ἱερῷ καὶ θάλασσα ἐν*; more explicit words it would be impossible to find), he coolly remarks, "*Videtur enim Herodoti Ausdrack etwas ungenau sein*." Of course, he knows better than Herodotus. The almost equally explicit testimony of Dionysius he sets aside in a still more arbitrary way, defying both grammar and lexicon. But what are texts, however explicit, to a German when he has once embraced a notion? That Michaelis's restoration of the Erechtheion is entirely wrong is proved by the concordant testimony of ancient authors and by the ruins themselves, which show that the building was not two-storied, as indeed no Greek temple was, except one of Aphrodite at Sparta. (Paus. III. 15, 8.)

a good filling, effectual in preventing the draught of air, but it has been found to induce rapid decay of the timber, and is therefore a failure."

Viollet-le-Duc, another good authority, says (*Dict. Rais., Art. PLAFOND*):—

"Des bois laissés à l'air sec peuvent se conserver pendant des siècles; enfermés dans une couche de plâtre, surtout s'ils ne sont pas d'une entière sècheresse, ils travaillent, fermentent et se réduisent en poussière. Nous ne croyons pas nécessaire d'insister sur ce fait bien connu des praticiens."¹

And in another place (*Art. Bois*), speaking of mediæval carpentry:—

"Les planchers se composaient d'une série de poutrelles ou solives apparentes recouvertes d'une aire, sur laquelle on posait le carrelage; les pans de bois laissaient voir leur deux faces intérieure et extérieure. Dans cette situation la durée des bois est illimitée, tandis qu'ils s'échauffent, fermentent et se pourrissent avec rapidité, lorsqu'ils sont complètement enfermés. Tous les jours nous voyons des planchers qui n'ont pas plus de vingt et trente ans d'âge, dont les solives sont totalement pourries. On objectera que ces planchers ont été exécutés avec des bois verts; cela est possible. Mais nous avons vu des poutres de planchers restées apparentes pendant deux ou trois siècles en parfait état, se pourrir en quelques années lorsqu'on les avait enfermées dans des enduits: ce n'est donc pas seulement à la verdure des bois qu'il faut attribuer leur décomposition lorsqu'ils sont enfermés, mais au défaut d'air, qui produit leur fermentation."²

Rankine (*Civil Engineering*, p. 449), says:—

"Slaked lime hastens the decay of timber, which should therefore in buildings be protected against contact with the mortar."

These, with the many other authorities which may be consulted on the subject, will perhaps suggest caution to inexperienced architects in such cases as those of which E. A. speaks; if so, the advance of the art of good building will, I think, be rather promoted than hindered.

Perhaps I may have misunderstood E. A. in supposing that he referred to the coating of the timber with plaster in contact with it. Having had the pleasure of examining a mill built under the control of his company, I found that the plastering, which was put on wire lathing nailed to three-eighths furring-strips applied to the sides of the beams, merely clung to the wire, not having been pressed through strongly enough to reach the timber, except in occasional spots. There was, therefore, a space of one eighth of an inch perhaps between the wood and the inner surface of the plaster, giving, in the intervals between the furring-strips, unobstructed channels for the circulation of air along the sides of the beam. This may have been what he meant by "enclosing timber in plastering." If so, it is not strange that it should be preserved, but there may be others who, like myself, understood him to refer to the complete coating of the wood with mortar, as for instance in the case of the partition described in General Meigs's letter to you not long ago. If he knows of instances of that kind, where heavy timbers have remained sound, say for twenty years, perhaps he will kindly furnish you with notes of them.

Before we leave the interesting subject of dry-rot, it may not be amiss to remark that paint, although it may, and often does, cause rot by preventing the evaporation of the natural or acquired moisture of the wood, as where shingle roofs are painted when first put on, or where basement floors are covered with oil-cloth, or in the cases which E. A. mentions, is yet very useful in preserving timber, where it is so applied as to exclude moisture from without, especially from the end grain of the wood. Thus good carpenters often paint the ends of clapboards before putting them on, that they may not absorb dampness from each other or from the casings and corner boards, and some architects paint the under side of the sills and the ends of the girders in wooden houses, to preserve them from the humidity of the cellar walls. In fact, the so-called ventilation of beams, which consists usually in leaving a space of an inch or so at the end, while the sides are closely built up, has always seemed to me to owe its undoubted good effect much more to the separation of the damp masonry from the ends of the capillary tubes of the wood than to any possible effective circulation of air about it.

E. A. quotes a letter of Mr. Waters, Vice President of the Clinton Wire Cloth Co., saying that "it is a chemical impossibility that the presence of plaster of Paris in gauged mortar can work as a corrosive on iron." You will perhaps allow me to make a few comments upon this assertion, which totally contradicts what we are accustomed to consider the best authorities, as will be seen from the following quotations.

Mr. Hatfield, in the same paper on fire-proof construction from which I gave an extract above, says, "This latter material" (gypsum) "is active in rusting iron, and should therefore not be allowed to come in contact with it."

Ramée (*Architecture Pratique*, p. 92) says:—

"Si le plâtre est mis en contact avec le fer, il en détruit la qualité au moyen de l'acide sulfureux, l'oxyde fortement, et cela en rapport du temps que le plâtre met à sécher."³

¹ Wood exposed to dry air will endure for centuries; enclosed in a covering of plaster, especially if it be not thoroughly dry, it works, ferments, and falls to powder. We do not feel it necessary to insist on this fact so well known to constructors. — Eps.

² The floors are composed of a series of exposed beams or joists covered with planks on which are placed the tiles. The inside and outside faces of the timbers are exposed to view. In such a situation the life of timbers is limitless; while they become heated, ferment, and rot rapidly when they are completely enclosed. Daily we see floors not more than twenty or thirty years old whose joists are completely rotten. The objection will be raised that green wood was used in such floors; that is quite possible. But we have seen floor beams which had endured in perfect condition two or three hundred years while they were left exposed, rot away in a few years when they were enclosed in plastering. It is not then to the greenness only of wood that must be attributed their decay when they are enclosed, but rather to the want of air, which produces fermentation. — Eps.

³ When plaster is in contact with iron it destroys the quality of the iron through the agency of sulphuric acid, oxidizes it rapidly, and this in proportion to the time the plaster takes to dry. — Eps.

The testimony of French architects is particularly valuable, as, aside from their more scientific and thorough habits of observation, they are accustomed to use plaster of Paris very freely.

Rondelet says (*Traité de l'Art de Bâtir*, ninth edition, vol. i., p. 197):—

"Les fers qui sont scellés dans du plâtre s'oxydent beaucoup, ceux qui le sont dans du mortier ne s'oxydent presque pas. C'est pour cette raison que les maçons en plâtre se servent ordinairement de truelles à lames de cuivre, ceux en mortier, de truelles de fer. J'ai trouvé dans les démolitions de très-anciens édifices des fers tout-à-fait enveloppés de mortier, qui n'étaient que légèrement oxydés à leur superficie; tandis que d'autres, placés dans des constructions en plâtre, beaucoup moins anciennes, étaient presque décomposés."⁴

I am told of similar cases in the experience of our own architects.

But any one who despises "book-larnin'" on such subjects can convince himself of the corrosive action of plaster of Paris, as compared with lime, by ocular evidence, if he will take two saucers, and, putting a coil of wire or a handful of tacks in each, fill up one with water and calcined plaster, and the other with lime paste. In a few hours the plaster will be stained brown with oxide of iron, while the wire in the lime will remain free from rust, to all appearance indefinitely.

What proportion of lime added to the plaster will neutralize this tendency I do not know exactly, but there is some corrosion even with equal quantities of lime and plaster. Perhaps some one will investigate the subject more fully. Meanwhile it will do no harm for young architects and amateurs to be somewhat circumspect about using gauged mortar on iron lath, or running cornices on wire, if they wish to avoid at least brown stains on their plastering.

In regard to the Boston Theatre ceiling, mentioned by Mr. Waters, Mr. Cabot tells me that the wire lathing was tarred before any mortar was applied, and that the lime mortar of the first coat, being well trowelled, practically buried the wire, which was thus doubly protected against the corrosive action of the plaster of Paris.

But this is hardly a practical objection to the use of wire lath in careful hands in those places for which it is adapted, as any good architect or builder would have intelligence enough to protect the metal by whitewash or tar before touching it with plaster; my question about the merits of the wire was not whether it might not be, with due care, admirably adapted to such ceilings as E. A. describes, and to other purposes, but whether it made, by nailing to wooden studs, as good a partition as could be obtained in other ways at the same expense, and this, in spite of Mr. Waters's opinion that the wire lath is "cheap," I still doubt.

The price list of the Clinton Wire Cloth Co. quotes their lathing of the lowest grade at thirty-five cents per square yard, let us say, delivered at four cents per square foot, the prices running from that up to sixty-five cents. Mr. Waters says it is easily put on by the average mechanic. That has not been my experience, but we will assume that it costs no more to apply than ordinary lathing.

The studding, bridging, straightening, etc., of a good partition will cost about three cents per square foot. With plastering at twenty-seven cents per yard, which it would be worth on wire lath, perhaps, by reason of the greater quantity of mortar consumed, the cost of the partition with wire lath and plaster on both sides would amount to: studding, three cents; lath, two sides, eight cents; plaster, two sides, six cents; total, seventeen cents per square foot. To compare this with concrete partitions. Mr. Schillinger wrote me some time ago that he would furnish perforated concrete partition blocks on board cars at eight cents per square foot, and that the putting up would cost about three cents more. Similar blocks are made in most of our large cities, so that twelve to thirteen cents per square foot may be taken as the cost of the partition in place. To this must be added the cost of a skim coat of plaster on both sides, but the total is less than that of the studding with wire lath, and the result will be, in my opinion, superior in many respects.

On one other point only I am compelled to say that my opinion differs from E. A.'s, but that is an important one. He says "it is possible that dampness might penetrate walls tied with bricks so as to preclude fine decoration," but he would "infer from the dryness of factory walls laid in half-cement mortar that there would be no such difficulty."

May it not be that his factory walls are built more solidly than those of ordinary structures would generally be, in order to resist the vibration of the machinery? If not, his experience differs from that of most architects. I can assure him that I have seen pails set to catch the water which came through solid freestone from ten to eighteen inches thick, and have been told of a case in Fall River where the rain came through a brick wall four feet thick, and ran down on the inside.

The outer wall of a house or hotel, tied to the lining with solid wicks of brick under every beam, would hardly be more than eight inches thick, so that it would be easily penetrated in driving storms.

In point of fact, after some little experience with hollow walls, plastered inside, even though laid in half cement, I think I have never seen one which did not show signs of dampness after heavy rains in places where the air-space was crossed by masonry, as it usually is, even in a wall with iron ties, in the jambs of windows and doors. The very mortar which dropped from above and lodged on

⁴ Iron which is enclosed in plaster oxidizes considerably, while iron enclosed in mortar hardly oxidizes at all. It is this fact which causes plaster-workers to use ordinarily trowels with copper blades, while masons who work in mortar use trowels with iron blades. I have found in tearing down very old buildings pieces of iron entirely enveloped in mortar whose surfaces alone were very slightly oxidized, while I have found other pieces placed in plaster in much more modern buildings which were almost wholly decomposed. — Eps.

the hoop-iron ties would often conduct the moisture of the outer wall across the air-space into the lining wall, where it showed itself in the plastering, so that in my last specification for work of the kind I have directed that the ties should be set in the vertical joints, so as to present the edges upward, instead of the flat, as is the usual way.

One of your correspondents suggests that horizontal slabs of slate might make good ties. I can inform him that that has been tried, but the moisture which trickles down the inner surface of the outer wall runs over the top of the slate ties and appears in the lining wall. In my opinion, the course of improvement in hollow-wall building should be in the direction of ventilation of the air-space by rapid and continuous currents. In this way we may be able to keep a brick-tied wall dry, and we should diminish the risk from pulmonary diseases, which we are told by the Massachusetts State Board of Health are more to be feared in brick or stone houses than in the dry, wooden ones.

E. A. asks me, in respect to the upper stories of warehouses used only for storage, which is the better way: to use double timbers, eight feet apart, planed and chamfered, with a floor upon them of three-inch matched plank, or the ordinary construction of beams twelve or fourteen inches on centres, with double flooring, and what would be the difference in cost.

Of course, I say at once that the construction with girders covered with three-inch plank is far better than the other mode, and if it were not for the underwriters, who do not apparently notice the difference in making their rates for insurance on the goods stored in such warehouses, it would have before this have become almost universal. But it is not so cheap, and so long as the owner cannot make anything, either in insurance or in rent, by adopting it, he is not likely to do so.

Let us look into the question of cost.

By the building law of New York, and the practice of careful architects everywhere, a specified load per square foot is fixed for the floors of dwelling-houses, places of public assembly, and warehouses of various descriptions, which they may be called upon, and should be able, to bear, with a suitable factor of safety; and the first step of the architect careful of his employer's money is to calculate the exact dimensions and spacing of the beams, and to select the kind of timber with regard to its market price in relation to its coefficient of transverse strength, which will just accomplish the result he desires, and no more. Now the actual bulk of timber necessary for making a floor of given strength, supposing the depth of the beams to be the same, does not vary appreciably, whether it be divided into many thin beams, or concentrated into one or two thick ones. The thin ones, near together, admit of a great practical increase of stiffness by bridging, which is impossible with the widely spaced girders, but that is not allowed to enter into the calculation of the absolute strength of a floor, so I disregard it.

The timbering being therefore the same, we have to compare the three-inch plank covering with a double floor, two inches thick in all. The matching of the plank, which would be necessary to prevent dust from sifting through, would cause three times the waste of stock incurred in matching seven-eighths-inch boards, and in addition, the plank floor contains one board foot more of stock for each square foot of floor than the other. The handling of the planks, the size of the spikes for securing them to the beams, besides the tripling of the waste of all kinds in stock, would, I should say, add as much more. Calling the extra cost of stock for the plank floor one and one half cents per foot, and waste and labor one and one half cents, we arrive at three cents per square foot for the increased cost of the plank floor, without counting any planing of girders or underside of floor, chamfering or other finish.

Now three cents per foot would pay for plastering the ceiling three coats, and my opinion is that until radical changes are made in insurance matters, owners of stores will put their money into neatly plastered rooms which they can rent for salesrooms, in preference to spending the same amount for rough, though slow-burning floors which can only be used for storage, or to spending a considerable additional amount in making the slow-burning construction as attractive for renting purposes as the white plastering now in common use.

E. A. quotes my observation that stud partitions carrying 12 inch by 12 girders or their equivalent would buckle unless interrupted by posts, and asks if he is to infer that I approve of hollow combustible partitions as supports for hotel or tenement-house floors. That would be a singular inference from my remark, but I hasten to assure him that I do not consider stud partitions, common as they are, to be fit supports for any floor, not even when lathed with wire; that I regret the necessity for using them in every case where I am compelled to do so, and do my best by courses of brick to diminish their dangerous qualities, and that I look with anxious eagerness for the time when underwriters, by refusing to insure, or discriminating heavily in rates against such constructions, shall make them unprofitable to their owners.

Does not E. A. see that the whole matter lies in the hands of the underwriters? How can architects, except in isolated cases, urge with any force a reform which is of no pecuniary advantage to the public, and will increase their own commissions? Their recommendations would, and do, sound to the public like those of quack doctors pushing the sale of their pills, while underwriters, especially officers of mutual companies, would be listened to with respect. Why should not the Underwriters' Association take the matter in

hand, and with the enthusiasm and knowledge of E. A. and a few others like him, for which no one can feel greater respect and sympathy than myself, a reform could speedily be inaugurated, which we architects, whose hands are tied by our compelled attention to the pecuniary interests of our clients, might preach forever in vain. Not only are we prevented from attempting to practise our cherished theories, but to be even known as an enthusiast for good construction would be fatal to an architect's business. For one man who wants a house which he can leave for a day, and be sure of not finding it and his family in ashes when he comes back, there are a thousand who are contented with the old ways, and avoid as a pestilence the architect who, they fear, would try to persuade them to spend money on extra security. All that could be changed if the underwriters saw fit to have it so. I have a vague impression that the rates for dwelling-house insurance on the Continent average about one sixteenth of one per cent per annum, while in this country they would be perhaps five to eight times that. Why cannot the insurance companies establish a system of inspection, and make rates varying from one sixteenth or less up to one per cent, according to the mode of construction? To build a house as secure against fire as the average Continental dwelling would cost but eight to ten per cent more than our common construction, — probably less than that when such improved construction came to be general. If an owner could save eight or nine tenths of one per cent a year on his house and furniture in insurance, he would not be long in adopting the new methods, and the architects would be quick to help him to the best of their ability, which is, I think, greater than E. A. supposes. At any rate the underwriters would have tried to do their part, instead of sitting still and inveighing against poor professional men for not cramming down the throats of their employers methods and materials, not to say designs, for building which they do not want, which it is not for their pecuniary interest to have, and which they will not pay for.

Let them make a little beginning, by enforcing a few precautions either through the persuasion of rates, or by lending their influence to promote the enactment of general building laws, applicable to whole states, and containing simple provisions, such as the prohibition of woodwork within eight inches of the inside of any flue; the compulsory use of trimmer-arches before every fireplace, kitchen chimney, and laundry boiler; the requirement that chimneys shall be plastered throughout on the outside, and shall go straight up through the roof, without those dangerous projections in the form of bases where the chimney leaves the roof, so beloved of country builders, and they will already have accomplished much, and opened the way for more. They may depend upon it that the architects will follow close at their heels, cheering on their clients with portfolios full of sketches and descriptions of the beautiful and picturesque "slow-burning" construction of the Middle Ages everywhere, and of many parts of Germany, Switzerland, and Italy to this day, the books about which, and the recollection of which, strange as it may seem to E. A., form the principal part of the libraries and the most cherished mental treasures of all cultivated architects.

Let E. A. persuade some one to try to build a hotel which shall burn slowly enough to allow the inmates to escape in case of fire without jumping from the windows, and I will answer for it that the architect will overwhelm him with sketches of Swiss chalet floors, of the timber ceilings of Blois and Pierrefonds, Châlecoate and Speke, with descriptions of the vaulted rooms of Tuscany, and the half-timbered walls of Germany, and will work twice as hard for that client as he would for the ordinary owner, for the pure delight in the picturesqueness and opportunity for design that the construction gives him, in place of the hateful but cheap smoothness of ubiquitous plaster, to say nothing of his satisfaction in the thought that no one in their death agony, struggling with flames from which they could not escape, would curse him as responsible for their fate.

C.

NOTES AND CLIPPINGS.

THE STATUES AT MENARS. — The historical dates of the end of the last century have within the last few days, says the Paris correspondent of the *Builder*, been showered down rather plentifully on the public in connection with the anniversary of the fall of the Bastille, but surely in no stranger manner than in an incident of the sale of the château of Menars, — a château on the Loire which was given by Louis XV. to Madame de Pompadour, and was lately the property of the Prince de Bauffremont. The estate was knocked down to M. Wotet, a municipal councillor, for 920,000 francs. But just as the adjudication was made a courier from the Minister of Fine Arts suddenly appeared, claiming in the name of the Government the famous statues — a collection of *chefs-d'œuvre* — which adorn the gardens of the château; the Minister declaring that he "opposed himself formally to the sale of these statues, precious objects of art, and of great value, which were carried off from the museums of the state in 1792, and placed at Menars, without having ceased, however, to be the property of the Government." The purchaser has appealed to the courts.

A NEW ARCHITECTURAL DICTIONARY. — Messrs. W. J. & J. A. Audsley are authors and publishers of a new architectural dictionary, the first volume of which has just appeared at Liverpool under the title of *A Popular Dictionary of Architecture and the Allied Arts*. It is to be complete in ten volumes. It will include, besides the usual amount of architectural information, papers on heraldry, iconography, mythology, both Christian and pagan, glass-painting, carving, embroidery, illuminating, mosaic-work, and other kindred topics.