PENCIL POINTS
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Functionalism and Architecture, 1

By C. Howard Walker, F. A. I. A.

Editor's Note:—*This is the tenth of a series of articles in which leading architects are discussing the philosophy of design, considered in the light of present-day practice. Preceding articles in the series have been by William Adams Delano, George Howe, Albert Kahn, Alfred Fellheimer, Irving K. Pond, William F. Lamb, Dwight James Baum, Louis La Beaume, and Ralph Adams Cram. Mr. Walker will continue his discussion next month.*

"M*an has always been recognized as the imitative animal 'par excellence.'*

"Each of us is in fact what he is almost exclusively by virtue of his imitativeness; the sense of self grows by the sense of pattern. The entire accumulated wealth of mankind—languages, arts, institutions, and sciences—is passed from one generation to another by social heredity, each generation simply imitating the last. Invention and imitation are the two legs on which the human race has walked. Imitation shades into emulation, the impulse to imitate another in order not to appear inferior, and is the nerve of human society. Emulation shades into ambition closely connected with pugnacity and pride and ownership, and constructiveness and destructiveness, two names for the same manual activity leading to objective and experimental methods."—"Talks to Teachers"—William James.

The mentality of mankind influences personal expression and creates two distinct preferences in men's action. Those of the larger body desire and are satisfied with what they consider irrefutable facts (*sic*), capable of proof. Hence is evolved logic and the exact sciences, in which a statement can be tested by reversing the process which produced it.

Most men are content with autocratic authority, provided it is of benefit and, without doubt, the physical welfare of the world has resulted from formulated truths capable of proof and of development, and men's lives are protected by the accumulated deductions of their ancestors.

The other class are both kings and slaves of imagination, inspirational, too often without physical knowledge, and subject, well or ill, to the winds of fancy. They are lone wolves and prefer to be—in fact, cannot be otherwise—and while they lead the pack and inspire its action, their success in a physical universe is dependent upon the other type of men.

It matters little what names are given to the two types—Materialists, Idealists, Practical Men and Dreamers, Traditionalists, Functionalists, Logicians and Philosophers, Craftsmen and Artists—in one or the other of these types men enlist. Each needs the other, the second crowns and glorifies the first, but for life alone is unnecessary to it. As it happens, the most distinguished men of either class acknowledge and possess the best attainments of the other class, but these are naturally comparatively few in number. The others are apt to be either hewers of wood or drawers of water—very useful—or else vaporizers of little value. Of the professions, architecture based upon physical demands is merely engineering and is not born or named architecture unless deified by the qualities of the Dreamer. It is Engineering plus Art. It is Art transcending but the scion of Engineering. From this premise it can be logical in its process and inspirational in its achievements, and be so considered in any diagnosis of its character.

Architecture relates to habitations of which the original purposes are entirely utilitarian, to shelter and protect from climate, from attack, and to secure isolation. The habitations are excavated or constructed, first single cells—later grouped.

The most elemental of all cells is a sphere, which is unstable like the egg of Columbus and therefore only a portion of it is used on a horizontal plane. Caves, tents, igloos, and cells with a central focus partake of this character, which is soon abandoned for rectangular cells as more adaptable to utilitarian uses. Of polygonal cells those of the hectahedron fit together as in the bees' hives, without interstices of waste space, but again are seldom used in architecture, since slight waste space is less to be considered than the simple angles of a rectangular shape.

The law of gravitation forces this common-sense conclusion, and planes are either vertical or horizontal, with inertia or with balance, slanting surfaces being avoided excepting when utility demands them to transfer unstable materials such as sand, water, and snow.

Up to this point utility only is considered, and the work is elementarily functional. Different materials from adjacent areas create no great variations in type. The single cell in its two lateral dimensions was established; its centre was a focus, its plan a square or circle. Almost at once a new element appears, that of a shift of this focus to one side, and a consequent straight line of approach to it from the opposite side —an axis is established, on which is the focus and the access to it. At once this axis becomes the dominant factor of plan. If the focal point of attention is at the centre—as in a number of monuments, cells surrounding an altar, a statue, a tomb—the simple circular plan ensues or, as in baptistries, that of a regular polygon, but an oval creates a longitudinal axis, which increases in proportion to the length of the cell compared to its width, and eventually becomes the spinal cord of the organic plan, a fact too often ignored in merely utilitarian plans but which is soon forced by the demands of adequate function. All circulation from the circular cell were upon radial lines, incoming or outgoing. It could be a ganglion on an axis, but the capacity for plan development of a circular cell from any cause was slight, and largely confined to niches, semicircular or rectangular, around the cell, as in the underground rooms of Roman catacombs, such tombs as that of Cecelia Metella, the circular temples of Vesta, the circular Calidaria of Baths and the domed circular buildings of Hadrian, all of which have no lateral axis, but develop a vertical axis.

Therefore, the circular cell in plan, functionally simple, is of little importance compared to that of the rectangular cell, which forms the component factors of the great majority of plans. Niches, apses, hemicycles, etc., are subordinate accessories.

The rectangular cell, starting from a square, is elongated and a longitudinal axis is established, carried through the rectangle, or terminated at one end, at which end is usually the principal feature of functional purpose. It is at first a single unit, in temple, tomb, and megaron. Its relation of length to width is created by the habit of groups of people to face directly the object opposite its entrance, and by the available length of material to span its width. Hence, the increasing growth of a long narrow cell, with its longitudinal axis, which forms the elemental cell of functional plan. Architectural plan is an organism, resembling in many respects an animal organism, and is not a mere collection of unrelated units. Its axes, however, are not analogous to structure but are to arterial circulation. Architecture is an organism with an arterial system surrounded by a shell. It therefore is a crustacean. Its arteries and lines of circulation create its axes; its shell surrounding the cells which its arteries feed creates its visual expression of areas and masses. Both are entirely elementally functional.

The Arterial or Circulatory Factors of Plan

The main artery is the main axis of each organic plan, from which secondary axes proceed, usually at right angles to the main axes. If important secondary axes parallel the main axes the result is that of an associated group, each with its own circulation. Minor axes can be established for factors of the integral independent of it, but the most harmonious results are obtained by axes paralleling each other, i.e., planning axes horizontally and vertically (see Durand and Letarouilly). The flow of circulation does not follow radial lines, excepting from foci or as occasioned by unusual considerations of land contours or light exposure, but the distribution of circulation is at right angles to the main axes. The occasion for such custom is economy of space in grouping cells, avoidance of impractical corners (exterior and interior), a unanimous system of distribution, and, in the processes of using structural materials, an economy of labor. Long halls and corridors are veins; openings, doors, etc., are valves across a line of circulation and therefore on its axes and opposite each other, forming vistas excepting at times in continuous suites in which a partial segregation or individuality of cells is desired. The splitting at the end of main axes into a series of radial axes causes a focal termination of the main axes (Theatres, Odeons, Apses, etc.).

Adequate Circulation

In attempts to take every advantage of land value for pecuniary return, plans are often starved and at times atrophied by scrimping areas of circulation. This is frequently a false economy, depreciating the apparent quality of a building. The people who used a building came from the outside, gathered outside, if in numbers, and then entered. In proportion to their numbers they were to be accommodated by the circulation within the building and distributed if necessary. Outside was merely the supply, analogous to the heart feeding the arteries. The supply was small and intermittent, or constant, or large and at definite intervals. The circulation was accommodated to the demands made upon it. Advanced courts centered on the main axes provided for unusual gatherings. (See Egyptian temple courts—plazas before public buildings.) They became, when within the building and under its roof, the atrium, the pronaos, the vestibule, the *Salle des Pas Perdus*, the advanced and welcoming factor of the circulation, reservoirs from which the circulation proceeds. Too often in poor plans for large circulation they are ignored.

Buildings used by few people, coming and going at will, naturally require less important circulation and ingress and egress than those used by congregations of people at definite periods. It is to these latter that adequate factors are to be carefully considered. At first these are simple cells as in temples and tombs, their ingress proportioned to the number of the congregation of people. As the people enter they converge and, having reached their destination, lessen their pace and are slower in action; as they depart, they diverge upon leaving the building and their speed is uncontrolled, their destinations various. The circulation is like the flow of a liquid, checked upon entering, freed upon exit from which it can burst. Entrance, therefore, if possible, should broaden from within.

Symmetry and Balance on Either Side of Main Axis

All the higher animal organisms have symmetry, i.e., identical proportions upon either side of the central line of their structure whether it be a solid or an arterial flow. When this is absent the result is abnormal, and so-called deformities or monstrosities occur, handicapping the organism. The cause for the symmetry is obvious. It is the law of gravitation which influences all objects upon the earth, and creates the stability of balance which is best obtained by absolute symmetry. The apparent exceptions are those of fixed organism proceeding from a focussed base as in the Vegetable Kingdom and in Algae, etc., which grow from a focus, but even these are influenced by the drag of gravitation as they expand. Actual or indicated stability and a consequent inspired confidence is one of the most desirable elements in artistic expression, overcoming as it does, excess of minor factors. Especially is this the case in architecture, both in plan and mass.

The Third Dimension

When from the plan the building arises, it is expressed at once in geometric solids, excepting when one façade only is visible, which is expressed by an area of two dimensions only. In either case stability should be evident; first, by verticality of walls, surfaces and supports, such as piers, columns, etc., which are merely perforated walls. Architectural design becomes either so-called trabeated architecture (*trave*, a beam) of verticals and beams, creating the Greek order, or a system of vertical walls, perforated or unperforated.

Regular geometric solids until superposed (i.e., of one mass only) demand little arrangement of proportion compared to those superimposed. Such are sarcophagi, pyramids, obelisks, etc. They are seldom criticized excepting in relation to their environment, are accepted as simple concrete facts. Cones and domes fall under the same category. But with superimposed solids, great care in relative shapes and geometrical proportions is demanded.

It is obvious that stability is evidenced by placing larger solids beneath smaller ones, as in terraced pyramids (Meidum), towers, minars and minarets, flèches, Renaissance lanterns and spires. The possibilities of skilled arrangement creating architecture has been especially evident in Mohammedan work and in the churches of Sir Christopher Wren, which, while acknowledging elemental functionalism, have developed it into an art of great beauty. Gothic Cathedrals and Italian Brolette have done the same.

Until functionalism has grown from mere adolescence to a state of high artistic expression, it has not earned a definition as architecture, nor is it to be considered as other than embryonic.

In proportioning areas and masses to each other, excessive subtlety is unnecessary and confusing. Some order, some module, declares arrangement and proportion—and therefore thought and consideration, lack of which induces chaos. Any order is better than no order, but it should be evidently present, and therefore simple. For this reason the simple rectangular subdivisions of horizontal and vertical lines of trabeated architecture are the controlling network of all design, and diagonals and curves are symmetrically arranged in relation to it. Subtleties have been used, variously deciphered, and the results have enamoured many, but like most intricate and involved processes tend towards vagueness. Painting and Sculpture have greater latitude in regard to the acknowledged stability of arrangement than does architecture, but they use it to advantage. Philosophies have dabbled with proportions and the attempted solution of the Pythagorean proportions has intrigued many, with few results. One fact seems definite, i.e., that proportions measured by the regular numbers 2, 4, 6, 8 are crudely evident compared to those of 3, 5, 7, etc., which are more subtle. Beyond this, in Architecture, little advantage is gained.

If identical polyhedrons are superposed, they diminish upward in relative masses, and, as their sides and surfaces are exactly in proportion to those of the ascending masses, the result is that of a stepped terraced pyramid. Such are the Ziggurats of Assyria. But great variety can be obtained by changing the heights in proportion to the bases, in which case systems of alternates and of ratios of solids are adopted. Haphazard piling of one mass above another is devoid of order, method and composition.

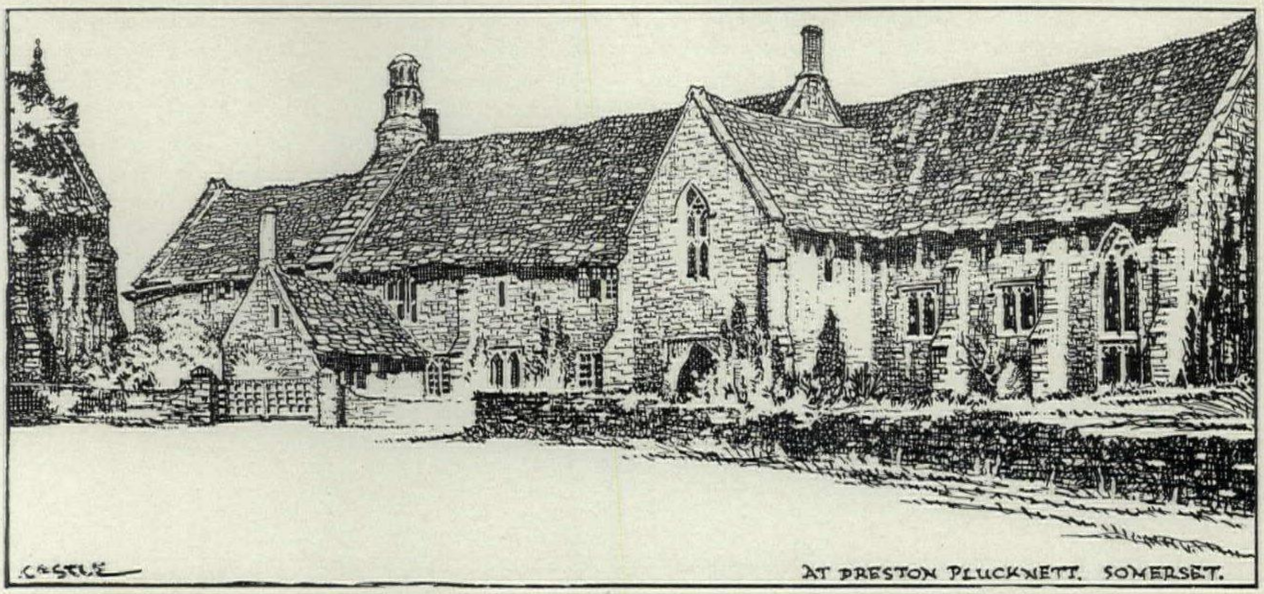
The element of arrangement and composition of geometric solids has at once transcended mere functionalism, and while maintaining functional purposes, bends them to its will. Architecture as an Art is born at this point. It satisfies the actual needs of function, but assumes control of its expression. It is a characteristic of all meticulous demands of specialists in all exact sciences that they are assumed to be as irrevocable as the laws of the Medes and Persians, despite the fact that Nature's laws are mutable. Results of the same character are obtained in many ways. The arrogant dicta of functionalism creates a muscle-bound condition without resiliency. Art, to be alive, requires resiliency, freedom, and law, stopping short of license.

It is at this point also that the Arts are characterized as vague, erratic and illogical, all of which attributes an indication of Free Will. With control, that will be Common Sense—for, like the Fire of which it is a blood brother, it is an unruly master but the best of servants.

Superimposed Solids of Various Shapes

Regular geometrical figures of equal areas are conspicuous in proportion to their simplicity of shape, as follows; the circle, isosceles triangle, square, pentagon, hexagon, octagon. Figures of a greater number of sides begin to take the character of a circle, but solids decrease in apparent relative scale as the number of their sides increase, therefore the sequence of their superposition is on the order above provided they have equal plan area, but as in plans axes are best when parallel, so in solids the planes of their sides are best when at least half of them are parallel to those of adjacent solids. At once triangular prisms, pentagons, and hexagons are found to be untractable and seldom used, especially as their incongruities are exaggerated by light and shade. All superposed solids, as their aggregation builds vertically, have vertical axes, and tend to announce it by having greater heights than diameters, excepting the solid at the base. Taking these characteristics into account, superposed solids carefully arranged have created a series of the finest of architectural structures which have reached their finest apogee in the so-called skyscrapers. *(To be continued.)*

A TREE STUDY IN PEN-AND-INK BY ERNEST F. LEWIS
Size of original, 8½" x 13"



An Architect's Notes on Pen Drawing, 9

By Sydney E. Castle, F. R. I. B. A.

The placid, naïve beauties to be found in Cotswold stone, while lending themselves so amiably to the softer tones of color or pencil, lend themselves, if no less agreeably, perhaps more problematically to the more articulate work of the penman.

In this peculiar respect the surfaces are nearly always bald—in reality, solid and enduring, on paper apt to be transparent.

One hardly theorizes when one quotes actual experience. My first serious attempt to impress an intelligent view of Cotswold architecture on a sketching card comes back as I write. It was a low, rambling building, gabled here and there and peeping with kindly roof slopes. But there were plenty of wall surfaces—restful and self-explanatory enough in themselves, but another proposition altogether on paper. My sketch proceeded, and the more it proceeded the more my building seemed constructed of glass. Very well for me to indulge in silent oaths to avoid stone joints I couldn't see, or go frisky with fancy reflections that didn't exist. But as soon as my pen became so restricted it became poor value for my eyesight.

It was problem. If I dared a background of dark trees—most of us who draw in the open are bits of Ananiases with foliage on occasion—what did they do? They either made my stone surfaces more transparent than ever, or danced impertinently and quite untruthfully in front of the building.

Hence, my early scorn for the technical difficulties of my subject matter quickly subsided. Fresh as I was then from the intricate complications of the Cloisters at Gloucester, which for a penman to overcome in any sort of intelligent manner would leave him, on the face of it, almost patronizing when he faced cottagy stone, I suffered mild shock.

There was a white road in front, I remember, and a part of my building dropped clean on to it without even a straggle of ragged grass. My eyes travelled up and down from paper to object almost furtively. Then wandered. Something beyond made the two distinct values of wall and road, something my wits connected but had not yet dissected—something that explained and made obvious the pale horizontal from the pale perpendicular. I found a dramatic definition in a dwarf wall and a clump of yew further along. At the other extreme I found a confused shadow with one spot of light divided between laying on the ground and travelling up the wall. In a flash I saw. The explanatory secret was *an unseen line.*

I put it into effect—deliberately let my wall and my road confuse as they liked, but very carefully studied every point of the two more clearly defined extremes. And lo I found, this done, that my wall and road took care of themselves!

My eye travelled eagerly. And thenceforth wherever I stared I discovered much the same thing —the simple secret of unseen line.

Thus, as one who has spent a goodish chunk of his life wandering in the Cotswolds with pencil and pen, I strongly recommend the penman wayfarer in England not to neglect his Campdens and Broadways. He will find pen fun in bushel-loads. There will be nothing to scare his modesty in draftsmanship. Architecturally, I doubt if any of these little townships has anything particular to teach over its neighbor. But in each will be charming unexpectedness in unchanged theme—a measure of delight for the humblest pen-wielder in which monotony is the very last guest he will be called upon to entertain.

Then let him turn in a radically opposed direction.

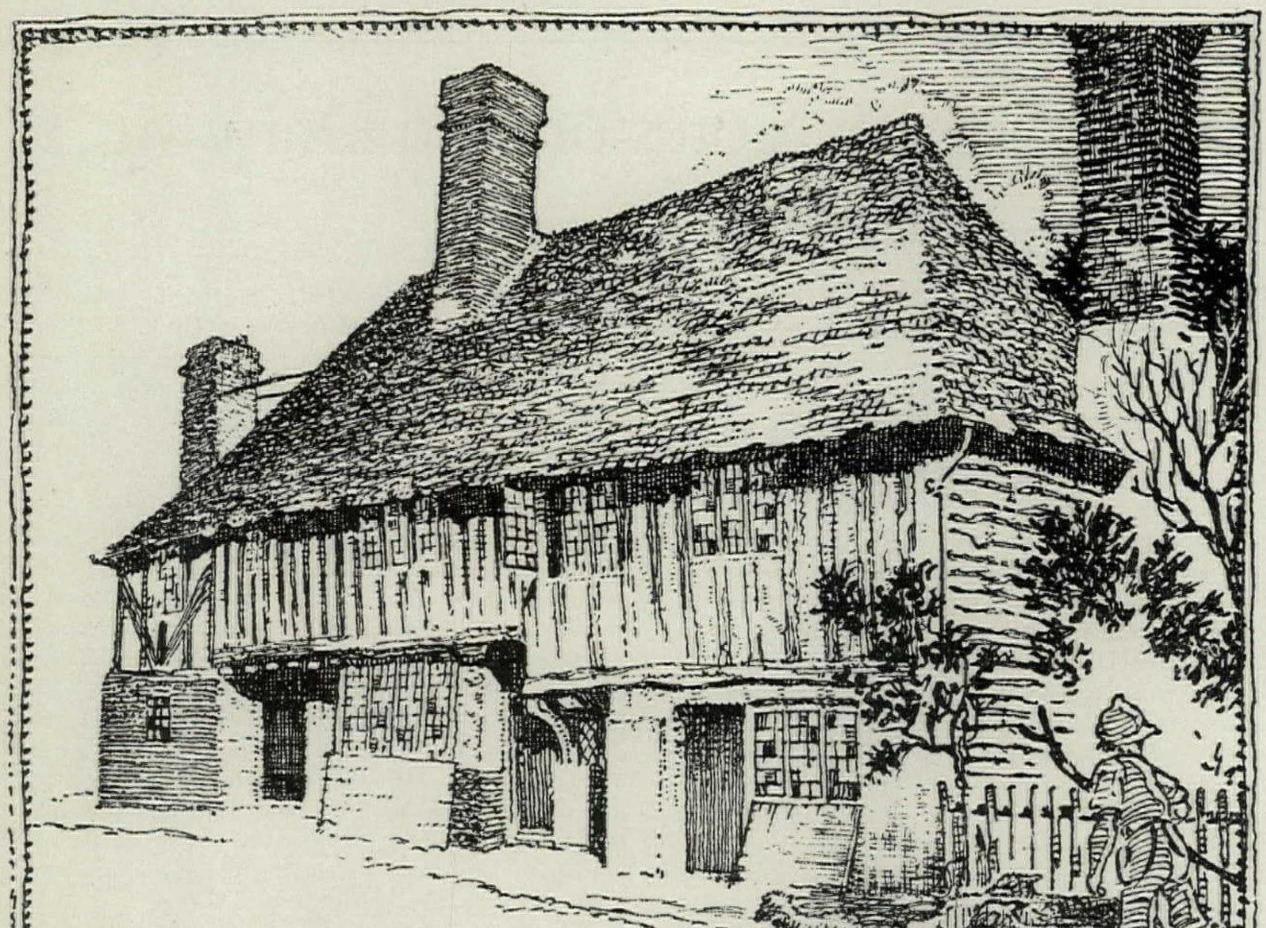
When he has taken a goodly fill of jotting down his prim, proper and uniformly severe Jacobean in West Country stone, let him take his pen where men could find no stone but found oak trees in plenty as a happy compensation.

Let him blink his eyes over wall surfaces as busy and talkative as those he has just left behind have been reticent and reserved.

Problem rushes up again—but rather opposite problem.

I may be wrong about half-timber work in pen drawing. In the ordinary course of things one would say, "Ah, here is the very essence of what is sometimes called 'black-and-white.' Dramatic contrasts everywhere. Big overhangings and eaves casting their handsome assisting shadows, every wall a forest of lines, and wherever I look a regular El Dorado for a niggly nib."

Well, on the face of it, that looks indisputable. But I am far less certain of it when it comes to test. I have just paused in order to recall drawings of half-timber work in pen and ink that have really impressed me from a realistic point of view; and I feel a little memory-impoverished. I will freely admit that I have been fairly constantly charmed by dexterous technique, but I have rarely found my lovable acquaintance with several half-timber friends as they in themselves fill my eye much supported by pen and ink representations of them.



AT ROBERTSBRIDGE, SUSSEX, ENGLAND

FROM A PEN-AND-INK DRAWING BY SYDNEY E. CASTLE

Reproduced one-fifth larger than original drawing

The Geometry of Architectural Drafting

22—Some Short Cuts with the Triangles

By Ernest Irving Freese

Editor's Note:—*This article, which is copyrighted, 1932, by the author, continues the series begun in August, 1929. Earlier installments have appeared in August, September, October, November, December, 1929; January, February, March, April, May, July, September, November, 1930; January, February, April, July, August, November, 1931; and May and August, 1932.*

As has been thoroughly demonstrated in foregoing Parts of this work, the greater portion of *drafting-room* geometry inheres in the sliding instruments alone—in the lines generated by the T-square and the three triangles operating in their normal working positions on the board. Obviously, if *all* extraneous construction lines can be eliminated from the graphical solution of a geometric problem, then that particular problem becomes solved with the utmost economy of means and in the shortest possible time. Many instances of such expeditious instrumental manipulation have heretofore been recorded. Others are contained in this Part; the particular ones here shown having to do with *circle* construction, that is, with the direct location of the required center, or centers, without recourse to a more general, and therefore more involved, geometric construction. Wherefore, all layouts here shown, and all special dimensioning data here given, are "short-cuts" and, like all short-cutting methods, are applicable only to the cases illustrated. However, and again like all short-cutting methods, they are ready for instant and everyday use. *Reach for your triangles.*

Figure 205:

Diagram "1" is a geometric demonstration of the usefulness of the "hexagonal diagonal," or 60-degree line, as a direct locus of centers. If a circle be drawn with each vertex of an equilateral triangle as center, and with one-half a side of this triangle as radius, then the three resultant circles will come tangent to one another at the points where they cross the sides of

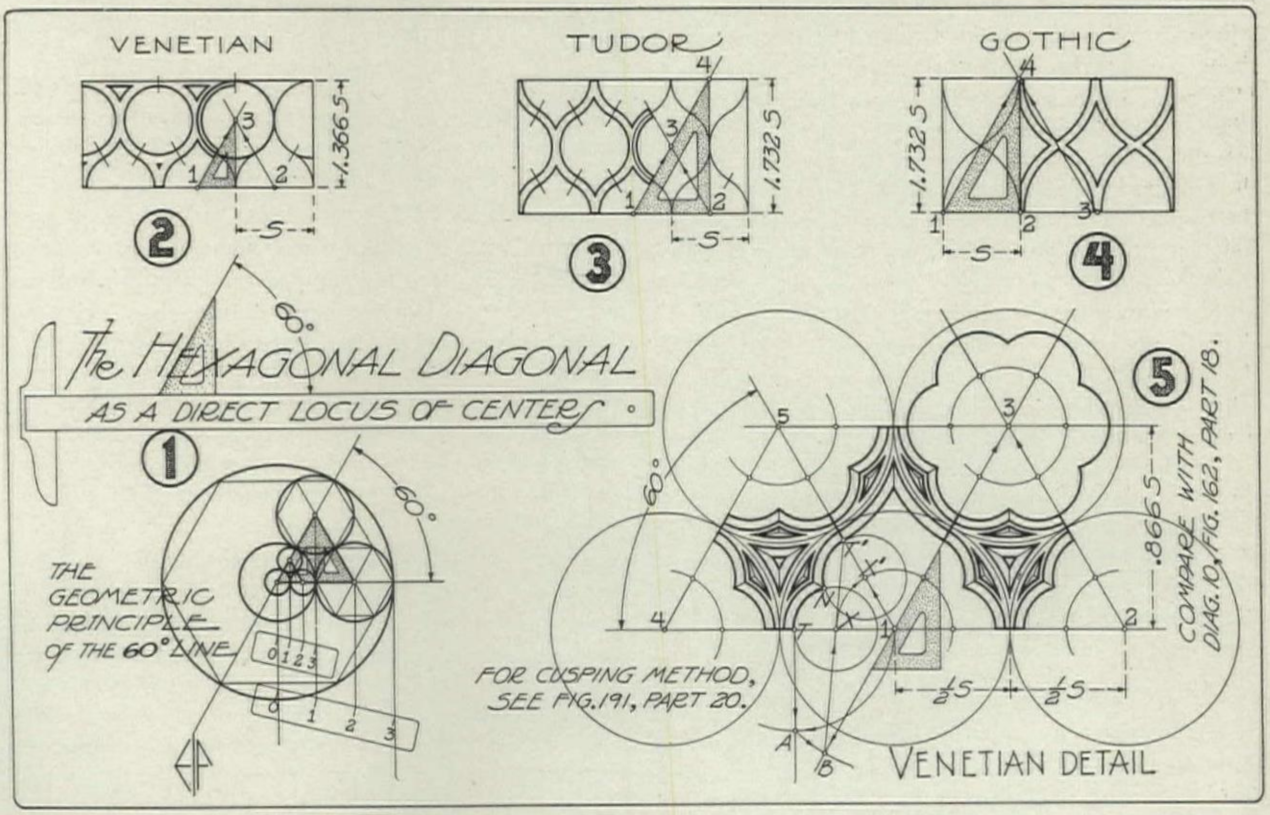


FIGURE 205

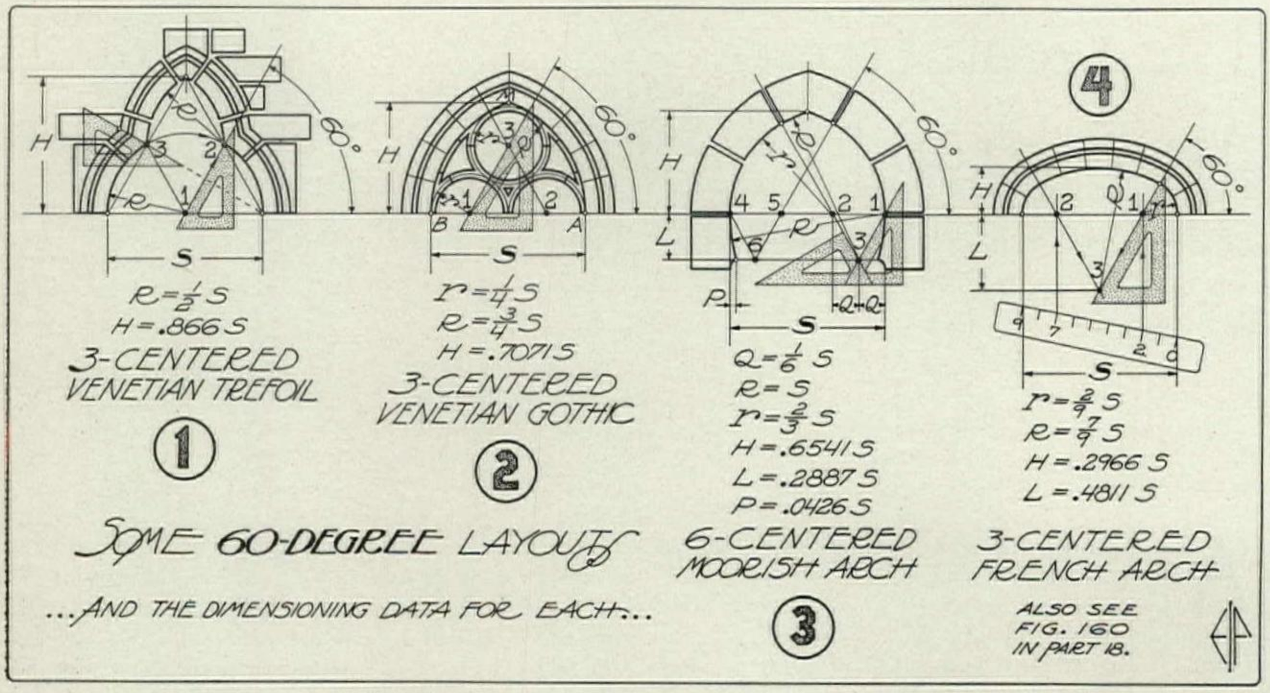


FIGURE 206

the triangle. A regular hexagon is a compound of six equilateral triangles. Six tangent circles may therefore be drawn either *outside* a given circle and tangent thereto, or *inside* a given circle and tangent thereto, by a direct utilization of the above facts. In the one case, the required radius would be the same as the radius of the given circle. In the other case, the required radius would be exactly one third the given radius. Any given circle, then, say of a rose window, will just contain seven equal circles, six of them around the circumference of the seventh, as Diagram "1" indicates. The other Diagrams of this Figure put the 60-degree line to work. The only extraneous line here employed is the projector BT' in the enlarged detail at Diagram "5." This line fixes the radius XT of each arc of the orthogonally cusped foliations; and X, in turn, is then revolved to X', etc., with the compass centered at point *1*, etc.

The altitude of an equilateral triangle, or half the short diameter of a regular hexagon, is equal to half the length of one side times the square root of 3. In other words, the longer rectangular leg of your 30-degree triangle is equal to the length of the shorter leg times the square root of 3. From this fact comes the special dimensioning data given in connection with the layout Diagrams of Figure 205. The square root of 3 is 1.7320508, but the last four decimals are of no earthly use. Call it 1.732. Then .866S is the simple mathematical formula for the altitude of an equilateral triangle, where S is the length of one side.

Figure 206:

More ready-to-use 60-degree layouts employing no extraneous lines at all. Every triad of centers forms an equilateral triangle. This drawing is replete with all information required, both as regards the graphical layouts and the subsequent figured dimensioning of same.

Note that the system of jointing worked out at Diagram "1" makes the Venetian trefoil arch structurally sound: the upper *actual* arch is carried by the lower cantilevered portions of arch *shape*.

Figure 207:

Here, the diagonal of a square—the 45-degree line—contributes a few typical instances of its use as a locus of centers.

At Diagram "1," the various suggested designs for circle-filled panels—sidelights, say—are all fabricated from centers located at the four corners of a square and at the crossing of its diagonals.

At Diagram "2," two slides of the 45-degree triangle locate X. The same manipulation will also locate the centers for cross-sectioning the quadrant arcs of Roman Doric column fluting, there being no fillets between said flutes. The other centers, X', etc., are then better found with the compass, as shown. Any slight inequality in the spacing of the points a, b, c, etc., will then not affect the radii of the connecting scallops, since the center for each scallop must, by the method shown, fall *equidistant* from each pair of spaced-off points.

In the next four Diagrams, the 45-degree ogee becomes a cyma of equal rectangular dimensions, the crossed diagonal locating the inflection-point d and, in turn, the line of centers XX'. These Diagrams are also utilized to clarify the distinction between the two kinds of cymas shown. Cyma means wave. *Any* ogee whose profile forms any portion of a continuous *horizontal* wave is a cyma *recta;* but, if the profile forms any portion of a continuous *vertical* wave, the cyma is a *reversa.* In other words, the distinction is

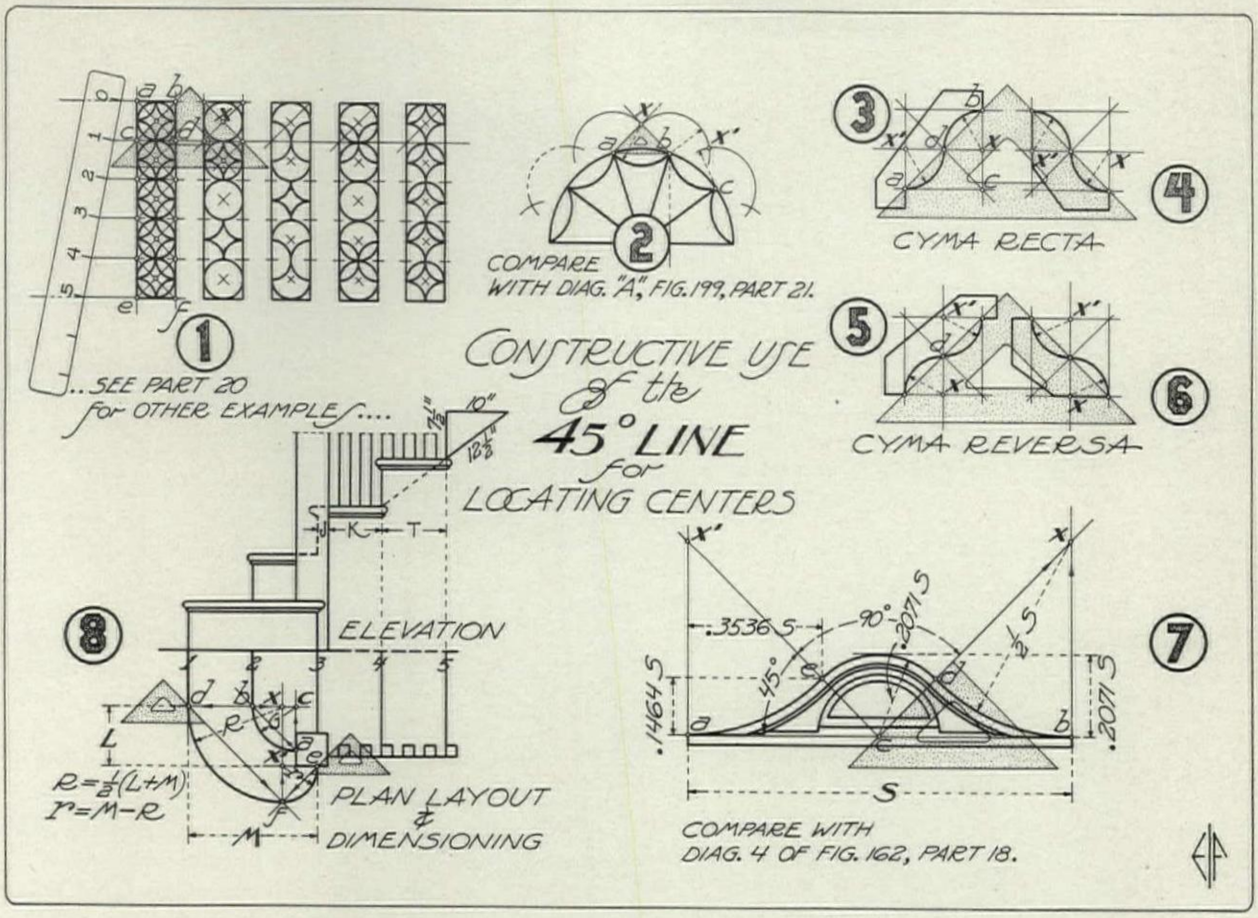


FIGURE 207

just the *reversa* of what one would naturally conclude.

At Diagram "7," a pleasing eyebrow appears. You can duplicate this trick as quick as a wink. And, by simple multiplication of the indicated values, you can discover its dimensions almost as quickly. But if this particular eyebrow doesn't "take your eye," then take your pick from any one of the half dozen *commensurables* set out at Figure 162 in Part 18 heretofore.

The plan layout of Diagram "8" is as follows: Slide your 45-degree triangle to point *a*, and mark *b* on the second riser line; draw a T-square line through *b*, both ways, crossing the first riser at *d*, and crossing a vertical from point *a* at one required center *C*; then, from *e* and *d*, project 45-degree lines to cross at *f*; whence, a vertical from *f* locates the centers *X* and

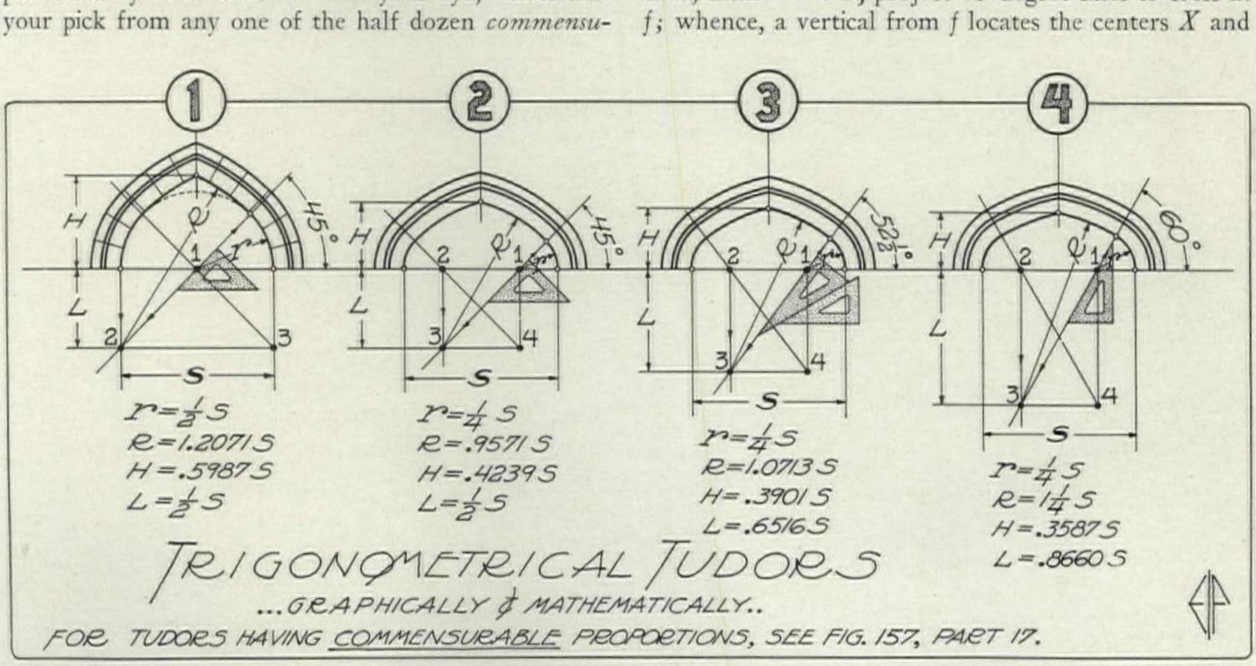


FIGURE 208

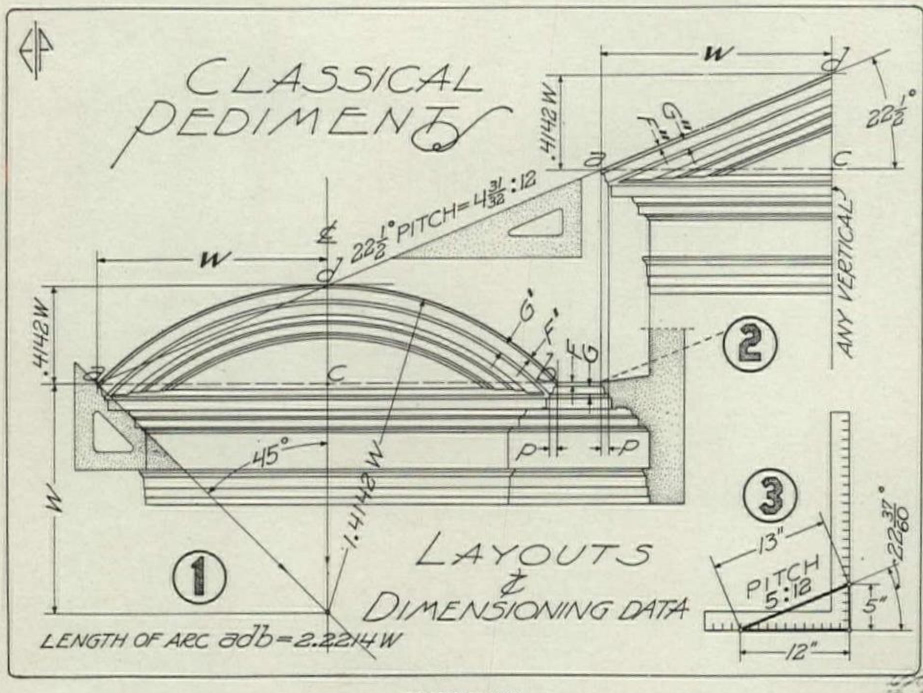


FIGURE 209

X′ for the compound curve of the "bull-nosed" first riser. The simple formulas for determining the dimensions are also given. The radius *G* is obviously known.

The elevation at Diagram "8" is shown to bring out two points that are worthy of such emphasis. First, the distance *J* should equal the width of a baluster instead of half the width of the newel. The balusters on the thus curtailed portion *K*, of the tread, will then "space out" the same as those on the full tread *T*. Second, in a stairway having 7½″ risers and 10″ treads—a common and good proportion, by the way—the "pitch block" forms a right triangle whose hypotenuse is exactly 12½″, as noted on the Diagram. You see, the 7½-10-12½ triangle is the same old 3-4-5 Egyptian rope-stretching rule for laying out a right angle—as you can easily discover by multiplying each factor of the latter triad by 2½. Wherefore, in a stairway of this pitch—or in a roof either, for that matter—any *horizontal* distance multiplied by 5/4ths, and any *vertical* distance multiplied by 5/3rds, will exactly determine the corresponding *raking* distance. Incidentally, a *roof* of this pitch would be 9 to 12, the rafter being 15. These facts are worth remembering.

Figure 208:

You can lay out any one of these "trig" Tudors just as fast as you can manipulate a triangle and swing a compass. And, if you can multiply two numbers together, you can determine all necessary figured dimensions quicker than the engineer in the next room could get out his trigonometrical tables preparatory to *commencing* to figure them. All of these shapes agree with what some one once said was the criterion of a Tudor; namely, that the angle subtended by each haunch arc should be neither less than 45 degrees nor greater than 60 degrees. Well, there you are: both of them, and one in between—45 degrees, 52½ degrees, 60 degrees. Moreover, the *three*-centered one, at Diagram "1," is almost a "dead ringer" for one in the aisle of Westminster Abbey: now I *know* you'll like it.

Figure 209:

"According to Vignola" the peak of a classical pediment is found as follows: Upon the extreme pediment-span as a diameter, describe an inverted semicircle; from the nethermost point of this semicircle, as a center, describe a segmental arc passing through the extreme points of the semicircle's diameter; whence, the crown point of the segmental arc becomes the Vignolan peak of the pediment. In other words, the pitch of a classical pediment is—merely 22½ degrees. Moreover, the center of a *curved* pediment, of the same qualified classification, lies on a 45-degree line projected from either point of the extreme span. The pictured triangles of Figure 209 tell the story.

Subtract 1 from the square root of 2. The result is the trigonometrical tangent of 22½ degrees. Hence, the classical roof pitch is practically 4-31/32nds inches to the foot. But a pitch of 5 inches to the foot would raise the peak of a 50-foot pediment scarcely 25/32nds of an *inch*, and would

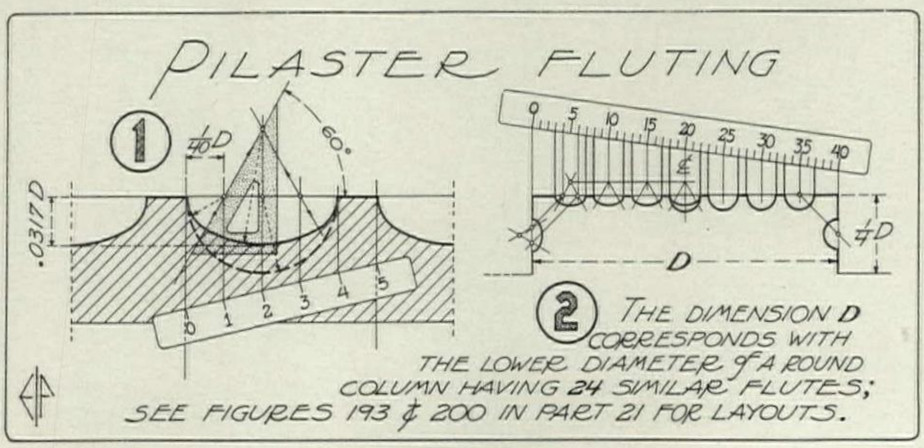


FIGURE 210

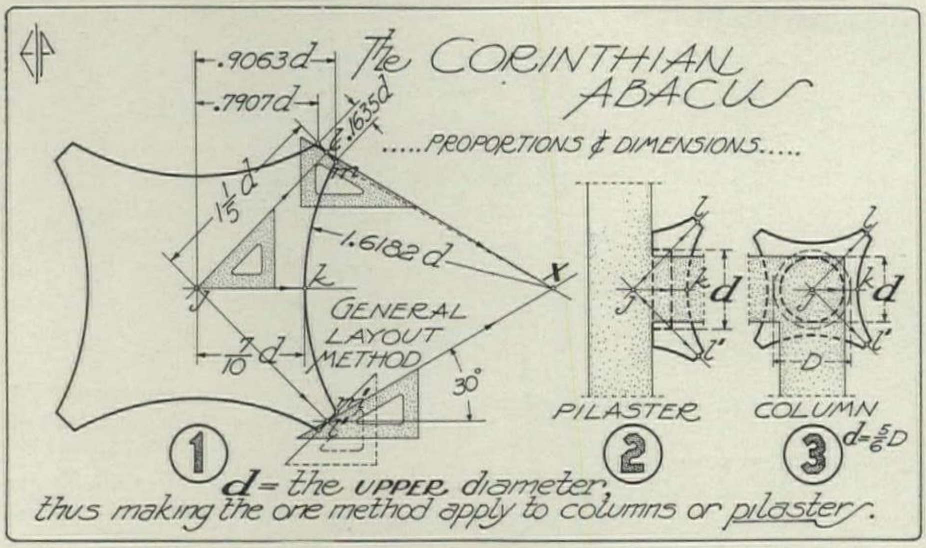


FIGURE 211

make the rake commensurable with the rise and run. Diagram "3" shows this latter fact in connection with the *un*classical steel square. But I've given you the dimensioning data, at Diagrams "1" and "2," for the 22½-degree pitch. If you use the more sensible 5 to 12 pitch, you don't need any data: the rise is merely 5/12ths of the run; and any distance along the straight rake is 13/12ths of the corresponding run; and the radius of a *curved* pediment is exactly 169/120ths of the *half* span W. Maybe, after all, the original perpetrators of classical architecture *intended* their pediments to be 5 to 12 pitch, but their perpetuators made a slight mistake. Who knows?

Diagrams "1" and "2," of Figure 209, are also utilized to make plain a peculiarity of all such gables, regardless of their pitch and regardless of whether the rake is curved or straight: namely, in all cases (except a possible imaginary one) the normal widths F' and G', or F'' and G'', of the raking crown moulding, will not be the same as the corresponding widths F and G of a membering level moulding, so long as the projection P remains the same, and so long as the face of the topmost fillet is maintained vertical. Note that this discrepancy in width between the level crown moulding and the raking one is particularly evident in the curved pediment at Diagram "1." This awkward situation, which requires special detailing, cannot be avoided if the horizontally-returned crown moulding, from which the raking one springs, must miter correctly with a similar horizontal one at the wall line. However, in the case of an isolated gable—the pediment of a Colonial doorway, say—the rake moulding and the horizontally-returned one may be identical in shape and size, since they may thus be correctly mitered, one to another, by making the miter-cut *perpendicular to the plane of the roof* rather than vertical. Suggestive instances of this latter method may be seen at Diagrams "H" and "J" of Figure 163 in Part 18; it being applicable either to a pediment with a *straight* rake or to one with *any type of curved rake.*

Figure 210:

In a round column containing 24 equally-spaced flutes, the straight line by which the eye gauges the spacing is the chord of a 15-degree arc. The length of such a chord is practically 13/100ths of the column diameter. The nearest manageable equivalent of this fraction is ⅛th. Hence, for a flat pilaster, the correspondingly-proportionate spacing of flutes or fillets, center to center, becomes ⅛th of a diameter. Again, in classical proportions, the width of a fillet, between consecutive flutes, is 1/40th of a diameter, which leaves the width of a pilaster flute exactly four times

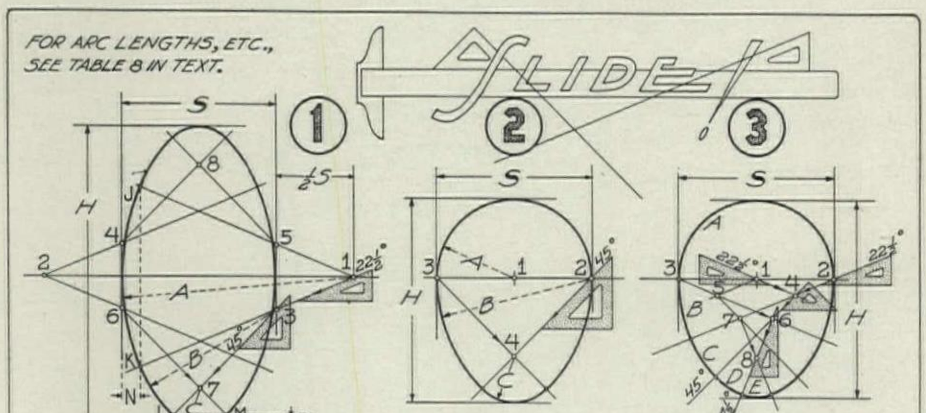


FIGURE 212

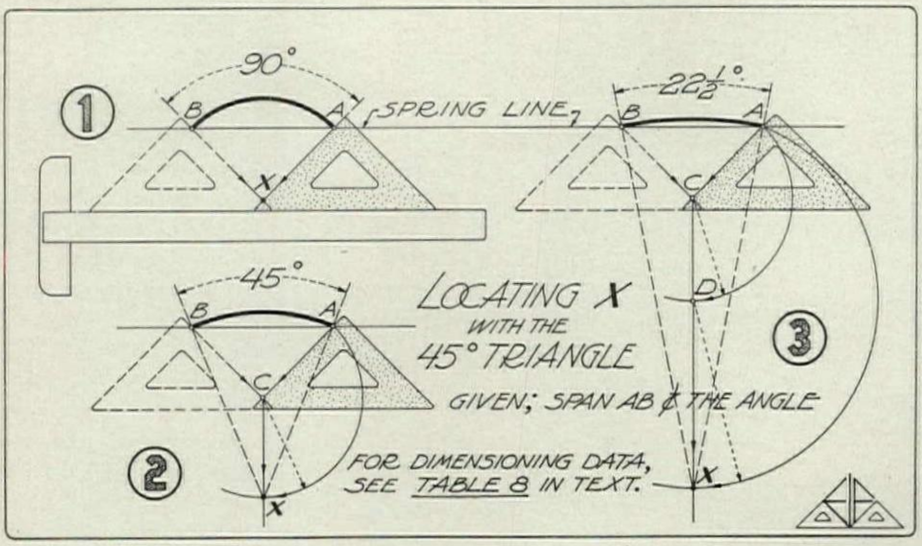


FIGURE 213

the confusing factor of *entasis*, and making the one method apply to round columns, square columns, and rectangular pilasters. Just remember: the dimension *d* is the *upper* diameter in each particular case; said upper diameter having already been determined either "according to Vignola" or according to a more complicated system productive of module-splitting differences in the comparative results. Then proceed to lay out the plan like this: Lay off *jk* equal to 7/10ths of *d;*

the width of a fillet; and allows of seven flutes to a pilaster face, thus placing one on the center line; and leaves the width of three fillets as a frame for the fluting; and fixes the minimum one-fluted projection of the pilaster at just one fourth of its face width.

The flutes and fillets can be quickly and accurately spaced as shown at Diagram "2."

Diagram "1" indicates the direct use of the 60-degree line in the full-size detailing of pilaster flutes having a three-centered cross section. The dimension giving the depth of this type of fluting is also there recorded, since it may help in predetermining the stock thickness of material required for a built-up wooden pilaster: practically, this depth is 1/32nd of the diameter *D*, which latter is the width of the pilaster as shown and noted in the Figure. Obviously, for the full semicircular fluting (indicated in a dotted line at Diagram "1"), the depth of a flute is equal to half its width, or to twice the width of a fillet, or to 1/20th of *D*.

Figure 211:

Another classical puzzle has here been unpuzzled—the plan layout and dimensioning of the Corinthian abacus both for columns *and* pilasters. In monumental work, such members are often of huge size, hence require to be accurately dimensioned. Note, especially, that the factor *d*, here used in both the graphical layout and in the values for figured dimensioning, is the diameter of the column or pilaster *at the line of the capital*, thus eliminating

then *jl* and *jl'*, on 45-degree lines, each equal to 6/5ths of *d;* then locate the required center *X* by 30-degree projectors from *l* and *l'*; then, with the compass centered at *X*, open it to *k* and swing the required arc *mkm'* limited by the 45-degree lines *lm* and *l'm'*. You will note that this arc is *not* a 60-degree arc, since its limiting radial is *Xm*, not *Xl*. Now, if necessary, you can readily figure its *dimensions*. This dimensioning data also has another use: namely, for determining "clearances" in a tight pinch. Anyhow—it's all there. Use it.

Figure 212:

Diagram "1" shows the layout of an eight-centered approximate ellipse having a ratio of short diameter, *S*, to long diameter, *H*, of practically 12 to 23. The four-centered oval at Diagram "2" has a ratio of *S* to *H* of about 24 to 31, while the diametral ratio of

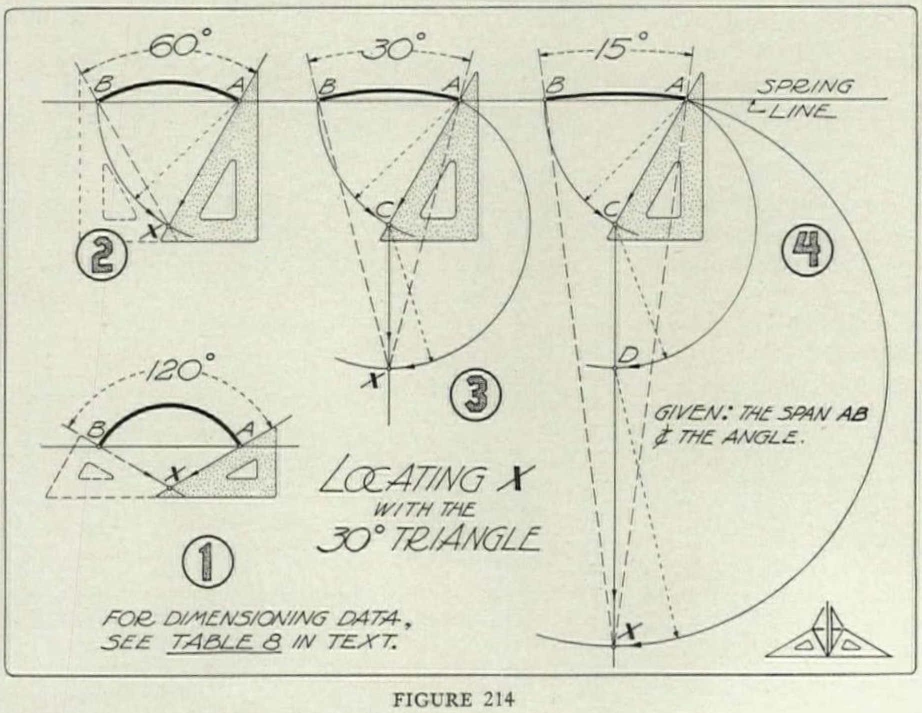


FIGURE 214

the eight-centered one at Diagram "3" is almost exactly 4 to 5.

Not one extraneous line is used in the above layouts. It's all done in a jiffy with the T-square, the 45-degree triangle and the 22½-degree triangle. Almost any desired combination of compound or reversed circular curves can be picked from these three Diagrams. The triangles tell the story. And the dimensioning data accompanying each Diagram, together with the use of TABLE 8, herewith, will yield any dimension wanted, including the lengths of the various chords and arcs.

Let it be assumed that you have used the complete curve shown at Diagram "1" for one purpose or another, and that S is a fixed, known, or assumed dimension of 12 feet. All right: then substitute 12′ for the letter S in the simple formulas there given, and perform the inferred operations of *multiplication*. The following *dimensions* are then yielded:—

Long diameter H	= 23.0112′
Radius A	= 18′
Radius B	= 11.5056′
Radius C	= 3.0204′

Now what is the distance around this complete curve? By an inspection of the layout Diagram, it is readily seen that:

Arc of radius $A = 45$ degrees
Arc of radius $B = 22½$ degrees
Arc of radius $C = 90$ degrees

Then, consulting TABLE 8, you will immediately discover that the:—

Length of a 45 -degree arc = .7854 × its *radius*
Length of a 22½-degree arc = .3927 × its *radius*
Length of a 90 -degree arc = 1.5708 × its *radius*

Wherefore, with its *angle* known, and its *radius* known, the *length* of each arc at Diagram "1" is found to be as follows:—

Arc of radius A = .7854 × 18′ = 14.1372′
Arc of radius B = .3927 × 11.5056′ = 4.5182′
Arc of radius C = 1.5708 × 3.0204′ = 4.7444′

But the total curve is compounded of *two* arcs of radius A, *four* arcs of radius B, and *two* arcs of radius

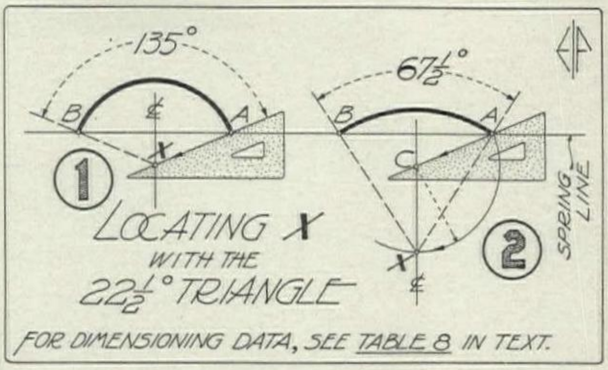


FIGURE 215

C. Wherefore, the required length of *circumference* sums up as follows:—

2 × 14.1372′ = 28.2744′
4 × 4.5182′ = 18.0728′
2 × 4.7444′ = 9.4888′

Circumference = 55.8360′

Now check this result by the purely *graphical* method given at Figure 126 in Part 14.

Again, by TABLE 8, the *span* of a 45-degree arc is listed as .76537 times its *radius*. Hence, since the *radius* A, of the 45-degree arc, has been found to be 18′, its *span*, or chord JK, becomes 13.7767′, or 13′-9-5/16″. Also, by TABLE 8, the *height* of a 45-degree arc is given as .07612 times its *radius*, which, for a radius of 18′, yields its *height*, or rise N, as 1.3702′, or 1′-4-7/16″. And, going still further, and by the same typical route, the *span* LM, of the 90-degree arc of *radius* C, is found to be 4′-3¼″; and its *height* P is found to be 10-39/64″. So now, if you like, you can mark on your plan the coordinate *dimensions* that will locate the points J, K, L, M, etc.; since the prerequisite lengths of the diameters, chords, and arc heights, have been determined. A further use of TABLE 8 follows, whereby any dimension associated with arcs of the tabulated inherent angles can be found in terms of the known *span*.

Figures 213 to 217, inclusive:

Each Diagram, of each of these Figures, depicts the most expeditious and accurate method of locating the required center X for an arc of any given span and of the given inherent angle; no extraneous construction lines being employed.

Figure 213 will be used to explain the simple and typical layout process. At Diagram "1," a given span AB is fixed on the board, and it is necessary to find the center X such that the resultant arc, of span AB, will be a quadrant; in other words, the typical general problem is *to draw a circular arc limited*

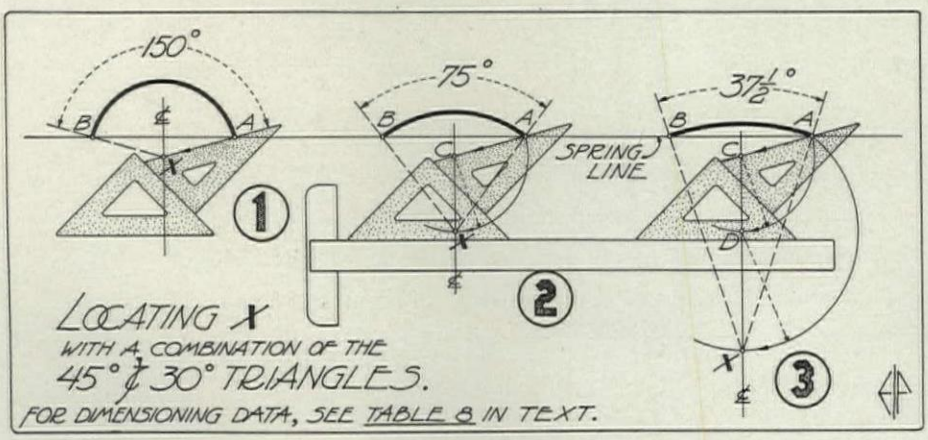
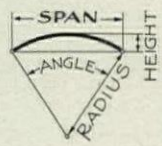


FIGURE 216

TABLE 8
DATA ON CIRCULAR ARCS SUBTENDING INHERENT ANGLES

R = Radius of the arc.
H = Height or rise of the arc.
L = Length of the arc.
S = Span or chord of the arc.



Angle in Degrees	Radius	Height	Length	Span
7½	7.64489 × S	.01637 × S .00214 × R	1.0007 × S .1309 × R	.13081 × R
15	3.83065 × S	.03278 × S .00855 × R	1.0028 × S .2618 × R	.26105 × R
22½	2.56291 × S	.04924 × S .01921 × R	1.0064 × S .3927 × R	.39018 × R
30	1.93185 × S	.06583 × S .03407 × R	1.0115 × S .5236 × R	.51764 × R
37½	1.55550 × S	.08255 × S .05307 × R	1.0181 × S .6545 × R	.64288 × R
45	1.30656 × S	.09946 × S .07612 × R	1.0262 × S .7854 × R	.76537 × R
52½	1.13048 × S	.11658 × S .10313 × R	1.0358 × S .9163 × R	.88458 × R
60	1 × S	.13397 × S .13397 × R	1.0472 × S 1.0472 × R	1 × R
67½	.89997 × S	.15167 × S .16853 × R	1.0602 × S 1.1781 × R	1.11114 × R
75	.82134 × S	.16973 × S .20665 × R	1.0751 × S 1.3090 × R	1.21752 × R
82½	.75833 × S	.18819 × S .24816 × R	1.0919 × S 1.4399 × R	1.31869 × R
90	.70710 × S	.20710 × S .29289 × R	1.1107 × S 1.5708 × R	1.41421 × R
105	.63023 × S	.24657 × S .39124 × R	1.1549 × S 1.8326 × R	1.58671 × R
120	.57735 × S	.28868 × S .5 × R	1.2092 × S 2.0944 × R	1.73205 × R
135	.54119 × S	.33409 × S .61732 × R	1.2751 × S 2.3562 × R	1.84776 × R
150	.51764 × S	.38367 × S .74118 × R	1.3552 × S 2.6180 × R	1.93185 × R
165	.50431 × S	.43849 × S .86947 × R	1.4523 × S 2.8798 × R	1.98289 × R
180	.5 × S	.5 × S 1 × R	1.5708 × S 3.1416 × R	2 × R

For *graphical* location of centers, given the angle and span, see Figures 213 to 217 inclusive, herewith.
For *graphical* development of simple and compound circular arcs, see Part 14.
For arcs having *commensurable* proportions, see Figure 147 in Part 16, and TABLE 5 in Part 17.
For *general formulas* having to do with the circle and segmental arcs, see Figures 151 and 152 in Part 17.

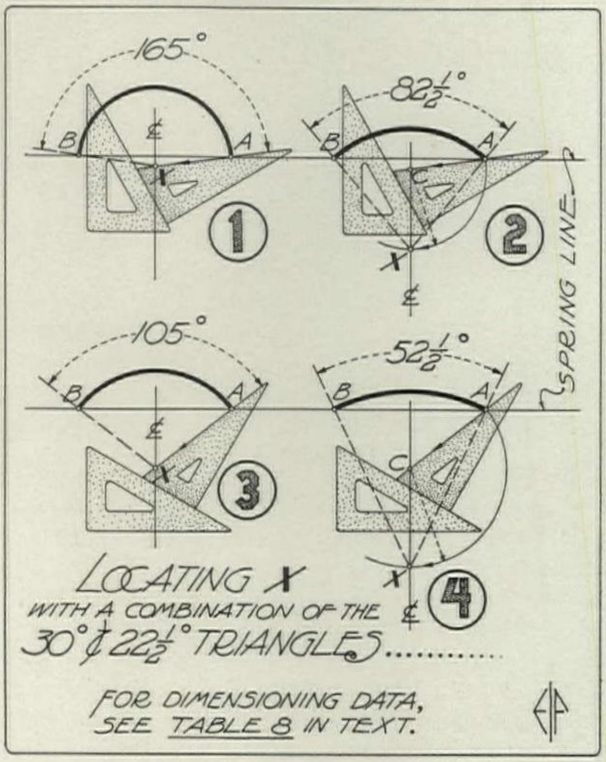


FIGURE 217

by two fixed points and subtending a given inherent angle. Having thus clearly stated a more or less common problem, the ensuing direct solution at Diagram "1" becomes self-evident. But, at Diagram "2," you may say that *X* could also be located directly by projecting a 67½-degree triangle-line from *A* or *B* to meet the known center line of the required arc. And so it could—theoretically. But, practically, the thus-intersecting lines would meet at such a slight angle that their exact point of meeting would *still* remain problematical. Hence, the somewhat less direct method depicted at Diagram "2" is productive of far more accurate *results.* In this case, the point *C* is first located with the 45-degree triangle, as shown, by lines crossing at *90 degrees*—a perfect intersection. (See Part 7.) Point *X* is then located by a swing of the compass, as shown, which also produces a *90-degree* intersection. Note that, by this process, the 90-degree angle *ACB* becomes exactly *halved*, while still maintaining the same span *AB*. The process is of perfectly general application. By a continuation of it, that is, by utilizing each successive center to locate the next, the immediately preceding angle becomes halved. Hence, the required center *X*, of Diagram "2," becomes the progressive center *D* from which the required center *X* of Diagram "3" is located. All of which is merely a practical *utilization* of the well-known-at-college fact that any angle with its vertex on the circumference of a circle is always one half the central angle subtended by the intercepted arc. So there you are—maybe it'll be well-known-in-the-drafting-room—sometime! Why not now? The remaining Figures of this Part require no comment—it's all there. So, TABLE 8 comes again into the discussion to add its final quota to the special short-cutting methods herein recorded:—

Let it be assumed that the circular segmental arc laid out at Diagram "2," of Figure 216 has a fixed span *AB* of 12 feet. As shown, the arc subtends, or shall subtend, a known angle of 75 degrees. What, then, is the radius-dimension, and what is the height-dimension, of this particular arc? Also, what is the length of this arc? Easy! For the particular angle of 75 degrees, TABLE 8 says that the *radius* is .82134 times the *span;* and that the *height* is .16973 times the *span;* and that the *length* of the arc is 1.0751 times the *span.* So go ahead and "figger." Just multiply the picked-off tabulated numbers by 12 feet, the *span*, and the results will accommodatingly become *dimensions in feet.*

The above single example serves again to show the efficacy of TABLE 8. You can quickly obtain therefrom all dimensions and the lengths of the arcs there tabulated, either in terms of the known *span*, or in terms of the known *radius.* Instances where the *radius* was the known quantity, have already been worked out in connection with Diagram "1" of Figure 212.

Now—just to keep in practice—work out the two following problems in *dimensioning;* utilizing the special data hereinbefore recorded. I'll do it too, and you can check your answers with mine, which'll be in *Part 23*, following.

Problem 1 (Dimensioning):

The arch laid out at Diagram "4," Figure 206, has a clear *span* of 10′-10″. What are its other *dimensions*, *r*, *R*, *H* and *L?* And what is the *length* of its intrados?

Problem 2 (Dimensioning):

At Diagram "2," Figure 217, *AB* is the extreme *span* of a Colonial porch roof; 7′-6¾″. What, then, is the *radius* of this 82½-degree arc? And how far will it *rise* above the spring line *AB?* And how long a single sheet of copper, say, would it take to just cover the roof surface from *A* around to *B?*

An Architect Who Went After Business—and Got It

By R. W. Sexton*

In boom times, the city may offer greater opportunities for an architect than a small town does, but in dull periods the small town is far more lucrative. At least, this was the opinion of Warren Shepard Matthews, a New York architect, who, realizing that he had everything to gain and nothing to lose, closed his city office last May and established quarters for the practice of architecture in New Milford, Connecticut, a small town about two and a half hours from New York by train.

He chose New Milford for several reasons. In the first place, it is readily accessible to the New York market; secondly, many New York people have recently built houses in the locality and they might reasonably be expected to be intelligent enough to recognize the benefits of architectural service; and, finally, there were no other architects located in the neighborhood. His first problem, then, was to get acquainted with these people, who lived there practically nine months of the year, and sell his services.

He engaged a secretary, a local girl, highly recommended by the Connecticut Light and Power Company, and who knew the country and the people. They then made a list of all the residents who were reasonably well off, not including the natives, and mailed them cards announcing that the firm was prepared to take care of all kinds of architectural, building, and engineering work, no matter how small or how large. The local newspaper, recognizing the "news value" of a New York architect establishing an office in the town, assisted in the publicity campaign by running an article on its front page.

Realizing that he might be called upon to do some work which required engineering service, Mr. Matthews interested Henry L. Felt, an engineer, in the idea and their card thus bore the name: Matthews & Felt, architects and engineers. Mr. Felt had been a classmate of Mr. Matthews at Princeton, 1912, and had been brought up in this section of Connecticut.

Their offices, located over a store on the main street of the town, cost then $20 a month. They paid the secretary $12 a week, and they rented a small house where the two partners lived for $35 a month. They took with them a foreman carpenter from New York who, for $7 a day, acted as the superintendent on all work, and employed local labor in all cases—including carpenters, plumbers, plasterers, steam fitters, electricians, etc. These men were only too eager to work for the firm and appreciated the opportunity to carry out plans by a registered architect.

Telephone calls soon began coming in asking for opportunities to consult with the firm on various matters. Their first job was to reverse a pair of casement windows from in-swing to out-swing. The owner complained that during heavy rain the windows, as previously hung, leaked badly. The job was done under the firm's superintendence by a local carpenter and the total charge was $30, including labor, material, and architect's fee of 15%. The owner was delighted with the result and the firm's service had been sold 100% to the first client.

With the aid of personal calls, other work began to come in. The firm built a tractor bridge over a brook that ran through a farm and made it necessary for the owner to drive around a main road for a distance of three-quarters of a mile to reach his farm land that was only 300 feet from the house. The bridge cost $210 and the owner probably will save enough money in gasoline charges and wear and tear on his tractor to pay for the cost of the bridge.

The architect found from a personal call that another owner was depending entirely for water on a rain water reservoir. In dry seasons, especially, he had barely enough water to meet his requirements. Mr. Matthews suggested that they run a one-inch water line to a small stream on the property, an eighth of a mile distant. The job cost the owner $326 including a small sand filter, and he has since had no more worries about lack of water or its quality.

In another case, the firm built a turn-around in the front yard of a house where the owner previously had had to back his car in and out of the garage at great inconvenience. A local contractor had at one time submitted a bid of $175 to build the new road, but the firm of Matthews & Felt had a much better plan and the entire charge for architectural service, labor, and materials was $52.

And so it went on, until on October first, four months after the office had been opened, Mr. Matthews reported that the firm had done $36,000 worth of business. Although Mr. Matthews expects to resume his practice again in New York this winter, he has definitely decided to make arrangements whereby he will continue his telephone connection and all calls will be relayed to his city office. And he is even now making plans for enlarging his New Milford office next summer and intends to take two labor foremen from the city to supervise the local workmen. At one time during the past summer he had as many as forty men on the payroll and with a list of three hundred prospects, many of whom he has talked to personally, and with economic matters improved, he looks forward to a better season than he had this year.

**Director, Bureau of Architectural Relations.*

Modern Heating Methods

A Discussion of Recent Advances in the Industry and Their Reflection in Building Design of Today

By Harold L. Alt

Editor's Note:—*The items covered in this discussion are limited to those which have been on the market and in use for a sufficient length of time so that the author, an active and well known heating engineer, is fully posted as to their practicability and satisfactory operation, at least in some degree under actual operating conditions. Very recent developments, such, for example, as the new complete oil-burner-boiler unit now being made by several leading manufacturers, are not covered since the author does not feel that he can yet give an authoritative opinion, based on experience, as to their merits.*

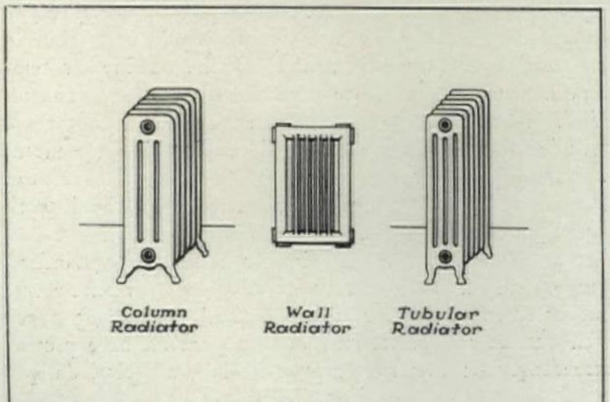
Tremendous strides in heating have been made during the last decade—which practically includes all the time intervening since the great war owing to the fact that, although the armistice was signed November 11, 1918, it was some time before factories and personnel could be brought back to a peace time standard and still further time had to elapse before new and improved equipment could be manufactured and placed on the market. By 1922 the influx of new and improved designs was well under way and has continued, in almost uninterrupted flow, from that time until the present with the likelihood of extending indefinitely into the future. This is largely owing to the keener competition now existing due to the depression which has taken heavy toll of the building industry in the last three years including not only the industry but architects, engineers, railroads which transport the material and, in fact, reaching into every channel of American business. Along with the others, the manufacturers of heating materials and devices have been just as hard hit and have reacted by turning some of their surplus energy to developing improved designs.

Now that all indications point to a gradual resumption of the normal flow of business which soon will affect every line of endeavor, it behooves one to stop and take stock of what the last few years have brought forth, especially of those things that are really worthy of notice and deserve general adoption in the heating plants of the future. For this purpose, the subject will be divided into the three general heads of radiation, heating systems, and heat production, and an effort will be made to summarize the major and outstanding features which may be included in each classification. Of course, in an article of this character it is impossible, simply because space limitation forbids, to note and describe every device which may be well worth mention, but we will endeavor to point out the revolutionary changes and those involving radical departures from what might be regarded as former standard practice.

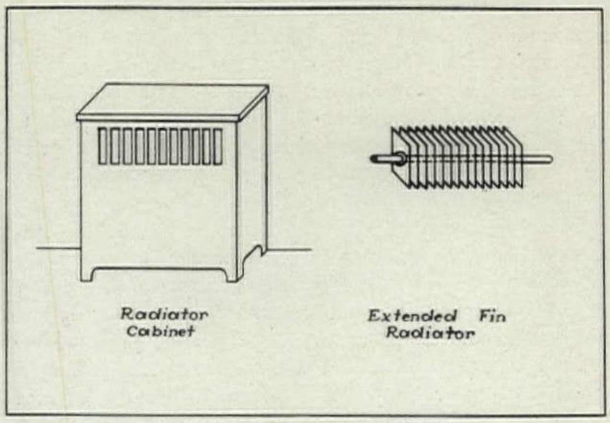
Direct Radiation

The architect is most intimately concerned with the radiator and dislikes the appearance of the common cast iron exposed radiator, ordinarily termed a "direct radiator." Shortly after the war the-then-new type of *tubular* cast iron radiator was placed on the market in an effort to meet the objections architecturally voiced against the ungraceful appearance of the standard *column* radiator (see Figure 1) which up to that time had been practically the only type of direct radiator offered outside of the wall radiator (see Figure 2) still being used today. Numerous advantages were pointed out as assets of the tubular radiator such as a larger number of small columns giving added surface, a more artistic design, and so on. Subsequently the manufacture of column radiation gradually dropped off until it ultimately was discontinued altogether. Today the tubular radiator (see Figure 3) may be regarded as the standard cast iron radiator although some other designs such as the flat front radiator, for installation in recesses under window sills, and a special type of radiation resembling tubular but more compact, may be obtained.

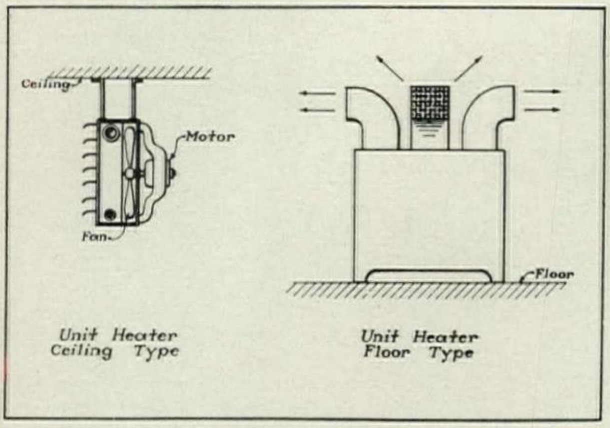
The fact remains, however, that the tubular cast iron radiator has lost ground in recent years and that—like coal which still is King—heavy inroads have been made on



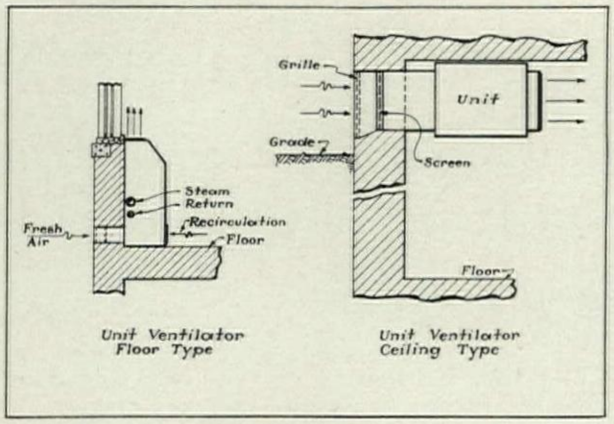
FIGURES 1, 2, AND 3



FIGURES 4 AND 5



FIGURES 6 AND 7



FIGURES 8 AND 9

its former exclusive territory. This is in spite of the efforts made to dress up the cast iron radiator in radiator cabinets, to conceal it back of grilles, and whatnot. Evidence of this trend lies in the advent of numerous types of cast iron convectors, usually of fin design, recently placed on the market.

Radiator Cabinets

One of the first efforts made to make the cast iron radiator inconspicuous, and as little objectionable as possible, consisted of placing such radiators in recesses with one or more grilles on the face or in the sill above. This, however, was often a very expensive solution owing to the cost of providing the recesses, lining and insulating them, and later supplying grilles to cover the inlets and outlets to the concealed radiation. The placing of radiator cabinets on the market, built of furniture steel, with enamel finish and grilles of various designs and styles (see Figure 4) did much to enhance the architectural appearance of the tubular radiator. The fact remained that such radiators, although greatly improved in appearance, still occupied floor space and often proved to be located in undesirable places when the furniture came to be placed in the room later. In spite of this, cabinets still are greatly in favor for certain classes of work, especially when convectors are installed.

Convectors

A convector is what formerly was termed an indirect radiator. Inasmuch as the major portion of the heat from such surfaces finds its way into the room via the convection air currents set up across the heater surface and little, if any, radiant heat is given off, it is felt that the term *convector* is more correct and descriptive and this type of surface now is officially so termed. The general construction is that of a central core, in which steam is contained, to which is attached extended surface of the "fin" type, the material usually being of copper although aluminum, brass, cast iron, and other metals are employed in some instances (Figure 5). The convector is placed either in a cabinet or a recess, and has the air enter below, pass up through the extended surface—where it picks up the heat—and issue forth either through a vertical grille above the convector or through a horizontal grille placed in the cabinet top or window sill above.

The question may come up as to why the convector does not cost just as much to recess as the cast iron radiator. To this inquiry, answer may be made that the convector is a much more concentrated type of heating surface, occupying in many cases only about 40% of the area that an equivalent cast iron radiator would, so that it is not as costly to recess with this form of heating surface. At the present time non-ferrous radiation is so low in price that it is closely competing with cast iron even when the cost of cabinets is included. Owing to the lesser weight involved it is claimed that copper surface heats up more quickly but it should not be forgotten that the same thing holds true when it comes to cooling off. The height of the flue above a convector will increase the amount of heat delivered and most of the convector manufacturers present tables showing the equivalent direct heating surface for various flue heights.

Unit Heaters

The unit heater is distinctly a development of the last decade and may be described in general as a concentrated bank of heating surface behind which a fan is placed to blow the air through the heater. When the fan is not running, a small amount of heat will be delivered by the heating surface although this is generally so small as not to necessitate the cutting off of the steam supply to the heater until all artificial heat can be dispensed with. Unit heaters are also constructed of the cabinet type with filters and humidifying devices and can embody a very great amount of heat capacity in a very small space. Usually the smaller designs are for mounting at the ceiling, as shown in Figure 6, but the cabinet designs are more frequently set on the floor with elbows on the top to direct the air delivery in several directions, as indicated in Figure 7. Unit heaters are much used in industrial installations, shops, and large assembly halls and gymnasiums. There also is another application very frequently made in cold vestibules where severe incoming cold draughts have to be met.

Unit Ventilators

Closely allied with the unit heater is the unit ventilator; in fact a unit heater taking its air supply from the outside may correctly be termed a *unit ventilator*. The unit ventilator, however, usually includes not only a fresh air supply but also an arrangement to bypass the air across or around the heater so that a tempered supply of air can be delivered at all times regardless of the outside air temperature and in accordance with the temperature demands of the room. Frequently air filters of the dry type are included with such ventilators and occasionally some means of humidifying the air. These ventilator units have been adopted to a very considerable extent for school work (see Figure 8) and can be obtained in standard sizes to deliver 30 cubic feet of air per minute for standard pupil-rooms in accordance with the legal requirements. For basement use these units are built in ceiling types with outside air connections and, in general, have proven exceedingly satisfactory. Figure 9 shows a typical design.

Pipe Coils

Pipe coils are no longer used to any extent outside of certain industrial projects and it is a question whether their

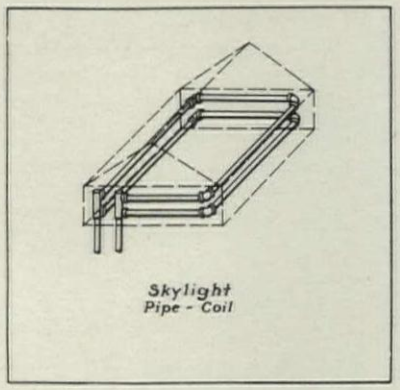


FIGURE 10

use is economically justified at all with the high cost of labor and the difficulty of erection. They still have an application in small skylights where one or two pipes can be run around the vertical walls of the skylight between the skylight glass and the sash below in the manner given in Figure 10, to prevent condensation and to take the heat loss from the glass. The vertical pipe carried up through a series of superimposed bathrooms still prevails in competition apartment house construction but is not an economical heating proposition owing to the fact that the heat emission cannot be controlled by any known method outside of a general control for the entire building, or individual manually controlled valves on each riser.

Summary

From the above it will be observed that the architect today must be acquainted with a great deal more than direct radiators and that he has not only a selection of several types of cast iron and copper surfaces but also numerous other devices having particular applications. He should, of course, know the places where such applications are unsuitable. It now has become more necessary than ever to be careful in the selection of equipment and no one type or device will fit every condition with the optimum of desirability.

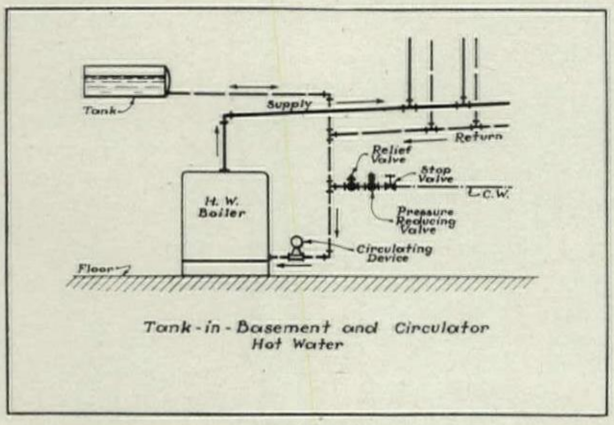


FIGURE 11

Heating Systems

Nowhere in heating is a greater diversity shown than in the new types of systems which have been developed. Up to about 1926 or 1927 there was no question on a large installation but that vacuum heating would be installed. Occasionally forced hot water was used especially in jobs covering large areas and without much height of structure. Vapor steam systems for residences and some smaller and, occasionally, moderate sized buildings had been used even prior to the war but at that time the one-pipe steam system had a great popularity which it still retains to a considerable extent largely due to the economical cost of installation. Gravity hot water systems had some very ardent advocates in some sections of the country for residence work and warm air furnaces had, and still hold, a very strong position in the central states. Now, closed hot water systems, tank-in-basement and impelled circulation with the aid of mechanical circulating devices are the rule. Vacuum systems have been radically modified. Let some of the more radical changes in heating systems now be considered.

Closed Hot Water Systems

The difficulty of placing overhead expansion tanks in positions sufficiently elevated above the top of the highest radiation, the danger of such tanks freezing during the night and boiling during the day when high water temperatures were being carried, led to an effort to use expansion tanks located in the basement in which air pressure was carried sufficient to force the water into the highest radiators. To keep such a tank filled, city water pressure is used and the compression of the air in the tank provides for the expansion of the water when heated. A relief valve insures the escape of a small amount of water if the pressures ever exceed the safe limit and a pressure reducing valve gives an automatic feed to the system so that there is no danger of going dry, nor does the system ever have to be filled up by hand except when starting up in the fall. Such is the so-called "tank-in-basement" closed hot water system frequently installed in residences where hot water heating is desired.

Forced Hot Water Systems

The use of forced hot water systems should be limited to installations where the height does not produce excessive heads in the lower portions. It is only such a type of structure which is particularly suited for this method of heating but even here there are grave objections, such as the danger of freezing, damage from leaks, and the cost of operating the circulation pumps—an item of no small magnitude. The old argument of better temperature control and greater economy in fuel consumption has lost much of its weight with the coming of better temperature control systems for steam, and steam systems of proper character can give hot water real competition when temperature control and economy are the only factors to be considered.

Circulator Hot Water Systems

The ordinary hot water system of either open tank or closed tank variety is much improved by the use of a small circulating device in the shape of an impeller installed in the circulation lines and operated by motors ranging from 1/10th to 2 horsepower according to the size of the system. These devices speed up the circulation, rapidly rotate the water and increase the boiler efficiency by means of the accelerated flow across the boiler heating surfaces. They do not require the entire water contents of the system to become heated before circulation begins but, on the contrary, circulation may be started as soon as the fire is lit and an almost equalized temperature of water is at once circulated to all parts of the

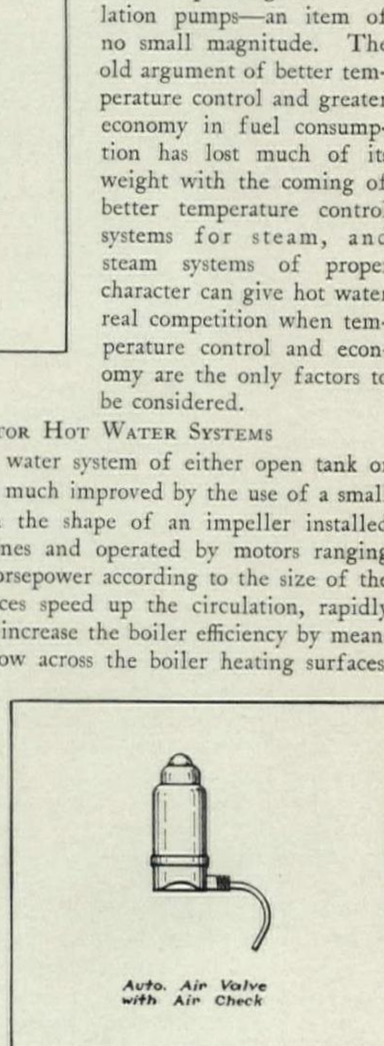


FIGURE 12

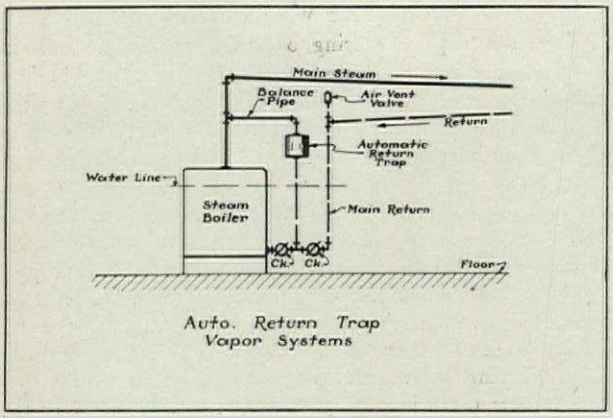


FIGURE 13

system. Slightly smaller pipe sizes are permissible and a slightly higher average radiator temperature is usually secured. The combination of a closed hot water system with an impeller or circulator added gives an installation greatly superior to the old type gravity system. A typical example of a closed system with tank-in-basement and a circulating device is indicated in Figure 11.

One-pipe Gravity Steam Systems

One-pipe steam heating has advanced but little in the past ten years; there has been a standardization of pipe sizes so that less trouble is experienced with such installations and an automatic air valve has been placed on the market with a check (see Figure 12) so that air after being expelled cannot return to the radiator. As a result, systems so equipped may be run under a partial negative pressure after the air has been initially expelled and can more nearly approximate vapor conditions than formerly. Outside of these two items there is little change from the original one-pipe steam job put in many years ago.

Two-pipe Gravity Steam Systems

The two-pipe steam system of gravity type is practically obsolete and no longer is used to any extent. There are many old systems still operating by this method but they are gradually being revamped into some other more satisfactory scheme of operation such as changing them over to vapor, vacuum, or some other more up-to-date method. The same may be said for air line systems. The inconvenience of operating two radiator valves in order to turn the radiator on and off combined with the difficulties experienced with circulation and the back-firing of the steam through the return connections had much to do with the passing of the two-pipe gravity steam design of piping.

Two-pipe Vapor Steam

Vapor heating still remains a very satisfactory method of heating residences and moderate sized buildings where something better than the one-pipe steam system is desired and yet where the operating cost can ill afford to carry the electric charge for running a vacuum pump. The primary idea back of vapor design is to expel the air from the system by initially raising a steam pressure until this is accomplished and then to prevent the return of the air when the fire goes down and steam is not produced as fast as it is being condensed. As a result of the reduced amount of steam formed and a continued condensation in the system, a self-induced vacuum—or, rather, a partial vacuum—is formed in the system and the steam expands under this partial vacuum with a corresponding reduction in temperature. The boiler fire will continue to produce steam—or vapor—under this partial vacuum with less fire than would be required if no vacuum existed on the system and with a corresponding reduction in fuel consumption.

Graduated valves are almost invariably used on such systems and an automatic-return-trap, as shown in Figure 13, should always be installed to prevent an excess, or unusual, steam pressure driving the water out of the boiler due to the return being open to the atmosphere. One of the beauties of this type of heating is the facility with which temperature control of almost any character can be applied without difficulty. Some types of vapor heating do not operate at an actual vacuum but, instead, operate at a pressure one or two ounces above the atmosphere; while such systems are not *strictly* vapor systems, they are so designated by trade practice and are generally included in the broad sense of the term "vapor heating." There also is a one-pipe system of vapor heating on the market which has won considerable success. This system employs a special plug cock type of valve on the radiator inlet and a special type of air valve on the opposite end of the radiator.

Two-pipe Vacuum Return Line System

In buildings where the luxury of a vacuum pump can be afforded, and in practically all work of large character, the vacuum system—either in its original form or combined with various other improvements which later will be discussed—forms the backbone of nearly every heating design. Occasionally forced hot water will be used especially if the structure is low in height and, recently, hot water with forced circulation was installed in a building of considerable height. This must be regarded as an exceptional job, however, and not by any means forming a general practice. In the two-pipe vacuum system, steam is delivered to the radiators through a system of steam mains at any pressure desired—usually about 2 lbs., gauge—and penetrates the radiator as far as the thermostatic trap on the return end. On the other side of the trap in the return pipe system the vacuum pump constantly maintains a vacuum fluctuating around 10 inches and discharges the air (coming back in the return line) to the atmosphere while the condensation is delivered to a feed-water-heater, or directly into the boiler, if the boiler is one operating under low pressure. Many persons do not understand that in a vacuum system there is no vacuum on the steam line nor in the radiators; the vacuum is actually confined to the return line so long as there is steam in the radiators and on the system.

This system possesses the faculty of being particularly suited for the application of the various temperature control devices and may be installed with graduated valves

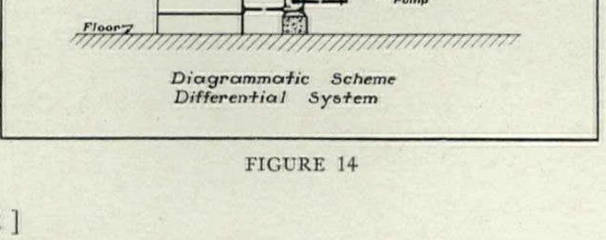


FIGURE 14

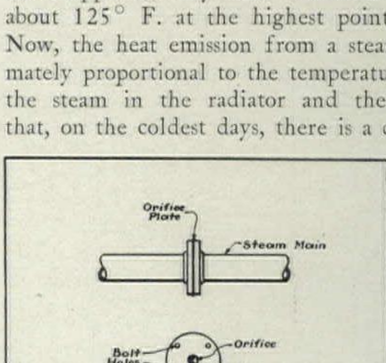
on the radiator supplies for manual control if so desired. In high buildings no excessive pressure is generated in the lower piping and with an overhead-down-feed arrangement, the return pipe sizes on the lower floors are kept down to the minimum.

Fixed Differential Systems

Although vacuum systems became more a standard method of heating than perhaps any other type of steam system and held an enviable position over a long period of time, in 1926 an improved type of vacuum system known as the fixed-differential system was placed on the market as a result of several years of experiment and investigation. This system immediately proved a success and has been adopted in an increasing number of buildings each year, involving as it does not only heating but temperature control as well. No attempt will be made here to go into the technical details of the system but every architect should be familiar with the basic principles under which it operates.

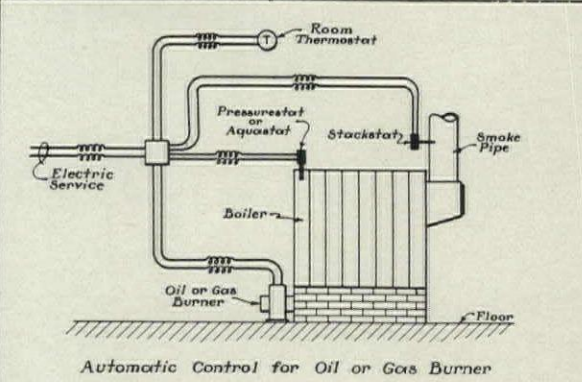
In this system the vacuum *does* penetrate through the radiators and into the steam line due to a control valve placed on the general steam supply line which valve cuts down the steam supply in accordance with the demands of the temperature in the building which, of course, are largely governed by the outside weather conditions. The vacuum pump is a special pump with a controller so arranged that whatever the vacuum on the steam line, the pump will carry approximately 2″ higher vacuum on the return (see Figure 14). As a result, there always is a lower pressure in the return than in the steam and this is the "fixed differential" on which the system operates. In very cold weather the system is run as a straight vacuum system but, as the temperatures outside rise, the control valve on the steam line gradually shuts down, thus supplying an inadequate amount of steam to fill the system. The condensation of the steam in the system, however, gives rise to a self-induced vacuum—the same as previously described as occurring in the true vapor systems—and partial vacuums are produced which may go as high as 26 inches, if the weather becomes sufficiently mild. Special traps are used to function under such vacuums and the vacuum pump is so designed that it will continue to operate no matter what vacuum is being carried in the system. The radiator valves are equipped with orifices to aid in the proper distribution of the steam.

The result of this is to reduce the steam temperature from approximately 220° F. at 2 lbs., gauge, down to about 125° F. at the highest point the vacuum reaches. Now, the heat emission from a steam radiator is approximately proportional to the temperature difference between the steam in the radiator and the air in the room so that, on the coldest days, there is a difference of 220° F. less 70° F. or 150° F. while, on the mildest days, the difference will be only 125° F. less 70° F. or 55° F. which indicates that the heat emission based on temperature difference alone would drop to about 36% of maximum. But, besides this, the enormous expansion of the steam under high vacuum produces velocities through the radiator orifices which help to throttle the radiators so that the control is carried down far below the 36% line. Thus, practically all the temperature control on the building as a whole may be secured by means of the main control valve which may be either manually or thermostatically controlled.



Plates in Steam Mains Orifice Systems

FIGURE 15



Automatic Control for Oil or Gas Burner

FIGURE 16

The two great advantages of this system lie in the additional comfort secured and the fuel savings resultant from never having the building overheated. Tests conducted on the same building (with the same occupancy and with the same heating system simply run as straight vacuum operation as against differential operation) show by test to range from 25% to 40%. The initial cost is considerably less than a straight vacuum system with sufficient thermostatic control to secure the same economy and the simplicity is very manifest.

Orifice Systems

Shortly after the fixed differential system was placed on the market orifice systems were designed in an effort to duplicate the results obtained with fixed differential. Some of these systems use radiator traps and some do not; some require a vacuum pump and others dispense with the pump altogether. The basic principle on which they are designed is that the steam flow through an orifice will go up to a certain velocity and then will not increase materially beyond this velocity. If the outlet pressure on an orifice is 58% or over of the inlet pressure, the flow through the orifice will be less than the maximum, graduating down to zero when the two pressures are equal. On the other hand, if the outlet pressure on the orifice is less than 58% of the inlet pressure, the velocity through the orifice will not be materially increased even though the outlet pressure falls as low as 1%. Therefore any pressure in the radiator which does not exceed 58% of the inlet pressure will give a constant—or practically constant—velocity through the orifice. Orifices are installed on the mains in some instances as shown in Figure 15.

As the volume of steam changes with the pressure, it follows that almost any quantity of steam can be delivered through a given orifice by simply changing the inlet pressure. This is what is done in the orifice systems, a high pressure being used when cold weather is attained and the orifice made of just sufficient size to allow the radiator to receive its full quota of steam at the highest pressure to be used. As soon as this pressure is dropped, the velocity remains unchanged but, owing to the greater volume of steam to be passed at the lower pressure, the weight of steam delivered is less and the radiator is partially starved, giving off only a portion of its full amount of heat.

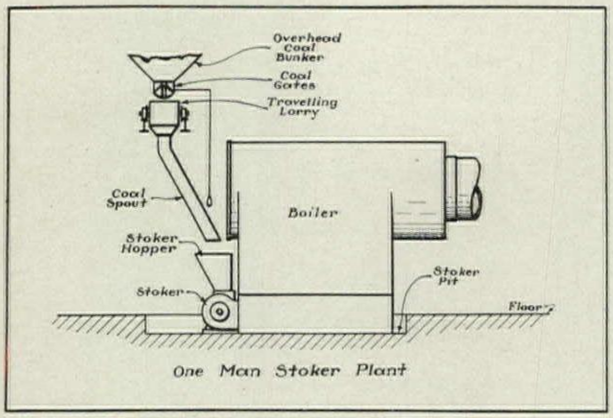


FIGURE 17

One of the most successful of these systems employs a special control with a thermostat on the roof and another in the building so that the pressure is governed by a mixed action of the two thermostats. This system is not recommended for systems under 10,000 sq. ft. of surface and is somewhat more costly than fixed differential. It has not yet been installed in a sufficient number of varying types of buildings to state with any positiveness just what may be expected from it, although it seems that it may have some very good possibilities.

Temperature Controls

In no branch of heating has there been greater progress than in the various automatic temperature and safety controls which have been developed within recent years. The well known systems of pneumatic control are still as strong as ever but a host of new controls, particularly of the electric type, have been developed. These started with the old electric control operating a motor to open and close the draughts on a coal fired boiler (sometimes with a clock for opening up in the morning) and have progressed to a point where almost anything that can be done pneumatically can also be done electrically. Oil and gas fired boilers gave a great impetus to the electric control business and aquastats, pressurestats, thermostats, stackstats, and motor-operated-valves have resulted. A typical automatic control installation for oil or gas fired boilers is given in Figure 16.

Temperature control may be divided into two general classifications these being "general controls" and "individual controls." By general controls is meant controls handling the building, or section of a building, as a whole and by individual controls is meant those handling the single unit, or radiator. There are many designs, for example, of the self-contained thermostatic radiator control valve which is attached to the radiator in place of the ordinary hand valve and, when so attached, automatically maintains the room temperature for which it is set. Then there are the general controls which operate the building as a unit, usually from the boiler, or else control the building in sections, such as occurs with motorized-valves placed on certain mains feeding the sections to be controlled.

Among the controls with which the architect most frequently will come into contact might be mentioned:

a. The room thermostat, controlling the temperature of the room or house by the temperature of the air surrounding the thermostat.
b. The aquastat, used on hot water boilers to prevent the water temperature going above the safe limit.
c. The pressurestat, used on steam boilers to prevent the pressure going above the safe limit.
d. The stackstat, which is used in the smokepipe of oil fired boilers and which turns off the burner oil if the stack does not heat up within a given time after the ignition is supposed to have taken place.
e. The motorized valve, which opens and closes in response to the electric impulses from the thermostat.
f. The potentiometer, which is an electric graduated thermostat controlling a motor in steps from full open to full closed.

These are only a few of the most common and the designs and types are legion. Each manufacturer has his own mechanisms and devices which he applies to the different cases and the best method is to hand the problem to him direct and let him work out what he would recommend.

Then there are the heating systems which have automatic control incorporated as an integral part of the system such as the fixed differential and orifice systems. Many steam jobs utilize what is commonly termed the "on-and-off" control where a clock actuated mechanism turns the steam on the building for greater periods with a shorter time of cut-off in colder weather and on for shorter periods with a longer time of cut-off in milder weather.

Controls for unit heaters usually consist simply of a thermostat of some character which stops the motor when the surrounding atmosphere has reached the desired temperature; the heat emitted by the heater when fan is not running normally is not sufficient to overheat the space in which the heater is located until outside conditions become warm enough to permit the closing off of the steam supply entirely which, of course, automatically shuts down the radiator.

Conditions occasionally arise where the heaters are located in basements where, at times, considerable heat may be generated in certain sections yet where it would be impossible to shut off the steam supply to the other portions, thus making it desirable to be able to shut down the radiators, as well as the fans, in the overheated sections. Under such conditions a duplicate control is provided for the heater, one portion of which first shuts down the fan and the other portion of which later closes off the steam supply to the heater if the temperature in the room continues to increase.

On unit ventilators for schoolhouse work the control must be arranged to suit the type of ventilator used; for example these units may be equipped either with a mixing damper, which bypasses the air across the heating surface in accordance with the demands of the room temperature, or the mixing damper may be omitted and the heater di-

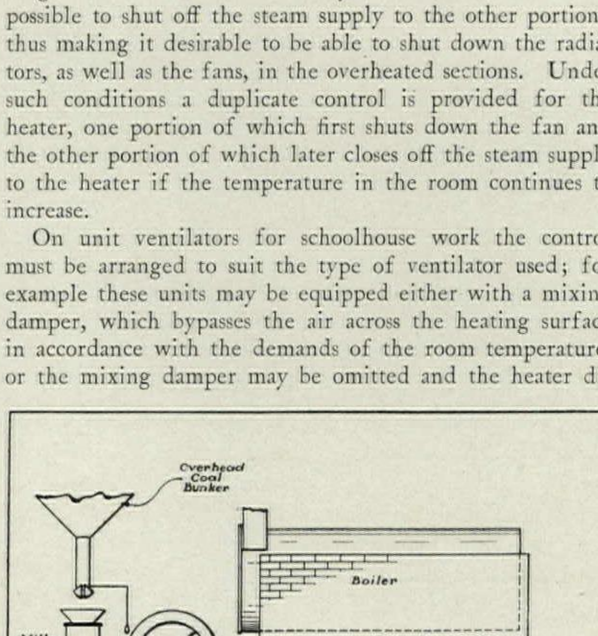


FIGURE 18

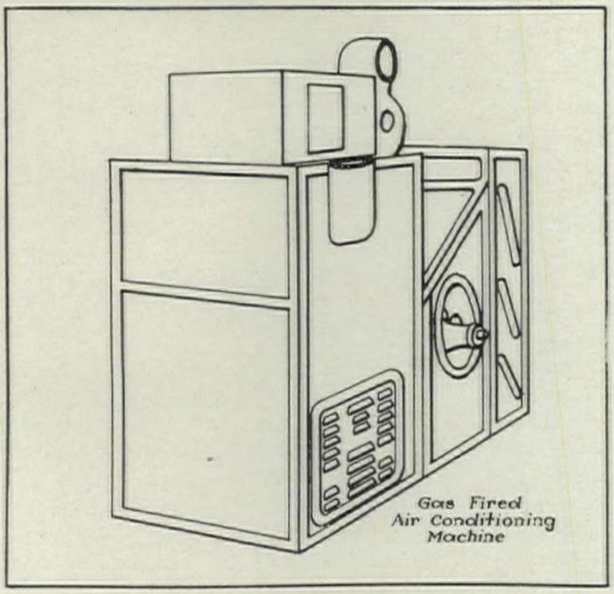


FIGURE 19

vided into two sections one set above the other. The lower section acts as a tempering coil and delivers air to the classroom at a temperature never less than 60° F. while the second section comes into service and heats the air to a higher temperature when the temperature in the classroom is below the desired point. Recirculation should be provided for in both types of ventilator on the basis of economy in heating up, although many school buildings are equipped both with ventilators and with radiators which are entirely independent. The function of the direct radiators in these cases is to bring the room up to temperature and to hold it there, either with or without occupancy. The function of the unit is to ventilate the room only when it is occupied. The fact remains, however, that even with this arrangement, the room can be heated up more quickly on Monday mornings, and mornings after holidays, if the ventilating units are equipped with recirculation dampers.

Now as to the matter of control; the units with bypass dampers are generally controlled by two thermostats, or by one thermostat with the so-called "step-action." With the two thermostats, one thermostat controls the bypass, or mixing, damper so as to throw on entirely cold air as the temperature in the room rises; the second thermostat cuts off the heater in the unit if the temperature continues to rise above the point where the damper is supplying entirely unheated air. With the single "step-action" control, one thermostat first throws the damper to entirely cold air and later cuts off the heater. With the two-part heater rig the first heater is in service at all times unless the room temperature goes above normal and the second heater comes into play only when the room temperature is below normal. Either two thermostats or the "step-action" thermostat may be used for this control. The recirculation dampers are best arranged with a manual control in the boiler or engineer's room so that all units can be thrown onto recirculation before class time in the morning and each unit then may be started up by throwing in the electric switches controlling the circuits on which the unit motors are placed. Later, at 9:00 A. M., the recirculation dampers can all be thrown over to fresh air by the custodian, or janitor, with the assurance that no heat has been wasted in ventilating empty rooms.

The addition of one or more direct radiators in conjunction with the ventilating units adds somewhat to the complication of the automatic control but is most easily provided for by putting the direct radiators on a control that will open them whenever the temperature in the room falls to 65° F. and closes them whenever the temperature rises to 67° F. so that the radiator comes in and boosts the temperature whenever the unit alone can not keep the room up to the proper degree. The exact degree at which the thermostats are set is developed on each installation to meet the ideas of the parties concerned, but the general principle—that the unit takes all the heating and ventilating load up to the limit of its capacity and that the direct radiator comes in only when the unit is unable to maintain temperature desired—is seldom deviated from. Such combination arrangements result in a considerable economy in electric power owing to it not being necessary to operate the units when only heat is required which, of course, covers all times when the room is unoccupied.

Summary

Thus it will be seen that, as far as heating systems are concerned, the greatest advance in the one-pipe steam system is the checked automatic air valve, in hot water heating the closed system and the mechanical circulator, in vapor heating the automatic return trap, in vacuum heating the fixed differential, in automatic control the electric systems for purely separate controls and the fixed differential system for combined control and heating. There may be some who would attribute certain other items as deserving prominence as, perhaps, they do, but the above covers the outstanding and principal high spots as seen from the designer's standpoint.

Heat Production

In the production of heat, radical innovations have come to stay; oil fired and gas fired boilers, stoker boilers for domestic use, and street steam, are probably the most important. There are two distinct reasons why the changes in heat production have been brought forth; one is economy and the other is convenience and cleanliness. For example, there is a widespread effort to get away from large size anthracite coal simply on account of the high cost of this fuel. Substitutes of smaller sizes, or of bituminous coal, usually are adopted. Then there is the individual generally well-to-do, or fairly so, who doesn't want to mess around with coal and ashes or who objects to his wife having to stoke a fire while he is away during the day or on long trips. Such people usually go to oil or —sometimes—gas. While there is considerable variation in different localities, it may be roughly considered that in the ordinary case oil compares economically with coal when coal is about $9.00 to $10.00 per ton. So it will be evident that a stoker with small coal will be able to turn out a yearly fuel bill somewhat less than with oil but an ordinary grate with large anthracite coal is likely to have an annual fuel bill in excess of oil. Gas —unless it is natural gas—always has a high rate compared to the heat delivered and the owner should secure careful

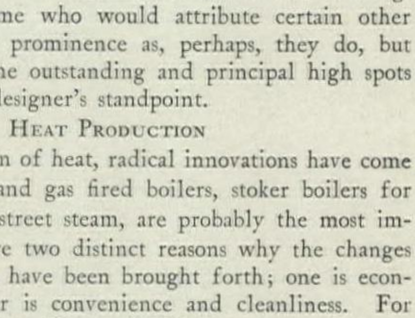


FIGURE 20

estimates as to the probable annual gas bill before committing himself.

STREET STEAM

The ordinary large building today, in districts where street steam is available, almost without exception utilizes this service. When this is done the cost of a boiler room and chimney is eliminated, the floor space which would be occupied by the chimney can be rented and produce an income, while the boiler room space often very conveniently can be utilized for storage or even may not be excavated at all. The nervousness about building a large skyscraper without a chimney has largely disappeared and it is interesting to note that the United States Government recently contracted for all the Federal buildings in New York City to use street steam service.

In this type of heat production exists the paradox of there not being any heat produced. The company brings in a main delivering steam somewhere around 100 lbs. pressure and the owner simply connects onto the end of this main beyond the meters and carries the piping from this point on through the building. The returns are pumped through a cooling coil or heat exchanger of some sort and delivered to the sewer at less than 100° F. In case the owner has any use for this water it is all his to use but in most instances it simply is allowed to run to waste. The advantages of this means of heat supply are many; all coal, oil, dust, noise, and smoke are immediately eliminated; the owner has no responsibility in operating a plant; there is no plant depreciation to be charged up against the building; and so on. Oh, yes, it costs a little more than to generate your own steam even when all the items of the building steam plant are considered, but the convenience is felt by many to be well worth the price.

COAL FIRED PLANTS

The coal fired plant still is king in economy, smoke has been eliminated, and mechanical coal and ash handling reduce the labor down to a level where further reduction becomes impossible. The coal-burning plant as designed today is frequently made as so-called "one-man" plant. That is to say the whole plant can be operated by one man with less labor than four or five men would have had to produce in the old days. This is accomplished by storing the coal in overhead bunkers from which it is delivered by gravity to the furnace and the fireman never does more than to pull a lever. This is indicated in the arrangement shown in Figure 17. The raising of the coal to the bunker and the delivery to the various parts of the bunker are accomplished either by a bucket conveyor and belt or by a skip hoist.

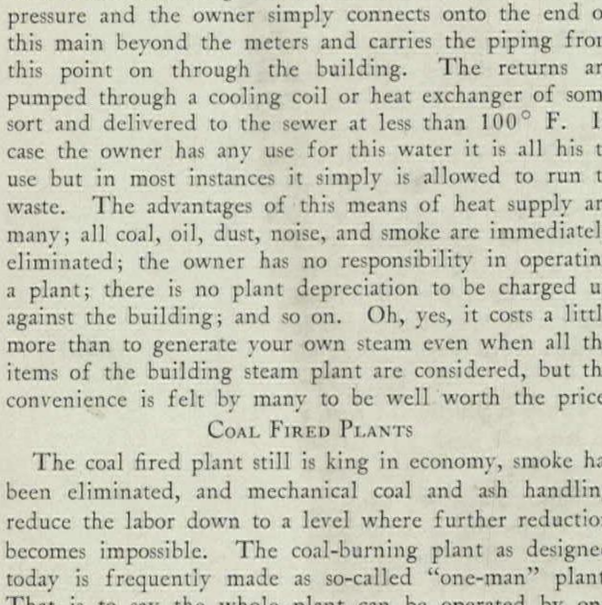


FIGURE 21

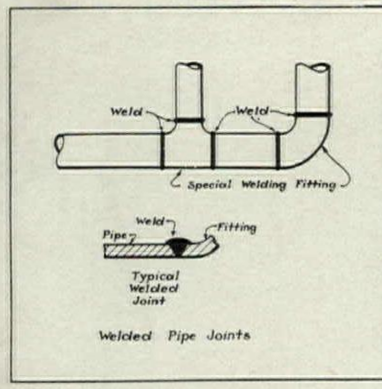


FIGURE 22

Ashes are removed by means of a scraper and elevator or some kind of steam jet ash conveyor. Sometimes the ash is raked out into a small ash car which runs down a short length of industrial track and dumps into the conveyor or skip hoist. No longer is the coal-fired plant a back-breaking, heart-breaking, filthy, dusty job. And this brings up the question of stokers.

STOKERS

Stokers have been in use in large power and steam plants for a great many years but it is only within the past six or seven years that they have begun to be built for smaller size jobs and even for domestic service. They may be roughly grouped into underfeed, overfeed, and chain grate types. They may be steam or electric operated although most of the smaller sizes are electric driven. The underfeed stoker can burn almost any material that is combustible and pushes the material in at the bottom with the fire on the top burning downward. The ashes are frequently spilled from dumping grates, located on each side, into a pit from which they are removed by hand or in one of the ways previously described. Most stokers employ fans for forced draft.

The overfeed stoker delivers the fuel on the top of the fire, gradually pushing toward the rear as it is consumed; the chain grate carries the fuel into the furnace supported on a link mesh gradually moving toward the rear so that, by the time the fuel has burned out and turned to ash, it is dropped off of the end of the stoker. The chain grate is used almost exclusively for anthracite coal and is somewhat more expensive in first cost than some of the others. The stokers can be provided with automatic controls which are actuated by the steam pressure and speed up or slow down in accordance with the rise and fall of the pressure within very narrow limits.

The small domestic stoker is equipped with an abnormally large hopper so that it can be filled up to last for a considerable length of time and, after this is once done, the stoker will automatically function until the supply of fuel is exhausted. So it will be seen that stokers too have gone to college and obtained a diploma for convenience and economy.

PULVERIZED COAL

Stokers at present are suffering from a rather keen competition offered by powdered coal installations. Formerly the pulverized fuel plant was a very expensive article and, just on account of the first cost, was limited to use by large utility companies and similar installations. With the advent of the single mill per boiler the pulverized fuel people began making installations as low as 150 horsepower and applying this method of firing even to existing boilers which had previously been using hand fired grates or some other method. The procedure is to construct a mill (or grinder) and blower of sufficient capacity to operate the boiler at the rating desired and to connect this mill with the boiler where a burner is located in the furnace. Coal is fed into the mill from an overhead bunker by gravity. Thus there is no storage of pulverized fuel, no danger of explosion, and about 5% greater efficiency can be had from the boiler. The first cost is likely to exceed that of stokers to a small degree. See the typical installation shown in Figure 18 for a horizontal return tubular boiler.

Oil Burners

Oil burners are distinctly a product of the last ten years and originally were put on the market without sufficient experimental work and with inadequate safety and control devices. The burners were soon improved, however, and the control people solved the other item in such a manner that oil burners today may be considered as quite safe and entirely satisfactory. They require only about 2/3 of the chimney area necessary for coal. They should be capable of burning as heavy an oil as consistent with the burner characteristics, on the ground that the light oils are more expensive for the Btu contained than the heavier grades, and should be full automatic; that is, pressure, ignition, oil valves, and burner should all function without human agency. The stackstat is an important item which should never be omitted.

The ordinary residence can be supplied for a very moderate price with an oil burner installation complete, including tank, applied to an existing boiler. All boilers, however, are not suitable for oil burners of all types, the general characteristic desirable being a long flue travel such as is offered by the ordinary steel firebox boiler. A reasonably sized storage tank with a proper indicator of the contents is a necessity for a proper oil burner job. If too small a storage tank is used, frequent refillings will be necessary and it has been found that the ordinary residence uses about 3 gallons of oil per season per square foot of steam radiation installed. This would work out a little over 3/5 as much per square foot of hot water radiation and from this some idea of the number of fillings per season can be obtained if the approximate amount of heating surface is known.

Steel Residence Boilers

The oil burner has been largely responsible for the development of the steel house-heating boiler. These boilers are of the firebox type and may be secured in sizes to suit the ordinary residence but hardly small enough for a bungalow. They have the advantage of a comparatively long flue travel, no cracked sections, and will fit in long narrow spaces where the ordinary cast iron boiler would be severely crowded. Boilers with copper tubes also are on the market with the claim of high efficiency, no corrosion, and smaller tubes. They are especially suitable for either oil or gas but usually are slightly more expensive than the steel boiler of equal capacity.

Gas Heating

Heating with gas is becoming quite common in some localities; it is recommended that houses be insulated by some means when this type of heat is employed. Boilers should be of high efficiency and specially constructed for gas use. The vent should not be connected direct to the chimney but must have an interceptor to break the draft as gas fired boilers do not require any draft at all. They are excellent where a proper height of chimney cannot be obtained. The ordinary residence can be equipped with a gas fired boiler at a cost ranging from $300 to $600 as there is no tank and very little control to be supplied. Usually a pressurestat in the case of steam, or an aquastat in the case of water, connected to a solenoid valve in the gas line is all that is required, although room thermostatic control can be added to this if desired.

Manufactured weather by means of a special apparatus which cleans, heats, and humidifies the air passing through the equipment is another innovation of comparative recent vintage, this device delivering the treated air into the rooms by means of a fan and recirculating a portion of the air from the house (see Figure 19). It is gas fired and is supposed to be very, very close to an ideal method of heating and air conditioning. Of course no cooling is involved but this can be added by installing a refrigeration machine and arranging to cool the air instead of heating it.

Gas heating is expensive—especially in localities where manufactured gas at the ordinary rates is encountered. Where natural gas is available, however, it will compete favorably with coal. This is the reason that house insulation is almost obligatory in such cases in order to reduce the heat demand as much as possible. There are many types of insulation on the market, some of which may be applied dry and others of which are applied wet. In existing structures only dry or flake insulation is practical, this being introduced between the sheathing and the lath and plaster by opening strips along the ceiling and pouring the spaces full. Similar insulation is introduced between the attic floor joists by removing attic floor boards at frequent intervals if any attic floor exists. Of course in new construction any good insulating method may be used—cork, zigzag felt and many others. Cellular concrete also has high heat resistance.

The Indirect Heater

An entirely new method of heating hot water from the main steam boiler has been made possible by the development of the indirect type of heater. This consists essentially of a shell, inside of which is placed a spiral copper coil, the shell being connected to the boiler with supply and return pipes and the coil being connected to the hot water storage tank with the usual circulation connections as shown in Figure 20. The result of this arrangement is that there is an exchange of heat between the boiler water and the water within the coil whereby the coil water is heated and flows up into the storage tank. These indirect heaters have the distinct advantage of never boiling the water in the water storage tank and their capacity does not fluctuate with the intenseness of the boiler fire as is likely to occur with a coil in the fire box. Incidentally they have made practical the securing of a summer supply of hot water from the main boiler without the use of another heating apparatus when the main heating system is closed down.

Summer Hot Water

For example, in the case of an oil fired steam boiler one or more indirect heaters are placed on the side of the boiler and connected up to the storage tank in the usual manner with the ordinary automatic controls on the boiler for winter use. In addition, an aquastat is installed set at about 160° F. and a switch to throw off the winter control and to throw on the aquastat is provided as illustrated in Figure 21. During the winter the operation of the burner is as usual and hot water is supplied through the medium of the indirect heaters. As soon as warm weather arrives the switch is thrown and the boiler goes on to the aquastat control which opens up the oil burner whenever the boiler water temperature reaches 160° F.

Of course the heater does not generate quite the same amount of hot water with 160° F. in the boiler as it will during the winter with 212° F. to 220° F. but it must be remembered that the water to be heated in summer does not come in at such a low temperature as in winter—which largely compensates for the difference. Another method is so to arrange the controls that the aquastat will automatically take control of the boiler whenever the boiler water reaches 160° F. or thereabouts and to leave the room thermostat and boiler pressurestat on all the time. Then, in a sudden cold snap the boiler automatically makes steam without manual resetting of the controls.

Pipe Materials

The materials used for piping in heating systems have undergone but little change outside of the matter of copper. Considerable residence work is now being done with copper tubing made up with special fittings, either sweated to the tube, or with the tube flanged over so as to form a sort of union joint somewhat similar in idea to the Van Stone joint. Copper bearing steel pipe also is being used on some quite important work with the idea of securing greater resistance to corrosion. This is simply steel pipe containing not less than 2/10ths of 1% and not over 35/100ths of 1% of copper.

In some cases, on the monumental type of building, advantage is being taken of the low price of copper to use red brass pipe (83% copper) on all returns from the radiator outlet to a point where the return line becomes exposed and accessible for replacement where copper bearing steel or wrought iron pipe is substituted. This is felt to give the maximum assurance against corrosion troubles in concealed locations and usually, when the return reaches an exposed position, it is a somewhat larger size of pipe with a correspondingly heavier shell so that corrosion is less likely to become serious in a comparatively short time.

Welding

Welding has stepped into the picture with a vengeance during the past few years. Nearly all of the low pressure steel heating boilers are electro-welded in the shop and some are acetylene welded right on the job when necessary. The results have been very satisfactory. It is difficult to say as much for acetylene welding on pipe in the field; expert welders are scarce and the supply is limited; certain joints are very difficult to make by means of welding. The government, on Federal buildings, is permitting welding down as far as 2½ inch size of pipe but only time will prove whether the weld will last as long as the pipe, even though it may be stronger than the pipe when made. Special welding fittings should be used when welding is permitted and several manufacturers now produce a line of fittings particularly designed for this purpose (see Figure 22). The principal things to look out for on a welding job are defective work by incompetent welders, icicles inside the joint, and misaligning of the straight pipe due to contraction of the last portion of the circumference to be welded, all of which can be guarded against by proper supervision. In spite of these hazards, welding is making great strides and some saving in cost is claimed for work made up in this manner.

THE FIRST SAVINGS BANK IN THE WORLD—DUMFRIESHIRE, SCOTLAND
LITHOGRAPH BY THEODORE DE POSTELS FOR THE SAVINGS BANK ASSOCIATION, NEW YORK

Trends of the Building Industry

A Talk to the Producers' Council at their Ninth Semiannual Meeting, November 1, 1932

By Rolland J. Hamilton*

It has been suggested that I speak with respect to the trend of the building industry. Now, the popular definition of the word "trend," as applied to any given thing, is "Where is it going?" but unless there is coupled with this the pertinent questions—"Where has it been?" and "Where is it now?" the discussion of "trend" becomes sheer prophecy and hardly worth while. As briefly as possible, therefore, let us consider together certain aspects of our industry in broad perspective.

With all the vaunted progress of mankind, food, clothing, and shelter are the trinity of human necessities today as conclusively as in the era of the cave man. Those of us engaged in the building industry (architects, engineers, contractors, building trades, and material men), therefore, rightfully consider that we are dealing with basic needs; and that we are producers in the best sense of that term. Rather unaccountably, there are those who would not question the status of industries supplying food or clothing but who rise up today and declare that there is no place for new building enterprise and question when there will be. Yes, and there are defeatists in our own ranks. The root of such ill-advised talk is probably the fact that whereas food and clothing are items of current consumption requiring constant replacement, the item of shelter, the third member of this family of human necessities, is a matter of capital investment. In other words, the replacement of food and clothing must be immediate; whereas the replacement of shelter can be postponed. In the midst of a period more acute than ever before experienced, the weak-hearted and nonobservant fail to appreciate that the stream of our business is dammed and not dried up; that the demand is piling up but not extinguished and that the longer we suffer our present situation the greater the force of pent-up requirements. The cycle of food replacement is daily; that of clothing is measured in months; whereas the cycle of building is equally inexorable but is measured in years.

Although there are no definite statistics, it is probable that the average life of all buildings in this country, past and present, is approximately forty years. That such life is not longer is no fault of the buildings, but is predicated on changing human desires, on fires and other calamities, and on economic considerations. There is nothing to indicate pending change in this situation. Let us then sound the keynote of our observations by asserting that the building industry is just as sound today as it has ever been in our history; and that never has the public demand for new and better buildings of all kinds been more pronounced than at this moment. In our opinion, every man connected with this industry should be prepared to affirm the integrity of this statement and refuse to be put on the defensive with respect to these fundamentals. A large industrial corporation recently circulated a questionnaire among its employees asking how they would choose to spend their surplus earnings upon the return of prosperity, and of these approximately 15% listed new homes as their first desire. (Assume entire population the same!)

The year 1925 was the peak of residential construction and during that year in 257 cities (constituting probably less than 40% of the total population of the country) there were erected accommodations for 491,000 families. By a steady process this shrank until in 1931 the like figure was 98,000 families, with an estimate for 1932 of 65,000 families. These 65,000 family units add only 2/10 of 1% to the existing stock of housing accommodations, and the cost thereof is probably less than the annual fire loss alone in this class of buildings. In other words, there are in this country approximately 32,500,000 family units and with a normal replacement factor of 2½% per annum, the average requirement without regard to growth of population, is between 800,000 and 900,000 family units per annum. During this period since 1925 there was an increase in population of probably 11,000,000 and approximately 7,500,000 marriages.

The doubting Thomases assert that regardless of these statistics the country is full of empty buildings and why talk of more. Leaving aside the fact that it is a good thing to talk about building for some time before actually beginning (see any architect!), the implication is false. The midsummer report of the National Association of Real Estate Boards indicated shortages in single family houses in 10% of the cities surveyed, and in spite of much doubling up of families, a normal balance of supply and demand in 76% of the cities. Six per cent of the reporting cities had a shortage of apartment buildings and 66% reported a balanced supply. This means that immediately economic betterment ensues, there will be a vast unscrambling of the prevailing "doubled up" situation, and a shortage of housing space for these families. There is little possibility of overemphasis with respect to the implications of this statement. Of lower priced city housing we shall speak later, but no one who will take the pains really to investigate can doubt that, despite our economic afflictions, there is a present demand for such accommodations of really tremendous proportions —and at prices which yield a fair return.

It is frequently stated that the country is not financially able to bear the burden implied by statistics of building needs. Let us investigate. In the peak year of residential building—1925—the total per capita expenditure for new housing accommodations was $24, and the total per capita expenditure for all classes of buildings (except public works and utilities) was $43—this with an estimated national income of $741 per capita. The truth is that even in this peak year of expenditures, the American people were amply able to afford the small percentage of their income dedicated to new construction; and are able to do so again. Does any one question that our people can afford as much for the building of their homes as

**President, American Radiator Co.*

they can for their automobiles? Yet in 1931 the approximate expenditure for new automobiles was $1,407,000,000 and for new residences was $811,390,000.

The difficulties of building finance have often obscured the real facts pertinent to the foregoing. This problem of finance of new buildings fundamentally is a very simple one. Funds to supply a capital investment of forty years' duration in any given case are desired at a certain time, and what does the owner do? Borrows wherever available one-half or two-thirds of the requirements of this forty-year investment at a high rate of interest for a short period, trusting to luck that the renewal will not come in one of those unfortunate periods such as the present when few possessors of capital desire to invest it. Why should bonds backed by the American home be unmarketable and bonds backed by our trunk line railroads sell on a 4½% basis? Why do the older countries of the world consider the home the best of security and people willingly put their savings into home securities at low rates of interest for periods of time sufficient to permit payment out of current savings, whereas in our great country the small home owner begs for the privilege of paying 6% interest plus commissions and takes the chance of being unable to renew at maturity. It is shocking that over a normal period of 10 to 15 years for payment, out of savings, of the cost of a small home, the owner, even if fortunate enough to renew his periodic mortgages, frequently pays over 25% of the original cost of the home in penalties, that is, in costs over and above a sound interest rate. For these and other evils the building industry is far from blameless. In an era when speculation and promotional activity were dominant, our industry went along with the rest. But let us not castigate ourselves to the point of self-deprecation. Let those who are without blame cast the first stone—and there will be few rocks flying.

The fact is that over a long period of time real estate mortgages have proven an excellent investment as shown by the large holdings thereof by our most conservative investment institutions. The losses witnessed in these abnormal times are no criterion of the past or future. Rather than yield to an ill-grounded pessimism let us attain a fresh perspective and use our utmost powers to prevent a recurrence of the present situation. Buildings well designed, honestly built with good materials, and intelligently adapted to human needs, are the best security in the world and immutably money will flow to the financing of such structures. If, to attain public confidence necessary to meet this financing situation, we must for a further period see our industry creep rather than run, let us face it as bravely as we can with the sure knowledge that money is the most fluid of all things and inevitably knocks at the door that opens the way to sound and profitable investment. And perhaps most of all is the need to carry to the American people the message that the building industry is not a creature of wild speculation, or unsound growth, or of financial fallacies, but represents a basic human need; and in its largest single expression, the home, is the veritable bulwark of every social system. The American home, church, and school are generally lauded as the institutions on which our civilization rests; but for each unit there must be a building before there is an institution. It is regrettable that our financial practices have not kept pace with the emotional appeals of these mighty forces.

That an awakening impends is amply implied by certain recent developments. October 15, 1932, is one of the most important dates in the history of the building industry because it was on that day the new system of Federal Home Loan Banks opened for business.

To the President of the United States must go full credit for proposing this measure and for holding before the people the pressing public need for its enactment from the day the Congress met up to the last day of the session. Once advanced, Democrats and Republicans alike joined in its support. The passage of that bill and the opening of these banks should mark the beginning of a new day in American home ownership.

In the words of President Hoover, "To possess one's own home, however small, is the hope of every family in our country. That is the American idea, born of an exquisite sentiment, nurtured by a long national tradition, and proved right by its innumerable practical advantages.

"Financing of home ownership has not kept pace with improvement in design. Almost any other desirable possession can be purchased in installments on the basis of 25 per cent in cash and the balance secured on the property and somewhat upon the character of the buyer. A home and the home owner are the best credit risks in our country. There is no character credit comparable to a family struggling to own its home. But finance of homes too often continues on terms comparable to the credit extended by a pawnbroker. The family willing to work, save their money, apply the savings to payment for their house is not only a sound basis of credit, but a sound basis for the nation. Every interest in life ties them to maximum effort to succeed. *They must have credit upon terms adjusted to their little of cash and their much of character.*"

This major addition to the nation's banking system is more than a device to meet the present emergency. It is a permanent central core for the financing of home ownership. As it gets under way it will separate long-term borrowing for a home from its present entanglement with short-time borrowing for commerce, industry, and speculation. That alone will do much to cut down hazards and so cut down home ownership costs. The new system will bring a large proportion of all home financing institutions under uniform regulations and set up specific and sound standards for the making of its own type of home mortgage loans. This done, all mortgages which meet these standards become readily discountable, or "liquid," just as commercial paper has for years been discountable through the Federal Reserve System.

All properly supervised banks, cooperative banks, building and loan associations, homestead associations, and insurance companies may now borrow money from these banks, giving their eligible home mortgages as security. For many months such institutions, generally, have been without funds for mortgage investment. With this new and stable source of credit they are, to the degree that they employ it, now in a position to make new loans or to refinance existing home mortgages.

As rapidly as it can be drawn into use the new reserve system will open a new and stable source of financing to families now ready to buy or build their homes. By assuring capital of a new degree of safety it will encourage its flow from the money centers to all geographical sections of the country, however remote, where there is demand for home construction and home ownership. Because of the standards of safety which it will enforce for its own loans, it will eliminate from them those factors of risk which are the largest element of cost. It will, therefore, be able to advance money to its member institutions at a minimum rate of interest. As this gain is passed on, the financing cost to the home owner for mortgages of the type eligible for discount should be reduced.

Again in the words of President Hoover, "The broad purpose is to provide for the home owner a comparable background of stable credit with that we have already provided nationally for the business man through the Federal Reserve Banks and for the farmer through the Farm Loan Banks and the Intermediate Credit Banks. The plan and method is not to engage the new institutions in the business of providing direct loans but to give impulse, security, and safety, and lower interest rates to the already existing institutions—especially the mutual institutions—in order that they may extend the fullest measure of credit to would-be home owners."

In brief, the Home Loan Bank System should accomplish these major objectives:

1. Relieve the immediate emergency in preventing further disastrous liquidation of home mortgages.
2. Provide immediate funds for necessary rehabilitation of existing homes.
3. Stabilize future home financing and establish sound future basis for the home construction industry.
4. Most important to all of us, it greatly widens the market for materials and labor for the entire building industry since these banks make available immediately $134,000,000 for new mortgages on homes and for refinancing present mortgages, and can draw potential capital for these purposes as rapidly as needed up to $1,600,000,000. This means that, after the Home Loan Bank System gets into operation, the building industry can expect this banking system to provide funds and credit to create approximately five billion dollars worth of home building and repair work during the next three years. The far-reaching effect of this is best appreciated when it is realized that in the peak year of 1925 we spent only one-fourth of this amount for single family houses.
5. This is the best assurance of the future of the building industry—next to agriculture the largest industry in the country and which in normal times with its total volume of seven billion dollars, pays in normal years, like 1926, the largest American wage bill amounting to more than three billion dollars.

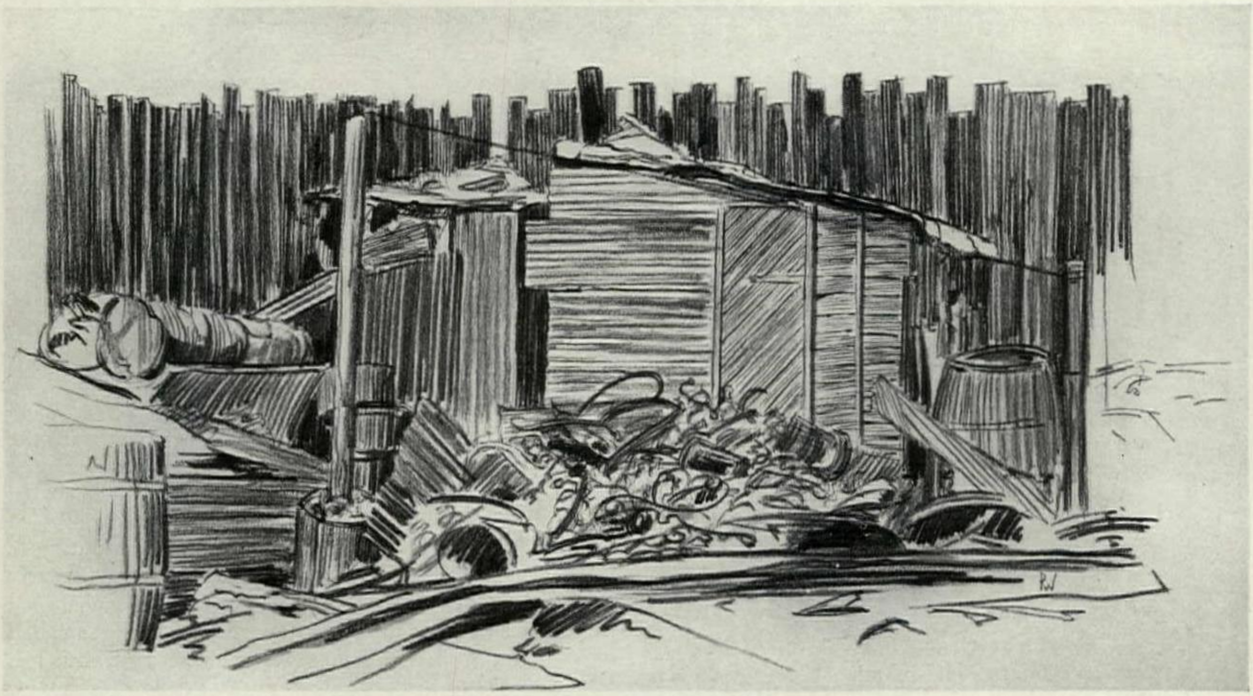
The lack heretofore of motivating social sense in our country with respect to living accommodations for that large proportion of our population with small incomes, becomes startlingly apparent when we consider the problem of blighted residential areas and slums. We are paying the price for the dogma of individualism or what is sometimes known as every man for himself and the devil take the hindmost. We take pride in saying that no man, woman or child, however unworthy, can be allowed to starve; but we have not reached the point of saying that families however worthy shall not be permitted to live in habitations unfit for human occupancy. It is probably an old story to all of you, but worthy of repetition, that of 640,000 family units of habitation outlawed in a very real sense a generation ago in the City of New York (commonly known as old law tenements), 525,000 thereof are still in existence; and to a greater or less degree this is true not only in our great cities but in the non-urban territory as well. The social conscience of every other industrial nation in the world has been invoked by the like problem. The United States stands alone in its isolation. We are not bespeaking the expenditure of public funds for this purpose, unless in times of emergency. An aroused social conscience on the part of the public and some straight thinking by the building industry will amply care for the problem. And when this comes, for it is surely coming, the building industry will have the opportunity not only of testing its capacity, but of proving that it is a faithful instrumentality for public good.

The knowledge of this speaker does not suffice for a detailed discussion of a phase of this general subject which is on the lips of many. What of new materials, new methods, a new approach to the problem of building that will give the public more for their money, and chiefest of all, give to the family of small means—and that is the average family—the opportunity for better living quarters whether in multiple story apartments or single family dwellings. We make no predictions, but at least let it be said that there are those who are dreaming dreams and seeing visions. There are those with a breadth of view that permits at least a temporary forgetting of precedents. There are those who are willing to forget that things have been done in a certain way and with certain materials for a long time and are open-mindedly searching for new ways and new materials, yes, and new design. I beg of you not to misunderstand these statements. There is not intended the slightest derogation of our industry; but I do appeal for more of the research spirit, for more tolerance toward new ideas, and for a searching of the mind on the part of all of us to the end that our industry may make more progress and better serve the needs of mankind.

In all these plans and aspirations there is requisite a unity of effort between the various factors contributing to successful construction. Candidly, the building industry has not been as "industry conscious" as the common good warrants; but that this problem is recognized and that substantial progress is being made toward its solution is betokened by the organization under whose auspices we are assembled this evening. As a manufacturer of building equipment over a long period I have yet to observe an authenticated instance of real unfairness on the part of a reputable architect or building contractor. Differences of opinion—yes; clashing of legitimate self-interest—certainly; but of bad faith not one case. Which leads me to believe that practically all the friction that does arise between architect, contractor, and material man, comes either because one or the other of these factors seeks to usurp improper functions in a given case; or just perchance may I whisper because we sometimes for a profit seek to beat the game by encouraging those who fall without the pale of the word "reputable." But it seldom pays; in fact the lesson we learn from the school of experience is that the building industry inherently requires various factors successfully to serve the public and that only by a recognition hereof and a drawing together of these factors into harmonious interest will the public be served and ourselves rewarded.

Much as one might desire to rest on an avowed optimism with respect to future trend, it would be taking advantage of your forbearance as listeners not to say something of the immediate trend—in other words of 1933. In our opinion the prospects for next year are definitely better than the status of 1932 especially as regards residential work, which in terms of square feet of floor space awarded normally represents about 55% of total building construction. We believe there is an exceedingly large pent-up demand for this class of work destined to bring substantial activity over a considerable number of years; and that 1933 will see a start of such activity. Commercial building comes later in the cycle and will probably have to await its turn. The measure of the start predicted for next year will depend on the customary factors governing industrial activity—revival of confidence in general and investment confidence in particular.

In conclusion and to summarize, the trend of the building industry is that of a basic need in the richest country in the world wherein the public are demanding better homes, schools, churches, and public buildings; a country which for over one hundred years has expanded its wealth and production at an average annual rate in excess of 4% and can well afford the better structures it desires. Because it represents a capital investment and the needs of the moment may be deferred, it is necessary in considering this trend to think in building cycles rather than in terms of a given year. With this approach, our industry is clearly seen as resting on unimpaired foundations; and after suffering recessions probably more severe percentagewise than any major industry, it has the vitality and the faith to envision a future greater and more prosperous than ever before known.



IN THE ERIE BASIN, BROOKLYN

PROPERTY STREET, CENTRAL PARK, MANHATTAN

TWO SKETCHES OF THE ARCHITECTURE OF UNEMPLOYMENT, NEW YORK

Drawn on the spot by Robert Wiseman who has made a series of such views to record a transient, we hope, phase of building that has become common in various parts of New York during the current depression.

HERE AND THERE AND THIS AND THAT

This department conducts four competitions each month. A prize of $10.00 is awarded in each class as follows: Class 1, sketches or drawings in any medium; Class 2, poetry; Class 3, cartoons; Class 4, miscellaneous items not coming under the above headings. Everyone is eligible to enter material in any of these four divisions. Good Wrinkle Section: a prize of $10.00 is awarded for any suggestion as to how work in the drafting room may be facilitated. No matter how simple the scheme, if you have found it of help in making your work easier, send it in. Competitions close the fifteenth of each month so that contributions for a forthcoming issue must be received by the twelfth of the month preceding the publication date in order to be eligible for that month's competitions. Material received after the closing date is entered in the following month's competition.

The publishers reserve the right to publish any of the material, other than the prize winners, at any time, unless specifically requested not to do so by the contributor.

THE PRIZES this month have been awarded as follows:
Class I—A. A. McGrath, New Haven, Conn.
Class II—Sherman G. Coates, Philadelphia.
Class III—No award.
Class IV—Joe Wertz, New York.
Good Wrinkle—William Fielding, Wellington, N. Z.

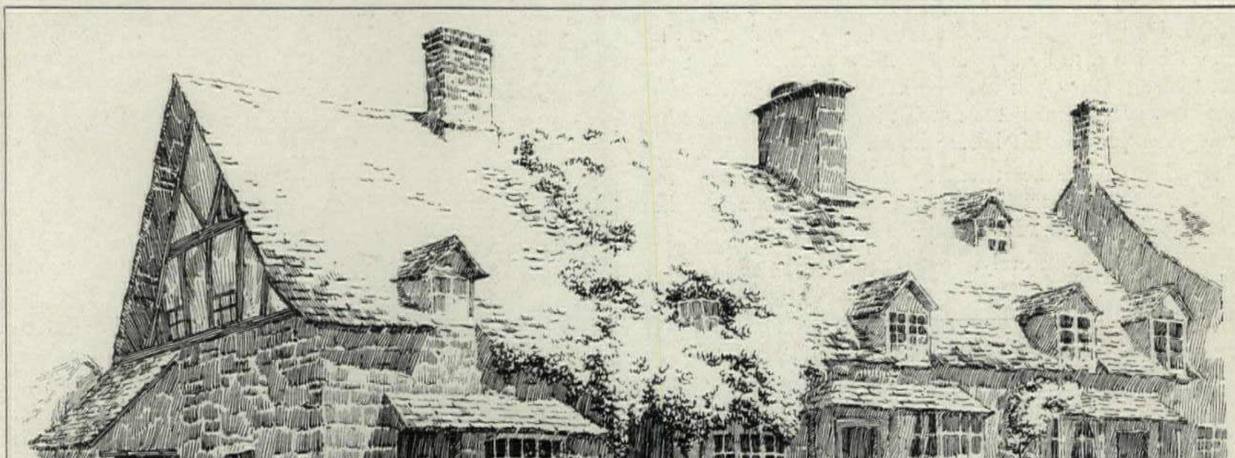
Don't forget our Christmas card competition. All entries submitted must be original designs, but each competitor may send in as many entries as he wishes, before January 12th, please!

Here's the prize Good Wrinkle this month, from William Fielding of New Zealand: "Tightly stretching large sheets of paper without a quick-drying hydraulic adhesive is often found to be difficult and to take up a considerable amount of valuable time. It can be done easily and quickly. Here's how:—Turn up the edges and thoroughly soak one side of the paper (including the edges). Apply paste or gum to the underside of the margins and place the paper on the drawing board. The secret lies in the next move. Iron the edges with a hot iron and you will find that they adhere to the board immediately. It is advisable to place some rags over the edges before ironing, or else the paste squeezed out will stick to the iron."

SALVADOR GLOOP, although for some days maintaining a discreet and disgruntled reticence as to the results of the recent election, was persuaded to loosen up and give us a statement just as we went to press. "I was the victim of a dastardly plot," said he. "Although I made many speeches from my powerful broadcasting studio which would have turned the tide overwhelmingly in favor of the Gloop Ticket, I later discovered that some ruffians in the employ of the rival parties had broken in and substituted an old rubber boot for my super-hetero microphone. This changed my wave length so that my message could be received only by voters with crystal sets.

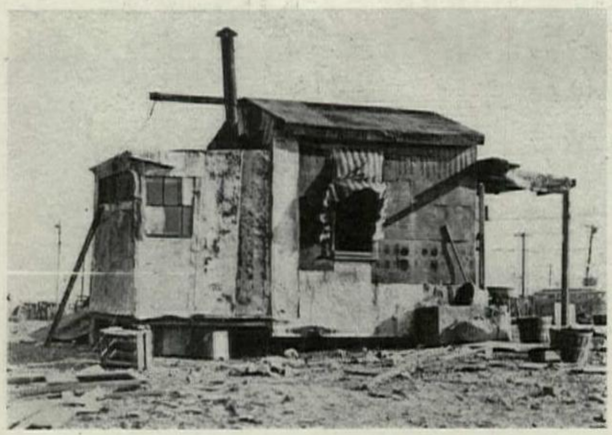
"Otherwise, I had everything in my favor. Besides possessing the necessary double o in my name, I had a platform that could not be beat. It called for compulsory beer drinking by all prohibitionists, the abolition of left-hand turns, and a Government post office in every backyard of this broad country of ours.

"That I got not less than two votes in the face of the difficulties of making a silent campaign effective, makes it obvious that, had my story gotten across, I would have swept the country and very possibly the city as well."



"COTSWOLD COTTAGE"—FROM A PEN-AND-INK DRAWING BY A. A. MCGRATH

(PRIZE—*Class One—November Competition*)



"A Residence of Unusual Design"

We had a letter from our friend, Joe Wertz, of Le Brun Scholarship fame, which we print herewith, together with reproductions of the snapshots sent to us!

Our Mutual Friend

"I passed a very handsome estate the other day and, glimpsing a residence of unusual design, drove in. I found the owner at home and to my astonishment it was none other than an esteemed mutual friend of ours. It seems he has taken upon himself a new and constructive hobby and being—for the moment—unemployed, he elected to construct this novel and unique domicile which had drawn my admiring attention. Like most architects fortunate enough to possess them he has found it expedient to turn to his estate for sustenance and occupation, and his new home is constructed entirely from its natural resources. Incidentally he finds the life of Country Gentleman highly agreeable. With his kind permission I was fortunate in acquiring photographs both of himself and of his house, the first of the latter, I believe, to be taken. He has even graciously consented that I allow you to publish them in order that his out of town friends may see to what ingenious advantage he has been employing his leisure hours.

"May we all be heartened by this illustration of how impotent is the depression against such a person as the redoubtable Mr. Salvador Gloop."

Sincerely,

Joe Wertz.

ME AND MR. ROOSEVELT

(Apologies to Messrs. Gallagher and Shean)

By Sherman G. Coates

(Prize—*Class Two—November Competition*)

"Oh Mr. Roosevelt, oh Mr. Roosevelt!"
"Oh good morning! How is business, Mr. Coates?"
"It is bad and getting worse,
And the reason for this verse
Is to ask what cheer your victory denotes."
"Oh Mr. Coates, oh Mr. Coates,
Since I won with twenty-seven million votes,
Have you really any doubt
That I know what I'm about?"
"Then you guarantee prosperity?"
"Absolutely, Mr. Coates!"

"Oh Mr. Roosevelt, oh Mr. Roosevelt,
Can you give us architects a little work?
We're all broke or badly bent,
So can you as president
Send a little ray of sunshine through the murk?"
"Oh Mr. Coates, oh Mr. Coates,
For depressions I've got lots of antidotes.
Right away I'll give you beer,
And if you're a bonuseer
You may get two hundred dollars—
Won't that help you, Mr. Coates?"

"Oh Mr. Roosevelt, oh Mr. Roosevelt,
It is business that we want, not petty doles!
Can you satisfy the banks
That they owe ten thousand thanks
For your overwhelming victory at the polls?"
"Oh Mr. Coates, oh Mr. Coates,
When my glorious Democratic Party floats
Fiat money by the ton
Don't you see that every one
Will have pockets fatly bulging
With two hundred dollar notes?"

"Oh Mr. Roosevelt, oh Mr. Roosevelt,
All we want is architectural work to do.
Will your taxes and your teriffs
Set us free from haunting sheriffs?
Four or five good jobs a year would see us through."
"Oh Mr. Coates, oh Mr. Coates,
You know a change of leadership promotes
Better times than were before,
So stop feeling sick and sore!"
"I'm still doubtful, Mr. Roosevelt!"
"I should worry, Mr. Coates!"

"Wot about 'aving this 'ere plumb line tested, mate?"
(From "Help Yourself!" Annual)

THE SPECIFICATION DESK

Or Equal as Approved

Or Who Gets the Order

By H. R. Dowswell*, A. I. A.

The late Thomas Edison was said to have posted this quotation from Sir Joshua Reynolds on the walls of his plants—

"*There is no expedient to which a man will not resort to avoid the real labor of thinking.*"

The Architect or Engineer who first faced the problem of establishing a standard for manufactured products avoided the real labor of thinking by specifying the product of his favorite manufacturer and then adding "or equal as approved." Since then producers have been seeking the answer to "who gets the order—and how."

The use of this phrase in specifications is, in part, responsible for one of the major ills of the building and manufacturing industries, because "or equal as approved" is a direct invitation to the buyer to seek the lowest priced product the market affords and then offer it as the equal of the product mentioned in the specification, or failing to secure approval, shop the price of an acceptable product to a lower level.

Competitive bidding has been firmly established as an accepted means of determining the buying price of commodities, whether such commodities are entire buildings, the labor required for their erection, or the manufactured products entering into their construction and equipment—but, is it logical to invite Builders and Contractors for the various trade divisions or Producers to submit proposals for the construction of a building or parts of it, or manufactured products without first establishing a real basis of comparison?

Why should a conscientious Builder, Contractor or Manufacturer be placed at a disadvantage because a less conscientious competitor is willing to base his bid on products of inferior quality and take a chance under the "or equal" clause? Is there any sound reason why bidders should not be judged on the basis of quality, integrity, and their ability and reputation to render service?

These are questions, gentlemen, which I am sure you have asked many times. They are likewise questions to which we, in our office, have for years sought answers.

Let us briefly analyze the organization of a building operation.

First, we have the Architect or Engineer, or combinations of them. What have they to sell? *Service*—presumably based on technical knowledge, experience, and judgment.

Second, the Builder or General Contractor. What does he sell? The services of an organization trained to supervise, direct and coordinate the various groups contributing to the completed structure.

Third, the Subcontractors for the various trade divisions. What have they to sell? A similar service but in a more limited field. And

Fourth, the Producer of manufactured products.

The Architect and Engineer should have technical knowledge and experience necessary to set up through drawings and specifications the standard required for various parts of the work.

Where work is executed entirely in the field this is done, but have you ever seen a specification which after setting forth the proportions and strength of concrete required added "or equal as approved"? Why? Because the materials and processes are standardized and the execution can be supervised so as to judge the work in process and on the final product.

This is not possible with most manufactured products since they are produced in widely separated plants, in accordance with standards of design and quality determined by the manufacturers and vary according to the manufacturer's conception of what will satisfy the market. Economical production prohibits the manufacture of each individual product to a special design, and if it did not, Architects and Engineers do not and cannot possess the detailed knowledge necessary to produce such designs.

The General Contractor and the Subcontractors are alike to the extent that their chief stock in trade is their ability to organize, direct, and efficiently execute the work delegated to them. They depend, however, upon the manufacturer for the finished products entering into the structure, and unless the proposals submitted by the Contractor are set up to show the relative price of their services, there can be no fair basis of comparison.

How can this be done?

I will tell you how we have sought to do it and I believe with fairness to all parties.

If we are calling for general proposals, we issue invitations to a carefully selected list of General Contractors, or if the General Contractor has been chosen by direct selection we, in conference with the selected Contractor, set up lists of sub-bidders chosen for their ability and integrity in the respective fields.

This procedure, we believe, establishes fair competition, provided—and this is vital—their proposals are set up so as to be truly comparative. We believe that this can only be accomplished by requiring each bidder to base his bid on the same products. We therefore require each bidder to base his proposal on furnishing products of definite manufacturers. *(Continued on page 853)*

**Mr. Dowswell, of the organization of Shreve, Lamb & Harmon, delivered this talk at the Ninth Semiannual Meeting of the Producers' Council.*

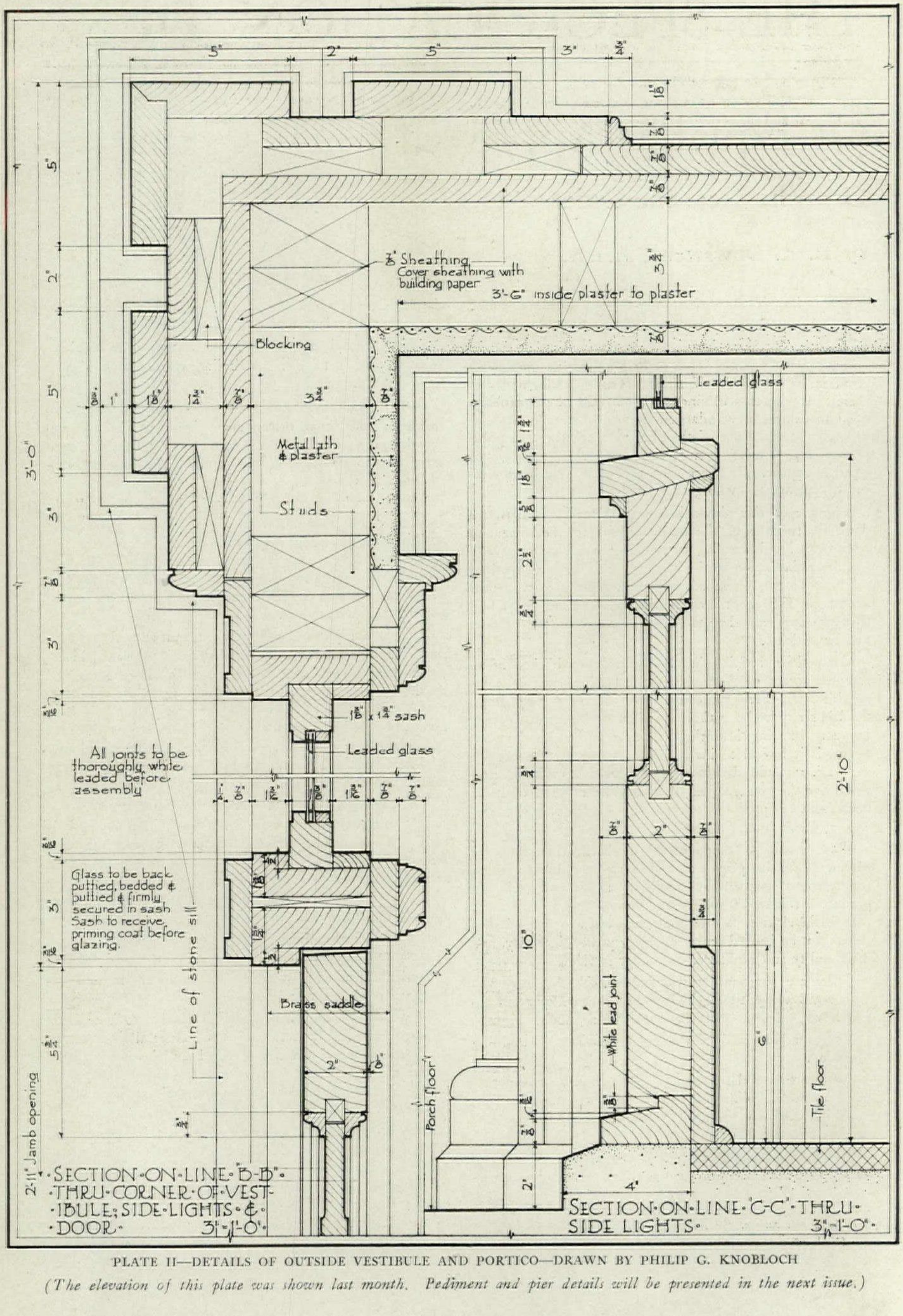


PLATE II—DETAILS OF OUTSIDE VESTIBULE AND PORTICO—DRAWN BY PHILIP G. KNOBLOCH

(The elevation of this plate was shown last month. Pediment and pier details will be presented in the next issue.)

SERVICE DEPARTMENTS

THE MART. In this department we will print, free of charge, notices from readers (dealers excepted) having for sale, or desiring to purchase books, drawing instruments, and other property pertaining directly to the profession or business in which most of us are engaged. Such notices will be inserted in one issue only, but there is no limit to the number of different notices pertaining to different things which any subscriber may insert.

PERSONAL NOTICES. Announcements concerning the opening of new offices for the practice of architecture, changes in architectural firms, changes of address and items of personal interest will be printed free of charge.

FREE EMPLOYMENT SERVICE. In this department we shall continue to print, free of charge, notices from architects or others requiring designers, draftsmen, specification writers, or superintendents, as well as from those seeking similar positions. Such notices will also be posted on the job bulletin board at our main office, which is accessible to all.

SPECIAL NOTICE TO ARCHITECTS LOCATED OUTSIDE OF THE UNITED STATES: Should you be interested in any building material or equipment manufactured in America, we will gladly procure and send, without charge, any information you may desire concerning it.

Notices submitted for publication in these Service Departments must reach us before the fifth of each month if they are to be inserted in the next issue. Address all communications to 419 Fourth Avenue, New York, N. Y.

THE MART

B. C. Holland, 721 Berea Avenue, Gadsden, Alabama, has the following copies of PENCIL POINTS for sale: August, 1929; May, 1929; August through December, 1931; January through September, 1932. Make offer.

Louis Pangaro, c/o D'Elia & Mastrangelo, 591 Summit Ave., Jersey City, N. J., would like to purchase the A.I.A. *Handbook of Architectural Practice*, and Babbitt's *Mechanical Equipment of Buildings*.

W. D. Connelly, No. 15, 327 14th Avenue, Minneapolis, Minn., would like to purchase the August and October, 1930, issues of PENCIL POINTS.

C. Ray Waddle, P. O. Box 1290, Station A, Lincoln, Nebraska, has the following for sale: Year 1929, PENCIL POINTS, in good condition, $3.50 postpaid, or 40c each copy; Harbeson's *Study of Architectural Design*, $4.00; *Masterpieces of Spanish Architecture*, $2.50; *Readers' Digest*, 1929, 1930, and 1931, each year $1.50, postpaid.

R. L. R., c/o PENCIL POINTS MART, has for sale 27 parts of the *White Pine Series of Architectural Monographs*, price $10.00.

Mrs. Tudor Tiedemann, 6 Pine Ter., Bronxville, N. Y., wants Vol. II, No. 6, of the *White Pine Series.*

Georgia School of Technology, Atlanta, Ga., Mrs. M. L. Hudson, Sec'y Architectural Dept., wants copies of PENCIL POINTS from July through December, 1928.

Richard Frost, Ramsey, N. J., has the following copies of PENCIL POINTS for sale: Years 1922, 1923, 1924 (except July), 1925, 1926, 1927, and January to May, 1928.

Joseph O. Cezar, 511 19th Street, Bedford, Indiana, has the following for sale: May, June, and July, 1929, PENCIL POINTS; Vol. I, Nos. 1, 2, and 3, and Vol. II, Nos. 2 and 5, *White Pine Series.*

George A. Hegewald, 450 Grant Avenue, Brooklyn, N. Y., has the following copies of PENCIL POINTS for sale: 1931 complete; January to November, 1932, inclusive; price $3.00 the lot.

Leo A. Hauser, 313 S. W. 30th Avenue, Miami, Florida, has the following copies of PENCIL POINTS for sale: complete for years 1926, 1927, 1928, 1929, 1930, 1931, 1932; also August, October, November, and December, 1925. All in perfect condition.

E. W. M., c/o THE MART, has for sale copies of PENCIL POINTS from November, 1920, to December, 1931, inclusive. Price $40.00.

E. W. B., care of PENCIL POINTS, has about twenty plates, interiors and exteriors, of Mizner's *Spanish Architecture in Florida.* Willing to sell at reasonable price.

Mr. Marion Davidson, c/o Hegeman-Harris, 360 Madison Avenue, New York, N. Y., would like to obtain the following *White Pine Series*: Vol. I, No. 3; Vol. II, Nos. 1, 3, 4, and 6; Vol. III, Nos. 1, 2, 3, and 4; Vol. X, No. 6; Vol. XI, No. 1.

George F. Wells, Horace Greeley House, East Poultney, Vt., has for sale beautiful collection of rare and fancy stones for fireplaces, rockeries, and ornaments.

PERSONALS

JOHN H. SAVOLAINE, ARCHITECT, has moved his office to its new quarters in the Johnson Bldg., New Castle, Pa.

JOHN A. D. MCGARR, ARCHITECT, has moved his offices from Brooklyn, N. Y., to 880 Bergen Avenue, Jersey City, N. J.

W. NEWTON DIEHL, ARCHITECT, formerly of Norfolk, Va., has become associated with the firm of Paul T. Stone, Inc., in charge of the architectural department, with offices at 1427 Eye Street, N. W., Washington, D. C.

STILES S. DIXON, ARCHITECT, has moved from Fayetteville, N. C., to P. O. Box 2372, Tucson, Arizona.

FRANK GRAD & SON, ARCHITECTS, have moved their offices from 1023 Broad Street to the Lefcourt Building, Newark, N. J. The firm name has been changed from Frank Grad due to the association with the office of Mr. Bernard J. Grad.

HOWARD D. FIEDLER, ARCHITECT, is now located at 99 State Street, Boston, Mass., instead of 89 Franklin Street.

HARRY E. REIMER, ARCHITECT, has moved his offices from 129 East Main Street to Nos. 11 and 13 West State Street, Marshalltown, Iowa.

F. A. LUDEWIG CO., ARCHITECTS, have moved from 3115 South Grand Blvd., to 4923 South Kingshighway, St. Louis, Mo.

ERNEST R. RICHARDS, ARCHITECT, has moved from 2123 Summerdale Ave., to 3822 N. Clark St., Chicago, Ill.

ANTHONY D'ELIA, JR., and N. R. MASTRANGELO, ARCHITECTS, have moved their offices from 591 Summit Avenue, to 905 Bergen Avenue, the Rowlands & Westphal Bldg., Jersey City, N. J.

OWEN & CLARKE, ARCHITECTS, formerly at 1805 Merchants National Bank Bldg., Mobile, Ala., have dissolved partnership. Mr. Fred W. Clarke will continue the practice by himself at No. 715 in the same building.

ROBERT WILLARD DEGROAT, B.FA., has opened an office and studio for the practice of architecture and work in the Allied Arts, at 176 York Street, New Haven, Conn.

(Continued on page 30)

EMPLOYMENT SERVICE ITEMS WILL BE FOUND ON PAGE 30, ADVERTISING SECTION

PENCIL POINTS

Index to Volume XIII, January to December, Inclusive, 1932

A closed specification you say. No—for we go further. We have developed a carefully worked clause which reads as follows:

"Estimates are desired on the following products. In each case bidders shall base their proposals on furnishing and installing the product numbered 1, stating additions or deductions for substituting, subject to the architect's selection, the other products listed."

The list is made sufficiently comprehensive to give each reputable manufacturer an opportunity to submit quotations.

Now let us sit in at the opening of bids. Remember that each bid is based on furnishing exactly the same manufactured products, therefore, unless the manufacturer quotes different prices to different contractors, the variation in bids will show the relative value of the services the Contractors have to offer.

If, because of credit standing or other similar reasons, producers have quoted more favorable prices to some of the contractors, we have no quarrel. That is undoubtedly the result of "good will" earned and they are entitled to any advantages accruing from it.

Our selection of the Contractor is made without reference to the additions or deductions quoted, unless the bids are so close that a consideration of these variations changes their relative standing.

The manufactured products are then considered on these relative merits and price, in conference with the Owner, Consulting Engineers and General Contractor.

The Owner is interested because it is his money we are spending and he frequently has business affiliations which he considers wise to recognize.

We have, however, succeeded in obtaining for the producer a fair and open consideration of his product.

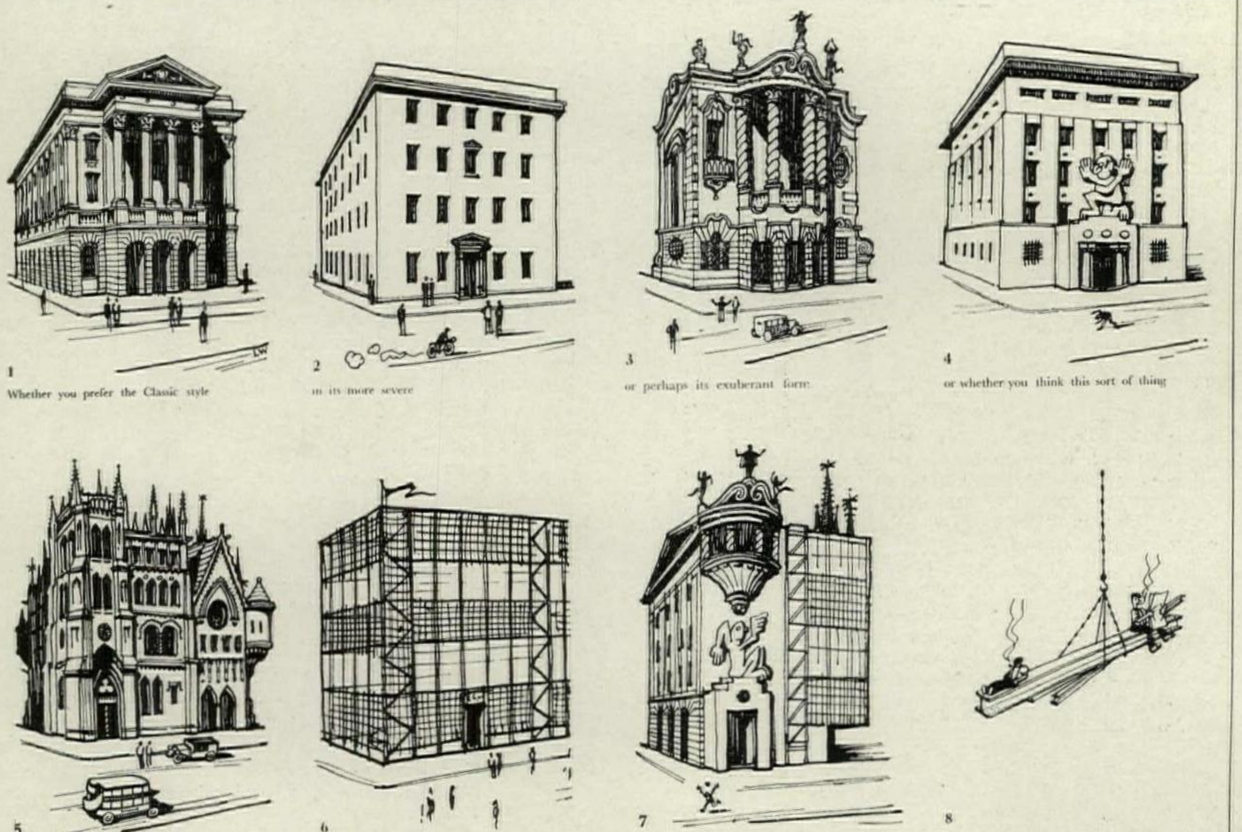
We endeavor to place before the Owner the relative merits of the different products, not neglecting the matter of service—but in the end "he pays his money and takes his choice," and the Contractor's base bid is increased or reduced in accordance with the additions or deductions quoted.

Have we accomplished anything? Manufacturers have told us during the five years we have followed this practice that we have established for them the opportunity they have been seeking, and insofar as our work is concerned, removed that bug-bear "or equal as approved."

What have we done about shopping or bid-peddling, you ask? What more can we do?

Gentlemen—I must place the evils of bid-peddling in your own lap—that is where it belongs.

When you have convinced the buyer that your first price is your final price, then there will be no more peddling of bids, but as long as the buyer knows that in your eagerness to secure the order you are willing to modify your original quotation—not once but several times—just so long will "bids be peddled." The evil is of your own making and the solution rests in your own hands.



1 Whether you prefer the Classic style

2 in its more severe

3 or perhaps its exuberant form

4 or whether you think this sort of thing

5 an improvement on this

6 or hold strong views about the essential rightness of this

7 or even though your tastes may be really catholic . . .

8 . . . it's the steelwork that holds them all up.

"It's Not the Clothes that Make the Gentleman"

Reprinted from "The Architectural Review" for November, 1932, from a pamphlet published by the British Steelwork Association.