VARIETIES OF CLAY, AND THEIR DISTINGUISHING QUALITIES FOR MAKING GOOD PUDDLE.*

GEOLOGISTS agree in ascribing the origin of clays to the decomposition and disintegration of the feldspars in granite, gneiss, mica slate, and clay slate, by atmospheric erosion and trituration in water. The argillaceous rocks, from which clays are principally derived, are distinguished by a peculiar earthy odor, emitted by them when breathed upon. Clay-beds are due to the deposition of water-borne materials at the bottom of estuaries, lakes or seas; and boulder-clay is ascribed to glacier action. Any substance formed of minute particles of decomposed earthy material, which, when worked up with water, becomes plastic or capable of being moulded, is commonly called clay. No natural deposit of absolutely pure clay has been found; but the residue, after washing out all the impurities from clay, is a hydrated silicate of alumina, which is the plastic, and consequently the most important constituent of clay, insoluble in water, and incapable of supporting vegetable life. Water combined with the silicate of alumina gives it its plasticity. Part of this water is merely absorbed into the pores of the clay, and can be driven off by exposing the material to a temperature of about 212° Fahr.; but the remainder, which is in combination with the clay, can only be removed by a prolonged high temperature, as in baking bricks, depriving the material of its plasticity, and causing it to shrink in proportion to the bulk of water expelled. Some analyses of different kinds of clay gave from 46 to 66 per cent. of silica, 22 to 38 per cent. of alumina, from 5 to 13 per cent. of water, small variable quantities of oxide of iron and lime, and traces of magnesia.

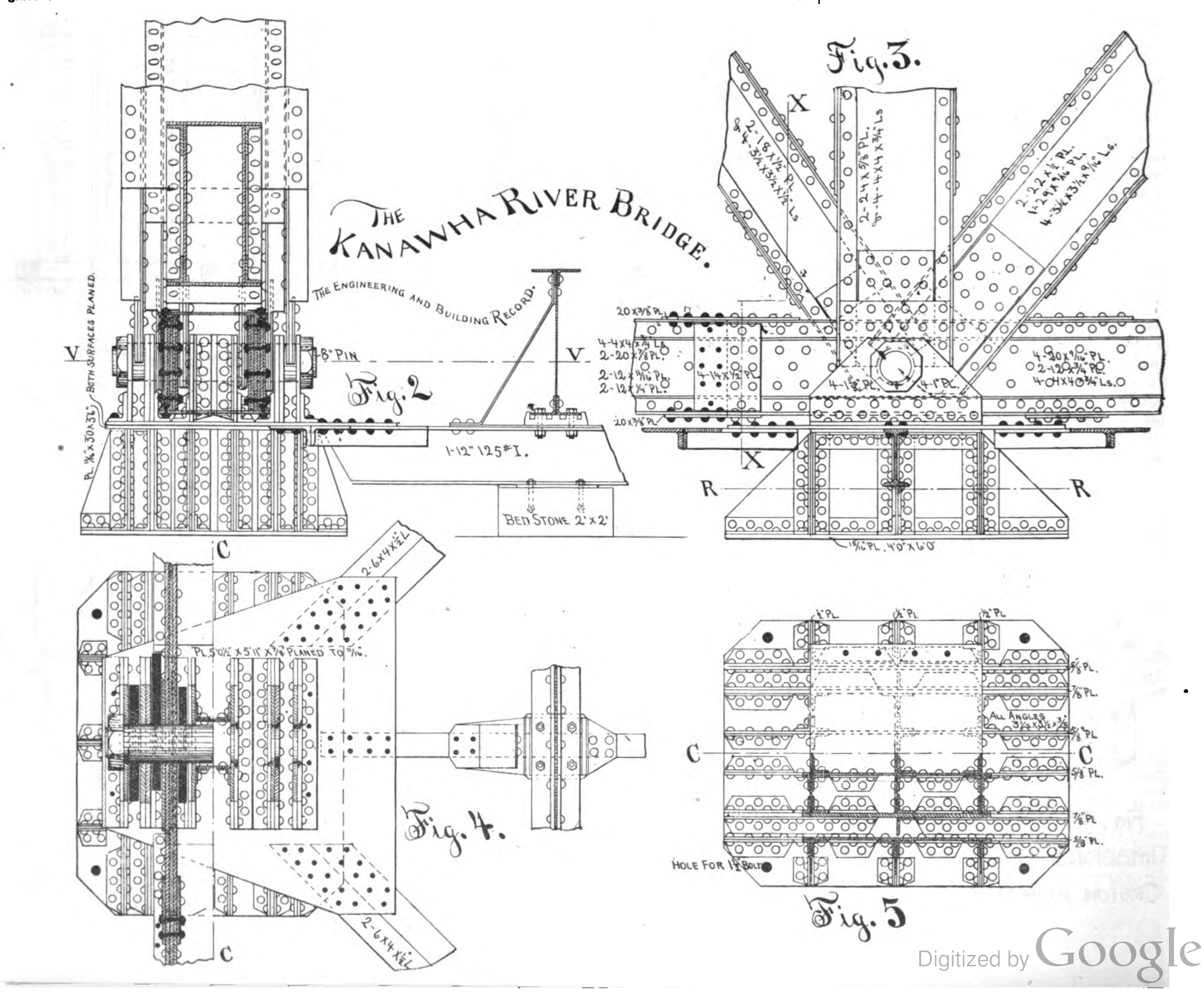
The purest form of clay, containing the largest proportion of alumina, is known as kaolin, the name of a mountain in China, where a pure white clay is worked, described as a pure chalk-white, dull, earthy, unctuous substance. The kaolin found in Devonshire and Cornwall is called Cornish, or sometimes China clay. Teignmouth clay, so called from being shipped at Teignmouth, is as free from quartz as washed kaolin, and is believed to be the sediment washed down from Dartmoor, which was deposited in a fresh-water lake. Some clays are designated by the principal use to which they are applied, namely, china-clay, potter's-clay, pipe-clay, and fire-clay. The main difference between china-clay and pipe-clay consists in the proportion of silica in their composition. Pipe-clay shrinks too much in heating to be available for making pottery. Potter's-clay includes a variety of clays containing considerable quantities of impurities. Fire-clay resists fusion owing to the large proportion of silica it contains; thus Stourbridge fire-clay contains 65 per cent. of silica, or nearly 20 per cent. more than pure koalin. Clays are also designated by their color, as red, blue, brown, yellow or ochrey, and variegated clay. The coloring matters consist mainly of metallic oxides, notably oxide of iron; organic substances also affect the color. A red color in clay in its natural state indicates the presence of peroxide of iron. A yellowish or brown color denotes the presence of hydrated peroxide of iron in the clay, which becoming anhydrous on burning imparts a red color to the clay. The Dorset and Devonshire clays, being free from iron, are white when burnt, which renders them especially valuable for pottery. Clays containing manifest impurities to a considerable extent are designated by the terms shaly clay, sandy clay, loamy clay, and marly clay. Any soft admixture of clay and lime is termed a marl—clay-marl when the clay is in excess, and marl-clay when the lime predominates. Many clays are known by the name of the neighborhood from which they are obtained, such as London clay, Oxford clay, Grinstead clay, Wadhurst clay, Weald clay, Kimmeridge clay, Gault clay, Poole clay, and others.

Puddle is of considerable importance in engineering works for arresting the passage of water. Some clays, such as the London, Kimmeridge, and Oxford beds, are practically impervious to water in their natural conditions; whilst others offer more or less resistance to its passage in proportion to the absence of impurities. Springs at faults or at the outcrop of clay-beds furnish evidence of the impermeability of these beds. Most clays, when free from coarse, gritty impurities, contain sufficient alumina to become practically impervious to water when worked up into puddle. When puddle is protected from evaporation, as is generally the case, the admixture of impurities has the disadvantage of diminishing its cohesiveness, and consequently its impermeability. If, however, puddle is placed so near the surface as to be liable to lose its moisture by evaporation or capillary attraction during dry weather, the addition of sand may be necessary to prevent the contraction of the mass, and the consequent formation of fissures such as occur in clay soils in times of drought. The sand, by diminishing the cohesiveness of the clay, obviates the rupture produced by the contraction of a tenacious mass; and with this object, the brickmaker adds sand to clays deficient in silica to prevent his bricks cracking when being burnt, and the potter incorporates ground flint with his clay to reduce the amount of contraction.

The general suitability of most kinds of clay for puddle has caused an absence of precision in the definition of the requirements for puddle in specifications. The essential condition for puddle is that it must be impervious to water; and no special purity in the clay is required to attain this result. Tempering the clay by working it up with water, so that its original formation is broken up and a new arrangement of particles formed, with additional water to fill up every pore, is the important requisite for the formation of good puddle. It is peculiar that puddle, though formed to exclude water, should require water for its manufacture. Tempering clay for forming puddle is greatly facilitated by exposing the material to the atmosphere, especially in winter, when rain, snow, frost and changes of temperature disintegrate the clay more thoroughly than even grinding it in a pug mill; and the labor of working it into puddle by cutting, cross-cutting, poaching it with a tool, or treading, is materially reduced. Clays well suited for puddle are opaque and not crystallized; they exhibit a dull, earthy fracture, exhale, when breathed upon, a peculiar faint smell termed argillaceous, are unctuous to the touch, free from all gritty matter, and form a plastic paste with water.

The important properties of clay for making good puddle are its tenacity or cohesion, and its power of retaining water, which really coexist, but are separated to facilitate description. The tenacity of a clay may be tested by working up a small quantity with water into a thoroughly plastic condition, and forming it by hand into a roll about 1 to 1½ inches in diameter by 10 to 12 inches in length. If such a roll is sufficiently cohesive not to break on being suspended by one end when wet, the tenacity of the material is ample. To test its power of retaining water, one to two cubic yards of the clay should be worked with water, by the usual methods, to a compact homogeneous plastic condition; and then a hollow should be formed in the centre of the mass capable of holding four or five gallons of water. After filling the hollow with water, it should be covered over to prevent evaporation, and left for about twenty-four hours, when its capability of retaining water would indicate its suitability or unsuitability for making puddle.

* Abstract of paper by William Gallon, Assoc. M. Inst. C. E., from Excerpt Minutes of Proceedings of the Institute of Civil Engineers.



SOME RULES FOR THE HEAD OF A DEPARTMENT.

Col. George Findlay, General Manager of the London and North-Western Railway, and Lieut.-Colonel in the Engineer and Railway Staff Corps, has written a book on "The Working and Management of an English Railway, in which, among other things, he gives, from the results of his own experience, some rules as to the way in which the head of a department should transact his business. Their sound practical sense will commend itself to every intelligent reader who has had experience in such a position and those in authority who have the wisdom and "grit," for it takes both, to adopt such rules and to stick to them will be well repaid. Rule 3 is especially important, and to secure its full benefit no duty should ever be put off beyond the time when it should be performed, for a duty postponed always weighs on the mind, and prevents undivided attention being given to anything else.

The rules are:

1. Choose your subordinates carefully and well, and let them be men you can thoroughly rely on. Do not concern yourself too much with points of detail, with which you must be fully conversant, but with which they are just as well able to deal as you are, and reserve yourself for such matters of moment as they are not competent to decide without your authority and experience.

2. Before any question is submitted to you for decision, insist upon having all the details filled in, and all the facts before you, so that you may not have to apply your mind to it a second time, but may decide it once and for all with a full knowledge of all its bearings.

3. Always decline steadily to attempt to do two things at once. If you are giving an audience to one person, be it a head of a department, or any other, let your door be rigidly closed to every one else for the time being. Let "one at a time" be always your maxim, and act upon it strictly. The man in authority, who is seen continually surrounded by a throng of subordinates, and striving to meet all their demands at once, is the man who, by reason of excessive wear and tear, is most likely to break down in mid-career, and fail either in health or intellect; but the man who steadily concentrates his brain power upon one thing at a time, never wasting a moment, but never flurried or hurried, is the man who gets through the greatest amount of work with the least toil and harassment to himself, and in the shortest possible time.

4. Always make a point of refusing (except, of course, in special circumstances) to see chance callers, who will otherwise occupy the best part of your time with trivial matters which could just as well be attended to by your subordinates. It is a good plan to make it a rule to see no one without an appointment made beforehand, either in writing or through your secretary, or else without previously knowing their name and the nature of their business. It is very amusing, at times, to see the pertinacious attempts which are made to break through this rule, and it can only be maintained inviolate by the agency of a wily and imperturbable secretary, and an office which can only be approached through his.

PORTLAND CEMENT FOR SETTING IRON WORK.

A correspondent has found clear Portland cement to be a good substitute for sulphur in bedding cast or wrought iron upon stone or iron foundations. It is unaffected by oil, and can be made thick or thin with water as may be required and does not chill upon contact with cold surfaces. Where used to bed wrought-iron beams upon cast-iron column brackets it has been found to answer perfectly, even when not more than an eighth of an inch in thickness.

THE KANAWHA RIVER BRIDGE.

PART I.—GENERAL DESCRIPTION, DIAGRAMS AND TOWER.

The single-track bridge carrying the Ohio River Valley Railroad across the Kanawha River, at Point Pleasant, West Virginia, is built chiefly of steel; has a total length of nearly 1,000 feet, and weighs about 2,000,000 pounds. It was built by the Union Bridge Company, of New York, at their Athens (Pa.) and Buffalo (N. Y.) shops, and was erected for the Union Bridge Company by William Baird. J. A. Fickinger was the Chief Engineer of the O.R.V.R.R.

The bridge is designed for a live load of two consolidated engines weighing 342,000 pounds on a wheel-base of 108 feet, and followed by a train weighing 3,000 pounds per lineal foot.

The lateral and vibration systems are proportioned for the following wind-pressures

ASSUMED WIND-PRESSURES PER LINEAL FOOT OF BRIDGE LENGTH.

The upper lines of figures are pressures assumed moving, the lower ones, static.	Cantilever Shore Arm.	Cantilever River Arm.	Suspended Span.
Lower chord	$L_0 L_1$ 375 / 75	450‡	450
Upper chord	$U_1 U_{11}$ 125 / 125	90†	120*

* 200 pounds when bridge is unloaded.
† 150 pounds when bridge is unloaded.
‡ 250 pounds when bridge is unloaded.

Figure 1 is a collection of diagrams in which the tension members are all shown by single light lines; the compression members of the lateral and vibration systems and vertical posts of the main trusses are shown by single heavy lines, and all other compression members of the main trusses are shown by double lines.

The points of connection in one truss are designated by the letters L M N U and T, and in the other truss by L' M' N' U' and T'. The trusses are both alike, and the bridge is symmetrical about its centre line L 24 U 24.

Figure 3 is an elevation from Z Z Fig 1, showing the connections of end posts and tower to pedestal at L 12.

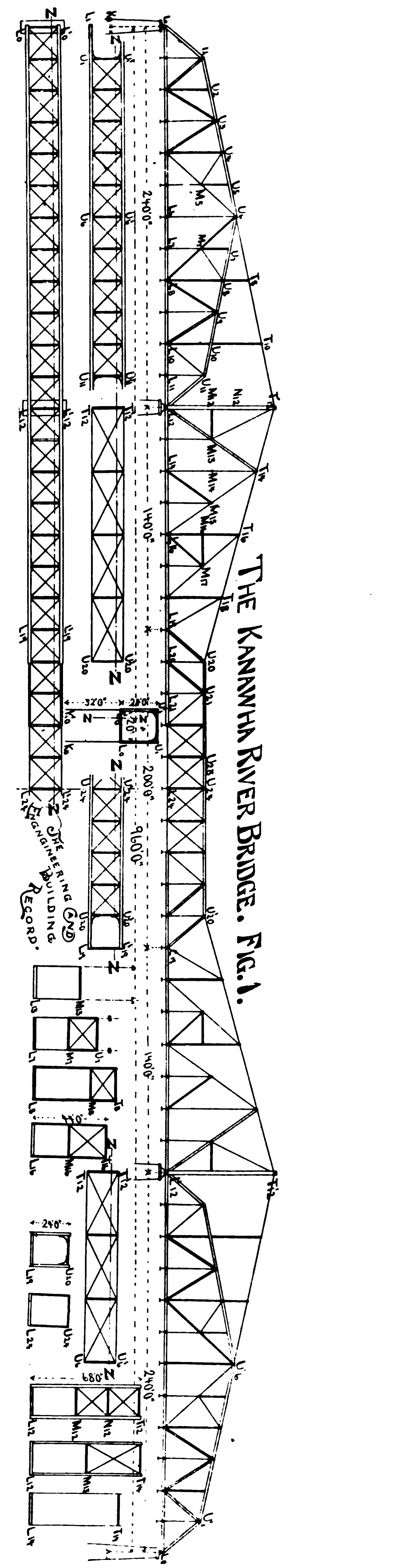
Figure 2 is a section and elevation at X X, Fig. 3.

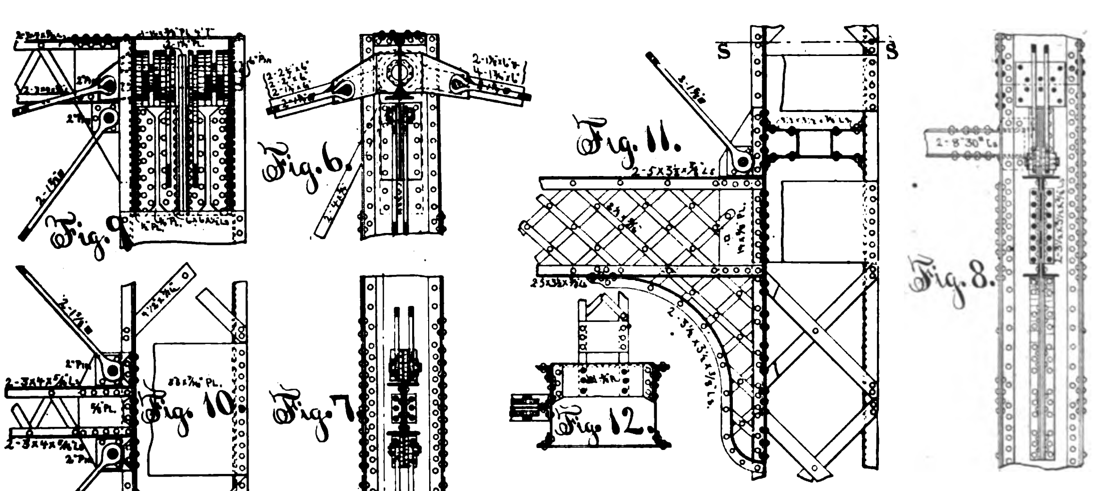
Figure 4 is a plan of the pedestal from V V, Fig. 2. At the left of centre line C C of the truss, the connected members are shown in section through the centre of the pin, the sections of the tower and end posts are made solid black for clearness. At the right of C C the pin and the tower and end posts are removed to show the shoe more distinctly.

Figure 5 shows the pedestal with the shoe and connected members removed. The upper half, above centre line C C is in plan, the lower half is in section at R R, Fig. 3.

Figures 6, 7 and 8 are elevations and sections from Z Z, Fig. 1, showing details of connection at T_{12} N_{12} and M_{12}. Figures 9, 10 and 11 are elevations at right angles to Z Z, of the same connections; and Fig. 12 is a section at S S, Fig. 7. At the left of Figs. 10 and 11 part of the vertical post is removed to show clearly the sway bracing connections.

(To be continued)





The Kanawha River Bridge.
The Engineering and Building Record.