former it is pecuniary loss chiefly, while to thousands of our youth it results in ruin for life, and becomes a curse to the land, as the crowded condition of our prisons prove. Some foreign-born workmen resisted the introduction of improved mechanism for a time, but the trouble was of short duration.

The introduction of improved machinery and processes of manufacture has given a great impetus to the development of the industry throughout the country. The capital now invested in the pottery industry here is nearly all of home growth—only a small proportion having been brought from outside. As the business grew and increased the potters turned their profits right back upon their respective works, enlarging them and improving their facilities for production, and mortgages upon works have been few in number and are now scarcely known. It is a remarkably self-contained, independent community, and calls no man or set of men master; and a striking proof of its solidity and strength is found in the fact that no failure of any magnitude, either among the potters or merchants, has taken place during all these panic years. That revolution proved a blessing in disguise to the pottery industry, in crippling the merchants of the country almost universally, so that each was in a brown study how to lessen the amount of capital constantly invested in stock which they were obliged to carry. Staffordshire and other foreign centers of crockery manufacture in the Old World were several thousand miles distant, and in order to keep a constant supply of goods of foreign make stocks must be large, involving a heavy outlay of capital, and consequent loss of interest. The American potters said to these panic-stricken merchants: "We are making good ware, and guarantee every piece. You can reach us daily and hourly by telegraph, if need be, and at small cost, to renew your stocks, and we will carry your stock for you, and you need to keep little more than a set of samples while these hard times continue." The offer was accepted, and in great numbers of cases merchants learned of the excellence of our American-made ware, as it were, upon compulsion of stern necessity. So, as the months passed into years, these merchants found that the ware which they had bought from these American manufacturers gave excellent satisfaction. They have gradually become enthusiastic in their admiration of American pottery. The potters both here and at Trenton have wisely employed traveling salesmen to present their ware to the merchants of the country and make them acquainted with its merits, and it is to be hoped that they will continue to do so until every merchant, not only in our own country, but on the American continent, shall be made acquainted with the excellence of American ware.

THE POLARISCOPE AS APPLIED TO SUGAR MANUFACTURING AND BREWING.

By J. STEINER.

I HAVE often been asked, when working with the polariscope, to explain the principles which govern it and permit its application for the determination of the different sugars familiar to us, and why it has become of such importance to the manufacturer and refiner of cane sugar; and I am confident it will also be used by the brewer as soon as he is acquainted with the simplicity, exactness, and rapidity of its working in ascertaining the amount of dextrin, which dextrin is not only a very valuable constituent in brewing, but also characterizes by its presence beer, and distinguishes it from all other alcoholic beverages. In the following I will endeavor to explain the principles on which such instruments are constructed on the Continent, and then describe their application.

An ordinary or common ray of light appears to us to possess always the same qualities, from which ever standpoint we direct our eyes, *e. g.*, if we throw a ray on to a mirror it is reflected under any inclination of the glass. This, however, is not the case with all rays, as there are some which do not exhibit this property of being reflected in every direction, and this peculiarity is called in science polarization, and rays having this singular and exceptional behavior are called polarized rays. Malus (1811) was the first to discover or observe this, and in order to understand clearly the nature of polarized light, let us consider how such light can be produced, and then by what experiments the qualities of such rays can best be demonstrated.

If a ray of sunlight, *a b*, fall on to a plane glass mirror under an angle of $35^{\circ} 25'$ it will be reflected in the ordinary

manner, *i. e.*, it will go forth again under the same angle in the opposite direction, *b c*; but this reflected ray is now polarized, because if a second mirror be interposed it will only be again reflected provided the two mirrors be parallel. On turning the second mirror round about *b c* as axis, and always under the same angle of $35^{\circ} 25'$ the ray, *c d*, will decrease in intensity and disappear completely when the rotation amounts to 90° ; but on continuing the motion the light again appears gradually and will be reflected with the original intensity or brightness at 180° distance from the starting point. In this position the planes of the mirrors are parallel again.

An apparatus provided with two such glass mirrors under the required inclination is the simplest form of a polariscopic instrument. The lower mirror is called the polarizer, and the upper one the analyzer. If the ray, *a b*, meet the mirror under another angle than the one given above, then only a partial polarization takes place, *i. e.*, the light is in no position of the analyzer quite extinct, although a maximum and minimum of the intensity be noticed.

The angle for which the polarization is a complete one is noted as the polarizing angle of the particular substance under examination, and it varies considerably with different bodies. As we have seen, this polarization is caused by reflection, yet such light can also be produced by other means. If light fall on to a transparent glass plate under the same angle of $35^{\circ} 25'$ it is partly reflected, *i. e.*, it goes

back into the old medium, and another part of it passes into the new medium, and is refracted or bent out of its original direction. These latter rays are now also partly polarized, and this property can be increased by making the light pass through a system of such plates held parallel to the first plate. A number of eight or ten plates produces a very distinct polarized light, and the plane of polarization of the refracted rays is rectangular to the one of the reflected rays; hence if such a system of glass plates be used as analyzer, the apparatus will be bright when the plates are rectangular to the position of the mirror, and it will appear dark when the polarizer and this analyzer are parallel.

This is the case with single refraction, but there are instances where a ray, on passing into a new medium, is split up in two rays. This property, which is called "double refraction," was first noticed with the Iceland spar or calc spar. It crystallizes in rhombs, and on placing a rhomb

a right-handed polarization, and the other to be left-handed.

To be enabled to understand this interesting experiment let us make use of monochromatic light instead of the white light. The simplest mode to do this is to look through a colored glass of a tint as much as possible homogeneous on the analyzing Nicol.

What appears now in the apparatus is as simple again as before interposing the quartz. Suppose we look through a yellow glass—the light appears again in its maximum of intensity at two points differing from each other by 180° , and at two other positions, differing from the former by 90° , the apparatus is quite dark. But the first bright position is no longer at zero, it is now at 24° , and therefore the other bright point at $24+180=204^{\circ}$. The corresponding dark points are, of course, at $24+90=114$, and at $114+180=294^{\circ}$.

FIG. 1.

over a mark or line on white paper and looking through it the object is seen double. Again, if we cover the upper plane of such a crystal with a cardboard, having a small hole in it for a ray of light to pass through, there will appear on the plane opposite to the first one, two white points, hence there are two rays moving along in the crystal in different directions. On studying the properties of these two rays it will be found that both are polarized. To prove this we look through a prism cut of Iceland spar on to an object, and, as explained before, two distinct pictures will be seen. If now an analyzing system of glass plates, or a plate of tourmaline, which acts in like manner, be interposed between the eye and the prism, a position can be found where only one of the two pictures is to be seen, and on rotating the analyzer, always in the same plane, the other ray will be noticed as well, but on continuing the rotation the first picture fades, while the other increases in intensity, and at 90° from the starting point of rotation only the second picture remains visible.

It is therefore clear that both rays are polarized, and further, that the planes of polarization are rectangular to each other. As all the rays which pass a double refractory crystal are polarized, it is more advantageous to use prisms made from such crystals instead of mirrors in the polariscope. But as there are two systems of polarized rays always present in the crystal, which are very confusing for the observer, it occurred to Nicol to eliminate one system by combining two such crystals, cut in a certain direction, with Canada balsam, and producing by it a total reflection for the one set of rays, whereby they pass out of the field of sight for the observer. The production of light or darkness can, of

A most important item is the thickness of the quartz plate, and for one millimeter thickness of the rock crystal the following maxima have been observed:

For Red,	19°	Green,	28°	Violet,	41°
Orange,	21°	Blue,	32°		
Yellow,	24°	Indigo,	36°		

It must also be pointed out that the angle of rotation increases in a direct ratio with the thickness, *i. e.*, in a plate of two millimeters, the maximum for yellow light is at $2 \times 24 = 48^{\circ}$.

It will now be clear why, on using the white or complex light, the quartz appears in each position of the analyzer to be more or less colored, and further, that the observed tints are not pure prismatic colors but mixtures of them, the shade of which depends on the kind of prismatic color which predominates or is in its intensity at the special point of rotation. Complete darkness and extinction of colors can never happen, because even if some of the prismatic colors be in the minimum of intensity, the others are still more or less intact. Yet if the quartz plate be very thin, *e. g.*, only $\frac{1}{4}$ millimeter, then the maximum of intensity for all the single rays which are contained in the white light are lying very near each other, that is, no color really predominates, and the plate appears almost white. In a similar manner the brilliancy of the picture influenced if the plate be very thick. Phenomena of this kind constitute what is called "circular polarization," and while there are only a few solid bodies known (calc spar, chlorate of potash crystals, cinnabar) possessing this wonderful property, it was discovered by the French philosopher Biot that many or-

FIG. 2.

course, be altered or fixed at will in an apparatus provided with two such Nicols. If a plate of quartz or rock crystal, formed by a section at right angles to the principal axis of the crystal, be inserted between the two Nicols, it appears, if observed through the analyzing Nicol, to be brilliantly colored, and the tints change with the rotation of the analyzer; but in no position of the circuit appears the crystal either quite pale or completely dark, and we further notice that the different shades follow each other in the order of the prismatic colors. Repeated experiments with different rock crystals show also that for some of them a right-handed rotation of the analyzer, *i. e.*, in the direction of the motion of the handles on the clock face, produces the change from red to yellow, from yellow to green, from green to blue, and from blue to violet, while for others the opposite motion is required. The one class is said to possess

ganic fluids act in the same fashion, only in a smaller degree, *e. g.*, a layer of 68 mm. of turpentine rotates the light not more than a rock crystal of only one mm. thickness.

A right-handed polarization shows, for example, a solution of cane sugar, maltose, dextrose, dextrin, soluble starch, camphor in alcohol, etc.

Left-handed rotate: uncrystallizable sugar, gum, albumen, oil of turpentine, etc.

In all these solutions the amount of rotation increases in a direct ratio with the concentration of the solution and with the length of the column through which the light passes. In order to determine the amount of polarization which any liquid exhibits, a solution of it is placed into a glass tube of an exact length (100, 200, or 300 mm. as a rule), which is closed with glass slides and screw caps, and then inserted between the two Nicols, which have previously been so ar-

ranged to each other that no light can pass through the instrument. The inserted liquid having a rotatory power, of course, alters the last mentioned circumstances, *i. e.*, light appears now in the apparatus, and either with or without prismatic colors, in accordance with the nature of the light (monochromatic or white) which is allowed to enter the instrument. To produce the same appearance as before interposing the solution, a certain amount of a reversed rotation is now necessary, and this indicates the rotatory power of the liquid in the instrument. There exists a number of different apparatus or polariscopes, according to the special requirements of different observations.

Those constructed for the use of the sugar manufacturer are called "saccharometers," and in the now following lines I will describe first such instruments and then others of a more recent construction, and which are specially adaptable in brewing.

Fig. I. represents the apparatus used by Biot for his researches into the nature of liquids, having the power to rotate the polarized light. The liquid under examination is contained in the tube, *d*, which lies in the groove, *g*. Such tubes of an exact length (mostly 200 mm.) are constructed of brass or glass, and have to be covered while in the apparatus, so as to prevent access of light from foreign sources. On the one end of the groove is the short tube, *p*, and in it is contained the polarizing Nicol, while on the opposite end of the instrument is the analyzing Nicol in the tube, *a*. The axis of *a*, *d*, and *p* coincide and allow the light, *l*, which is reflected from the black glass mirror, *m*, to pass through the instrument and to be noticed by the observer at *a*.

The tube, *a*, can be turned round its axis, and the amount of rotation may be read off on a scale fixed on the disk, *c*.

Fig. II. shows the instrument constructed by Mitscherlich for the special purpose of determining the amount of cane or beet-root sugar in commercial products, and it was for many years the only apparatus used in German beet sugar works.

P contains the polarizing Nicol, and A the analyzer, which latter may be rotated round its axis. The source of light is an oil lamp or a common gas burner. The zero of the index, J, coincides with the one on the scale, when the minimum of intensity of the light which passes the instrument is observed. The field of sight has then a dark violet color, and the least motion of K makes this tint change into blue and red, hence its name "teinte de passage." If now the brass tube, T, filled with a sugar solution, be inserted, a change of color takes place, each half of the disk appears in a different color, but on carefully moving K the original tint can be restored.

This amount of deviation is indicated by J on the disk, and it is, as stated above, in a direct proportion to the concentration and the column length of the inserted solution. Mitscherlich found by carefully conducted experiments that in his instrument a 200 mm. long column of an aqueous cane sugar solution, containing 30 grammes in 100 c.c., rotates the polarized light for 40 angular degrees if the appearance of the "teinte de passage" is looked to; hence each degree on the disk indicates 0.75 gramme of cane sugar, or, as it is technically called, "crystallizable sugar."

(To be continued.)

TESTING TEA FOR ADULTERATIONS.*

By A. W. BLYTH, M.R.C.S., F.C.S.

THE time is probably not far distant when the tea trade will buy entirely by analysis, supplemented in a few cases by a "taster's" report. An experienced palate will detect particular flavors which analysis may fail to show; but a fairly complete chemical examination of tea is of the highest value, whether as a guide to the purchaser, or merely to show its freedom from adulteration.

(1.) *Preliminary Examination of Tea.*—The tea leaves should be soaked in hot water, carefully unrolled, and their shape and structure examined. Sections can be made of leaves by placing them between two pieces of cork and cutting fine slices of both the cork and the inclosed leaf; on floating the sections in water, the film of cork may be readily separated from the leaf. The epidermis of the lower and upper surfaces can, with a little practice, be detached in small portions by the aid of a sharp razor, and examined in water, glycerine, or dammar balsam, under the microscope.† The structure of the tea leaf has been already noted. The following is a brief description of the principal leaves supposed to be used as adulterants:

Beech (Fagus sylvatica).—The leaves of the beech are ovate, glabrous, obscurely dentate, ciliate at the edges, the veins running parallel to one another right to the edge. The leaf, slightly magnified, is seen to be divided into quadrilateral spaces by a network of transparent cells. On section, the parenchyma of the leaf is found to consist of an upper layer of longitudinal cells, and a lower of loose cellular tissue, inclosed between the epidermis of the upper and under surface. The whole section is thus divided into oblong spaces by transparent cells connecting the cuticle of the upper and lower surfaces. The epidermis of both the upper and lower surfaces is composed of cells with an extremely sinuous outline. The stomata are small, not numerous, and almost round; average length, 0.000996 inch; average breadth, 0.00083 inch. Beech leaves contain manganese.

Hawthorn (Crataegus oxyacantha).—At least two varieties, the more common of which is the *C. monogyna*, with obovate three to four deeply-lobed leaves, with the lobes acute. The leaf is divided into quadrilateral spaces, like the beech and many other leaves, by a transparent network. The epidermis of the upper surface is composed of a layer of thin-walled cells, generally quadrilateral, outline seldom sinuous. The epidermis of the lower surface has a layer of thin-walled cells, with a very sinuous outline. Stomata large, distinct, and numerous, and in many instances nearly round, but the shape mostly oval. The average length of the stomata is 0.00166 inch, the average breadth 0.00149 to 0.0015 inch.

Camellia Sasanqua.—The leaves of *Camellia sasanqua* are oval, obscurely serrate (the younger leaves entire), dark green, glabrous, of somewhat leathery consistence; the lateral veins of the leaf are inconspicuous.

Micro-structure.—The parenchyma of the leaf is placed between two thickened epidermal layers; the epidermis of the upper surface, as seen upon a section, forms a wrinkled,

continuous, thick membrane, in which a cellular structure is not very evident. Below this there are two or three layers of large cells, more or less oblong, with their long diameter at right angles to the surface of the leaf; and underneath this again is a loose network of cells, resting upon an epidermis in every respect similar to that of the upper surface, but only half as thick. A thin layer of either the upper or lower epidermis shows a peculiar dotted or reticulated appearance, not unlike the rugæ of a stomach. The lower epidermis is studded with frequent stomata, which are of an oblong shape, length 0.001328 inch, breadth 0.00083 inch.

Sloe (Prunus communis).—The leaves of the common sloe are rather small, elliptic or ovate-lanceolate in shape, and slightly downy beneath. The sectional thickness of the leaf is the same as that of tea, *viz.* 0.00664 inch. The stomata on the lower surface are scanty, in length about 0.00166 inch; in breadth, 0.00083 inch. The microscopical appearances are wholly different from those of tea leaves, more especially as seen in section.

Chloranthus Inconspicuus.—The leaves of the *Chloranthus inconspicuus* are long, oval, serrate, wrinkled, the veins running nearly to the edge, and there forming a network in such a manner, that at the point of intersection little knots are formed, which give the margin of the leaf a very rough feeling. The structure of the leaf is very simple. The epidermis of the upper surface is formed of one or two layers of thin-walled cells, the epidermis of the lower of one or two layers also of cells, and between the two there is a parenchyma of loose cellular tissue. The stomata are oval and rather numerous; their length is from 0.001992 to 0.002188 inch, their breadth 0.001338 inch. The cells of the epidermis are large, some of them 0.005 inch or more in their long diameter.*

The dimensions of the stomata of the various leaves just described may be conveniently arranged in a tabular form, thus:

	Length of Stomata, Inch.	Breadth of Stomata, Inch.
Beech.....	0.000996	0.00083
Camellia sasanqua.....	0.001328	0.00083
Tea .. from 0.001162 to ..	0.001328	from 0.000996 to 0.001162
Sloe.....	0.00166	0.00083
Hawthorn.....	0.00166	0.00149
Chloranthus inconspicuus.....	0.001992	0.001328

A chemical method for the detection of foreign leaves (adulterants) was first described by the writer in June, 1877.† It is based upon two facts, first: that every part of a theine-producing plant—wood, stem, leaf, flowers, and even hairs, contains the alkaloid; and secondly, that this can be readily sublimed. The leaf, or fragment of a leaf, is boiled for a minute in a watch-glass with a very little water, a portion of burnt magnesia equal in bulk is added, and the whole heated to boiling, and rapidly evaporated down to a large-sized drop. This drop is transferred to the "subliming cell," described in another portion of this work (see *Index*), and if no crystalline sublimate be obtained, when heated up to 110° C. (a temperature far above the subliming point of theine), the fragment cannot be that of a tea plant. On the other hand, if a sublimate of theine be obtained, it is not conclusive evidence of the presence of a tea leaf, since other plants of the camellia tribe contain the alkaloid.

Finally, there is a negative test which may occasionally be valuable. All fragments of tea hitherto examined contain manganese, and there are a few foreign leaves in which manganese is constantly absent. Hence, if a leaf be burnt to an ash, and a fragment of the ash be taken up on a soda-bead, to which a little potassium nitrate has been added, the absence of the green manganate of soda would be sufficient evidence that the leaf had not been derived from the tea-plant, while conversely, as in the case of theine, it does not in itself prove it to be tea.

Another portion of the tea leaves should be thoroughly bruised, spread on a glass plate, and carefully searched with a magnet for ferruginous particles—the so-called iron filings, which are occasionally found, especially in capers and certain species of congou. It is almost unnecessary to state that the black, irregular masses found in tea, and attracted by a magnet, are not metallic iron.‡ Their chemical composition is somewhat variable; they all contain magnetic oxide of iron, and many of them in addition phosphate of iron, titanate of iron, quartz, and mica with a little sand. They are, without doubt, sometimes an adulteration (the author has himself found over 1 per cent.), and sometimes an impurity, for in a few teas mere traces only of this ferruginous sand may be discovered. Any particles of the kind extracted by the magnet should be collected and treated with hot water, which soon disintegrates them; the adherent tea-dust is separated, and the sand dried and weighed.

To detect facing, the tea in its dried state should be mounted as an opaque object. If it has the appearance of being heavily faced, soaking in warm water will soon detach the film; and indigo, Prussian blue, or similar substances will sink to the bottom, and may be collected and examined. Indigo may be identified by the microscope. Prussian blue may be tested for by warming the deposit with caustic alkali, filtering, acidifying the filtrate with hydrochloric acid, filtering again if necessary, and testing the filtrate with ferric chloride. The residue left after treatment with caustic alkali may be tested for magnesium silicate, by first extracting with HCl, and then collecting the insoluble residue, and fusing it with an alkaline carbonate. The silica is now separated in the usual way by evaporation with HCl to dryness, subsequent solution in weak acid, and filtration; any lime is removed by ammonia and ammonia oxalate; and lastly, magnesia is precipitated as ammon. mag. phosphate. Magnesia found under these circumstances must have been present as steatite or other magnesian silicate.

(2.) *Chemical Analysis.*—The preliminary examination of the tea having been concluded, the sample is next submitted to chemical analysis. If the question to be decided is simply that of adulteration, the taste of the infusion, the percentage of extract, and a determination of the chief constituents of the ash, are in most cases all that is necessary; but a more or less complete examination embraces a quantitative estimation of hygroscopic moisture, theine, total nitrogen, tannin, extract, gum, and ash.

* The leaves of *Epilobium angustifolium* (common willow herb) are said to be extensively used in Russia for the adulteration of tea. The dried leaves are sold for from four to six rubles a pound, and are used by the poorer classes in the place of tea. Alcohol produces in infusions of *Epilobium* a precipitate of mucilage. —*Pharm. Zeitsch. für Russland, Year Book of Pharm. Acty.*

† "Micro-Chemistry, as applied to the Identification of Tea Leaves. By A. Wynter Blyth. *Analyst*, June, 1871.

‡ Mr. Allen appears to have found metallic iron in tea. The test for metallic iron is that nitric acid, 12 specific gravity, dissolves it with the production of red fumes; it also precipitates metallic copper if added to an acidulated solution of cupric sulphate.

Hygroscopic Moisture.—The ordinary method of taking the hygroscopic moisture of tea is to powder as finely as possible an indeterminate quantity of from 1 to 2 grms., and to heat it in a watch-glass over the water-bath until it ceases to lose weight. It should be finally weighed between two watch-glasses, since it rapidly absorbs moisture from the air.

The method given is in its results incorrect, since some volatile oil and a small portion of theine are always volatilized. That theine is actually lost is capable of rigid demonstration; it is only necessary to heat a few leaves of tea between two watch-glasses over the water bath, and theine crystals can be readily discovered by the microscope. To devise a process of drying tea which will represent water only is easy; but since the loss both of volatile principles and theine does not materially affect the results, it is scarcely worth while to complicate the analysis by the use either of a lower temperature or of processes of absorption. The highest amounts of moisture in a genuine tea which are on record are two specimens from Cachar, analyzed by Professor Hodges—the one (indigenous) gave 16.06 per cent., the other, a hybrid, 16.2 per cent. These were, however, not commercial teas, and appear to have been simply dried in heated rooms. The average hygroscopic moisture found by Mr. Wigner in thirty-five teas, consisting of hysons, capers, souchongs, gunpowders, and others, was 7.67 per cent., the driest teas being the hysons and gunpowders, the moistest the congous:

	per cent.
The maximum amount of moisture found in hyson,	5.68
The minimum " " " "	4.84
The maximum " " " gunpowder,	6.55
The minimum " " " "	4.94
The maximum " " " congou,	10.39
The minimum " " " "	6.36

[Continued from SUPPLEMENT, No. 200.]

THE SOUTH PASS JETTIES.

NOTES ON THE CONSOLIDATION AND DURABILITY OF THE WORKS, WITH A DESCRIPTION OF THE CONCRETE BLOCKS AND OTHER CONSTRUCTIONS OF THE LAST YEAR.

By MAX E. SCHMIDT, C.E.

III.

Recent Constructions at the end of the Jetties.

THE mode of constructing and depositing the concrete at the South Pass Jetties is novel in many respects, and, with the aim of contributing facts that may be of value, for the information and study of those interested in such matters, I have prepared the following notes on the two most important parts, now under construction at the sea ends, namely, the concrete work and the slope at the sea end.

1.—CONCRETE WORK.

(A.) Preparatory Work, Machinery, and Implements.

Both jetties have been treated in the same manner, both having received an independent and similar share of the preparatory and auxiliary work.

The plan on Plate V. represents the immediate surroundings of the concrete mixer on the East Jetty, ten thousand two hundred feet below the eastern land's end.

On account of the shoalness of the water near the jetty, and, in order to facilitate the transportation of the material from the barges to the storage wharf, the latter has been connected by a bridge-portion sixty-three feet long, with the deeper water in the channel.

The storage wharf, bridge-portion, and wharf-head are founded upon four hundred piles, driven at intervals of eight feet, and connected with a 5x14 inch cap, for the support of the flooring.

The cement house occupies the northeastern portion of the storage platform. It is a low building, nearly square, and without windows. The roof is covered with felt, a layer of liquid pitch, and fine sea shells. The climate is damp, and these precautions were necessary for the preservation of the cement.

All the other ingredients, namely, sand, gravel, and broken stone, are piled loose at different places on the platform, ready for immediate use.

The mixer or mill is placed over the jetty proper, and consists of a 5 foot 9 inch cube, made of quarter-inch boiler iron, well riveted and held together by bands of flat and T iron.

This cubical box is suspended by two hollow cast-iron trunnions, seven and one-half inches in diameter, which are riveted from the inside of the box to two diagonal corners opposite each other, and rest in a tower or framework substantially built of heavy timber. The center of the trunnion is twenty-two feet above average flood tide, and the mixer is revolved by a steam engine which stands on the wharf below.

The two views on Plates VI. and VII., together with the plan on Plate V., will materially aid in understanding this partly novel machinery.

It will be seen that the cubical box has been cut off horizontally on one of the corners, so as to obtain a triangular opening for admitting and discharging the material. A cover (D, Plates VI. and VII.) is made of the severed portion, and a small hand crane is provided by which it can be lifted and shifted.

As the mixer has to be opened and shut once for each charge of concrete it is a matter of consequence to have the manipulation proceed as rapidly as possible. The method employed has worked satisfactorily.

When the mixer is filled it is closed by sliding the cover under the four clasps or lips, which may be seen on the drawing, and at once secured by four point screws. The hinged screws, *s s*, are then righted up and screwed with their nuts down.

To allow the rapid working of these six screws long handles have been attached to their upper ends.

The water enters the box through the hollow journal at B while the ingredients are being revolved. The tank, C, which supplies the water stands on the top platform, and has a floating gauge attached to it which is watched by the man whose duty it is to shut the valve, A, when the requisite quantity of water is admitted. The engine in its turn fills the tank.

For the transportation of the dry material from the wharf to the opening in the mixer, and the lift of nearly forty feet in height necessarily included in the operation a steam elevator forty-two feet high has been erected on the river side, and close to the mixer.

Hand carts, constructed for this purpose, as an improvement on wheel-barrows, are used for conveying the ingredients to the elevator box, E E, where they are deposited in