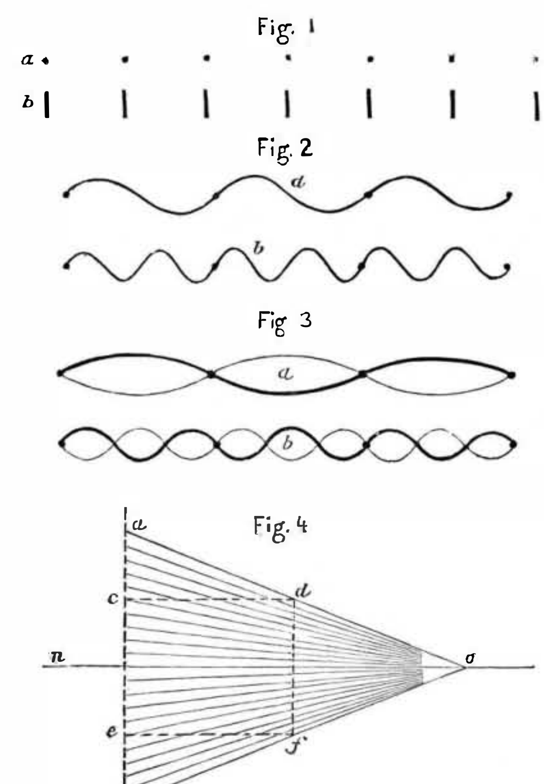
THE CYCLOSCOPE.

The very remarkable apparatus which we are about to describe was invented by Professors McLeod and Clarke, of the Royal Indian Engineering College. It is designed for measuring the velocity of revolution of any kind of machine whatever, and allows the *absolute* speed of the mechanism in motion to be determined at the very moment of observation, and that too with an accuracy that has been hitherto unknown. In order to make the description of the apparatus easier understood, we will state, in a few words, some of the phenomena upon which it is based. Every one knows, or has observed, that if any series of objects whatever are revolving or moving with a certain velocity the eye loses the faculty of distinguishing their outlines; and this is owing to the persistence of impressions upon the retina. Upon this physiological phenomenon are based the "phenakistiscope" and other similar toys. Now, then, let us suppose that a certain number of points (Fig. 1, *a*) are examined in a mirror fastened to one of the prongs of a tuning fork. When the latter is set in vibration, these points, by reason of the phenomenon above mentioned, will appear to us like so many lines (Fig. 1, *b*). Now let us place these points (which we will suppose to be equidistant) on the diameter of a cylinder, and let us cause the latter to revolve with a uniform motion. If we arrange our tuning fork so that the vibrations will occur in a direction parallel to the cylinder's axis of revolution, the points will then appear to us in the form of a sinuous line (Fig. 2, *a*) or wave, and the height of this wave will naturally depend upon the amplitude of the vibrations, while its length will vary with the velocity with which the cylinder revolves. It will be readily understood that if a certain relation exists between the period of the tuning fork and the speed of the cylinder, the wave will appear stationary. Nothing is easier than to determine the conditions which are necessary for the formation of a stationary wave. In fact, if, for example, the velocity of the points is such that the time taken by each of them in traversing a space equal to the distance which separates them, is equivalent to the duration of *one* complete vibration of the tuning fork, a stationary line will appear (Fig. 2, *a*). If, on the other hand, the time employed by each point to pass over a space equal to *two* intervals is again equivalent to the duration of one complete vibration, the wave traced by the image of each point will meet the adjacent point; and, as each point will trace a wave of its own in space, these waves will be superposed and form a double one (Fig. 3, *a*). Each of these waves may, through a change of length, vary as to its form In fact, if we apply to the tuning fork the same reasoning that we have applied to the points, that is to say, if we suppose the duration of the vibrations is changed in some manner, waves like those represented in Fig. 2, *b*, and Fig. 3, *b*, might appear. Theoretically we might obtain for each wave an infinite number of waves of like order.

Now let us see how this phenomenon can benefit us in estimating, for example, the speed of a revolving cylinder. For this, let us suppose that our points are 100 in number, and that they are placed at equal intervals. Let us take a tuning fork making 60 complete vibrations per second; then let us examine our points, and let us, moreover, suppose that a *stationary* wave (similar to that represented at Fig. 2) appears to us; then it is very evident that 60 *points per second* (or 3,600 per minute) will pass before the mirror. But for *one* turn of the cylinder 100 points will have to pass before the mirror, so the velocity of the cylinder is then equal to $\frac{3600}{100}$=36 revolutions per minute. The least change in the speed of the cylinder will give an apparent translatory motion to the wave; and, if the velocity is too great, the wave will move in the same direction as the points, but if too little it will move in the opposite direction. This very simple experiment is the fundamental base of the "Cycloscope," which it now remains for us to describe.

If upon the cylinder we had but one series of points, a single rate of speed might produce the wave that we should have chosen to determine its velocity; but if we place a series of dotted rings side by side, the number of points varying in each, it is very evident that in order to obtain the same wave on examining the points of one of these rings, it would be necessary to give the cylinder different rates of speed. Nevertheless, it would be practically next to impossible to place such a series of dotted rings upon a cylinder. Fig. 4 shows the ingenious means employed by the inventors to overcome this difficulty. Upon a sheet of paper are traced a series of lines all converging to a point, *o*, and passing through equidistant points marked off on the line, *a b* (these lines are usually white on a blue ground); this done, a parallelogram, *c d e f*, is cut out equal to the superficial area of the cylinder and glued upon the latter. The distance from the point, *o*, to the line, *a b*, as well as the number of points between *c* and *e*, are determined by a very simple calculation. If we now examine these lines, not as before in a mirror, but through a slit cut in a thin sheet of metal or cardboard, all the abovementioned phenomena will exhibit themselves exactly in the same manner; and, moreover, from a single inspection of Fig. 4 it will be readily seen that these lines act the part of an infinite series of equidistant points, and that consequently we shall be able to determine all the velocities that are possible between the extreme ones determined by *e c* and *d f*. These lines possess another important property: if we trace lines parallel to *e c* they will cut the oblique ones at a great number of points proportional to their distance from the line, *e c*. If, for example, the side, *e c*, is equivalent to 60 revolutions of the cylinder, and the



THE CYCLOSCOPE.

side, *d f*, to 20, the line which divides *e f* and *c d* into two equal parts will mark the position that must be occupied by the slit through which it will be necessary to examine the lines in order to obtain the stationary wave when the cylinder is revolving at a velocity of 40 revolutions per second. The wave generally adopted is the one of the second order (Fig. 3, *a*), as being the easiest to recognize.

Fig. 5 represents the cycloscope as it is now constructed. At B we see the cylinder with its paper covering. The wheel, R, serves to put it in communication with the machine whose rotary speed is to be measured. The movable box contains a reed or vibrating lance, which performs the functions of a tuning fork, and to which is fastened a small plate of zinc, in which there is a slit about equal in width to the breadth of the lines traced upon the cylinder. The lance vibrates 60 times per second. The small toothed wheel, E, and the wheel, D, being situated upon the same axis with the box, A, the latter can, by simply turning the wheel, D, to the right or left, be moved to any position in front of the cylinder. At S is an opening through which the lines are examined; it contains a lens for the purpose of magnifying the images. When the apparatus is to be operated the plate is caused to vibrate by means of a small bellows, the tube of which is seen at C C′. The box, A, carries an index by means of which the speed is read upon a graduated scale. Supposing that the cylinder is revolving and that we wish to learn its speed, we place the eye at S, and with the right hand turn the wheel, D, until we meet with the stationary wave which has served to determine the divisions; the index, O, will then point to the figure that indicates the speed. The graduated scale has also been arranged by Professor McLeod so that the speed can be read off without removing the eye from S.

By means of the cycloscope we can ascertain the minutest variations in velocity, and learn thereby that the most perfect machines, no matter how well regulated they may be, are constantly subject to variations. The services that such an apparatus may render are numberless, and, as Sir William Thomson has well said, Professor McLeod has here given us a more sensitive and more perfect measurer of time than that which we possess in the best made chronometer.—*La Nature.*

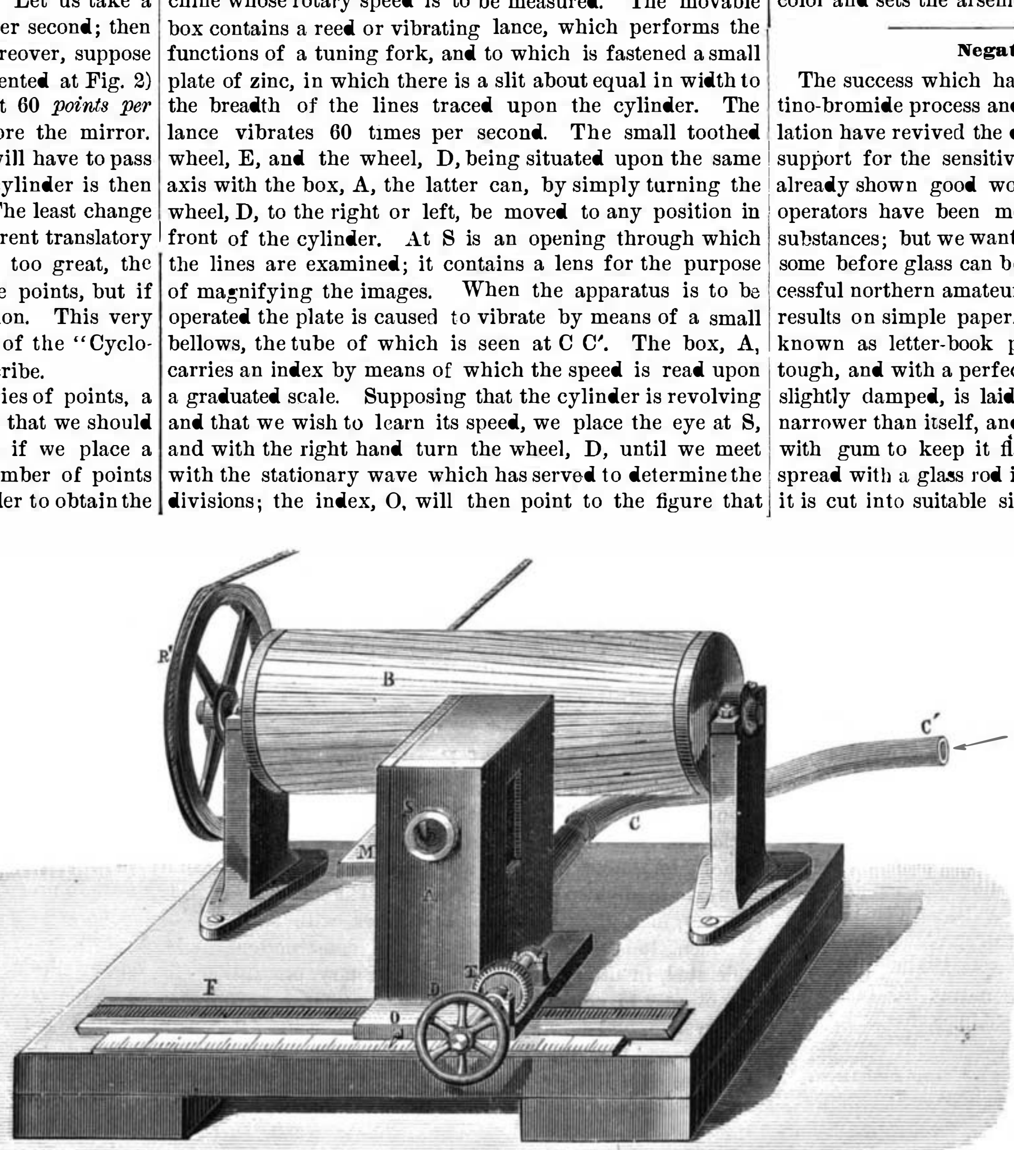


Fig. 5.—THE CYCLOSCOPE.

ARSENIC IN WATER COLORS.

According to the *Chemiker-Zeitung*, M. Fleck, in searching into the causes of the death of a young engineer, found in the corpse remarkable quantities of arsenic, the origin of which he attributed to the water colors which the deceased had been in the habit of using; for, on an analysis, he found that a specimen of sepia contained 2·08 per cent of arsenious acid; one of terra di Sienna, 3·14 per cent, and one of red brown, 3·15 per cent. The deceased engineer having been in the habit of drawing his brush, charged with the color, through his lips, it is not impossible that the arsenical colors were absorbed by degrees in the saliva. M. Fleck was then led to make a profounder study of the subject, and with the following result:

The dark colors of French make usually have an iron base; when they are dissolved in water they give a colorless liquid most generally containing no arsenic, while the residue left on the filter contains the organic matter combined with iron and mixed with arsenious acid. Some of the darker colors, marked "chenal," and "Paris et Richard," gave the following quantities of arsenic: Colored sepia, 1·10 per cent; natural sepia, 0·98 per cent; burnt sienna, 1·76 and 2·23 per cent; Van Dyke brown, 0·81 per cent; brown ocher, 0·52 per cent; sap green, 0·82 per cent; bister, 0·67 per cent; Indian red, terre de Cassel, burnt umber, raw umber, each 0·5 per cent.

Among the water colors known under the name of "Hornemann's technical colors," which were submitted to analysis, brown ocher and sepia contained only traces of arsenic, while terra di Sienna showed 1·19 per cent. It might be perhaps inferred that because oxide of iron has been successfully employed as an antidote to arsenic, and because arsenite of iron is not poisonous of itself, the arsenic contained in water colors in the form of arsenite of iron could exert no injurious influence on the health. But this would not be so unless the arsenite of iron were accompanied by ferric hydrate and magnesia in a free state (as happens when iron is exhibited as an antidote), since these substances neutralize the acid juice of the substance and thus prevent the decomposition of the arsenite of iron formed. When the latter comes in contact with the gastric juice without being protected by a base, the hydrochloric acid of the juice destroys the arsenite of iron introduced with the color and sets the arsenious acid free.

Negatives on Paper.

The success which has followed the practice of the gelatino-bromide process and the easy character of its manipulation have revived the desire for a substitute for glass as a support for the sensitive film. The Rev. H. J. Palmer has already shown good work on a gelatine film, and several operators have been more or less successful with various substances; but we want something simpler and less troublesome before glass can be dispensed with. One of our successful northern amateurs is at present getting pretty good results on simple paper. The kind he at present prefers is known as letter-book paper—a variety extremely thin but tough, and with a perfectly smooth surface. A roll of this, slightly damped, is laid on a perfectly level board a little narrower than itself, and the edges folded over and fastened with gum to keep it flat. The emulsion is poured on and spread with a glass rod in the ordinary manner. When dry it is cut into suitable sizes and exposed between plates of glass, as was the case with waxed paper. So far the results are promising, and I have little doubt that some such arrangement will ultimately be found in every way satisfactory for all outdoor work. It is probable that a previous coating of rubber in benzole, as suggested by me a number of years ago, might be an advantage by keeping the emulsion on the surface. Should simple paper be found to answer, as I have little doubt it will, some of our enterprising manufacturers will soon be sending it into the market in rolls similar to carbon tissue, as it may be made by the same apparatus and in exactly the same way by simply substituting the sensitive emulsion for the pigmented gelatine. In addition to the advantages of lightness and non-liability to break, there will be the further and, to many, greater advantage of reduction in cost. The price of glass is altogether saved and the labor reduced to a minimum, a band of several yards being coated in the most perfect manner in a few minutes. I hope to return to the subject again as the experiments of my friend proceed, and trust that, meanwhile, other workers will turn their attention in this direction, as the greater the number who put their hands and heads to the work the sooner will the desirable end be accomplished.—*John Nicol, Ph. D., in the British Journal of Photography.*

MECHANICAL INVENTIONS.

An improvement in the class of cotton presses whose followers are operated by a screw or screws, and are provided with an automatic mechanism for shifting the driving belt, and thus arresting the follower either in its ascent or descent, has been patented by Mr. George Cooper, of Augusta, Ga. Its construction cannot be readily described without an engraving.

An improved form of axle box and journal for vehicles has been patented by Mr. James A. Manning, of Danville, Ind. It prevents rattling, and it may be adjusted to compensate for wear; the journal will retain the oil or grease, and the box is prevented from wedging upon the journal.

An improvement in side-bar wagons has been patented by Messrs. William and Cyrus R. Fenstermacher, of Shippensburg, Pa. The invention consists in combining with the king bolt and fifth wheel a stay or brace having rear branches secured to side bars passing up on the inside of fifth wheel, and having the front branches fastened to the bolster.

A machine for manufacturing barbed fence wire of that kind in which the barbs are formed by wrapping a strip of sheet metal having inclined slits formed in its edge or edges around a wire spirally, has been patented by Alanson Cary, of New York city.

An improvement in the class of sash locks, in which an eccentric and sliding bolt are so connected that the action of the eccentric operates the bolt, has been patented by Mr. Hermann T. Raeke, of Baltimore, Md.

An improved monkey wrench has been patented by Mr. Baziel W. Lloyd, of Jackson, La. It consists in the combination of a box having arm and screw cutter sections held in the box, and a wrench having parallel jaws, the movable one being provided with a socket for holding the dies.

Mr. Moses R. McGregor, of Pine Bluff, Ark., has invented a lap ring or link of novel construction, adapted for use with plows and chains, and wherever available. It consists of the two flat links of similar size and shape, each having an opening at one side, and connected together. Upon one link is fixed a flat-sided pin or lug, which passes through a slot that is formed in the other link. This pin is headed or upset upon the link so as to retain the links together.

Mr. Daniel Kunkel, Sr., of Oregon, Mo., has patented an improved washing machine, which may be applied to an ordinary wash tub. It is simple, convenient, and effective. It is an improvement upon the washing machine for which letters patent No. 155,873 were granted to the same inventor, October 13, 1874.

An improved clay press has been patented by Mr. Simeon G. Phillips, of Perth Amboy, N. J. The object of this invention is to construct a press or adapt the ordinary presses for pressing clay in thin sheets one half the usual thickness, more or less, and sufficiently dry for the potter's use, without increasing the bulk of the press or using more cocks to produce the usual amount obtained at one pressing.

An improved attachment for clocks, to be connected with a self-lighting and self-extinguishing attachment for gas burners, which shall be so constructed that the gas will be lighted and extinguished automatically at fixed times, so long as the clock continues to run, so that the only attention required will be to wind up the clock at the proper time, has been patented by Mr. Simon Goldsmith, of Boston, Mass.

Mr. John F. Curtice, of Fort Wayne, Ind., has invented an improvement upon the car brakeshoe, patented March 21, 1876, by I. H. Congdon, in which detached pieces of wrought iron are embedded in a body portion of cast iron, by casting the said body portion around the wrought pieces, whereby the wearing face of the shoe is composed in part of wrought iron, and is enabled to better resist wear, and gives an increased friction for stopping the motion of the car. The object of this invention is to provide such a construction of this composite brake shoe as will, while retaining and even increasing the wearing qualities, also secure the requisite strength to resist the breakage to which its use renders it liable, and at the same time allow the use of a much lighter and less expensive shoe.

Mr. James Tripp, of Coldwater, Mich., has patented improvements in that class of sewing machines in which a revolving shuttle takes the upper thread from the needle and loops it around the lower thread, which is carried by a bobbin contained within said revolving shuttle. The invention consists in the peculiar arrangement of the revolving shuttle with respect to its driving mechanism, its holding plates, and other co-operating parts, and in the means for facilitating the removal of the shuttle and its bobbin.

Relative Economy in Steam and Gas Engines.

According to Mr. J. T. Sprague some of the improved gas engines now in use, of small capacity, realize 1 horse power on the gas derived from 1 3-5 lb. coal; and the best steam engines, of large capacity realize 1 horse power on 2½ lb. coal. Gas engines are thus shown to be much more economical as motors than steam engines.

A Couple of Clocks.

Dr. J. L. Blair, of Abingdon, Illinois, has recently completed a clock which is locally regarded as one of the most wonderful pieces of mechanism ever made. This clock is 8 feet 2 inches high, 3 feet 4 inches wide, and 10 inches deep—lower half. The upper half is 6 inches deep and has a circle top. The largest wheel is 13 inches in diameter. The longest shafting is 3 feet. Weight of clock, 118 pounds; of weights—two in number—8 and 22 pounds. The case and works are made mostly of walnut wood. In addition to its time-keeping capacity, this clock minutely illustrates (it is claimed) the composition and movements of the solar system. Time is indicated at the center of the sun, a ball 15 inches in diameter. Around the sun the planets circle in their respective orbits. The earth is 3 inches in diameter, turns on its axis once a day, and goes round the sun in an orbit 9 feet in circumference once a year. In its daily revolution the earth indicates the time of day everywhere, shows day and night, longitude, and so on.

The moon, 1¼ inch in diameter, accompanies the earth with its proper motion, illustrating its phases, eclipses, and the rest. The motion and phases of Venus are illustrated in like manner, and similarly the orbits and motions of other planets. Halley's comet, 7 inches long, traverses an orbit 14 feet in circumference, with a period of 76 years.

At the right of the clock a skeleton, 10 inches high, strikes the hours. At the left another skeleton plays a tune as often as required. A skeleton "Father Time" swings his scythe at the center of the lower half of the clock. Above are places for showing pictures of historical events. Other details are described, at great length and with much enthusiasm, in the local newspaper, the most remarkable feature being the circumstance that the entire contrivance was whittled out with a jack-knife in the space of one year.

This Abingdon clock, however, appears to be a very rude affair in comparison with one now on exhibition in Detroit, Mich. The latter is the work of Mr. Felix Meier, a mechanic, and is said to eclipse the famous clock at Strasbourg in complexity and interest. It stands 18 feet in height, and is inclosed in a black walnut frame elaborately carved and ornamented. The crowning figure is that of Liberty, upon a canopy over the head of Washington, who is seated upon a marble dome. The canopy is supported by columns on either side. On niches below, at the four corners of the clock, are four human figures representing infancy, youth, manhood, and age. Each of these figures has a bell in one hand and a hammer in the other. The niches are supported by angels with flaring torches, and over the center is the figure of Father Time. At the quarter hour the figure of the infant strikes its tiny bell; at the half hour the figure of the youth strikes his bell of louder tone; at the third quarter the man strikes his bell, and at the full hour the graybeard. Then the figure of Time steps out and tolls the hour, as two small figures throw open doors in the columns on either side of Washington, and a procession of the Presidents of the United States follows. As the procession moves, Washington rises and salutes each figure as it passes, and it in turn salutes him. They move through the door on the other side, and it is then closed behind them. This procession moves to the accompaniment of music played by the clock itself. The music machinery is capable of playing several airs.

The mechanism also gives the correct movement of the planets around the sun, comprising Mercury, which makes the revolution once in 88 days; Venus, once in 224 days; Mars, once in 686 days; Vesta, once in 1,327 days; Juno, once in 1,593 days; Ceres, once in 1,681 days; Jupiter, once in 4,332 days; Saturn, once in 29 years; Uranus, once in 84 years. As these movements are altogether too slow to be popularly enjoyed, the inventor has added a device by which he can hasten the machinery to show its workings to the public.

There are dials which show the hour, minute, and second in Detroit, Washington, New York, San Francisco, London, Paris, Berlin, Vienna, St. Petersburg, Constantinople, Cairo, Pekin, and Melbourne. The clock also shows the day of the week and month in Detroit, the month and season of the year, the changes of the moon, etc. It is said that Mr. Meier has worked upon this clock nearly 10 years, and for the last four years has devoted his whole time to it.

No doubt this ingenious contrivance may make a curious and possibly a remunerative show; still it would seem that the maker's time, skill, patience, and ingenuity might have been put to better use.

Fireproof Partitions.

A provincial builder, who is not acquainted with London practice, would be surprised to find that the inside partitions of most of the houses in the suburbs are constructed wholly of timber framing, and that the rooms of several stories are divided in this manner. The house, in fact, is nothing more than a shell of brickwork with partitions of wooden studs. How such a mode of construction can be tolerated, in utter contempt of all sanitary precautions, it is not easy to conjecture, but leasehold tenure encourages the system, and surveyors themselves wink at it. Of course this method expedites the erection of houses, and we would not complain if they were filled in with brick-work, or if the joists over the heads of one partition and its lower portion were filled up with incombustible material, so that a fire may have less chance of destroying the partitions above it. In Paris, as every one is probably aware, timber framing is largely resorted to, but the spaces between the uprights or quarters are built up with rubble laid loosely, and then plastered on both sides to fill up all interstices, so that, practically, a fire-resisting partition is the result. Our system of brick-nogging is a somewhat analogous operation, and answers tolerably well if properly done. In France the usual operation is as follows: The framed partition is inclosed on both sides by strong oak batten laths about three inches wide, nailed horizontally about six inches apart; within this the spaces are loosely packed with rough stone, and a strong mortar or plaster of Paris is laid on from both sides at the same time, and pressed through the interstices, so that the rubble becomes embedded in the mortar, consolidating both it and the timber. The surfaces are also covered so that the laths are hidden entirely. In this way a thoroughly concrete partition is formed, more effective and self-supporting than the brick wall; certainly superior and more durable than the English brick-nog partition, and throwing all ordinary plastered partitions into the shade. The brick-nog partition often fails; when the timber decays the bricks are not held together by a strong and independent thickness of plaster. The common hollow plastered partition becomes a nest for mice and a receptacle for vermin and dirt, and when a fire occurs it forms the means of communication, between the floors, and affords a channel for the supply of air. It is strange that although these facts are patent to every practical builder, architects and builders still adhere in an obstinate fashion to the plastered partition and the hollow wooden floor. We have constantly advocated floors, staircases, and landings, particularly, of concreted and incombustible materials, and though the idea is recognized and carried out in all large and important buildings, the ordinary dwelling-houses are allowed to be exempt from such salutary provisions. We called attention some time ago to the value of concrete in wall-building, and suggested the use of light timber lattice framing filled in or compacted with concrete. In a recent number of an American journal we find the same idea has been thrown out, and the writer gives a diagram of the system. The plan we suggest is to form a rough lattice of battens or strips 2½ × 3 in. or 3 × 2 in., with spaces of 4 inches or so apart, to fill up both sides with lime concrete, and to finish the two sides by a coat of plaster of the usual thickness. This construction would be cheaper than framing, and be admirably adapted for internal partitions, and for all temporary buildings.

It is occasionally necessary to divide an upper room into two by a partition, and to relieve the floor of unnecessary weight it becomes necessary to truss the former. Now the lattice partition or wall we have referred to becomes a self-sustaining structure, and may be supported easily by corbels at the ends. We are led, in speaking of weight, to say a word in favor of earthenware pottery as an excellent substitute for rubble or stone concrete. Common agricultural drain pipes of small diameter have been introduced by Mr. Pritchett for this purpose, but any kind of cellular construction may be adopted. It is to be regretted that architects do not adopt more largely the indestructible forms of partitions we have mentioned, and thus render a service to both sanitary construction and sound building. It is not less surprising that such ordinary precautions to insure buildings against fire, such as incasing and rendering solid the floors and partitions, should have escaped the vigilance of those who frame our building enactments.—*London Builder.*

The First Steam Ferry Boat Between New York and Jersey City.

In 1810 arrangements were made with Robert Fulton to construct steam ferry boats, and on the 2d of July, 1812, one named the Jersey was put in operation. The event was celebrated with a grand banquet given by the Jerseymen to the New York Common Council. A correspondent, writing to a newspaper of the time, says:

"I crossed the North River yesterday in the steamboat with my family in my carriage without alighting therefrom, in 14 minutes, with an immense crowd of passengers. On both shores were thousands of people viewing the pleasing object. I cannot express to you how much the public mind appeared to be gratified at finding so large and so safe a machine going so well."

This "large machine" was 80 feet long and 30 feet wide.

A year later the York was put on with the Jersey. They were supposed to run every half hour from sunrise to sunset, but frequently an hour was consumed in making a trip. The following is Fulton's description of the boat:

"She is built of two boats, each 10 feet beam, 80 feet long, and 5 feet deep in the hold, which boats are distant from each other 10 feet, confined by strong transverse beam knees and diagonal traces, forming a deck 30 feet wide and 80 feet long. The propelling water wheel is placed between the boats to prevent it from injury from ice and shocks on entering or approaching the dock. The whole of the machinery being placed between the two boats, leaves 10 feet on the deck of each boat for carriages, horses, cattle, etc.; the other having neat benches and covered with an awning, is for passengers, and there is also a passage and stairway to a neat cabin, which is 50 feet long and 5 feet clear from the floor to the beams, furnished with benches and provided with a stove in winter. Although the two boats and space between them gave 30 feet beam, yet they present sharp bows to the water, and have only the resistance in the water of one boat of 20 feet beam. Both ends being alike, and each having a rudder, she never puts about."