indicated, through their intersection with the vertical ones, the hours and half hours of a day. The horizontal lines had curves that receded from each other progressively in one direction and approached each other in the other, and this permitted of measuring the difference of the days and nights from each other in length. During six months of the year the hour was read in one direction and during the six others in the opposite direction (Fig. 4, No. 3). In this way were obtained the long and the short hours, according to the season.

The intersection of the curves with the perpendiculars marking these different hours was indicated by a light, rectilinear bar placed horizontally upon the engraved plate. This was mounted upon the weight and operated like the index of the vertical dials above mentioned. Japanese clocks struck the hour and the half hour, but there was here a curious peculiarity that we shall describe.

The primitive clocks had the European striking train that struck from one to twelve, with or without the halves. Afterward, the Japanese divided their striking trains so that they corresponded with their hours, that is to say, in counting from 9 to 4 without the halves.

Finally, they made the trains in such a way as to strike the halves, as follows : The half hour was sounded alternately by one stroke or two strokes. For example, in order to indicate half past nine, the train struck one ; for half past eight, it struck two ; and for half past seven it struck one again, and then two for the following half. This system had one advantage that explains itself. The hours in Japan correspond to two of ours, since only twelve a day are reckoned, instead of twenty-four. The periods of the hours are sufficiently distant from sunrise to sunset to prevent the single stroke or the two strokes of a half hour from being confounded. They serve, on the contrary, to render precise the half of the hour to which it corresponds.

In certain clocks of vertical form the Japanese have conceived the ingenious idea of using a striking train actuated by a spring as a motor for the movement. This train includes a pawl which, at every hour and half hour, meets the prolonged rods of the twelve cartouches upon which the hours are engraved and twelve other cartouches that are ornamental, and are interposed between the preceding and indicate the halves. The pawl, lifted by these rods, causes the striking train to operate. The weight of the train is wound up every day to the top of the case that incloses it, and here the square of the remontoir of the spring of the train presents itself opposite an aperture in the dial, and the spring is coiled with the same key that serves to wind up the cord of the clockwork movement (Fig. 4, Nos. 1 and 2).

We shall explain, according to Kaempfer, how the time of night was announced to the public in Japan.

In certain cities the watchmen did this by striking two wooden cylinders against each other. In others, different instruments were used. Thus, the first hour after sunset was made known by beating a drum ; the second, by beating a gum-gum—an instrument in the form of a large flat basin, which, upon being struck, made a loud and piercing noise ; and the third, or midnight, by ringing a bell, or rather by striking it with a stick of wood. Then they began over again for the following hours. The sounder, or awakener, whose duty it was to measure the time, was the lowest of the public officers.

The bell that sounded the hours of the day was often that of a temple. It was the rising and setting of the sun especially that was announced with the most care.

Along with mechanical clocks, the Japanese used portable sun dials, some of which had the form of a watchcase (Fig. 5). To the center of one of the halves of the case was fixed a small gnomon, the shadow of which reached the plane surface of the periphery, which latter, according to the Japanese system, was divided into twelve hours. The other half of the case carried in its concavity a magnetized needle, which oscillated freely in the horizontal plane. Beneath this needle there were four characters, which were 90 degrees distant from each other and designated the four cardinal points. The circular plane surface of this half of the case was divided into twelve parts, corresponding to those of the opposite side and marked with the same numbers, but in inverse order. In order to make use of the sun dial, it sufficed to orient it by means of the magnetized needle, and the direction of the shadow of the little style would then permit of estimating the time more or less approximately. Other sun dials consisted of two hollow disks, one of them containing the compass and the other the style. These two parts folded one over the other and entered a case to which they were jointed (Fig. 6). This arrangement is essentially Japanese. The other form has often been made for Japan in Holland.

The Japanese have as a proverb : "The style and the disk, despite their great utility, are not as valuable as an inch of shadow."

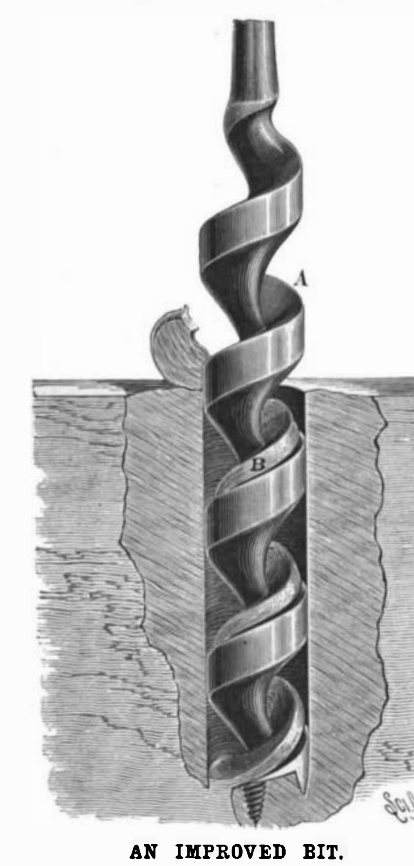
The sun dials of which we have spoken, as well as the clocks that we have described, are manufactured by clockmakers, who are called in Japanese tokei, while their shops are styled to-kei-yo.—La Nature.

AN IMPROVED BIT.

We illustrate the Ford patent bit, a tool which has been subjected to thorough testing upon different kinds of wood and which has a distinguishing peculiarity over other bits, which lies in the twist.

Its shape is determined by and defined as that of a single concaved twist. This gives it a single cutting edge and a single projecting lip. The thread of the screw point is a continuation of the twist of the upper part, so that one merges into the other. The concave shape of the upper surface of the twist has the effect of drawing the borings toward the center or axis of the bit, thus preventing friction of borings against the sides of the hole, and thereby also preventing choking. For this bit, the necessity of constantly withdrawing for removing the chips does not exist. The cut shows the self-cleaning action of the tool, and also presents its general shape. The drawing was made from an actual boring with the bit, the hole being made one-half in each of two separate pieces of wood, which were then separated to give the model for the artist and to show its action.

The bits were tried in different kinds of wood vertical to the grain, diagonal thereto, and in other ways. The straightness of the hole was also remarked, and the absence of any tendency to split the wood was an evidence of the good clearance. The screw point



AN IMPROVED BIT.

held its grip very well, no pressure whatever being required for the feed, even in end grain boring. The action of the edge is a true cutting one, not a scraping one. The Ford Bit Company, of Holyoke, Mass., are the manufacturers.

Improved Calorimeter.

An improved calorimeter, for the application of the method of mixtures in determining specific heats, is described by Mr. F. A. Waterman in the Philosophical Magazine. Mr. Hesehus' ingenious suggestion is acted upon, to maintain the calorimeter, after the introduction of the heated body, at a constant temperature by means of cold water, instead of measuring the rise of temperature of the calorimeter. This arrangement gets rid of the radiation error, and eliminates the "water equivalent" of the vessel. By dropping the cold water in, stirring is also made unnecessary. The method has been placed by Mr. Waterman upon a footing of equality at least with other methods, but his success may be partly due to other improvements. The body experimented upon is heated by a coil of wire conveying a current, and surrounded by ice. The initial temperature of the body may thus be regulated by simply maintaining the current of a certain strength and this temperature can be kept constant for five or six hours together to within 0·1° C. The body is then plunged into a silver calorimeter surrounded by the bulb of a delicate air thermometer indicating a difference of temperature of 0·01° C. The cold water is contained in a copper vessel having the shape of an inverted cone surrounded by ice. In this manner the ice cannot melt away and leave a free space round the vessel. The water dropping arrangement and the electric heater are mounted on vertical axes in such a manner that they can be quickly swung into position just above the calorimeter. After the heated solid or liquid has been dropped in, the water dropper is set to work, at first rapidly, and then slowly, until the body has assumed the original temperature of the calorimeter. For bodies of the same weight and the same initial temperature, the specific heat is then, Nature says, simply measured by the amount of ice cold water necessary to cool them to the temperature of the room.

Acetylene for Steam Engines.

The use of acetylene for the production of power has been suggested several times since it has become a commercial product ; but Dr. A. Frank, of Charlottenburg, has stated its advantages and disadvantages for the purpose very explicitly in the Journal fur Gasbeleuchtung. Calcium carbide capable of yielding 90 per cent of the theoretical amount of acetylene which the pure carbide should give is now obtainable from the works of Bitterfield ; and a very good article is also now made at Neuhausen. Dr. Frank suggests that the carbide furnishes an excellent means of transporting power (derived from water for instance) to a distance from the source. He considers Herr Ihering's proposal to compress acetylene to a liquid at a pressure of 50 atmospheres for transportation a less practicable one than that of conveying the calcium carbide itself. He bases this conclusion on the following figures : 64 parts (by weight) of calcium carbide on addition of water should produce 26 parts of acetylene : or 100 pounds of calcium carbide should yield 40·62 pounds of acetylene=559 cubic feet at atmospheric pressure. The liquefied compressed acetylene weighs 28·15 pounds per cubic foot, or 40·62 pounds occupies 1·443 cubic feet ; while the calcium carbide necessary to produce this quantity will have a volume of only 0·722 cubic foot, taking its specific gravity of 2·22. The volume of the calcium carbide is therefore about half that of the acetylene gas it would yield, when the latter is stored as a liquid under a pressure of 50 atmospheres. The space occupied by the walls of the containing vessel is, moreover, unconsidered in this comparison of volume. But the commercial production of acetylene from the carbide only gives 90 per cent of the theoretical yield ; and therefore 111 pounds of carbide would be required to produce the 40·62 pounds of acetylene, and a space of 0·800 cubic foot would be occupied by it. The calcium carbide may be run into cubical or other rectangular blocks ; and these may be put into light tins for protection from the air and moisture. The liquefied acetylene, on account of the weight and shape of the containing vessel, needs more space than the carbide for its storage.

The liberation of the acetylene from the roughly powdered carbide may be effected with simple apparatus. It may be observed that recent experiments show that the toxic properties of acetylene have been much overrated. Small mammals can remain for half an hour in an atmosphere containing 4 per cent of acetylene without perceptibly suffering inconvenience. Slight leakages from the generating apparatus need not, therefore, be regarded as dangerous to the workmen. If a comparison of the weight and volume of coal, liquefied acetylene, and calcium carbide needed to provide power for a 1000 horse marine engine for 25 days is made, the following results :

1. COAL.—The 600,000 horse power hours will need, at 1·543 pounds per horse power hour, 413 tons of coal, occupying, when well stowed, a space of 14,800 to 15,200 cubic feet.

2. LIQUID ACETYLENE.—According to Ihering and Slaby's figures, 0·4 pound nearly is required per horse power hour with large engines, or 106 tons for 600,000 horse power hours. A specific gravity of 0·451 at 0° C. corresponds to 364 at 35·8° C. (about the temperature of the ship's hold) ; and therefore 106 tons would require vessels of 9,500 to 10,600 cubic feet capacity, and these to be absolutely safe at a pressure of upward of 50 atmospheres.

3. CALCIUM CARBIDE.—The corresponding amount of 90 per cent carbide would be 295 tons, which, at a specific gravity of 2·22, would occupy a space of 4,625 cubic feet ; or, allowing for the tins in which the blocks are stored, about 5,300 cubic feet.

Therefore to supply power for 25 days to a 1,000 horse power engine requires : Good coal, 413 tons, having a volume of 14,800 cubic feet ; compressed acetylene, 106 tons, having a volume of 9,890 cubic feet ; or calcium carbide, 295 tons, having a volume of 4,770 cubic feet. Moreover, coal needs a boiler which is expensive both in first cost and in maintenance ; while liquid acetylene requires large storage vessels, whereas simple apparatus only is needed with the carbide. To one unversed in shipbuilding, it seems that, in the endeavor to find a very concentrated form of fuel to fit war vessels for long journeys, calcium carbide must attract attention. Stationary and locomotive engines on land might also use it, and be independent of foreign petroleum, which has lately also been used for ships' boilers.—Journal of Gas Lighting.

WHAT is claimed to be the largest single pane of glass in the country was received at Hartford, Conn., from Belgium recently. It is 12½ feet high, 15½ feet wide, ⅛ inch thick, and weighs 1,800 pounds.