MELDE'S EXPERIMENT WITH THE TREVELYAN ROCKER.

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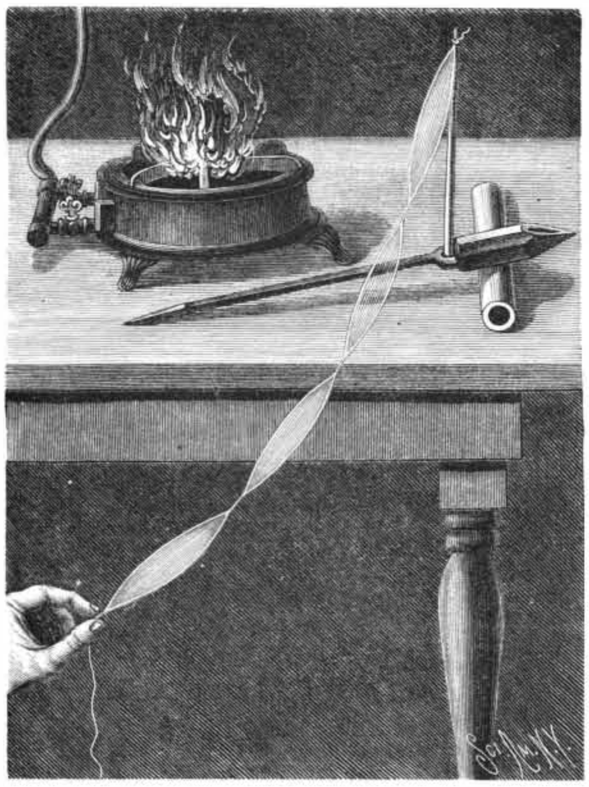
A very simple way of performing Melde's experiment, in which visible loops and nodes are produced upon a long thread, is shown in the cut accompanying this description. The well known phenomenon of the Trevelyan rocker is utilized and made to take the place of a vibrating diaphragm. As Melde's experiment



MELDE'S EXPERIMENT WITH THE TREVELYAN ROCKER.

is usually performed, a tuning fork is the source of vibration. A fine and very flexible thread is attached to the extremity of one leg of a tuning fork, and is held in a generally horizontal position, of course curving downward. If stretched to the right degree of tension, the thread, when the fork is vibrated, will be thrown into a beautiful series of loops and nodes. This is not all. By varying the tension of the thread, the nodes can be varied in number, two, three, or more loops being produced. The looser the thread is, the more loops will be developed.

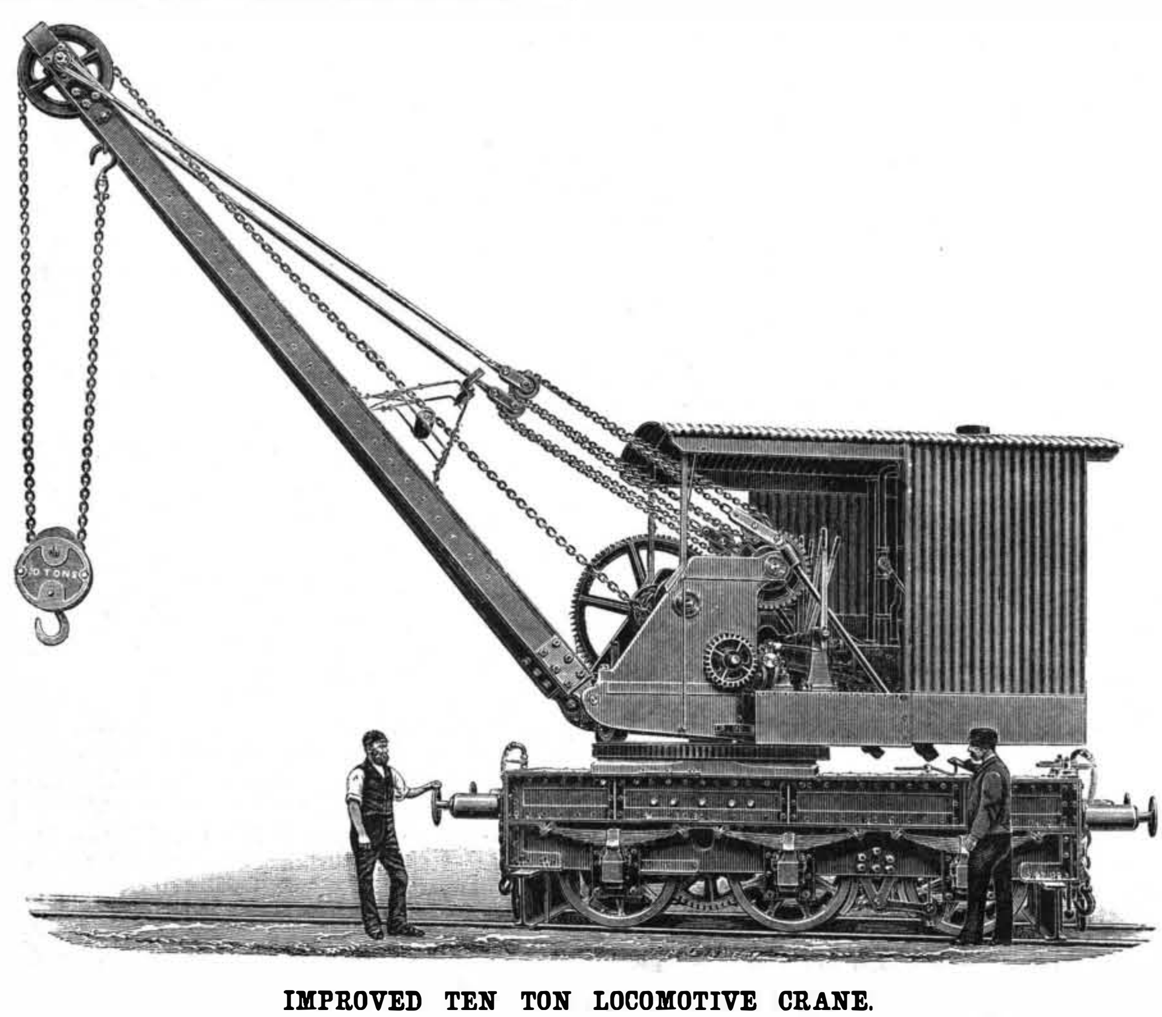
It will be evident that some adjustment is required, and it is in this respect that the common tuning fork is a failure. It will only vibrate for a short period, and gives little time for adjustment. While it is sounding, its note cannot be changed. In the Trevelyan rocker is found an extremely simple way of producing vibratory motion that will continue for many minutes. If a soldering iron is heated and laid with its head upon a piece of lead pipe, and the end of the iron handle resting on the surface on which the pipe lies, a very efficient rocker is produced. If the bolt is tilted a little to one side and released, it falls back to its first position, and at once begins to rock back and forth very rapidly, producing a musical note. The usual explanation of the phenomenon is that the lead is heated as the iron strikes it, and throwing up little elevations, first at one and then at the other corner of the bolt, under thermic expansion, keeps the bolt in oscillation. Another feature will be observed. A soldering iron of octagon section should be used. It has sides of two sizes, its cross section being a square with truncated corners. If placed upon a narrow side, it rocks slowly through a considerable amplitude; if placed on the wide side, it rocks much quicker and with less amplitude. Furthermore, the note can be changed by pressing with the point of a penknife vertically down upon a point over its axis.

To produce loops and nodes a stick about five inches long is secured to the hot iron by driving into the fork of the iron handle. A silk thread is tied to the end of the stick, and the rocker is started. The other end of the string is now held in one hand and the tension varied until the right point is reached, when suddenly the thread, hitherto quiet, starts into action, and is thrown into a series of beautiful loops, as shown in the illustration. The string may be ten or fifteen feet long. By increasing or diminishing the tension, the thread will again become quiet, and again will move, producing a different number of loops. As the rocker will keep moving for ten minutes or more, there is time during a single experiment to vary the effect indefinitely. The rocker may be used upon its short or wide side, with different results in each case.

Another way of changing the number of loops may be tried. The thread in this case is stretched across the room and secured at such tension as to produce one series. Then, by pressing on the iron with the point of a knife as described, its note may be raised, and the loops will cease to appear. If a still further variation is produced, a different series may appear. It is easy by this change to throw a quiescent string into motion, or to stop a moving one; but it is difficult to successfully carry the thread through two phases of vibration. In the time afforded for experimenting, and the variations that can be produced, the method is far superior to the ordinary one.

If the string is held as shown, it makes two vibrations for one of the rocker. If held in the prolongation of the axis, so that the stick swings across its line, its vibrations correspond in number with the oscillations of the bolt.

An experiment of some interest can be performed by placing a microphone and battery in circuit with the lead pipe and rocker. One end of the wire should be in contact with the pipe, the other with the end of the handle of the rocker. The telephone then reproduces the sound very loudly, showing that if not an absolute make and break, a very great change of contact is produced by the motion. The telephone may then be placed in circuit with a microphone, and the pipe may be placed upon the base of the latter. Upon starting the rocker into action on the pipe, the telephone responds loudly with much the same note as when the rocker was in the direct circuit. These supplementary experiments go to show that there is a certain field of experiment open for the rocker. It will be found an admirable producer of rapid oscillatory motion, so that it can be utilized in many other experiments than that of Melde.

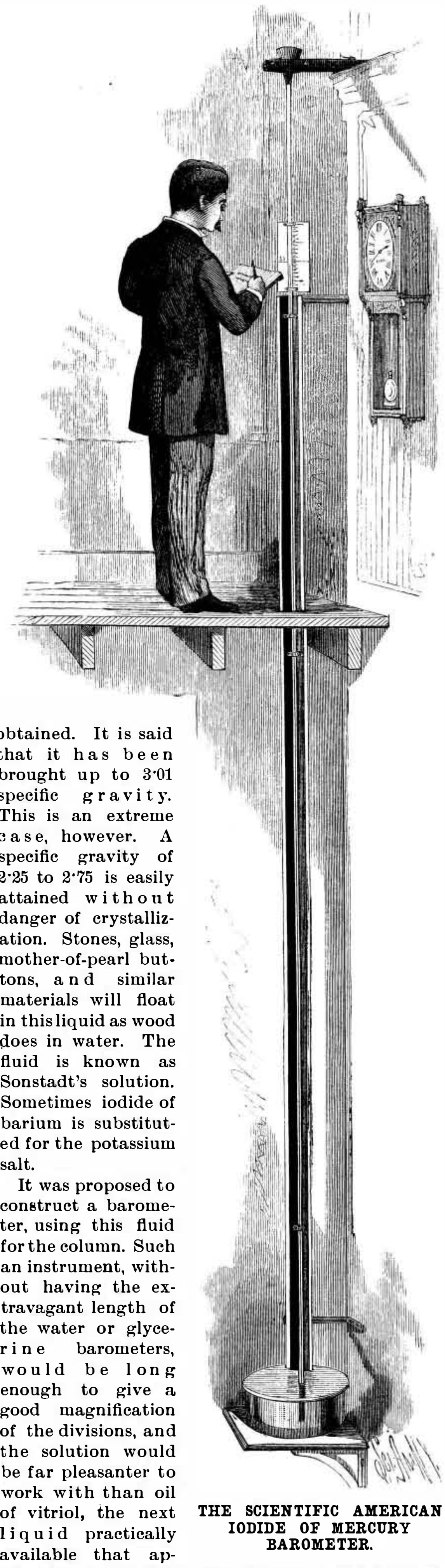


IMPROVED TEN TON LOCOMOTIVE CRANE.

FOR DESCRIPTION SEE PAGE 136.

THE SCIENTIFIC AMERICAN IODIDE OF MERCURY BAROMETER.

If iodide of mercury is dissolved in iodide of potassium and water, a liquid of very high specific gravity can be



THE SCIENTIFIC AMERICAN IODIDE OF MERCURY BAROMETER.

obtained. It is said that it has been brought up to 3·01 specific gravity. This is an extreme case, however. A specific gravity of 2·25 to 2·75 is easily attained without danger of crystallization. Stones, glass, mother-of-pearl buttons, and similar materials will float in this liquid as wood does in water. The fluid is known as Sonstadt's solution. Sometimes iodide of barium is substituted for the potassium salt.

It was proposed to construct a barometer, using this fluid for the column. Such an instrument, without having the extravagant length of the water or glycerine barometers, would be long enough to give a good magnification of the divisions, and the solution would be far pleasanter to work with than oil of vitriol, the next liquid practically available that approaches it in weight. The details of the barometer are shown in the cut. It was constructed for and stands in the SCIENTIFIC AMERICAN offices.

The tube is in one piece, and is about ⅜ in. internal diameter. At its upper end it expands so as to form a funnel. It was made open at both ends. As cistern, a cylindrical glass vessel, 9 in. wide and 4¾ in. deep, is used. A round plate of glass is provided for cover. The upper edge of the cistern is ground off so as to form a tight joint with the under surface of the plate. A hole through the plate admits the end of the tube, which, carried by a wooden frame and brackets, rises vertically from the cistern. The latter stands upon a shelf. The tube rising from it passes through a hole in the ceiling and terminates about six feet from the floor above it. The upper end of the tube is corked with an India rubber cork, to which, by means of a piece of platinum wire, a thermometer is suspended. This hangs down within the tube above the solution, and may be assumed to give a very close indication of its temperature. The funnel holds some metallic mercury, which is used to insure the tightness of closing of the upper end of the tube.

The tube contains Sonstadt's solution. The same is placed in the cistern to a depth of about one inch, so as to cover the end of the tube. The Torricellian vacuum, less the tension of the vapor of water, exists above the solution in the tube, so that a true barometer is constituted.

The filling was thus effected: The tube and cistern were put in place, and the lower end of the tube was corked. Solution was poured into the cistern until the end of the tube was immersed. Next the solution was poured into the upper end of the tube until it rose in the funnel. After standing a sufficient time to be sure that no bubbles existed in the liquid, the India rubber cork, with the thermometer hanging from it, was introduced, the thermometer descending into the tube. As the cork was depressed, it entered the solution in the funnel, and while thus immersed was pressed hard into its seat. The long column of difficultly compressible liquid acted like a solid body and forced out the cork at the bottom, and the column at once dropped to the height due to atmospheric pressure. Some metallic mercury was poured around the cork, and the lower cork floating about in the solution was removed, the plate and cistern were adjusted, and the filling was complete.

The scale was determined by comparison with a mercurial barometer. An arbitrary scale of equal parts was first attached, and its readings were compared with those of a mercurial barometer. A great many readings were taken at varying heights, and from them two average readings for extreme height and depression were deduced. Not only did this give a ratio of parts, but it also fixed the initial point corresponding to thirty inches.

On the basis thus determined a scale marked as for inches and hundredths was constructed and put in place. A number of readings were taken, and an error constant in size, the readings being always too low, showed that the 30 inch point was wrong. The scale was then shifted a fraction of an inch, and a new series of readings were taken. These showed that the instrument was at last correct.

At first the thermometer was read at every observation, and corrections for temperature and tension of aqueous vapor were applied. But it was found that the slight discordance existing between it and the mercurial barometer was not lessened by this correction. Practically both instruments read alike, without any correction, so it came to be regarded as unnecessary.

It is proposed ultimately to cement the glass plate to the cistern and to fill with cement the joint between the tube and plate. Then a small glass tube is to be secured in a second hole in the cover, to the outer end of which tube an India rubber balloon is to be attached. This will exclude air and prevent all evaporation, and yet will allow the atmospheric pressure to act freely upon the liquid in the cistern.

By calculation from the relations of its scale to the true inch, the specific gravity of the fluid is found to be 10·51 that of mercury, or, referred to water, 2·662.

The method of construction adopted has been found exceedingly convenient. On one or two occasions it has been found necessary to open and refill the tube, but no trouble has ever been experienced in doing this. In a long series of readings the greatest difference from a mercurial barometer was 0·055 inch. The general error was about one-third this amount, and a number of readings practically coincided. These comparisons are made with the Draper registering barometer, which is also located in these offices.

TEN-TON LOCOMOTIVE CRANE.

The ten-ton permanent way locomotive crane which we illustrate on preceding page was constructed for the Swedish and Norwegian Railway by Grafton & Co., London. It is driven, says *Engineering*, by a pair of engines having cylinders 9 in. in diameter by 12 in. stroke, and fitted with link motion. The chain barrel is 11 in. in diameter and 4 ft. long between the flanges. The chain is of $\frac{7}{8}$ in. iron, and was proved to 25 per cent above the Admiralty strain.

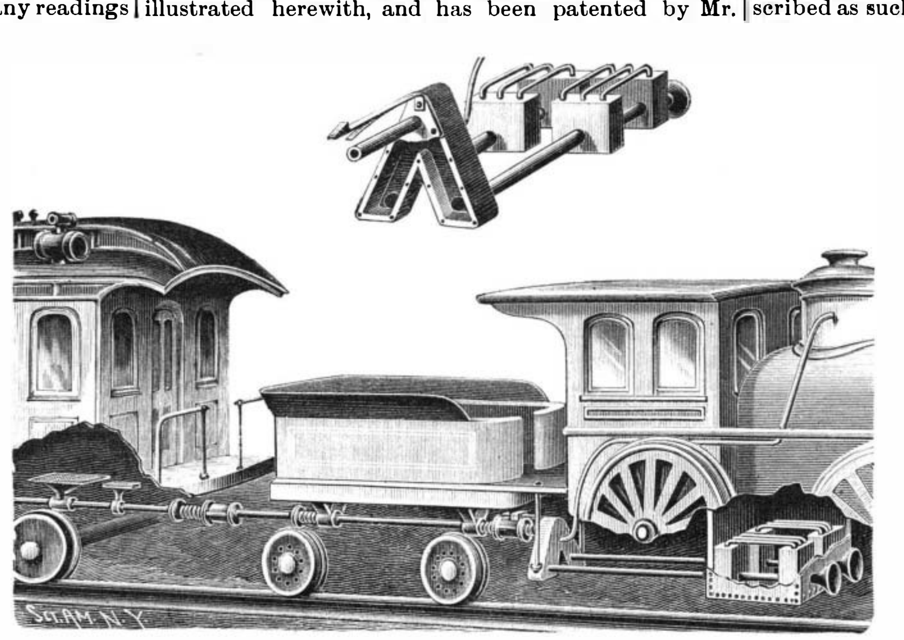
The slewing gear is constructed according to an arrangement patented by Mr. Alexander Grafton. The roller path and the toothed ring, or circular rack, are made in one piece, the anti-friction rollers running on its upper surface, while the pinion travels round its circumference. This combined ring is not fastened to the carriage, but merely lies on a circular turned surface, on which it is retained against lateral motion by a raised ring or flange which fits its interior diameter. When the slewing pinion is rotated, the ring remains stationary, since there is more friction between its lower surface and the carriage than between its upper surface and the rollers. But should any shock come upon the gear, as, for instance, if the jib of the crane should be struck by any moving object, or if the engines should be suddenly reversed in the act of slewing, then the ring will slip on the carriage, and the breakage of the gear, which would otherwise occur, will be avoided. The carriage is mounted on six wrought iron wheels with steel tires. The boiler is 4 ft. in diameter and 7 ft. 6 in. high.

Coal in the Argentine Republic.

According to a consular report, discoveries of coal have been made in the Argentine Republic. A company is now working the Dehera and Colorado coal mines, about sixteen miles from San Juan, in the province of the same name. It is stated that a seam nearly two feet thick has been discovered. Another bed has been discovered and works undertaken at Loude. It is reported that the coal is large, firm, and gives a great heat, suitable for the manufacture of coke and gas. This news has been received with satisfaction at Buenos Ayres, the want of coal in the Argentine Republic and the necessity to obtain supplies from abroad, chiefly in England, having been hitherto considered one of the chief obstacles to the establishment of a native industry able to compete with foreign products.

IMPROVED APPARATUS FOR HEATING CARS.

An apparatus designed to convey heated air from the locomotive to the several passenger cars of a train is illustrated herewith, and has been patented by Mr.



WOOD'S APPARATUS FOR HEATING RAILWAY CARS.

Marshal Wood, of Alderson, West Va. Air tubes, having funnel-shaped front ends, open into boxes or reservoirs in the fire box, these boxes being connected to rear ones by a series of small pipes designed to serve as grate bars. From the rear boxes the hot air pipes connect with a triangular-shaped heating drum, shown in the small figure, suspended beneath the cab and connected with a coupling. Each car is preferably provided with two registers. To aid in carrying the heated air to the several cars, the hot air drum is connected by means of a tube with the steam dome, and sufficient steam used to drive the air through the train and afford all the heat desired.

The St. Louis Bridge.

The beautiful bridge built by Captain Eads over the Mississippi River at St. Louis, bold in its design and excellent in its execution, is an object of admiration to all who visit it, but the impression of its importance would be greatly magnified if the part below the surface of the water, which bears the massive towers, and which extends to a depth twice as great as the height of the pier above the water, could be visible. There are three steel arches, the center one having a span of 520 feet, and each side arch a span of 502 feet. Each span has four parallel arches or ribs, and each arch is composed of two cylindrical steel tubes, 18 inches in exterior diameter, one acting as the upper and the other as the lower chord of the arch. The tubes are in sections, each 12 feet long, and connected by screw joints. The thickness of the steel forming the tubes runs from 1 3-16 to $2\frac{1}{4}$ inches. These upper and lower tubes are parallel and 12 feet apart, connected by a single system of diagonal bracing.

The double tracks of the railroad run through the bridge adjacent to the side arches at the elevation of the highest point of the lower tube. The carriage road and footpaths extend the full width of the bridge, and are carried, by braced vertical posts, at an elevation of 23 feet above the railroad. The clear headway is 55 feet above ordinary high water. The approaches on each side are masonry viaducts, and the railway connects with the city station by a tunnel nearly a mile in length. The great tubular ribs were built out from each side of a pier, the weight on one side acting as a counterpoise for the construction on the other side of the pier. They were thus gradually and systematically projected over the river, without support from below, till they met at the middle of the span, when the last central connecting tube was put in place by an ingenious mechanical arrangement, and the arch became self-supporting.—*Scribner's Magazine.*

Labor in State Prisons.

The Committee on Political Reform, of the State of New York, have recently issued a report on the above subject. For a number of years the prisoners in the prisons of this State were kept at work during the period of their incarceration. They were employed on the contract system. The labor of the prisoners was farmed out to manufacturers of shoes, stoves, and other goods, who made large quantities of manufactured material in the prisons. Much of the work was done by machinery, so that so far as the convicts were concerned, they were only taught a trade in the most limited sense of the term. Many articles were only partly completed in the prisons. The reformatory or educational aspects of labor were really subordinated to considerations of profit to the contractors.

The labor interest of the State, rightly or wrongly, looking upon prison labor as an injurious form of competition, succeeding in bringing about legislation practically abolishing prison labor, and reducing nearly all the prisoners to idleness. The results are described by the wardens of the different prisons as horrible. The body of criminals are left the greater part of their time in idleness, if a walk for exercise cannot also be described as such. The mind and body alike become unhealthy. Restlessness and ennui, leading to death, disease, and insanity, ensue, and the ultimate consequences may be very grave. Already the consignments to the insane asylum have begun to increase. The workers of this great State need protection at no such cost as this.

A prison should be a reformatory. At the best, but little reformation can be effected, but even a neutrality of operation is better than inflicting bodily and mental injury upon criminals. The plea of the committee is for employment for these wards of the State, which shall be so regulated as to have little or no effect upon general industrial occupations.

Assuming all the prisoners to be employed, their proportion to the total labor list of the State is put at fifty-two one-hundredths of one per cent. The committee hold that such competition, properly distributed, can do no harm. It is true that, under the old system, where the occupations covered a very restricted field, it might be felt. Admitting this, anything seems better than to maintain prisons as hot-beds for the fostering of evil habits, indolence, and some of the lowest forms of vice, and it seems perfectly clear that so small a proportion of laborers can be kept busy without perceptible effect upon the true interests of workmen. As compared with outside labor, prisoners are reckoned as having an efficiency of only sixty per cent. This reduces their competition to about three-tenths of one per cent—an infinitesimal amount.

To restore industrial occupation to prisoners, legislation is needed. It is proposed that a law shall be passed directing that prisoners be made to work. To prevent injurious competition, the number of prisoners employed in manufacturing any one kind of goods, according to the terms of the proposed law, shall not exceed ten per cent of the number of free workmen employed in manufacturing the same goods within the State. If this numerical ratio be further reduced by the coefficient of efficiency of prisoners, it will diminish to six per cent effective labor. By proper distribution of employments it can be reduced still lower, so as to approximate to the labor ratio of one in two hundred. The passage of such a law will undoubtedly do the prisoners much good, increase their chances of reformation, and will not perceptibly affect the prospects of outside workmen.

Salt Water in the Gas Wells.

Salt water is beginning to be a great nuisance to the oil and gas resources of Northwestern Ohio. It is invading nearly all the wells and making an immense amount of trouble, some property having been altogether abandoned on account of its presence. Salt water is affecting the gas wells of Findlay to a large extent, more noticeably in the famous "Karg," which at times cannot be used for several days. After a period of rest, however, the disturbing element seemingly disappears, but under high pressure upon the well returns again.