SCIENCE

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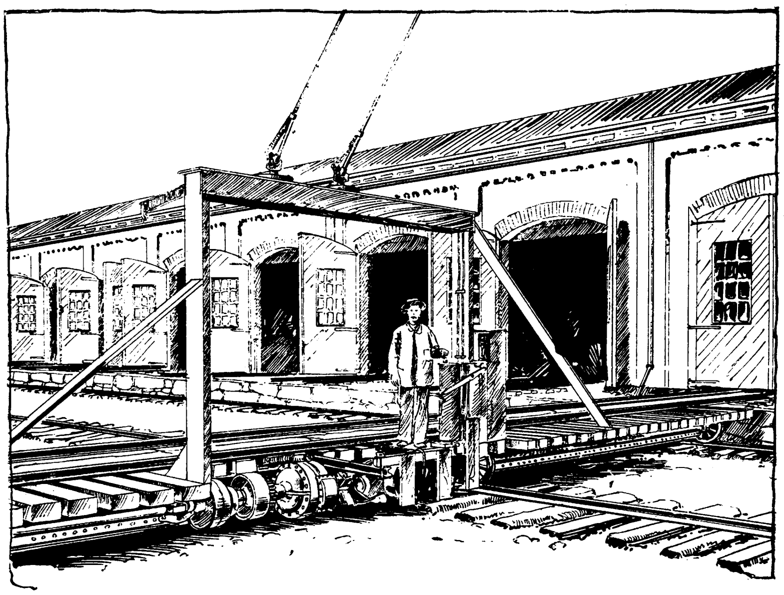
AN ELECTRIC TRANSFER-TABLE.

THE accompanying cut represents the new transfer-table at the Fitchburg car repair shops at Fitchburg, Mass., just built by the Fitchburg Railroad Company. The table or car is moved by the Union Electric Car Company's system. The motor, gears, clutches, etc., are all on the front axle of the car. The motor is geared to the axle, and the gears run in an enclosed bath of oil. They are brass cut gears, and work with the least possible amount of friction and consequent loss of power. The switch which governs the motor and controls the car is just above the motor, on a platform built out from the front of the car, as are also the reversing bar and the handle throwing in and out the clutch by which the motor is used either to propel the car in the desired direction or to draw off and on the cars to be changed from one track to another.



ELECTRIC TRANSFER-TABLE AT FITCHBURG, MASS.

The two shops are each five hundred feet long, and face each other. Each shop is divided into three divisions, separated by brick walls running through the roof. In each division there are eight tracks, making twenty-four in each shop. Between these shops, which are seventy-five feet apart, is the pit in which the table or car moves. The car is ten feet long and seventy feet wide, and runs on four rails laid in the pit. The track on the car, running from side to side, matches the tracks in the shops. The control of the table is so perfect, by the use of the switch, that it can be put and matched to any track desired without the least trouble or hitch; the same power that moved the car forward, stops or slows it. The table is run by the dynamo which lights the shops at night, and is connected by two overhead wires, on which run two trolleys, the trolley-poles being on the top of the house built over the front platform at the front of the table. Three men, one being at the dynamo, now run the table and draw on and off the cars, which work formerly required twelve men and a shifting locomotive and its men, and some four times the amount of work can be done by these three men.

The Union Electric Car Company will use this same system on the Beverly and Danvers Railroad, which is being equipped by the company, and will be running this month. These cars will use storage batteries in place of the overhead wires for the propelling power. The storage batteries are placed under the seats, with two sets to each car. They are charged by a steam and electrical plant in the car-house. Each set runs the car forty miles. It takes eight hours to charge. The batteries are changed by the conductor and driver in from three to ten minutes, and each car makes a run of eighty miles per day.

THE SOFTENING OF HARD WATERS FOR DOMESTIC USE.

SINCE waters possessing an inconvenient degree of hardness are very common in many localities, owing to the almost universal prevalence of calcareous soils and geological deposits, it is of no little interest to have some simple means of doing away with this property, so as to render such waters more convenient for domestic uses. This is the more important, as in some cases the presence of a large proportion of magnesia tends to cause serious, even though usually only temporary, gastric disturbance with persons unused to such waters, whereby quite frequently an unfounded prejudice against the general health-conditions of perfectly healthful localities is created. This subject has been heretofore discussed in many places, especially in California, but its continued importance and the frequent demand for information in the premises justify the more elaborate consideration recently given it by Professor Hilgard of the University of California.

When, as is most commonly the case, this hardness is due to the presence of large proportions of the carbonates of lime and magnesia, it can be recognized by the extent to which the water becomes turbid, or forms whitish scum or incrustations, when boiled. Boiling, then, is one of the means for softening waters that are hard and "curdle the soap" from this cause; and this fact is well known to housekeepers, but owing to the inconvenience of the application of this remedy, it is rarely resorted to except for drinking-water. For this purpose boiling has the special and additional advantage of insuring the destruction of any minute germs of disease that might contaminate the water.

To soften water for washing, a common and very good remedy is the use of carbonate of soda (sal soda) in sufficient quantity to bring down the lime and magnesia, and thus insure the proper solution of the soap to form suds. Only there is too often a mistake made in not allowing time for the soda to bring down the lime and magnesia in a powdery form, which requires from half an hour to an hour when the water is cold, but occurs very quickly when the water is hot. When, as is commonly done, the soap is put into the water while the lime is still in the gelatinous form and diffused in the water, a certain amount of "curdling" will still happen, and the washed clothes (especially flannels) will have that soggy and unpleasant touch which is caused by the accumulation of the lime and magnesia soaps in them.

That it is undesirable to use soda for softening water to be used for drinking hardly needs more than mention. The natural hard waters usually contain quite as much of saline matters as is desirable in drinking water. Soda, however, does not in any manner correct the sanitary condition of a water; on the contrary, it aids in keeping vegetable and animal matters in solution, and unless added in very large excess does not interfere with the vitality of fungous or other germs.

By far the most convenient and effective mode of purifying larger quantities of hard water for domestic use, is the introduction of a definite amount of quicklime, proportioned to the requirements of each particular water; a point that can be readily ascertained by any one having an ordinary capacity for observation.

The principle upon which this apparently paradoxical process is based is this: The lime and magnesia in most hard waters are contained in the form of carbonates, dissolved in the water by the aid of free carbonic acid. Whatever drives off or takes possession of this free acid will bring down the earthy substances in an insoluble form, and thereon depends the efficacy of boiling as well as of the addition of washing soda; cooking soda or bicarbonate will not produce the effect. Now, lime in the caustic condition, as lime-water, or milk-of-lime, freshly prepared, will most effectually take possession of any free carbonic acid, and will form with it the same insoluble compound that, when hard water is boiled, settles to the bottom or incrusts the boiler. Hence, when an amount of clear lime-water, just sufficient to absorb all the carbonic acid in a water, is added to it, both the lime added and the lime and magnesia originally contained, are brought down in the insoluble form, and the mineral contents of the water are diminished very materially, sometimes to less than one-half of the original amount. With the sediments thus brought down there also usually comes a large proportion of the vegetable or animal matters contained in the water; so that instead of perhaps becoming putrid in a tank serving for domestic supply, water so treated will remain clear and odorless for a long time if protected from recontamination by insects, falling leaves, dust, etc.

The only practical difficulty in carrying out this purification is the ascertainment of the proper proportion of lime or lime-water to be used, so that the water shall neither retain too much of its original hardness nor acquire an unpleasant taste and astringent action from an excess of lime. This can, however, be done quite readily by a few tests with different proportions of lime-water, and the very simple trial as to which will produce the least "curdling" of soap when ready-made soapsuds are added in small proportion. Whatever proportion of lime-water or lime satisfies this easily ascertained condition, is the best for all purposes.

Numerous experiments prove that for the waters of the wells, springs, and smaller streams, as well as the catchment reservoirs of the middle coast ranges and their valleys, the best effect is usually produced by the addition of from one-tenth to one-twentieth of clear lime-water.

As one part by weight of pure, unslaked lime requires seven hundred parts of water for its solution, a simple calculation shows that the above proportion corresponds to from five to eight grains of lime per gallon, or about three-quarters to one pound per thousand gallons.

In the practical working of this process it is best to have, for small tanks up to one or two hundred gallons, a supply barrel in which clear lime-water of full strength can always be kept on hand ready for use. A few pounds of lime, slaked into a creamy mass, may be put in the barrel, the sediment being stirred up from time to time as the clear water standing over it is replaced. Of course, in order to preserve the proper proportion, once determined, only clear water must be used, otherwise more lime than is called for, will be introduced into the water. The lime-water barrel should be kept closely covered.

For larger tanks it will be more convenient either to take a weighed amount of unslaked lime for each one thousand gallons, slack it into milk-of-lime and stir it in, or else to prepare a large quantity of milk-of-lime which, when thoroughly stirred, will for each measure (bucketful) contain a known amount of lime. This would be the best way to handle cases in which the feeding water of boilers requires to be corrected. It should, in this connection, be understood that the lime treatment is very efficacious against the frothing produced in boilers by waters containing a large amount of vegetable matter, as is commonly the case in that from ponds or other catchment reservoirs.

The sediment that accumulates in tanks used for this treatment is usually of a sandy nature, and not readily stirred up; it therefore causes little inconvenience, and can be removed at leisure, from time to time, as it becomes too large.

It is true that, like some other household measures conducive to sanitation and comfort, the maintenance of this system requires some regular personal interest and attendance on the part of some member of the family. If carelessly handled, there may be unaccountable variations in the gastric conditions of the family, from one extreme to the other, and the soap may curdle from the water's natural hardness one week, and from excess of lime the next. But there is no excuse for such occurrences, except as the result of carelessness or negligence, and the advantage gained, whether as to health or comfort, amply repays the trouble when these hard waters require to be used.

A NOVEL ELECTRIC BATTERY.

A NOVEL and simple form of electric battery has recently been invented in Italy. As described in the *Rivista Technica*, it consists of conical vessels of cast iron and porous earthenware, with nitric and sulphuric acid. An iron cone is placed point downwards in a stand, and is partly filled with strong nitric acid. Into this there is placed a cone of porous earthenware containing dilute sulphuric acid. Then follows an iron cone surmounted by an earthenware one, and so on in a series, each vessel containing its respective acid. It follows that the inner surface of each iron vessel is bathed in nitric acid, and becomes passive, acting the part of the platinum or carbon in an ordinary cell. The outer surface is attacked by the dilute sulphuric acid, and takes the place of the zinc. There are no connections to make, the simple building of the pile putting all the parts into union. The earthenware cones are eight inches in diameter and four inches in height, and contain five hundred and fifty cubic centimetres of ten per cent sulphuric acid solution. The iron vessel contains one hundred and ten cubic centimetres of nitric and sulphuric acids, the latter being three times the volume of the former. Sixty elements, arranged in two piles, have a resistance of ten and one-half ohms, an electromotive force on open circuit of eighty-one volts, and on closed circuit of forty-five volts, with a current of four and four-tenths ampères. After five hours the difference of potential falls to twenty-eight volts and the current to two and seven-tenths ampères.