this crude borax will be sent home in thousands of tons. The cost of collecting it is trifling, but the carriage from the place of production to the sea coast is expensive. There are wonderful deposits of borate of soda and borate of lime in the United States in Nevada and California.

I believe I am correct in stating that no case of cholera was ever known to have taken place in any of the villages where the boracic acid is made, the vapors arising from the lagunas acting as a charm against this terrible epidemic.—By ARTHUR ROBOTTOM, in *The Manufacturer and Builder*.

GRAPHITE LUBRICATION.

In the development of the world's history, the time has arrived, it would seem, when a change is to come about in the mode of lubricating machinery, carriages, waggons, etc.

This change is to be brought about by substituting graphite for oil or grease in whole or in part.

For more than fifty years it has been known that graphite was one of the best lubricants extant, but no way has been discovered to hold it in position and utilize it as a lubricant except by mixing it with oil or tallow, and yet its use in this form has gradually been growing for the last twenty years; and it is now quite extensively used in oils for heavy bearings and particularly for packing boxes for railroad cars.

A few years ago the process was invented, and the invention patented, for holding graphite in its position, in a journal box, thus furnishing dry lubrication.

Like all other useful inventions, the graphite bushing or journal box was greatly in advance of the times, and after being invented the invention came near to being lost to the world for want of recognition. Graphite bushings and boxes could not be sold, in fact they could not be given away with an agreement that they were to be put in use and used. Scientists were against the invention, engineers condemned it, and capital could not be found to introduce it; and while it was successfully introduced in the block trade in the fall of 1877 and on machinery in the fall of 1883, and on carriages and waggons about the same time, we are informed that its progress in actual use has been very slow. In this particular history repeats itself. Professor Morse in 1832 discovered the first principles of the telegraph, but for want of means he struggled until 1837, a period of five years, before he could get sufficient assistance in money and mechanical skill to put up the first few miles of telegraph wire in a room. In 1837 many of the principles of the telegraph were as perfect as they are to-day, but pecuniary assistance could not be obtained to construct a mile of telegraph wire for commercial use, and Congress was also appealed to in vain, notwithstanding Morse and Vail had put up a wire in a room ten miles long in Washington in 1838, and operated it successfully. In 1842 Morse again applied to Congress for an appropriation, and on March 3, 1843, Congress appropriated $30,000 to build a line of telegraph from Baltimore to Washington, and the first message passed between the two cities on May 24, 1844, some twelve years after the first discovery of the telegraph. The rest is fully known.

We have observed above that graphite bushings went into use in the block trade in 1877, but the difficulty then presented itself of getting a box into use upon a machine in a mill or factory, and the first one put to use was in the factory of the Norfolk and New Brunswick Hosiery Company at New Brunswick, New Jersey, and was started November 20, 1883. On the 5th of March, 1884, the company, by their superintendent, issued the following certificate:

"We have one of the graphite boxes in use on a fancy move of our cards since November 20, 1883. We oiled it a few times after putting it on, but it has been running since November 28th without oil at a rate of about 600 revolutions a minute, and about 10 hours per day."

"The bearing surfaces at this date are found to be in good condition, without showing signs of cutting or beating."

From this single bushing, the graphite boxes on machinery started, and in future articles we will endeavor to trace its further development and also to explain the principles of the lubrication, so that engineers, mechanics and others using machinery can see how the revolution is being brought about of discarding oil and substituting graphite in its place.—*American Engineer*.

HEAVY UNIVERSAL MILLING MACHINE.

It is designed for boring, facing, turning, milling, profiling, key-seating, splining, rack cutting (any length), gear cutting with the vertical attachment up to five feet in diameter, etc.

It not only admits of a greater range of work, but will do work than can be done on no other universal milling machine. It is specially designed for use in railroad shop, and for builders of locomotives, portable and stationary engines. In repairs to locomotives, where duplication of wearing parts is so frequent, it is particularly valuable on account of its great capacity, and work can be done to better advantage and with greater precision than on planers, lathes, shapers, etc.

The gearing as shown in cut is external and back geared 4 to 1, it is also made with external gearing, back geared, 8 to 1. All running parts have oil tubes and are accessible for oiling, and is driven by a $3\frac{1}{2}$-inch belt on a 4-step cone, of which the largest diameter is 13 inches.

The spindle is of steel and runs in atlas bronze boxes. The front bearing is $3\frac{1}{2}$ inches in diameter by 6 inches long; back bearing $2\frac{9}{16}$ inches diameter by 5 inches long and provided with easy means of adjustment for wear. The front end of the spindle is threaded on the outside for face plates or face mills. In the spindle is a taper hole for cutter arbors 2 inches diameter at the front end, diminishing $\frac{1}{2}$ inch in 12 inches, to $1\frac{1}{16}$ inches diameter, through which the arbors are driven out by a rammer. The atlas bronze boxes have an adjustment by which the original centres are always retained without altering their position laterally—this is a very important point, as the journal and bearing wear always in the same place. In all other sleeve bearings, when wear is taken up by moving either the box or spindle laterally, a new position is taken and wear commences and takes place very fast—the above style of bearing overcomes this entirely.

The cutter arbor supporting bar, with its adjustable centre, can be moved out to support cutter arbors 26 inches from the end of the spindle or pushed back out of the way, thus facilitating the milling or boring of a large piece of work that would be prevented by the ordinary fixed bar.

The three feeds, vertical, horizontal (in line with spindle), and traverse (at right angles to spindle), are all *reversible*, and are operated and stopped altogether by the handle shown in the cut near the cup-board. This reversing device is common to engine lathes, does away with the crossing of belts and saves time. The 4-step cone on the spindle belts to the lower cone, the shaft of which runs in a hollow stud and drives, by means of the reversing device referred to above, a shaft running through the base of the column. Bevel gears connect this shaft with the vertical shaft, and the latter by bevel gears with the horizontal shaft in the knee, which communicates in turn with the several screws for the various feeds in the front of the knee by clutch gears. These clutch gears can be engaged or disengaged at will by the knarled knobs shown in front, giving