water cistern; the pipe no longer broke when the cock was suddenly closed, but it was noticed that a jet of water was forced from the higher end of this new pipe to a considerable distance, consequently the height of the new pipe was increased by carrying it up to the top of the hospital, where still a small quantity of water was emitted each time the cock in the kitchen was shut. The local genius, in fact, without intending to do so, had provided a means of raising a small quantity of water without labor to the highest floor of the hospital, where it was, no doubt, much appreciated. He had arranged a water ram, which, except that it was not self-acting, was not different in principle from the hydraulic rams of the present day. In 1772, a watchmaker of Derby, Eng., named Whitehurst, made a water ram, although not self-acting; but water was raised the desired height by opening and shutting a cock. He had a pipe 600 feet long, with a fall of 16 feet. At the extreme end was the cock from which water was taken at repeated intervals. Whenever it was closed, the momentum of the long column of water in the main pipe forced a small quantity through a valve into an air vessel, and then up a vertical pipe into a tank placed some distance above the original source of supply. The invention of a self acting ram is claimed by Montgolfier, a Frenchman, who brought out his Belier hydraulique in 1796, a year before Mr. Boulton, of Boulton & Watt, took out a patent in England for a similar contrivance. It was, no doubt, upon *the same plan as Whitehurst's, but the cock for domes*tic draughts which he affixed to the lowest parts of his pipe was replaced by a valve, loaded with just weight enough to open when the water in the main pipe was at rest: whenever this valve was open, the water in the main pipe acquired by the fall sufficient force to carry the valve against its seating; this brought the water in the main pipe to rest, and the shock caused by closing the valve had the same effect as the closing of the cock by hand; it forced a small quantity of water through a valve into an air vessel, and thence through the delivery pipe. When this had taken place, the water in the main pipe having been brought to rest, the escape valve opened, the water in the main pipe was again set flowing, and the whole process was repeated and went on constantly as long as the supply of water lasted and the apparatus was kept in order. This is precisely the hydraulic ram of the present day, which is so often inexpensively employed in raising water for different purposes.

THE PRODUCTION OF METALLIC BARS OF ANY SECTION BY EXTRUSION AT HIGH TEMPERATURES.*

The author stated that the system of manufacture he now had the privilege of bringing before the Institute was the invention of Mr. Alexander Dick, the inventor of Delta metal. It related to the production of all kinds of metallic sections, from thin wire or plain bars to complex designs, by simply forcing metal, heated to plasticity, through a die by hydraulic pressure. He referred to the fact that although the principle of extrusion was employed in the manufacture of lead pipe and lead wire, yet the temperature in those cases was very much lower than in Mr. Dick's system, which required the metal to be red hot (about 1,000° Fahr.).

Mr. Dick's process consists in placing the red-hot metal in a cylindrical pressure chamber or container, at one end of which is a die. Upon pressure being applied at the opposite end the plastic metal is forced through the die, issuing therefrom as rods or bars of the required section and length. The container of the first apparatus was a solid steel cylinder, bored out to the required diameter, to form the chamber for the hot metal, and heated in a coke fire. In practice, however, it was found that the strain set up by the unequal expansion and contraction of the walls of the cylinder, added to that caused by the internal pressure applied to force the metal through the die, developed cracks in the cylinder which rendered it useless. After a long series of experiments with various kinds of steel cylinders, Mr. Dick abandoned the solid wall principle and devised a built-up container. It is composed of a series of steel tubes of different diameters placed one outside the other with annular spaces between them, the spaces being filled in with a dense non-conducting packing. This proved perfectly successful, and machines on this principle are now in operation on a commercial scale not only at the Delta Metal Company, Pomeroy street, New Cross, London, of which Mr. Dick is managing director, but also in Germany, and at one of the large Birmingham metal rolling mills on license.

These machines are served by two men and one boy, so that the cost of labor per ton is very small.

The author described the working of the system and referred to the great variety of sections (some of a very complex nature) produced in Delta metal, brass, *aluminum, aluminum bronze, and other alloys and* metals, samples of which were exhibited. These ranged from wire weighing about $\frac{1}{100}$ of a pound per foot run, to heavy rounds, squares, hexagons, etc., weighing 40 lbs. and over per foot run. He pointed out that the pressure put upon the metal greatly increased its strength, and at the same time rendered it still more homogeneous. Some tests made at Woolwich Arsenal with Delta metal bars produced by this machine showed a tensile strength of 48 tons per square inch with 32.5 per cent. elongation on 2 inches, as against 38 tons per square inch tensile strength and 20 per cent. elongation of rolled bars of the same metal.

*Abstract of a paper read before the British Iron and Steel Institute, by Perry F. Nursey.

THE ELECTRIC WAGON ON THE FARM.

For THE CANADIAN ENGINEER.

The application of steam to farming operations is no novelty, and since electricity seems at every point to be crowding steam power, we are not surprised that many efforts have been made to apply the newer motive force to the simplification of agriculture.

The accompanying engraving shows two elevations of an electric traction engine for ploughing and general farm work, the product of the inventive skill of O. W. Ketchum, of Baltimore, Md.

A 16 horse-power steam traction engine weighs about 14,000 lbs. Tests that have been made by different experimenters to ascertain the power required to draw heavy wagons, artillery, etc., over soft ground such as is encountered in fields, show that the tractional resistance or pull amounts to from 6 to 10 per cent. of the weight of the wagon; assuming a pull of 6 per cent., it would require 9 horse-power to propel the wagon alone over a field at a speed of four miles per hour. This would only leave 7 horse-power available for drawing ploughs.

As it is evident from the data available as to the power which horses can exert when ploughing and doing other similar work, that it would require in the