

accomplished by fitting each into a separate extension of the tube, thus entailing the handling of awkward and heavy pieces, has been much simplified in this telescope by leaving the tube full length and devising a simple means of interchanging the mirrors only. Less than one-quarter the weight has to be handled, it can be done in one-tenth the time, and with no danger of accident.

The worm wheel, which is 9 ft. in diameter with 720 teeth cut in its bronze rim, was mounted on a rigid stand on its own ball and ball thrust bearings and each tooth cut by a cutter set at the proper angle. The spacing was done by means of a circle 42 ins. diameter graduated on silver to half degrees by the Warner & Swasey circular dividing engine whose greatest error is six-tenths of a second of arc. This was concentrically mounted on the worm wheel and the settings made by two micrometer microscopes. The teeth were cut around three times to remove any error due to springing and the previously lapped worm and the worm wheel were finally polished together by running them for several days with rottenstone and oil.

The three sections of the polar axis, the declination sleeve, the central section of the tube and the mirror cell are all steel castings heat treated. They were cast and machined at the Bethlehem Steel Works and are striking examples of the perfection to which the process has

attained. They are entirely free from blow holes or other defects and as tough and homogeneous as forgings.

**The Mirror.**—The 72-in. mirror, which is 12 inches thick at the edge, has a hole  $10\frac{1}{8}$  inches in diameter through the centre, and weighs some 4,340 lbs.; is finished on edges and back, and its front surface is now practically spherical. Before it can be made a paraboloid of revolution, the surface necessary to bring the parallel pencil of light from any celestial object accurately to a focus, it is necessary to prepare a large flat surface for the purpose of testing the paraboloid. It is hoped that this will be finished and the mirror completed as soon as the mounting is ready to receive it.

The mounting was practically completed and it was temporarily erected in the factory of the makers, the Warner & Swasey Co., of Cleveland, Ohio, about the end of March last. Some finishing touches to one or two details, the holding of a formal reception and exhibition of the telescope, delayed by the absence of members of the firm until March 25th, and the fact that the dome was not sufficiently advanced to offer protection from the weather, caused the postponement of the shipment to Victoria until the middle of June.

The erection of the mounting will occupy some three months, hence occurring during the most favorable season, and should be completed by the early autumn.

## INDUSTRIAL USES OF HYDRO-ELECTRIC POWER.\*

By J. B. Challies,

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**A**T the present time the great steel mills of this continent are absolutely dependent upon the electric furnace for the production of alloys. The automobile manufacturer is dependent upon another electric furnace production, aluminium, for car bodies. The manufacturer of steel products needs these materials for making tools, and countless factories require abrasives which cannot now be imported, and which are now being produced in the United States, at any rate, only by electric processes. Without acetylene gas and graphite, and other electric products, many existing industries would be absolutely crippled.

So far as the products of electro-chemistry are concerned, it is found that the surgeon and the doctor look to electric plants for chloroform and disinfectants; the cotton and the paper manufacturer need the bleaches produced by electricity; the user of soap patronizes the electro-chemical establishment, as does every user of matches. Gold and silver mining of the west requires electric products to assure a profit, and it is only lately that the United States, cut off from its supply of German dyes, has found itself dependent upon electric products to supply the deficiency, in part at any rate.

These are but a few of the industries dependent upon cheap electric power. The further development in either Canada or the United States, or the inauguration of such processes in Canada, is very largely, if not altogether dependent upon cheap available, dependable power. The source of such power is admittedly, for a very large portion of our country, water-power. The development of water-power in making available a supply of cheap hydro-electric energy in various parts of the Dominion, would

probably result in the reduction of the cost to the consumers of countless articles of every-day use, which, to the man on the street, are in no way associated with hydro-electric development.

To be more specific, the manufacture of steel is one of the greatest of the United States industries, and is fast becoming a very important one for Canada. To-day, electrically produced ferro-silicon is used as an alloy by most steel manufacturers, with the result that the Bessemer process is fast becoming obsolete. The essential element in the manufacture of armour plate and armour-piercing projectiles, is introduced into steel by the alloy, ferro-chromium, strictly an electric furnace product.

Ferro-chrome, another product of the electric furnace, has made possible the manufacture of high-speed tools, which in turn have tripled the capacity of our machine shops and enhanced the efficiency of our mechanics. It has cut to one-third the capital invested in tools to accomplish a given volume of work.

In the absence of chromium, tungsten, vanadium and molybdenum, all alloys made by electrical processes, the builders of American battleships and other weapons of national defence, and a large portion of our Canadian steel and metal-working industries and other industries, would be in the condition of twenty years ago. The electrical industry itself is largely dependent upon silicon steel, a product that does not age and does not wear.

The development of aeroplanes also calls for aluminium, and only with the abundant production of cheap electric energy from water-power will the price of aluminium kitchen utensils come within the reach of every housewife.

At the outbreak of the war, we were cut off from the supply of Greek and Turkish emery. To-day the metal-

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