placed a thin wrought-iron hoop, and holes are punched through this hoop and the body of the tube. The tube end, properly cleaned, is then placed in a mould, and the cast-iron cap is cast upon it, the metal running through the punched holes, as shown in Fig. 1, on the present page. To perfect the joint the wrought-iron hoop, which, as shown, projects slightly beyond the casting, is caulked all round the tube. Messrs. Howard assure us that the joints thus made stand well and give no trouble. The mode of attachment is certainly a simple one, and the introduction of the wrought-iron caulking strip is ingenious.

To connect the superimposed pipes forming each section, the end caps or chambers are provided with nozzles turned slightly conical externally, these nozzles entering wrought-iron junction rings bored out conically to receive them. The arrangement is shown clearly in the upper part of Fig. 1, the detail views, from which it will be seen that the nipples on the cast-iron caps take their bearing entirely against the conical surfaces of the junction rings, and do not butt against each other. Messrs. Howard have tested the joint for a considerable period at their own works with satisfactory results.

The series of caps are drawn tightly together by a pair of internal bolts at the end of each section, these bolts, which are of rectangular section lying close to the sides of the caps, and being furnished at their lower ends with T heads, which take hold of the lugs cast inside the lowest caps, as shown in Figs. 1 and 4 of the detail views. These tie bolts are tightened up at the top as shown. The caps are provided with doors opposite the ends of the tubes, so that good facilities are afforded for inspecting the latter. On the outside of the caps are cast square flanges and ribs for holding fire-bricks or tiles for filling up the spaces at the ends between the sections. The arrangement of the setting of the boiler will be readily understood from the general views, from which views it will also be seen that the steam is lead off from the higher end of the sections through curved pipes communicating with a cross pipe or steam drum. The pipes connecting the sections with the steam drum are but 1 in. in diameter, and they might, we think, be made larger with advantage. It will be seen from what we have said, that in the new boiler the screwed joints which gave trouble in many cases in the boilers of the older pattern, have been entirely got rid of, while greatly improved facilities are given for the circulation of the water. Altogether we think that this new type of Howard's boiler is characterised by some material improvements, and we shall watch its performance with much interest. Messrs. Howard have worked hard for some years to perfect their type of boiler and hence they are deserving of every success.—*Engineering.*

GREENWICH TIME SIGNALS.

The following facts regarding these signals are taken from the report for the past year of the Royal Observatory, Greenwich, or as the Astronomer-Royal more accurately puts it, for "the period of twelve and a half lunations included between Full Moon of 1873, May 11, and New Moon of 1874, May 15":—

With the exception of eight days, on which the violence of the wind prevented the raising of the ball, and of two days on which accidental failures occurred, the Greenwich time-ball has been regularly dropped every day through the year to which this report refers. The Deal time-ball was not raised on five days on account of high-wind, and was not dropped on five days owing to interruption in the telegraphic communication. On one day, October 10, it was erroneously discharged four seconds before 1h. by a telegraph-signal; on 321 days it was dropped correctly by the current; and on thirty-seven days, principally in rainy weather, the current was too weak to release the trigger without the assistance of the attendant's hand A proposal has been made to me to drop a ball at Portsmouth by direct current from the Royal Observatory, but no further action appears to have been taken in the matter by the Admiralty.

Since the removal of the telegraph department from Telegraph Street, Lothbury, to the new building facing the General Post Office, a new and more elaborote chronopher has been constructed for the signal at 10h a.m., in which provision is made for sending signals in sixty different directions, the old chronopher being still in use for the signal at 1h p.m. Mr. H. Eaton, of the Post Office telegraphs, has kindly furnished me with the following account of the distribution of signals:—"The Greenwich current is received hourly. This hourly current is transmitted to ten subscribers (mostly chronometer-makers) in London. The method of observing the current varies, and is fixed by the subscriber In two cases, time-balls are dropped on the top of the buildings; in some other cases, model time-balls are placed in the windows; and others again use an electric bell; while two or three have a simple galvanometer, and observe from the deflexion of the needle. The Westminster clock records its correctness and errors at Greenwich, as also the clock at the Lombard Street post-office. The 10 a.m. current is most extensively used for the provinces. It is transmitted automatically to twenty-one provincial towns in England (where there are subscribers), to Guernsey, Edinburgh, Glasgow, Dublin, and Belfast. In addition to the automatic sender, a sound-signal is established in the instrument room here; when heard, a current is sent by the clerks to over 600 offices in direct communication with the Central Telegraph Office, including the principal railway termini. Many of these offices re-distribute the time-signal to the offices radiating from them, so that practically from the 10 a.m. current from Greenwich most of the post-office and railway clocks in the kingdom are regulated. The 1 p. m. current is transmitted automatically to nine provincial towns, viz, Newcastle, Sunderland, Middlesborough, Kendal, Hull, Norwich, Stockton, Worcester, and Nottingham. At the first four named, guns are fired; at the others, the current is observed by means of time-balls or galvanometers. With regard to the 10 a.m. current, I should have said that there is no rule as to the method of observing; the subscribers use the form of apparatus most suitable to themselves. At the telegraph office the signal is recorded or observed on the telegraph instrument."

To this account it is proper to add that wire communication has been made, experimentally, from the chronopher to the Royal Observatory, so that, by two Galvanometers, the time of a current leaving Greenwich and the time of its distribution by the chronopher could be immediately compared. No sensible difference could be discovered. It follows that the hourly time-signals, based upon the most accurate determinations of of time that the Observatory can furnish, may be used for accurate determinations of longitude At the Lombard Street post office, the Greenwich current at noon *starts* the clock which had stopped itself were few seconds previously, or at noon of its own time, the clock having a gaining rate. For the guidance of the attendant who regulates the Westminster clock, a signal is received at the clock tower from Greenwich, and a return signal is sent to the Observatory by this clock, as well as by the Lombard Street clock, to give information as to their errors. The errors of the Westminster clock were below 1s. on sixty-seven per cent. of days, below 2s. on twenty-five per cent., and below 3s. on five per cent.; when the error amounts to 4s. it can be corrected by the attendant, by lifting a pallet.

Recently published statistics show that the yield of the mines of the Pacific slope during the last quarter of a century reached the enormous total of $1,588,644,934. Of this immense sum California has produced three-fourths, or $1,094,-919,098, nearly all of which was in gold. Nevada has produced $221,402,412 in gold and silver, but chiefly the latter Utah, although known for many years to be rich in precious metals, has only lately been made to produce them, and the yield has been no more than $18,527,537. Montana has added $119,308,147 to the riches of the world, and Idaho has given $57,249,197. Colorado has been only lately developing as a mining region but its yield has already reached about $?0,-000,000. Oregon and Washington Territory have together produced $25,504,250. British Columbia has contributed about $9,000,000, and Arizona a small sum, but the latter territory has not been worked to any great extent. The production of the Pacific slope has been steadily increasing year by year. The increase of last year was about 14 per cent., the actual yield being $80,287,436 against $70,236,914 in 1872. The great bulk of this wealth has been exported chiefly to England, China and Japan, but mostly to England, which has had nearly $1,100,000,000, leaving only about $500,000,000 for the rest of the world.