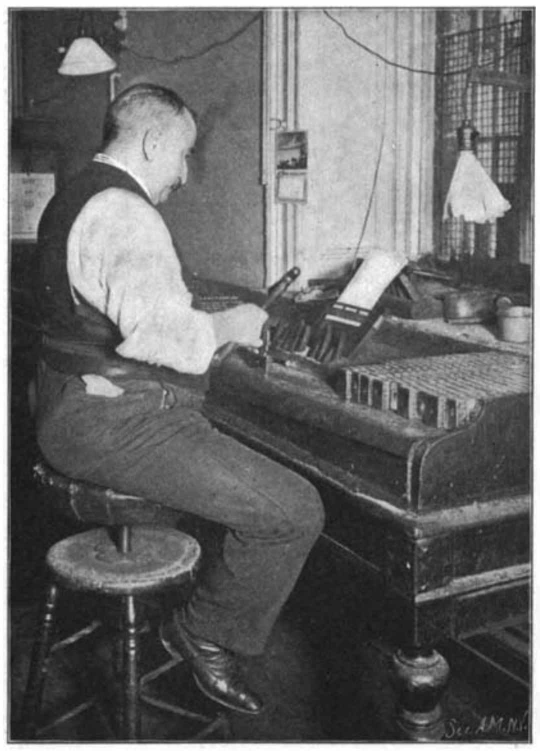
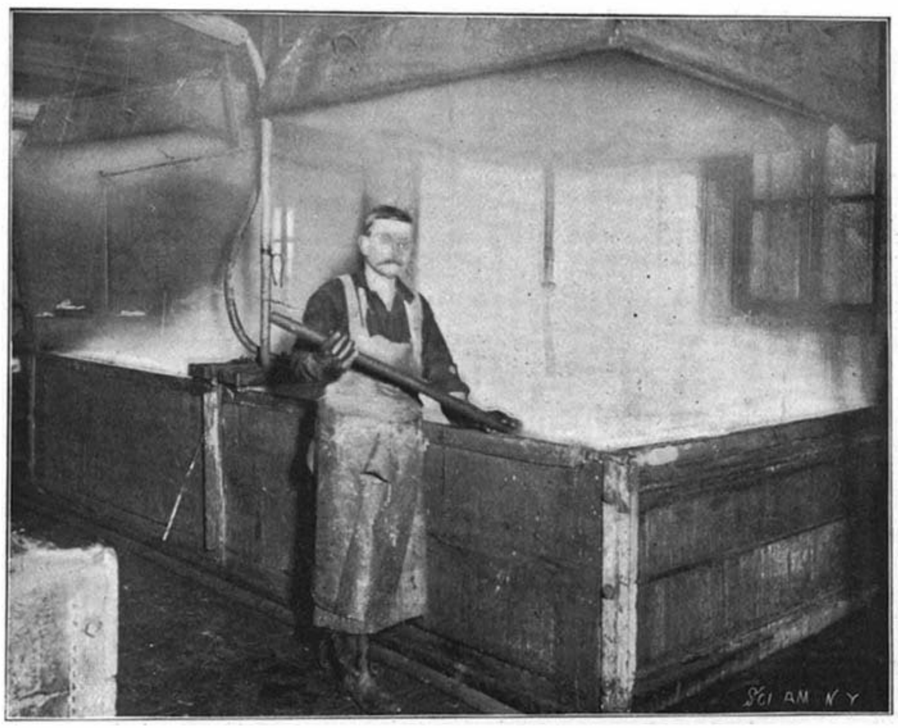
THE NEW YORK ASSAY OFFICE—MELTING AND REFINING.

In a previous article in the SCIENTIFIC AMERICAN for February 15, 1902, the process of assaying gold and silver bullion was described, and in the present issue the question of refining the bullion will be taken up. After the Assayer has stamped his bars, the owner can either take away these bars, which have now been officially certified as to their purity, or the government will purchase them according to its need. The work of refining and melting is carried on in the rear building and is under the charge of Mr. B. T. Martin, who became Melter and Refiner in 1883, having been connected with the Mint service since 1850. The bars now purchased by the government are classified, as far as possible, into groups which represent approximately the same degree of fineness. They are first melted in crucibles and furnaces heated by gas or coal. Then they are poured into molds which are so arranged as to permit a large surface being exposed to the acid. The bullion is mixed in such proportion that the gold or silver which is mixed, or has been added to assist in the process. shall not exceed one-third or one-twelfth, respectively, of its entire weight. About 200 pounds of these granulations are placed in each of the large kettles on the upper floor, shown in our engraving, with 150 pounds of sulphuric acid. This is termed the "separating room," for here the silver is separated from the gold. About 200 pounds of sulphuric acid are added gradually during approximately three hours' boiling. The silver is also dissolved and the resulting solution is siphoned off into reducing vats on the floor below. Another charge of 150 pounds is added and heated for one and one-half hours, when it is also run off. The fire having been withdrawn a third charge of acid is added, and the gold is taken out with a perforated iron ladle and put in small kettles. Here it is heated in three successive charges of acid for about six hours. The gold is emptied into the washing tub, where it is treated with one charge of cold and two of warm water. These solutions are poured into the washing jar, from which, on settling, the solution is run into large tanks on the floor below. The gold is emptied into one of the filters, then roughly washed with warm water and drained. This process is repeated and the gold is pressed into a cake or cheese with the aid of a hydraulic press. These cheeses are then dried in an oven and melted and cast into bars of from 997½ to 998½ thousandths fine.



Stamping $8,000 Gold Bars with Fineness, Weight and Value.

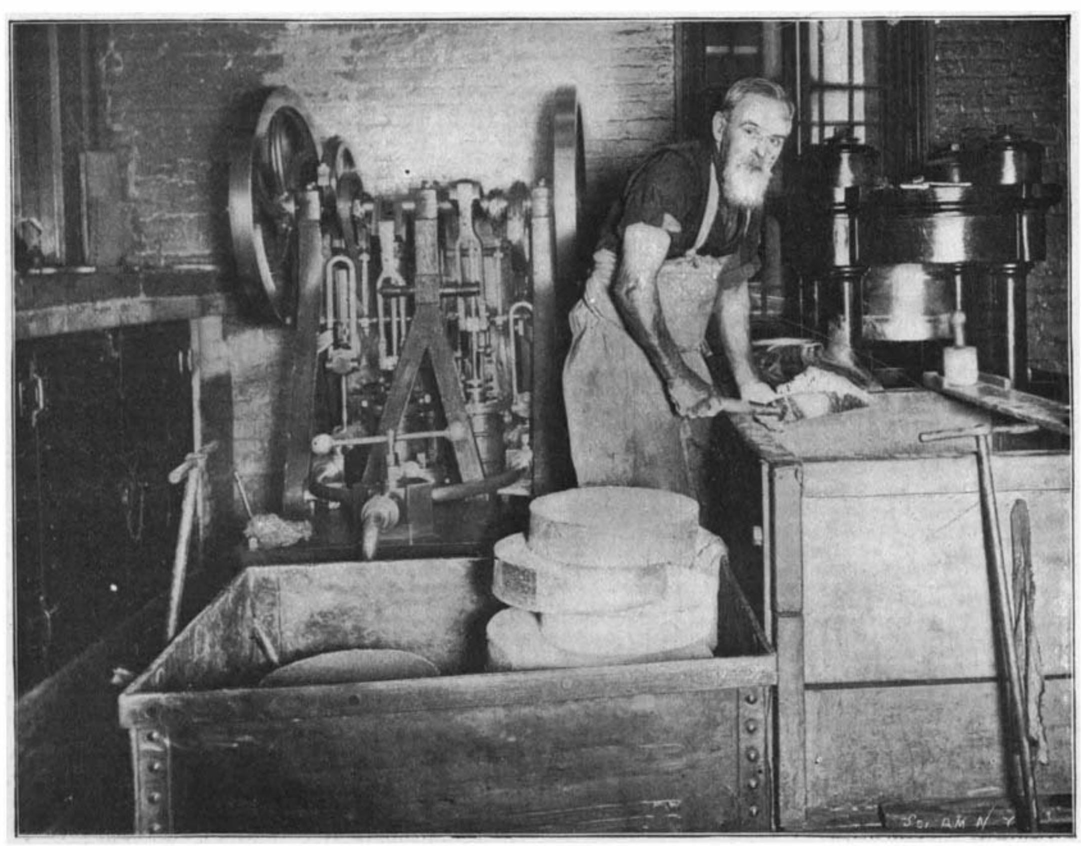
The silver was entirely dissolved by the acid, and the next process is to recover it from its liquid state. In the silver reducing vats, ingots or bars of copper are placed on end around the sides next the heating coils and subjected to ten or twelve hours' boiling. The resulting copper solution is run off through a filter into a concentrating vat. The silver remaining on the copper bars is scraped off and the whole of it is taken out and put in a filter, copper hoes and shovels being used. After washing it is pressed into cakes, dried and melted with sodium nitrate as a flux. It is then cast into bars of a fineness of 999 to 1,000 fine. The whole process depends upon the fact that sulphuric acid has more of an affinity for copper than for silver. The solution of copper sulphate which has been formed is strengthened by boiling about ten hours. It is then run off into the crystallizing vats. In from two to three days the mother liquor is run off into the large tank on the floor below; from whence it is run off into the carboys or tanks of its purchasers. The crystals of copper sulphate (blue vitriol) are taken from the sides and bottom of the vats, drained and subsequently redissolved in water and run off into the crystallizing vats again. The crystals form on lead strips and are very handsome. The proceeds of the blue vitriol and mother liquor nearly cover the entire cost of the acid and copper. The



Concentrating the Silver Solution and Precipitating the Silver.

Separating the Gold from the Silver by Boiling with Sulphuric Acid.

Stamping Value, Weight and Fineness on Silver Bars.



Pressing Precipitated Silver into "Cheeses."

THE NEW YORK ASSAY OFFICE—MELTING AND REFINING.

acid is conveyed by gravity about the building. Each bar is stamped with its fineness and weight, and these marks are accepted all over the world. Bars are of various sizes, those of a value of $8,000 being preferred. Bars are made all sizes to accommodate even the small manufacturer, small bars of $100 worth being made. Last year about $14,000,000 were taken out for use in the arts. The deposits for the fiscal year ending June 30, 1900, had a value of $56,296,096.15 for the gold and $7,516,742.58 for the silver. The number of gold deposits melted was 8,581; of silver, 3,223, making a total of 11,804. The number of fine mint and standard bars made and delivered to the Superintendent was, of gold 40,616, and of silver 42,562.

One of our engravings represents bars of various sizes with the value stamped upon them. The smallest bar at the left is worth about $105. Then the bars run up in size to $8,000. Two silver bars are shown at the back. A "gold brick" has come into our language as the very epitome of fraud, and that they are a grim reality is shown by the four samples which were placed upon the truck. They are of all sizes and shapes to meet the varying fancy of their victims and are rarely of the shape of the Mint bars. Two of them would have been worth $18,000 had they been actually of gold instead of base metal. Those who are in need of gold bricks should be willing to purchase them at the regular rates, and all sizes may be had at the Mint office. It might be said in closing that the Assay Office is open to visitors.

"Gold Bricks"—Spurious Imitations Sold to the Unwary.

Gold Bars—Value $100 to $8,000 Each.

THE NEW YORK ASSAY OFFICE.

A NEW EQUATORIAL TELESCOPE FOR OXFORD.

BY OUR ENGLISH CORRESPONDENT.

At the Radcliffe Observatory, Oxford, England, a new 24-inch equatorial telescope is being erected. Although by no means the largest in the world, this instrument is replete with several new features and appliances, the result of recent experiments and investigations, so that it is one of the most modern combinations of the refinement of inventive skill and mechanical arrangements extant.

The telescope has been constructed entirely by the famous optical instrument manufacturer, Sir Howard Grubb, F. R. S., at the Rathmines Astronomical Works, Dublin, Ireland. Curious to relate, the designing and construction of large telescopes is now practically an Irish monopoly, since Sir Howard Grubb, who is now the greatest authority on this work, has built all the large telescopes worthy of mention in all parts of the world. It will be remembered that the Lick Observatory and telescope was erected mainly from his designs and it was the first observatory to be equipped with the mechanical rising floor, which has proved so successful that it was adopted in all the subsequent observatories.

The glass for the lens of the Oxford instrument was cast at the celebrated Mantois works in Paris, thence transported to Dublin in the rough, and there cut and ground to the requisite shape.

All the lenses for these huge telescopes are cast in Paris. The process employed by the Mantois firm in the manufacture of the glass as a jealously preserved secret. It was originally discovered by a Swiss mechanic, who divulged his secret to Mantois. The secret was afterward secured by an English lens-making firm, Messrs. Chance Brothers, of Birmingham. The latter firm, however, has never entered into competition with the Parisian manufacturers in the casting of telescopic lenses. Their work is entirely restricted to the manufacture of the prisms and lenses utilized in lighthouses, and they are the sole manufacturers of this specialty for the Trinity House Brethren, who control the lighthouses and light ships round the coasts of Great Britain. The Mantois firm cast the huge 40-inch object glass for the Yerkes instrument, and also those for the telescope at the last Paris Exhibition, which proved such a dismal failure.

The Radcliffe Observatory at Oxford, for which the new telescope has been designed, is one of the oldest in existence. It was founded about the year 1772 by the Radcliffe Trustees, after whom it is named, in response to a request by Dr. Hornsby, the Savilian Professor of Astronomy of that day. At that time it was probably the finest observatory in Europe, and was equipped with instruments by the famous maker, John Bird. About 1840 an important addition was made to the instrumental equipment in the great 7½-inch heliometer, which was for many years the finest and largest instrument of its class in the world.

For some time past the necessity of a modern equatorial telescope has been experienced, and the new instrument has been installed, through the efforts of the Observer, Dr. Arthur Rambaut, F. R. S., formerly Astronomer Royal for Ireland.

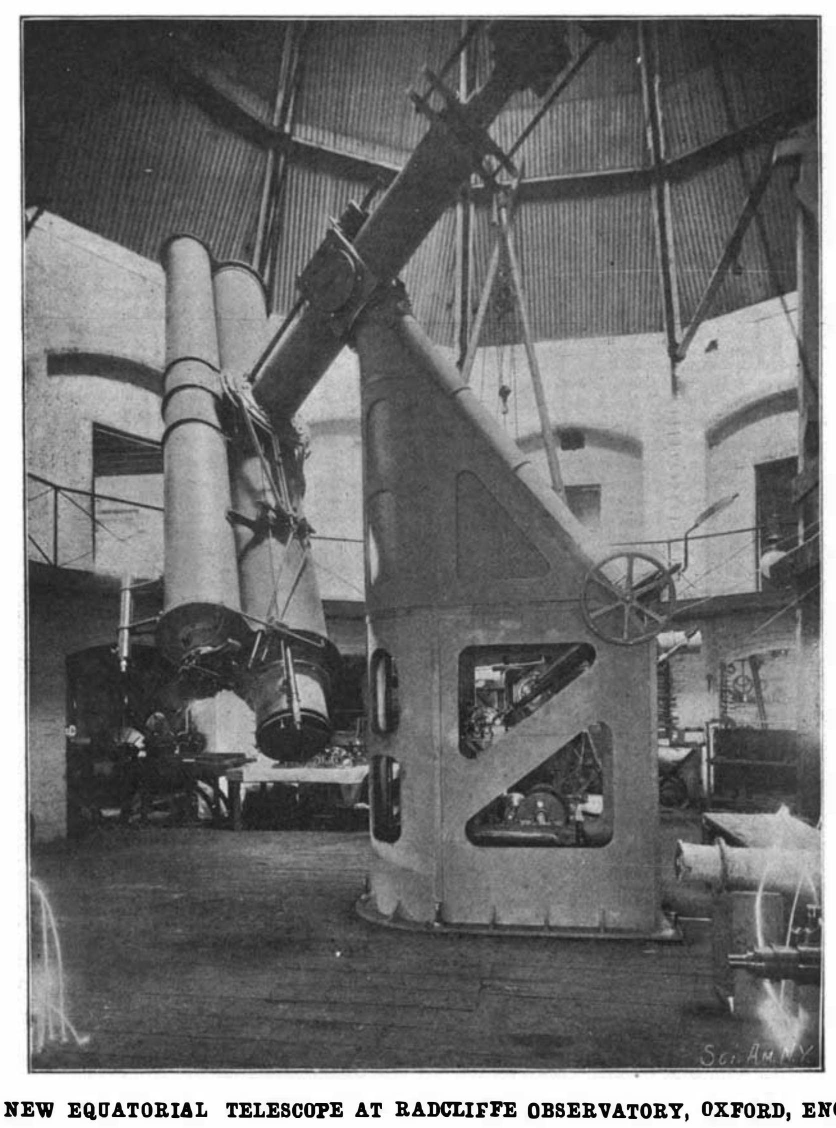
The instrument consists of two telescopes combined—one for photographic observations of the heavens, and the other for direct visual work.

The photographic telescope contains a lens of 24 inches diameter, and is 22 feet 6 inches in focal length. The direct visual telescope is of 18 inches aperture, and is of the same length as the 24-inch telescope. The necessity for two telescopes arises from two causes. In the first place, owing to the fact that light of different varieties is unequally refracted by the glass of which the lenses are composed, it follows that an object glass which is constructed to give the best possible image when viewed directly by the eye, will not bring those rays, which are chiefly active in forming the photographic image, to a perfect focus, and it is found necessary to use an object glass made especially with a view to receive these rays. In the second place, in order to obtain photographic pictures of the fainter objects, some of which, from the astronomer's standpoint, are just as important as the more conspicuous ones, it is necessary to submit the photographic plate to their feeble rays for a prolonged period of several hours. In certain instances even the whole length of the winter's night is not sufficient to obtain a useful picture, and it is necessary to expose the plate for several nights in succession upon the same object. All the time that the star is being photographed it is moving across the sky, and consequently to obtain a sharp image it is of fundamental importance that the telescope should be kept pointing exactly at the particular star during the whole of the exposure. This is accomplished to a high degree of precision by means of very accurate clockwork. But no mechanism with uniform motion made by human hands, can be made to move regularly with the accuracy which some branches of astronomy demand. The precision which has been attained in Sir Howard Grubb's newest form of electrically-controlled clock may be comprehended from the fact that exposures of half an hour's duration are sometimes taken, which, even under the microscope, will show no distortion of the star's image, although an error in the motion of not more than the twentieth part of one second would leave its mark upon the plate. What actual quantity this twentieth part of a second of motion represents may be gleaned from the fact that the telescope takes 24 hours to complete a revolution, so that the space passed over in this time would be little more than 1-2,000,000th part of a revolution. When the exposure is prolonged for hours and hours, a slight correction is necessary, due to the effect of refraction of the earth's atmosphere. Owing to this refraction, the apparent motion of the stars is not absolutely regular, and, therefore, it becomes necessary for the observer to keep an occasional watch upon the star during exposure through a second telescope placed beside the photographic instrument, and to introduce any slight corrections rendered necessary from this cause. The clockwork which drives the Oxford instrument is of the same construction as that designed by Sir Howard Grubb for the telescopes installed by him with such conspicuous success at Greenwich, Cape Town, Melbourne, Mexico, Perth (West Australia), Madrid, Cork, etc. Some new features of special interest are worthy of note, the most important of which is that in connection with the circles. In the Oxford instrument all the silver divided circles can be read by one microscope fixed to the eye-piece of the telescope, so that the observer has no occasion to leave his seat to see that his circles are properly set. By turning a small lever fixed in close proximity to this telescope, one or other circle can be brought into the field of view, while the same motion causes a little electric lamp attached to each circle to be lighted up automatically, so as to illuminate the particular circle required. New slow motions have been designed, and in some cases, little electric motors are utilized to do this work, the motor itself being started and controlled by an electric switch of peculiar construction, available to the observer in any part of the room.

The latter is driven by delicate clockwork and controlled by a touch of the observer's finger.

The observatory for the accommodation of this instrument at Oxford is 60 feet from the ground level to the crown of the dome. It is equipped with the Grubb elevating floor, having a rise and fall of 9 feet; when the floor is at its lowest elevation the telescope may be pointed vertically, and when raised 9 feet the instrument is practically horizontal. The controlling gear of this floor is within convenient reach of the observer's chair, so that it may be manipulated in the dark, with perfect safety and without necessitating the observer's moving from his seat. As a rule, however, a telescope for useful work does not have to be brought lower than 20 degrees to the horizontal axis, as the earth's atmosphere at a more lateral elevation prevents accurate observations being made.

The floor is operated by a hydraulic ram, exerting a pressure of 50 pounds per square inch. As a matter of fact, however, this ram is not acually required for raising and lowering the floor, as the latter is so delicately counterbalanced by weights that a ram is only utilized to lift any extra weight, such as that of the observer, that may be standing on the floor. In the earlier types of elevating floor, there was a decided seesaw movement, as the observer moved from one side of the apartment to the other; but in this case, all such possibility of any tilting, no matter how great the weight placed at one side may be, is obviated. This is accomplished as follows: The ropes upon which the counterbalancing weights move up and



NEW EQUATORIAL TELESCOPE AT RADCLIFFE OBSERVATORY, OXFORD, ENG.