borderland where matter and force seem to merge into one another, the shadowy realm between the known and the unknown, which for me has always had peculiar temptations. I venture to think that the greatest scientific problems of the future will find their solution in this borderland, and even beyond; here, it seems to me, lie ultimate realities, subtle, far-reaching, wonderful."

GREAT ASTRONOMICAL TELESCOPE.

The greatest refracting telescope in the world—Lord Rosse's is a reflecting telescope—has been constructed for the Vienna Observatory by Mr. Howard Grubb, at his celebrated manufactory of astronomical instruments, at Rathmines, near Dublin. We give an illustration, from a sepia drawing of it by Mr. G. Browning, and abridge the following account of it from a description received at this office.

The idea of crowning the observatory at Vienna with a refracting telescope of surpassing power was conceived by the Austro-Hungarian Government about five years ago. Such a building was worthy of the best instrument that could be constructed. Every visitor to the Austrian capital must be struck by it, standing upon a site of between fourteen and fifteen acres at a height of 200 feet above the city, and extending 330 feet in length and 240 feet in width. Desiring to possess the finest telescope which could be procured, the Government commissioned Dr. Edward Weiss, now Director-General of the Observatory at Vienna, to visit all the principal observatories and workshops in the world. He recommended that the task should be confided to Mr. Grubb, of Dublin, who was ordered to construct a refracting telescope of at least 26 inches aperture. A commission was appointed by the Austro-Hungarian Government to superintend the work. It was composed of the following gentlemen: The Earl of Crawford and Balcarres, Dr. Higgins, the Earl of Rosse, Professor Stokes, of Cambridge, Professor Ball, Astronomer Royal for Ireland, Dr. Stoney, Secretary of the Queen's University in Ireland, many years connected with Lord Rosse's observatory, Dr. E. Reynolds, professor of chemistry, Trinity College, Dublin, and Mr. Walsh, Austro-Hungarian Consul in Dublin. On the 16th ult. the Commissioners reported their unanimous approval of the finished instrument.

The general form of the telescope is that known as Grubb's modified Gramme, and is similar to the well-known standard equatorial which he constructed for the Earl of Crawford and Balcarres, Dr. Huggins, Oxford University, Berlin, Cork, and other places. It possesses all the modern improvements and special arrangements of an ingenious character, which are rendered desirable by its great size. The length of the tube is 33 feet 6 inches, and the aperture is 27 inches. The tube is entirely of steel, 3½ feet in diameter in the centre, and tapering to each end. The entire moving parts, including the tube, polar, and declination axis, counterpoise and various adjustments weigh between six and seven tons; yet the whole apparatus is under such control that one person can move it about and manipulate it with the utmost ease. The mechanism is remarkable for its solidity and strength, as well as for its exquisite delicacy.

In order to render the motion of such ponderous instruments sufficiently easy, the makers are generally obliged to reduce the diameter of the axes, particularly that known as the declination axis, to an extent that makes one almost alarmed for their safety, to say nothing of their stability. Mr. Grubb, however, has mastered the difficulties of the position by a peculiar and most interesting system of equipoise, by which he is enabled to make his axes so large and solid as to ensure stability and give perfect confidence without sacrificing the ease of motion. The application of antifriction apparatus to the polar axis has been already successfully effected, and was a simple problem, but Mr. Grubb has the exclusive merit of applying it to the declination axis, which is a task of great and complicated difficulty, demanding the highest scientific skill.

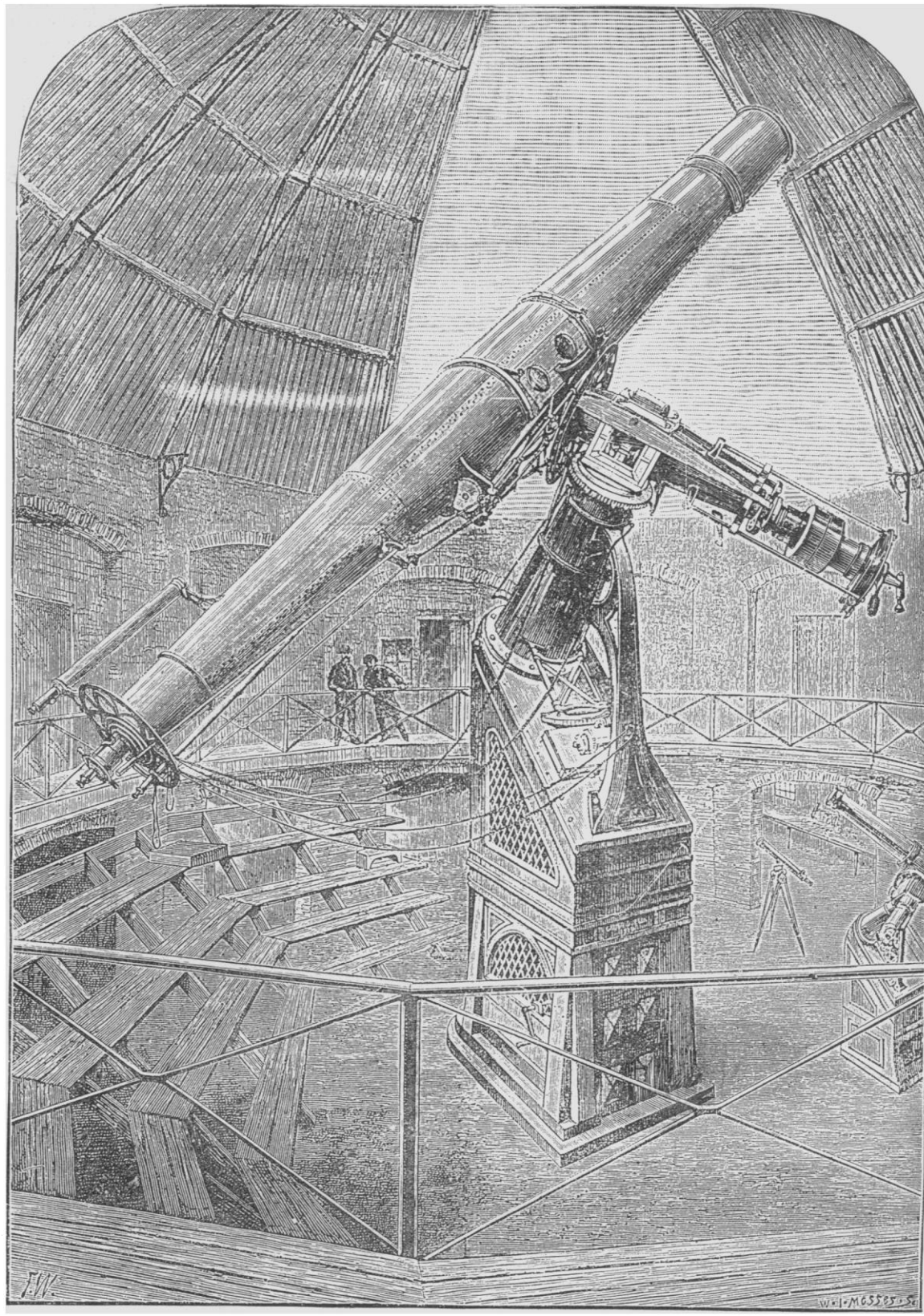
Another remarkable feature in the work is the ingenious arrangement by which the circle can be read with the utmost ease and certainty. It is usually a very troublesome operation with large telescopes to read the circle, and when the circles are about 20 feet or more from the ground the labor and delay which it involves are very formidable. In Mr. Grubb's instrument, the circles are carefully and accurately divided on a band of gold, and by a system of reflectors, at once beautifully simple and ingenious, the observer can without stirring from his chair read all the circles of the instruments through one little reader telescope attached to the side of the main telescope tube.

The setting of the telescope is massive and graceful. The frame on which it rests down to the ground level is of cast iron, and there are chambers of considerable size at the base. In the lower one, which is entered by a door at the end, is a clock for driving the instrument in order to follow the paths of the heavenly bodies. The castings of which the frame is formed are of about ten tons weight, and are of simple but not inelegant design. The clockwork is controlled by Mr. Grubb's novel frictional governor, and is also furnished with his new electric control apparatus. There are two right ascension circles, each 2 feet in diameter, one read from the eye end of the telescope and the other from the ground floor. The declination circle is 5 feet in diameter, and is read from the eye end of the telescope. All the circles are divided on an alloy of half pure gold and half pure silver, which is found to be very white and not liable to corrode or tarnish.

The material for the object glasses was procured from M. Feil, of Paris. The protracted delay in procuring this material for the work was a subject of great anxiety to Mr. Grubb, and occasioned heavy additional outlay on his part. In October, 1879, however, discs were obtained, which in working gave good promise, and in December last he was able to report the work finished—his part of it being, in fact, accomplished in less than half the time stipulated by the agreement with the Austro-Hungarian Government. His task was practically trebled by the difficulty experienced in obtaining pure discs. The success of his undertaking is regarded with great satisfaction and with national pride. He has supplied equipments to most of the modern observatories, but this telescope is his greatest achievement.

THE *Athenæum* prints an interesting extract from a letter from Prof. Draper, giving a description of the progress he has made in photographing the nebula in Orion:—"I have succeeded," he says, "in taking stars in it of the 14.1, 14.2, and 14.7 magnitudes of Pogson's scale. Prof. Pickering has made a series of measures on these magnitudes especially for me at the Harvard College Observatory. You will perceive that we have photographed stars which approach the *minimum visible* of my 11 in. telescope, and we may, therefore hope shortly to photograph stars actually too faint to be seen with the eye in the same instrument. The nebula, which was exposed 104 minutes, extends over an area of about 15′ in diameter, though, as it becomes fainter toward the exterior parts, it is difficult to determine its precise limits." This is a great advance; no star of less than the ninth and a half magnitude has hitherto been photographed.

A CURIOUS magnetic property of the meteoric iron of Santa Cattarina (Brazil), has been lately observed by Professor Lawrence Smith. Small detached fragments, not weighing more than 0.1 to 0.2 gr., were very weakly affected by a magnet; but on being flattened on a piece of steel, with a steel hammer, they become very sensitive to it. By heating red-hot, the particles were made to be still more easily attracted than by flattening. The meteoric iron in question contains 66 iron, 34 nickel.



THE NEW TELESCOPE, VIENNA OBSERVATORY.