

do this," they say, "but at the same time we know that in actual practice a cut on a hand, which lasts for a long time in a coal mine, here, when powdered by the ore, gets well very quickly."

CHR. ANTOONOVICH.

St. Petersburg, Russia, M. Possadskaya 21,
December 4.

Lunar Rainbow of December 1.

ON Wednesday, December 1, about 11 p.m., we saw here a very fine lunar rainbow. It was a perfect bow in the west, showing on a black sky. At the two ends the colours of the rainbow were to be seen quite plainly, though there was only about half a moon. Had there been a full moon, the sight would have been very fine. The rainbow was visible for about twenty minutes.

RICHENDA CHRISTY.

Orchards, Broomfield, Chelmsford.

THE TERCENTENARY OF THE TELESCOPE.

THE year 1609 is one of the most remarkable epochs in the history of astronomy. In the summer of that year Kepler's book on the motion of Mars was published, in which for the first time the actual orbit of a planet in space was determined, while astronomers had hitherto only been able, with more or less success, to investigate the projection of that orbit on the celestial sphere. In the same year the newly-invented telescope was directed to the heavenly bodies, and enabled mankind to form an idea of their constitution, instead of being, as hitherto, reduced to making wild guesses on this subject. But while many years had to pass before Kepler's work became generally recognised (even Galileo never accepted it), the telescope at once became an indispensable tool to astronomers.

Though many attempts have been made to prove that some of the ancient or mediæval philosophers made use of telescopes, it is now generally acknowledged that the telescope was not known to anyone before the year 1608.¹ On October 2 of that year Johan Lipperhey, a spectacle-maker of Middelburg, submitted to the States General an instrument for seeing at a distance, which he had invented, "as was known to the members of the States," and demanded either a patent for thirty years or an annual pension. The States General desired the inventor to produce a binocular telescope, and when he did that they eventually paid him 900 florins for three instruments of this kind, while the patent was refused on the plea that the invention had already become known to many people. These facts are certain enough, but it is quite possible that Lipperhey may not have been the first to construct telescopes, but that the claims of Zacharias Janssen, another spectacle-maker of Middelburg, may be well founded. It appears that this man had invented a compound microscope in 1590. A story was current early in the seventeenth century that some children, when playing with lenses, had found that a weathercock viewed through two of them appeared much enlarged and turned upside down, and that this led to the invention of the telescope. But a telescope which produces an inverted image must have been the so-called astronomical telescope soon afterwards invented by Kepler, which has a convex eye-lens, and not the Dutch or Galilean telescope with a concave eye-lens of which the modern opera-glass may serve as a specimen. A man who had invented a compound microscope would not be unlikely to possess lenses good enough to produce a fair image of a weathercock, and to have been capable of modifying this acci-

dental discovery by substituting a concave eye-lens to make the image upright. Some person is said to have gone to Middelburg to procure a telescope from the spectacle-maker there, but to have applied, by a mistake, to Lipperhey, who thus first heard of the invention.

Whether Lipperhey or Zacharias Janssen was the first to make telescopes will probably never be settled with absolute certainty, but in any case the first telescopes were undoubtedly made in Middelburg. In the introduction to the catalogue of his library (p. xviii), Libri describes a small tract printed at Lyons and dated November 12, 1608, in which mention is made of "nouvelles lunettes" made by a poor, pious and God-fearing man of "Mildebourg"; and the writer states that "even the stars which ordinarily do not appear to our view and our eyes on account of their smallness and the weakness of our vision may be seen by this instrument." From several other contemporary sources we know that knowledge of the new invention spread very rapidly, so that telescopes were not difficult to procure in the spring of 1609, both in the Netherlands and elsewhere. In December, 1608, the States General sent two telescopes made by Lipperhey to King Henry IV. of France; others were publicly offered for sale in Paris about the end of April, 1609, while the news of the invention had reached Venice in December, 1608, and a specimen of the new instrument was brought to Milan in the following May. The wonderful new toy was so very simple that it is not strange that "there was nobody who did not say he had invented it," as a contemporary writer tells us. Among these was Galileo, who in August, 1609, on the Campanile of San Marco at Venice, exhibited a telescope made with lenses purchased in that city. He claimed to have merely heard that a certain Belgian had presented to Prince Maurice of Nassau a glass by means of which distant objects were seen as clearly as if they were quite near, and that this meagre information sufficed to enable him in a single night to design a telescope. If the information received by Galileo was really as scanty as he says, it is very strange that the man who from it constructed a telescope should shortly afterwards, in his "Sidereus Nuncius," show that he hardly had grasped the most rudimentary notions as to the passage of rays of light through lenses and the formation of images. He would have done better if he had followed the explanation of the effect of convex and concave lenses given by Kepler in his book on optics, published in 1604.¹

But even if we cannot give Galileo the credit which he demanded of having re-invented the telescope, and though, as we have seen, others before him had pointed a telescope to the stars, he deserves full credit for having at once grasped the great possibilities offered by the instrument, and for having made the first serious attempt to explore the heavens with it. He did not grind the lenses himself, but made use of such as he could purchase. Judging by the very rough sketches of the lunar surface given in his little book "Sidereus Nuncius" (published in March, 1610), his small telescopes, magnifying from three to thirty diameters, cannot have been very good; still, they were sufficient to show that the moon was a body like our earth, having mountains and plains, that the Milky Way really was composed of innumerable stars; and, above all, they enabled him to discover the four satellites of Jupiter in January, 1610. Continuing his work, he detected in the following autumn the phases of Venus and Mars, and about the same time he became greatly puzzled by the peculiar appearance of Saturn, which planet, instead of showing a round

¹ See in particular Thomas Henri Martin's paper "Sur des Instruments d'Optique faussement attribués aux anciens par quelques Savants modernes" in Boncompagni's *Bulletino*, iv., 1871.

¹ "Opera ed. Frisch," i., p. 56.