we may read the smallest letters at an incredible distance, and may number things, though never so small, and may make the stars also appear as near as we please.”

These passages certainly prove that Bacon had very nearly, if not perfectly, arrived at theoretical proof of the possibility of constructing a telescope and a microscope; but his writings give no account of the trial of an actual telescope, nor any detailed results of the application of a telescope to an examina­tion of the heavens. It has been pointed out by Dr Robert Smith, in his *Complete System of Opticks,* that Bacon imagines some effects of telescopes which cannot be performed by them, and his conclusion is that Bacon never actually looked through a telescope.

Giambattista della Porta, in his *Magia Naturalis,* printed in 1558, makes the following remarkable statement:—

“ If you do but know how to join the two (viz.,'the concave and the convex glasses) rightly together, you will see both remote and near objects larger than they otherwise appear, and withal very distinct.”

Wolfius infers from this passage that its author was the first actual constructor of a telescope, and it appears not improbable that by happy accident Porta really did make some primitive form of telescope which excited the wonder of his friends. Here, however, his interest in the matter appears to have ceased, and he was unable either to appreciate the importance of his discovery or to describe the means by which the object was attained. Kepler, who examined Porta’s account of his concave and convex lenses by desire of his patron the emperor Rudolph, declared that it was perfectly unintelligible. Poggen- dorff *(Gesch. der Physik,* p. 134) throws considerable doubt on the originality of Porta’s statement.

Thomas Digges, in his *Stratiolicus,* p. 359, published in 1579, states that his father, Leonard Digges,

"among other curious practices had a method of discovering by perspective glasses set at due angles all objects pretty far distant that the sun shone upon, which lay in the country round about,” and that this was by the help of a manuscript book of Roger Bacon of Oxford, who he conceived was the only man besides his father who knew it. There is also the following passage in the *Pantometria* (bk. i. chap. 21) of Leonard Bigges @@1 (originally published by his son Thomas in 1571, and again in 1591):—

“ Marvellous are the conclusions that may be performed by glasses concave and convex, of circular and parabolic forms, using for multiplication of beams sometime the aid of glasses transparent, which, by fraction, should unite or dissipate the images or figures presented by the reflection of other.”

He then describes the effects of magnification from a combina­tion of lenses or mirrors, adding:—

“ But of these conclusions I minde not here to intreate, having at large in a volume@@2 by itselfe opened the miraculous effects of perspective glasses.”

It is impossible to discredit the significance of these quotations, for the works in which they occur were published more than twenty years before the original date claimed for the discovery of the telescope in Holland.

But it is quite certain that previous to 1600 the telescope was unknown, except possibly to individuals who failed to see its practical importance, and who confined its use to “ curious practices ” or to demonstrations of “ natural magic.” The practical discovery of the instrument was certainly made in Holland about 1608, but the credit of the original invention has been claimed on behalf of three individuals, Hans Lippershey and Zacharias Jansen, spectacle-makers in Middelburg, and James Metius of Alkmaar (brother of Adrian Metius the mathe­matician).

Descartes, in his treatise on *Dioptrics* (1637), attributes the dis­covery to Metius "about thirty years ago," whilst Schyraelus de Rheita, a Capuchin friar, in his *Oculus Enoch et Eliae* (Antwerp, 1645), gives the credit to Lippershey about 1609. Peter Borel,

physician to the king of France, published at The Hague, in 1655, a work *De Vero Telescopii Inventore.* He was assisted in its pre­paration by William Borel, Dutch envoy at the court of France, and the latter declares, as the result of patient investigation, that Jansen and his father were the real inventors of the telescope in 1610, and that Lippershey only made a telescope after hints acci­dentally communicated to him of the details of Jansen’s invention. But the most trustworthy information on the subject is to be got from the researches of J. H. van Swinden.@@3 Briefly summarized, this evidence is as follows. In the library of the university of Leyden, amongst the MSS. of Huygens there is an original copy of a document (dated 17th October 1608) addressed to the states- general by Jacob Andrianzoon (the same individual who is called James Metius by Descartes), petitioning for the exclusive right of selling an instrument of his invention by which distant objects appear larger and more distinct. He states that he had discovered the instrument by accident when engaged in making experiments, and had so far perfected it that distant objects were made as visible and distinct by his instrument as could be done with the one which had been lately offered to the states by a citizen and spectacle­maker of Middelburg. Among the acts of the states-general pre­served in the government archives at The Hague, Van Swinden found that on 2nd October 1608 the assembly of the states took into consideration the petition of Hans Lippershey, spectacle-maker, a native of Wesel and an inhabitant of Middelburg, inventor of an instrument for seeing at a distance. On 4th October a committee was appointed to test the instrument, and on the 6th of the same month the assembly agreed to give Lippershey 900 florins for his instrument. Further, on the 15th December of the same year they examined an instrument invented by Lippershey at their request to see with both eyes, and gave him orders to execute two similar instruments at 900 florins each; but, as many other persons had knowledge of this new invention to see at a distance, they did not deem it expedient to grant him an exclusive privilege to sell such instruments. The dates of these documents dispose effectually of Borel’s statement that Lippershey borrowed the ideas of Jansen in 1610. They also prove that, whilst Metius was in possession of a telescope, with which he may have experimented, about the time when Lippershey presented his application for patent rights, yet he makes no pretension that Lippershey borrowed the invention from him. The conclusion is that Lippershey was the first person who independently invented the telescope, and at the same time made the instrument known to the world. The common story is that Lippershey, happening one day, whilst holding a spectacle-lens in either hand, to direct them towards the steeple of a neighbouring church, was astonished, on looking through the nearer lens, to find that the weathercock appeared nearer and more distinct. He fitted the lenses in a tube, in order to adjust and preserve their relative distances, and thus constructed his first telescope. But doubt may be thrown on this traditional account owing to the further statement that the image of the weathercock so viewed was seen turned upside down. All the original Dutch telescopes were composed of a convex and a concave lens, and telescopes so con­structed do not invert. The inverting telescope, composed of two· convex lenses, was a later invention; still it is not impossible that the original experiment was made with two convex lenses.

Telescopes seem to have been made in Holland in consider­able numbers soon after the date of their invention, and rapidly found their way over Europe. Sirturus, in his *De Telescopio* (1618), states that “a Frenchman proceeded to Milan in the month of May 1609 and offered a telescope for sale to Count di Fuentes and Lorenzi Pigorna writes,@@4 under date 31st August 1609, that “ Galileo had been appointed lecturer at Padua for life on account of a perspective like the one which was sent from Flanders to Cardinal Borghese.” Simon Marius, the German astronomer, appears to have made astronomical observations in 1609 with a telescope which he procured from Holland, and Professor S. P. Rigaud of Oxford found from the MSS. of Harriot, the mathematician, that he had been making astronomical observations with a Dutch telescope as early as July 1609. Galileo, in his *Nuncius Sidereus,* states that, happening to be in Venice about the month of May 1609, he heard that a Belgian had invented a perspective instrument by means of which distant objects appeared nearer and larger, and that he discovered its construction by considering the effects of refraction. In his *Saggiatore* Galileo states that he solved the problem of the construction of a telescope the first night after his return to Padua from Venice, and made his first tele­scope next day by fitting a convex lens in one extremity of a leaden tube and a concave lens in the other one. A few days afterwards, having succeeded in making a better telescope than

@@@1 He died about 1570. His son alludes to his untimely death in the preface to the *Pantometria.*

@@@2 There is no further trace of this volume.

@@@3 See Dr G. Moll of Utrecht, in *Journ. Roy. Inst.,* vol. i., 1831.

*@@@4 Lettre d' Uomini Illustri,* p. 112 (Venice, 1744).