

THURSDAY, AUGUST 18, 1898.

THE CORRESPONDENCE OF HUYGENS.

Œuvres complètes de Christiaan Huygens publiées par la Société Hollandaise des Sciences. Tome Septième. Correspondence 1670-1675. Pp. 624. 4to. (La Haye, 1897.)

SEVEN large quarto volumes of letters to and from Huygens have now been published; but the completion of the work is not yet in sight, as the volume before us only reaches the end of the year 1675, and Huygens lived till 1695. We may therefore probably look forward to three or four more volumes, making in all ten or eleven, before this undertaking is brought to a close. A future historian of science in the seventeenth century will no doubt find excellent material in this vast collection of letters exchanged between Huygens and the principal physicists, astronomers, and mathematicians of his time, to which are added many short papers, reprinted from the *Journal des Savants* and the *Phil. Trans.* But, on the other hand, the task of the historian would have been materially lightened if he had been spared the trouble of wading through a great many uninteresting, more or less private, letters, which help to swell these bulky volumes, but which might very well have been omitted. This is particularly the case with the letters written to Lodewijk Huygens, for though they bear witness to the brotherly affection of the writer, and are often of interest as throwing light on the state of the Netherlands in the days of William III., particularly in the year 1672, when the armies of Louis XIV. overran the country, and the last days of the Republic seemed to have come, still most of these letters are rather out of place among the scientific ones, and would have been better published separately. But hero-worship is unfortunately a disease which it is extremely difficult to resist, and we can well understand that the Dutch Society of Science has wished to do honour to their great countryman by giving as complete a picture of him as possible, both as a private man and as a philosopher.

The years covered by the present volume, 1670-1675, were by Huygens spent in Paris, where he had resided since 1666, except the period from the summer of 1670 till the following spring, which he spent in his native country in order to recover his health after a severe illness in the beginning of 1670. It was a stirring time in the scientific world. The discovery of the solar spectrum by Newton and the method of drawing tangents to curves discovered by Sluse were published in 1672, the "Horologium Oscillatorium" of Huygens was issued in 1673, giving to the world the theory of the pendulum, the discovery of evolutes, the isochronism of the cycloid and other problems of importance; while the application of a spiral spring to the balance of a watch was first announced in 1675. These and other matters are discussed in the correspondence; while the great respect in which Huygens was held is also shown by letters on other subjects, on which his opinion was asked. Thus the architect Perrault, the builder of the palatial Paris

Observatory, "le plus somptueux monument qu'on a jamais consacré à l'astronomie," as Lalande calls it, sends Huygens a long essay giving his ideas about the origin of springs in the earth; it forms the preface to his "Traité de l'Origine des Fontaines," and need therefore not have been inserted among the correspondence of Huygens, as the reply of the latter, in which he shortly gives the theory of the barometer and the syphon, can be read without reference to Perrault's essay. We also find Huygens consulted on matters more outside his own sphere; thus he and Hudde in 1671, at the request of the States of Holland and West Frisland, sent a lengthy report to the States-General on the deepening and regulation of the Lower Rhine and the Yssel, on which subject Huygens and Hudde also exchanged several letters.

There are not many letters in this volume on practical astronomy, for the simple reason that most practical astronomers at that time lived in Paris; Cassini, Picard and Roemer were there; in England, Flamsteed and Halley were still young men, and in the rest of Europe there were simply no observers except Hevelius. There are, however, some letters and short papers (some of which were printed at the time in the *Journal des Savants*) on the disappearance of Saturn's ring in 1671, in which year the earth twice passed through the plane of the ring and supplied a splendid confirmation of Huygens' discovery of the true nature of the appendages of the planet. The phenomena were carefully observed both by Huygens himself and at the new Paris Observatory by Cassini, who shortly afterwards discovered two satellites of Saturn with the new telescopes constructed by Campani. The excellence of these is acknowledged by Huygens in a letter to his brother Constantin, in which he humorously remarks that though the new lenses of 36 and 46 feet focal length show mountains and other surface-details on the moon much better than the old ones did, we have not yet got so far as to see church spires and trees. The construction of telescopes was a subject in which the two brothers were both specially interested, and on several occasions Christian sent Constantin information about the new methods of polishing lenses practised in Paris by Le Bas and Borel. It is well known that the single-lens objectives of those days were of very great focal length; there was one of 60 feet at the Paris Observatory, which was very troublesome to use, and Borel even boasted of having made one of 150 feet; "mais il est Gascon," says Huygens.

In England the desire of getting achromatic telescopes had led Gregory and Newton to the invention of the reflecting telescope. In this country Huygens, who was himself a Fellow of the Royal Society, had an indefatigable correspondent in Oldenburg, who not only as secretary to the Society and editor of the *Philosophical Transactions*, but also by his very extensive correspondence, was one of the chief centres of scientific life. At the desire of the Society, Oldenburg communicated an account of Newton's invention to Huygens, who published it in the *Journal des Savants* of February 29, 1672, and also sent his brother Constantin a description of it. He tried at once to make a mirror for himself, but found great practical difficulties in getting a good polish with-

out altering the figure. His defence of Newton's construction against the objections of Cassegrain is reprinted in this volume from the *Journal des Savants*. With Newton himself Huygens does not seem to have been in direct communication, but through Oldenburg the doubts of the Dutch philosopher as to the actual number of colours in the sun-spectrum were brought to the knowledge of Newton, who replied to them in two papers printed in the *Philosophical Transactions* and reprinted in the present volume. The first and last pages of one of the papers, which was written in the form of a letter to Oldenburg, are given in facsimile.

Among letters concerning Huygens' principal work, the "Horologium Oscillatorium," we find his well-known letter to Leopold de' Medici of May 1673, protesting against the accusation of plagiarism, which for years caused him a great deal of annoyance. Both this letter as well as Leopold's reply have been printed before, but the editor takes the opportunity of reviewing in a very long footnote the whole question as to the priority of Galileo. The *mensurator temporis* actually constructed by Galileo was a failure, but in 1641 he gave verbal instructions to his son Vincenzo which resulted in a design of the latter described by Viviani in 1659 in a report to Leopold of Toscana. The editor maintains that a clock can never have been made from this design, or that if made it must have been impossible to make it go, as the wheel would have oscillated instead of rotating; but this conclusion seems very doubtful, since it depends altogether on the accuracy of the drawing published by Favaro in 1891, from among several existing in the National Library of Florence. In any case it remains an undoubted fact that Galileo was the first to propose the application of pendulums to clocks, that he found the principle of the escapement, and that he only by his age and blindness was prevented from perfecting the invention. The mythical claims of Joost Bürgi, so strenuously advocated by Rudolph Wolf, may be safely dismissed; and that Huygens made the invention quite independently is not doubted by anybody.

Tiresome questions of priority were always cropping up in the seventeenth century, and Huygens had also to deal with such in the matter of the isochronism of the cycloid. He defended himself against the claims of Hooke and others in a letter to Oldenburg in June 1673, which called forth a dignified reply from the latter, in which he says that English philosophers are not in the habit of attributing to themselves the discoveries of others, but neither will they allow others to deprive them of what is theirs; many inventive Englishmen have found new truths of which they have spoken freely before printing anything about them, but of late years they have been more careful to preserve their discoveries through the medium of the *Phil. Trans.* Huygens seems to have taken offence at this, as he did not answer for a long time; and when he wrote again he explained his silence by saying that his letters apparently "ne servoient qu'à me mettre mal avec vos Messieurs dela, les vns ne prenant pas en bonne part la liberté dont j'usois a dire mes sentiments sur leurs ouvrages, et a leur faire des objections, les autres se formant d'autres sujets de mecontentements, ou je n'en attendois point du tout."

The last great invention of Huygens dealt with in this volume is the application of a spiral spring to the balance of a watch. On January 30, 1675, Huygens in a letter to Oldenburg informed him that he had made a new invention in timekeepers which he announced in an anagram, and a few days later he applied to Colbert for a patent in France for twenty years. The watchmaker Thuret, whom he had employed to carry out the invention, gave Huygens a good deal of anxiety by pretending that the invention was his own, or at least was made by him and Huygens jointly; but after a few weeks he was obliged to give up his pretensions. Eventually, however, Huygens left all watchmakers at liberty to work at the new invention, foreseeing that any attempt to enforce the patent would involve him in endless lawsuits and expense. A scatter-brained person, Abbé Hautefeuille, had resisted the granting of the patent on the plea that he had himself applied a straight spring to a clock instead of a pendulum, and that the invention of Huygens was essentially the same thing! Of more importance was the claim immediately made by Hooke, that he had many years previously made the same invention and that watches had actually been made in accordance with it. How Hooke stuck to his colours, and how he picked a violent quarrel with Oldenburg, whom he described as "one that made a trade of intelligence" and accused of having betrayed the invention to Huygens, all this is well known, and the present volume, in which all the documents are reprinted, does not throw any additional light on the matter.

In addition to several plates giving photographic reproductions of letters and sketches, the volume contains a fine portrait of Huygens and a view of the manor-house of Zuylichem. The very numerous footnotes give ample information about persons and matters referred to in the letters and documents. J. L. E. DREYER.

DANTES TEN HEAVENS.

Dante's Ten Heavens. By Edmond G. Gardner, M.A. Pp. xii + 310. (Westminster: A. Constable and Co., 1898.)

THE many works in the English language which are being constantly added to the already colossal Dantesque literature are a subject for sincere congratulation alike to the country which gave birth to the immortal author of the *Divina Commedia*, and to the English nation. It is, I think, the most conclusive proof of the conspicuous greatness of Dante that his fame should increase in proportion as the era of which he was the first bard and prophet advances in civilisation. "Dante's Ten Heavens," by Mr. E. G. Gardner, is one of the latest contributions to the great subject under discussion, and for the earnest and loving care which the author has evidently devoted to his work he deserves unstinted praise. He has studied a great deal of what has been said about Dante's theological and ethical ideas, and, although Mr. Gardner in his book treats especially of the *Paradiso*, he often compares similar passages in the three parts of the poem; so that his work will be of great service to those who are interested in these studies. It is, however, to be regretted that