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

he has published his work in the form of an essay; in my opinion, he should have appended his notes to an edition of the whole text of the *Paradiso*; for his valuable remarks would then have presented themselves to the reader singly, and each in its proper place; but in the form they have been published, my conviction compels me to say that the uninitiated, for whom the book is avowedly intended, will be rather discouraged or repulsed by the mass of theological and ethical disquisitions the book mainly consists of, with but a very few glimpses of the poetry which richly adorns *Paradiso*, and makes the serious matters dealt with in it attractive, enjoyable, and exalting. In reading Mr. Gardner's book, one would almost think that Dante in his *Paradiso* simply rhymed St. Thomas Aquinas, Dionysius the Areopagite, St. Bernard, and Richard of St. Victor; whereas, in reality, he was the great Christian poet who expressed in the language of his people, and handed down to posterity, vivified and enhanced with his beautiful poetry, the thoughts and ideas which the school and the cloister entertained and preached concerning the deep questions of human existence. Mr. Gardner should have kept in mind the words which he himself quotes on p. 48 of his book:—

"Metter potete ben per l'alto sale
Vostro navigio, servando mio solco
Dinnanzi l'acqua che ritorna uguale."

Par., C. ii., lines 13-15.

Had he done so, had he been more graphic in his account of the sublime ethereal pilgrimage, his readers would follow much more easily his guidance, and feel a greater interest in the poem. The fact is that Dante's *Paradiso* should be read and studied (with good notes, of course) in the very words of the sublime poet himself; in truth, many passages in the translations already published of it are dim and clumsy rendering of the original, and oftentimes, for anybody who knows any Italian at all, more difficult to understand than the original text itself. Little, far too little is said by Mr. Gardner about the beautiful diction, the marvellous style, and the stupendous poetic conceptions abundantly displayed by Dante in the last, but the greatest and most sublime, of the three parts of the *Divina Commedia*; and he has said scarcely anything at all of his surprising and admirable knowledge of the physical sciences and astronomy. But, surely, it is for these eminent qualities I have just enumerated that Dante is entitled to that great and ever-increasing consideration and admiration which he attracts at the present time; it is the all-surveying, all-embracing, all-stirring character of his intellect that arrests and commands the attention of all the thinking minds of the present inquiring age. As Mr. Gardner cannot, I think, be one of those critics who injudiciously hold that science is opposed to poetry—that the one must inevitably mar the scope of the other—I cannot understand why he does not praise Dante for his great and, considering the age he lived in, truly amazing knowledge of the highest problems of science. Had not Dante's mind been so copiously stored with all the learning of the best instructed of his contemporaries, most certainly his poetic imagination could never have taken its start from the lofty plane it rose from in the *Divina Commedia*, and his *Paradiso* could never have been more than a grand

rhapsody. It suffices to compare Dante's magnificent poem with the Vision of Alberigo, the monk of Monte Cassino, or "De Jerusalem Celesti," of Fra Giacomino of Verona, to see how puerile even poetic conceptions will appear when they are expressed by minds untaught, and obliged to rely upon their unaided natural resources.

The *Purgatorio*, and the *Paradiso*, the work of heaven and earth,

"Al quale ha posto mano e cielo e terra,"

Par., C. xxv., line 2.

contain innumerable passages, which prove Dante's immense knowledge of the physical sciences, and astronomy. With reference to the physical sciences, I will only mention the following points:—

His allusion to the principle of universal gravitation: Inf., C. xxxiv., lines 73 and 74.

His remarkably accurate description of the origin of rain: Purg., C. v., line 109-112.

His explanation of the way in which the vegetable humour of the vine, fostered by the light and heat of the sun, becomes grapes: Purg., C. xxv., lines 77 and 78.

His knowledge of the theory of the decomposition of light; in fact, the prismatic nature of the solar spectrum: Purg., C. xxix., lines 73-78.

His knowledge that flowers are only leaves metamorphosed: Par., C. xxxvii., lines 38 and 39.

And, to go no further in this department, his recommendation of experiment and scientific observation, in preference to empiricism: Par., C. ii., lines 95-97.

In astronomy, Dante's knowledge was still more remarkable; not so much for any great discovery made by himself, but because of the thorough mastery he possessed of what was then known of that science, and also because of the many theories then advocated, his pre-eminently eclectic mind seems, generally, to have embraced those only which more recent researches have proved to be the correct ones. And if it be said that Dante did not acquiesce in the Pythagorean system of astronomy (*Convito*; Bk. iii., Ch. 5), we must remember that the illustrious astronomer Ptolemy himself also withheld his approval of that grand but badly advocated system, and, what is more, three centuries after Dante the immortal Galileo was, at first, strongly opposed to the Pythagorean system, as revived and supported by Copernicus.

The following lines, for instance, unmistakably show that Dante knew the theory of the Precession of the Equinoxes, in about 26,000 years. To indicate the vanity of worldly fame, Dante makes a spirit ask him what his fame will be in a thousand years,

"ch' è più corto
Spazio all' eterno, ch' un muover di ciglia
Al cerchio che più tardi in cielo è torto."

Purg., C. xi., lines 106-108.

Also the following lines, in which our poet describes the obliquity of the ecliptic, and eloquently reminds us of the beneficial influence therefrom:—

"Vedi come da indi si dirama
L' obliquo cerchio che i pianeti porta,
Per satisfare al mondo che li chiama;
E se la strada lor fosse men torta,
Molta virtù nel ciel sarebbe invano,
E quasi ogni potenza quaggiù morta."

Par., C. x., lines 13-18.

See, also, how Dante characterises in the following lines the mighty power of the sun :—

“Lo ministro maggior della natura,
Che del valor del cielo il mondo imprenta,
E col suo lume il tempo ne misura,”
Par., C. x., lines 28–30.

It is also remarkable that the great Italian poet, differing in opinion from Aristotle (“il maestro di color che sanno”), and Ptolemy, who believed that the light of the Milky Way was caused by the density of the sky at the zone through which it passes, thought, with Democritus, that the puzzling galaxy consisted of an immense number of stars, more or less bright; as the following lines tell us :—

“Come, distiuta da minori e maggi
Lumi, biancheggia tra i poli del mondo
Galassia sì, che fa dubbiar ben saggi,”
Par., C. xiv., lines 97–99.

And, to finish with quotations, see in the following lines how Dante held firm the true one of the many theories of the tides which were advocated in the Middle Ages :—

“E come il volger del ciel della luna
Cuopre e discuopre i liti senza posa,
Così fa di Fiorenza la fortuna;”
Par., C. xvi., lines 82–84.

The foregoing quotations are sufficient to prove that Dante possessed a vast amount of scientific knowledge, which, in most cases, he displays most judiciously to interest his readers, and to inculcate in their minds the truths he wants to teach them. In conclusion, I beg leave to say again that if the fame of the great Italian grows in proportion with the world's civilisation, it is because he was not merely a great poet, but because he was also a great artist, a profound philosopher, an eminent astronomer, and an inspired theologian.

N. PERINI.

COLENZO'S MAORI DICTIONARY.

A Maori English Lexicon. By the Rev. W. Colenso. (Wellington, 1898.)

MR. COLENZO'S Maori English Lexicon, being, as stated on the title-page, a comprehensive dictionary of the New Zealand tongue, including mythical, mythological, “taboo” or sacred, genealogical, proverbial, poetical, tropological, sacerdotal, incantatory, natural history, idiomatic, abbreviated, tribal and other names and terms of and allusions to persons, things, acts, and places in ancient times, also showing their affinities with cognate Polynesian dialects and foreign languages, with copious pure Maori examples, has a sad history to tell. To begin with, it is only a first instalment, going no further than *Anguta* in the Maori English part, and *to come* in the English Maori part; nor does it seem settled even now that Mr. Colenso will be able to finish the publication of it. That such a lexicon ought to have been published by the New Zealand Government long ago, admits of no gainsaying. It is a work practically useful to the whole Colony, and who is to publish such a work if the Government declines to do so? As far back as 1861 the Rev. W. Colenso made his first proposal to the House of Representatives. His motion, he tells us, was favourably received, and the

resolution was passed, “That the House considers it highly desirable that a sum of money be devoted for the purpose of commencing a Standard Library Dictionary of the Maori Language.” But there followed the ominous sentence, “as soon as the finances of the Colony will permit.” A new application was made in 1862, when the finances seemed to be in a flourishing state, but without results. Then came the war in 1863, and nothing was done. The Governor, Sir George Grey, took an active interest in the matter; but in spite of that, nothing was done in 1864. At last, in 1865, an estimate was asked for, and Mr. Colenso stated that the time required would be seven years, and the expense would be 300*l.* per annum. In 1865 the House once more decided that it is highly desirable that the Maori dictionary should be commenced forthwith. Mr. Colenso then devoted himself entirely to this work, shutting himself up, as he says, fourteen and even sixteen hours a day. He gave up his official duties and his useful natural history studies, which had made his name familiar to students at home. He received, however, but scant recognition from the Government, and in 1867 it seems that an official inquiry was called for by the House, and another gentleman was appointed to inspect and report. The report was favourable, and so were some other reports in 1868. But the House seems to have grown impatient. Mr. Colenso was informed that the work must be finished by 1870, and that no more money should be paid after that date. After that, the relations between the Government and the compiler of the dictionary seem to have become strained. Unfortunately illness supervened, possibly aggravated by disappointment, for Mr. Colenso speaks of “having been goaded on to desperation almost through the remarks made in the House and the bad faith of the Government.” In 1870 Mr. Colenso entered the Provincial Council again, and was appointed Inspector of Schools, so that he could devote his spare time only to the prosecution of his literary labours. A last appeal was made by Mr. Colenso in 1875, offering to hand over his materials to Government, or to go on again with his work if the Government would grant the necessary funds. To this, we are informed, no answer was returned, but transactions went on, more or less unsatisfactory, till at last the first instalment of the dictionary was sent to press, and published in 1898!

This certainly seems a sad history, and, considering Mr. Colenso's age, we can hardly hope that he will be allowed to finish this great undertaking. In the meantime two Maori dictionaries have been published by Williams and by Tregear, but on a smaller scale; so that Mr. Colenso's work may still be very useful as filling many a gap left by his predecessors. It is difficult for an outsider to form an opinion as to the rights of the case. Scholars are sometimes dilatory, and Governments are sometimes stingy, and that on the highest principles. Personal feuds, too, are difficult to avoid when different parties divide the Government, and patronage is put into the hands of whatever party is in power.

The loss to science, particularly to linguistic studies, is very great, for by his long residence among the Maoris Mr. Colenso seemed highly qualified for the work which