

MEETING OF THE ROYAL METEOROLOGICAL
SOCIETY.

THE opening Meeting of this Society for the present Session was held on the evening of Wednesday, November 15, at the Institution of Civil Engineers, *Dr. H. N. Dickson*, President, in the Chair.

Mr. C. Harding read a paper on the abnormal weather of the past summer. He presented statistics showing the distribution of temperature, rainfall, and sunshine week by week in the various districts of the British Isles, and also made a comparison of the results with the Greenwich Records back to 1841. From the facts thus brought together, Mr. Harding showed that as far as temperature is concerned the summer of 1911 was unique. The maximum temperature of 100° at Greenwich on August 9 is the highest temperature recorded in the British Isles since the establishment of comparable observations. The mean temperature for the summer was also higher than for any similar period during the last 70 years. The maximum temperature of 96° in July has only been slightly exceeded on two previous occasions, and the September temperature of 94° has not previously been equalled during that month. So many hot days during the summer have never before been recorded. Mr. Harding further showed that the rainfall for the three summer months has only been smaller in three previous years during the period of 70 years, and also that the duration of bright sunshine was greater than in any previous summer since the introduction of sunshine recorders in 1881. As a consequence of the exceptional weather, the harvest was everywhere commenced at an earlier date than usual, and was quickly concluded under the most favourable conditions. The effects of the drought, other than in relation to the water-supply and vegetation, were very far reaching. Sports of all description were but little interfered with, and the summer will long be remembered as having been exceptionally fine for holiday-makers.

A paper by *Mr. W. Larden*, describing some observations which he has made on solar halos, was also read.

Dante and Mediæval Astronomy.

READERS of Dante's 'Divina Commedia' and 'Convivio,' who have admired his knowledge of astronomy, experience something of a shock when they become acquainted with the 'Quæstio de Aqua et Terra,' and find that in this learned Latin treatise he has apparently made a sad blunder with the Moon. The authenticity of the treatise has been questioned, but there is strong internal evidence that it is, as it purports to be, the work of Dante*.

* See especially Moore's "The Genuineness of the 'Quæstio de Aqua et Terra,'" *Studies in Dante*, series ii.

The subject is one which was sometimes discussed in Dante's day—viz., why land existed only in the northern hemisphere of Earth (as was then supposed), and by what natural agency it had been produced there while the rest of our globe was covered by ocean. Some thought that when the Creator bade the dry land appear, ocean had been lifted up and rolled back; but the author of the 'Quæstio' argues that it must have been the earth which was raised and was maintained constantly above the water. After establishing this, he proceeds to inquire whence comes the elevating "virtue," or influence. Not from Earth herself, for her inherent tendency is to sink downwards towards the centre of the universe, which is also her own centre. Not from the other elements—water, air, or fire; for they are "homogeneous bodies" which cannot exercise a partial influence, taking effect in one hemisphere and not another.

To which of the heavenly bodies, then, can it be assigned? Not to the Moon; for her southern declination is as great as her northern, so that the force, if it resided in her, would elevate land beyond the Equator as well as on this side; and this is not the case. Then follows the puzzling sentence:—

Nec valet dicere quod illa declinatio non potuit esse propter magis appropinquare terræ per excentricitatem; quia si hæc virtus elevandi fuisset in luna, quum agentia propinquiora virtuosius operentur, magis elevasset ibi quam hic.—Quæstio de Aq. et Terr. xx. end, Moore's Oxford Edition.

This has no sense as it stands, but by reading "elevatio" instead of "declinatio," and suppressing the "non," commentators understand it thus. It is useless to suggest that the elevation (of land) may be caused by a nearer approach of the Moon, due to the eccentricity (of her orbit); for if so, the elevation would have taken place in the south rather than here in the north, seeing that agents have greater power the nearer they are. This clearly implies a belief that the Moon is always in perigee when in the south*. Yet the revolution of her apsides, which makes her perigee travel constantly round the zodiac, thus alternating between north and south of the Equator, was as well known to mediæval as to modern astronomers.

Such an error is distressing to Dante's commentators, who can only conclude that if the interpretation is correct, he knew less about astronomy than has been supposed. It is suggested that he was perhaps influenced by a popular notion that the Moon was like the Sun in having her perigee always in the south; yet Dr. Moore has searched mediæval writings in vain to find any trace of such a popular fallacy.

May we suggest another interpretation, which follows from a consideration of what Dante was most likely to mean by "excentricitas" and "declinatio"?

Ibid. and Wicksteed's note on the passage in the Temple Edition of Dante's Latin Works.

Mediæval astronomers did not talk about the eccentricity of the Moon's orbit, for they did not think of her motion as performed in an ellipse, but as compounded of many circular motions. Her "orb," or sphere, was indeed eccentric, as the author of the 'Quæstio' once remarks* ; but this was not the main cause of her varying distance from Earth. Ptolemy had accounted for this by placing her on a small sphere, or epicycle, which rotated with regard to Earth in a retrograde direction, while its centre travelled with direct motion round the equator of her sphere (called the "deferent") once in a sidereal month. When she was at the "upper apsis" † of her epicycle, she was in apogee ; when at the "lower apsis," in perigee. The period of revolution of the epicycle was a little longer than that of the deferent, and this accounted for the revolution of the apsides in nine years.

But Ptolemy had to account, in addition, for his own discovery of the evection: it was to accomplish this that he placed the deferent excentrically to Earth, and he usually spoke of it as "the eccentric." This circle, therefore, had an apogee and perigee as well as the epicycle ; and according to a well-known mediæval authority on astronomy, the perigee of the Moon's eccentric was always south of the ecliptic.

Thirteenth-century scholars did not possess Ptolemy's work in the original ; and Dante's text-book, it is believed, was the 'Elementa Astronomica' of Alfraganus (the Arab astronomer of the ninth century), translated into Latin by Gerard, of Cremona. This gives a description of Ptolemy's lunar theory representing the Moon's movements in longitude, and when Alfraganus comes to speak of her movements in latitude, together with those of the planets, we find this statement:—

Saturnus, Jupiter, atque Mars eccentricorum suorum absidas summas et imas habent declinatas a zodiaco, illas ad boream, hasce ad austrum, secundum eandem deflexus mensuram: quemadmodum res in Luna obtinet.—*El. Ast.* ch. xviii. edition Golius, Amsterdam, 1669.

Clearly, then, if Dante spoke of eccentricity in connection with the Moon's movements, his readers could only understand him as referring to her "eccentric" ; and his had its perigee "declined" to the south. Therefore, although the Moon was in perigee once every month, when passing the lower apsis of her pericycle, her nearness to Earth was greatest when she was also in the lower apsis of her eccentric ; and this could only happen when she was south of the ecliptic. (Alfraganus usually calls the ecliptic the zodiac, like other writers of his time.)

The word "declinatas" in the above quotation from Alfraganus also gives us a key to the meaning of Dante's "declinatio" ; for both are using this expression in the modern astronomical sense

* Quæstio de Aqu. et Terr. vii. & xxiii.

† "Upper," because further from Earth and nearer heaven. Compare *Convivio*, ii. 14, where Saturn is said to be the "highest" of all the planets.

of position north or south, and Dante is referring to what he has just said about the Moon's declination south being as great as her declination north. If we delete "quod" and "non potuit," the sentence from the 'Quæstio' may be translated literally as follows:—

Nor does it avail anything to say that this declination (of the Moon to the south) results from a nearer approach to Earth through the eccentricity (of her sphere). . . .

And the whole argument may be stated thus:—

Can the Moon, in any of her various positions, influence the northern hemisphere of Earth more powerfully than the southern?

Firstly, her declination varies. But it carries her quite as far south as north.

Secondly, her distance varies, owing to the eccentricity of her sphere, which brings her nearer Earth when in the south. But this would give her greater power in the south, because the influence is greater, not less, the nearer the agent comes.

Her variation in distance, due to the epicycle, although far larger, is not mentioned, because its perigee alternates regularly between north and south.

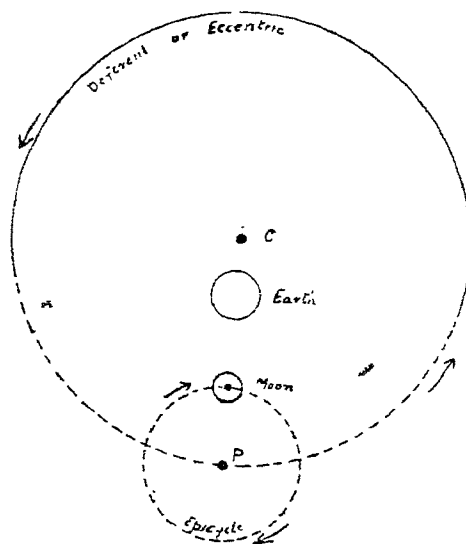
This interpretation makes the rest of the sentence less elliptical, and connects the whole of it more closely with what has gone before, besides retaining the word "declinatio" instead of altering it. The argument is the same and leads to the same conclusion, viz. that it cannot be the Moon which has raised the land out of the ocean; but the assumption upon which the argument is based, instead of proving ignorance, shows how well the author knew his Alfraganus.

The accompanying diagram (p. 444) shows the Moon at her least possible distance from Earth, when she is in the perigee of her epicycle, and the centre of the epicycle is simultaneously in the perigee of the eccentric. The plane of the paper is the plane of the ecliptic, to which the plane of the eccentric is inclined 5° . The arrows show the two directions in which the epicycle revolves—(1) round its own centre, (2) upon the eccentric.

The system was further complicated by giving two motions to the eccentric itself, in order to account for the retrogression of the nodes and the evection; but these do not concern our present inquiry. All we need note is, that through all these changes P remains below the plane of the paper, that is, the perigee of the eccentric is always south of the ecliptic. It was sometimes north of the Equator by as much as $23^\circ - 5^\circ = 18^\circ$, but never north of the apogee, which is all that is required by the hypothesis—viz., that the Moon was more often at her least distance from Earth in south declination than in north.

The lunar circles of Ptolemy, described by Alfraganus, are decidedly complicated; but this is not a matter for surprise or blame, since the Moon's motion is, in fact, very complicated. It

is remarkable that the irregularities caused by the elliptical form of her orbit, the revolution of the apsides, the retrogression of her nodes, and the evection, had all been observed, and a geometrical system invented to represent them, so early as the second century A.D.



C = centre of Eccentric.

P = perigee (or "lower apsis") of Eccentric.

The full line represents the part above, the dotted line the part below, the ecliptic.

The diagram is not drawn to scale.

The only detail that specially concerns Dante students is the passage above quoted from Alfraganus, in which the statement that the perigee of the Moon's eccentric is south of the ecliptic is as simple and straightforward as could be wished. Latin scholars, and those who have opportunities of consulting early editions of the 'Quæstio,' may be able to suggest a better emendation of the text than is here proposed; but we should be very glad to know whether the statement of Alfraganus, and the general meaning given to the sentence in the 'Quæstio,' explains this enigmatical passage to the satisfaction of Dante experts.

Kodaikanal Observatory,
1911, Nov. 8.

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