

THE PLANET SATURN.

IN these days, when the telescope is in more or less common use, and so many have opportunities of observing the heavenly bodies, it is interesting to look back on the past and survey in a general manner the thoughts and ideas of those who in the earlier period of observational astronomy were not so well equipped. To take the case of the great Florentian astronomer, who practically had the whole Cosmos, so to speak, at the end of his telescope, since he was the first who surveyed the objects in the sky with something in addition to the naked eye—one can picture him sweeping with his "optik tube" or small telescope the starry heavens, and suddenly coming across the planet which we have under consideration. Here he had an object which was quite unique, and which, with his small power of magnification, must have puzzled him considerably.

In a letter to the Grand Duke of Tuscany, he refers to Saturn as appearing triple (*tergeminus*). Later, in a communication to the Austrian Ambassador (November 13, 1610), he makes the interesting statement: "When I observe Saturn with a telescope magnifying more than 30 times, the largest star appears in the middle; of the others, one lies to the west and the other to the east in a line which does not coincide with the direction of the equator, and seems to touch the central star. They appear to me as two servants, who wait upon the aged Saturn, travelling with him and not departing from his side. With a telescope of smaller magnifying power the star appears elongated and of the form of an olive."

Such, then, is the earliest telescopic observation of this planet that we have on record, and it might be interesting to pursue Galileo's inquiries a little further, and follow his state of mind when these "two servants" disappeared, as was the case in his later observations, causing him to look upon his earlier observations as phantoms or illusions.

With us to-day the case is different, and what we see in place of the "two servants" is the beautiful series of rings which girdle the planet in the region of his equator. Huyghens it was who first announced this ring system, and since then observations have shown many details of great interest, both in the ring itself and on the planet's surface.

Many are the objects of inquiry which lead observers to make a study of the appearance of this planet. The ring system and its varied shades, the belts girdling the planet's surface, the dark and light spots on the belts, the period of rotation &c., are only a few that might be mentioned.

Recent oppositions have enabled much work to be done in these lines, and the one just passed (April 11) has, we hope, still more increased our stock of knowledge. About the present time the planet and the brightest star in the constellation of the Virgin (*Spica*) make a fine pair in the sky. Both are fairly bright objects, and Saturn is known by the more golden hue with which he shines. At the present moment Saturn is retrograding, *i.e.* moving in the westward direction, and his position about the present time is to the north of *Spica*. The next stationary point in his orbit will be reached on June 21, conjunction occurring on October 23.

With reference to the general brightness which the planet and his ring system exhibit at different times, Dr. G. Müller¹ has recently made some interesting observations. The light-conditions, on account of the rings, are referred to as very complicated. If sufficient observations be considered, he has found that distinct changes in brightness are apparent, depending on the phase of the planet, while much more apparent and naturally greater variations are noticeable, depending on the change

of the plane of the ring from the line joining Saturn and the earth. When the rings are broadest, the planet in mean opposition shines a little brighter than Arcturus, and when they are invisible Aldebaran may be taken as their equal in brightness. In referring to some of the larger light changes, such as those which occur at different times with the planets Mars and Jupiter, the proportions here developed do not, we are told, tell us anything. In 1883-85, for instance, the reduced magnitude at opposition (0.85) was a little brighter than that for 1880 (0.90), 1880-83 (0.88), and 1886-88 (0.90). Other magnitudes at opposition, eight in number, have been derived by Siddel: thus in 1852 three values gave the mean opposition magnitude as 1.16 ± 0.07 , the remainder (5), made from 1857-58, gave 0.97 ± 0.02 . At a later date (1862-65) Zöllner from fourteen observations suggested a magnitude of 0.95; while Müller, in this paper, after a formula of his own, obtains 0.88 as the mean oppositional magnitude.

With regard now to the period of rotation of the planet, Herschel, in 1793, was the first who studied this question, giving its length as 10h. 16m. 0.4s., a value, accurate as he stated, "to much less than two minutes either way."

Since that time several more minute discussions have arisen, from which have resulted different values, among which may be mentioned Prof. Asaph Hall's period of 10h. 14m. 23.8s. ± 2.3 s.

The latest important results on this question are due to Mr. Stanley Williams,¹ who has taken every pains for the determination of an accurate value, and to free the results from any possibility of their being influenced by preconceived ideas. With regard to the method of observation employed, and the details of the observations themselves, we must refer the reader to the publication mentioned below, but a brief summary of the results may not be out of place.

The observations were made in 1893, and two kinds of spots were observed: (1) dark spots upon a conspicuous double belt in the northern hemisphere; and (2) bright spots in the equatorial zone.

In the case of the former, the period was obtained from numerous spots, but eleven of them have been used as giving well-ascertained values, a table of these figures showing that they can be arranged into two classes, the means of which are 10h. 14m. 29.07 and 10h. 15m. 0.74s. Between these values there is a difference of over half a minute, a quantity too large, judging from the way sets of observations agree *inter se*, to be due to errors of observation.

With the bright spots a similar result is noticed, only here the difference is not the same. Out of the five series of deduced values, four may be coupled well together giving a mean value of 10h. 12m. 59.36s. The fifth or outstanding value is 13 seconds shorter than this.

These different values for the periods of rotation point out pretty distinctly that the spots that have been observed are by no means fixed relatively to the planet's surface, but are endowed with a proper motion of their own. In the case of the dark spots, the surface material must have rotated over half a minute more quickly in the same latitude upon one side of Saturn than upon the other. Mr. Stanley Williams summarises the results of his discussion in the following words:—

"Between N. Kronometric latitudes 17° and 37° the surface material of Saturn rotated in 1893 at the rate of 10h. 14m. 29.07s. ± 0.27 s. between longitudes 45° and 140° , and at the rate of 10h. 15m. 0.74s. ± 0.56 s. between longitudes 175° and 340° , whilst between longitudes 340° and 45° there was a region in which the surface material rotated at a rate intermediate between the above values.

"Between N. Kronocentric latitude 6° and about 2° S. latitude, the surface material of Saturn rotated in 1893 at the rate of 10h. 12m. 59.36s. ± 0.27 s. between latitudes

¹ "Publikation des Astrophysikalischen Obs. zu Potsdam," 2, No. 30, Stück 4.

¹ *Monthly Notices of R.A. Society*, vol. liv. No. 5, March 1894, p. 297.

0° and 140° , whilst between longitudes 140° and 360° the rate of rotation was rather quicker, the average period of rotation here being well represented by . . . 10h. 12m. 45^s.²

The importance of such results as those stated above will help considerably to unravel the mystery surrounding the circulation of the envelope of this great planet, but, for the observations to be comparable, they must be accurate, systematically made, and extend continuously over moderately long periods. For the years 1891-93, Mr. Stanley Williams points out that the acceleration in the motion of the bright equatorial spots can be clearly deduced from the different periods of rotation.

They are for—

				h.	m.	s.
1891	...	...	...	10	14	21 [·] 8
1892	...	...	...	10	13	38 [·] 4
1893	...	...	...	10	12	59 [·] 4

For the determination of the latitudes of Saturn's belts, the Rev. W. Freeman has recently published a method¹ which should prove useful for observers wishing to measure kronocentric latitudes.

Recent work on Saturn has, however, been done in another direction, Miss Klumpke having undertaken a further investigation of the problem of the figure of a fluid ring or a solid ring covered with liquid, in equilibrium about Saturn. This has been previously treated of by Laplace, and in recent times by M. Tisserand and Mdme. Kowalewski. Miss Klumpke has carried on Mdme. Kowalewski's work, but includes terms of a higher order, showing that the main result is very little altered. The second part of her thesis deals with the hypothetical case in which Saturn's mass is taken as zero: the rings thus will be subject only to the centrifugal force of its motion and mutual attraction of its particles. A first approximation gives the cross section of the ring as a circle, the second becomes an ellipse, and the third cross section is inclined to be egg-shaped, one end being oval.

W. J. L.

NOTES.

THE New York Mathematical Society proposes to organise a general session, extending over several days, to be held annually during the summer vacation, at some appropriate place and time. This year the session is to be held in Brooklyn, on August 20, 21, 22, the days immediately preceding the session of the American Association for the Advancement of Science. The Council of the same Society has been considering with great care its present organisation. One of the recommendations made by it is that the name should be changed to the American Mathematical Society.

WE regret to have to announce the death of Mr. Adolph Leipner, Professor of Botany in University College, Bristol. Prof. Leipner occupied the office of honorary secretary of the Bristol Naturalists' Society from its inception in 1862, and was elected President of the Society last year. The loss caused by his death, not only to the Society, and the College he served, but also to all those who are interested in the natural history of the Bristol neighbourhood, is a serious one, for he was a naturalist of wide experience, ever ready to place his stores of knowledge at the disposal of his fellow students.

THE death is announced, at an advanced age, at Marseilles, of M. A. Derbès, one of the pioneers in the study of the life-history of Alge. His "Recherches sur les zoospores des Algues et les anthéridies des Cryptogames," published in 1847, in conjunction with M. Solier, was a perfect mine of new facts with regard to the reproduction of Cryptogams, and formed the

¹ *Monthly Notices*, liv. No. 1, Nov. 1893.

basis of all later observations on the same subject. For many years M. Derbès had been prevented, by the results of an accident, from the pursuits of botany, with the exception of the duties of his professorial chair.

AT the Annual Congress of German Naturalists and Physicians, which will be held at Vienna towards the end of September, there will be an exhibition of objects of interest in natural history and medicine.

THE Government of India are making systematic inquiry into the efficacy of hypodermic injections of strychnine in the treatment of snake-bite. The Punjab Government have at their request forwarded a list of cases so treated in the province during the past year.

AT the congress of the Sanitary Institute, to be held in Liverpool next September, Dr. Klein, F.R.S., will act as President of Section I.—Sanitary Science and Preventive Medicine; Dr. T. Stevenson has accepted the presidency of Section III.—Chemistry, Meteorology, and Geology.

AN earthquake was felt in several districts of South Wales on Wednesday, May 2. At Caerphilly, dwelling-houses were so shaken that light articles of furniture were upset, and crockery-ware fell to the ground. The tremor was also felt at Cardiff, a decided vibration being experienced at about half-past twelve in the day.

THE sum of five thousand rupees has been given by the Maharajah of Bhownagger towards a Pasteur Institute for India. Though the scheme has met with some opposition, the strong committees that have been formed in various parts of India in order to support it, leaves little doubt that the Institute will eventually be established.

THIS year's conversazione of the Society of Arts will take place on Friday evening, June 22, at the Imperial Institute.

THE Institution of Electrical Engineers will hold a conversazione in the galleries of the Royal Institute of Painters in Water Colours, Piccadilly, on the evening of Thursday, May 31.

THE Yorkshire Naturalists' Union will hold a meeting at Sedbergh, for the investigation of the neighbourhood of Dowbiggin, Lune Valley, and Uldale, on Whit-Monday, May 14.

ON Thursday last a public meeting was held in Prince's Hall, Piccadilly, in support of the proposal to erect a memorial to the late Sir Andrew Clark. The Duke of Cambridge took the chair as President of the London Hospital, and the audience contained a large number of persons eminent in all branches of knowledge. Mr. Gladstone testified to his late physician's high character, referring to him as a representative of all that is best and noblest in the medical profession. He concluded by moving:—"That in recognition of the great services rendered to the community by Sir Andrew Clark, Bart., M.D., a memorial be established which shall perpetuate his name and his work." This resolution was carried, and also the following, moved by Canon Wilberforce:—"That steps be taken to raise a sum sufficient for the erection of a block of buildings at the London Hospital, to bear the name of Sir Andrew Clark, which will afford increased facilities for the relief of suffering and the advancement of medical science." Mr. Jonathan Hutchinson, who was one of Sir Andrew Clark's colleagues, made some very appropriate remarks in supporting the first resolution. Medical men did not claim for the deceased physician the discoveries of a Harvey, a Jenner, or a Hunter, he said, but they nevertheless held that he was in the highest and best sense of the word a representative man, to whom it was the duty and the privilege and the interest of the whole community to do honour. Shakespeare had said "one good deed, dying