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URANUS AND ITS SATELLITES,

WITH THE HISTORY OF THEIR DISCOVERY.

THE history of Uranus, the most distant known planet of our solar system, in the various characters of *Fixed Star*, *Comet*, and *Planet*, which at different periods of time have been assigned to it, is no less remarkable than are some of the phenomena which, despite of its excessive elongation, observation has been able to detect in regard to it. Previous to that train of discoveries which eventuated in adding this to the number of known bodies of our system, through a period so long that 'the traditions of man run not to the contrary,' Saturn was supposed to mark the utmost bound of that system. This was taken as an admitted fact, from the time that planetary distances first were measured; and when the telescope had revealed the singular appendage of rings to that planet, these were supposed to yield some support to the opinion that this body had its orbit upon the confines of that region of space through which our sun could bear sway, by the power of its attraction. The wildest vagaries of nature, it was believed had been exhibited here, in arrangements altogether unknown elsewhere, for the purpose of more pointedly attracting the attention of mortals who should witness the fact, and thereby fixing the bounds beyond which they need not seek. Such, if not in words, are by apparently just inference, the views that have been more or less entertained, along with the other almost countless opinions to which credence has, in past times, been given. The indefinite distance, then, from the orbit of Saturn to the fixed stars, was regarded as a realm that, however extensive, could yield no harvest in reward for the labor which science might bestow within it, and therefore it was held unprofitable, in all respects.

The fixed stars which, so far as we know, were never supposed by any of the human family, to belong to our solar system, were objects of the most anxious attention, in the earliest period of the history of our race. They constituted the calendar of primitive man; and served not only to indicate to him the several seasons, and other necessary divisions of the year, but they were also his time-keeper by night, as the sun was by day, and pointed out to him the lapse of hours, by their apparent motions in the heavens. This early discovery of the utility of the stars, in the common purposes of life, led to the division of them into groups or constellations, each of which received a name: and in addition to this, individual stars, that by their

brilliancy or particular location were rendered peculiarly serviceable, received particular names, for their more perfect identity, or from mere caprice. This was done at a period so remote as to be now lost; yet we continue both the divisions and the names, at the present day. In the book of Job, and again in Amos, we find these divisions recognised; and many of the early poets make mention of them. Numbers of the fixed stars are now known to revolve in proper orbits around each other; but still they are termed fixed, because to the unassisted eye, they suffer no change of position with regard one to another.

It was to this class of heavenly bodies that Uranus, until the year 1781, was supposed to belong. Being visible to the naked eye, it was probably seen by millions of the human family, in the earlier ages of the world; but it was seen only as one of the countless gems that immovably deck the celestial vault.

When astronomy had so far advanced as to render accurate catalogues of the fixed stars desirable, the compilation of such was undertaken; and Uranus must of necessity have had a place in each of these which embraced stars of so low a magnitude, unless overlooked by inadvertence: in several it certainly appeared.

Observations made by Flamsteed, an English astronomer, record the position of this body in the heavens, in the year 1690; and at several other periods. Mayer, a native of Maspach, in Wurtemberg, 'one of the greatest astronomers, not only of the 18th century, but of any age or any country,' (says Delambre,) in his new catalogue of zodiacal stars, for 1756, has inserted it as star No. 964. Bradley, an Englishman, also observed and noted this body as a fixed star, in 1753. Lemonnier, a French astronomer, first observed and noted Uranus, as a fixed star, in 1765; and his manuscripts, now at the Royal Observatory of Paris, show no less than *twelve* observations, upon the same planet. In all these instances no opinion was entertained, by any one of the observers, that this particular body differed in any respect, from those by which it was surrounded; and the fact of its identity with these was first suspected by finding no star in either of the several places where stars had been designated, in the maps; and such suspicions were subsequently verified by calculations that show it to have occupied the respective positions thus assigned, at the stipulated periods of time.

As no planet was suspected to exist beyond Saturn, so none was sought for there; nor had the discovery of motion, in Uranus, the most distant connexion with any preconceived intention of such discovery: it was the result of accident alone. Herschel, (father of the present English astronomer now observing at the Cape of Good Hope,) a native of Hanover, had established himself in England, where he had been some years engaged in the construction of telescopes, through mere curiosity and a taste for astronomy. These instruments he applied to use, as he completed them, and thus became a highly creditable and able practical observer. On the night of the 13th of March, 1781, while engaged in a series of observations upon the parallax of the fixed stars, and regarding with attention several small ones, near the feet of Gemini, he was struck with the fact that one appeared larger than the rest, when seen in his telescope. As

the fixed stars are not materially magnified by these instruments, the fact of this enlarged appearance, when once detected, fixed the observer's attention. The telescope with which this discovery was made was one of seven feet in length only, and the eye-piece in use at the moment was one which magnified two hundred and twenty-seven times. Having, by subsequent observations, determined that the star in question had changed place, in relation to those by which it was surrounded, Herschel no longer concealed his discovery. Still he had no suspicion he had discovered a *planet*: he wrote to the Royal Society, of which he was a member, stating the facts, and adding that his first impression was he had detected a small comet, without either tail or envelope; and in a subsequent part of his announcement he adds: 'the sequel has shown that my surmises were well founded, this proving to be the comet we have lately observed.' This announcement was published in the succeeding volume of the Society's transactions; but in the mean time Maskelyne, the English astronomer, announced the discovery to M. Messier, and the astronomers of Paris were at once engaged in observing the supposed comet, and in calculating its orbit. Nor were they long in detecting the error that had been committed, in regard to the body in question. On the 8th of May, 1781, less than two months from the first discovery of Uranus as a moving body, *Jean-Baptiste Gaspar Bochard de Saron* ascertained that it was much more elongated from the sun than any of the other planets; and his extraordinary facility, in calculating cometary orbits, had thus early enabled him to know that the motions of this body answered not to a parabolic curve. He gave the first idea of a circular orbit, and this suggestion was carried out, and the orbit determined, by his co-laborer, Méchain, according to the method of La Place. Thus, through the combined agency of a most happy piece of unexpected good fortune, on the part of Herschel, in England, and the industry and mathematical skill of the Paris astronomers, a new planet stood revealed to the knowledge of mankind, belonging to our own solar family, and yet revolving in an orbit so immensely distant as to envelope all the others, and to give to the known limits of the solar system an augmentation of dimensions almost beyond conception.

It has often been averred — and it is necessary here to repeat the truth, because the errors in question are still found in the newest books — that Dr. Herschel discovered motion in Uranus through the agency of his noted forty feet telescope; and also that he recognised that body as a planet. For the promulgation of the former of these errors, we may refer, among others equally respectable, to a no less authority than Arnott's *Elements of Physics*; and for the latter, among others, to the *North American Review*, not to enumerate a multitude of minor publications, many of them school books, and hence in the hands of most of our youth, which have given them currency until they have well nigh passed into proverbs. Advertence to this subject was called for here, as the only means of justifying some of the above statements; and the expose is equally demanded in justice to the memory of Dr. Herschel himself, who certainly, in his publications upon these subjects, has given no authority for these creations of some unknown pen.

That research might be stimulated, the French Academy of Sciences proposed the theory of the new planet for the subject of the prize of 1790; and although but eight years had transpired, since investigations began, Delambre, produced tables of Uranus which took the prize; and which are found so accurate as to be still retained.

By these it was disclosed that Uranus revolves in an orbit whose distance from the sun is more than nineteen times as great as that of the earth; and more than twice as great as that of Saturn — the most distant planet known, before this discovery. In this orbit Uranus accomplishes its sidereal revolution in a little more than eighty-four years and twenty-nine days — moving like the other planets from west to east. Less than three quarters of a single solar year of that planet, then, has transpired since its first discovery as a member of our solar family! Its apparent diameter is about 4"; yet its real diameter is about thirty-five thousand miles, and its bulk about eighty times that of our earth. Though of such magnitude, yet at the enormous distance at which it is placed, and considering the slowness of its apparent motion, we can scarcely be surprised that its real character escaped detection so long. The inclination of its orbit to the plane of the ecliptic is less than that of any other planet, being not quite 47'. Dr. Herschel says, 'the flattening of the poles of this planet seems to be sufficiently ascertained, by many observations. The seven feet, the ten feet, and the twenty feet instrument equally confirm it;' and hence this planet, it has been inferred, has a motion upon its axis; which, reasoning from analogy, is certainly probable in the highest degree, although the fact has not yet been verified by observation. When its planetary character was detected, fifty-seven years since, this body was in the constellation Gemini: it is now near λ of Aquarius, about 8° almost due north from the star Scheat, of the same constellation.

The number of satellites belonging to Uranus is not settled; but those which are well known offer some peculiarities forming exceptions to rules that have been observed by nature in all other parts of the celestial mechanism with which we have become acquainted.

It was not until 1787 that Uranus was known to be attended by moons. On the 11th of January, of that year, Herschel believed he discovered two; and subsequent observations left no doubt of this fact. This discovery was made with his twenty feet reflector, after it had been transformed from the Newtonian form to a front view instrument. Of his great telescope, of forty feet, he says he had his first view in it on the 19th of February, 1787, but that it was not finally completed until the 28th of August, 1789. He afterwards supposed he had discovered four other satellites, and two rings, belonging to this planet; but he subsequently disproved the existence of these last, retaining only the four additional satellites. These have never been seen by any other astronomer, nor has any proof, additional to the opinion of Herschel, been obtained, that there are such bodies. The suspected rings were evidently optical illusions; and it is highly probable that they arose from the defect of figure of the speculum of the forty feet telescope. Indeed this instrument, which has been so often and so constantly the theme of eulogy and admiration, seems never to have been of very extensive

practical use. The figure of the speculum is well known to have been so defective, that the images of the celestial bodies which it produced were distorted, and although very high magnifying powers were tried upon it, yet the Rev. W. Pearson, a member of the Royal Society, does not hesitate to state, in his "Practical Astronomy," (4to. London, 1829,) that owing to this defect the magnifying powers used upon it seldom exceeded 200. The belief in its limited usefulness is still farther, and very strongly confirmed, by the fact that this telescope was taken down, some years since, and laid aside, for no other avowed reason except that the *frame work* had become decayed!

All, then, which is known with certainty respecting the attendants of Uranus, is that it has two satellites; but these present phenomena wholly unknown in any other portion of the celestial mechanism. 'Contrary to the unbroken analogy of the whole planetary system—whether of primaries or secondaries—the planes of their orbits are *nearly perpendicular to the ecliptic*, being inclined no less than $78^{\circ} 58'$ to that plane, and in these orbits their motions are *retrograde*; that is to say, their positions, when projected on the ecliptic, instead of advancing *from west to east*, round the centre of their primary, as is the case with every other planet and satellite, move in the opposite direction.'

For these peculiarities no satisfactory cause has been assigned; and they leave us no less strikingly impressed with the peculiarity of the appendages of the most distant planet now, than we were with those of Saturn, when that was supposed to move upon the utmost border of the solar system. But of the limits of that system, whatever may once have been thought, we can now form no settled opinion. The space beyond the orbit of Uranus, within which the attraction of our sun surpasses that of the sun of any other system, is shown, by the orbits of some comets, to be almost beyond our conception; nor have we any evidence that these bodies, in their 'protracted journeys of a thousand years,' do or do not reach the confines of that space. Certain it is, that space enough is there to allow of a farther augmentation of the number of our primary planets; but whether we shall ever recognise them, if such there are, cannot now be known.

The remarkable, yet wholly empirical law of Bode, touching the distances of the planetary orbits from the sun—a law which is also found applicable to the distances of satellites from their primaries—if continued beyond Uranus, would give the next planet a distance three hundred and eighty-eight times greater from the sun than the earth, and a sidereal revolution of about two hundred and forty-three years. As no fixed proportion between the size and the distances from the sun, is found to prevail among the planets, a body, so far as we know, may hereafter become known to us, even at that prodigious elongation, by reason of great size, aided by improved telescopes, and perhaps, also, by some happy fortuity, such as that which first fixed attention upon Uranus, and one or more of the telescopic planets.

Indeed we cannot aver, with any certainty, that the first observations are not already made and recorded, that are to eventuate in perfecting the discovery of one or more such bodies. Mr. Wartman,

of Geneva, observed, in September, 1831, a small star which had an appreciable motion, both in right ascension and in declination; and in May, 1835, Mr. Cacciatore, of Palermo, observed another (for their positions showed them not the same) distinguished for like motions. In the case of the latter body, calculations, based upon the imperfect observations obtained, render it probable that its orbit, if this be a planet, is at near the same distance from the sun as that of Vesta; but of the star observed by Mr. Wartman, no such approximate determination was obtained. Neither of these bodies, we believe, has ever been seen since the year in which it was discovered; and what they are, or where arranged, in the celestial economy, if ever made known to us, is still to be disclosed by the future.

R. W. H.

Buffalo, June, 1838.

THOUGHTS ON EARLY SPRING.

By the deep forest's yet unawaken'd green,
 To tread on wither'd leaves, and herbage new,
 And trace the first young buddings' tender sheen;
 The downy liverwort's sweet eye of blue,
 And pale anemone, on amber stem,
 Faint — blushing delicate — the woods first gem.

Where the fresh fountain bubbles into light,
 Amidst the ferns that fringe her mossy brink,
 Inlaid with scarlet berry, gleaming bright,
 Invites the wanderer to stoop and drink:
 O! give me one sweet day amidst the woods,
 The vernal, stirring breeze, and rous'd-up floods!

The fitful spirit of the wilderness
 Raiseth the heart, and the adoring eye,
 To HIM who doth with early beauty, bless
 The slender service-tree that waves so high,
 Her snow-white wreathes amidst the unclad wild;
 And owns the sparrow for His mercy's child.

I love all blossoms of the early spring;
 All living things the winter-storm hath left:
 The red-cup moss, the myrtle — fragrant thing!
 Each tinge of life within the rock's dark cleft:
 And when the blue-bird warbles sweet and clear,
 To rest in some charm'd spot, the hymn to hear.

Where the sweet water-fall is chiming low,
 Amidst the shrub-roots, and the old gray stone;
 Catching the sunbeams in her sparkling flow,
 And shadows of the forest branches, lone,
 Yet leafless, rustling tuneful over head,
 With thwarted twigs beneath the blue sky spread.

There flow to HIM my soul! my joyful soul,
 Upward with the elastic air, and scent
 Of early buds; and gentle sounds that roll
 Amidst the boughs; and song of waters, blent
 With hum of new-waked insect, on the wing,
 And all the breathing harmonies of spring.

HE who hath form'd us for devotion, He
 Hath worn our nature; and hath lov'd to pray
 Where the wild woods, his temple's canopy,
 Gave a religious color to the day;
 Here let us gather strength, e'er we depart
 Where the world calls. God keeps the pure in heart.

w.