OBITUARY NOTICES.

John Couch Adams. By Professor Copeland.

(Read March 6, 1893.)

At Lidcot farm, in the rural parish of Laneast, some seven miles to the west of Launceston, in Cornwall, on June 5th, 1819, was born John Couch Adams, whose name will ever be inseparably associated with the discovery of Neptune. Educated at Devonport, he entered St John's College, Cambridge, in October 1839. He graduated as Senior Wrangler and first Smith's Prizeman early in 1843, and shortly afterwards was elected a Fellow of his college, and became one of its mathematical tutors. As a student, he had read in Airy's *Report on the Progress of Astronomy during the Present Century* about certain unexplained perturbations of Uranus, as shown by Bouvard's tables of that planet, and at once perceived that they probably arose from the action of an unknown member of the solar system. Seeing, however, that no merely superficial research could throw light on the subject, he, for the time, contented himself with jotting down on Saturday, July 3rd, 1841, the following memorandum :—"Formed a design, in the beginning of this week, of investigating, as soon as possible after taking my degree, the irregularities in the motion of Uranus which are yet unaccounted for; in order to find whether they may be attributed to the action of an undiscovered planet beyond it, and, if possible, thence to determine approximately the elements of its orbit, &c., which would probably lead to its discovery."

The investigation must indeed have been taken up immediately after his graduation, for already, in 1843, by combining the modern observations with the residuals of Bouvard's equations, on the assumption of a circular orbit for the unknown planet, a first solution was

obtained which showed that an agreement between observation and theory might be brought about. Further, earlier data still wanting were supplied by the Astronomer-Royal, who, in February 1844, sent to Adams all the Greenwich observations of Uranus.

In other quarters the irregular motion of Uranus had attracted attention. Our countryman, Dr Hussey, had proposed an extended search for an outer planet, combined with a partial survey of the heavens. The illustrious Bessel had devoted considerable time to an attempted explanation, at first on the hypothesis of an elective attraction on the part of Saturn. Failing health compelled him to hand the work over to one of his assistants, whose health in turn also gave way before anything was accomplished beyond a reduction of the older observations. The Royal Academy of Sciences of Göttingen, however, proposed the Theory of Uranus as their mathematical prize; and although Adams tells us that his college duties prevented him from attempting the complete examination of the theory, which a competition for the prize would have required, yet this fact, together with the possession of such a valuable series of observations, induced him to undertake a new solution of the problem. With indomitable perseverance the subject was now attacked by the sure method of successive approximations. Not one solution, but several solutions were obtained, differing little from each other. Gradually more and more terms of the perturbational series were taken into account, until at last, in September 1845, he was able to communicate to Professor Challis the definite values he had obtained for the mass, the heliocentric longitude, and the elements of the orbit of the assumed planet. Slightly corrected results were communicated to the Astronomer-Royal a month later. But Adams did not rest content. The excentricity being larger than was probable, the whole investigation was again repeated, using a less mean distance. The final result was communicated to Mr Airy in the beginning of September 1846.

Meanwhile, on November 10th, 1845, the brilliant young French astronomer, Le Verrier, had presented to the French Academy a most thorough investigation of the orbit of Uranus as perturbed by Saturn and Jupiter, taking into account several minute perturbations neglected by Bouvard. This he followed up by a second memoir presented on the 1st of June 1846 (or nine months later than

Adams's decisive communications to Challis and Airy), in which the outstanding perturbations of Uranus were explained by the action of a planet whose position agreed very closely with that indicated by Adams. This close agreement by two investigators, each working in ignorance of what was being done by the other, at once set Professor Challis to work on a search for the planet, but the want of a proper star-map necessitated the survey of a relatively considerable area of the heavens. In the course of this survey the planet was actually seen on August 4th and 12th, 1846, but failing a comparison of the observations, it was not then recognised as the object so eagerly sought for. That no search was made at Greenwich is explained by the simple fact that they had no telescope at all suited to the work.

On the last day of this month of August 1846, Le Verrier submitted to the Academy in Paris a third memoir, in which the mass of the unknown planet was worked out, together with new elements and limiting values for its heliocentric place. Eighteen days afterwards, Le Verrier wrote to Dr Galle, then Encke's assistant at Berlin, asking him to look for the planet in the assigned place, and holding out a hope that it might even be recognised by its disc. The planet was found the very day, September 23rd, on which Le Verrier's letter reached Berlin. Everything favoured the search—Galle was an accomplished observer, the instrument was one of Fraunhofer's masterpieces, and Galle cordially accepted the aid of the young astronomer D'Arrest, then a student at the Berlin Observatory. D'Arrest contributed notably to the immediate finding of the planet, by suggesting the use of Bremiker's section (Hora xxi.) of the Equatorial Star-maps, then in course of publication by the Berlin Academy. This very sheet had just been struck off, but had not yet been distributed, although a copy was lying at the Berlin Observatory. Galle estimated the planet's diameter at about 3″, but in his letter to Le Verrier says it was not much to trust to, except under very favourable atmospheric conditions, and adds, "c'est principalement la carte qui a facilité la recherche." The place of the stranger was accurately determined by midnight, and again on the following evening, when it was found to have moved about 64 seconds of arc in the interim. From Dr Galle's letter it is also interesting to find that Bremiker's map was not the only new publication pressed into

the service, as the final determining star was taken from the British Association Catalogue, which had just been placed in the hands of astronomers.

On October 1st, Professor Challis heard of the successful search at Berlin, and on turning to his notes, not only readily identified the new planet amongst the numerous stars which he had recorded nearly two months before, but also found that it had again been seen on September 29th, when, aided by a hint from Le Verrier's last paper, the observer singled out the planet from 300 stars, and appended to it the note "it seems to have a disk." The next night was cloudy at Cambridge, and, as has just been said, the news of the discovery came the following day.

It is not too much to say that the whole world rang with these tidings, but for a moment it seemed as if a painful international rivalry might arise as to the relative merits of the two great mathematicians to whom science owed one of her grandest triumphs. Better counsels, however, prevailed; and with an impartiality that will ever be regarded with satisfaction, the Testimonial of the Royal Astronomical Society was awarded to Le Verrier as well as to Adams in 1848. The Institute of France made Adams one of its corresponding members, as did also the Academy of Sciences of St Petersburg and many other societies. From Oxford he received the honorary degree of D.C.L., and that of LL.D. from Dublin and Edinburgh. He was elected an Honorary Fellow of this Society in 1849.

In 1851, Adams became President of the Royal Astronomical Society, to which position he was again elected in 1874. In 1858, he was appointed Professor of Mathematics in the University of St Andrews, but he returned to Cambridge in the following year, to take up the Lowndean Professorship of Astronomy and Geometry, which he held until his death. Three years later, he became Director of the University Observatory. Apart from many observations of planets, comets, &c., the zone + 25° to + 30° of stars down to the ninth magnitude was observed under his superintendence with the Cambridge transit-circle as a component part of the great international work set on foot by the Astronomische Gesellschaft. The actual observations are all finished and the reductions far advanced.

The Gold Medal of the Royal Astronomical Society was awarded to Professor Adams in 1866 for his researches on the moon's parallax and acceleration. After the great display of the Leonid meteors in the same year, Adams undertook the difficult task of determining their period. The researches of Professor H. A. Newton, of Yale College, had already shown that they must move in one of five definite orbits, but the difficulty was to decide which of them they followed. Here, again, Adams invoked the perturbations to solve the problem, and as the result of a most profound investigation, showed beyond all doubt that the periodic time of the meteors is $33\frac{1}{4}$ years. This orbit, it is scarcely necessary to add, closely resembles that of Comet 1866, I., as was first pointed out by Professor C. F. W. Peters.

Professor Adams communicated 43 papers to scientific societies, according to the Royal Society's Catalogue. To the Nautical Almanac he contributed valuable tables of the moon's parallax, and a Continuation of Damoiseau's Tables of Jupiter's Satellites. His classical *Explanation of the Observed Irregularities in the Motion of Uranus* appeared in the Appendix to the Nautical Almanac for the year 1851.

Professor Adams died at Cambridge Observatory on January 21st, 1892, after having been more or less an invalid for fully two years. Those who knew him most intimately cannot sufficiently express the profound impression made on them by his great gentleness and unassuming manner.