He was elected a Fellow of the Society 1864 April 8.

[The Council are indebted for the above notice to Mr. G. F. Dodwell, Government Astronomer, South Australia.]

FREDERICK WILLIAM WATKIN, youngest son of the late Reverend John Woodlands Watkin, D.D., vicar of Stixwold, Lincolnshire, was born there, 1859 March 20. He was educated at Manchester Grammar School and Corpus Christi College, Oxford, where he won the junior mathematical scholarship. In 1883 he was appointed a master at St. Paul's School, and took charge of the recently created Science Side, which, during his twenty-six years of service to the school, grew to rival the Classical Side in numbers and success. For many years he was a house-master, and shortly before his death he was appointed Surmaster of the school.

Mr. Watkin married in 1898 Mary Elizabeth Simpson, eldest daughter of the late Robert Henry Simpson. He died 1910 April 6, leaving a widow and four children.

He was elected a Fellow 1884 February 8.

With the death of JOHANN GOTTFRIED GALLE the curtain finally descends upon the great drama of the discovery of Neptune, the opening scenes of which thrilled the whole world two-thirds of a century ago. The end is calm after storm. The exit of the last actor stirs no memories of conflict save by association, for Galle took no part in the scenes where the battle raged. His own honourable share in the discovery was never seriously questioned; he made no claims likely to be disputed, but, on the other hand, excited admiration by the modesty with which he ceded all glory to Le Verrier. In a long and tranquil life devoted to astronomical work he won ample recognition for himself independently of his share in the great discovery; and now, twenty years after all the other actors have left the stage, Galle, full of years and honours, makes his farewell to a generation which first heard his name and fame from their grandfathers.

Galle was elected one of our Associates on 1848 May 12, several years before the oldest existing Fellow was elected, and for some time past he has therefore been the "Father of the Society." The interval of eighteen months between his observation of Neptune (1846 September 23) and his election as Associate would probably have been even shorter but for the circumstance that the election of Associates was formerly left to individual initiative, which apparently did not "secure a proper attention to the names of rising astronomers" (*Mon. Not.*, viii. p. 79). The Council accordingly took the matter into their own hands in February 1848, and the result was the election of twenty-one associates in a body on May 12. The second name in the list is that of Dr. C. Bremiker, whose map of Hora xxi. was used by Galle in finding Neptune. Three of the twenty-one, Faye, Galle, and O. Struve, survived their election by more than half a century, the death of Faye in 1902 closing the long partnership.

Johann Gottfried Galle was born, 1812 June 9, at Pabsthaus, near Wittenberg, the eldest of seven children. He got early instruction from a neighbouring pastor, and then went to the Wittenberg Gymnasium till 1830, when he entered the Berlin University, graduated after three years, and was in 1833–5 mathematical master in the gymnasiums at Guben and Berlin.

In 1835 he was appointed Encke's single assistant at the new Berlin Observatory, and devoted sixteen years to work with the refractor of 9 Paris-inches aperture. In 1838 he discovered the crêpe ring of Saturn, and Encke mentioned the discovery twice to the Berlin Academy, without, however, laying much stress on it, as he was more interested in "Encke's division" between the rings. Galle did not trouble about wider publication, and when Dawes and Bond noticed the crêpe ring in 1850 they made practically a new discovery. Galle thereupon (in 1851) called attention to his earlier observations (*Ast. Nach.*, No. 756) and elicited a reply from Dawes (*Mon. Not.*, xi. p. 185) in which ungrudging credit is accorded to Galle, combined with a very reasonable expression of regret that more stress had not been laid on the observations. It appears that Galle made six days' micrometric measurements which established the main facts, but which Encke did not consider worth communicating to the Berlin Academy in his paper on Saturn; and Dawes writes:—

"It is to be regretted that Dr. Galle's observations and measures were not published in the *Astronomische Nachrichten* soon after they were made, as they would long since have directed attention to this remarkable phenomenon."

It is all too easy to point out faults of omission after the event, but it is almost impossible to study the surroundings of the discovery of Neptune without turning a strong light on such details. We shall presently see that this was not the only occasion on which Encke was apathetic at an important moment; his attitude might have had the result of discouraging Galle's search for the new planet. There might have been, at any rate, a few weeks' delay, in which, conceivably, Challis might have realised that he had already found the planet. What a difference that would have made in history! Airy and Encke would have changed places, and Encke would indeed have been in much worse plight than Airy was if it could have been said that he had discouraged acting on the letter given below. Encke owed much to Galle and d'Arrest.

In the winter 1839–40 Galle discovered three comets in rapid succession (on 1839 December 2, 1840 January 25, and 1840 March 6), which attracted the more attention that no new comet had been found for five years previously. The King of Denmark honoured the triple discovery with three Comet medals (*Ast. Nach.*, 400). A diary of Galle's tells us that the first of these discoveries was quite accidental. He was experimenting, on the Fraunhofer lines, with a glass prism attached to a theodolite in the observatory, and had got up at 3 a.m. to look at the spectrum of Venus.

Glancing over the heavens he saw a nebulous star near γ Virginis which he did not remember to have seen before, and turning the telescope on it found that it was a comet.

Comets occupied a large share of Galle's working life, for he contributed to Encke's 2nd edition of Olber's *Abhandlungen über die Bahn eines Cometen* a list of the elements of 178 comets; he himself prepared a 3rd edition of the whole work in 1864; and in 1894, at the age of eighty-two, he prepared (with the aid of his son, Dr. Andreas Galle) a comprehensive list of the elements of the orbits of 414 comets.

In 1851 he was appointed Director of the Breslau Observatory in succession to Boguslawski, and this position he held till his retirement in 1897. Perhaps the most noteworthy incident of this long career of devoted astronomical work was the suggestion in 1872 of the present accredited method of determining the solar parallax by the observation of a minor planet. He put his suggestion into successful practice in 1873 by the observation of Flora, obtaining the excellent pioneer result $8''{\cdot}82 \pm 0''{\cdot}06$.

But it is inevitable that he should be chiefly remembered in connection with Neptune, and little excuse is needed for recalling once more all the circumstances relating to that eventful night when he verified Le Verrier's prediction in the sky. A year before he had sent Le Verrier his new reduction of Roemer's observations. A great fire destroyed the bulk of these observations in 1728, and only a fragment, giving the observations for the three days (Triduum observationum astronomicarum) October 20–23, 1706, were rescued. They had been used by Tobias Mayer for proper motions, but for various reasons a new and more careful reduction of this precious fragment seemed desirable, and Galle undertook it as his dissertation for a Doctor's degree. He took immense pains with the work, and was so much impressed with its value that he thought it might help Le Verrier in the researches on the orbits of the planets on which he was known to be engaged. Before considering Le Verrier's reception of the memoir, we may glance for a moment or two at the memoir itself, which is now scarce (there is, for instance, no copy in our R.A.S. Library). It is written in Latin, with such simple directness that there is no difficulty in following it, even for the unskilled. He explains how Roemer had used Tycho's instruments, but preferred to observe R.A.'s directly, using three clocks for the purpose, one in the instrument-room being compared constantly with two others kept in closed cases. He relates also how Roemer had first observed from a tower, but found the wind troublesome, and so came down into his house in 1690. "Ob altitudinem vero turris rotundæ venti et tempestas observationibus sæpius obnoxia erant, et Roemerus a MDCXC in domus suæ fenestra meridionali machinam transitibus per meridianum inservientem construxit." After a careful reduction, Galle gives on pp. 33–34 a catalogue of the positions of 88 stars, and compares them with the observations of Bradley and Piazzi; and then three observations of the Sun, the Moon,

Mercury, Venus, Mars, Jupiter, and Saturn; and he calculates the obliquity of the ecliptic from a few observations of the Sun not belonging to the three days, but preserved by Horrebow.

Le Verrier did not acknowledge the receipt of the memoir for a year. (Correspondence was apparently leisurely in those days, and this fact is worth remembering in connection with other incidents of the drama.) He then wrote the following letter, which was first printed in *Himmel und Erde* by Professor Scheiner of Potsdam, by permission of Professor Galle:—

À Monsieur J. G. Galle,
Astronome à l'Observatoire Royal de Berlin à Berlin.

Paris, le 18 Septembre 1846.

Monsieur,—J'ai lu avec beaucoup d'interêt et d'attention la reduction des observations de Roemer, dont vous avez bien voulu m'envoyer un exemplaire. La parfaite lucidité de vos explications, la complète rigueur des résultats que vous nous donnez, sont au niveau de ce que nous devions attendre d'un aussi habile astronome. Plus tard, Monsieur, je vous demanderai la permission de revenir sur plusieurs points qui m'ont interessé, et en particulier sur les observations de Mercure qui y sont renfermées. Aujourd'hui je voudrais obtenir de l'infatigable observateur qu'il voulait bien consacrer quelques instants à l'examen d'une region du ciel, où il peut rester une Planète à découvrir. C'est la theorie d'Uranus qui m'a conduit à ce résultat. Il va paraître un extrait de mes recherches dans les *Astronomische Nachrichten.* J'aurai donc pu, Monsieur, me dispenser de vous en écrire, si je n'avais eu à remplir le devoir de vous remercier pour l'intéressant ouvrage que vous m'avez adressé.

Vous verrez, Monsieur, que je démontre qu'on ne peut satisfaire aux observations d'Uranus qu'en introduisant l'action d'une nouvelle Planète, jusqu'ici inconnue; et ce qui est remarquable, il n'y a dans l'écliptique qu'une seule position qui puisse être attribuée à cette Planète perturbatrice. Voici les elements de l'orbite que j'assigne à cet astre:

Demi-grand axe de l'orbite	36·154
Durée de la revolution sidérale	217·387 ans
Excentricité	0·10761
Longitude du Perihelie	284°45′
Longitude moyenne 1er Janvier, 1847,	318°47′
Masse	1/9300
Longitude Heliocentrique vraie au 1er Jan. 1847	326°32′
Distance au Soleil	33·06

La position actuelle de cet astre montre que nous sommes actuellement, et que nous serons encore, pendant plusieurs mois, dans des conditions favorables pour le découvrir.

D'ailleurs, la grandeur de sa masse permet de conclure que la grandeur de son diamètre apparent est de plus de 3″ sexagesimales. Ce diamètre est tout-à-fait de nature à être distingué, dans les bonnes lunettes, du diamètre factice que diverses aberrations donnent aux étoiles.

Recevez, Monsieur, l'assurance de la haute consideration de votre dévoué serviteur, U. J. Le Verrier.

Veuillez faire agréer à Mr. Encke, bien que je n'aye pas l'honneur d'être connu de lui, l'hommage de mon profond respect.

When he received this letter on September 23, Galle consulted his chief. Encke was not enthusiastic, was even dubious; and Galle must be given full credit for persisting, in spite of the lukewarm attitude of his superior officer. A young student who had been allowed to take up his quarters in what was intended for an anteroom at the observatory, counted for far more in the way of encouragement; he begged permission to be present; he apparently waited patiently until Galle had made his first scrutiny hoping to detect the planet by its disc, and when nothing came of this he suggested hunting for a star map. Galle took the suggestion, and led his companion to a cupboard which he knew contained all available star maps. The visit was not made with any great alacrity, for Galle had been observing in the region some time before, and had realised the deficiencies of Harding's map.

But the visit was made, and by a fortunate chance a new map was found, Bremiker's Hora xxi., printed but not yet distributed. There had been a delay in the distribution, and here again speculations have been formulated as to the changed course of events if that distribution had not been delayed. Challis might have had the map, and then——? But we must stick to the facts. Galle and d'Arrest found the map and carried it to the telescope: d'Arrest put it on a desk and verified the stars which Galle called out at the telescope. Presently there came an object which was not on the map. Encke (who was celebrating his fifty-fifth birthday in the family circle) was told the news and took part in the further observations. The object was followed as long as possible, but neither from the disc nor from the motion was it certain that a planet had been found. The mean time of observation for the night of September 23, given in *Mon. Not.*, viii. page 155, is midnight, and the planet set about 2·30 a.m. Its motion was 3″ per hour. The observers must wait with patience till the next night. Fortunately the weather was excellent (as is clear from the fact that observations of the planet were secured on September 23, 24, 25, 26, 27, 28, 29, *loc. cit.*), and the motion was soon verified. On September 25 Galle wrote to Le Verrier, "La planète dont vous avez signalé la position existe réellement," and Le Verrier communicated the intelligence to

the Academie des Sciences on October 5. He replied to Galle as follows:—

Paris, 1846 Octobre 1.

Monsieur,—Je vous remercie cordialement de l'empressement que vous avez mis à m'instruire de votre observation du 23 et du 24 Septembre. Grace à vous, nous voilà definitivement en possession du nouveau monde. Le plaisir que j'ai éprouvé de voir que vous l'avez rencontré, à moins d'un dégré de la position que j'avais donnée, est un peu troublé par l'idée qu'en vous écrivant plus tôt, il y a quatre mois, nous aurions obtenu dès lors le resultat que nous venons d'atteindre. Je communiquerai votre lettre, lundi prochain, à l'Academie des Sciences. Permettez-moi d'espérer que nous continuerons fréquemment une correspondance qui commence sous d'aussi heureux auspices.

Je suis sous une haute consideration, votre dévoué serviteur,—

U. J. Le Verrier.

Le Bureau des Longitudes s'est prononcé ici pour *Neptune*. Le signe un *trident*. Le nom de Janus indiquerait que cette planète est la dernière du système Solaire, ce qu'il n'y a aucune raison de croire.

And so the name and sign of the planet were fixed within a week of discovery! Galle had suggested the name Janus, because he had some little time previously learnt in a lecture that Janus was a predecessor of Saturn. Le Verrier's comment in the postscript, objecting to limit the solar system, is full of interest.

Galle, as already remarked, claimed no share in the discovery, which he assigned entirely to Le Verrier. He nevertheless received from Paris the cross of the Legion d'Honneur, and, for the second time, the Prix de Lalande.

The following letter from Airy to Galle has no direct bearing on the events just related, but is of interest as illustrating Galle's relations with another important actor in the drama. Dr. Andreas Galle informs me that, so far as he knows, his father received no letters from Adams or Challis:—

Royal Observatory, Greenwich, 1847 October 14.

Dear Sir,—I should, on my return to Greenwich, have written to you as early as possible, to acknowledge the kindness with which you devoted so much time to me at Berlin. But I found much business waiting for me when I returned, and I was very soon occupied with arrangements for the observation of the solar eclipse. As it was doubtful whether the eclipse would be annular at Greenwich, I selected four stations to the north of Greenwich and three to the south, and equipped all with observers and instruments. Unfortunately the weather was so bad that only at one station was the eclipse seen at all, and then only for a few minutes.

I have lately written to Lt.-Colonel Bayer respecting the Prussian Survey and its connection with those of the neighbouring kingdoms. If you should see him, you may possibly be able to add something to my explanation of the nature of my wants.

I left Berlin by the early train on the morning after I last saw you, and saw Mr. Schumacher in the evening and on the next day. He appeared to be extremely well, but was then much oppressed with letters. There were then some comets on his hands. I have nearly given up the observation of comets here: the usual business and the addition caused by the use of my altitude and azimuth instrument, occupy all the time of my assistants.

* * * * * * *

I hope to see you in England.—I am, dear Sir, yours very truly, G. B. AIRY.

Galle married a daughter of Professor Regenbrecht, of Breslau, and had two sons, who survive him, Professor Dr. Andreas Galle, of the Geodetic Institute at Potsdam, and Dr. Georg Galle, a physician in Hirschberg: they are both married, and there are nine grandchildren. Galle's early working years were clouded by much domestic sorrow. His mother died in 1839, and a second wife whom his father married followed in 1848. A brother died in 1844, a sister in 1847, another brother in 1852, his father in 1853. All six of his brothers and sisters were gone by 1866, leaving the eldest to survive them by forty-four years.

In 1830 Galle made a journey on foot from Berlin to the Rhine and Switzerland; he saw the first steamer on the Rhine, and on his return to work used a steel pen for the first time. He knew Bessel and Alexander von Humboldt, and often helped the latter with various small calculations required in the writing of the *Kosmos*. As a student in Berlin he attended the lectures of Hegel (Philosophy); Ohm, Dirksen, Plücker, Dirichlet (Mathematics); Encke, Ideler (Astronomy); Erman, Seebeck, Dove (Physics); Ritter (Geography); Weiss (Mineralogy); Schultz (Botany); Wichmann (Zoology); Mitscherlick (Chemistry).

His ninetieth birthday on June 9, 1902, was honoured by deputations from the Astronomische Gesellschaft, the Astrophysical Institute of Potsdam, the Berlin and Breslau Observatories, and several other bodies. He answered all the letters of congratulation himself on this and other occasions up to his ninety-eighth birthday last year, when his son took over the correspondence. Many honours were conferred upon him independently of those at his jubilee.

He died on July 10, 1910, in his ninety-ninth year.

(To Dr. Andreas Galle the writer is indebted for much kind help and information, both direct and through the help formerly given to Mr. F. A. Bellamy, for his comprehensive biography in *Knowledge* for August and September 1910. The help given by Mr. Bellamy is also gratefully acknowledged.) H. H. T.

GIOVANNI VIRGINIO SCHIAPARELLI was born at Seviglano in Piedmont on the 14th of March 1835. His parents originally came from Biella, in the Novara province, and were probably of well-to-do circumstances, as they were able to enter their son in his seventh year at the Gymnasium Lycée of Seviglano, where he remained for nine years until July 1850. In the following November he was admitted to the mathematical course at the University of Turin, where he studied under Plana, Billotti, and other mathematicians. Here he gained a high reputation with his professors, and rapidly outdistanced his fellow-students in the study of pure and applied mathematics and in drawing, so that in August 1854 he graduated with honours as a hydraulic engineer and civil architect. On leaving the University he devoted himself to private teaching of mathematics at Turin, which gave him some means of livelihood, and enabled him to take up at the same time the study of modern languages and of astronomy.

In his early life Schiaparelli had shown evidence of a strong versatile and precocious genius. This attracted the notice of Paolo Dovo, a theologian of Seviglano, of whom Schiaparelli wrote that "he was a man of gold, a great lover of astronomy, and one whose image could never be erased from the memory of those who had known him." There can be no doubt that it was the influence and teaching of Dovo that laid the first seeds of that unceasing devotion to astronomy which he displayed throughout his life.

In November 1856 he held for a short time the post of teacher in elementary mathematics in the Gymnasium of Porta Nuova at Turin, but his love of astronomy, and the field for research that it offered, made him reluctant to continue in a position that was distasteful; he accordingly made great efforts to obtain assistance to enable him to pursue his astronomical studies abroad, which, happily, by the influence of his friends, was accomplished by the Sardinian Government making a grant of money for that purpose.

In February 1857 Schiaparelli went to Berlin, where for two and a half years he pursued his studies under Encke. His versatile mind was not satisfied by astronomy alone, and during this period he studied philosophy under Michelet, geography under Ritter and Kiepert, meteorology under Dove, physics under Poggendorf, and terrestrial magnetism under Erman. In considering the life of one who contributed so much to astronomical science, it is interesting to note the comprehensiveness of his studies and his tastes, which were developed not only in the mysteries of nature, but also in intricate historical questions, and in the realms of literature and art.

Anxious to learn practical astronomy, Schiaparelli, in June 1859, obtained admission to the observatory of Pulkovo, where, under Struve and Winnecke, he remained for twelve months in what was perhaps the best school of instruction in observation and calculation. In July 1860 he received the appointment of second Astronomer to the Brera Observatory at Milan under Carlini. At first he was not received with much encouragement, but his