WARREN DE LA RUE was born at Guernsey on January 18, 1815, and was the son of Mr. Thomas De la Rue, the founder of the eminent firm of manufacturing stationers in London. He was educated at the College Saint-Barbe in Paris, where he remained until he returned to London to enter his father's business.

But little, unfortunately, is known of the early career of one who in after life occupied so distinguished a position in the scientific world.

From an early age mechanics and machinery had a strong attraction for him, and possessing a shrewd inventive faculty, he devoted himself so successfully to technical work that he became a good engineer without having received any special training. His mechanical skill was evidently of a high order, and found its appreciation among those with whom he was associated, for at the early age of 23 he was entrusted with the erection of some large white lead works, the drawings for which he made entirely himself. Mr. De la Rue's ability and intelligence at this time are well displayed in the fact that his drawings were found to be so carefully prepared as to need no alteration, and the works were erected upon his designs with entire satisfaction.

Some year or two before this period he had begun to devote himself in his leisure to electrical researches, in which he afterwards attained so eminent a position. The first scientific paper he appears to have published was one dated September 15, 1836, when he was living in Bunhill Row, and which is printed in the *Philosophical Magazine* for December of that year, "On Voltaic Electricity, and on the Effects of a Battery charged with Sulphate of Copper." In this paper he gives an account of experiments made with a battery in which he used a saturated solution of sulphate of copper as the exciting agent. This principle had independently been employed by Daniel in his researches in voltaic electricity, but was relinquished by him as it failed to give a constant combination.

From this time until 1848 Mr. De la Rue appears to have devoted his scientific thoughts mainly to chemical and physical researches, for in this period we find papers by him "On the Agency of Caloric," "On the Structure of Electro-precipitated Metals," "On a Crystallised Alloy of Zinc, Iron, Lead and Copper," and "On Cochineal."

The earliest mention in the *Monthly Notices* of his attention being directed to astronomy appears in the number for December 1850, when a very beautiful drawing of *Saturn*, made by him with his 13-inch reflector, is announced to be exhibited the following month. This drawing fully confirmed Mr. Bond's discovery of the crape ring made on the 15th of the previous month. The same number of the *Monthly Notices* contains a brief note by Mr. De la Rue on his method of drawing double stars and nebulæ, which indicates that for some time previous to

this period he was in the habit of making observations of these objects with his large reflector.

This is the first reference to a telescope which afterwards became celebrated, and its history has, therefore, considerable interest. It was an equatorially mounted reflector of 13 inches aperture and 10 feet focal length, made in his own workshop, the optical portion being entirely his own handiwork.

From the following interesting reminiscence of him by Mr. James Nasmyth, we learn not only the origin of this historic telescope, but we ascertain also that Mr. De la Rue's thoughts were inclined to astronomy as early as the year 1840:

"I well remember the visit I received from my dear friend Warren De la Rue in the year 1840. I was executing some work for him with respect to a new process which he had contrived for the production of white lead. I was then busy with the casting of my 13-inch speculum. He watched my proceedings with earnest interest and most careful attention. He told me many years after that it was the sight of my special process of casting a sound speculum that in a manner caused him to turn his thoughts to practical astronomy, a subject in which he has exhibited such noble devotion as well as masterly skill. Soon after his visit I had the honour of casting for him a 13-inch speculum, which he afterwards ground and polished by a method of his own."

He was well acquainted with the labours of both Mr. Lassell and Mr. Nasmyth in the construction of telescopes, as is shown by the ready acknowledgment he made to the former "for his communication from time to time of his methods of manipulation," and to the latter "for many most valuable hints in polishing and grinding, more particularly for imparting to him a plan of producing a beautiful uniform surface to specula previous to the final pitch polishing." Indeed, it was Mr. Nasmyth who planted the germ that developed into the love for astronomy which characterised Mr. De la Rue throughout his life. The admission of this fact is contained in a letter to him from Cranford in 1864, in which he says, "No one has so great a claim on the fruit of my labours; for you inoculated me with the love of star-gazing, and gave me invaluable aid and advice in figuring specula." This impulse wrought upon Mr. De la Rue's rare mechanical genius, so that he was able to effect improvements in the most approved methods of polishing the specula of reflecting telescopes, and perfecting the mechanical arrangements by which operations of such refined nicety are performed.

The mechanical means he adopted for figuring specula are fully described in his paper in the *Monthly Notices* for December 1852, upon which Sir John Herschel has thus commented: "Mr. De la Rue's machinery, though grounded on Mr. Lassell's rotatory principle, is by no means a servile imitation of Mr. Lassell, inasmuch as several distinct improvements have been introduced

tending to distribute the polishing action more equally over the whole surface of the metal. One of these improvements consists in his interposition of a plate between the supporting plate and sliding plate of Mr. Lassell's traversing slide, which being made to revolve, causes the traversing movement of the speculum to take place, not across the same diameter of its area, but at every stroke across a different diameter; and he also obviates the irregularity of the motion of Mr. Lassell's polisher on its centre, by governing that rotation by mechanism instead of leaving it to be determined by the excess of external over internal friction." . . . "Such is Mr. De la Rue's mechanism, which has afforded very admirable results in the production of specula of 13 inches in diameter and 10 feet focal length, the perfection of which is enhanced by his practice of bestowing the same care and precision on every step of the figuring of the speculum, from the grinding, the smoothing on a bed of hones, or rather a slab of slate cut into squares,* carefully brought to the same figure, and to the figuring of the polisher itself, which being thus previously rendered almost perfect, the speculum is saved the rough work of having to figure the polisher for itself on every occasion of repolishing."

It was the possession of this telescope of surpassing excellence, that subsequently enabled Mr. De la Rue to produce results in celestial photography and planetary delineation of such high and enduring value.

In 1851 and 1852 he demonstrated "his rare skill as a draughtsman as well as an observer" by the drawings of *Mars* and *Saturn* which he presented to this Society. He continued such observations for some years until he had achieved those unexampled representations of the planets, with which all are familiar, and which stand as models for imitation.

In 1851 Mr. De la Rue's attention was vividly attracted to a Daguerreotype of the Moon which was exhibited at the Great Exhibition of that year. This had been taken by William Cranch Bond in the focus of the great 15-inch refractor of the Observatory of Harvard College. Some Daguerreotypes of the Moon, taken by Messrs Whipple and Jones of Boston with the same instrument, were also exhibited at the meeting of this Society on May 9, 1851.

It was the sight of these very promising photographs which first gave the impulse to Mr. De la Rue's labours in this direction, and to the new field of research thus revealed, he at once devoted himself with an intelligent skill that soon made him the foremost pioneer of celestial photography in this country.

From the epoch of the first researches in photography by

* Mr. De la Rue's alteration of the plan adopted by Mr. Nasmyth consisted in substituting a slab of common slate for a grinder made up of squares of German blue stone (hone); the former having the advantage of always retaining its figure, which the hone-tool does not, when laid on one side for any length of time.

Daguerre in 1839 to the present day, the great progress of photographic science is mainly due to the successive introduction of two important methods—the first, the discovery in 1851 by Mr. Scott Archer, Mr. Fry, and Dr. Diamond of the advantages offered by collodion as the medium for the sensitive film, and the second, the invention of the dry gelatine plate. The collodion process was brought into practical operation at a time coincident with the exhibition in London of the Harvard pictures of the Moon. Mr. De la Rue was not slow to avail himself of a method which offered such enormous advantages over that discovered by Daguerre.

At the latter end of 1852 he made some successful positive photographs of the Moon, employing the reflecting telescope already referred to, which was then mounted in the garden of his residence at Canonbury. The necessary exposure was from ten to thirty seconds, the images having a diameter of $1\frac{1}{10}$ inch. The plan of operations may be best described in his own words. "In taking these early photographs, I was assisted by my friend Mr. Thornthwaite who was familiar with the employment of the new medium (collodion). At that period, I had not applied any mechanical driving motion to the telescope, so that I was constrained to contrive some other means of following the Moon's apparent motion; this was accomplished by hand; in the first instance by keeping a lunar crater always on the wire of the finder by means of the ordinary handgear of the telescope, but afterwards by means of a sliding frame fixed in the eyepiece holder, the motion of the slide being adjustable to suit the apparent motion of our satellite; the pictorial image of the Moon could be seen through the collodion film, and could be rendered immovable in relation to the collodion plate, by causing one of the craters to remain always in apparent contact with a broad wire placed in the focus of a compound microscope, affixed at the back of the little camera-box which held the plate." Notwithstanding the absence of any automatic driving motion, several good positive pictures of the Moon were obtained, but the difficulties encountered were so great that experiments were discontinued until such time as clock motion could be applied to the instrument. This was not accomplished until the year 1857, when Mr. De la Rue removed from Canonbury to Cranford in Middlesex. There he mounted the telescope with a remarkably good driving-clock, and resumed his experiments in celestial photography. At the November meeting of this Society in that year he exhibited some beautiful photographs of the Moon obtained under these new conditions.

In his first attempts, he obtained positive pictures, but in 1857, he made experiments with negative collodion plates, not only because they admitted of more easy multiplication, but mainly because the image was finer in grain. Employing a method suggested to him by Mr. Howlett, he was able to obtain good negatives with an exposure of 10 seconds.

Mr. De la Rue's pictures of the Moon possessed great sharpness of definition and accuracy of detail, and admitted of considerable amplification—they would indeed bear examination under a magnifying power of 16. Until the appearance in 1865 of Mr. Rutherfurd's pictures of the Moon, the Cranford lunar photographs remained unequalled, to testify to the assiduity and skill he had displayed in overcoming all the difficulties attendant upon their production.

Mr. Wheatstone's ingenious invention of the stereoscope suggested to Mr. De la Rue the happy idea of combining, by means of that instrument, photographs of the Moon of the same phase, but differing only in libration. Upon these stereoscopic pictures Sir John Herschel has remarked: "Nothing can surpass the impression of real corporeal form thus conveyed by some of these pictures, as taken by Mr. De la Rue with his powerful reflector, the production of which (as a step in some sort taken by man outside of the planet he inhabits) is one of the most remarkable and unexpected triumphs of scientific art."

On comparing the photographs with the image of the Moon viewed in the telescope, Mr. De la Rue discovered two important features, which he announced to this Society in November 1857. He found that points on the lunar surface which have optically equal intensity of light, do not produce equally brilliant positive, and equally obscure negative impressions; and he also observed that those portions of the lunar surface which are illuminated by a very oblique ray from the Sun, do not produce an equal effect on the sensitive plate, though they are equally bright to the eye.

At the meeting in the following month, he exhibited some photographs of great beauty of *Jupiter*, *Saturn*, and the double star *Castor*. On that occasion he read a noteworthy paper on the photographic determination of the relative light of the Moon and the planets *Jupiter* and *Saturn*—the important conclusions to which he came were that the actinic power of the Moon to *Jupiter* is about six to five or six to four; and that the chemical rays of *Jupiter* are twelve times more energetic than those of *Saturn*.

Mr. De la Rue's connection with solar physics may be said to date from the early part of the year 1854. In April of that year Sir John Herschel suggested to the Kew Committee of the British Association that arrangements should be made for securing daily photographic representations of the Sun. He considered that a telescope with a 3-inch object-glass would be sufficiently powerful, and advised that the image should be formed not in the focus of the object-glass, but in that of a secondary magnifier. The object of this arrangement was to obtain a considerably magnified image of the Sun, and also to allow of a system of spider lines being photographed on the plate. On May 3 the Kew Committee requested Mr. De la Rue to ascertain the probable cost of such an apparatus. On the 29th of the following June the Council of the Royal Society, in

consequence of an application made to them on the subject, decided to grant the necessary funds, and the instrument was forthwith constructed by the late Mr. Ross. It should be noted, however, that the cost of this photographic apparatus was eventually defrayed out of a fund placed at the disposal of the Council of the Royal Society by the late Mr. Oliveira.

The photoheliograph, which is an equatorially-mounted photographic telescope, was devised entirely by Mr. De la Rue. It had an object-glass of $3\frac{4}{10}$ inches aperture * and 50 inches focal length. It was not corrected for achromatism in the ordinary manner, but so as to produce a coincidence of the visual and photogenic foci. The secondary magnifier was of the Huyghenian form, with a system of fixed micrometer wires between the lenses.

The Kew solar photographic operations were inaugurated by Mr. De la Rue in March 1858, when the first pictures were obtained. The subsequent observations are too well known to need detailed description. The work was continued regularly for fourteen years—1858–1872—when it was discontinued at Kew, and the instrument transferred to Greenwich, where photoheliographic observations have since formed part of the routine work of the Royal Observatory. The results were communicated to the Royal Society in a series of important memoirs by Mr. De la Rue in conjunction with Professor Balfour Stewart and Mr. Loewy, entitled "Researches on Solar Physics." The credit of having successfully established a convenient system for the daily record by photography of the condition of the Sun's visible surface belongs undoubtedly to Mr. De la Rue.

At the meeting of the British Association at Aberdeen in 1859, Mr. De la Rue presented an exhaustive report "On the State of Celestial Photography in England" at that time. This paper forms a most complete and valuable monograph on the art, in which all instrumental, chemical and astronomical questions bearing on the subject are succinctly described and explained. Attention had been directed to celestial photography in this country for eight years, but though some other observers had occasionally made experiments, there had been no systematic pursuit of this branch of astronomy in England except by Mr. De la Rue in his own observatory, or under his immediate superintendence at Kew.

At this time Mr. De la Rue had decided to take the Kew photoheliograph out to Spain, to endeavour to photograph the red flames which might be seen during the total solar eclipse of July 18, 1860; but he had doubts whether the light

* The aperture of the telescope was usually reduced to two inches, as early experiments led him to conclude that, for an image of the Sun of any given size, when once the aperture of the telescope which is sufficient to produce the picture with the necessary degree of rapidity has been ascertained, it is not beneficial to increase that aperture; that is to say, no more details are depicted, nor does the picture become sharper than when the smaller aperture is used.

of the prominences would be sufficiently intense to imprint themselves on the sensitive plate. He had formed the opinion that the light of the corona and red flames taken together was not greater than the light of the full Moon, and he found that with an exposure of three minutes, employing the full aperture of the photoheliograph, he could obtain only a very faint impression of the Moon. The well-known expedition to Spain, which he has described so fully and so graphically in the Bakerian Lecture for 1862, was therefore undertaken with considerable misgiving as to the results that might be secured. Those results are now matter of history. The two photographs, which were obtained during totality, each with an exposure of sixty seconds, when compared with the photographs taken by Padre Secchi at a position some 250 miles distant, removed all remaining doubts as to the real existence and solar character of the red flames, by exhibiting them on the plates gradually covered up on one side, and uncovered on the other side of the Sun, by the progress of the Moon. Mr. De la Rue's comparison of these photographs showed that the images of the prominences in both series accorded in their most minute details; and he establishes an important point in the following words: "The photographs must, from the difference of position of the two stations, have been made at an absolute interval of about seven minutes; and this fact, while it strongly supports the conclusion that the protuberances belong to the Sun, at the same time shows that there is no change in their form during an interval much greater than the whole duration of an eclipse."

In the history of celestial photography in this country Mr. De la Rue stands pre-eminent. Perhaps no words could define his position with greater justice, than those made use of by the late Dr. Lee in presenting to him the Gold Medal of this Society: "Mr. De la Rue's claim to the special notice of astronomers, as a delineator of celestial objects through the medium of photography, does not rest on the absolute priority of his application of a well-known art in a new direction. It is rather based on the fact that, by methods and adaptations peculiarly his own, he has been the first to obtain automatic pictures of the Sun and Moon, sufficiently delicate in their detail to advance our knowledge regarding the physical characters of those bodies, and admitting of measurements astronomically precise." The tribute that was then paid to a mind so highly cultivated, whose energy had been directed for so many years to the attainment of scientific perfection, met with a wide sympathetic response.

In 1864 he was elected President of this Society; and the period for which he held that position was marked by the delivery of two very able addresses: the first in presenting the Gold Medal, in 1865, to Professor G. P. Bond for his work on Donati's Comet; and the second in 1866, when a like honour was awarded to Professor Adams for his contributions to the Lunar Theory.

In 1873 Mr. De la Rue terminated his observational labours in astronomy by offering to the University of Oxford his far-famed reflecting telescope and the greater part of the contents of his observatory, on the sole condition that they should be usefully employed. On November 27 of the same year Convocation accepted this generous gift, and authorised the expenditure of a sum of money for the erection of suitable buildings. His sympathy with practical astronomy was now transferred to Oxford, and henceforth it was a constant pleasure to him to assist and encourage the excellent work of the observatory that sheltered his old telescope.

In 1887 he took great interest in Admiral Mouchez's scheme for charting the heavens by means of photography, which was discussed at the International Congress, that assembled at Paris in April of that year; and on becoming acquainted with the results of the conference, he, in the most generous and liberal spirit, placed a considerable sum of money at the disposal of the Oxford University Observatory, to provide a suitable photographic telescope, so as to enable its distinguished director to take a full share in this important undertaking.

In 1873 Mr. De la Rue had removed from Cranford to London, and in the following year he fitted up a private physical laboratory near his house in Portland Place, where, employing a battery at first of 11,000, and finally of 15,000 chloride of silver cells, he, in conjunction with Dr. Hugo Müller, carried on an elaborate series of researches on the electrical discharge. The results were communicated to the Royal Society in a series of four Memoirs published in the *Philosophical Transactions*.

It remains but to mention that over a long period he pursued many important chemical researches which met the appreciation and recognition of the Chemical Society by his election to the president's chair for two periods, viz. from 1867 to 1869, and again from 1879 to 1880. We have already referred to some of his early papers. The nature of his chemical work appears to have been mainly technological, and the discoveries he made were, in one case at least, of considerable pecuniary value to him. At the Great Exhibition of 1851, Mr. De la Rue was a member of the jury, and reporter of Class XXIX. In this connection his attention was particularly attracted to the processes and manufacture of Price's Patent Candle Company, and the interest he took in the matter is shown by the Jury Report. He subsequently made some researches on "Rangoon Tar," published in the Proceedings of the Royal Society, which led him to patent a process to improve the special manufacture of Messrs. Price & Co., from whom, in consequence, he received a considerable sum of money. In his own business, his scientific knowledge enabled him to introduce a great number of improvements in processes and machinery which cannot be more particularly referred to here, but conspicuous among them may be mentioned the envelope-making

machine, which was one of the attractions of the Exhibition of 1851.

It is impossible in this brief notice to adequately record all the eminent services to science rendered by Mr. De la Rue. The various papers and memoirs that will be found in the Transactions of the Royal, the Royal Astronomical, the Chemical and other societies, testify to his genius and consummate skill in those branches of practical astronomy, solar physics, and technical chemistry with which he was peculiarly identified. But there is no record of what constitutes one important item in the sum of his usefulness; for it is only those who served and were associated with him on scientific committees, who can measure the wisdom and good sense of his counsel, his generous and disinterested devotion, and the charm and geniality of his manner.

He was always ready to assist important astronomical work with his purse and his influence. Many Fellows of the Society will remember the admirable *soirée* which, as President, he gave to the Society, at his own expense, at Willis's Rooms, on January 17, 1866. In 1876 he showed his opinion of the value of Mr. Gill's proposed expedition to Ascension by offering to contribute a large sum towards it, if the funds could not be obtained from other sources; and more recently at the meeting of the Council of this Society, when it was proposed to apply for a Government grant for some extensive lunar computations, Mr. De la Rue privately urged the writer of this notice not to delay putting the work in hand, as he would advance the money.

By these characteristics of a generous nature, as well as by his masterly power, he won for himself the respect, the honour, and the devotion of all who knew him, and made his name illustrious among men.

He had been in feeble health for some time, but after a short illness from an attack of pneumonia, he died on April 19, 1889 at the age of 74.

Mr. De la Rue was elected a Fellow of this Society on March 14, 1851. He was one of the honorary secretaries from 1855 to 1862. In 1862 he received the gold medal of the Society "for his astronomical researches, and especially for his application of photography." He was President from 1864 to 1866, and from that time till his death was nearly continuously a member of the Council. He was elected to the Royal Society in 1850. The list of honours he received is a long one. Oxford conferred upon him the degrees of M.A. and D.C.L. In 1864 he received a Royal Medal from the Royal Society "for his observations on the total eclipse of the Sun in 1860, and for his improvements in astronomical photography." He was for many years President of the London Institution, from which he retired in 1878, and became Secretary of the Royal Institution in succession to Mr. Spottiswoode, who was elected President of the Royal Society.

This post Mr. De la Rue resigned in 1882. In 1872 he was President of Section A of the British Association. He was one of the founders of the Royal Microscopical Society. He was a corresponding member of the French Académie des Sciences for the department of astronomy; also of the Imperial Academy of Sciences, St. Petersburg, the Philomathic Society of Paris, the Royal Society of Upsala, the Society of Agriculture and Commerce, Caen, the Society of Natural Science, Cherbourg, and the Berlin Chemical Society. Three foreign Orders had been conferred upon him—Commander of the Legion of Honour, Commander of the Order of St. Maurice and St. Lazare, and Knight of the Order of the Rose, Brazil. Mr. Warren De la Rue retired from the firm of Thomas De la Rue & Co. at the end of 1880. E. B. K.

HARRY SAVILE WARD EVANS was born at Torquay on January 18, 1851. He was the younger posthumous son of William Bertram Evans, M.P. for Leominster, and Jane his wife, of Forde Abbey, Dorset, and Wimbledon Park House.

He was educated at Eton and Trinity College, Cambridge, where he graduated in the Moral Sciences Tripos in 1872. He was called to the Bar at the Inner Temple, but never practised. While at Trinity he was captain of the Cambridge University Volunteer Corps, and devoted great attention to rifle-shooting, and was for some years a member of the "English Eight" team at Wimbledon, and also of the British team when they competed in the United States against the Americans.

For the last seven or eight years he spent the greater portion of his time on a property he had acquired at Gulf Hammocks, Florida, U.S.A. He died in Paris, after a very few days' illness, on September 10, 1889.

He was elected a Fellow of this Society March 12, 1875.

CHARLES HOOD was born in 1805, and was the son of an iron-founder in Blackfriars. For many years after his father's death he and his brother carried on the business, from which he retired some time ago.

Mr. Hood attained considerable eminence in practical science. His researches into the chemistry of the combustion of coal gained for him the silver medal of the Society of Arts. He was consulted by the Government on the ventilation and warming of the new Law Courts, when, however, the work had proceeded too far to allow of his suggestions being adopted. His treatise on ventilation and warming by hot water is the standard work upon the subject. For this he was awarded the Telford Medal by the Society of Engineers. At the time of his death he was nearly, if not quite, the oldest Fellow of the Royal Society in date of election. He was one of the founders of the British Home for Incurables (chairman from 1861 to 1866), to which