ROYAL ASTRONOMICAL SOCIETY.

VOL. XVI. *February* 8, 1856. No. 4.

THE Annual General Meeting of the Society, MANUEL J. JOHNSON, Esq. President, in the Chair.

Andrew Barclay, Esq., Kilmarnock,
Charles Tennant, Esq., Glen, Peeblesshire, and
Capt. Norman M'Leod, Local Marine Board, Liverpool,

were balloted for and duly elected Fellows of the Society.

Report of the Council to the Thirty-sixth Annual General Meeting of the Society.

The Council can, as has so often happened before, meet the Society with expressions of satisfaction at the general state of astronomy, both at home and abroad. But though science lives, its supporters are removed, one by one, and the great interests of humanity are left to find new promoters. The past year has been saddened to us by the almost sudden death of Mr. Sheepshanks, one of our most valuable colleagues and one of our oldest members.

The Report of the Auditors, subjoined, will show the state of the finances:—

RECEIPTS.

	£	s.	d.
Balance of last year's account	314	11	8
By dividend on £2878 17*s*. 5*d*. new 3 per Cents	40	13	3
By ditto on £1650 Consols..	23	2	0
By ditto on £2878 17*s*. 5*d*.	40	6	1
On account of arrears of contributions	103	14	0
106 contributions (1855–56)	222	12	0
8 ditto (1856–57)	16	16	0
Carried forward	£761	15	0

	£	s.	d.
Brought forward	761	15	0
5 compositions	105	0	0
21 admission fees	44	2	0
18 first year's contributions	33	12	0
Sale of Publications	67	17	0
	£1012	6	0

EXPENDITURE.

				£	s.	d.
Cash paid Mr. Grant				9	10	0
Ditto				20	0	0
Mrs. Jones (Lee Fund)				4	18	3
J. Rumfitt, bookbinder				3	14	0
Mr. Grant				10	0	0
George Barclay, printer				144	13	2
Taxes { 1 year's land tax	5	12	6			
Taxes { 1 year's property tax	2	18	4			
				8	10	10
J. Williams' salary				100	0	0
Ditto commission on collecting £488 13*s.* 0*d.*				24	8	6
Charges on books, and carriage of parcels				2	12	9
Postage of letters and Monthly Notices				13	16	8
Porter's and charwoman's work				25	14	2
Tea, sugar, biscuits, &c. for evening meetings				13	13	0
Coals, candles, &c.				15	6	6
Waiters attending meetings				3	17	0
Sundry disbursements by the Treasurer				21	12	0
Expenditure of Turnor Fund				11	15	7
Balance in the hands of the Treasurer				578	3	7
				£1012	6	0

Assets and present property of the Society:—

				£	s.	d.
Balance in the Treasurer's hands				578	3	7
1 contribution of 8 years' standing	16	16	0			
4 —— of 7 ditto	58	16	0			
2 —— of 6 ditto	25	4	0			
1 —— of 5 ditto	10	10	0			
2 —— of 4 ditto	16	16	0			
7 —— of 3 ditto	44	2	0			
8 —— of 2 ditto	33	12	0			
22 —— of 1 ditto	46	4	0			
				252	0	0
Due for publications of the Society				1	0	0
£1650 3 per Cent Consols.						
£2878 17*s.* 5*d.* new 3 per Cent.						
Unsold publications of the Society.						
Various astronomical instruments, books, prints, &c.						
The balance of the Turnor Fund (included in Treasurer's balance above)				29	14	5

Stock of volumes of the *Memoirs*:—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	36	VII.	221	XVII.	243
I. Part 2	80	VIII.	207	XVIII.	242
II. Part 1	99	IX.	212	XIX.	259
II. Part 2	65	X.	224	XX.	265
III. Part 1	127	XI.	235	XXI. Part 1 (separate).	302
III. Part 2	143	XII.	243	XXI. Part 2 (separate).	101
IV. Part 1	150	XIII.	259	XXI. (together).	154
IV. Part 2	160	XIV.	445		
V.	172	XV.	252	XXII.	251
VI.	197	XVI.	255	XXIII.	444

Progress and present state of the Society:—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1855	151	186	61	6	404	60	464
Since elected	3	17	...	...	20	...	20
Deceased	−3	−3	...	−1	−7	−2	−9
Removals	2	−2	...	...	...	...	...
Resigned	...	−1	...	...	...	...	...
February 1855	153	197	61	5	417	58	475

The instruments belonging to the Society are now distributed as follows:—

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Herschelian* 7-foot telescope,
The *Greig* universal instrument,
The *Smeaton* equatoreal,
The *Cavendish* apparatus,
The *Lee* circle,
The 7-foot Gregorian telescope (late Mr. Shearman's),
The Universal quadrant by Abraham Sharp,
The *Fuller* theodolite,
The Standard scale,

are now in the apartments of the Society.

The Brass quadrant, said to have been *Lacaille's*, is in the apartments of the Royal Society.

The remaining instruments are lent, during the pleasure of the Council, to the several parties under mentioned, viz.:—

The *Beaufoy* clock,
The two invariable pendulums, } to the Royal Society.

The Variation transit (late Mr. Shearman's), to Mr. Gravatt.

The other *Beaufoy* clock, to the Rev. J. B. Reade.

The *Wollaston* telescope, to the Rev. T. W. Webb.

The Council have great pleasure in stating that the Society continues to receive from time to time valuable donations of different kinds calculated for the advancement or illustration of our science. Among the recent accessions to the Library of the Society arising from this source may be mentioned a copy of a new edition of the works of Galileo, in twelve volumes, royal octavo, which was prepared for the press by a careful examination of the original manuscripts of the author, in the possession of the Grand Duke of Tuscany. It is understood to be the first complete edition of the works of the illustrious Italian which has hitherto been published. For this precious gift the Society is indebted to the Authorities of the Imperial and Royal Museum of Physics and Natural History of Florence. The Council would also beg to call the attention of the Society to a collection of very beautiful photographs of the moon, which were executed with the great equatoreal of Cambridge, U. S., and which have been recently presented to the Society by Mr. Bond.

Every succeeding year shows the advantage of having a small sum, such as is yielded by the Turnor Fund, to expend in the purchase of books. The additions made to our library from this source are slowly, but surely, rendering it worth the attention of the astronomical antiquary. The Council could, at any time, have afforded an equal annual amount for the purchase of old books, if the wants of the Fellows had demanded such an expenditure. But there exists so little taste for antiquarian investigation, that no such thing was ever proposed. The Turnor Fund may be one more instance of a useful but neglected branch of a subject the cultivation of which is fostered by an endowment.

It will be proposed to the meeting, on the part of the Council, to make such addition to the Bye-laws as will add an ordinary meeting of the Society in July to those already customary. This experiment is a consequence of some discussions the tenor of which it may be desirable to lay before the Society, with a view to bringing into notice the question whether other changes may not be desirable.

It is well known that since the formation of the Society the London season has considerably altered, both its beginning and ending having been advanced in time. The Christmas vacation is practically longer, and the month of July is fully as much within the working political and scientific year as the month of June was thirty years ago. Under these circumstances, it was discussed whether it would not be advisable to discontinue the meeting in January, and to substitute for it a meeting in July. The Council decided to recommend the addition, but not, as yet at least, the counterbalancing subtraction.

Again, the month of February has various disadvantages with reference to the annual meeting and the anniversary dinner which follows. It is very early in the political season, and the weather is seldom favourable. If the anniversary were placed in May, the month in which London is so full, both of residents and visitors, it is very likely that a much better attendance would be procured. The Council have not decided on any alteration except the one of which notice has been given. But they are desirous of having this subject discussed, and hope to learn the opinion of the Fellows at large, when due time for consideration shall have elapsed.

The Medal has been awarded to Mr. Grant, for his *History of Physical Astronomy*, a work which, from its first appearance, has been felt to supply an urgent want, and is now entitled, by the tests which have been applied to it, and by the resulting opinion formed of it, to rank as an astronomical classic. The President will deal with this award in the usual manner.

The twenty-fourth volume of the *Memoirs* has just been published. It contains several communications which cannot fail to attract the attention of all those who take an interest in the progress of our science. The paper by the Astronomer Royal on the determination of the difference of longitude of the Observatories of Greenwich and Brussels by galvanic signals indicates the application of a method which has only been devised within the last few years, for more effectually comparing the recorded times of observations at two distant places on the earth's surface. The satisfactory nature of the results which had been already obtained in America by employing the agency of galvanic electricity in effecting an astronomical connexion between various stations of importance throughout the Union, has been amply borne out by the operations of a similar character detailed in Mr. Airy's paper. The consistency of the individual observations leaves nothing to be desired, and the definitive value of the difference of longitude of the two Observatories may be considered as a faithful exponent of the degree of accuracy attainable in researches of this kind when conducted by the aid of some of the most refined appliances of modern science.

It will be remembered, that in a letter to the Astronomer Royal, which was published in the *Monthly Notices* for November

1854, M. Hansen announced that he had discovered a series of irregularities in the values of the principal equations of the moon's longitude which he was unable to account for by the existing state of the lunar theory, and which led him to suspect that they might be occasioned by a displacement of the moon's centre of gravity relative to its centre of figure. This idea suggested to M. Hansen the investigation of the consequences which would ensue if such a displacement really existed in nature; and an elaborate paper on the subject, which he communicated to the Society, appears in the volume of *Memoirs* for the past year. While the Fellows of the Society will, therefore, now have an opportunity of examining how far the results obtained by M. Hansen tend to confirm the hypothesis upon which they are based, they assuredly cannot fail to admire the consummate mathematical ability with which the author has treated so intricate a question.

The theory of atmospheric refraction is so intimately associated with the accuracy of astronomical determinations, and still leaves so much to be desired in the way of further improvement, that each successive attempt to develope more fully its principles by the aid of sound physical considerations cannot fail to be hailed with general satisfaction. It is under a strong conviction of the promptitude with which the Fellows of the Society will acquiesce in the justness of this remark, that the Council would beg to call their attention to a valuable paper by Sir John Lubbock, embodying his researches on this important subject, which is inserted in the volume of *Memoirs* just published.

The same volume also contains an important paper by Mr. Main on the determination of the constants of nutation and aberration, including a simultaneous investigation of the parallax of γ *Draconis*. The materials which formed the groundwork of Mr. Main's researches on this occasion consisted of an extensive series of observations of γ *Draconis*, executed with the twenty-five-foot zenith tube of the Royal Observatory. The utmost precaution was employed in examining and guarding against every circumstance which might be conceived to exercise a disturbing influence on the observations, and the whole investigation has been rigorously conducted according to the most refined principles of modern computation. The resulting value of the constant of nutation exhibits a satisfactory agreement with the various determinations of that element which have been deduced from the most trustworthy researches of recent times, and must be considered as forming a valuable contribution to our knowledge on the subject. The resulting parallax of the star is negative, and this anomalous circumstance, as well as the smallness of the deduced constant of aberration, affords reason to suspect that the observations have been affected in a slight degree by some unknown disturbing cause of a variable nature, and, in all probability, of a short period. From the excellence of the observations, the anomaly thus presented is interesting and important, and although it may be difficult to discover its origin and eliminate its effects, still it cannot be doubted that it is regulated by some fixed law, the complete elucidation of which on some future occasion will be productive of advantage to astronomy, as has happened in numerous other instances of a similar kind recorded in the annals of our science.

With respect to the *Monthly Notices*, it is only necessary to state, that they still continue to be conducted upon the plan which has been for some time pursued, and which has been found to give general satisfaction to the Fellows of the Society. Every astronomical phenomenon of any interest, every useful computation, however modest may be its pretensions, finds a ready vehicle of publication in the pages of this journal. It must be obvious to every Fellow of the Society, that the usefulness of the *Monthly Notices* will be most effectually promoted, not by confining its pages mainly to any one branch of our science, but by so adjusting its subject-matter as to enlist in its behalf the services and excite the unceasing attention of every class of astronomers throughout the country. The attention of the Council continues to be seriously directed to every circumstance which may appear calculated to facilitate the attainment of so desirable an object, so far as it can be accomplished without any undue expenditure of the funds of the Society. We need scarcely say that it always affords us great pleasure to receive communications from our foreign friends, either directly or through any Fellow of the Society. Although it has been found most convenient to adhere to the English language in the editing of the *Monthly Notices*, the Council would not the less cordially invite contributions from other countries, since they will always endeavour, consistently with a due regard to the general character of this journal, to give currency to any results which may appear to them to be calculated to promote the advancement of our science, whatever language may have been employed as the vehicle for communicating such results to the Society.

The Council have to regret the loss by death of our Associates, M. Augustus Ludovick Busch, M. Charles Frederick Gauss, and General Ferdinand Visconti; and also of the following Fellows:— Lieutenant George Beaufoy; Bryan Donkin, Esq.; Sir Robert Harry Inglis; Henry Lawson, Esq.; Joseph Parkinson, Esq.; William Devonshire Saul, Esq.; Rev. Richard Sheepshanks.

The Council are desirous of recording some particulars of the career of every deceased Fellow: but it is obvious that without the assistance of the immediate representatives this object cannot be attained. It does not always happen that information of the decease reaches the Council in time for the next Annual Report. Application is always made for the requisite particulars as soon as due respect to the feelings of surviving relatives will permit: but this application is not always attended to.

Augustus Ludovick Busch was born at Dantzic on the 7th of September, 1804. His parents were in wealthy circumstances at the time of his birth, but the bombardment of Dantzic by the French, in 1813, reduced them to a condition of poverty.

After acquring a knowledge of the ordinary branches of education, Busch entered the Royal School of Arts in Dantzic. The Director of this institution, John Adam Breysig, possessed a peculiar aptitude for awakening in his pupils a love of geometrical drawing and also of geometry itself. Under his tuition young Busch made considerable progress in several useful applications of geometry. Subsequently he associated himself with an architect named Pape, whom he assisted with his drawings and measurements. Not being inclined to adopt the profession of an architect, he turned his attention to the study of pure mathematics, which he cultivated unner the guidance of Förstmann, Professor of Mathematics in the Gymnasium of Dantzic, who instructed him privately for several years free of charge.

In the year 1827, having proceeded to Königsberg, he was appointed private tutor to the children of the poet Freihern, of Eichendorff, who was then Catholic Consistorial Councillor of that city. While occupying this situation he enjoyed the advantage of attending the lectures of Bessel and the other professors of the University.

In the year 1831 he was appointed assistant to Bessel, who was then Director of the Observatory of Königsberg. The labours of Busch in this situation are well known to all those who are in the habit of perusing the *Königsberg Observations* and the *Astronomische Nachrichten.* In the year 1833 Busch undertook the reduction of Bradley's observations with the zenith sector. The results were published in 1838 under the title of *Reduction of the Observations made by Bradley at Kew and Wanstead to determine the Quantities of Aberration and Nutation.* In 1849 he was appointed to the Directorship of the Königsberg Observatory, which had become vacant by the death of Bessel. He died of cholera on the 30th of September, 1855.

Charles Frederick Gauss was born at Brunswick on the 30th of April, 1777. His father, who was a bricklayer, intended that his son should adopt the same occupation. Accordingly, in the year 1784, young Gauss was sent to the public school of Bütner, in Brunswick, for the purpose of being instructed in the ordinary elements of education. During his attendance at this school, his extraordinary intelligence attracted the notice and procured for him the friendship of Bartels, subsequently Professor of Mathematics in the University of Dorpat, and father-in-law of our celebrated Associate, M. Struve, Director of the Imperial Observatory of Pulkowa. Bartels having kindly represented the merits of young Gauss to Charles William, Duke of Brunswick, he was sent, in the year 1792, to the Collegium Carolinum, very much against the will of his father, who perceived that his own intentions with respect to the future calling of his son would thereby be completely frustrated. In 1794 he entered the University of Göttingen, not yet quite decided whether he should devote his life to the pursuit of mathematics or philology. During his residence here he made several of his greatest discoveries in analysis, which induced him to make the cultivation of mathematical science the main object of his life.

Having completed his studies, he returned to Brunswick, and, in 1798, he repaired to Helmstadt for the purpose of availing himself of the library of that place, having been then engaged in preparing for publication his celebrated work, *Disquisitiones Arithmeticæ.* Shortly after his arrival he was introduced to Pfaff, but he was merely in company with him for an hour or two. Upon his return to Helmstadt, however, in the following year, with the same object in view, he had the opportunity of renewing his acquaintance with Pfaff, which soon ripened into a very intimate friendship. In the course of their evening walks they were in the habit of exchanging their thoughts on mathematical subjects, on which occasions it may be presumed that Gauss communicated quite as much as he received. It has been considered necessary to state these facts in consequence of an erroneous impression which has very extensively prevailed, even in Germany, that Gauss studied mathematics at Helmstadt under the tuition of Pfaff. The *Disquisitiones Arithmeticæ* was published at Brunswick in 1801, under the auspices of the Duke of Brunswick. It immediately stamped its author as one of the most profound and original mathematicians of the age.

The discovery of the planet *Ceres* by Piazzi on the first day of the present century had the effect of introducing Gauss to the world as a theoretical astronomer of the very highest order. The Italian astronomer not having communicated a sufficient number of his observations of the planet previous to its passing into the rays of the sun, which happened soon after its discovery, there existed no means of ascertaining the form or position of the orbit in which it revolved; and the consequence was, that upon its emerging again from the solar rays in the autumn of the same year, astronomers were totally unacquainted with the precise region of the heavens in which they ought to search for it. Piazzi having at length published his early observations of the planet, Gauss, by a method of his own invention, determined the elements of its orbit, and calculated an ephemeris of its motion, by means of which De Zach succeeded in re-discovering the planet on the 31st of December, exactly after the lapse of a year from the date of its original discovery by Piazzi. The discovery of three other small planets, which soon followed that of *Ceres*, supplied Gauss with so many occasions for improving his solution of the problem for determining the orbit of a planet from a definite number of observations, and suggested to his inventive mind a variety of beautiful contrivances for computing the movement of a body revolving in a conic section in accordance with Kepler's laws. These results were finally embodied in his *Theoria Motus Corporum Cœlestium in Conicis Sectionibus Solem Ambientium*, which was published at

Hamburgh in 1809. In this celebrated work the author gives a complete system of formulæ and processes for computing the movement of a body revolving in a conic section, and then explains a general method for determining the orbit of a planet or comet from three observed positions of the body. The work concludes with an exposition of the method of least squares, which the author appears to have invented independently of, and even prior to, Legendre, although the latter was the first who communicated it to the world.

The *Theoria Motus* will always be classed among those great works, the appearance of which forms an epoch in the history of the science to which they refer. The processes detailed in it are no less remarkable for originality and completeness than for the concise and elegant form in which the author has exhibited them. Indeed, it may be considered as the text-book from which have been chiefly derived those powerful and refined methods of investigation by which the German astronomy of the present century is more especially characterised.

It is a curious fact that the date of the preface to this immortal work is exactly two centuries later than the date of Kepler's equally renowned work *De Stella Martis*. The former is dated March 28, 1809; the latter is dated March 28, 1609.

The other astronomical researches of Gauss are chiefly contained in De Zach's *Monatliche Correspondenz*, the *Transactions of the Royal Society of Göttingen*, and the *Astronomische Nachrichten*. Although not of equal importance with those expounded in the *Theoria Motus*, they all bear the impress of original genius.

In 1807 Gauss was appointed Professor of Mathematics at Göttingen, where he continued to reside during the remainder of his life. Latterly he devoted considerable attention to the subject of terrestrial magnetism, and in concert with Professor Weber made some very important improvements in that branch of science. He died on the 23d of February, 1855. His remains were accompanied to the grave by a vast multitude of persons, including the entire corps of the University of which he was so distinguished an ornament.

Gauss was one of the leading mathematicians of the age, and was the last of the powerful school which is headed by Lagrange; but he lived to an age which made him the survivor of many who must be said to belong to a later epoch. His researches are of the most abstruse character, and turn much on the theory of number and its applications. The *Disquisitiones Arithmeticæ* is one of the standard works of the century. But though the character of his subjects tempts few readers—though his own severe brevity renders these subjects even more difficult than they need be—yet the young reader of Euclid may be brought into contact with Gauss, so as to understand the tone of his genius in a manner which would be utterly impossible in the case of Newton, or Lagrange, or Euler.

It had always been supposed that Euclid had attained the boundary of what is possible in geometrical construction, with the allowance of constructive means to which he limits himself by the three first postulates. Two thousand years had past without any construction being achieved of which a geometer would have supposed Euclid or Archimedes incapable, had the attention been turned that way. But when Gauss, by the highest algebra applied to numerical considerations, showed that a regular polygon of 17 sides (or of any number which is prime, and also one more than a power of 2) can be inscribed in a circle under Euclid's restriction as to means, he made the first advance upon Euclid, and established the connexion of trains of thought so widely different in character, in subject-matter, and in difficulty, that his theorem is of a most useful application. It is the most remarkable standing proof that every part of mathematics must be looked into for the progress of every other; and we have no doubt that this theorem has very much encouraged research into the hidden points of relation between the different branches of pure science.

It was reserved to Gauss to open that extension of plane geometry which consists in transferring the field of reasoning from a plane to any surface whatever. Every surface has its shortest line, as a plane has its straight line; and a triangle drawn upon a surface, bounded by shortest lines, such as the common spherical triangle on the surface of a sphere, has close analogies with the rectilinear triangle in a plane. Gauss showed how the sum of the three angles of such a triangle is connected with the constitution of the area inclosed; thus extending to all surfaces the well-known theorem which Roy and Legendre applied in geodetical calculation. The time may come when the advance of mathematical reasoning shall convert plane geometry into a geometry of all surfaces, in such manner that any theorem which is established on one surface shall immediately be read off on every other. Should this time ever arrive, it will be remembered that Gauss first opened the career, and suggested the possibility of the extension, by giving some of the principal theorems.

The Council have not till now been able to procure any account of the life of the late General Ferdinand Visconti. He was born in Palermo in the year 1772, and educated in the Scuole Pié of that city, whence he was placed among the cadets for the army. Whilst still at the Military College he was arrested, and confined, without any distinct charge against him, in the dungeons of the island of Pantellaria, where he was placed in a small cell with three other political victims, who soon died in misery. Although liberated in 1801, he was obliged to expatriate himself and flee to Milan, where he entered the corps of Engineers, and rapidly distinguished himself as an expert geographical astronomer.

Visconti was charged by the Emperor Napoleon with the construction of a new large military and administrative map of Lombardy. The materials placed at his disposal were so imperfect that he was compelled to begin by fixing for himself the latitudes and longitudes of numerous principal places and points of the triangulation. In 1810 he accompanied General Danthouard into the Tyrol, to fix the boundaries between Bavaria and the new kingdom of Italy. In 1814 he was permitted to return to Naples, where he was soon placed at the head of the Bureau Topographique, which he speedily placed on a sound and serviceable scientific footing; and on the return of Ferdinand IV. from Sicily, was confirmed in his office. In the Carbonari commotion of 1820, he was nominated by the hereditary Prince as a Member of the Provisional Junta of the Constitutional Government; yet, when King Ferdinand arrived with the Austrians, our excellent associate was dismissed from all his employments. Between 1822 and 1826 he was a wanderer; but in the latter year the hereditary Prince restored and promoted him.

The principal works of General Visconti were: the map of Italy, already alluded to, and a large topographical map of Naples and its environs—works evincing a rare union of accuracy and artistic talent. Between the years 1817 and 1820 he was a zealous co-operator with Rear-Admiral Smyth in the Survey of the Adriatic Sea and its shores.

Lieutenant George Beaufoy was a son of the late Colonel Mark Beaufoy, of Bushey Heath, so well known as a practical astronomer and for his nautical tables founded on a long series of hydraulic experiments conducted by himself. Bent upon maritime life, Mr. Beaufoy was placed in the Royal Navy in the summer of 1810, on board the Elizabeth of 74 guns, then commanded by his father's friend, the Hon. Capt. Henry Curzon. Subsequently he served in various ships on the West-Indian and Mediterranean stations; and, after witnessing the fall of Genoa in 1814, he went to the East Indies in the Iphigenia, Capt. Andrew King, to whom he proved useful as being a scientific navigator. Still it was not till the year 1821 that Mr. Beaufoy obtained a lieutenant's commission, when serving on board the Forte frigate on the Halifax station, whence he was paid off in 1824. Having remained some time on half-pay, he joined the Samarang in 1828, and from that date to 1845 served on the North American, West Indian, African, and Home stations, till disappointment at non-preferment and deteriorated health drove him again to half-pay, and he thenceforth remained unemployed till his death.

It is known to the members of the present meeting that Colonel Beaufoy—who was one of our first Fellows—bequeathed the valuable instruments of his excellent private observatory to this Society; and for the marked attention with which Lieut. Beaufoy conveyed the bequest, he was placed upon your honorary list.

Bryan Donkin was born at Sandoe, in Northumberland, March 22, 1768. His celebrity in the profession of an engineer, in which he passed the greater part of his long life, is not within our province to describe in detail. He prepared the heavy parts of the zenith micrometer, which was made by Troughton for the Royal Observatory. His practical completion of the machine for making paper, and his conquest over the difficulty which the original inventor left to him, would alone place his name high in the list of useful inventors. His improvements in the printing machinery maintained his reputation; while his well-known method, to which his name has been attached, for preserving meat and vegetables for long voyages at sea, has added to the safety of many and to the comfort of multitudes.

Mr. Donkin is best known to astronomers by his dividing engine and by his level.

The dividing engine consisted of an application of Maudslay's method of compensating the erroneous length of a screw by a bent lever and straight bar. This method was applied to the intermediate errors by the use of a curve obtained experimentally by continual bisections.*

Mr. Donkin's level may be understood by conceiving a slender spring fixed at its base, to stand upright, and to have a little weight at the top. If the weight be very small, the spring will stand majestically. If large, the spring will bend down. If of a certain magnitude, the spring will stand upright; but a very little force, or a very little alteration of adjustment, will make it incline much. In this state, if the base-piece be inclined a little, then the spring will incline very much, so that every tilt of the base-piece will be enormously exaggerated in the inclination of the spring.

In applying this contrivance to the transit instrument, Mr. Donkin constructed a bar resting with forks upon the pivots of the transit, and fixed the spring on the top of this bar. Then, with a small microscope fixed in the box which shrouded the spring, he observed on a further magnified scale the inclination of the spring.†

Mr. Donkin's pursuit of practical astronomy was with him a mere recreation, and extended little beyond the regulation of his clock by the transit instrument, the occasional observation of an eclipse, or an occultation of a star by the moon, or the determination of a latitude or longitude with a sextant or reflecting circle. His instruments were of the very best, for he would never work with an indifferent tool, if it were possible to procure a good one. His only fixed instrument was a transit, which, with an excellent regulator, stood in a neat little observatory. He was a good judge of a telescope, and possessed two of the best ever made by the elder Tulley. He was expert in the use of the micrometer, and knew well how to handle and make the most of such instruments as are especially intended for the scientific traveller.

* A detailed description of this contrivance will be found in Holtzapffel's *Turning and Mechanical Manipulation*, vol. ii. p. 651.

† A spring in this position had been used dynamically before as a pendulum vibrating slowly and admitting of being adjusted to correspond to the vibrations of another pendulum, in which it would be shown whether a pendulum-stand was shaken by its pendulum. It was called a "Noddy." But the statical use is purely Donkin's.

Mr. Donkin died February 27, 1855. He had long been a Member of the Society, and was frequently in the Council. As an adviser in the matters to which he had especially attended, and not in them alone, his aid was of the highest value; and his moral worth and kindness of heart and of manner added to his weight and influence. For some years previous to his death he was unable to attend our meetings; but as long as it was possible, and up to a very great age, he was active wherever his services were required.

Sir Robert Harry Inglis died at his residence in Bedford Square, on the 5th of May, 1855, in his seventieth year, deeply regretted by a large circle of friends of all persuasions and pursuits: for though strictly consistent in his own views during a long political career, his good sense, moderation, and invariably amiable demeanour, had endeared him to all. With his acknowledged assiduity in his parliamentary duties we have nothing to do here; but as a firm and early friend of this Society, and for his active zeal in promoting the efficiency of the Radcliffe Observatory at Oxford, he is well worthy of our respectful recollection. Sir Robert was, moreover, an elegant scholar, and well versed both in classical and English literature; hence he had long been a distinguished member of our leading societies.

Henry Lawson was born at Greenwich on the 23d of March, 1774. He was second son of the Very Rev. Johnson Lawson, Dean of Battle. His mother was Elizabeth, eldest daughter of Henry Wright, Esq., of Bath, a gentleman of considerable standing, being twice mayor of that city; she was thrice married. Her third husband was Edward Nairne, the eminent optician, of Cornhill, London, who died in 1806. It appears that Henry and his brother were pupils of the celebrated Dr. Burney, of Greenwich. They quitted school at an early period, and were apprenticed to Mr. Nairne. From some cause neither of them followed the business of an optician; indeed, Henry never entered into any trade or profession. No doubt the connexion with Mr. Nairne caused Henry's attention to be directed at an early age to those scientific subjects to which in after-life he devoted so much of his time. During the mother's life (she died in 1823, and was buried at Greenwich, having survived her third husband about seventeen years) Henry never kept house, living at Chelsea with Mr. and Mrs. Nairne, yet having lodgings in London for convenience. Wherever he was located he always had a room which he converted into a workshop, and in which he spent a large portion of his time.

Mr. Lawson was descended from Katharine Parr; Miss Agnes Strickland, in the life of that queen in the *Queens of England*, says that she has presumptive evidence that he derives his descent from the daughter of Katharine Parr. Some relics of Katharine Parr's personal property descended to Henry Lawson as heir-looms.

These relics Mr. Lawson bequeathed to Miss Strickland, who is also a descendant of Katharine Parr. They consisted of "The Picture of Katharine Parr;" — the napkin which had descended to the Queen from the first Queen of Henry VIII.;—the Arms of England, engraved on copper, which had occupied the centre of a large dish, and belonged to Henry VIII.; — a large gold ring containing Queen Katharine's hair; — an oil picture of Henry VIII.;—a miniature picture of his son King Edward VI.;— and a number of papers on the subject.

Henry Lawson, at the close of 1823, married Amelia, only daughter of the Rev. Thomas Jennings, vicar of St. Peter's, Hereford. From this time he resided at Hereford till the death of a relative (Miss Westwood), who left him a considerable fortune. In 1841 he moved to No. 7 Lansdowne Crescent, Bath, where he resided until his death, which occurred but a few weeks after that of his wife's. In 1820, Mr. Dollond supplied him with a $2\frac{1}{2}$-foot telescope; in 1826, with a remarkably fine 5-foot telescope; in 1834, with his celebrated 11-foot telescope; and in 1841, with the atmospheric recorder. These and numerous other instruments were removed to Bath, where he had converted the roof of his house into an observatory. Indeed, from the time of his marriage he spared no expense in the construction of his astronomical and meteorological observatory. After his removal to Bath he had for some time weekly conversational parties, to whom the large telescope was naturally an object of much interest. Both at Hereford and Bath he was accustomed to record such astronomical, meteorological, and other observations, including the accounts of all earthquakes; and, in short, anything curious in nature of which he thought a record would be useful, in manuscript books which he had for the purpose. It is to be regretted that all these manuscripts were disposed of at the sale of his house and furniture.

Mr. Lawson was elected a Fellow of the Royal Astronomical Society in 1833, a Fellow of the Royal Society in 1840, and a Member of the British Meteorological Society in 1850. To each of these Societies he has bequeathed the sum of 200*l.*, free of legacy duty. In 1796 a number of young men united to form a philosophical body called the Askesian Society (an account of which will be found in the Appendix to Howard's *Barometrographia* and also in the *Life of William Allen, F.R.S.*), the objects of which were to elucidate, by experiment, either facts generally understood, or to examine and repeat any novel discovery. The meetings were held twice a-month during the winter recess, first at Mr. Allen's and afterwards at Dr. Babington's. At these meetings each member in turn was expected to produce a paper upon some subject of scientific inquiry, and many of these papers were afterwards published in *Tilloch's Philosophical Magazine.* Amongst the members were,—William Allen, William Phillips, Luke Howard, Joseph Fox, Henry Lawson, Arthur Arch, W. H. Pepys, Samuel Woods (the President), Astley Cooper, Dr. Babington, Joseph Ball, Richard Phillips, A. Tilloch, and Joseph Woods, jun. This Society, limited at first to fifteen, and afterwards to twenty members, fully answered its original objects, and continued its labours until superseded by the formation of the Geological Society. Mr. Lawson was also one of the oldest members of the Spectacle Makers' Company, to whom he has left 100*l.* He had been twice Master. From August 1831 to August 1832 he kept a careful record of the solar spots, which he presented in a neat form to our Society.

In 1846 he published an account of his observatory (with drawings) under the title of *The Arrangement of an Observatory for Practical Astronomy and Meteorology.* This paper describes his achromatic refracting telescope of 11 feet focal length and 7 inches clear aperture—an instrument which Mr. Dollond boasted of as the finest he had ever made. It is supported on a polar axis, with declination and horary circles. This telescope is unusually well furnished with micrometers and eye-pieces up to the power of 1400, which the telescope fully bears. The telescope is driven by clock-work upon a novel construction, the maintaining power being a weight, and the correcting power paddles immersed in a basin of quicksilver. For the observation of zenith stars, Mr. Lawson contrived a convenient chair denominated a "Reclinea," for which the Society of Arts (of which he was a member) voted him their silver medal. The pamphlet next describes his 5-foot telescope, with a clear aperture of $3\frac{3}{4}$ inches, *twin* to the Rev. W. R. Dawes' fine instrument, and considered very perfect. This was mounted upon a stand of Mr. Lawson's own contrivance, called "The Journeyman," which had a vertical and horizontal movement, and being so constructed that at whatever height might be the object examined, the eye of the observer need not be moved. After alluding to the Magnetic Variation Transit, the pamphlet goes on to describe the different test stars examined, together with some observations of curious astronomical phenomena. He next describes the meteorological observatory, the construction of the "Atmospheric Recorder," "Thermometer Stand," and "New-Point Instrument." His 11-foot telescope, together with all the apparatus attached, was shortly before his death presented to the Royal Naval School of Greenwich; his 5-foot telescope to Mr. W. G. Lettsom, whilst the whole of his meteorological instruments, including the atmospheric recorder, Franklin's hygrometer (which was made by and belonged to that philosopher), the magnetic variation transit, two telescopes, and a number of meteorological books, to Mr. E. J. Lowe, to found a private meteorological observatory at Beeston, near Nottingham.

In 1845 Mr. Lawson read a paper of "Observations on the Placing of Thermometers, with the Plan of a Stand," at the Meeting of the British Association; and in 1846 presented a model of this stand to the Society of Arts, who awarded a prize for it. Plans of this thermometer-stand were subsequently published and distributed by Mr. Lawson. In 1847 he published a brief *History of the New Planets*; in 1853, an account of two inventions of his called the "Lifting Apparatus," and the "Surgical Transferrer." The former is so contrived that upon being fixed to a bed, the patient may be lifted up by means of it without altering his recumbent position; the latter is adapted for moving the wounded without inflicting pain. In March 1855, he also published a pamphlet, *On the Advisability of Training the Youth of Britain to Military Exercises, as productive of National Safety.*

In December 1851, Mr. Lawson proposed to give the whole of his astronomical and meteorological instruments, together with 1050*l.*, to the town and county of Nottingham, provided a requisite sum of money could be realised, in order to build an observatory, and to endow it with 200*l.* a-year. A public meeting was called on the 13th of January, 1852, for the purpose of devising proper means in order to secure this noble boon both to science and the neighbourhood. A committee was formed, of which the Duke of Newcastle was chairman, and Mr. E. J. Lowe honorary secretary. This committee prevailed upon 727 individuals to subscribe. A sum amounting to 6562*l.* was collected, the Corporation of Nottingham voted land of the value of 600*l.*, and Government proposed to add 2000*l.*, making a total of 10,211*l.* A codicil was added to his will, at the request of the committee, and afterwards the instruments were conveyed to the Duke of Newcastle, in joint trust with Mr. Lawson, to secure the due fulfilment of the agreement. In this great undertaking, Mr. Lawson was ever ready to sanction the extension of time allowed, and other requests made to him by the committee. Unfortunately, however, when everything had been accomplished, the money valuation of the instruments was disputed, and differences of opinion arose, which ended in the return of all the subscriptions, and the abandonment of the plan.

Mr. Lawson's talent was not wholly confined to scientific pursuits, and many are the improvements he made in various domestic arrangements. He was both a philosopher and a philanthropist. Lamenting, as he did, the necessity of the present war, still he was quite alive to the national honour of his country, and strongly urged the advisability of every preparation being made to ensure the security of Great Britain. He was fond of microscopic investigations, and had a good microscope. Indeed, his house literally teemed with objects of interest, and he always took great pains to describe and explain, in a clear and perspicuous manner, either the wonders of the starry vault or of terrestrial objects. Mr. Lawson would spend hours together in his observatory with those who wished to learn more about the heavenly bodies. He also delighted to exhibit various specimens of minute objects with his microscope, and endeavoured to bring down his knowledge to the comprehension of his audience — a trait of real benevolence in a true philosopher.

Mr. Lawson's charity, without ostentation or publicity, was during his lifetime as unbounded as his love for science, and at his death he bequeathed to the Bath General Hospital 200*l.*; to the Bath United Hospital, 200*l.*; to the Walcot Dispensary, 200*l.*; to the Ear and Eye Infirmary, 100*l.*; and to the Bath Baths and Wash-houses, 300*l.* He had a large fortune, which he divided in his will among 139 persons.

The loss of all his papers prevents the possibility of describing the different inventions of Mr. Lawson. Amongst them, however, may be mentioned his "Solar Eyepiece," "Astronomical Reclinea," "Surgical Transferrer," and "Lifting Apparatus." In 1821, 1822, and 1823, he made daily observations on atmospheric electricity, and subsequently occasional records. He felt a great desire to spread a knowledge of the different branches of philosophy as widely as possible, and to promote a taste for science in young persons, which he endeavoured to encourage when once begun, and to this purpose much of his time was devoted. He died calmly on the 22d of August, 1855, in his eighty-second year, his clear-sightedness and kind disposition continuing to the last. His remains were deposited at Weston, on the 27th of August, in a vault containing many members of his family. It is painful at all times to record the loss of a friend, but one so deeply lamented, and whose many amiable qualities endeared him to all who were personally acquainted with him, will cause his memory long to be cherished and deeply felt.

William Devonshire Saul, who died April 27, 1855, at an advanced age, was in business as a spirit-merchant. He was a member of several scientific societies, and was greatly attached to knowledge, and much interested in its spread and progress. He was especially attached to geology, and has formed an excellent museum in Aldersgate Street. This he invited those who chose to inspect on a fixed morning in each week; and on these occasions he would give a descriptive lecture, and then encourage free conversation, giving and receiving information on his favourite subject. While travelling in the country on the business of his firm, it was his custom to take every opportunity of delivering lectures on geology. His museum is bequeathed to the Institution in John Street, Tottenham Court Road.

Mr. Saul was a regular attendant at our meetings until his death. He was a useful and upright member of society, and made it his business to advance all that he held good and useful. A dealer in spirits, he was a donor to Temperance Societies.

Richard Sheepshanks was born at Leeds, July 30, 1794. His father was engaged in the cloth manufactory, and the son was intended to be in the same business. His earlier education, therefore, though of the liberal kind, was rather commercial, and arithmetical and other mathematical training was plentifully bestowed. At the age of fifteen he found out that the prospect of a mercantile life was not agreeable to him, and he wrote to inform his father of his wishes. The father, without hesitation, gave up his own plan, and applied by the post of the night on which he received the letter to the late James Tate, of Richmond in Yorkshire, to know if he could receive his son as a pupil. Mr. Tate had at that time one of the highest reputations as a classical teacher, a reputation to which his scholars were continually adding. He, was, moreover, one of the kindest of men, and his social virtues and literary celebrity will often be alluded to, as one after another of his distinguished pupils claims the notice of the biographer. Between the teacher and the pupil the warmest feelings of affection grew up: and the closest friendship subsisted between them so long as they both lived. Under such tuition Mr. Sheepshanks soon made up deficiencies, and was placed at Trinity College, Cambridge, in October 1812. He took a wrangler's degree in 1816, and was elected a Fellow of his college in 1817, at the same time as his contemporary, Dr. Whewell, the present Master of the College, one of his oldest and closest friends. He applied himself to the study of the law, and was called to the bar in 1824. He intended to practise this profession, but was partly prevented, it is supposed, by a tendency to inflammation in the eyes, which accompanied him through life. It is, however, as likely that the death of his father, which placed him in easy circumstances, and his own increasing bias towards scientific pursuits, were the principal reasons of his declining to pursue the career for which he had fitted himself. In 1825 he took orders, at the same time as his friend, Mr. (afterwards Archdeacon) Hare; the two read and prepared themselves together. His attention to astronomy soon absorbed a great part of his time. He became a Fellow of this Society in 1825, and from that time was one of the most active in the administration of our affairs. He filled at one time the post of Secretary; but that of President he always refused. This fact must be stated in justice to the Council, who often, and especially after the death of Mr. Baily, pressed the presidency of the Society upon him. Among the services rendered by him to the Society, one of the most prominent is the elevation of the *Monthly Notices* to their present form. Before the change, these *Notices* were strictly abstracts of proceedings, and the possessor of the quarto *Memoirs* might almost dispense with them. Since the change they are, as we all know, supplements to the *Memoirs*, which are imperfect without them. In maturing this alteration he spent time, labour, and money. It was for some years his practice to print, at his own expense, an additional number of copies, which he distributed in his own way, to bring the work into greater notice and circulation. In fact, his pecuniary benefactions to the Society were more than most of the Fellows knew anything about. When the portrait of Mr. Baily, which is now in our meeting-room, was nearly completed, the funds for payment were found to fall considerably short of what was required, owing to a misunderstanding, which need not be further alluded to. Mr. Sheepshanks, who had no hand in creating the difficulty, quietly made up the necessary amount, and never allowed what he had done to be known, except to a few of his most confidential friends.

In the summer of 1828 he joined Mr. Airy and Dr. Whewell in the pendulum operations which they undertook in Cornwall. The object of this operation, as is well known, was to determine the difference of gravity at the top and bottom of a mine, by simultaneous observations of the vibrations of invariable pendulums, and by the comparison of the clocks with which the pendulums were immediately compared. In planning the order of observations, Mr. Sheepshanks took an important part; and we have the testimony of the Astronomer Royal that it was to his energetic representations that the adoption of the laborious principle of incessant observations (to which the Astronomer Royal ascribes the success of his late repetition of the experiment) was entirely due. In the execution of the work Mr. Sheepshanks took charge of the upper station. The enterprise was frustrated, after various difficulties had been met and mastered, by an accident in the mine itself, which stopped works of all kinds, and finally caused a partial flooding of the mine.

In 1829 Mr. Sheepshanks was an active member of the Syndicate for establishing the regulations of various kinds by which the Cambridge Observatory is still governed. We need hardly say that he was an active member of the Board of Visitors of the Royal Observatory at Greenwich.

In 1832 he first interfered in a matter into the personal part of which there is no occasion to enter,—we mean the action brought by Messrs. Troughton and Simms against Sir James South, to recover payment for mounting his large equatoreal. This was, in truth, a scientific question, and it led to one of the closest discussions which an astronomical instrument ever underwent, before Mr. (now Mr. Justice) Maule as arbitrator. Mr. Sheepshanks was, though not nominally, yet actually, one of the counsel for Troughton and Simms, and the late Mr. Drinkwater Bethune,—a loss to science in England, and to education in India,—was counsel for Sir James South. The claim of the plaintiffs was awarded to them, after the sifting of a great deal of evidence; and it is to be regretted that the nature of the proceeding rendered it inexpedient to publish a discussion in which two men so acute and so well versed in their subject contended before a judge who was in both points in the same rank with either of the two. It may be noted that the first simple and efficient clock-motion applied to an equatoreal was that invented by Mr. Sheepshanks, and used in trying the instrument above alluded to.

In 1833 he was referred to by the Admiralty with respect to the edition of Groombridge's Catalogue which had been prepared and even printed. To his representations on this subject it is mainly due that an edition which would have fallen short of the reasonable expectations of astronomers was suppressed, and a fitting publication was prepared by Mr. Airy.

After the return of the expedition down the Euphrates under

Col. Chesney, with the loss of their excellent astronomer, Lieut. Murphy, the mass of astronomical observations was placed in the hands of Mr. Sheepshanks for reduction. This labour cost him much time and thought, but it involved a service to astronomy and a tribute to the memory of a friend; and either of these circumstances would have commanded his best exertions.

Mr. Sheepshanks was a member both of the Commission of 1838 for considering the mode of restoring the national standards of length and weight, and of the Commission of 1843 for superintending the actual constructions. On the death of Mr. Baily, in 1844, he volunteered to undertake the re-construction of the standard of length. On this great work the last eleven years of his life were much occupied: and there is too much reason to fear that his days were shortened by the exertions which he made. The Fellows would hardly suppose, that in one of the cellars under their Apartments, while otherwise occupied in the business of the Society, and always ready to advise a young astronomer, or to pass an hour of pleasant gossip, Mr. Sheepshanks recorded micrometrical observations to the number of just five hundred short of ninety thousand. The account of the result, which received its legal sanction on the day following that on which Mr. Sheepshanks was struck by his mortal illness, will be published by the Astronomer Royal. But the following few sentences may serve the purpose of the present notice.

The first part of the work consisted in examining and selecting, among the existing measures of length, those which, having been carefully compared with the imperial standard, and being in other respects trustworthy, might be used as bases for reproduction of a standard identical in length (within the limits of uncertainty which the construction of the old standard allowed) with the imperial standard. Mr. Baily had first pointed out, and Mr. Sheepshanks more strongly urged, that it would be imprudent to rely so completely upon the permanence of the standard scale of this Society as they had at first intended to do; and that the Kater scale of the Royal Society, and the two 3-feet bars of the Ordnance Survey, though inapplicable to any other purposes of a scale, would probably be judged by the scientific world to be better adapted to the purpose of delivering down a single measure of length. The Superintending Committee assented to this opinion. The next work was, to arrange a comparing apparatus, which, on the score of mechanical firmness and freedom from the effect of changes of temperature, should present such a security for the accuracy of comparisons as had never been obtained before. How these advantages were gained, by use of the massive apparatus in the cellars of this Society, it is beyond our purpose to point out; but there cannot be a doubt that the comparisons made by Mr. Sheepshanks are so far superior to those of all preceding experimenters, including Kater and Baily, as to defy all competition on the ground of accuracy. What trials were made of different methods of producing the terminal divisions of the measure,—different modes of illuminating, &c., it is impossible here to state; but in illustration of the unsparing labour which Mr. Sheepshanks was ready to bestow whenever the question of accuracy was raised, the following incidents may be mentioned. The first is that, when the bars intended for the new Parliamentary standard and its official copies had been, as was supposed, sufficiently compared, a new and hitherto unsuspected difficulty showed itself in the nature of personal equation. At once Mr. Sheepshanks rejected the mass of observations already made, and commenced a new series; availing himself of the services of those of his friends whose habits of observation and general accuracy made it probable that the combination of all their observations with his own, as repeated in the new series, would sensibly eliminate the personal equation; but charging himself with the labours of adjustment and of immediate computation of results. The second incident is, that in the spring of 1855 some circumstances led Mr. Sheepshanks to think that his "Generating Bar," on which he had relied mainly for the production of accurate copies of the standard, had undergone a small change, and he at once proposed to reject all the observations which had entirely occupied several years, and to commence *de novo*. The whole of the suspected change amounted, in its greatest apparent effect, to no more than the thermal change produced by $\frac{1}{10}$th of a degree of Fahrenheit. Ultimately, the grounds for suspecting a change so far disappeared that it was not thought necessary to repeat the observations.

Mr. Sheepshanks was actively engaged in 1838 in the chronometrical determinations of the longitudes of Antwerp and Brussels; and in 1844, of those in Valentia, Kingstown, and Liverpool. Some discussions which arose about the site of the Liverpool Observatory led him into controversy, the result of which was a pamphlet exposing the futility of the objections made.

Mr. Sheepshanks resided in town from 1824 to 1841 at a house in Woburn Place, where he fitted up a small observatory. He then removed to Reading, where he continued to reside, though constantly called to London by the business of the standard of length. He died at Reading August 4, 1855, of apoplexy, after a day or two of illness.

Mr. Sheepshanks was more than an astronomer. He had a taste—a family taste—for the fine arts. He retained to the last a love of and familiarity with classical authors, and he was well versed in modern European letters. He was especially attached to the old English dramatists, and was never at a loss to turn to a passage in any of them. From Shakspere, as the readers of his controversial pamphlets know, he could produce something to any purpose. To keep up and augment his classical learning was with him, for many years, a positive duty. He looked forward to becoming a Senior Fellow of his College; in which case he would have been required to take part in the examinations of candidates for fellowships; and he determined to enable himself to fulfil this duty in a manner worthy of the reputation of the college as a school of philology. When he found that he was unlikely, from other occupations, to perform this duty, he determined not to accept his place in the seniority when it fell to him; and he accordingly remained one of the Junior Fellows till his death.

For history, especially political history, he had a strong taste; and the newspaper of the day was but the end of a long series, the whole of which he had studied. One of his pursuits was not a little remarkable. He had studied military tactics, ancient and modern, to an extent which was hardly credible to those who had no means of knowing it except ordinary report. He had read on the subject from Polybius to Napier, and could speak on any marked campaign with readiness, and with an apparent precision which military judges pronounced real. We suspect that if there be any one in Britain who has studied *both* ancient and modern warfare to an equal extent with Mr. Sheepshanks, his name is not before the public in the credit due to the combination.

In public life he took no part except on one occasion. In 1831 he allowed himself to be nominated one of the commissioners for regulating the boundaries of the boroughs under the Reform Bill. In this character he visited and arranged most of the boroughs between the Humber and the Thames. When associated with another, his colleague was the late Mr. Tallents, agent to the Duke of Newcastle, who, as might be supposed, was a strong Tory. Mr. Sheepshanks himself had been a thorough Liberal in politics from his youth. The two agreed to differ so well, that they contracted a warm friendship for each other.

As an astronomer, Mr. Sheepshanks especially devoted himself to the theory and history of the astronomical instrument; and his peculiar pursuit led him to know more of the history of astronomy in general than usually falls to the lot of the practical observer,—we mean, more of the original records of that history. The articles which he wrote on astronomical instruments for the *Penny Cyclopædia* are not yet surpassed in current utility, and were never surpassed in soundness and clearness. He was of a strong mechanical turn, and has been heard to say, that if in his youth machinery had been applied as it is now, he might probably have acceded to his father's wishes, retaining the direction of the works, and leaving the buying and selling to his brothers.

He was, above all other Fellows of this Society, the adviser of the aspirant who desired to build an observatory, or to devote himself to any astronomical pursuit. For this he was especially qualified, not only by his familiarity with all the detail of the instruments, but by his leisure and by his sense of the duties which that leisure imposed upon him.

On his social character we may be permitted to quote an extract from the *Examiner* newspaper of the 8th of last September; and the more so as the freedom of expression of the journalist will permit a more pictorial representation of our departed friend than the Council might choose to make on its own account:—

"Any one who was in company with Mr. Sheepshanks for the first time would have remarked, and at first with some curiosity, a man of hardly middle stature, of rapid and somewhat indistinct utterance, of a very decided opinion upon the matter in discussion, and apparently of a sarcastic turn of thought and a piquant choice of phrase. By the time he ascertained, which he would not be long in doing, that the speaker was a scholar and a gentleman, he would at first be inclined to set him down as a very irreverent scholar and a very positive gentleman. This would last until a point arose on which Mr. Sheepshanks had not thought or had not read; and then his auditor would perceive that he had the not very common faculty of making a wide difference between his mode of talking about what he had attended to, and what he had not. His utterance would slacken, his energy of manner would abate, and he would resemble a cautious witness speaking upon oath. When it happened that the necessity arose of defending what he really respected against any opposition worth considering, the tone of flighty sarcasm disappeared, and an earnest deportment took its place.

"All this arose from a mixture of two prominent feelings: a strong, abiding, and self-sacrificing devotion to what he held good and true, and a keen, sarcastic, and laughter-loving contempt for all that pretended to be what it was not. No wonder that, in the world we live in, the second feeling predominated over the first in the formation of his habits of speech and of argument. With no lack of allowance for every well-meant and honest effort, his temperament did not permit him to work out an average from the head of gold and the feet of clay: the clay did not depreciate the gold, nor did the gold enhance the clay. No man knew better how to defend his scientific and personal opponents, on those points on which they were defensible; and no man more constantly did it. The remaining trait which must be noticed is the vigorous and practical character of his friendship: his active and unwearied assistance was as surely to be reckoned on as a law of nature, especially if to the cause of his friend was attached the opportunity of supporting some principle, or aiding some question of science. Nor was his kindness of feeling limited to his friends. It showed itself in real and thoughtful consideration for all with whom he came in contact. Had he been a physician, his fanciful and self-tormenting patients would have thought him the worst of their ills; his milder cases of real suffering would have been cheered by his bantering kindness; while severe and dangerous malady would have felt the presence of the sympathy which money cannot buy, shown with a delicacy which benevolence itself cannot always command."

The last of Mr. Sheepshanks's publications was a defensive pamphlet—or partly defensive—in answer to an imputation, to which we need not here allude further than by describing it as an impeachment of his integrity, upon the evidence of a conversation alleged to have been held thirty years before it was brought forward with an eminent man who died twenty years before it was brought forward. Of course this sort of evidence never received the slightest attention from any of the scientific bodies before whom it was proposed for inquiry; nor would it have been mentioned here, public as the matter has become, except simply to record that sense of the utter needlessness of any reply to such an accusation, which the Council showed when they neglected the formal application made to them on the charge. The subject of this memoir lived in the regard and respect of all who knew what he was, and were unbiassed by the feelings which controversy too often creates. In this Society he must always be remembered with gratitude as an earnest friend, a laborious servant, an enlightened manager, and a conscientious administrator.

At the Royal Observatory of Greenwich, there is no important change or addition to be recorded. Indeed the recent developments of the organisation of that establishment, involving as they do the reduction to routine of the processes for connecting astronomy, magnetism, and meteorology, with the sciences of galvanic electricity and photography, and the surmounting of the various practical difficulties which are sure to attend such applications, have afforded ample employment to the Astronomer Royal and his staff of assistants, and have taxed the skill and industry of all connected with the establishment as much, if not more, than in any preceding year. While the ordinary routine operations of astronomy have been carried on without any abatement of the vigour of former years, the details of the operations by which time is transmitted to determinate stations along lines of railway and to the port of Deal have been watched with scrupulous care and anxiety; and such improvements have been from time to time effected as have been taught by the experience gained in the working of the system.

It was stated in the Report of last year that the dropping of the Deal ball automatically by means of a current sent primarily from Greenwich at the instant of the drop of the Greenwich ball, had come into regular operation at the beginning of the year 1855, and confident hopes were expressed that the drop of the ball at this port would be soon accomplished with all desirable regularity as a matter of routine business. This hope has been fully realised. The number of cases of failure, arising from causes of all kinds beyond the control of the Observatory, since the last Report, has been only sixteen; and during an interval of five months,—namely, from the middle of June to the middle of November,—there were only two failures. The failures of the galvanic apparatus within the precincts of the Observatory have been very few indeed, and the whole of it is completely under easy control of the assistants charged with the management of it.

Though time has been transmitted throughout the year 1855 to those stations only which were specified in the last Report of this Society, yet arrangements have been made for extending the benefits of the system to the public on a still larger scale. In compliance with a request urged by the Post-Office authorities, the Astronomer Royal has succeeded in negotiating with the Electric Telegraph Company for a line of wire, and in devising the mechanical measures necessary for putting into galvanic connexion with Greenwich four clocks at the General Post-Office at St. Martin-le-Grand, and one clock at the Office in Lombard Street, with the object of supplying to those important establishments accurate Greenwich time. If no unexpected obstacle should intervene, we may expect that this desirable object will be shortly accomplished. If the galvanic communications with the Post-Offices should succeed to the extent confidently anticipated, it is not improbable that the system may be extended so as to include the Houses of Parliament, the Admiralty, and such other of the public offices as may find it desirable or convenient.

With regard to photographic manipulations, the routine operations now in use give almost invariably excellent delineations of the movements of the magnets, and of the dry and wet thermometers, and the barometer; and nothing more seems to be desired, either with regard to the cleanness and delicacy of the photographic sheets, or to the distinctness of the traces on them. It has been thought, therefore, a desirable object to obtain a considerable number of copies of each of these magnetical and meteorological records; and for this purpose, considerable time and thought have been expended in printing off as many as the force of assistants attached to this department would permit, the bright sunshiny days being devoted chiefly to this purpose. Though, however, by this means a great many valuable secondaries and tertiaries of the original traces have been obtained, still it appears that the resources of the Observatory are not sufficient to produce with regularity that number of copies which the interests of science seem to require, and the Astronomer Royal has proceeded to make preliminary inquiries concerning the expense which would be incurred by the printing of a definite number of copies by a professional photographer.

Thus, though the operations of the last year at Greenwich are not characterised by any actual novelty, yet enough is exhibited of its steady and vigorous action and of its preparation for still greater extension of its organisation and usefulness, to give evidence of its vitality, and of its attention to the highest and best interests of science.

On closing the observations for the Circumpolar Catalogue, it had been Mr. Johnson's intention to have applied the instruments of the Radcliffe Observatory to a revision of Piazzi's Catalogue, on the same plan as he had pursued with Groombridge's. However, after having made some preliminary arrangements for this purpose, it seemed to him that the amount of observation and reduction it would entail would be more than the personal resources of the establishment could well bear, while at the same time engaged in preparing the Circumpolar Catalogue for the press. He has, therefore, relinquished this scheme, for the present, for the less laborious task of constructing a catalogue containing all known objects among the fixed stars remarkable for physical or systematic peculiarities; including under these heads,—

1st. Stars of conspicuous brilliancy to the 3d magnitude inclusive.

2d. All stars known to be, or suspected of being, variable.

3d. Stars remarkable for colour.

4th. Stars having proper motion amounting to $\frac{1}{10}$th of a second of space.

5th. Double stars known to be affected by orbital motion.

There is no existing collection in which all these objects are to be found, therefore the proposed catalogue, in addition to its value as such, will also furnish a useful index for reference to persons interested in researches connected with such objects. Care will be taken to introduce all new discoveries coming under the forementioned heads.

The first portion of this new work will appear in the Fifteenth Volume of the Radcliffe Observations, which will be published in the course of a few weeks. This volume will also contain the first specimens of photo-meteorographic registrations, which are being carried on regularly at that establishment.

The Heliometer has been employed almost exclusively in parallax researches. *Arcturus*, *Castor*, and *α Lyræ*, have been the principal objects of investigation, but as none of the series were completed at the end of 1854, the year comprehended in the new volume, Mr. Johnson has thought better to reserve the publication of the Observations until he is able to present them complete.

The Cambridge Observatory has now been under the direction of Professor Challis for twenty years, and during that time observations have been continued with scarcely any interruption. The hardest portion of the work is the keeping up the publication of completely reduced observations. A reduced catalogue of the stars, chiefly zodiacal, observed in 1850, has been completed, and additional errors in the catalogues of Lalande, Weisse, and the British Association, have been discovered.

The apparatus for eliminating from the transit observations the effect of the irregularity in the forms of the transit pivots has been used again,—this having been now become an annual operation. The results obtained are completely confirmatory of those of former trials, and of the exactness of the method. As a general result of these trials, it may be stated that the deviation of the pivots from the cylindrical form affects observed R.A. differentially and to a very small amount, and that the total amount of the error takes effect only in a determination of the longitude of the observatory.

Professor Challis has recently adopted the following method of eliminating the effect of flexure in observations with the mural circle.

Two collimators are mounted on a wooden stand in such a manner that, being carried on two arms about a horizontal axis nearly coincident in direction with the axis of the circle, they can be made to collimate with the circle telescope, and with each other, for any zenith distance. This method has already been applied in other observatories for determining the amount of flexure in the horizontal positions of the telescope; but this is the first time that it has been extended to all positions. The apparatus has been so arranged that when the collimators are mounted, they do not seriously interfere with the use of the circle in daily observations. The collimators have been employed for determining the effect of flexure in only two positions of the telescope up to the present time, the zenith distances of 90° and 45°. In the former the amount of flexure is found to be not less than 4″, and in the other little more than 1″, which is somewhat larger than the amount indicated by the direct and reflexion observations of stars. Probably by longer experience in the use of the collimators, greater precision will be attained and the above results be modified.

The object proposed to be effected by the use of this apparatus is to ascertain the law which the flexure follows from 0° to 90° of zenith distance, and thus to eliminate the effect of flexure from the observations of north polar distances more completely than is practicable by the direct and reflexion observation of stars. Mr. Challis adds as follows:—

"Since June last, I have proceeded further with the experiment for finding the effect of the flexure of the Circle Telescope on observations of N. P. D. The results of the first trials were found to be unsatisfactory, owing to the support of the collimators not being sufficiently steady. I have had the support placed on a firm basis of brickwork, surmounted by a stone slab; and, acting upon a hint given me by the Astronomer Royal, I have provided means of clamping the extremities of the arms which carry the collimators. The results of trials made since these arrangements have been very consistent, and have shown that the amount of horizontal flexure, mentioned in the Report of the Syndicate, is much too large, the actual amount being certainly below 1″. I have not yet completed a series of determinations for different altitudes."

In the usual Report to the Observatory Syndicate, Professor Challis gives a detailed account of the observations made during the year. Mr. W. T. Lynn has succeeded Mr. Criswick (removed to Greenwich) as Junior Assistant.

At Liverpool, Mr. Hartnup has observed all the planets and comets that have been discovered during the past year. Most of the observations have been printed in the *Astronomische Nachrichten*.

In lunar photography considerable progress has been made; Mr. Crookes, the celebrated chemist and photographer who assisted Mr. Johnson at Oxford, being in the neighbourhood, visited the Observatory for a few days, and with his assistance they succeeded in taking a good collodion negative of the full moon in the short interval of *four seconds*. Previous to this, Mr. Hartnup had never succeeded in obtaining a picture of the full moon in less time than from twenty to thirty seconds. Mr. Crookes has taken several collodion negatives to London with him, with the view of enlarging them and printing from them. If the small pictures cannot be enlarged satisfactorily, there would probably be quite sufficient light to produce a picture of five or six inches diameter, or even larger, direct from the telescope, with chemicals so sensitive as those prepared by Mr. Crookes. There is no difficulty in making the telescope follow the moon perfectly for two or three minutes.

The chronometrical expedition of the American United States Coast Survey was again renewed last summer. Mr. Sidney Coolidge, accompanied by one of the assistants of the Cambridge U. S. Observatory, came over three times with upwards of fifty chronometers. Mr. Coolidge brought out one of Mr. Bond's Spring Governors with him, and the transits were observed and the chronometers compared by the American galvanic process, both at Liverpool and at the Cambridge Observatory, by Mr. Coolidge. This result will therefore be free from the effects of personal equation.

The Board of Trade have supplied the Observatory with apparatus for testing barometers and thermometers, and Mr. Hartnup finds that it is of but little use giving captains the rates of their chronometers as dependent on the temperature, unless they are furnished with more accurate thermometers. An error of four or five degrees is quite common, and Mr. Hartnup recently tested a fine-looking thermometer, fitted up for taking the temperature of water at different depths, for a merchant captain, which stood at 80° when his standard read 88°·5. It is no uncommon thing to find barometers from half an inch to an inch wrong in some part of the scale between 28 and 31 inches. He tested one a short time ago which had the following corrections for scale reading:—

	in.	in.	in.	in.	in.	in.	in.
At	28·0	28·5	29·0	29·5	30·0	30·5	31·0
	— 2·22	—1·88	—·73	—·30	—·02	+·33	+1·07

The Annual Report for the past year has not yet been printed; but it will be seen that the Observatory maintains its character for amount of work done.

At his observatory at Redhill, Mr. Carrington has, during the past year, been making unimpeded progress in the two subjects to which his attention continues to be directed, namely, the observations of stars within 9° of the North Pole, and the forms and positions of the solar spots.

The region within 4° of the pole was, as related in the last report, under observation in the year 1854, and was very nearly finished in that year. During the past year the few observations still wanting were obtained, the reductions of the whole to apparent places finished, and the corrections to mean place, 1855·0 computed, but not applied.

In the next sub-zone of 4° to 7°, which was the intended work of 1855, 4540 observations were made, exclusively of observations of stars for the determination of instrumental and clock errors, being three observations apiece of 1514 stars, with two sole exceptions. The observations of this sub-zone are concluded, the reductions to apparent places within a fortnight of completion, and the corrections to mean place about one-third computed.

In the third and last sub-zone of 7° to 9°, about 1050 observations were obtained in 1855. It is expected that this sub-zone will be finished in September next.

In his second subject—the solar spots—Mr. Carrington has had a very light year, the reduction of all the observations obtained in 1855 occupying less than a fortnight. The sun was viewed on 227 days, on 150 of which the surface was found to be blank. The observations of the nuclei and detached spots seen on the remaining 57 days amounted in all to 135 only, the whole of which are finally reduced and diagrammed on the same system as was pursued in the former year. At that stage they are left for the present.

In a recent number of the *Monthly Notices* mention was made of a part-volume received from the Observatory of Harvard College, Massachusetts, containing observations of small stars in the neighbourhood of the Equator made with the great Cambridge refractor. The contribution is one towards the filling in of the details of the starry heavens; fourteen new stars being given for every one previously observed. A comparison might accordingly be naturally made between the present work and the volumes which have emanated from the Observatory of Mr. Cooper of Markree Castle; but in this, as in most other astronomical undertakings, diversity of method will be expected and found to exist, arising from the individual motives of the observers in selecting their fields of labour. Mr. Cooper's observations have been taken in the region of the Ecliptic by means of a frame of bars with an accuracy sufficient for the purpose of forming improved maps; while Mr. Bond has confined himself to a ribbon of stars on the Equator observed and reduced with a degree of refinement and an arrangement in the publication, especially aimed at the discovery of planetary or proper motion in the objects observed. The preface to these observations is an instructive one, and well worthy the attention of the practical astronomer. We might almost say that the probable errors were over-discussed, were not the results the first obtained by the new method of galvanic registration. We are much gratified also with this volume as testifying to an increasing recognition of the principle that a star once observed is a star incompletely and insufficiently observed for most of the purposes for which after-reference will be made to its recorded position. Although Mr. Bond has not rigidly followed out the second observation of every star in his zones, he has done so in as many instances as his method of sweeping his ground twice with a fixed telescope has practically allowed of. If it were suggested that an increase of breadth of the zones, and a limitation to the stars of the 10th magnitude, coupled with a strict adherence to the rule of observing every star down to the 10th magnitude twice, would be more immediately useful; it would be a sufficient reply that Mr. Bond has an instrument which sets its own conditions in some respects, and that these are partly inconsistent with what might be our wishes. The suggestion might be aptly made to those who are unfettered in the choice of an instrument for work of this class; and our unqualified thanks are due to Mr. Bond for his valuable contribution as it comes before us.

We have the pleasure of announcing that the First Part of the Volume of which the observations now commented on form the Second Part, is already in the press, and will contain an account of the circumstances which led to the foundation of the Observatory, and the observations of *Saturn* in the years 1848 to 1856, illustrated by numerous engravings. Letters from the Messrs. Bond also inform us of the completion of a second volume of zone observations, and add, that the printing fund by which these his first results have been given to the world is an endowment by private bequest of a permanent character.

After the decease of Mr. Sheepshanks, the Astronomer Royal undertook the examination of the papers relating to the comparisons of Line-measures or Standards *à traits*. It was found that, besides the five standards which, under the title of National Standard and Parliamentary Copies, had been deposited in various offices of the Government, there were more than forty well-compared and disposable copies nearly ready for distribution. Under the superintendence of the Astronomer Royal these have been numbered, engraved, and packed up, and thirty complete sets of British Standards (every set including a bronze copy of the yard-measure, and a gilt-bronze copy of the avoirdupois pound weight, and some including, in addition, an iron or steel copy of the yard measure,) have been distributed to our colonies and to foreign states.

The troublesome work of forming End-measures, or Standards *à bouts*, has been intrusted to Mr. Simms, acting under the general superintendence of Professor Miller. Several bars are finished with hard stone-ends, and are otherwise prepared; but none are yet actually compared with the fundamental line-measures.

In the autumn of 1854, the Astronomer Royal, assisted by a staff of six observers, made a series of pendulum experiments in the Harton coal-mine, near South Shields, for the determination, in the first place, of the difference in gravity at the top and bottom of a mine, and, in the second place, of the mean density of the earth; completing, in fact, an experiment which, in conjunction with Dr. Whewell, he had commenced twenty-eight years before in the Dolcoath Mine of Cornwall. The reduction of the mere pendulum experiments was effected in a few months, but much yet remained to be done. The country was to be surveyed, so as to give means of computing the theoretical attraction of the ground, and the specific densities of the rocks were to be investigated. The Corporation of South Shields gave directions for the survey; the owners of the mines supplied specimens of the rocks; and Professor W. H. Miller, of Cambridge, undertook the troublesome work of ascertaining their specific gravities. The whole of the computations have now been effected, and the result is, that the mean density of the earth is 6·57. This result, it will be remarked, considerably exceeds those obtained by Mr. Baily and Mr. Reich, from repetition of the Cavendish experiment, as the latter exceeded that obtained by Drs. Maskelyne and Hutton from the Schehallien experiment. In the opinion of the Astronomer Royal, the new result is entitled to compete on at least equal terms with the old ones.

Astronomy is indebted to Archdeacon Pratt for a valuable investigation of the effect produced upon the direction of the plumb-line by the attraction of the Himalaya Mountains and the elevated regions beyond them. The operations connected with the measurement of the great arc of India had established beyond doubt the existence of a sensible disturbance arising from this cause. Thus, the amplitude of the northern division of the arc included between Kaliana and Kalianpur, when determined by astronomical observations of latitude at the two extreme stations, was found to be *less* than the value obtained geodetically, which ought to have been the case if the attraction of the elevated region in question exercised a sensible influence. The difference of the results amounted to $5''\cdot236$, but it still remained to ascertain whether this represented the exact effect of the disturbing forces to which it seemed to be attributable. Archdeacon Pratt has computed the effect of mountain attraction in this case by a skilful use of the most trustworthy data available for such an inquiry, and he has found that it considerably exceeds $5''\cdot236$, even upon the most favourable supposition which can be made for diminishing its value. His final conclusion is, that the Indian arc is in reality somewhat more curved than it ought to be, upon the assumption of the generally-admitted mean value of the ellipticity of the earth; but that, when the effect of mountain attraction is taken into account, the deviation from the mean ellipticity is *less* than when that effect is neglected in the proportion of 5 to 9. The

Astronomer Royal has suggested an explanation of the discordance between the result of Archdeacon Pratt's investigation and the quantity brought to light by the Indian Survey, which does not suppose any irregularity in the curvature of the earth's surface, but refers the discordance to the neutralising effect produced by the partial subsidence of the mountainous masses on the earth's surface into the heavier fluid underneath. It may be difficult to ascertain beyond all doubt the origin of the discordance; but it will be generally admitted that all speculations of this nature, when conducted upon sound principles, have a tendency to exercise a salutary influence upon the progress of science.

Since the last Anniversary of the Society the group of minor planets has received an accession of five new bodies, viz. *Circe*, *Leucothea*, *Fides*, *Atalanta*, and *Leda*.

Circe was discovered by M. Chacornac at the Imperial Observatory, Paris, on the 6th of April. Its period is about 1812 days.

Leucothea was discovered by M. Luther at the Observatory of Bilk, on the 19th of April. Its period is about 1865 days.

Fides was discovered by M. Luther, at the Observatory of Bilk, on the 5th of October. Its period is about 1580 days.

Atalanta was discovered also on the 5th of October by M. Goldschmidt at Paris. Its approximate period is 1683 days.

Leda was discovered by M. Chacornac on the 12th of January, 1856, at the Imperial Observatory of Paris. Its period appears to be nearly 1660 days.*

Three new comets have been discovered in the course of the past year.

The first comet was discovered by M. Schweizer, at Moscow, on the 11th of April. It was a faint telescopic object, which continued visible for a few weeks. The orbit has been found to be sensibly parabolic.

The second comet of the past year was discovered by Dr. Donati, at the Observatory of Florence, on the 3d of June. It was also discovered independently on the following evening by M. Dien, at the Imperial Observatory, Paris, and by Dr. Klinkerfues, at the Observatory of Göttingen. Dr. Donati has deduced elliptical elements from the observations of this comet, indicative of a period of 492 years. He has shown that there are some grounds for supposing it to be identical with a comet which appeared in the year 1362.

The third comet of the past year was discovered by M. Bruhns, at Berlin, on the 12th of November. It continued visible till about the end of December. A parabolic orbit appears to satisfy the observations.

* Since the Report was sent to press, intelligence has been received of the discovery of another minor planet, by M. Chacornac, at the Imperial Observatory, Paris, on the 8th inst., the evening of the anniversary. The total number of minor planets now amounts to thirty-nine.—Ed.