ROYAL ASTRONOMICAL SOCIETY.

VOL. XIV. *February* 10, 1854. No. 4.

THE Annual General Meeting of the Society, G. B. AIRY, Esq., President, in the Chair.

Capt. H. Toynbee;
Arthur B. Martin, Esq., 43 Albion Street, Hyde Park;
Rev. Josephus Glover, M.A., Grosvenor College, Bath;
W. H. Besant, Esq., St. John's College, Cambridge;
Charles Roberson, Esq., 51 Long Acre; and
S. H. Wright, Esq., Royal Mail Steamship Lady Jocelyn,

were balloted for and duly elected Fellows of the Society.

Report of the Council to the Thirty-fourth Annual General Meeting.

The Council have once more the satisfaction of presenting to the Fellows a report of their proceedings, and of some other matters in which the Society must take interest, during the past year.

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

RECEIPTS.

	£	s.	d.
Balance of last year's account	476	6	7
By dividend on £2575 18s. 9d. $3\frac{1}{4}$ per Cents	40	12	9
By ditto on £1650 Consols	24	0	7
By ditto on £2575 18s. 9d. $3\frac{1}{4}$ per Cents	40	12	9
By ditto on £1650 Consols	24	0	7
On account of arrears of contributions	58	16	0
101 contributions (1853–54)	212	2	0
3 ditto (1854–55)	6	6	0
5 compositions	105	0	0
16 admission fees	33	12	0
12 first year's contributions	19	19	0
Sale of Publications	66	9	0
	£1107	17	3

EXPENDITURE.

				£	s.	d.
Cash paid Mr. Basire, engraver				36	6	3
George Barclay, printer				87	6	7
Cheque returned				2	2	0
George Barclay, printer				49	3	6
Executors of the Rev. Charles Turnor				50	0	0
George Barclay, printer				147	1	10
Investing compositions of Dr. Roxburgh and P. Kernan, Esq.				42	0	0
Taxes { 1 year's property tax	1	9	2			
Taxes { 1 year's land and house tax	5	4	2			
				6	13	4
J. Williams' salary				100	0	0
Ditto commission on collecting £395 2*s*.				19	15	0
Charges on books, and carriage of parcels				2	16	0
Postage of letters and Monthly Notices				38	6	2
Porter's and charwoman's work				12	0	2
Tea, sugar, biscuits, &c. for evening meetings				13	13	0
Coals, candles, &c.				12	18	6
Wages of boy to attend the door				9	10	0
Sundry disbursements by the Treasurer				20	1	0
Balance in the hands of the Treasurer				458	3	11
				£1107	17	3

Assets and present property of the Society :—

				£	s.	d.
Balance in the Treasurer's hands				458	2	11
1 contribution of 6 years' standing	12	12	0			
4 ——— of 5 ditto	42	0	0			
3 ——— of 4 ditto	25	4	0			
4 ——— of 3 ditto	25	4	0			
9 ——— of 2 ditto	37	16	0			
26 ——— of 1 ditto	54	12	0			
				197	8	0
Due for publications of the Society				2	1	6

£1650 3 per Cent Consols.
£2575 18*s*. 9*d*. $3\frac{1}{4}$ per Cent Annuities.
Unsold publications of the Society.
Various astronomical instruments, books, prints, &c.

Stock of volumes of the *Memoirs* :—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	40	VII.	223	XVII.	251
I. Part 2	83	VIII.	210	XVIII.	264
II. Part 1	101	IX.	217	XIX.	281
II. Part 2	63	X.	228	XX.	285
III. Part 1	130	XI.	238	XXI. Part 1 (separate).	340
III. Part 2	150	XII.	245	XXI. Part 2 (separate).	68
IV. Part 1	152	XIII.	264	XXI. (together).	222
IV. Part 2	165	XIV.	449		
V.	180	XV.	277		
VI.	198	XVI.	263		

Progress and present state of the Society:—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1853	133	184	64	6	387	58	445
Since elected	5	13	...	...	18	3	21
Deceased	...	−6	...	...	−6	−3	−9
Removals	2	−2	...	...	...	...	...
Resigned	...	−3	...	...	−3	...	−3
Expelled	...	−4	...	...	−4	...	−4
February 1854	140	182	64	6	392	58	450

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 reflector,
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,

are in the apartments of the Society.

The Brass quadrant, said to have been *Lacaille's*,

is in the apartments of the Royal Society.

The Standard scale

is in the charge of the Astronomer Royal, with the consent of the Council, to be employed in the construction of a new Standard Measure, under the direction of the Standard Committee.

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

The *Beaufoy* clock, } to the Royal Society.
The two invariable pendulums, } to the Royal Society.
The *Wollaston* telescope, to the representatives of the late Professor Schumacher.
The Variation transit (late Mr. Shearman's), to Mr. Gravatt.

The Council have received the amount of the legacy left by the late Mr. Turnor for the augmentation of the library, as stated in the last Report. The proceeds of the Turnor Fund will be applied according to the testator's desire, as occasion shall arise. It is hoped that Fellows who become aware of the exposure to sale of copies of valuable astronomical works, ancient or modern, which are not in the library, will communicate the name of the work and the place of deposit to the Assistant Secretary.

The medal has been awarded to M. Rümker, for his large and laborious catalogue of stars, now happily completed. The President will state the grounds of this award at the close of the meeting, in the usual way. M. Rümker's long and useful activity as an astronomer will probably cease with this work, but the Council trust that he will be spared to see the effects of his labours, and to enjoy the progress of the science to which his life has been devoted.

The printing of the twenty-second volume of the *Memoirs* of the Society has been completed within the last few days. The communications, although not numerous, are of a more than usually diversified character. The Council would especially call the attention of the Society to a paper on the observations of the late Rev. Thomas Catton, of St. John's College, Cambridge. These observations relate chiefly to eclipses of *Jupiter's* satellites, occultations of stars by the moon, and other similar phenomena. As they were found to extend over a period of forty years, and were apparently executed with great care, it was considered desirable to put them into a shape which would render them generally accessible to astronomers. The expense attending the reduction and printing of these interesting memorials has been defrayed out of a fund placed by the Government at the disposal of the Royal Society. The operations connected with both these objects were entirely superintended by the Astronomer Royal, who also drew up the communication embodying the results, and introduced it with a luminous preface. This is only one of many similar occasions on which the Council have experienced the gratification of acknowledging the personal exertions of Mr. Airy in rendering available for scientific inquiry materials which, notwithstanding their intrinsic value, might otherwise have either perished entirely or have slumbered for ages in the archives of some public institution.

The volume of the *Memoirs*, which has just been completed, contains also a paper on the theory of clock escapements by Mr. Bloxam, of Madeira, respecting which a short statement is desirable. Upon an examination of the paper, as originally communicated by the Astronomer Royal on the part of the author, it was found to possess much merit, but still it was not considered by the Council to be of so purely an astronomical a character as to justify them in publishing it in its actual form. In this emergency Mr. Airy very obligingly undertook to adapt the paper for publication and to superintend its progress through the press. Practical astronomers will thus have an opportunity of consulting a valuable investigation of a very important subject.

With respect to the *Monthly Notices,* the present Editor has uniformly endeavoured to adhere to the plan of publication which Mr. Sheepshanks introduced about a year since with the approval of the Council. The expediency of modifying to a certain extent the plan hitherto pursued was suggested to Mr. Sheepshanks by a consideration of the large and growing space which was being devoted to observations and ephemerides of the minor planets, arising from the continual increase of the number of those bodies by new discoveries. If, indeed, no other channel existed for the publication of these materials than that afforded by the *Monthly Notices*, the benefits which might be expected to accrue to astronomy from giving them forth to the world would have served in some degree to compensate for their effect in excluding other subjects of more varied interest. It was, however, universally admitted that all communications of this nature were published with greater regularity, as well as earlier and more fully, in the *Astronomische Nachrichten*, and that the pages of the latter periodical were familiar to all those who were in the habit of consulting such materials. The discovery of four additional minor planets since the last Annual Meeting has only served to strengthen the views of the Council in favour of the modification recently introduced. By imparting a more varied complexion to the subject-matter of the *Monthly Notices,* it is confidently expected that the interests of astronomical science will be more effectually promoted. Even as regards the minor planets, the theory of the movements of those bodies has given rise to a train of interesting researches which it will manifestly be desirable to record. On this and every other subject of astronomical science the *Monthly Notices*, under the present arrangement, offer a channel of communication, the advantages of which cannot fail to be generally appreciated.

The present Editor has gladly acknowledged to the Council the deep sense which he entertains of his obligation to Mr. Sheepshanks, who has most effectually aided him in the performance of his duties by kindly and liberally favouring him with his valuable counsel on many occasions when, from his own inexperience, he might naturally have felt some hesitation in deciding upon the course which was best calculated to advance the interests of the Society.

It is with sincere regret we have to announce the loss of Dr. PETERSEN, who died at Altona on the 3d of February. An account of this excellent and indefatigable astronomer must necessarily be postponed till next year; but we may be allowed to hope that the Altona Observatory will still be maintained in a state of activity and usefulness. We have not heard who is to undertake his department in the editorship of the *Astronomische Nachrichten*, but we conceive that, among the many highly cultivated and intellectual astronomers which Germany can boast, some one will be found possessed of the qualities requisite for the discharge of these duties. In the present state of astronomy, scarcely any injury could be more serious than any delay or irregularity in the publication of this universal journal, which connects the observers of every country, and collects into one accessible whole the various improvements and discoveries which are continually making.*

The Council have also to regret the loss, by death, of three Associates:—M. Arago; Don Cerquero; Sears Cook Walker, Esq.; and of the following Fellows:—Edmund J. Dent, Esq.; George Frost, Esq.; Henry Harvey, Esq.; Lieut. Stratford, R.N.; Thomas Weddle, Esq.

Jean François Arago was born on the 26th of February, 1786, at Estagel, near Perpignan, a town in the south of France. His father, who inherited a small patrimony, was Treasurer to the Mint at Perpignan. François was the eldest of a family of five children, consisting of three sons and two daughters. In early life he contracted a strong predilection for a military life, an avowal of which on one occasion had the effect of determining his future career as a philosopher. Happening to meet an officer of Engineers on the ramparts of Perpignan, he inquired of him by what means he might become qualified to wear a similar uniform. The officer told him that he would require to study the military art at the Polytechnic School. Accordingly, soon afterwards, when he was still very young, he repaired to Paris, and entered the Polytechnic School, where he soon distinguished himself by his extraordinary vivacity and intelligence. At this time the French Revolution had occurred, and a new system of education was generally introduced throughout France, from which the study of classical literature was almost wholly excluded. It happened, in consequence, that Arago did not enjoy the advantages of a good classical education, a circumstance which he regretted very much during the subsequent period of his life.

In 1803, he entered the University of Thoulouse, where he made such rapid progress in the study of mathematics and physical science, that, at the close of a year, he was induced, at the suggestion of the elder Monge, to attach himself to the Observatory of Paris, which was then directed by Bouvard.

In 1804, being the year of his entrance into the Observatory, Arago was appointed by Laplace to co-operate with Biot in a series of experimental researches for determining the refractive powers of different gases. Biot was also at this time an assistant at the Observatory, but he was older than Arago by twelve years. The results of their joint labours were embodied in a paper which was communicated in both their names to the Institute of France, and which was published in the Memoirs of that body for the year 1806. The paper was entirely drawn up by Biot, to whom these experimental researches must be considered as mainly due. Arago,

* Until further arrangements are made, Professor Hansen undertakes the sole direction of the *Nachrichten*.

however, by his activity and intelligence, made such a favourable impression upon his elder colleague, that he was received by him into his house and treated as a member of his family.

In 1806, MM. Biot and Arago were appointed by the French Government to execute the geodetical operations required for prolonging the French Arc of the Meridian from Barcelona, in Spain, to Formentera, one of the Balearic Isles. During the latter period of that year and the beginning of the following year, they succeeded in connecting the kingdom of Valentia with the Island of Yviça, by means of an immense triangle, the spherical excess of which amounted to 39″. This had hitherto been regarded as a hazardous operation, of the success of which Méchain had altogether despaired.

The triangulation was now rapidly continued on to Formentera, the southern extremity of the Arc. Upon their arrival here, however, they found themselves unable to determine the latitude, in consequence of the repeating circle having been accidentally broken in the course of their expeditionary journeys. Biot was induced, in consequence, to return to France for the purpose of obtaining another instrument, leaving Arago and the Spanish Commissioners, Rodriquez and Chaix, to execute the triangulation of Valentia. During the summer of 1807, Arago was employed in this operation, in the execution of which, says M. Biot, he displayed uncommon ability as an observer and great powers of endurance, having been exposed to devouring heats, the effects of which his southern origin alone enabled him to withstand.

In the autumn of 1807, M. Biot returned to Spain, and in concert with Arago determined the latitude of Formentera. The facility of connecting their operations with a small arc of parallel having been recognised, they resolved to measure the latter, but for this object two observers were no longer necessary. Biot accordingly proposed to Arago either to return to France, or to remain in Spain and complete the additional operations which they had decided upon executing. Arago chose the latter alternative, and Biot returned to France.

While Arago was engaged in the operations connected with the determination of the arc of parallel, the war between France and Spain broke out, and he became henceforth exposed to great danger. Rumours were spread abroad that the fires which blazed at the signal stations on Mount Galatzo were telegraphic messages to the invading army, and it was even alleged that the astronomical instruments were pregnant with danger to the country. Arago was accordingly denounced as a spy, and he was saved from the fury of the multitude only by the authorities imprisoning him. On the 2d of June, 1808, he escaped to Algiers, where he remained ten days, and then embarked for France in an Algerine frigate. The vessel had reached the Gulf of Lyons, and was already within sight of the coast of Provençe, when it was captured by a Spanish privateer and conducted to Rosas. Arago, dreading that he might be recognised by persons who had formerly seen him in Spain, was induced to assume the character of a pedlar. He was first confined in a windmill, but he was subsequently imprisoned along with the crew of the Algerine vessel in the Fort of Trinity, from which, after a short confinement, he was transferred to the hulks of Palamos, where he was subjected to much cruel treatment, having almost perished for want of food.

The Dey of Algiers, upon becoming acquainted with the capture of one of his vessels by a privateer of Spain, demanded satisfaction of the Spanish Government, insisting at the same time upon the immediate liberation of the crew of the vessel, including Arago. It has been said that he was prompted to this spirited act more especially by the circumstance that there had been two lions on board the vessel which were intended as a present to Napoleon, and one of which had been killed by the Spanish sailors.

Arago, having been thus liberated by the intercession of the Dey, again embarked for Marseilles on the 28th of November, 1808. Once more, however, his hopes of returning to his native country were frustrated. Just as the ship was about to enter the harbour of Marseilles, a sudden storm drove it out to sea and carried it to the coast of Sardinia, which was then at war with Algiers. The vessel, although much shattered, dared not make for the land, but directed its course towards the coast of Africa, which it reached on the 5th of December, entering a place called Bougia, about three days' journey from Algiers. Arago arrived at Algiers on the 25th of December. The Dey, who had rescued him from the hulks of Palamos, had been beheaded in his absence. The new Dey opposed his departure, believing him to possess great wealth; and he was saved from a cruel death only by the interference of the Danish Consul. Fortunately the Dey was soon afterwards executed, and Arago, after a residence of six months, quitted Algiers on the 21st of June, 1809. On the 1st of July, when the vessel was within sight of Marseilles, it was chased by an English cruiser, but fortunately it escaped, and Arago safely arrived in his native country, bringing with him all his instruments, manuscripts, and plans.

The friends of Arago, who had received no intelligence respecting him since the return of Biot, believed him to be dead. His mother, during his absence, had succeeded in obtaining possession of the watch which he had been obliged to sell at Rosas; but she had despaired of ever more seeing her beloved son. The first letter which Arago received, while he was yet in the Lazaretto of Marseilles, was one from the illustrious Humboldt. Then commenced a close friendship between these two distinguished men, which continued without interruption till death put an end to it.

Upon the arrival of Arago in Paris, he was received with great attention by Laplace, Monge, and many of the other *savans* who then adorned the metropolis of France. In 1809, when he was only twenty-three years of age, he was elected a Member of the Institute of France in the room of Lalande, whose death had occasioned a vacant place in the section of astronomy. Soon afterwards he was appointed one of the Professors of the Polytechnic School, and also one of the astronomers attached to the Imperial Observatory.

The discovery of the polarisation of light by Malus, in the year 1811, had the effect of directing the attention of Arago to that interesting branch of optical science. His brilliant labours on this subject, and his subsequent researches on magnetism, will always secure for him a high place among the successful cultivators of experimental physics. It would be unsuitable, however, to give any detailed account of them on the present occasion.*

In 1816, Arago, in conjunction with Gay-Lussac, established the *Annales de Chimie et de Physique.* In the same year he visited England, when he became personally acquainted with Dr. Young, and several other distinguished philosophers of this country. In 1818 he was appointed along with Biot to execute the geodetic operations required for connecting the French Arc of the Meridian with the English Arc. In 1821, the results of their joint labours in Spain, and on the present occasion, including Biot's pendulum experiments in Scotland, were published in a work entitled, "*Recueil d'Observations Géodésiques, Astronomiques et Physiques, exécutées par ordre du Bureau des Longitudes.*" It is right to mention that the text and the calculations of this work are exclusively due to Biot. It may be stated, also, that the work does not contain any account of Arago's operations relative to the measurement of the arc of parallel in Spain, to which allusion has been made in a former part of this notice.

In 1822 Arago was appointed a Member of the *Bureau des Longitudes.* Henceforward he continued to publish in the *Annuaire* of that body a series of scientific notices relative to different subjects, which, besides being remarkable for the lucid and charming style in which they are expressed, are highly valuable on account of the light which they throw upon many interesting points of physics.

In 1830, when the revolution of July broke out, M. Arago, who had always been an ardent friend of liberty, gave his cordial adhesion to the movement party. He was consequently elected member of the Chamber of Deputies for the Lower Seine, and thus became involved in the strife of political warfare. In the same year he was appointed Director of the Observatory of Paris, and also Perpetual Secretary of the Institute for the Mathematical and Physical Sciences in the room of M. Fourier.

Although gifted with great powers of eloquence, M. Arago seldom spoke in the Chamber of Deputies except when advocating some question relating to the interests of science. On every such occasion his opinion was listened to with profound deference, and was generally effectual in persuading the Chamber to sanction the

* The reader is referred for an account of M. Arago's experimental researches, and also for further details of his life, to an article in the *North British Review* for the present month (February), drawn up, it is understood, by a personal friend of the deceased.

project recommended by him. It was mainly by his influence that the Observatory of Paris was repaired and furnished with new instruments, and thus placed in a condition of rivalling the other great Observatories of Europe. He was also instrumental in procuring the publication of new editions of the works of Laplace and Fermat at the expense of the country. In short, every project of a scientific nature—whether relating to engineering, surveying, telegraphs, or any similar object, which recommended itself for adoption on the ground of its practical utility, found in M. Arago an indefatigable and eloquent advocate.

As Perpetual Secretary of the Academy it became the duty of M. Arago to write the *éloges* of eminent deceased Members and Associates of that body. His compositions of this nature are all remarkable for the chaste and eloquent language in which they are clothed.

In 1834 M. Arago visited England a second time, and attended the meeting of the British Association for the Advancement of Science, which was held that year in Edinburgh. In 1840 he was elected Member of the Council General of the Seine.

In 1848, when the revolution of February broke out, M. Arago was appointed a Member of the Provisional Government, having been nominated to the vacant offices of Minister of War and of Marine. During the insurrection of the working classes, which occurred in the month of June 1849, he displayed great personal courage in endeavouring to appease the angry multitude, but although formerly the object of their reverence, he was no longer able to exercise any influence over them. The hopes which he had long entertained of the establishment of a Republic in France were thus completely frustrated by the folly of the people. Henceforward he ceased to occupy his attention with politics. Unfortunately about this time his health became impaired and his sight began to fail. Warned by these symptoms, he now resolved to prepare for publication the great mass of scientific writings which he allowed to accumulate during his active career.

The *coup d'état* of the 2d of December, 1852, formed the death-blow to the illusion which he had so long cherished relative to the establishment of a Republic in France. When summoned to take the oath of allegiance to the new Government, he refused to do so. On that occasion he addressed a memorable letter to the Government justifying his conduct, and setting forth his claims to the favourable consideration of his countrymen. Notwithstanding his refusal to comply with the demands of the Government, he was allowed to retain his appointment as Director of the Observatory.

In the summer of 1853 the health of M. Arago having become very feeble, he proceeded to the Eastern Pyrenees, under the care of his niece, Madame Laugier, his friends having advised him to try the effect of his native air upon his constitution. He soon afterwards, however, returned to Paris, without any hope of recovery. He died on the 2d of October, 1853, in the sixty-seventh year of his age. His remains were interred in the cemetery of Père La Chaise. A funeral oration was pronounced over his grave by M. Flourens, the Perpetual Secretary of the Academy.

M. Arago in early life married a lady of the south of France, who has been dead many years. He had two sons by her, both of whom have survived their parents.

In his family relations he seems to have enjoyed a source of great happiness. "This man," says M. Flourens, "in whom were united so many excellencies, devoted a portion of his life to the cultivation of domestic affections. He had experienced all the sweets of filial piety; the cord of his affections extended itself without being weakened; his brothers, his sisters, were always with him, under the paternal roof; his own children and theirs were equal objects of his regard: thus he found a daughter whose pious and touching cares ought to receive this day the grateful acknowledgment of the Academy."*

Researches on subjects which have no immediate connexion with astronomy form the principal claims of this distinguished man to the remembrance of posterity; but his acute and brilliant intellect, combined with his extraordinary energy and his enthusiasm in the cause of science, exercised a powerful influence upon the cultivation of almost every branch of physical inquiry, more especially among his own countrymen. He possessed a remarkable aptitude for expounding the principles of science, and rendering them intelligible to the uninitiated classes of the community. His eloquent lectures on astronomy delivered at the Royal Observatory of Paris were always listened to with attention by a crowded audience.

M. Arago was endowed with an ardent temperament, which occasionally had the effect of involving him in controversies tending to detract from the influence so justly due to his high intellectual qualities. These, however, are faults which are more or less inseparable from human nature in its present existence. Assuredly when they have been long forgotten the name of François Arago will still continue to occupy a distinguished place in the annals of science.

It has been announced since the death of M. Arago that his writings are about to be published in twelve volumes octavo, under the superintendence of M. Barral, an intimate friend of the deceased.

Don Jose Sanchez Cerquero entered very young into the Spanish naval service: he was born about 1784. He was actively engaged during the war; but his whole leisure, from boyhood up to his appointment, in 1816, to a subordinate post in the Observatory of San Fernando, was devoted to the study and application of mathematics. Admiral Smyth, who was his comrade at the siege of Cadiz in 1810, informs us that he there commanded a gunboat under Admiral Valdez. In 1825, he was promoted to be Director of the Observatory, and immediately undertook the task of

* Madame Laugier, his niece.

bringing it up to the existing state of science. For this purpose he came to England, and made a close inspection of the Observatory at Greenwich, an account of which was found among his manuscripts; he also visited France and Belgium. In the midst of the cares which the choice and mounting of instruments threw upon him, he undertook the improvement of the *Nautical Almanac*, and the extension of its size. His first publication was on the longitude of Puerto-Rico, which appeared in De Zach's "Correspondence." In addition to the *Nautical Almanac*, he wrote on the various methods for obtaining latitude at sea by observation of altitudes, on the formulæ for reduction of observations, and on the calculation of eclipses. He published also in the Brussels Correspondence of M. Quetelet a memoir on the errors of the transit instrument, and left various memoirs on pure mathematics, &c. unpublished.

Cerquero died in 1850. He was an elegant scholar, and well acquainted with English, French, Italian, and German.

Sears Cook Walker was born at Wilmington, Massachusetts, on the 28th of March, 1805. The early life of Mr. Walker was marked by an uncommonly precocious mental developement. At the village school, while yet a child, he so easily outstripped every other boy in the school, that he became the wonder of the neighbourhood; but his very delicate bodily organisation demanded, and obtained, the most untiring watchfulness and care from his admirable mother, upon whom devolved the whole responsibility of his education, as his father died just as the son had attained the age of six years. She happily appreciated the importance of strengthening the physical, as an aid to the mental powers, and never, in the desire to have her son admired as a youthful prodigy, failed to act upon that conviction.

Her efforts, guided by excellent judgment, were successful; he was soon restored to health; and, until about a year before his death, his bodily vigour was unimpaired.

Having received preparatory education at the school of Mr. Putnam, of Andover, Mr. Walker entered Harvard College in 1821, at the age of sixteen, and during his college life it might have been doubted whether he would most distinguish himself as a linguist or as a mathematician; he could read with ease seven languages; and having a very retentive memory, could quote from them all to an extent that is rarely surpassed. He had also a great aptitude for the natural sciences,—botany, mineralogy, and geology, were his favourite recreations,—we might say his only recreations; for, in the amusements of the world, with the single exception of the Opera, he took no interest. These tastes, in addition to a fondness for chemistry, induced him to go through with a regular course of medical studies; not, however, intending at any time to pursue this as a profession.

On graduating, in 1825, Mr. Walker chose a mathematical subject for his thesis, and acquitted himself with honour. He then opened a school in the vicinity of Boston; and it was at this time that his partiality for astronomical pursuits first developed itself, as he would often pleasantly remark, that the Observatory at Dorchester, where he was a frequent visitor, must be held responsible for all his astronomical sins. Shortly afterwards he removed to Philadelphia, and there established a school, in which he soon became distinguished for his success in imparting knowledge, and inspiring the minds of his pupils with zeal for scientific and literary pursuits. While thus engaged he was elected a member of the American Philosophical Society, the Geological Society of Pennsylvania, and of the Franklin Institute: that he proved an active and efficient member of these Societies their records amply indicate.

As soon as his means permitted, he procured a small Dollond telescope, an astronomical clock, and a 20-inch transit instrument. The use of these proved so attractive that all other recreations were abandoned, and astronomy absorbed his whole leisure. From the year 1834 to 1842, he computed the occultations visible in the United States. These were published monthly in the Journal of the Franklin Institute.

After some years of severe toil as a schoolmaster, he was, in 1836, appointed Actuary of the Pennsylvania Life Insurance Company: here he had daily occupation for only six hours, and all the remainder of his time, not required for rest, was devoted to astronomy.

In 1837 he was invited to suggest a plan for an Observatory to be erected in connexion with the Philadelphia High School; and in accordance with his recommendation, a 9-foot Fraunhofer equatoreal, a meridian circle by Ertel, having a telescope of 5 feet focal length, and a comet-seeker, were procured from Munich, and placed on suitable piers under a revolving dome in a building adjoining the schoolhouse.

The equatoreal was mounted in 1840, and here Mr. Walker laboured assiduously, in company with his brother-in-law Professor Kendall, who, as principal of the school, had charge of the Observatory, until the year 1845, when Professor Walker was called by Mr. Bancroft, then Secretary of the Navy, to a position in the National Observatory at Washington city. Here his presence was soon felt in the increased energy of the well-directed efforts of the corps of observers. It was during Mr. Walker's brief sojourn at the National Observatory that he commenced his well-known investigations in regard to the planet *Neptune*. These he continued while his health permitted, through the remaining years of his life, with increasing interest for astronomers.

While residing in Philadelphia, Mr. Walker had acquired the warm friendship of Dr. A. D. Bache, Superintendent of the United States Coast Survey, and on retirement from the National Observatory accepted Dr. Bache's offer to take charge of the astronomical department of the Survey, for the determination of the latitudes and longitudes of the principal stations of the main triangulation by astronomical observation, and subsequently of the differences of longitude by aid of the electric telegraph. This important office Professor Walker continued to fill during the remainder of his life, to the entire satisfaction of Dr. Bache and credit of the country. It was here that he found encouragement to extend and perfect the different methods of scientific investigation which his ever-active mind was continually suggesting; its acuteness and delicacy were evinced on many occasions: we may instance his detection of a delay in the transmission of the galvanic inducing waves proportionate to the space traversed. His report to the Superintendent of the Coast Survey, under date of April 24th, 1851, is highly interesting, as it contains an account of the progress of improvement and invention in the art of determining longitudes by the electric telegraph; and proves, without the slightest undue assumption on his part, that to him more than to any other individual science is indebted for the introduction of the electric method of observing.

Mr. Walker had made the largest collection of American observations of moon-culminations and occultations ever made in this country, and had prepared to discuss them thoroughly for longitudes, and to bring them to bear, as far as applicable by the geodetic results of the Coast Survey, upon the longitude of a central point. During this discussion he reached the conclusion that the longitudes from moon-culminations could not be reconciled with those from occultations, and that the lunar theory must be re-examined for an explanation. His published reports show the successive steps of his investigation, which was not completed at the time of his decease.

An apparently slight attack of paralysis was followed by mental alienation, which continued with scarcely a lucid interval to the time of his death, which took place at the residence of his brother, Judge Walker, in Cincinnati, on the 30th of January, 1853.

This brief sketch cannot be more appropriately closed than in the language of Judge Walker:—"We may not say that he died a martyr to science, but he lived one of its most devoted lovers. His delight was among the stars,—all else was labour. This was pleasure, or rather intense delight, and he had no other passion or ambition. What he had accomplished, we know; what he might have done had his life and health been spared, it is vain to conjecture. A more simple-hearted, amiable, and affectionate person would scarcely be imagined. He wooed science with a devotion that excluded all other loves, until, in the ardour of pursuit, his brain gave way."

The following communications were made by Professor Walker to the American Philosophical Society, and published in the Transactions and Proceedings of that body:

In the Transactions.

Vol. V. On the Longitude of the Hall of the American Philosophical Society, deduced from an Occultation of *Aldebaran,* Jan. 5, 1830.

Observations on the Solar Eclipse of Nov. 30, 1834, made at Philadelphia and Germantown, Pennsylvania.

Determination of the Longitude of several stations near the northern boundary of Ohio, from Transits of the Moon and Moon-culminating Stars, observed in 1835 by A. Tolcott, Captain U. S. Engineers. Report of Committee on Solar Eclipse of May 14–15, 1836.

VIII. Researches concerning the Periodic Meteors of August and November.

Observations of Encke's Comet at the High School Observatory, Philadelphia, March and April 1842, with the Fraunhofer Equatoreal. (Walker and Kendall.)

X. Investigations which led to the Detection of the coincidence between the computed place of the Planet *Neptune*, and the observed place of a Star recorded by Lalande in May 1795. Read Feb. 19, 1847.

Proceedings.

Vol. I. On Galle's Second Comet, and reference to the Discovery by Galle of a Third Comet.

On determining Longitudes from corresponding Observations of Meteors.

The August Meteors.

Meteors of August and November 1840.

The Observations at Harvard.

The Parallax of the Star 61 *Cygni*, recently investigated by M. Bessel.

II. Periodical Meteors.

Comet of 1843.

Encke's Comet.

III. Comet of 1843.

Supplementary Letter.

IV. Comet of February 1843.

Comet in *Orion.*

Herries' Comet.

Biela's Comet.

Elements of Planet *Neptune.*

On Identity of Lalande's Star and *Neptune.*

New Elements of *Neptune.*

V. Results of his Labours in regard to the Planet *Neptune.*

Abstract of Report of the Results of Telegraphic Operations of the United States Coast Survey.

Kirkwood's Discovery of a new Analogy in relation to the Periods of Rotation of the Primary Planets.

To these papers may be added a large number of reports made by Mr. Walker, on subjects connected with the Coast Survey, and published in the annual reports of the Superintendent.

The individual—a well-known American astronomer—to whom the Council are indebted for the foregoing details respecting the life and labours of Professor Walker, concludes his communication in the following terms:—"In my endeavour to trace the social and scientific life of my deceased friend, I have felt that it was only by those who knew him intimately, and in retirement, that the excellence of his character could be fully estimated."

Though it is not usual to introduce supplements to obituary notices contained in former reports, yet the interest which is here felt in all that relates to Francis Baily will justify the statement of some facts relative to his early life, which have been brought out by a recent examination of his correspondence, and of the journal of his voyage in America.

Perhaps the earliest mention of his name in print is in the proceedings of the American Congress. The Spanish authorities had imposed various hardships upon citizens of the United States and other foreigners, by the depreciation of their coinage; and in the discussions which took place at Washington upon this subject, the name of Baily is cited as one of the parties aggrieved. It distinctly appears that one of the objects of his tour was the formation or extension of commercial connexion, probably of some house in England. It also appears that during his voyage he gave formal notice of his intention to apply for the privileges of citizenship, with a view to take up his permanent residence in the United States; and further, that his friends in England were made cognisant of this intention. Some allusions to a young lady seem to give the reason of this contemplated change of country; but nothing is found which explains the abandonment of the plan. Two subjects are concealed in short-hand; one is that which has just been hinted at, the other is the expression of his feelings towards Washington, for whom he entertained a respect, the depth of which may best be judged of from the description of his mode of recording it.

On his return to England, he seems for some time to have had no decided plan, except that of adopting some life of active adventure. In May 1798, he was seeking a commission in the militia, and an ensigncy in the Volunteer Company of the Berkshire corps was actually offered. In December of the same year, he had been inquiring as to the means of obtaining a commission in the Engineers; and a letter from Bonnycastle, which represents the impossibility of such a thing, hints at the East India Company's Service, and informs him that several officers and other gentlemen are soon going to Turkey. In May 1799, he applied to the African Association, with an offer to enrol himself in their service as a traveller, and by a letter from Sir Joseph Banks (June 11), it appears, that, if there had been sufficient funds, his offer might have been seriously considered. In a private letter to Sir John Stepney (Sept. 18, 1799) is the following passage:—"I had proposed to myself a route which should be less circuitous than those of Park or Horneman, namely, to proceed northwardly or north-eastwardly from Calabar or Wydah, till I should strike the Niger. I had the subject so much at heart, that I would have gone through any trials to have accomplished my object. With respect to the difficulties and dangers of such an undertaking, they would no doubt have been many; but they are things which much experience of this mode of travelling in the New World has induced me to think light of. I can even say with Horace, *Dulce periculum est.* So true is it that habit and custom can soon efface those disagreeable sensations which arise from some of the rough accidents of life. After a number of fruitless attempts to succeed in my object, and meeting with so little encouragement in the prosecution of it, I have at length determined to give it up; and an event is about to take place which most probably will prevent my ever resuming it —this is, my going to enter into partnership with an eminent stock-broker in the City."

All this time it appears that Baily was paying close attention to mathematics, astronomy, and botany. The earliest astronomical writing of his now extant is a paper (dated October 1798), written apparently for his own instruction, containing a description of a neatly drawn projection of the heavens after sunset on April 5, 1799, at which time, he says, "all the planets in our system will be above the horizon at the same time, forming a line along the ecliptic from the most westerly point to near the zenith."

The origin of the work on *Tables and Formulæ* is in a manuscript having the title "Elements of Astronomy, deduced from M. Laplace's 'Exposition du Système du Monde.'" London, 1810. This manuscript, most neatly written, was certainly intended for publication; and by being marked in pencil, "Communicated by Francis Baily, Esq.," and "25 copies for Mr. Baily," it seems to have been drawn up for some society for mutual instruction, or other private association.

To complete what was said on Baily's writings in Sir John Herschel's memoir of his life, it may be added that a large mass of his astronomical papers and correspondence, including much of the account of Flamsteed, and the whole of the Catalogue, is, or will be, deposited at Greenwich. The manuscripts of the works on leases, on interests, and on annuities, are in the library of the Institute of Actuaries. An account of his correspondence with Mr. George Barrett, which was the means of laying before the world one of the greatest improvements ever made in the calculation of life contingencies, will appear in the *Assurance Magazine* for April next.

The Council have not been furnished with any details respecting the life of Mr. Dent, but the following tribute to his merits as an artist, contained in a letter from M. Otto Struve to the Astronomer Royal, dated Jan. 17, 1854, cannot fail to be gratifying to his friends:—

"It is my fault that I have not more particularly written to you before, for the Council's Annual Report to the Astronomical Society, by what means the late Mr. Dent had contributed to advance Russian geography. Perhaps it is not yet too late to point out the following principal merits: 1st, the unequalled (at least so far as we know) perfection of his chronometers; 2d, the liberality with which he put to our disposition a large number of his chronometers; 3d, the assistance with money, credit, and instructions, by which he enabled our Petersburg chronometer-maker, Mr. Pitt, to establish himself in St. Petersburg, on purpose that we might have our chronometers and watches cleaned and repaired *in loco* by a first-rate artist.

"The number of chronometers Mr. Dent had lent us, without any direct pecuniary remuneration,—and most of them for many years,—amounted to more than seventy. It was by the free command of that large number of his excellent productions that we were enabled to give to our chronometrical operations that rapid display, by which at present nearly the whole of European Russia is regularly covered with thousands of astronomically determined positions. We owe this acknowledgment to his memory, and would be very much gratified if you will mention it in the Annual Report."

George Frost was born on Christmas-day 1798, at Thorpe-le-Soken, in Essex, and is descended from an ancient family in Lincolnshire. He received the early part of his education at a private academy in his native village, where he studied navigation with the intention of entering the Navy. In 1819, he came to London and finished his education. He then abandoned his former intention of going to sea, and became a member of the London Mathematical Society, where he made considerable progress in that branch of science. At that time he was engaged as mathematical tutor in the family of the present Bishop of London, and in other quarters. In 1833, he was elected a Fellow of this Society, and the same year published a work under the title of "The View of the Earth and Heavens." His other publications were principally mathematical, and amongst his manuscript papers is a work on Astronomy which he was preparing for the press.

Being fond of pursuits in the country, he was latterly much engaged in directing the agricultural operations of his estates in Essex and Suffolk. He died suddenly, December 23, 1852, much respected.

Henry Harvey was born at Holt, in Somersetshire, in July 1783; he finished his education at Trinity College, Cambridge. He passed sixteen years in the East India Company's service, and was severely wounded at the battle of Assaye. Being independent in his circumstances, he returned to England, and occupied himself in his own pursuits, one of which was astronomy: in the last years of his life he took a large share in the management of a joint-stock bank. He died on the 6th of March, 1853. He was a brother-in-law of Captain Basil Hall, and an intimate friend of Captain Kater. He was three times married, and his first wife was the widow of Sir William de Lancy, who fell at Waterloo. He was a man of highly cultivated mind and manners, and much attached to science.

William Samuel Stratford, eldest son of William Stratford, Esq., of Farncote, Gloucestershire, was born on the 22d of May, 1789, at Eltham, Surrey. He received his early education at Hanwell Heath Academy, and afterwards attended the school of a Mr. Oard, in London. He was one of a family remarkable for their mathematical attainments, and always evinced great aptness and inclination for those studies.

In the year 1806 he entered the navy as a first-class volunteer on board the Pompée, under the command of Sir Sydney Smith, whose favour he soon acquired, and from whom he invariably received the greatest kindness. He always spoke of Sir Sydney in terms of the highest regard, dwelling particularly on his friendly feeling towards, and great interest in, all the young men who came under his care. He served for some time in the Mediterranean, was engaged in the defence of Gaeta and the reduction of Capri, and served in the expedition to the Dardanelles, and at the destruction of a Turkish squadron off Prinkipos Island. He accompanied, as a midshipman, the force sent against Copenhagen, where he received a slight wound; and continued in active service till 1812. In 1815 he received his promotion as lieutenant, and after that time remained on half-pay.

He was one of the earliest and most active members of the Royal Astronomical Society, and filled the office of Secretary from 1825 to 1831. He was afterwards one of its vice-presidents, and a member of the Council until the state of his health obliged him to discontinue his attendance.

He was one of the committee of the Society to whom the state of the *Nautical Almanac* was referred by the Admiralty in 1830. In 1831 he received the appointment of Superintendent of that work, which office he held till his death, which occurred on the 29th of March, 1853. Under his superintendence the recommendations of that committee were ably carried out, the character of the *Almanac* as a work of science was greatly raised, its magnitude and circulation, and its public usefulness, were greatly increased.

Besides the performance of his public duties, he rendered other valuable services to the science of astronomy. He performed one set of the duplicate calculations for the original catalogue of the Royal Astronomical Society, for which he received their silver medal, at the same time that Baily received the gold one. In 1837 he published, as an appendix to the *Nautical Almanac*, a volume on the elements of the orbit of Halley's comet; and in 1845 completed the printing and notes, after the death of Mr. Baily, of the catalogue of stars for the British Association for the Advancement of Science. When a young man he was a correspondent of some of the mathematical periodicals. He was a fellow of the Royal Society, and was a member of, and correspondent with, several foreign scientific bodies.

Mr. Stratford will long be remembered in this Society as one of the most devoted, and for a long period one of the most active and useful, of its supporters. It should be recorded, that, during the time he was Secretary the office of Assistant-secretary did not exist; and that the whole routine of the business was conducted by him, from the correction of the proofs of the *Memoirs* to the folding of circulars. The amount of actual labour performed by him was very considerable; and during the time in which the Treasurer did not reside in London, a large portion of the management of the accounts fell to his share. He was always willing to undertake any useful work, and brought to its performance all the energy of his character. He had strong feelings, and was accustomed to confide in their impulses, so that, as may be supposed, his career in this Society, and in the world, was not without storms. But he had great kindness of heart and good temper, and could bear with any amount of remonstrance, or even reproof, from those to whom he was sincerely attached. Among the number of these was Mr. Baily, with whom he long lived in great intimacy, and for whom he had a respect amounting to veneration.

Mr. Thomas Weddle was born November 30, 1817, at Beaumont House, near the village of Stamfordham, in the county of Northumberland. His mother's brother was the late Mr. Henry Atkinson, of Newcastle-on-Tyne, well known by his writings, especially the paper on refraction, in our Transactions.

Mr. Weddle received part of his early education at Stamfordham. He made rapid progress in classics, which however he did not prosecute to any great extent, but he subsequently acquired such a knowledge of the French and German languages as enabled him to read with facility the writings of the Continental mathematicians. The bent of his mind lay evidently towards the exact sciences, and under the care of his grandfather he acquired an accurate knowledge of the usual preliminary branches of a mathematical education. Though he was educated principally by his grandfather, he likewise received some instruction at the Anchorage School, Gateshead, of which the late Mr. James Charlton was the able conductor. Here his genius for mathematics began to develope itself, for he not only acquired a knowledge of the Elements of Euclid with wonderful rapidity, but while studying them, suggested various improvements in the demonstrations, and pointed out many extensions and modifications of different propositions. The work on geometry he studied at this school was Playfair's Euclid, in which the propositions of the Fifth Book are demonstrated algebraically. On reading the Eighth proposition of that book he remarked to his master that Playfair's demonstration of that proposition was defective: that it was not general, and that there was a case entirely unnoticed by that great geometer. While at school, Mr. Weddle became acquainted with the Cartesian method of applying algebra to geometrical investigations.

Mr. Weddle began his profession as a teacher with the Rev. Mr. Walton, of Allenheads; he shortly afterwards came to Horsley, near Ovingham, where he kept a school for some years, and where he prosecuted his mathematical studies with remarkable success.

It was while at Horsley that Mr. Weddle first attracted notice as a profound mathematician, for it was here that he discovered his *Method of Solving Numerical Equations of all Orders.* This highly meritorious and most important method was communicated to the Royal Society, and read before that learned body in 1841; it did not however appear in their Transactions, but was published by subscription in the following year, after he had removed to Newcastle-upon-Tyne. This is a method by which numerical equations of very high orders and involving large coefficients can at all times be solved, which were quite unmanageable, even by the most modern and effective processes which analytical skill had yet been able to devise. The solution of numerical equations of all orders yielded to its power: for by it Mr. Weddle obtained the actual solution, without help from logarithms or trigonometry, of an equation of the twentieth degree, complete in all its terms, and solved another of the 622d degree, consisting of four terms involving large coefficients. By this ingenious method any specified root of a given number may be extracted without a very great expenditure of labour, even to a considerable number of places of decimals.

In 1841, a vacancy having occurred in the Rev. Mr. Bruce's Academy, Newcastle-upon-Tyne, by the appointment of S. Fenwick, Esq., to a mathematical situation in the Royal Military Academy, Mr. Weddle was so highly recommended by those who knew his character and abilities, that Mr. Bruce at once engaged him as mathematical master in his distinguished seminary. Here Mr. Weddle continued about six years. On the retirement of Professor Barlow from the Royal Military Academy, at Woolwich in 1847, Mr. Weddle appeared as a candidate for the situation of a mathematical master in that institution, and though on examination he was placed first in mathematics, he was considered not the most eligible for the appointment. In the same year, 1847, he came to Wimbledon and taught the senior mathematical classes in Messrs. Stoton and Mayor's School, at that place. Here he remained upwards of two years, and when Mr. Tate was transferred from the Battersea Training College to a similar institution at Kneller Hall, Mr. Weddle was appointed his successor at Battersea, the situation having been kept open for him six months, that he might complete his term of engagement with Messrs. Stoton and Mayor. Mr. Weddle's stay at Battersea was comparatively short, not much exceeding twelve months. In 1851, he was appointed (without examination, which he refused to undergo) a mathematical professor in the Royal Military College at Sandhurst.

As a Diary correspondent, Mr. Weddle's name was recorded both in 1839 and 1840, but his first contributions to that inestimable publication appeared in 1841. As a sequel to Professor Davies' *Horæ Geometricæ*, which appeared in the Appendix to the Lady's Diary, Mr. Weddle contributed an elaborate article on the *Symmetrical Properties of Plane Triangles*, with their inscribed and escribed circles. This paper was spread over three

Appendices of the Diary, the first part appearing in 1843, the second in 1845, and the last in 1848. The subject of this paper was thought by Professor Davies to have been exhausted, or nearly so, in his last communication to the Diary, but when taken up by a master mind, it soon appeared that the properties of these figures were almost inexhaustible, and that new theorems might be discovered without limit by any one qualified for their investigation. Mr. Weddle's paper is a complete storehouse of theorems, amounting to no fewer than 249 classes of elegant and interesting formulæ.

Mr. Weddle was also one of the most valued and able correspondents of *The Mathematician*, a mathematical periodical conducted for several years by Messrs. Davies, Rutherford, and Fenwick, of the Royal Military Academy. From its commencement in November 1843, to its discontinuance in September 1850, its pages were enriched by numerous excellent papers and solutions from Mr. Weddle's pen, distinguished alike for depth and originality. In the second volume of that periodical he published his very ingenious method for the *Computation of Logarithms and Antilogarithms*, a paper of considerable interest, as by the processes there developed, with the aid of a few simple auxiliary tables, the logarithm of any number, and the number corresponding to any given logarithm, can be readily computed. A similar method of *Computing Tangents and Antitangents*, from the same pen, appeared in a subsequent number of that volume. Besides these, and many others to which allusion cannot be made here, Mr. Weddle contributed to the third volume, *A New and Easy Method of Approximating to the Unreal Roots of Trinomial Equations*, and an excellent paper *On Analytical Geometry of Three Dimensions relative to Oblique Axes.*

Of late years Mr. Weddle was a regular contributor, as far as his health permitted, to *The Cambridge and Dublin Mathematical Journal*, a work of European circulation; and his elegant papers will not suffer in comparison with those of the first mathematicians of the age, by whom that journal is supported. His very elaborate paper entitled, *On the Theorems in Space analogous to those of Pascal and Brianchon in a Plane*, is an admirable specimen of analytical skill. Availing himself of the abridged methods of notation, he deduced a great variety of interesting and curious properties relative to surfaces of the second order, with a degree of neatness and symmetry which has never been surpassed. He contributed a short paper on the *Parallelogram of Forces* to the Philosophical Magazine.

Mr. Weddle was naturally a very delicate man, and of a consumptive family. The last two or three years of his life were passed at Sandhurst in a declining state of health, indeed he latterly became so feeble that he could not walk more than a few hundred yards without feeling completely exhausted, and though the distance of the College from his residence was not more than a quarter of a mile, he felt unequal to the task of walking that distance, having become so excessively weak as to require a carriage to convey him to and from the College. Consumption at length terminated his valuable life, on Sunday, the 4th of December, 1853, at the early age of thirty-six years. He has left a widow, but no family, to deplore his loss.

In Mr. Weddle's death, the Royal Military College lost a distinguished ornament, and mathematical science one of its most successful cultivators. Though cut off in the flower of his age, he had written enough to show what might have been expected from him had he lived. He was an excellent teacher, his own thoughts were as clear as day, and he had the tact of communicating them to others with remarkable facility. Mr. Weddle was more than a mathematician:—he was also a well-informed man, possessed of a fine taste for polite literature, with which he was well acquainted, and took delight in its cultivation; he was an acute metaphysician, and reasoned as well on other subjects as he did in his favourite science. In every relation of life he was good and amiable: an excellent husband, a generous son, and a faithful friend, so that those who knew him best will most lament his premature death.

Mr. Weddle has left several scientific manuscripts, and it is to be hoped that some one of his scientific friends will, ere long, collect the scattered emanations of his pen, and republish them, together with his manuscript papers, in a connected form. Indeed, everything that Mr. Weddle published was distinguished for originality, and it cannot be doubted that his entire mathematical papers would, if brought together, form a most attractive, interesting, and useful publication, and transmit to posterity his fame and genius as a mathematician of the first rank.

The method for the solution of equations, by which Mr. Weddle's name will be conspicuous among algebraists, proceeds neither by successive acquisition of root-figures like that of Horner, nor by continued fractions like that of Lagrange. Each correction consists in the application of an easy factor to the preceding result, and this mode of proceeding in an organised form is perfectly original. By the nature of the method, every power of the unknown quantity which is missed dispenses with a corresponding proportion of work, a facility which is totally unknown in the two great methods mentioned.

With regard to the standard Astronomical Instruments of the Royal Observatory no important or organic change has been made since the last Report of the Council in February 1853. The transit-circle still maintains its high character for steadiness, and the observations made with it are of first-rate excellence; the altazimuth has been worked with the same assiduity, and the proportion of the observations of the moon made with it to those made with the transit-circle, remains the same as in former years: finally, the accuracy of the principle of construction of the zenith tube is borne out by the observations which have been made with it at every opportunity, though it becomes more evident that a larger object-glass, and a position for the instrument less exposed to disturbance, will ultimately be required.

The organisation of the Galvanic operations connected with the ordinary business of the Observatory is gradually becoming more complete. By means of the galvanic motor-clock and the system of wires connecting the Observatory with the South-Eastern Railroad Company's Station at London Bridge, hourly signals, giving accurately Greenwich mean solar time, are transmitted to the offices of the Electric Telegraph Company at Lothbury and the Strand in London, and to Tunbridge, Deal, and Dover, several times in the day. Signal-balls are dropped at the Strand and at Liverpool simultaneously with the drop of the Greenwich ball at 1 o'clock. In addition, by means of an ingenious contrivance at Lothbury, time-signals are sent at 10 o'clock A.M. and at 1 o'clock P.M. each day, primarily from Greenwich, to various stations on the line of the Electric Telegraph Company. Preparations are also making for the erection of a ball at the port of Deal, which it is also intended to drop simultaneously with the drop of the ball at Greenwich, by means of the wires on the line of the South-Eastern Railway.

The various difficulties which occurred from time to time in the mechanism of the barrel or smooth-motion clock, used for giving motion to the cylinder on which will ultimately be recorded the transits made with the transit-circle and altazimuth, according to the American method of self-registration, have been overcome. It now carries the cylinders put into connexion with it with perfect regularity, its rate having all desirable steadiness.

The Astronomer Royal is in negotiation with Mr. De La Rue for a supply of paper best adapted for receiving the record of the transits, and that gentleman, with his accustomed zeal for the interests of science, has given his attention to the subject. In the mean time satisfactory trials have been made of the general efficacy of the apparatus by trial of an ordinary sheet of paper applied to the cylinders, on which, by a pricker acted on at every beat of the transit-clock by the electro-magnets attached to the frame, marks were made with perfect regularity and with adequate force during several revolutions of the barrel.

From the first instant of the laying of the wires connecting the Greenwich Observatory with the stations of the South-Eastern Railway Company and the Electric Telegraph Company, it was evident that one of the earliest and most useful applications of them would be the determination of the longitudes of several of the principal observatories in the British Isles and on the Continent, which lie near the lines of the wires. During the last year, the earliest possible opportunities have been taken for settling definitively, by the admirable facilities thus afforded, the longitudes of Cambridge, Edinburgh, and Brussels, with complete success, as far as regards the galvanic communications and the observations of the signals at all the observatories, and with only one instance of defective determination of the local time at one of the observatories.

The method was first tried successfully in May last for determining definitively the longitude of the Cambridge Observatory, the requisite preliminaries for the accurate observation of the signals and the accurate determination of local time at each station being previously arranged between the Astronomer Royal and Professor Challis, and the requisite arrangements for insuring a complete circuit between Greenwich and the Lothbury Station, and from thence to the Cambridge Railway Station, being made at the instance of the Astronomer Royal by Mr. C. V. Walker, Engineer and Superintendent of Telegraphs of the South Eastern Railway, and by Mr. Edwin Clark, Engineer of the Electric Telegraph Company, respectively. The details of the operations are given in the *Monthly Notice* for June 1853, and the definitive result deduced from 279 signals is $22^s{\cdot}956$, by which the transit instrument of the Cambridge Observatory is east of the Greenwich transit-circle.

On May 25, signals conducted on a similar plan were simultaneously observed at Greenwich, and at the Terminus of the Railway at Edinburgh, for the determination of the longitude of the Royal Observatory of that place. The details of the operations were in every respect satisfactory, excepting as regards the transmission of the times observed by chronometer at the Edinburgh Station to the Observatory, by comparison with the transit-clock. Something unsatisfactory resulted in this portion of the operations, which will make it necessary to repeat the experiment. This circumstance is the less to be regretted on account of the present intention to carry the wires from the station to the Observatory on the Calton Hill, which will prevent any possibility of a like failure for the future.

But by far the most elaborate series of experiments yet made by means of the galvanic communications, is that which was made in December last for the determination of the longitude of the Royal Observatory of Brussels. Two distinct series of observations were made for this purpose, the one extending from November 25 to December 4, and the other from December 19 to 30. In the first series, Mr. Dunkin was despatched to Brussels for the purpose of observing signals and the stars necessary for determining the error of the Brussels' transit-clock, while M. Bouvy, one of the Brussels' observers, was sent to Greenwich for a similar purpose. In the latter series the observers were interchanged, M. Bouvy observing at Brussels and Mr. Dunkin at Greenwich.

In the first series the results of December 1, 2, and 4, only were available for the determination of longitude, as on those days only a sufficient number of stars were observed at both stations to give the corrections of the clocks without sensible error. The signals observed on the other evenings were, however, perfectly available for determining the average time of transmission of the current between Greenwich and Brussels, and the retardation is proved to be very approximately equal to one-tenth of a second. The whole number of signals available for the determination of longitude on Dec. 1, 2, and 4, were 446, and the mean result for the longitude of the Brussels is $17^{m}\ 29^{s}\cdot256$ East.

In the second series of observations the evenings of December 24, 28, 29, and 30, were available for the determination of longitude, a sufficient number of clock stars being observed at each station, and the number of available signals observed on these evenings amounted to about 680. The Greenwich sidereal times of observation of the signals have been computed and transmitted to Brussels, but the Brussels' sidereal times have not been yet received at Greenwich; consequently, the definitive result for longitude cannot yet be given.

The cloudy weather which prevailed during the second series, and which rendered the continuance of the observations necessary for so long a period, severely tried the patience of the observers, but their perseverance has been rewarded by the most satisfactory result which has been yet obtained by this novel application of galvanism.

By a recent decree, the Observatory at Paris is entirely removed from under the superintendence of the Bureau des Longitudes. It is possible that the new administration may cause some delay in the completion of the arrangements for the connexion of the two observatories of Paris and Greenwich.

The meridian instruments of the Radcliffe Observatory have been engaged during the past year in completing the circumpolar Catalogue, on the plan of observing every star in at least *two* different years. This, though a laborious process, has been found to be not an unnecessary one for ensuring the identity of stars observed with both instruments, particularly in places where they happen to be clustered thickly together.

More remained to be done in this respect than was expected, so much so, that it was thought advisable to desist altogether, for the present, from extending the range of observations to more southern stars, for which preparations had been made. Partly owing to this circumstance the publication of the Catalogue has been delayed beyond the time expected; but it is hoped that this delay will be more than compensated for by the additional accuracy and certainty which will be attained. In the mean time, with the assistance of a series of indexes which will accompany the next volume (a great part of which is already printed), there will be little difficulty in referring to any star which has been observed. The plan of noting the magnitudes at every observation, when there is no visible impediment to a correct estimate, has led to the detection of *four* variable stars, which appears to have been hitherto unnoticed.

The positions of the stars in question are as follows :—

	Star's R.A.	N.P.D.	
	h m s	° ′	
1	10 34 15	20 37·6	
2	12 37 32	28 6·4	
3	19 32 54	40 7·6	(2896 Groomb.)
4	23 51 1	39 25·4	

The last, it must be remembered, is the sf. of a double star. The companion is 10·5 and *not* variable.

Mr. Pogson (to whom and to Mr. Lucas, the detection of their variability is due) has watched them very carefully during the last two years, and considers that their periods and ranges of variation are nearly represented as follows:

1	period	304 days	range	(7·5) to invisibility
2	—	222·5 —	—	(7·0) to (12·0)
3	—	387 —	—	(8·0) to (13·0)
4	—	500 ? —	—	(6·5) to (13·5)

Mr. Pogson considers the two first periods to be the best determined, though, of course, all will probably undergo a future modification.

Preparatory to entering on any systematic plan of research on the parallax of the fixed stars, it was thought that the Heliometer might be profitably employed in a fresh examination of those stars which have already been the subjects of observation elsewhere, as affording the best test by which astronomers may judge of its powers.

Accordingly, 1830 *Groombridge* and 61 *Cygni* were selected, and during the years 1852–53 long series of observations have been obtained of both of them. Though the whole of these observations have not yet been discussed, enough has been done to justify the announcement that, with regard to 61 *Cygni*, they fully confirm the fact of an annual parallax, very nearly of the same amount as that found by Bessel.

The stars selected for comparison with 61 *Cygni* were different from those Bessel used; one being 7320 B.A.C., nearly of the 6th magnitude, and the other 41030 Lalande, of the 8th magnitude. Both stars lie nearly in the direction of the components of 61 *Cygni;* the former (7320 B.A.C.) being about 2090″, *in arc*, distant from their centre, and 41030 Lalande about 1480″. The principal reason for choosing them was that they were both of sufficient brightness to allow of being brought into juxtaposition with 61 *Cygni* without reducing the aperture of either segment.

The observations already reduced, comprehending nearly three periods of maximum and minimum, treated in the same way as Bessel treated his, give the parallax of 61 *Cygni*.

By 7320 B.A.C.	= +0″·364	Mean Error	±0″·0315
41030 Lalande	= +0·400	— —	±0·0278

The mean of which is +0″·384, mean error ±·0182. Bessel's last determination, it will be remembered, was $0''\cdot348 \pm 0''\cdot014$, subject to a further correction for the effect of temperature on the micrometer-screw, which Dr. Peters considers (in an able paper in *Ast. Nach.* 866, p. 38), would increase it to $0''\cdot360$, mean error $\pm 0''\cdot016$.

With regard to 1830 Groombridge, the result promises to be less decisive; but the present is not an occasion for entering into a discussion of this subject, and there is less necessity for doing so, as the observations themselves, and the deductions from them, will be in the hands of astronomers in the course of a few months.

The electric communication between this Observatory and the Great Western Railway Station, whence a direct correspondence may be carried on with the Royal Observatory, which was mentioned as being in contemplation last year, was completed several months ago, but no experiments have been yet made with it.

The report of the astronomer at Cambridge to the Observatory Syndicate was mentioned in the *Monthly Notices*, vol. xiv. p. 25. The meridian observations of 1848 are now printed, and vol. xvii., containing those of 1846, 1847, 1848, is out of the press, and will soon be distributed. Professor Challis is now proceeding with the reduction of the meridian observations for 1849 and following years. In this labour much time is saved by making use of the instrument described in vol. x. p. 182 of the *Monthly Notices.* The publication of the equatoreal observations of planets and comets is in a more hopeful state than formerly. A scheme has been devised, applicable to all the observations as yet unpublished in a regular manner, according to which the record of each observation will be completely exhibited, and the mean result of the series of observations of any body on one night may be readily obtained. The calculations of each comparison of a planet or comet with a star, will not be so full as in the scheme originally proposed, but the mean result will suffer no diminution of accuracy. The material of approximate reductions for immediate use, on which much time has hitherto been expended, will, for the future, be made available in the final reductions for publication. The observations of the asteroids, particularly with the Northumberland equatoreal, are diligently pursued, to keep this numerous class within view, and under the control of observation.

The observations now making at the Edinburgh Observatory are chiefly confined to meridian measures of stars, and are completely reduced up to the end of 1852, and partly to the end of 1853. The printing, which had been delayed on account of official difficulties, has been resumed, and a slight alteration has been introduced on the excellent method commenced by the late Mr. Henderson, but of a nature to carry out his views more completely, viz., to insert more of the particulars of the observations themselves as made and entered in the note-books at the time, so as to enable persons at a distance to have a complete knowledge of the exact value of the raw numbers to which the subsequent computations have been applied.

A long-proposed scheme of further utilising the scientific observations, has lately been realised in the establishment of a time-ball on the lofty tower of Nelson's Monument, in the neighbourhood of the Observatory, and in immediate connexion with it by electric wires, through which the signal is given at once from the transit-clock. During the three months that the machine has been in operation, it has been found of such extensive benefit, and of such extreme accuracy, that there are movements commencing to erect time-balls in Glasgow, Greenock, Dundee, and other Scottish ports; and the ball being raised by local means, to have them all dropped by the electric signal from the Edinburgh Observatory.

An attempt to determine the difference of longitude between Greenwich and Edinburgh in the course of last summer, was not so successful as it might have been, owing to a change of rate in the portable time-piece employed in communicating between the Observatory and the Edinburgh telegraph station, where the wires from Greenwich terminated. Means have, however, been lately supplied by Government for bringing the line of wire up to the Observatory itself; and some further points essential to developing the uses of the establishment are at present under consideration in the same quarter.

At Durham the chief attention has been directed to observation of the small planets and computations relating to them. Mr. Ellis, the observer, was placed upon the establishment at Greenwich in the early part of the summer, and has been succeeded at Durham by Mr. George Rümker, whose name is well known as a practised computer.

The account given of the Liverpool Observatory in the Report of last year will serve for the present year almost without alteration. Mr. Hartnup continues to devote his principal attention to those extra-meridional observations of a delicate nature, which are also of pressing and immediate interest. The pages of the *Astronomische Nachrichten* will best show the industry and skill of this zealous observer, the quality of his instruments, and the European estimation in which the Liverpool Observations are held. In computing the orbits of *Calliope*, *Thalia*, and *Euterpe*, MM. Bruhns and Marth have relied very much on Mr. Hartnup's places. Mr. Hartnup observed Comet III. 1853, *in daylight*,— a remarkable phenomenon, only seen by M. Julius Schmidt and himself, so far as we have heard.

The meteorological department of this Observatory has been carefully attended to, and the results made public. An account is given every week in the Liverpool *Times* of the *general* results, and another, in a more precise and tabular form, in the Liverpool *Mercury;* the latter is identical with the statement furnished to the Liverpool Medical Office of Health, agreeably to the request of the

Health Committee. A summary of these results for the two years ending Dec. 31, 1852, was presented this year to the Literary and Philosophical Society of Liverpool, and has been published in their Proceedings.

These purely scientific researches do not, however, constitute Mr. Hartnup's main business, that of assisting, with all his might, in improving the aids to navigation. The Society will be glad to learn that seamen are beginning to take somewhat more interest in matters of such vital interest to them personally, and which nationally are so important. Attention has frequently been called to the great advantages of the mode of rating chronometers pursued at the Liverpool Observatory, in which a correction to the rate is given *depending on the temperature.* It is found, experimentally, that when a captain will apply the rate thus corrected, the performance of all chronometers is much improved, and in many cases the change is wonderfully for the better. Yet it is only very gradually, and among the more intelligent of foreign captains (especially Americans), that this simple precaution can be introduced. In testing the requisite qualifications of a mariner, it might be advisable to call his attention to the fact of the general imperfection of chronometers, and the mode of correcting it empirically; at any rate, it is not too much to expect that he should be able to note a thermometer, and take out a corresponding rate from a table furnished to him. In steam navigation, the danger from an incorrect rate is quite of another order from what it used to be in sailing vessels.

The time-ball, which is dropped at the Liverpool Observatory at 1 o'clock, Greenwich Mean Time, would be of more service if it were in a more conspicuous situation; and it has been proposed to drop the ball from some more elevated point. Whether the ball be dropped from Greenwich or from Liverpool is not of much practical importance, but it must be dropped, *directly*, from one of the two Observatories. At present, perhaps, few seamen would pay attention to this easy mode of getting a *rate* and an *error*, quite independently for themselves, as a check to those furnished by the rater; but the observation takes so little time and costs so little trouble, that a little persuasion might be sufficient to induce its adoption. There are risks at sea against which no foresight can provide; but losses from defective compasses or from ill-regulated chronometers should be treated as crimes, since common care and common sense will secure the efficacy of both these instruments. It is to be feared that life and property to a large amount are yearly sacrificed for want of a little elementary knowledge and a small amount of precaution on the part of our seamen, who neglect the safeguards which are furnished them by modern science.

Captain Jacob, of the Madras Observatory, has forwarded to the Society, and to most of our active members, copies of a new catalogue of 144 double stars. This is founded on observations made with the Lerebours equatoreal in 1850–2, and may be considered to be a continuation of the Poona Catalogue by the same observer, published in the 17th volume of our Transactions. The means of each set of observations, with remarks, is first given (there are 501 sets), and then follows the Catalogue itself, in the usual form. The stars, which are suspected of proper motion, are set down for two or more dates. The most remarkable among them is *α Centauri*, in which the change of angle is very conspicuous, even in this short period. There is no need of recommending the Poona and Madras Catalogues to the attention of double-star observers, as Captain Jacob's zeal and skill are sufficiently estimated, and this important contribution to one of the most interesting branches of practical astronomy is sure to be rated at its intrinsic value. We regret to learn that the climate of Madras does not agree with the astronomer, and that it is not particularly favourable for astronomical observations.

Since the last Annual Report Mr. Sheepshanks has been engaged in examining those Standard Yards which presented any anomaly in his previous observations. The method of floating the bars in mercury (which seems to be almost perfect, but is very troublesome) assumes, that the bars are uniform in their composition and alike in form. It would appear that in some instances uniformity of composition has not been attained, and that the bars do not float even, and the divisions are, consequently, not in good focus. Mr. William Simms, who always prepared the bars for observation, made a note of these unsymmetrical bars, and Mr. Sheepshanks has recently re-compared them. In these later observations, the bars rested on a block and roller or stirrup, placed at the distance assigned, theoretically, by the Astronomer Royal. In two bars the divisions were found to be unsatisfactory, the coaling having been carried too far, and the edges of the divisions rounded. These will be redivided and measured when the temperature becomes nearly 62°.

The copper, brass, cast-iron, Low Moor and Swedish bars, which had been carefully compared in cold weather with the bronze standard, have been again carefully compared during the past summer at the highest natural heat, and also with the temperature artificially raised. These observations have been reduced at Greenwich, under the direction of the Astronomer Royal, and they supply an excellent scale of *comparative* expansions of the different metals from about 45° to 65°. This range is sufficient for what is at present required; but it is intended to carry the comparative measures much higher (and perhaps lower), and also to get an *absolute* measure of expansion. It is known that the usual tables of expansion are very erroneous, especially in assuming that the rate is uniform between freezing and boiling; whereas the expansion for 1° at 212° is very much larger than that for 1° at 32°. As the bars in the comparisons above mentioned were plunged in the same mercurial bath, and the temperature very carefully ascertained by plunged thermometers divided by Mr. Sheepshanks himself, it is hoped that these determinations possess very great accuracy. The expansion of cast-iron is lowest, and that of cast-steel next in order. The observations for restoring the lost parliamentary standard (that is, a new type of the *optical* yard with numerous authentic copies) may be considered therefore to be all but finished. Some time and trouble are necessary for reducing all the observations to order, but there is very little work to be done and no difficulties.

Some attempts have been made to ascertain the causes of the anomalies which are to be found in the observations of MM. Baily, Murphy, &c. in 1836, but only with partial success. Mr. Sheepshanks found, as he expected, that when two bars are compared with the Society's apparatus (employed by those gentlemen), the difference varied according as the bars were on the nearer or farther T piece: the bar nearest the observer appearing longer, and that farthest from the observer appearing shorter, than it should do. This difference, however, though always the same way, changed considerably in magnitude; and when, in consequence of the cold weather, the to-and-fro motion became stiffer, the irregularity was almost lawless.

An attempt to measure a brass bar belonging to the Kew Observatory was quite unsatisfactory while using the Society's apparatus. The anomaly depending on position was very large, and the final means contradictory. It is almost certain that these errors were not caused by temperature, or by the insecure mounting of the microscopes; but were probably a compound of flexure, racking of the frame, and clinging of the Kew flat bar to the T piece.*

Mr. Sheepshanks conceives that the Society's apparatus could be greatly improved by some slight alterations; and, perhaps, it would then serve its purpose, if delicately and judiciously handled. It is very convenient and handy, and if it could be relied on, would serve for the graduation of scales, as well as for the comparison of different measures.

The scale of the Society is likely, we believe, to be ultimately placed in a national collection, and if the Society is willing, and the Standard Committee approves of his proposal, Mr. Sheepshanks intends to replace it with another scale of the same form, but shorter, which will present a yard *decimally* divided. This, he conceives, would be the most useful scale which could be made for the Society's objects. At the same time such alterations should be made in the measuring apparatus as will fit it for service.

The preparations for executing the *touch* or *end-yard* are almost completed, and the types or generators nearly made. The subject has been very carefully considered, and at present no difficulties are foreseen. The ends are to be ground on a flat surface, the centre of the bar being made the centre of motion. The

* Subsequent comparisons of the Kew scale with the Government apparatus at Somerset House, were fairly consistent; the Kew bar was supported on numerous rollers.

grinding apparatus is made, and looks promising enough. The touching surfaces in the standard bars are to be of agate, or some similar material, expanded into the axis of the bars. It is intended to prepare standards of different metals, so that future experimenters may not be teased with large differences of expansion.

Several methods of comparing two touch-bars have been suggested, some of which promise to succeed. Possibly, it may be found that the most accurate method will not be too nice for ordinary purposes, but, at present, the subject has not been sufficiently examined. There is no reason to doubt but that a satisfactory practical result will be attained, and that without much delay.

In a report presented, or shortly to be presented, to the Government, the Committee for constructing the standard yard and standard pound has expressed its opinion, in the strongest manner, that the guardianship, use, and regulation of the weights and measures of the empire should be given in future to a man of science, specially selected for his fitness for the office. There is, perhaps, no reason to fear the scandalous incompetency which distinguished the former keepers of these important types, to which, ultimately, most material things must be referred; but even a careful, and respectable, and conscientious man will not do, unless by education and natural talent he is fitted for the duty. A good geometer, with delicate eyes and fingers, well acquainted with cognate subjects, and familiar with the languages and practices of the Continent, would do himself honour and be of great service to the country in such a post, and it is to be hoped that no one less qualified will be appointed. The desire which the chiefs of our Government have shown, especially in later times, to select well qualified men for their scientific appointments, is a warrant that proper representations on these points will be attended to if judiciously urged.

The committee of the Royal Society for promoting the erection of a large reflecting telescope in the Southern hemisphere, have applied to the Government for the necessary funds; and it is understood that their application has been favourably received. The statement of the sum required was based upon an estimate furnished by Mr. Grubb of Dublin, on the supposition that the telescope is to be a 4-foot reflector, mounted equatoreally, on a plan arranged by Dr. Robinson and Mr. Grubb. It must, we apprehend, be understood that this plan is only provisional, as no decision, we believe, has yet been arrived at, on the mode of overcoming the difficulties which are peculiar to the equatoreal movement of a reflecting telescope. The Society will learn with satisfaction that the more immediate management of this business is intrusted to a sub-committee, consisting (besides Dr. Robinson), of the Earl of Rosse, Mr. De La Rue, and Mr. Lassell; and the experience and judgment of these four gentlemen, both in optical and in engineering arrangements, are a sufficient guarantee to the astronomical world that no construction will be distinctly recommended for adoption until all the difficulties incidental to it have been sufficiently considered.

Four small planets revolving between the orbits of *Mars* and *Jupiter* have been discovered since our last anniversary ; the entire number of bodies in this remarkable group now amounts to 27.

Two out of the four new planets were detected during the same night (April 6) ; one early in the evening by Dr. Annibal de Gasparis, at Naples, and the other some hours later by M. Chacornac, of Marseilles, who is understood to be engaged in the preparation of a series of charts under the superintendence of M. Valz. The former has been named *Themis*, the latter *Phocea*. *Themis* was a very minute object, estimated as not brighter than stars of the twelfth magnitude at the time of its discovery, and the greater merit therefore belongs to the diligent observer through whose exertions we have been made aware of its existence. The period of *Themis* is about 2044 days, and that of *Phocea* 1352 days.

The third planet of 1853 was found by Dr. Luther, of the observatory at Bilk near Dusseldorf, on the 5th of May, apparently during a comparison of one of Mr. Bishop's ecliptical charts with the heavens. At the suggestion of Baron von Humboldt, this planet has received the name *Proserpine*. Its revolution is accomplished in about 1580 days.

The latest planetary discovery was made by Mr. Hind, at Mr. Bishop's Observatory, on the evening of the 8th of November, when an object shining as a star of the 9th magnitude upon the ecliptical map for 3^h R.A., was speedily proved to be a new planet, which it is proposed to call *Euterpe*. The position on the above night was less than 1° distant from the point at which *Thalia* was detected eleven months previously. So far as can be ascertained at present, the period of *Euterpe* would appear to be 1313 days, or about a fortnight less than that of *Vesta*.

Five comets have been discovered during the past twelvemonth; two out of this number have become unusually conspicuous in the heavens.

The *first* was found, independently, by our Associate Professor Secchi, at Rome, on March 6; by M. Schweizer, at Moscow, and Mr. Tuttle, at Cambridge, Massachusetts, on the 8th; and by Dr. Hartwig, at Leipsic, on the 10th. It was not visible to the naked eye. The elements bear a strong resemblance to those of the comet of 1664, about which so much has been written by Lubienietski and others, but the parabola appears to satisfy the observations so well as to decide against the identity of the two bodies. A direct calculation assigns a period of 1200 years.

The *second* comet was discovered by M. Schweizer, at Moscow, on the 4th of April, and continued visible in Europe before the perihelion passage for about three weeks. At the end of the month it was detected at various points in the southern hemisphere ; the nucleus had the brilliancy of stars of the 3d magnitude, and the tail was 5° or 6° in length. Various observations of this comet, taken at sea, have appeared in our *Monthly Notices*. The orbit exhibits no perceptible deviation from the parabola.

The *third* comet, called by some "the great comet of 1853," was discovered by M. Klinkerfues, at Göttingen, on the 10th of June, at which time it was a somewhat faint telescopic object. The perihelion passage took place on the 1st of September, and about a fortnight before this date the comet had become sufficiently bright to be seen without optical power. During the last ten days of August it attracted general attention in the western heavens, by the brilliancy of its nucleus and the length of its tail. When finally sinking below our horizon, a few days previous to perihelion, the head was brighter than stars of the first magnitude. The tail is reported to have extended from 15° to 20° from the nucleus, as viewed in the clear sky of Italy and more southern stations; in this country it was not traced more than 8° or 10°. A remarkable series of observations of this comet was obtained in full daylight by M. Schmidt, at Olmütz; though distant but a few degrees from the sun's place, it was seen and well observed each day from the 30th of August to the 4th of September inclusive. Mr. Hartnup succeeded in finding the comet in daylight on the 3d; his interesting remarks thereupon will be found in the *Monthly Notice* for November. The observations of this body do not exhibit any marked indications of ellipticity. The elements have some resemblance to those of a comet observed by Tycho Brahe in 1582.

The *fourth* comet was discovered by Mr. C. Bruhns, of Berlin, on the night of September 11, soon after which date it was visible, though not very conspicuous, to the naked eye. The elements have some resemblance to those of the comet observed in the year 1582 by Tycho Brahe, and computed by Pingré, but the parabola represents the observations very closely. The comet was visible both before and after perihelion passage.

The *fifth* comet was discovered by Mr. Van Arsdale, at Newark, New Jersey, U.S., on the 25th of November, and on the 2d of the following month by M. Klinkerfues, at Göttingen. It is still visible, but continues to be, as at the epoch of discovery, a faint telescopic object. The perihelion distance is very considerable, and only exceeded in a few previous comets.

MM. Encke and Hansen, to whose labours on the subject of planetary perturbation astronomy already owes so much, have recently been engaged in researches on the theory of the movements of the minor planets, and have both arrived at apparently very satisfactory results. Each of these geometers has assigned formulæ by which it would appear to be possible, without an immoderate amount of labour, to calculate the perturbations of any planet whatever throughout an indefinite period of time, whether past or future. Dr. Brünnow, who has co-operated with M. Encke in his researches on this subject has calculated from such formulæ the perturbations of *Flora* by *Jupiter* and *Saturn*, employing the polar co-ordinates of the disturbed planet as on the occasion of his former labours relative to the calculation of the perturbations by quadratures. M. Hansen has exhibited a similar application of his method by calculating from his formulæ the perturbations of *Egeria* by *Jupiter*.

The recent researches of Mr. Adams in lunar astronomy have led to some important results. It appears from a searching examination of Burckhardt's Lunar Tables by that eminent geometer, that the fundamental expression upon which the tables of the parallax are based has been seriously vitiated, in consequence of several of the terms being affected with errors of considerable magnitude. Mr. Adams has found that the error in the moon's computed place resulting from the combined influence of these errors in the fundamental expression may occasionally amount to between 6″ and 7″. This imperfection of Burckhardt's tables was the more difficult of detection, from the artificial manner in which their author has presented Laplace's theory, upon which his tables of the parallax are professedly founded; but it acquires great importance from the circumstance of Burckhardt's Lunar Tables having been chiefly employed in recent years in computing the moon's place for the Ephemerides which are published annually in the different countries of Europe. The rectification indicated by Mr. Adams has already been taken into account in the computations for the Nautical Almanac, the Berlin Ephemeris, and doubtless all other works of the same kind, in the preparation of which it has been usual to employ Burckhardt's Lunar Tables.

Mr. Adams has also subjected to a rigorous scrutiny the expressions for the moon's parallax which Damoiseau, Plana, and Pontécoulant, had severally deduced from theory, and has succeeded in rectifying the labours of these geometers so effectually that the three expressions for the parallax now exhibit an agreement with each other which leaves nothing further to be desired. Finally, he has shown that Henderson's value of the constant of parallax, as deduced from observation by the aid of Damoiseau's Lunar Tables, when slightly amended, exhibits a perfect accordance with the corresponding result deducible from theory by the aid of M. Peters' value of the constant of nutation.

The results to which Mr. Adams has been conducted by his researches on the moon's parallax admit of being directly verified by actual observations of the moon in our own day. The case is different with respect to another department of the lunar theory which has recently engaged the attention of that geometer, and to which his powers of analytical investigation have been successfully directed. The secular inequalities of the moon's motion cannot fail to be always regarded with deep interest, not only on account of the important chapter which the researches relative to them form in the history of the theory of gravitation, but also by reason of the valuable light which they are calculated to throw upon ancient chronology. Mr. Adams has recently detected the existence of a class of terms in the expression for the secular inequality of the moon's mean motion, which had escaped the sagacity of Laplace, and which, from the considerable magnitude of their aggregate effect, may not impossibly exercise a sensible influence on some of the ancient eclipses. This question can only be definitively decided after Mr. Adams has subjected the secular inequalities of the perigee and node of the lunar orbit to a similar process of investigation, an object to which it is understood that his attention is at present directed.

An important investigation of the theory of the pendulum, taking into account the rotation of the earth, has recently been published by the Physical Society of Danzic, being a memoir on the subject by M. Hansen, which has been honoured with the prize of the Society. The chief novelty of the investigation consists in introducing the supposition of the pendulum being not a mere mathematical point, but a physical agglomeration of particles. By adopting this more general view of the subject, M. Hansen has succeeded in deducing several results of a hidden character which had hitherto escaped notice. The most important of these consists in the fact that a rotatory motion of the pendulum about its axis is capable of exercising a very sensible influence on the azimuthal motion of the plane of oscillation. M. Hansen illustrates his results by a variety of striking examples, and he concludes his valuable essay by investigating the motion of a pendulum of a novel construction invented by himself, with the view of obviating certain disadvantages attending the usual form.

The results of Mr. Lassell's Maltese expedition are mentioned in the *Monthly Notices* for November and December 1852, and for March and April 1853, and the observations of *Saturn* are now in course of printing in the *Memoirs.* Some observations on the great nebula of *Orion* and some other nebulæ, are now in the hands of the Secretaries. Nevertheless, Fellows would feel that this report was incomplete if it omitted some mention of so remarkable an undertaking. Mr. Lassell's principal inducement was a desire to take advantage of the approach to conjunction of the remotest three planets, and to observe them in a lower latitude. Malta, as a British possession easily accessible, and known to be favoured with a large proportion of clear sky, appeared to unite more advantages than any other place. It was hoped that its position, surrounded by at least a hundred miles of sea in all directions, would secure an equable temperature and a quiet atmosphere. Nor was this hope disappointed, the tranquillity of the air being even more conspicuous than its transparency. The following extract of a letter from Mr. Lassell to one of the Secretaries may be quoted: "Excepting the transparency of the obscure ring of *Saturn*, perhaps my discoveries abroad were rather negative than positive. I ascertained, at least to my own conviction, that no other satellite exists about *Neptune* large enough to give hope of discovery without considerable improvement of our telescopes. Also, that while I was enabled most fully to confirm my discovery of the previous year, of two new and more interior satellites of *Uranus*, I arrived at an equally strong conviction that these two, together with the first two satellites simultaneously discovered by Sir W. Herschel in 1787, constitute the whole of the planet's retinue hitherto discovered. In the nebula of *Orion* I have, I believe, seen some minute stars in the neighbourhood of the trapezium which are new. On the other hand, some of Mr. Bond's stars I have not been able to make out. A comparison of Sir John Herschel's, Mr. Bond's, and my own drawings of this wonderful object must, I think, suggest the idea of change in the nebula, or variability of the stars, or otherwise, a less uniformity of delineation of the same thing than might have been hoped for."

The Fellows will most assuredly join the Council in congratulating Mr. Lassell on his safe return, and in expressing their high sense of his devotion to astronomy. Nor will it be forgotten that such expeditions are sure to leave something behind, as well as to bring something home. Many a year from this date, the obituary notice of some distant correspondents from Malta, or from the Cape, may record that their attention was first called to astronomy by Lassell or Herschel.

Mr. De La Rue has recently presented to the Society a beautiful coloured representation of *Saturn*, embodying *exclusively* the results of his own observations of the appearance of the planet during the latter part of the year 1852. In this drawing, which is highly creditable to the observer and to his instrument (a 13-inch Newtonian of 10 feet focal length, mounted equatoreally, and constructed by himself), several interesting features are exhibited, most of which have been already brought under the notice of the Society. It may be mentioned that the outer ring exhibits the division seen by Mr. Dawes and other observers, and also a bright zone close to it, which does not appear on the drawings of other observers of the planet. As Mr. De La Rue has engraved the drawing on steel, and very liberally placed copies of it at the disposal of Fellows of the Society, those who are not already in possession of one can obtain a copy on applying to the Assistant-secretary.

The beautiful art of Photography seems likely to be of much utility in conducting to a more accurate knowledge of the physical constitution of the celestial bodies. At the Annual Visitation of the Royal Observatory of Greenwich, in the month of June last, much interest was excited by the exhibition of a photographic image of the moon in her first quarter, which had been taken with the great refracting telescope of the Cambridge Observatory, U. S. At the meeting of the British Association held in the month of September, Professor Phillips exhibited several interesting specimens of the same kind taken with a telescope of eleven-foot focal length. Mr. De La Rue, who has also turned his attention to this department of photography, exhibited to the Society in the course of the past year an apparatus which he has contrived to facilitate the taking of such images. A good collodion picture of the moon was shown which had been taken by him in 30 seconds by the aid of this apparatus.

Our Transatlantic brethren continue to cultivate the various branches of astronomy with the same persevering energy which has already secured for them so honourable a position in the scientific world. Their labours during the past year have been signalised by the publication of what is intended to form the first volume of an Astronomical Ephemeris, a work resembling in its main features the *Nautical Almanac* and other similar Ephemerides which are published annually in the principal countries of Europe. A brief account of this important production has already appeared in the *Monthly Notices.* It is hardly necessary to state that the expense of publication is defrayed by the Government of the United States, which has on several former occasions exhibited a gratifying proof of its enlightened zeal in promoting the advancement of astronomical science. Lieut. Davis of the United States Navy has been appointed to the general superintendence of the Ephemeris; the arrangements connected with the theoretical department have been confided to Professor Peirce. The cordiality and zeal with which various individuals of acknowledged competence, residing in different parts of the Union, cooperated in executing a large portion of the laborious calculations required for this work, cannot be too strongly applauded by every lover of science; while such spontaneous efforts constitute as favourable an omen as could be desired of the future career of eminence which, in all human probability, is in store for American astronomy.

The Council can only briefly refer to the American Lunar Tables which have been recently published in connexion with the Ephemeris above mentioned. These tables are founded on Plana's theory of the moon, modified by the recent researches of Airy, Hansen, and Longstreth. The artificial mode of forming the arguments, which had been employed by Mayer, Bürg, and Burckhardt, is rejected, the expressions for the co-ordinates of the moon's place having the same form which they assume when deduced directly from theory, subject to a slight modification of the expression for the latitude which facilitates the process of computation, while it leaves the connexion with theory still obvious. But the peculiarity by which these tables differ from all other lunar tables, consists in their being so constructed as to give the values of the arguments in *time* instead of *arcs of the circle.* This mode of construction, which had been already employed successfully by Carlini in his solar tables, doubtless affords great facility in forming the arguments; but when the question refers to the theory of the moon's motion, which is a vastly more extensive subject, it would be premature to pronounce an opinion on its merits without some actual experience of its working.

With respect to several other investigations which the publication of the American Ephemeris has given rise to on the part of American astronomers, the Council can only allude to a determination of the sun's semi-diameter by Professor Winlock, from observations made at Greenwich by Bradley and Maskelyne with Bird's mural quadrant, and from the Greenwich observations made with the mural circles between the years 1836 and 1851 under the superintendence of the present Astronomer Royal. The anomalous character of the results derived from the modern observations induced Professor Winlock to scrutinise the data more closely, when it appeared probable, from a comparison of the determinations of the different observers collected together into separate groups, that the inconsistencies were attributable to some cause which was constant for the same observer, but which operated differently with respect to different observers. This conclusion agrees with the result of an investigation of the sun's horizontal diameter, which had been undertaken about the same time by M. Goujon, a French astronomer, and which was founded upon observations of the transits of the opposite limbs of the sun made in recent years at the Observatories of Paris and Greenwich. M. Goujon found that the time occupied by the transit of the sun's disk over the meridian was not sensibly affected by the use of diaphragms of different shapes and sizes, whence it was manifest that the inconsistencies which presented themselves when the mean results of the different observers were compared together, as regards both the Observatories above mentioned, could not be attributable to diffraction. If the discordance is due to irradiation, which is exceedingly probable, it would seem to confirm the theory of this principle originally suggested by Galileo, viz., that it is a physiological effect which is liable to be modified by the peculiar constitution of the eye of the observer.

The Council cannot omit to make mention of a remarkable work by M. Struve, which was published in 1852, but of which a copy did not reach England soon enough to be commented upon in the Annual Report of the last year. The work in question is in some measure a summary of the sidereal labours of the great Russian astronomer during his residence at Dorpat, and gives the mean places of all the stars (the greater number of which were double stars) observed under his own direction, and that of his successor, M. Mädler, from the year 1822 to 1843. It must also be considered as complementary to the *Mensuræ Micrometricæ*, published in 1837, and both volumes taken together constitute one of the greatest boons conferred upon sidereal astronomy in the present century, the first volume containing the distances and positions of upwards of 2500 double stars, and the other, accurate mean places, for 1830, of all these, as well as of the others more recently discovered.

An elaborate abstract of the introduction to the catalogue, and a general account of the contents of the work, are given in the *Monthly Notice* for January, recently distributed; and it will be sufficient to draw the attention of the members to this, to enable them to gain a competent knowledge of its very great importance. We may, in the mean time, content ourselves with pointing out that almost all the fundamental quantities required in the star reductions, including the nutation, precession, aberration, and the constant of refraction, are deduced independently from the observations themselves; that the proper motions of all the stars of the catalogue which are found in the *Fundamenta* are accurately calculated; and finally, that the catalogue itself will be, for the astronomers of the next generation, the great treasury from whence the materials will be drawn for making the first great step in the hitherto neglected theory of the proper motions of telescopic stars.

Some interesting researches on the theory of the double star η *Coronæ* have been communicated to the Society in the course of the past year by M. Villarceau. In a previous investigation that geometer had shown that, from the close physical resemblance of the principal star and the companion, and the consequent impossibility of distinguishing the one from the other in the early observations of Sir William Herschel, the period of revolution was affected with an ambiguity, being either 43 or 67 years, according to the mode of interpreting the observations of the last-mentioned astronomer. M. Villarceau announced on that occasion that, in the year 1853, the observations executed by modern astronomers would admit of the two orbits being sufficiently separated to decide the question of the true period of revolution. The period of 43 years was that which had hitherto been generally recognised as belonging to the star; but M. Villarceau seemed rather disposed to believe that the true period of revolution was 67 years. The result of his recent investigation of the subject has afforded a complete confirmation of his views, the latter period representing the totality of the observations in a most satisfactory manner.

It will be remembered that the last Annual Report of the Council contained an account of a remarkable paper by M. Wichmann on the parallax of the star *Groombridge* 1830. By a combination of his own measures of distance and those of Schlüter, of this star from three other stars, he arrived at a result startling and unexpected in itself, and contradictory to those arrived at separately by M. Peters and M. Otto Struve.

The result arrived at was this, that the principal star *Groombridge* 1830 has a conspicuous parallax amounting to $0''{\cdot}71$, but that one of the comparison stars denoted by (a) has also a parallax still more remarkable, amounting to $1''{\cdot}17$. On the contrary, M. Peters, by observations made at Pulkowa with Ertel's circle, had obtained for the parallax of *Groombridge* 1830, $0''{\cdot}226$; and Otto Struve, by micrometer measures of polar distance made with the great refractor, had obtained a result less than $0''{\cdot}1$. Finally, M. Wichmann's own discussion of the measures of Schlüter gave $0''{\cdot}18$.

Consequently, though there was nothing absolutely incompatible with known facts regarding the parallaxes of the stars in general in M. Wichmann's result, yet, since it was decidedly contrary to all preconceived notions, that stars so low in the scale of magnitude as (a) should have so large a parallax, and the result, as regarding the principal star, was at variance with the investigations of other astronomers, it was necessary to look most jealously upon the more questionable parts of the investigation, and especially upon those assumptions by which the large parallaxes in question had been obtained. These views were distinctly stated in the account of M. Wichmann's paper inserted in the last Annual Report; and the paper itself has been since that time subjected to a most searching analysis by M. Peters, in a paper given in Nos. 865–6 of the *Astronomische Nachrichten*, of which a lucid abstract has been made by Mr. Grant, and printed in the number of the *Monthly Notices* for December 1853.

M. Peters observes, as had been previously observed in the Report of the Council before alluded to, that the sole ground on which the large parallaxes in question were attributed to the stars A and (*a*), is the precarious assumption that the difference in the summer and winter measures of a distance of more than a degree of arc by the heliometer, which amounted to about 2″, was to be attributed altogether to parallactic effect, and not to an error in Bessel's temperature-correction applied to the value of the screw of the micrometer.

In defence of this view of the subject, M. Wichmann alleges, first, that the measures can be reconciled on the supposition of parallax whose maxima values occur in summer and winter; and, secondly, that if the effect be attributed to temperature, the coefficient would result five times as large as that deduced by Bessel. To this reasoning M. Peters objects that if, of the measures instituted by Bessel for determination of the temperature-correction, those of Schlüter alone were used, the result would be nearly four times as great as that given by Bessel, and that the effect, which varied with the season of the year, could not be due to parallax, since, "although the stars of comparison lay in every direction round the principal one, the variations for each day of observation always took place in the same direction."

On the whole, therefore, M. Peters is inclined to reject the resulting parallaxes deduced from this assumption with regard to the sums of the measures.

With regard, however, to the parallax of A deduced from the measures of difference of distances of (*a*) and (*a*′) from A, viz. 0″·135, M. Peters considers this result to be entitled to great confidence, since every source of error, whether arising from optical imperfections in the instrument, the unequal heating of the air in the tube, the difference of the temperature within and the temperature without, or the uncertainty in the value of the temperature-correction, will be almost completely eliminated.

Thinking, therefore, that the measures from which this result has been obtained deserve every care which can possibly be bestowed upon them, he has subjected them to a fresh reduction, according to a method formerly applied by him to the measures of 61 *Cygni*, so as to get rid altogether of the effect of any uncertainty in the temperature-coefficient; and in this manner he deduces for the most probable value of the relative parallax of A, or *Groombridge* 1830, 0″·141, with the probable error 0″·013.