ROYAL ASTRONOMICAL SOCIETY.

VOL. XV. *February* 9, 1855. No. 4.

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

Frederick Brodie, Esq., The Gore, Eastbourne, Sussex;
H. S. Ellis, Esq., Exeter;
William Lethbridge, Esq., St. Paul's School;
H. W. Buxton, Esq., 37 Abbey Road, Regent's Park;
Jon. T. Owen, Esq., Swansea; and
Charles H. Wild, Esq., 103 St. Martin's Lane,

were balloted for and duly elected Fellows of the Society.

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

The Council, in presenting the following Report, desire to congratulate their constituents on the state of the Society, and on the general progress of the science of astronomy.

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

RECEIPTS.

	£	s.	d.
Balance of last year's account	458	3	11
By dividend on £2619 5s. 9d. 3¼ per Cents	41	6	6
By ditto on £1650 Consols	23	6	2
By ditto on £2832 16s. 11d. 3¼ per Cents	43	7	0
By ditto on £1650 Consols	23	6	2
On account of arrears of contributions	55	14	0
104 contributions (1854–55)	218	8	0
4 ditto (1855–56)	8	8	0
12 compositions	252	0	0
24 admission fees	50	8	0
15 first year's contributions	26	5	0
Sale of Publications	59	10	6
	£1260	3	3

EXPENDITURE.

		£	s.	d.
Cash paid Mr. Basire, engraver		18	4	6
J. Rumfitt, bookbinder		9	0	4
Mr. R. Grant		40	0	0
George Barclay, printer		114	0	8
Mrs. Jones (Lee Fund)		3	5	6
Mr. R. Grant		10	10	0
Investing compositions of E. B. Powell, C. G. Prideaux, A. B. Martin, T. W. Burr, James Cockle, W. H. Besant, and W. Huggins, Esqs., and Capt. Toynbee		189	0	0
J. Rumfitt		8	15	0
Mr. R. Grant		10	0	0
Investing compositions of James Samuel and J. J. Burman, Esqs.		42	0	0
James Basire, engraver		22	6	0
Mr. R. Grant		10	0	0
George Barclay		208	17	6
J. Rumfitt		9	15	11
Taxes { 1 year's land tax	5 12 6			
Taxes { 1 year's property tax	1 9 2			
		7	1	8
J. Williams' salary		100	0	0
Ditto commission on collecting £418 14*s*. 6*d*.		20	18	6
Charges on books, and carriage of parcels		3	15	2
Postage of letters and Monthly Notices		36	15	9
Porter's and charwoman's work		24	14	4
Tea, sugar, biscuits, &c. for evening meetings		13	13	0
Coals, candles, &c.		15	6	6
Waiters attending meetings		3	17	0
Sundry disbursements by the Treasurer		23	14	3
Balance in the hands of the Treasurer		314	11	8
		£1260	3	3

Assets and present property of the Society:—

					£	s.	d.
Balance in the Treasurer's hands					314	11	8
1 contribution	of 7 years' standing		14 14 0				
4 ———	of 6	ditto	50 8 0				
3 ———	of 5	ditto	31 10 0				
3 ———	of 4	ditto	25 4 0				
5 ———	of 3	ditto	31 10 0				
16 ———	of 2	ditto	67 4 0				
18 ———	of 1	ditto	37 16 0				
					258	6	0
Due for publications of the Society					12	12	6

£1650 3 per Cent Consols.

£2832 16*s*. 11*d*. $3\frac{1}{4}$ per Cent Annuities.

Unsold publications of the Society.

Various astronomical instruments, books, prints, &c.

	£	s.	d.
The balance of the Turnor Fund (included in Treasurer's balance above)	24	8	6

Stock of volumes of the *Memoirs*:—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	39	VII.	221	XVII.	247
I. Part 2	82	VIII.	208	XVIII.	258
II. Part 1	100	IX.	214	XIX.	273
II. Part 2	62	X.	226	XX.	272
III. Part 1	129	XI.	236	XXI. Part 1 (separate).	333
III. Part 2	149	XII.	243	XXI. Part 2 (separate).	62
IV. Part 1	151	XIII.	262	XXI. (together).	210
IV. Part 2	164	XIV.	447		
V.	178	XV.	275	XXII.	251
VI.	198	XVI.	262	XXIII.	444

Progress and present state of the Society:—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1854	140	182	64	6	392	58	450
Since elected	11	13	...	...	24	4	...
Deceased	−2	−4	−3	...	−9	−2	...
Removals	2	−2	...	...	...	...	...
Resigned	...	−3	...	...	−3	...	...
February 1855	151	186	61	6	404	60	464

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

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Beaufoy* clock,
The *Herschelian* 7-foot reflector,
The *Greig* universal instrument,
The *Smeaton* equatorial,
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 *Wollaston* telescope,

having been returned by the representatives of the late Professor Schumacher, is now in the hands of Mr. Dollond for repair.

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

The other *Beaufoy* clock,
The two invariable pendulums, } to the Royal Society.
The Variation transit (late Mr. Shearman's), to Mr. Gravatt.

Among the presents will be found some valuable editions of different writings of Galileo, presented by Sir W. C. Trevelyan, Bart. In thus thanking the donor for his very acceptable contribution to our library, the Council remark that a doubt seems to have existed as to whether it would be worth while to offer the works to a library professedly astronomical, and which, therefore, might be presumed to possess copies. It should be known that, up to the present time, our library is by no means rich in anything but the astronomy of the present century. The great bulk of it, with the exception of the books of the Mathematical Society, consists of presents of the works of men who have lived in our own day. The application of the Turnor Fund will surely, though very slowly, remedy this defect: in the meantime, works of the astronomers of the three centuries preceding the present one will be valuable additions, and will be duly appreciated.

The medal has been awarded to the Rev. W. R. Dawes, for his astronomical labours generally, but especially for those recorded in our *Memoirs*. The President will, in the usual manner, lay before the Society the grounds of this award, and present the medal, at the conclusion of the ordinary business.

The twenty-third volume of the *Memoirs* has been published some time since. The Council would direct the attention of the Fellows of the Society to a Paper in it by Lord Wrottesley, containing a Catalogue of the right ascensions of somewhat more than one thousand stars. This is not the first occasion on which the Council have had the pleasure of directing attention to the labours of this excellent observer. From the recent researches of various astronomers on the motion of the solar system in space, and the remarkably accordant results which have been deduced from such inquiries, the determination of the places of the stars acquires a high degree of importance in a speculative point of view, independent of its otherwise inestimable value in forming a sure groundwork upon which to establish the fundamental points of astronomy.

The same volume of the *Memoirs* also contains some results of Mr. Lassell's observations at Malta, to which allusion was made in the last Report of the Council.

The *Monthly Notices* still continue to be conducted upon the plan introduced by Mr. Sheepshanks about two years since, and to which allusion was made in the last Report of the Council. It may now be stated pretty confidently that this modification of the original plan has answered the purpose for which it was designed, and appears to have given general satisfaction to the Fellows of the Society. Indeed, it could hardly be doubted, that by adapting the form of publication so as to co-operate with the *Astronomische Nachrichten*, instead of clashing with the arrangements of that valuable journal, the *Monthly Notices* would assume a more special character, and their utility in promoting the interests of astronomical science would thereby be materially enhanced. It may, perhaps, be unnecessary to repeat, that although it has been deemed expedient to assign to the foreign periodical just referred to the publication of all ephemerides and observations of the minor planets, as being the channel best adapted for such communications, still there remains an immense field of observation and research, in respect to which the pages of the *Monthly Notices* offer a readily accessible medium of intercourse among astronomers. If there is one point more than another which the Council would urge upon the Fellows of the Society in regard to promoting the usefulness of the *Monthly Notices*, it is the importance of subjecting to a searching process of computation the numerous and valuable results of observation which emanate annually from the public observatories of the country, and also occasionally from several private observatories. With respect to observations of an exceptional character, such as those relating to comets, double stars, and satellites, it is gratifying to find that an increasing desire has recently been evinced to apply the rich store of observations which have been accumulated in recent years towards improving some of the elements of astronomy. It cannot be expected that those more extensive series of observations constituting the normal results established in continuous succession at the public observatories of the country will so frequently form the subject of discussion. Still, the Council cannot refrain from reminding the Fellows of the Society that the facilities for such researches have been very much increased in recent years. From the circumstance of the results of the Greenwich observations being now published annually in a separate form, which may be obtained gratuitously upon application at the Royal Observatory, a confident hope is entertained that our countrymen will not be slow to avail themselves of those precious materials.

It will have been remarked by the Fellows of the Society, that since the commencement of the present session the *Monthly Notices* have appeared upon a stamped sheet. In regard to the easier transmission of the *Notices* to their various destinations, the practicability of employing a better quality of paper than hitherto, as well as several other obvious advantages, the expediency of this alteration cannot fail to suggest itself to every one. It is to be hoped, more especially, that it will have the effect of facilitating the transmission of the *Notices* to various countries on the Continent, where, hitherto, serious impediments have existed in regard to this object.

Our obituary list for the past year contains the names of Baron von Lindenau, Dr. Petersen, and M. Mauvais, Associates, and of the following Fellows:—Captain Blackwood; Edward Riddle, Esq.; Lieut. St. John; Professor Scott; Robert Snow, Esq.; the Rev. J. B. Wildig; and Dr. Whittaker. The official recognition of the loss of the Arctic expedition has made it the duty of the Council to add to the list of this year the names of Sir John Franklin and Captain Crozier.

Bernard von Lindenau was born in Altenburg, the capital of Saxe Altenburg, on the 11th June, 1780. His father was a wealthy proprietor. He studied law and political economy at Leipsic, but even there gave his leisure hours to his favourite pursuits, mathematics and astronomy.

On the completion of his legal studies, Von Lindenau repaired to the Observatory of Seeberg, where he continued his astronomical education under the direction of Von Zach. His progress was proportioned to his talents and unwearied industry, and when Von Zach left Seeberg in 1804, the direction of the Observatory and editorship of the celebrated *Monatliche Correspondenz*, which was established by Von Zach, were both committed to him.

In 1814, Von Lindenau left the Observatory in Nikolai's charge, while he made the campaign as adjutant to the Duke of Saxe Weimar. After the war, though he returned to the Observatory, and did not altogether neglect astronomy, his attention was directed to government and administration. The capacity with which he conducted the business intrusted to him, and the services which he rendered to Saxe Altenburg and Saxe Gotha, at that time united, raised him in a few years to the first offices in the State. He was prime minister of the two dukedoms, while he still retained, under the title of curator, the supervision of the affairs of the Observatory and of its working.

When the reigning line of Gotha and Altenburg failed, and those possessions were united to Saxe Coburg, Von Lindenau entered into the service of the King of Saxony, and was for some years the representative of Saxony at the Frankfort Diet. He then returned to Dresden as Minister of the Interior, an office which he actively discharged till 1843. In this year he took leave of public life, and spent the remainder of his days at Altenburg on his own property. Although his important ministerial duties forbade, during a large portion of his life, much personal contribution to astronomy, he never lost sight of this science. He took a lively interest in everything which occurred, and kept up as active a correspondence with his astronomical friends, Bessel, Gauss, Schumacher, Hansen, Olbers, Von Zach, Encke, &c., as his public occupations permitted.

On his retirement, Von Lindenau gave himself up to science and art, and resumed his original activity. He executed scientific researches, completed his rich library, and built a museum, which he furnished with the treasures he had already purchased of ancient and modern art.

Providence kindly favoured him with almost uninterrupted good health, till within a few weeks of his decease.

He died on the 21st May, 1854, at ten in the morning, possessing his intellects unclouded to the last.

After this sketch of Von Lindenau's scientific and public services, it should be added that he is to be classed among those men in whom great intellectual powers are united with the Christian virtues. A manly uprightness, which knew no way but that which is straightforward, guided him in all his dealings, and his sole desire was to act according to his convictions. With this he combined great benevolence. A large part of the income which he derived from several inheritances was devoted to charitable purposes, and he had the happiness to alleviate many a want and to dry many a tear. He bequeathed nearly half of his fortune to public or charitable purposes. His library and museum, with the means for supporting them, were left to Altenburg, 60,000 thalers to the charitable institutions of Altenburg, and 30,000 to those of Gotha, besides legacies to particular persons. By his will he bequeathed his chronometers to his scientific friends; the chronometer presented to him by Frederic VI. of Denmark to Professor Hansen, and two by Emery to Professors Encke and Möbius, with a request that they should descend in their families as a remembrance of him. It may truly be said of Bernard von Lindenau that his memory will live not only in the results of his industry and talent but in his Christian virtues.

Adolphus Cornelius Petersen was born July 23, 1804, at Vester-Bau, in Schleswig, where his father was a farmer. Up

* Professor Schumacher used to tell with great humour a story of Von Lindenau, which marks well his chivalrous character. When the Allies had entered Paris, one of his fellow-officers, congratulating him on their success, applied a term of insult to Napoleon. "We Germans may hate Napoleon," was Von Lindenau's reply, "but not insult him." The dispute grew so warm, that it ended in a duel, in which Von Lindenau received a wound, that afterwards caused him much trouble and a painful operation.

to the time of his confirmation, in March 1820, he attended an elementary school at Buhrkarl, and occasionally assisted his father in husbandry. He subsequently learned land-surveying, and got so well acquainted with the subject in a year, that he was able to undertake the execution of plans without assistance. From 1820 to 1824 he was partly employed in measuring, and partly in plan-drawing. In the spring of 1825 he was engaged on the drainage of the district of Tondern, which had suffered greatly from the floods of the 3d and 4th of February. Here he got acquainted with the late Captain Von Caroc, one of the ablest officers employed in the measurement of the Danish arc of the meridian; and through him Petersen became known to Professor Schumacher, who invited him to fill the place of Thomas Clausen, as assistant-observer at the Altona Observatory (Clausen had been invited to Munich by the optical establishment of Utzschneider). In this situation he carried on the current observations of the Altona Observatory with great zeal and skill for twenty-four years, till Schumacher's death, and distinguished himself by the discovery of three comets. At the same time he took a share in many other scientific labours, which we owe to the Altona Observatory. In 1829 and 1830 he made the astronomical observations for the pendulum experiments at Güldenstein, and afterwards worked for many years on Schumacher's arc of the meridian. He connected the Amager base, measured with Bessel's apparatus, with the triangulation. He also connected Schumacher's triangulation with that of Sweden, and took a considerable share in its connexion with that of Prussia.

Bessel has given a striking proof of his reliance on Petersen's scrupulous trustworthiness. This great astronomer, shortly before his death, specially directed that Petersen and Busch should complete the reduction of the declinations of the fundamental fixed stars, which he had observed with the Repsold Meridian Circle, and in the way in which he himself had already commenced the work. In consequence of this honourable commission, Petersen visited Königsberg to bring away the necessary papers. The Philosophical Faculty of Königsberg took this opportunity of presenting him with a doctor's diploma. These reductions were completed before Petersen's death, and the publication may be looked for from Professor Busch, the director of the Königsberg Observatory, at no very distant time.

After Schumacher's death, Petersen held, temporarily, the direction of the Altona Observatory, and continued the publication of the *Astronomische Nachrichten*, at first alone, but afterwards in conjunction with Professor Hansen. In 1852 he was named by the King of Denmark a member of the commission for regulating the Altona Observatory, and received the title of Professor. He died at Altona on the 3d of February, 1854.

Petersen, as is evident from the preceding notice, came to Altona with but little knowledge of mathematics or astronomy; but he strove with great zeal and great success to repair these deficiencies. The volumes of the *Nachrichten*, from the 7th to the 37th, give abundant evidence of his astronomical proficiency, especially in the departments of observation and calculation. He married Sept. 2, 1832, but left no family. His private life was in the highest degree peaceful and happy, and his upright and unpretending character won the respect of all who knew him.

Felix-Victor Mauvais was born at Maiche, a village in the Department of Doubs, France, on the 7th March, 1809.

He was sent early to the seminary of Besançon, and there laid the foundation of a good education. The desire of acquiring more extended knowledge induced him to proceed to Paris, where, after pursuing his studies with assiduity in the various schools of learning of the capital, he was admitted as a student at the Ecole Polytechnique. Monsieur Mauvais afterwards gave instruction in the Mathematics at the Institution of Monsieur Barbet.

About this time he received a gratifying mark of the esteem in which he was held in his native Department by being comprised in the number of young men adopted by the town of Besançon, when he received a pension on the Suard Foundation, which afforded him additional means for pursuing his studies.

His taste for astronomy and for the exact sciences generally rendered him desirous of being attached to the Observatory, to which he was appointed by the Bureau des Longitudes in 1836, at the recommendation of Monsieur Arago.

Finding himself permanently attached to the Observatory, and at liberty to follow his favourite scientific pursuits, he did not limit his labours to an active participation in the ordinary duties of the establishment, but entered with ardour upon various astronomical investigations.

His zealous exertions were rewarded by the discovery of four comets.

During the eighteen years that Mons. Mauvais belonged to the Observatory he was indefatigable in making observations, and acquired much distinction as a practical astronomer, so that his labours added much to the high reputation of that establishment.

The talents and industry displayed by Mons. Mauvais caused him to be appointed a member of the Institute of France. He was named in 1843 to succeed Mons. Bouvard in that learned body; and at the end of the same year he was selected as an astronomer to the Bureau des Longitudes.

His varied acquirements and his thorough acquaintance with every part of practical astronomy caused his opinions to be much valued at the meetings of this body. Mons. Mauvais was not less distinguished for his amiability and independence of character than for his scientific attainments.

His health began to fail under his continual labours: however, his love of science was too great to allow him to seek renewed health in tranquillity and a cessation from astronomical studies.

This distinguished astronomer died in March 1854, at the comparatively early age of forty-five, much regretted by his numerous friends and by those who looked forward to further contributions to science from so intelligent and so energetic an astronomer.

Capt. FRANCIS PRICE BLACKWOOD, R.N., was the second son of Vice-Admiral the Hon. Sir H. Blackwood. He entered the Navy in 1821, at the age of thirteen, and was promoted to the rank of captain in 1836. His activity and his taste for scientific pursuits pointed him out as well qualified to conduct the examination of part of the north-east coast of Australia and the adjacent seas, which were imperfectly known; and in the beginning of 1842 he sailed in command of H.M.S. Fly on that service. While visiting the island of Teneriffe he ascended the Peak and obtained a satisfactory barometric observation, which afforded a height agreeing very nearly with that of Humboldt: he also made a slight survey of the island of St. Paul's, in the Indian Ocean, which was published by the Admiralty. Capt. Blackwood made a detailed examination of many of the small groups of islands within the barrier reefs on the north-east coast of Australia, and of the "inner passage," or expanse of smooth water between these reefs and the coast.

This service, performed amongst coral reefs rising suddenly from great depths, was one of considerable danger, and proved that Capt. Blackwood possessed in an eminent degree the professional skill and personal qualities which are indispensable to a successful issue in such circumstances, and by which, combined with patience and good temper, he preserved his crew from hostile collision, except on two occasions, with the treacherous natives of Australia and New Guinea. Capt. Blackwood erected a beacon on Caine's Island,—a very important position to navigators in those seas.

Some occultations observed by Capt. Blackwood and computed by Mr. Breen will be found in the *Monthly Notices* of the Society. He also devoted particular attention to the measurement of some important differences of longitude.

An account of the voyage was published by Mr. B. Jukes, M.A., the naturalist of the expedition, by the authority of the Admiralty, under the title of *Narrative of the Surveying Voyage of H.M.S. Fly*.

Capt. Blackwood returned after this expedition to the ordinary course of service; but his career, on which his zeal and abilities would, it was hoped, confer lustre, was prematurely closed by cancer, of which he died, at the age of forty-five, much regretted. He has left a widow and two children.

EDWARD RIDDLE was born in 1788, at Troughend, in the county of Northumberland. At this place he received his early education, and afterwards attended a school at Otterburn, on Reedwater, a village not less interesting from its beautiful and romantic situation than from its historical reminiscences. At this ancient village Mr. Riddle commenced his professional career, and kept a school for a short period. Here he became acquainted with a very remarkable person, the late Mr. James Thompson, who, from his varied attainments in science and natural philosophy, was regarded as a "prodigy" by the rustic population of the village and neighbourhood. In his intercourse with this gifted man, it is not improbable that Mr. Riddle caught a spark of that enthusiasm for science which pervaded his character, and derived from him that taste for scientific pursuits which he retained to the end of his life. It is well known that he urgently pressed upon Mr. Riddle the absolute necessity of acquiring a thorough knowledge of the principles of geometry, and to take Playfair's *Euclid* as his guide, assuring him that it was "a capital book."

While at Otterburn, Mr. Riddle made an electrical machine with his own hands, and with it showed all the ordinary phenomena produced by that instrument: and at that period it may be easily imagined what wonder and alarm would fill the minds of a row of rustics when the electric impulse was made to dart through their bodies with a sensation never before experienced.

In 1807 Mr. Riddle removed from Otterburn to Whitburn, in the county of Durham, where he remained nearly seven years. Here he commenced to study science in earnest; and, acting on the wise counsel given him by Mr. Thompson of Otterburn, he first completely mastered the whole of Playfair's *Euclid;* and he has been heard to assert that the accomplishment of this task produced such an effect upon his mind as to render the acquisition of any other mathematical subject a matter of comparative ease. He now became a *Diary* correspondent, his first communications to that work appearing in 1810, dated from Whitburn. This periodical was at that time under the management of Dr. Hutton; and Mr. Riddle's mathematical correspondence speedily procured him the esteem and friendship of that distinguished mathematician, who rendered him important assistance in advancing his success in life. Though, at this period, Mr. Riddle was little more than twenty years of age, he had acquired a considerable knowledge of mathematical science, and for many years he continued to be a distinguished contributor to the *Diary*, in which his solutions were always remarkable for conciseness, elegance, and accuracy. In the years 1814 and 1819 Mr. Riddle obtained the prize given by the editor of that well-known periodical.

Through the recommendation of his friend, Dr. Hutton, Mr. Riddle was appointed, in 1814, Master of the Trinity House School, Newcastle-upon-Tyne. The nautical instruction in this school, at the time of Mr. Riddle's appointment, was in the lowest possible state; but, by his zeal and abilities, he speedily raised its character to a high standard. His fame, as a teacher of navigation and nautical astronomy, spread far and wide; he drew around him a large number of pupils, and gained the respect and esteem of a wide circle of friends and contemporary teachers, who, after he had left Newcastle, never ceased to remember him with feelings of the deepest regard. Here also he became noted for the surprising quickness and accuracy with which he took celestial observations.

In 1821, Mr. Riddle published an essay, entitled, " Observations on the Present State of Nautical Astronomy; with Remarks on the Expediency of Promoting a more General Acquaintance with the Modern Improvements in the Science among the Seamen in the British Merchant Service." This essay, which was dedicated to the Master and Brethren of the Trinity House, Newcastle, is admirably written, and reflects great credit on its author. From a series of lunar observations, taken in 1821, and recorded in this essay, the longitude of Trinity House School was found to be $1^{\circ}\ 37'\ 17''$ W.

In 1821, by the same powerful influence of Dr. Hutton, Mr. Riddle was appointed Master of the Mathematical School, Royal Naval Hospital, Greenwich, where he remained to the time of his retirement in 1851. Soon after his removal to Greenwich he was elected a Fellow of this Society, and, in 1825, his name first appeared on the list of Council for that year. From that period to 1851 he was either one of the Council or a vice-president, and took an active part in every plan of the Society for the advancement of astronomical science. Mr. Riddle was always a regular attendant at the meetings of Council; and it is remarkable that he never attended one of these meetings without having previously obtained leave of absence from the Governor of the Institution. He was always so highly esteemed by the authorities of Greenwich Hospital, that he might have left his post on these occasions without the fear of censure, but his stern integrity, and unbending rectitude of character, would not suffer him to neglect the monthly presentation of his request; and it is needless to say that such leave of absence was never refused him.

Mr. Riddle contributed some valuable practical papers to the *Memoirs* of this Society. Among them is one " On the Longitude of Madras, by Moon-Culminating Observations," which he prepared at the request of the late Mr. Baily. This is an excellent paper, containing some valuable formulæ and remarks. It is printed in the twelfth volume of our *Memoirs*.

Mr. Riddle is best known by his valuable work on Navigation and Nautical Astronomy. He had been collecting materials for this work before he left Newcastle, but it was first published in 1824. It was an immense improvement on the empirical compendiums in vogue when it appeared, combining practice and theory in just proportions. Its leading characteristic is,—that while it contains all the tables and rules for computation necessary for the practical seaman, it contains also the investigations of the rules, and the preparatory mathematical information necessary for understanding these investigations. This is the crowning excellence of the work; and, as a proof of its admirable adaptation to the purposes of instruction, no less than five editions of the work have been disposed of, and the sixth, under the superintendence of his able and talented son and worthy successor, Mr. John Riddle, will shortly be published. It is hoped that the forthcoming edition will be found to be one of the best books for nautical instruction that can be put into the hands of seamen.

In 1822, Mr. Riddle communicated a short paper to the *Philosophical Magazine* "On the Simplification of Ivory's Solution of the Double Altitude Problem." By a very simple trigonometrical transformation, he adapted Ivory's solution to logarithmic computation, and gave to it that practical working form now in use.

In 1841, the school which Mr. Riddle had so long conducted was divided, Mr. Riddle retaining the superintendence of the senior portion, which was then called the Nautical School. The mistaken zeal of some persons in the cause of education led to the appointment of a very incompetent person* to the mastership of the junior portion of the school, who, thoroughly ignorant of the heavy and much self-imposed labour in which Mr. Riddle had so long delighted, proved a source of much anxiety and annoyance. Assertions were made to the Board of Admiralty, in reference to the progress of Mr. Riddle's pupils, which induced the Board to request two public teachers of mathematics to visit the school and report on the state of the instruction. The report made by these gentlemen completely refuted the assertions, and strongly expressed to the Lords of the Admiralty the opinion of the reporters, that the state of the school was not only highly satisfactory in itself, but, considering the low state of instruction of the pupils at entrance, and the small number of teachers allowed, a very remarkable proof of Mr. Riddle's energy and ability. It will be unnecessary further to revert to these circumstances — peculiarly painful to a sensitive mind like Mr. Riddle's — than to state that they resulted, if possible, in a higher estimation of him by all who knew him, and added not a few to the list of his friends. Something of disappointment, however, remained; neither was there from that time the same elasticity and cheerfulness which had marked his earlier career.

In 1845, a most able and efficient staff of masters had been happily gathered around him, and they united to present him with a testimonial of their esteem. On that occasion the Governor, Admiral Stopford, complimented Mr. Riddle on the firm stand he had made under some recent difficulties which had then happily passed away.

Shortly after Mr. Riddle's retirement in 1851, his bust in marble, finely sculptured by Mr. Theed, was presented to him by a large number of his former pupils and friends, accompanied with the expression of their high esteem for his worth, both as a public and private man. It was presented to him in the presence of the boys, and a large circle of friends and naval officers, includ-

* Since deceased.

ing the Governor, Admiral Sir Charles Adams, who, in a very feeling and effective address, adverted to Mr. Riddle's long, useful, and honourable services in the Institution.

Mr. Riddle was allowed to retire on his full salary; but he did not live long to enjoy his cessation from active duty, as successive attacks of paralysis issued at last in the complete prostration of his physical powers. His death took place at his residence in Greenwich, on the 31st day of March, 1854, in the sixty-seventh year of his age.

Mr. Riddle was distinguished among the many mathematicians who have done honour to the county of Northumberland; he was much esteemed by all who enjoyed the privilege of his acquaintance; his habits were plain, unobtrusive, and unostentatious; his hospitality and obliging disposition will be long remembered by those who have experienced them; and his attachment to his friends was warm and sincere. He was partial to music; at one time he could perform very pleasingly on the violin; and his taste for the songs and music of Scotland, as well as the Irish melodies and Welsh airs, led him to purchase every work of this description on which he could lay his hands.

Mr. Riddle's success as a teacher of navigation and nautical astronomy has never been surpassed—nor even equalled; he brought to his task a thorough acquaintance with the minutest details of the subject he had to expound, and his activity of manner and energy of character carried him through almost any amount of labour. Nor did his toils always close with the day; at midnight, or in the early morning, he would frequently repair to the dormitories of the boys, and rouse the elder ones, who were accustomed to take observations of the moon or other celestial visitant, with the quick call of "*my first class.*" Thus day and night witnessed his unwearied exertions and unparalleled industry in the dissemination of both theoretical and practical science among the youth attending the Royal Hospital Schools. He was one of the most indefatigable teachers of the age: the high status which these schools have so long maintained, in preparing youths for sea-service, is almost entirely attributable to his exertions and example; and there are very many masters and commanders in the Royal Navy, as well as officers in the Merchant Service, in every part of the world, whose naval services are at this time testifying to the soundness and efficiency of their early education derived from Mr. Riddle of Greenwich. No teacher ever deserved the gratitude of his country more than Mr. Riddle; few have done her more real and substantial service, and conferred so many advantages on her naval and commercial interests.

While the Council regret the loss of the services of Mr. Riddle, who was one of their number for twenty-five years, they have the pleasure of congratulating his son on his succeeding to the position of Head Master of the Nautical School; and they trust that with his high mathematical attainments and professional abilities, and stimulated by the example of his father, his exertions in promoting the cause of nautical instruction will be equally successful and distinguished.

St. Andrew St. John was the second son of the Rev. Edward Beauchamp St. John, and great-grandson of Henry Lord St. John, of Bletshoe in the county of Northampton. His early education was conducted by his father until he was placed at the Plymouth New Grammar-School, under the superintendence of W. Bennett, M.A., of Trinity College, Cambridge. Here he was prepared for admission to the Royal Military Academy at Woolwich, which he entered in February 1843. During his rapid progress through the Academy he displayed mathematical abilities of the highest order. His career was most brilliant, and it is believed almost unequalled. At the final examination he far outstripped all his competitors in mathematical attainments, and obtained his commission as a Second Lieutenant in the corps of Royal Engineers.

In December 1846 he was appointed to a command at Templemore, in Ireland, and was removed from thence to Gibraltar in 1847, and in the following year to Hong Kong, returning to England in August 1851. He obtained leave till the following January, when he went to Portsmouth and Hurst Castle. On the 17th December, 1853, he sailed on the Darien Expedition, the exposure and fatigue of which injured his constitution, and he returned the following spring much impaired in health, and was appointed to a command at Devonport, but was obliged to obtain leave on a sick certificate, and was never able to return to his professional duties. His death took place at Plymouth, 21st September, 1854, at the early age of twenty-seven.

Lieutenant St. John was passionately devoted to the study of mathematics, and whenever his military duties would admit, his leisure hours were spent in the prosecution of his favourite pursuits. Not a month before his death, he told the writer of this memoir, that, if he could obtain three years' leave, his most ardent wish was to proceed to the University of Cambridge with the intention of taking a degree in mathematical honours. His published writings are to be found in vol. i. (new series) of the *Professional Papers of the Corps of Royal Engineers.* They consist of a paper on the "Equilibrium of Roofs;" another on the "Equilibrium of the Arch;" and a third on "Dialling." He left many valuable papers unpublished.

William Scott attained his position almost wholly by his own exertions. He was born in October 1800, at Maxton, in Roxburghshire, of a good family, but which then was in reduced circumstances. He had the misfortune to lose his father at an early age; but that father, while he lived, spared from his narrow income what was necessary to give his two sons, of whom William was the eldest, the best education which a country town afforded.

At eleven years of age he was sent to the parochial school at Maxton, where he acquired a good knowledge of the English language and a fair amount of arithmetic; and three years afterwards he was sent to a school in the neighbouring town of Mertoun, in Berwickshire, in order that he might be instructed in the rudiments of classical literature, as well as extend his progress in arithmetic and algebra. Here he obtained a competent knowledge of Latin.

In November 1818 young Scott entered the University of Edinburgh, where he studied the Latin and Greek languages, besides logic, mathematics, and natural philosophy, under the distinguished professors of that time, among whom may be mentioned the names of Christison, Wallace, Leslie, and Jamieson, who honoured him with their particular friendship.

Mr. Scott began his mathematical studies under the tuition of Dr. Nicol; and the lessons of that mathematician he attended, as a private pupil, according to the practice in the Scotch Universities. By diligent application he speedily made the progress necessary to qualify himself for the mathematical class at the University, and was, in consequence, received there as a pupil of Professor, afterwards Dr. Wallace. A testimonial from Professor Wallace (1821) shows that he was one of the four students who shared the first prize for mathematics, given by the magistrates, patrons of the University. While at Edinburgh he supported himself, and paid the University dues, with what he could save from the remuneration he received for the lessons he gave to private pupils.

He was afterwards engaged at Edinburgh as an amanuensis by the late Capt. Basil Hall, R.N., whom he assisted in his astronomical pursuits; and, in preparing for the press the works of that officer, he greatly improved his style and increased his facility in English composition. In 1826, while so employed, he took his degree of M.A. in the University of Edinburgh; and, in the same year, he was recommended by his patron, Professor Wallace, on an application from the late General Butler, to fill the post of a Mathematical Master in the Royal Military College at Sandhurst.

The reputation of Professor Wallace was deservedly so high in that Institution, in which for many years he had been one of the mathematical professors, that the recommendation was immediately accepted, and Mr. Scott, being found duly qualified, at once received the appointment. He joined the Institution in February 1827. A reduction happening at that time to be made in the educational staff of the College, Mr. Scott was at first charged with the instruction of a class of gentlemen cadets in History and Latin; but, within a year, he entered upon his regular duty as a Professor of Mathematics, and this duty he continued ably to fulfil to the time of his death. The retirement of two professors, who were his seniors, placed him in a few years in the rank of first professor in the junior department of the Institution. In this situation all the energies of his mind were devoted to his duties as an instructor, and to the composition of his lectures.

Before this time the course of study in mathematics at the College must be considered as having been very elementary; and to Mr. Scott fell, in a great degree, the task of preparing the plan, and carrying out the measures adopted, for extending the course into the higher branches of mathematical science. In furtherance of this view he published, 1844, his *Treatise of Arithmetic and Algebra*, and, in 1848, his *Treatise on Plane Trigonometry and Mensuration*—works which, without, in matter or treatment, being beyond the mental powers of the youths for whom they were intended, have the great merit of being written in a philosophical spirit; and, had his life been prolonged, those works would have been followed by treatises on the higher departments of mathematical analysis. These he had in a great measure prepared, and in a manuscript form were in the hands of his pupils, who owe to him the knowledge they acquired of an important branch of human learning, and who cannot but remember with pleasure the general suavity of his manner, and the pains he ever took to remove the difficulties which beset the career of their professional education. Besides the works just mentioned, Mr. Scott, in 1854, published an elementary treatise on arithmetic, which is rendered particularly valuable by containing a series of elaborate tables computed for the purpose of facilitating the introduction and employment of a decimal scale of weights and measures. He was admitted a Fellow of the Royal Astronomical Society in 1835, but his distance from town, and the duties of his professorship, which required his presence almost daily at the College, rarely permitted him to attend its meetings; he took, however, the greatest interest in its proceedings, and in the discoveries which have added of late so much lustre to the science, for the promotion of which it was formed.

In 1852 Mr. Scott was appointed examiner in mathematics of the candidates for commissions in the British army, and this delicate post he held till his death, exercising the duties with strict impartiality, and to the entire satisfaction of those in authority.

Mr. Scott's constitution had never been strong; and in the beginning of last year (1854) his health began rapidly to decline. He died on the 8th of July; his complaint being aggravated by unremitting attention to his studies and the duties of his professorship.

Robert Snow was the eldest son of Robert Snow, the banker. He distinguished himself much at Eton and Cambridge, gaining especially Sir William Browne's medal for the best Latin ode in 1825. Since he took his degree he gave up many years to literary pursuits. Some publications, printed a few years since, prove how sincere an admirer he was of poetry, and how acutely he observed the beauties of the natural and celestial worlds. In the work called *Memoranda of a Tour on the Continent*, he gives much information during his expedition amongst the Alps, particularly during the passage of the Col du Géant; and his journey to Sweden to observe the total eclipse, some years ago, proves his zeal in the pursuit of astronomical researches. He also published a small compendium of astronomical definitions for the use of learners.

For the last few years a painful and distressing complaint prevented his application so earnestly to his favourite studies, and at last obliged him even to give up his observations at his observatory at Ashurst.

Mr. Snow was for a long time a Fellow of the Society, and was for several years on the Council. He was at one time a regular observer, and our volumes of *Memoirs* and *Notices* contain many of his observations. He was a remarkably nice noter of phenomena, and his occultations of stars by the moon may be safely relied upon.

George Burgess Wildig was born at Lichfield in the year 1784. His parents were inhabitants of Betley in Staffordshire. He received his school-education at the Grammar-School of Newcastle-under-Lyne. Though remarked as intelligent and studious, he left school at an early age, and entered a mercantile house at Liverpool, in which he at length became a partner. When about twenty-five years of age he abandoned business for pursuits in which he might more easily gratify the bent of his mind towards study and meditation. With this purpose he removed to Edinburgh in 1808, and for three sessions attended classes in that university, particularly those of Professors Dugald Stewart, Christison, and Leslie. By these eminent men he was especially noticed, and was honoured with their lasting friendship. His services were given in correcting for the press some of Professor Leslie's important works. In 1811 he entered at Caius College, Cambridge, where Professor Woodhouse appreciated his merits, and used his assistance, as Leslie had done at Edinburgh. He graduated B.A. in 1815, and then went to reside again in Liverpool, entered into holy orders, and held a curacy in that town. A short time afterwards he accepted the mathematical professorship at the Liverpool Institution, which office after a few years he resigned. In 1826 he was instituted to the Rectory of Norton-on-the-Moors, near Burslem, in Staffordshire, of which parish he previously possessed the advowson. His discharge of parochial duties was marked by attention, moderation, sound judgment, and consistency. His spare time was given to his favourite pursuit of mathematical science, blended with ancient and modern literature. With the Italian writers of the best ages, and with the niceties of their language, he was intimately acquainted. The rupture of a blood-vessel compelled him in the latter years of his life to resign clerical duties, and to make his abode in a mild climate. He chose St. Heliers in Jersey, where he died on the 9th of December, 1853.

His attachment to mathematical science continued to the last, and he beguiled many of the hours of pain and weakness in the two years next before his death by an elaborate recension of every article in one of the treatises on algebra most in use in our universities. Though he has left much matter in manuscript, he rarely gave anything to the world through the press. A short geometrical treatise on the conic sections, which he printed in 1822 for the use of the Liverpool Institution, is marked by elegance, geometrical purity, and comprehensiveness. He was the author of some mathematical articles in the seventh edition of the *Encyclopædia Britannica*, the signature to which is O. O. O.; but in the list of contributors his name is erroneously given as the Rev. G. B. Wild*ing*, M.A., *Oxford.* Many friends of similar pursuits, and many grateful pupils remain sensible of the advantages they have had from his luminous conversation and instructive guidance. His scientific strength lay on deep foundations. He was conversant with the Greek geometers, and with the discoverers, promoters, and perfectors of modern mathematical investigations from the middle ages to the present day. His remarkable talents and learning, though so little displayed to the world, were well known to many friends; among whom it is needless to mention those Cambridge men of his day, who were among the first founders, and are yet distinguished members of the Astronomical Society, and leading names in British science.

John William Whittaker, D.D., was born about the year 1790. He graduated at St. John's College, Cambridge, where he took his B.A. degree in 1814, his name appearing as thirteenth on the list of Wranglers for that year. He was subsequently elected a Fellow of his College; and it was while residing on his Fellowship that he published his celebrated work which introduced him to the notice of the late Archbishop of Canterbury. This was entitled "A Historical and Critical Enquiry into the Interpretation of the Hebrew Scriptures, with Remarks on Mr. Bellamy's New Translation." It was printed at the University press during 1819, and was followed shortly after by a "Supplement" containing numerous additions and corrections. In consequence of the publication of this work he was appointed Examining Chaplain for the Archbishop, who presented him to the Vicarage of Blackburn on the demise of the Rev. Thomas Durham Whitaker, LL.D., F.A.S., the well-known historian and archæologist, in 1822. He proceeded to the M.A. degree in 1817; was admitted B.D. in 1824; and completed the usual course for the degree of Doctor in Divinity during 1830. The offices of Rural Dean and Honorary Canon of Manchester Cathedral were also conferred upon him by the Bishop of that diocese.

During Dr. Whittaker's residence at Blackburn he published a series of letters on the church; and in 1825 he was appointed to preach a course of sermons before the University of Cambridge, the subject being justification by faith. This course was published the same year, and was appropriately dedicated to his patron the Archbishop. Besides these he also published various pamphlets on passing subjects of controversy; one of which was a sermon preached to the Chartists when they took possession of the parish church in 1839; and another related to the remains of the ancient British language in the northern part of the kingdom. Although his parochial duties necessarily occupied a large share of his attention, he always kept up his scientific and general reading. Not long before his death the writer of this notice had an opportunity of hearing him explain his researches into the affinities of the Chinese language so far as they had a bearing upon the cosmogony of the first chapter of Genesis; and he listened with delight to his examination of the different systems of computing time adopted by our leading geologists. He had elaborated, to use his own expression, a theory of the universe, which, in his opinion, tended to remove all difficulties, and reconciled the biblical, the astronomical, and the geological theories. Had his health permitted, he would undoubtedly have favoured the world with some of his researches concerning the nebular hypothesis and geological time. He was one of the first Fellows of the Astronomical Society, having, as the writer understood, assisted in its formation. He always entertained a high opinion of the value of the labours of the Society, but regretted that other urgent duties had almost isolated him from subjects in which he formerly took a deep interest.

As a preacher Dr. Whittaker never aspired to the character of a popular orator; but the calm and argumentative style of his sermons was calculated rather to correct the judgment of his hearers than to rouse their feelings by appeals to the imagination. As a writer he had few superiors in the purity of his diction and the rhythmical composition of his sentences. His health had been failing for some years, and he finally sank under a complication of diseases, at the Vicarage, on August 3d, 1854, in the 64th year of his age. The public of Blackburn honoured his remains with a public funeral a few days after his decease, the Lord Bishop of Manchester officiating at the ceremony.

Captain Sir John Franklin, of the Royal Navy, Knight Commander of the Guelphic Order of Hanover, D.C.L. and F.R.S., was an early Fellow of this Society, and must be well remembered by many of those who are now present. He was born at Spilsbury in Lincolnshire, in the year 1786, entered the navy at the age of fourteen, and was on board the Polyphemus at Lord Nelson's attack on Copenhagen in 1801. Shortly after that memorable action he joined the Investigator sloop, Captain Matthew Flinders, and sailed on a voyage of discovery to New Holland; and it was under that regretted officer that he imbibed that zeal for geographical research for which he was distinguished through life.

While thus engaged, he had the misfortune to be wrecked on a coral bank; and in returning home on board an East-Indiaman, he was present at the celebrated repulse given to a French squadron under Admiral Linois, by Commodore Dance and his merchant-ships, on which occasion Franklin was one of those who managed the signals which so greatly deceived the enemy. On arriving in England he was immediately appointed to the Bellerophon, of 74 guns, in which well-known ship he bore a part in the great battle of Trafalgar, on the 21st of October, 1805. He served with great merit during the remainder of that arduous war, and was strongly recommended for promotion for his conduct at New Orleans.

On the general peace in 1815 his mind reverted to its former bent, and he bestirred himself in the cause of discovery. In January 1818, he assumed command of the hired brig Trent, and accompanied Captain David Buchan on a voyage of research to Spitzbergen, which led to his being intrusted with the charge of an expedition to the Coppermine River and the northern regions of America. The details of that fearful undertaking, together with his subsequent polar explorations, are too widely known to need repetition here; as is also having been some time the Lieutenant Governor of Van Dieman's Land. Suffice it to say, that he sailed in the Erebus on the 3d of March, 1845, on his last and ill-fated voyage. Since then the public feeling has been painfully excited respecting the fate of our hapless countrymen in those inhospitable wastes, and the most liberal and spirited measures were adopted, as well by our Government as that of America, and by the bereaved Lady Franklin, for their rescue; but an unusually dense mystery pervaded the whole.

The hope which glimmered faintly in the gloomy uncertainty has at length been quashed by the recovery of certain unmistakeable articles belonging to Franklin and the officers of the Erebus; and yet even this requires further evidence. The plate, the clothing, and the decorations of knighthood, which have been brought to England by Dr. Rae, form a conclusive token of a terrible catastrophe having happened to that ship; but as Dr. Rae is confessedly unacquainted with the Esquimaux language, and only gained his information through the equivocal medium of an interpreter, we must pause upon several points of the tale he has published, and especially the distressing statement that our people resorted to cannibalism. It must be borne in mind that the period of the tragedy is stated to be in 1850,—that the natives communicated with were not those who had communicated with the Franklin party,—and that there would be an obvious object in their misleading Dr. Rae. Notwithstanding, however, the accounts being unsatisfactory, there can be no reasonable doubt of the extent of the disaster. The Council have not ventured to erase the name of Sir John Franklin from our list until the Admiralty set the example: and it is with feelings of deep sorrow that they acknowledge the propriety of such a step.

Captain Francis Rawdon Moira Crozier was born at Bainbridge, in the county of Down, in Ireland, and was early destined for sea life. He entered the navy in June 1810, on board the Hamadryad frigate, under the command of that active officer, Sir Thomas Staines; whom he afterwards accompanied to the Pacific in the Briton, and made an interesting visit to Pitcairn's Island, which they found peopled by the mutineers of the Bounty. In 1824, Mr. Crozier was appointed master's mate of the Fury, discovery ship, under Sir Edward Parry, with whom he became associated in three successive polar voyages; having been made a Lieutenant in March 1826.

Mr. Crozier was afterwards employed on the coasts of Spain and Portugal, till December 1835, when he joined the Cove, a hired vessel, which was despatched from the Humber in search of certain missing whalers, under the command of Sir James Ross. Being now distinguished for science, seamanship, and fertility of resource, his services came into demand; and in May 1839 he was appointed to command the Terror, in which ship he accompanied the same officer on a voyage of research into the Antarctic Ocean, during which time he was advanced to post rank. In March 1845 he was re-commissioned to the Terror, and sailed on a fresh attempt to explore the north-west passage, through Lancaster Sound and Behring's Strait. He has not since been heard of!

Though the articles brought to England by Dr. Rae were mainly illustrative of the fate of the crew of the Erebus, there is every apprehension that Crozier and his gallant associates shared the fate of their commander. As the seas and land on the meridian of Cape Walker, and north of it to a distance exceeding 100 miles, have been thoroughly searched for the missing ships without success, it is not improbable that they are frozen up in one of the channels between North Somerset and Banks's Land, which have not been yet explored. It is therefore just possible that a few of the juniors, with hardy constitutions, may survive; but the seniors must, long ere this, have succumbed to privation and suffering.

The operations at the Royal Observatory, Greenwich, have been characterised, during the past year, by the same activity that has prevailed in former years. No important addition has been made to the instruments; but those already in use have been employed with the same inflexible steadiness and on the same classes of objects. It was stated in the last February Report, that the mechanism necessary for the registration of transits, by means of electro-magnetism, was nearly complete; and we may now add that the method has been for several months in use with perfect success and with considerable advantage to the observations. The first transits recorded by this method were made on March 27, 1854; and since that time all the transits, with trifling and occasional interruptions, owing to derangements of the machinery, have been made by the same agency. The observations made over nine wires by this method are indisputably of a higher order of excellence than those formerly made by the ordinary method of the eye and ear; and great hopes are held out that the personal equations of the different observers will be comprised within very narrow limits.

The only important addition to the external galvanic communications, as they were reported last year, is that arising from the completion of the arrangements for dropping a time-signal ball at the Navy Yard at Deal. The dropping of the ball systematically came into operation at the commencement of the present year, and with perfect success as far as the general action of the machinery is concerned, though several failures have arisen through defects in the local galvanic clocks, and from other causes. All these defects have since been remedied, and there is no doubt of the facility with which the dropping of the ball can be ultimately effected as a matter of routine business; and there cannot be a doubt of the great advantage which will accrue to this important port by the correct knowledge of Greenwich time.

The arrangements for determining the difference of longitude between the Observatories of Greenwich and Brussels were stated with some detail in the last February Report. The result was there given that was deduced from the first part of the operation, namely, a difference of longitude amounting to $17^{m}\ 29^{s}{\cdot}256$. We may add in this place that the second part of the operations, namely, that after the interchange of the observers, gave, for the resulting difference of longitude obtained by the same mode of treatment, $17^{m}\ 28^{s}{\cdot}538$; and that the results corresponding to a rather different mode of treatment of the star-observations, were respectively $17^{m}\ 29^{s}{\cdot}340$ and $17^{m}\ 28^{s}{\cdot}476$, as deduced from the two sets of operations, and that the whole number of signals on which these results are based was 1104. The definitive result of the whole series of operations is $17^{m}\ 28^{s}{\cdot}90$, which differs by $1^{s}{\cdot}3$ from the result previously deduced by M. Quetelet and Mr. Sheepshanks by means of chronometers. We may also remind the Society that a paper by the Astronomer Royal, which explains with full detail every part of the operations, has been printed in the current volume of our *Memoirs* recently commenced.

But the most important series of operations for the determination of longitude performed during the past year, is that by which the difference of longitudes of Paris and Greenwich has at length been definitively settled. It is well known to the Society that this determination was intended as one of the earliest applications of the galvanic method; and, as early as the year 1851, a correspondence was commenced by the Astronomer Royal with M. Arago on the subject. Various causes contributed to the delay of the projected operations, amongst the most prominent of which were the ill-health and subsequent death of M. Arago, and the consequent unsettled condition of the administration of the Paris Observatory; as also the failures which occurred soon after the completion of the submarine galvanic connexions with the Continent, and the delays in establishing the connexion of the Observatory of Greenwich with the line of wires of the Submarine and European Telegraph Company.

Owing to all these causes, the operations connected with the determination of the longitude of Paris did not commence till the month of May 1854, but they were then carried through with a completeness and accuracy superior to all preceding attempts at the determination of longitude. Independently of the care bestowed at Greenwich on every part of the operations, the successful issue of them was due mainly to the energetic way in which M. Le Verrier entered into every part of the details of his share of the work, and surmounted the successive difficulties which lay in his way.

It has been proved, with regard to earlier attempts at determining longitudes by other methods, that, generally speaking, the doubtful or failing point has been in the determination of local time at the different stations. However well rocket or other signals may be observed, and how skilfully soever all the details of the operations may be conducted, yet any errors affecting the time as obtained by the transit instrument, whether from faulty construction, bad determinations of instrumental errors, or uneliminated personal equations of the observers, are fatal to the whole operation.

On entering upon the Directorship of the Paris Observatory, M. Le Verrier found his transit instrument very defective, and utterly unfit, without great alterations, for the delicate work required of it. With his characteristic energy he proceeded immediately to remedy this serious defect; and, though he was obliged to put up with considerable delay, he at length got the transit instrument reinstated in a perfectly satisfactory condition. To this cause, as well to his minute attention to the instrumental errors during the whole course of the operations, is mainly due the confidence which we repose in the final determination.

With regard to the operations themselves, they consisted, as in former instances, of two series; in the first of which M. Faye, on the part of the Paris Observatory, observed stars and galvanic signals at Greenwich, while Mr. Dunkin, on the part of the Greenwich Observatory, made the similar observations at Paris. In the second series, the observers were reversed — M. Faye observing at Paris, and Mr. Dunkin at Greenwich.

In the first series, the observations commenced on May 27, and terminated on June 4, 1854; five evenings during that interval being made available for the determination of longitude by the observation of transits of stars as well as galvanic signals at both observatories. In the second series, the observations commenced on June 12 and terminated on June 24, seven evenings being available for longitude. The determination from the first series, as derived from more than 700 signals, was that the east longitude of Paris is $9^{m}\ 20^{s}{\cdot}50$; and that from the second series, as derived from nearly 1000 signals, gave for the east longitude, $9^{m}\ 20^{s}{\cdot}76$. The definitive result is, therefore, $9^{m}\ 20^{s}{\cdot}63$, differing by nearly one second of time from that formerly determined by means of rocket signals.

In the course of the last summer, an important series of experiments was instituted by the Astronomer Royal for determining the variation of gravity on descending to a considerable depth in a mine, with the ultimate view of inferring from the result of this observation the mass, or the mean density, of the earth. Without referring to the indirect determinations of the law of density from the figure of the earth and the motions of the moon, the direct determinations hitherto made use of are of two classes,—one the attraction of Schehallien; the other the attraction of leaden balls, as observed by Cavendish, Reich, and Baily. In both these methods there are peculiar difficulties, and it appeared, therefore, at least desirable that a trial of a different method should be made. And it appears on calculation, that the probable effect of unavoidable errors when the mean density is inferred from experiments in a mine is less than in the other methods. These considerations induced the Astronomer Royal many years ago, in conjunction with Dr. Whewell, Mr. Sheepshanks, and other friends, to institute pendulum experiments in the Dolcoath mine in Cornwall. In two different years the experiments were tried, and in both they failed in consequence of local accidents. In the experience, however, of these abortive attempts, the observers learned that the principal inaccuracies arose from the difficulty of comparing a clock at the surface of the ground with one at the bottom of the mine. In the year just past, the observers at Greenwich acquired considerable practical familiarity with the manipulations of the galvanic telegraph; and it became evident to the Astronomer Royal that by its agency the difficulty, so formidable in other years, would now be easily overcome. Accordingly, he proceeded in the summer to inquire into the circumstances of different mines in the great Durham coal-field, and he found that the Harton Colliery, near South Shields, reported to be 1260 feet deep, was admirably adapted to the experiments, and that the owners of the mine were anxious to give every assistance. An expedition on a competent scale was soon prepared. It was necessary to obtain the assistance of observers from several English observatories. The working party, as finally arranged, consisted of Messrs. Dunkin and Ellis from the Royal Observatory, Mr. Rümker of the Durham Observatory, Mr. Pogson from Oxford, Mr. Criswick from Cambridge, and Mr. Simmonds from the Red Hill Observatory. Pendulums were lent by the Royal Society. The labour and skill of telegraph engineers, required in establishing simultaneous galvanic signals between the upper and lower stations, was gratuitously supplied by the liberality of the Electric Telegraph Company. The Admiralty assisted by a grant of a sum of money. The observations consisted of 104 hours of incessant observations of one pendulum (A) above and another (B) below; then of 104 hours with (B) above and (A) below; then of 60 hours with (A) above and (B) below; then of 60 hours with (B) above and (A) below. The result, as to the mechanical firmness of the instruments and trustworthy character of the observations, is most satisfactory. The first conclusion is, that the lower pendulum is accelerated $2^s{\cdot}25$ per day, or that gravity is increased at the lower station by $\frac{1}{19190}$ part. Operations are now in hand for the precise measure of the depth of the mine, for ascertaining the general form of the country, and for obtaining the specific gravity of the rocks; and till these are completed the final result for the earth's mean density cannot be obtained. It appears, however, likely to prove high,—between six and seven times the density of water.

The publication of the thirteenth volume of the *Radcliffe Observations* has been already mentioned in the *Monthly Notices*. It contains the continuation of the observations for the circumpolar catalogue to the end of 1852. The *Observations* with the *Heliometer*, the publication of which was unavoidably delayed, are now printed, and the results are in the hands of the Society. They will appear, with the rest of the fourteenth volume, in the course of a few weeks.

It was mentioned in the last Annual Report, that they had been principally directed to the determination of the parallax of 61 *Cygni* and 1830 *Groombridge.* The partial result there mentioned, which gave a parallax of $0''{\cdot}384$ to 61 *Cygni*, has been fully confirmed. Subsequent investigation, taking in a greater number of observations, having only altered that value to $0''{\cdot}392$ or $0''{\cdot}402$ (accordingly as a temperature correction is used or not), with a probable error of $\pm\ 0''{\cdot}015$.

The observations of 1830 *Groombridge* have presented greater difficulties, and apparently an anomalous result, inasmuch as they assign a greater parallax to one of the stars of comparison than to 1830 *Groombridge.* Dr. Wichman, it will be remembered, fell upon a similar difficulty; and what adds to the perplexity is, the star which appears to have the greater parallax in this case is one of those which in Dr. Wichman's researches appeared to be most distant.

This is not the place to enter into a disquisition on the subject, but a short statement of the circumstances may not be uninteresting to the Society.

The stars selected for comparison with 1830 *Groombridge* are the same which Otto Struve used, but they have been designated in contrary order, the star which he called *b* being the *a* of the present inquiry. The same stars were also observed by Dr. Wichman in his more recent researches, in connexion with a *third* star. The two stars now in question are Wichman's *a* and *a''*. The comparative measures between 1830 *Groombridge* and the former give a parallax of $0''{\cdot}26$ to 1830 *Groombridge;* whereas in the other case the resulting parallax is $-0''{\cdot}18$, or, in other words, the parallax of Wichman's a'' (the b of the present inquiry) is 0''·44.

Dr. Wichman found the parallax of 1830 *Groombridge* 0''·72, and that of his a (which is also a in this case) 1''·17 (*Astron. Nach.* No. 844, p. 50).

It were vain, in the present state of our knowledge of the structure of the heavens, to attempt to argue on the abstract probability of results such as these. It will appear to many minds just as improbable that a star having a proper motion of 7'' of the great circle *should* be immeasurably distant from us (for this is the alternative), as that another having no physical peculiarity *should not* be.

It is not on such argument that Mr. Johnson founds his suspicion of the accuracy of the result at which he has arrived, but on the simple fact of two observers, with instruments similar in principle, though somewhat different in construction, having arrived at such opposite conclusions.

In his opinion, this seems to show some imperfection in double-image measures of objects separated by large arcs, which still remains to be explained.

It is true Dr. Peters has shown most ingeniously (*Astronomische Nachrichten*, No. 866) that Wichman's adopted temperature correction is probably too small. But he has not shown that the amended correction will reconcile independent results, so that each star separately will tell the same story; and until this has been done, Mr. Johnson conceives that his objection is not refuted.

The strongest argument in favour of Mr. Johnson's result, as it stands, is, that the observations of 61 *Cygni*, where the comparison stars are more unfavourably situated with regard to distance, show no such anomaly; and both series were carried on, in great part, contemporaneously. The parallax of 61 *Cygni*, with regard to its stars of comparison, is a maximum in April and October, about the times of the mean temperature of the year; while the maximum parallax of 1830 *Groombridge* occurs in December and June, at the extremes of annual temperature. Any disturbance, therefore, produced by expansion might affect the latter determination without affecting the former. But it happens that, of the *four* independent cases which have come under discussion, *one* only has shown symptoms of such disturbance, amounting to −0''·11 for an increase of 10° of Fahrenheit on a distance of nearly 2100''; while in *every* case the accordance of the separate results is improved by rejecting a temperature correction altogether. There was, however, this difference in the optical condition of the instrument in the two cases. In the case of 1830 *Groombridge*, in order to render the small stars visible when in juxtaposition to it, the aperture of one segment was reduced to about two inches, while with 61 *Cygni* no such reduction was necessary. Mr. Johnson is at a loss to explain *how* this circumstance can affect the accuracy of comparative measures: it is mentioned as being the only apparent source of error which was not common to both series.

The observations for the Circumpolar Catalogue have at length been brought to a close. Some reasons for the delay which has occurred have been before mentioned. Besides these, another was the necessity of investigating into the cause of a small difference which has often been noticed between the N.P.D. given by the Radcliffe Observations and by other authorities.

Mr. Johnson has now satisfied himself on this point. A small excess of the adopted over the true latitude, amounting to about $+0''\cdot35$, and an error in the adopted constant of refraction (Bessel's) of about $+0''\cdot2$, will explain a portion of the difference. But the principal cause is the discrepancy between the horizontal points in different parts of the instrument, as given by direct and reflexion observations. Here we have another confirmation of the propriety of the warning often given to observers by the Astronomer Royal, not to trust to any single point for the determination of this important element of reduction. The effect of the accumulated errors will be to increase the N.P.D. about $1''\cdot25$.

Considerable progress has been made during the last six months in bringing into action the photo-meteorographic instruments which had been some time erected. They consist of a barograph and thermograph, designed by and constructed under the superintendence of Mr. Ronalds, late of the Kew Observatory, to whose disinterested zeal and attention Mr. Johnson wishes to make this public acknowledgment.

The photographic process remained to be arranged, and for this purpose Mr. Johnson has been fortunate in securing the services of Mr. Crookes, a gentleman well known for his skill, and for several improvements he has introduced into the art. Under his direction everything has been very satisfactorily completed, and the observations are now being regularly carried on.

While on the subject of the Radcliffe Observatory, though not forming part of its strictly official routine, it would be unjust to pass unnoticed the personal labours of Mr. Pogson at intervals when released from his immediate duties.

Observations of the smaller planets at important parts of their orbit with the 10-foot equatoreal and ring-micrometer,—the determination of the periods of several known variable stars, and search for new ones,—the construction of a set of maps to connect Mr. Bishop's with those of the Berlin Academy, are subjects which engage his attention as circumstances allow. His progress cannot, of course, be that of a person exclusively devoted to this kind of research. But by system and perseverance he has accomplished a great deal, and it is hoped that no long time will elapse before the Society is put in possession of some of the fruits of his exertions.

Mr. Pogson was one of the observers whom the Astronomer Royal selected to take part in his important experiments at South

Shields. These experiments afford, as far as we are aware, the first example of the mutual assistance one observatory may render to another,—an example which, we are sure, will be hailed with satisfaction by every astronomer. Apart from the direct advantages which accrue to men of kindred minds from the interchange of ideas, such intercourse between separate establishments serves to extend their sympathies beyond the sphere of local operations, and to remind them, while labouring each in his special vocation, that they are also members of an astronomical commonwealth, in the progress of which they have a direct concern.

At Cambridge, Professor Challis is proceeding steadily with the usual work. He has recently gone through a series of observations and calculations for determining the effect of the forms of the transit-pivots on the calculated times of meridian transit. Two sets of measures were taken, on different days, with the micrometer microscopes provided for bisecting dots at the ends of the pivots, the transit-axis being in one position, and two sets were similarly taken after reversing the instrument. The result of the calculations exhibited an effect of the same kind as that found by the trials made in 1850, but greater in degree. By the experiments of 1850 and 1854 the effect of the forms of the pivots on all the transit observations from the year 1850 inclusive, to the present time, may be eliminated. The more immediate object of the experiment of 1854 was to correct for the forms of the pivots, the determination of the longitude made last year by galvanic signals. Professor Challis was unwilling to publish a final result till this source of error had been got rid of. The calculations for this purpose, which were of great length, are now completed; and the final determination of the longitude by this method is $22^s \cdot 70$ east of Greenwich, which is about eight-tenths of a second less eastward than the longitude hitherto used. Professor Challis considers this result to be trustworthy, and proposes to adopt it in future. A detailed account of the galvanic experiment, and of the calculations connected with it, has been submitted by him to the Cambridge Philosophical Society.

Last summer he was engaged upon a plan for mounting collimators for the purpose of determining the effect of flexure in observations with the mural circle. As this instrument is of large dimensions, being 8 feet in diameter, the effect of the alteration of form caused by the mere weight of the parts is of sensible amount. He has hitherto attempted to eliminate this source of error by the comparison of direct and reflexion observations of the same star. This method, though generally good, fails, or becomes uncertain, when the stars are less than 25° above the horizon. On this account he proposes to use collimators so mounted as to be capable of collimating with the circle telescope in any position of the latter, being carried about the circle by opposite arms which revolve round a horizontal axis. The stage for mounting the collimators is prepared, and the collimators have been received from

Mr. Simms, so that this method will soon have a trial. If successful, it will supersede the necessity of reflexion observations, which occupy a great deal of time, and are troublesome on account of failures arising from disturbances of the mercury. In any case, however, reflexion observations will be taken of stars near the zenith, in order that the determination of zenith point may not depend on a single set of divisions of the circle, which would happen if the zenith point were determined exclusively by the collimating eye-piece.

Steady progress has been made in the reduction of the meridian observations of stars near the elliptic, contained for the most part in the *Histoire Céleste*, and in Weisse's Catalogue reduced from Bessel's Zones. A considerable number of errors has been detected in these two catalogues, and some also in the catalogue of the British Association.

Mr. Carrington has during the past year been steadily pursuing the plan of observation proposed for his Observatory at Red Hill which was put forth in the *Monthly Notices*, vol. xiv., No. 1. Of the region comprised in the maps which he presented to the Society, the portion within 4° of the north pole has been exclusively under observation during 1854; and, with the exception of a mere trifle, is now exhausted. It was found that about one-sixth of the stars laid down in the maps were too faint to bear the slight amount of illumination necessary for the wires to be seen with any sharpness, and these have, consequently, been struck off the observing list. The remainder, which is believed to comprise all the stars not below the $10\frac{1}{2}$ magnitude, numbers 709 stars, of each of which, with very few exceptions, four observations, at least, have been procured in both elements. There are nineteen stars observed within $40'$ of the pole, of which the nearest, situated in about 16^{h} by $0^{\circ}\ 5'$, may be accepted as an example of his lowest magnitude, the $10\frac{1}{2}$.

The companion to *Polaris* is rated at rather higher than the tenth. The reductions are also steadily progressing; but, from the additional labour required in the neighbourhood of the pole, are not likely to be concluded before Midsummer next. His transit-circle has given him the greatest satisfaction; but although he has evidence enough before him to show that its permanence of adjustment is nearly unrivalled, he thinks it better to defer any statement on the point till his reductions are more advanced. In the ensuing year, the zone 4° to 7° will be under observation, and, it is hoped, will likewise be exhausted within the year.

Throughout the past year the solar spots have been observed in position and sketched on every available opportunity. The method of observation is that which was explained in vol. xiv., No. 5, of the *Notices;* but the form of reduction has been modified in a manner which will shortly be published. It is sufficient now to state that the sun has been thus viewed during 1854 on 153 days, on thirty of which no spots were visible; and that the number of observations of nuclei and detached spots is 328, the whole of which are finally reduced and diagrammed, showing the appearance on the disk, and the heliographical longitude and latitude, the latter quantities computed to the nearest minute of arc. Mr. Carrington has not hitherto found time for their special discussion to any extent beyond this point. He intends to continue their observation and reduction on the same system during the present year. Mr. Carrington has likewise, from time to time, during the year, been engaged in the revision of the observations taken by him at Durham; and as the printer has some time since received the whole of the copy for the press, and about half the sheets are worked off, the Society may shortly expect to receive the second volume of the Durham Observations, which will be about the size of the first one.

The principal work of the Edinburgh Observatory during the past year has been the making, computing, and printing of the ordinary meridian observations of stars.

The several steps alluded to in our last Report for enabling the Observatory to undertake a larger amount, and a more special department of business, though advanced a stage further with the authorities, are not yet confirmed and allowed. But during the past year particular questions have been examined into as follows: the details will appear elsewhere.

1. The condensation of the luminiferous ether in the neighbourhood of the sun. The probability of such a condensation having been pointed out last spring by Prof. W. Thomson as resulting from the dynamical theory of heat, Prof. Piazzi Smyth proceeded to institute observations to test the fact, and measure its amount. The operation proved very tedious on account of atmospherical difficulties preventing the visibility of stars in the immediate neighbourhood of the sun; and, in fact, only two observations have been procured of a class fit to be employed in so delicate an inquiry. That these two observations unite in showing the fact of such a condensation, and give for the amount of it at 12° distance from the sun; one of them, ·03 sec., and the other, ·04 sec., is, Prof. Piazzi Smyth thinks, the result of accident; but he also thinks that we may safely conclude from them that while the quantity is certainly small, it may be sensible to a long series of good observations.

2. The physical character of the surface of the Mare Crisium in the moon, at the request of the British Association.

3. The application of electric agency to improve the accuracy of time observations.

4. The improvement of astronomical observations at sea, under circumstances to which the principle of Hadley's quadrant does not apply.

At the Liverpool Observatory, Mr. Hartnup's attention has of late been directed towards obtaining photographical pictures of the moon. At our June meeting, several specimens were exhibited to the Society, which were exceedingly promising, notwithstanding the imperfection of the apparatus for displaying them. At the meeting of the British Association at Liverpool, photographs of the moon were shown in St. George's Hall, which are said "to have outstripped all other attempts made elsewhere," and "to have superseded all maps of the moon now in existence." Mr. Hartnup does not think that, *at present*, his pictures quite deserve such praise; but he feels great hopes that they will do so before long.

The sensible defect is apparently in the *chemical* part of the process, for he finds that when the picture is magnified from 1·3 inches to 50 feet diameter, there is no fault which can be traced to the *motion* of the telescope. He conceives, too, that he is not yet "master of the best method of copying and enlarging the original pictures." It may confidently be expected that an experimenter of Mr. Hartnup's zeal and capacity, aided as he is, and will be, by the best chemical talent, will bring this art speedily to perfection; and that we shall soon have portraits of the moon painted by herself, and in which the drawing and effect are perfectly true. The last and most minute details must always probably be *directly* observed; but even an incompetent artist can fill up such details, when he has a good photographical sketch on a large scale before him. If any change is going on in our satellite, it may thus perhaps be made sensible in time.

At the same meeting of the British Association, the meteorological results of the Liverpool Observatory obtained the most flattering approbation. The Association has good reason to be proud of its creation, for the Liverpool Observatory sprung from the recommendation of that body in 1837, and few projects have been more successful. The anemometer results, diagrams, &c., were ordered to be printed entire in the next volume of the Proceedings of the Association.

The special object, however, of the Liverpool Observatory is that which was also the original object of the Royal Observatory,—to render navigation more safe. This humane and patriotic purpose has always been *first* in Mr. Hartnup's mind; and he has been furnished with the most ample means by his patrons. We have repeatedly attempted to draw attention to this most important subject, and Mr. Hartnup himself has taken every opportunity to press the matter on those most interested, but hitherto with only very partial effect. In chronometers of the usual construction, it is well known that the *compensation* for *heat* and *cold* is *imperfect*, but that the errors in a well-made time-keeper follow a certain fixed course, and can be tabulated for each instrument according to the indications of the thermometer. It has been proved by actual experience, that out of 100 chronometers, 95 will perform satisfactorily, where this special correction is applied. Now Mr. Hartnup supplies a table to every chronometer rated at the Liverpool Observatory, assigning the rate according to the temperature in which the watch is going. The additional trouble is merely this. A thermometer of the rudest kind must lie near the time-keeper, and be noted once a-day, or, when the temperature is steady, once a-week. In bringing up the error, the seaman must use the daily rate *corresponding to the thermometer*, instead of *one* rate for the whole voyage. This operation would scarcely cost an additional minute a-week; and it would make every sound, well-made, but imperfectly compensated, chronometer, as good as a perfectly compensated chronometer, if such a thing ever exists. This method, however, is practised by but a small number of the English captains who sail from Liverpool, although they would have nothing additional to pay for the advantage of being rated in this manner at the Observatory. This fact, if it were not undeniably true, would surely seem incredible, that men should risk their own lives, those of their crew, and of their passengers, rather than take the trouble to use a rate corresponding to the daily temperature, instead of one rate for the whole voyage. Let us hope that the interest which has lately arisen with respect to the merchant service may be directed to this point.

With the consent of his Committee, Mr. Hartnup has been appointed an agent of the Board of Trade for the issue of instruments, logs, books, &c., at the Port of Liverpool. In matters of vital importance we cannot regret the appointment of so trustworthy a person, though astronomy may somewhat suffer. It must, however, be clear that in directing the attention of the Liverpool astronomer to so many objects, some of them must be neglected, unless due provision be made and assistance given. Sometimes, through thoughtlessness, more work is imposed on a willing man than human force can sustain; and we may venture to hint to the munificent patrons of the Liverpool Observatory that the limit, in Mr. Hartnup's case, has already been attained, and cannot be exceeded safely. Yet it would be a great pity to stop, or even to reduce, permanently, the astronomical work of this establishment, after so brilliant a career. The Observatory of Liverpool cannot well be spared, now that it has shown how useful it is and can be.

The Madras Observatory has put forth another volume during the past year, containing the results of observations from 1848 to 1852, while an Appendix brings up a certain portion of them to the beginning of 1854.

The most important part of the contents is a "Subsidiary Catalogue of 1440 Stars," being the result of a thorough revision of the British Association Catalogue between the limits of N.P.D. 40° and 155°, with notes, giving particulars of proper motion and other interesting points. This was a piece of heavy work requiring pretty constant labour for about four years, in observing and reducing. The agreement of the places with those given in the British Association Catalogue is, in the great majority of cases, pretty close, but there are about 100 whose errors are

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large, exceeding 1^s of time or $10''$ of arc; some of these are mere blunders of whole minutes of time or arc, and a few may be cases of proper motion. Fifty-five numbers were missing, and the objects set down in the Catalogue as nebulæ appear, as far as they have been examined, to be loose clusters of small stars.

In the Planetary Observations, *Neptune* for the first time makes his appearance, and has been observed pretty assiduously since 1849; a few attempts were also made on some of the new planetoids, but they were speedily abandoned for want of sufficient optical power.

There is a pretty long list of double stars (or rather two lists, there being a second in the appendix), in which *α Centauri* holds a conspicuous place, having been carefully watched, and showing an angular motion of 30° in less than four years. These observations were made with the new equatoreal, by Lerebours and Secretan, of $6^{in.}\cdot 2$ aperture and $89^{in.}$ focus, which seems an effective instrument, though the object-glass originally furnished was of bad quality; but this defect has been remedied by the makers supplying a new one, which appears unexceptionable.

The observations in the appendix were all taken with this new glass; and we notice some pretty careful measures of *Saturn* and his rings, including the new features of the obscure ring, and fine dark line in the outer ring. There is also a second list of double stars, in which the most notable points are the indications of the binary nature of *α Piscium*, and of the parallax of *α Herculis*, which last is thoroughly discussed at the end, and shown to be $= 0''\cdot 060 \pm 0''\cdot 0041$, from the measures of position, a result nearly confirmed by those of distance; so that the quantity, small as it is, must be considered as *real*, until it can be disproved by observations equally numerous and accordant.

In April 1854, Captain Jacob was compelled to quit his post in search of health, and is now in England, his *locum tenens* being Major Worster of the Madras Artillery. The work now in progress there is an examination of those stars, especially Southern stars, affected (or supposed to be so) by proper motion to the extent of $0''\cdot 5$ annually; these amount to about 400.

The present state of the Observatory, as regards *matériel*, would seem susceptible of some improvement. The meridional instruments are rather behind the age. Originally small, and with some defects of construction, they have not been improved by somewhat rough usage for about a quarter of a century. The mural circle has large errors of division, by which most of Taylor's early observations are vitiated; and though these are now tabulated, and applied to every observation, this of course involves loss of time in reduction, besides being an eyesore. The transit instrument was seriously injured some years back in a hurricane, and though pretty well repaired is still not perfect; its optical power is too small to allow of its being used effectively on the new planetoids, a class of observation for which the geographical position of Madras is well suited.

It is to be hoped that ere long the liberality of the Court of Directors will furnish this Observatory with a meridian circle similar, if not equal in size, to those lately erected at Greenwich and the Cape. Such an instrument would have been invaluable in the revision of the B.A. Catalogue above referred to; and there can be no doubt that it would materially add to the efficiency and usefulness of the Observatory.

At the last meeting of the Committee for restoring the standards of weight and length, the members were of opinion that a larger number of standards would be required than had been originally contemplated. Mr. Sheepshanks therefore applied to Mr. Simms for *all* the bars in his stock, which was readily complied with, Mr. Simms reserving only one for his own use. These additional bars have now been most carefully prepared, divided, and measured, so that the number of standard bronze yards amounts to forty. There are four more, which were cut down to 37 inches by Mr. Baily; but he left them undivided. These have been divided and compared. Altogether there are forty-four bronze yards and several more in other metals.

There is, and always must be, some uncertainty about the bisection of anything so imperfect as the best division is when highly magnified; and this uncertainty cannot be eliminated, as it varies, *accidentally*, with each division and each observer. But with the *same* observer a very satisfactory result is soon arrived at. When the divisions are fairly defined, 100 comparisons have a probable error varying from about a seven-millionth to a twelve-millionth of the whole, or somewhere about four millionths of an inch. This *degree* and *kind* of *certainty* has been arrived at in all cases. The bars, which, being observed in different manners, presented any anomaly, have been all re-measured.

Notwithstanding the elegance and security of Professor Miller's system (that of cutting the division at the bottom of a cylindrical well, which goes half-way through the bar), Mr. Sheepshanks is of opinion that it has considerable disadvantages. Even in Mr. W. Simms' hands, and with especial contrivances, it is rather uncommon to find both the gold pins, and both the divisions, perfectly satisfactory. The small aperture does not allow the surface to be worked to a uniform degree of *dead* brightness; the burr cannot always be well cleaned off without polishing or rounding the edges; and when in use, it is not easy to wipe off any occasional dirt which may interfere with the divisions. For bars which are to be floated in mercury the *well* is essential, but for ordinary purposes, Kater's plan of cutting away half the upper substance of the bar would be found more convenient. If, as Mr. Sheepshanks suspects, the *accuracy* of the measure depends *mainly* upon the sharpness and cleanness of the division, and the perfect uniformity of the face of the dot, every facility should be given to the workman to get at his work.

Besides the anomaly heretofore mentioned, viz. that practised and steady observers differ uniformly as to what *is* a bisection, Mr. Sheepshanks finds that the bisection greatly differs in his own case, according as the division crosses the eye vertically or obliquely. This difference is very large, with him, between the vertical and horizontal direction. Mr. W. Simms says that *he* does not find this to be the case, but he has heard it remarked by others. It will be odd enough if there is a sensible personal equation in *position* and *distance;* and it would be worth each observer's while to make out whether it is so or not, in his own case.

In making *end-yards* with *steel* tips no difficulty was found; but by an oversight, which Mr. Sheepshanks can scarcely explain, or excuse himself for, the bars hitherto made, tentatively, have all been too short. In other respects they were satisfactory. But even the comparisons that were made, though few in number, showed an evident *wearing* in the metal, and it seemed hopeless to *preserve* a standard touch-yard in use (though it is easy to get one) unless some harder material could be applied, and, if possible, one not corrosible. Professor Miller recommended quartz, and after one or two trials it was found very practicable to insert a conically-shaped piece of quartz into an iron or bronze socket, moderately heated. But when this was exposed to the cold of a freezing mixture, the quartz crashed: it was held firmly enough.

It was then considered that perhaps an intervening bed of soft metal would make the squeeze of the enveloping bronze or iron more uniform and more endurable; and Mr. James Simms further suggested that chalcedony would be found tougher than quartz. A request was made to Messrs. Elkington to deposit a layer of gold in a bed for the stone; but as this was declined by the firm in London, Mr. James Simms had the kindness to attempt to supply the want. Before, however, his attempts were perfectly successful, it was suggested that the chalcedony plug, which is very slightly conical, might be inserted in a heated gold or silver socket; that this again might be worked into a conical form and similarly inserted, in a reversed position, in the bar intended for a standard. A piece of chalcedony was thus fixed in a brass cylinder, which was afterwards turned very nicely and let into an iron socket, exactly representing the terminating portion of the end-bar. Exposure to a freezing mixture had no effect upon this combination, and the chalcedony was found to be of great toughness, such as would bear a considerable blow without injury. Some standards of end-measure would have been made before now, but the engineers have been so busy, that an order for steel bars has only just been executed. If any one can suggest a tougher or handsomer stone than chalcedony, and one which can be easily procured and of some size, Mr. Sheepshanks would feel greatly obliged by the information; but, so far as is known at present, this stone will do very well.

Besides comparisons of the discrepant bars and of the additional bars, the brass tubular scales which were measured in 1836 by Mr.

Baily, have been compared with the new standard. The Royal Astronomical Society's standard, contrary to what was expected, was found to be nearly unaltered, that is to say, supposing the new standard to be exactly equal to that which is lost. But the other tubular scales presented considerable differences, viz., the Danish standard and those of Mr. Baily and Mr. Simms. All have been carefully determined, with a probable error considerably less than the hundred-thousandth of an inch.

The question now arises, how are these discordances in the tubular scales to be accounted for? And to say the truth it is not easy. Some further attempts have been made to ascertain the effect of the strain which undoubtedly exists in the apparatus used by Mr. Baily; but the results were not consistent. It seemed that the effect of the strain upon the microscopes was influenced by the greater or less friction which attends the motion of the frame, and which depends partly on the temperature. There are two evident objections to the tubular scales: they are too long, and they are very inadequately supported, at only two points. Mr. Baily's measuring apparatus is undergoing some alterations and improvements with a view to the subdivision of the yard, and the comparison of measures other than yards.

A yard with its Miller's stand has been prepared for the French Government, and will be conveyed to France in time to make its appearance at the Exposition.

The commission of the Government which, on Mr. Baily's death, was undertaken by Mr. Sheepshanks under the direction of the Astronomer Royal, is now brought to a conclusion, though there are several small matters to attend to which will take some time. But though we may hope that there never can be any doubt in future of the *length* of the *yard*, a great deal remains to be done to make the result of this long and expensive affair practically useful. For the business of ordinary life, standard-end bars and beds are required, and types, probably, of the units most frequently in use. It is very desirable, too, that accurate comparisons should be made between the English yard and the measures of those countries which possess an accurate standard. A well-divided scale of 40 inches is absolutely required for such researches and comparisons; and it would seem a necessary completion of the work, to connect the archetypes of the great national surveys with the new parliamentary standard yard. Whether any considerable portion of that which has just been described, can be effected by Mr. Sheepshanks is doubtful. The work hitherto has pressed rather heavily on his eyesight, if not on his health, and might now, probably, be advantageously transferred to younger and abler hands. But if the Government do not object to supply the necessary apparatus, and if he can satisfy himself that the work is competently executed, Mr. Sheepshanks is willing to continue his operations some steps further. He relies mainly on the advice and counsel of the Astronomer Royal, and on the good-will, intelligence, and beautiful workmanship of Mr. Simms and his house.

Within the past twelvemonth our knowledge of the group of small planets between *Mars* and *Jupiter* has been increased by the addition of six new members, which have been respectively named *Bellona*, *Amphitrite*, *Urania*, *Euphrosyne*, *Pomona*, and *Polyhymnia*.

Bellona was discovered by our Associate, Dr. Luther, director of the observatory at Bilk, near Dusseldorf, on the night of March 1. The period of revolution is 1700 days, or $4^{yrs}\cdot655$. The name was selected by Professor Encke.

On the same night, but about two hours later, Mr. Marth detected the planet which, on Mr. Bishop's suggestion, has been called *Amphitrite*, at the observatory of South Villa, Regent's Park. On the following night it was independently found by Mr. Pogson, who has been for several years attached to the Observatory of Oxford, where he devotes his leisure hours, after the regular duties of his office are completed, to the formation of charts of small stars, with the view to the detection of new planets or variable stars. A third independent discovery was made at the Imperial Observatory of Paris on the 3d of March by M. Chacornac, who is engaged on similar researches. The period of *Amphitrite* is 1484 days, or $4^{yrs}\cdot063$. The eccentricity of the orbit is less than that of *Ceres*, being the smallest in the group.

The *third* planet of 1854, called *Urania* on the proposition of Professor De Morgan, was found by Mr. Hind at Mr. Bishop's observatory on the night of July 22d. The time of revolution is about 1332 days, or $3^{yrs}\cdot647$, but has not yet been very satisfactorily determined.

Euphrosyne was found in a rather singular position on the 1st of September by Mr. Ferguson, of the Observatory, Washington, U.S. It was so close to the planet *Egeria*, of which Mr. Ferguson was in search, that it appears to have been observed along with it on that evening,—possibly from uncertainty as to which was the right object. Another night's observation proved that both were planets, the new one appearing of about the same degree of brightness as *Egeria*. The period of revolution is, probably, the same within a few days as that of *Hygeia* or *Themis*.

Pomona, so named by M. Le Verrier (who, as the Society will be aware, has succeeded to the direction of the observatory at Paris), was discovered by Mr. Hermann Goldschmidt, an amateur astronomer resident in that city, on the 26th of October. We already owed to the same gentleman the discovery of *Lutetia* in 1852. The approximate period is 1518 days.

Polyhymnia, the last of the six planets of 1854, also named by M. Le Verrier, was detected at the Paris Observatory by M. Chacornac on the night of the 28th of October. The elements are remarkable for the very large eccentricity they exhibit, whereby the difference between the perihelion and aphelion distances amounts to a diameter of the earth's orbit. The time of revolution appears to be about 1787 days, or $4^{\text{yrs}}\cdot892$.

Since the last anniversary four new comets have made their appearance.

The *first* of these was for some time a very conspicuous object in the western sky. It was first seen in the south of France on the morning of March 24, the day before its perihelion passage. In this country it was remarked by several persons after sunset on March 28, and became generally visible on the following evening. It decreased rapidly in brightness, and disappeared after an interval of three weeks. A parabola satisfies the whole series of observations.

The *second* comet was discovered by Mr. Klinkerfues at Göttingen on the night of June 4, and three weeks later by Mr. Van Arsdale at Newark, in the United States. At the time of its perihelion passage it became visible to the naked eye. A sensible ellipticity was at first suspected, but it has not been confirmed. The whole series of observations, which extends to the end of July, cannot well be reconciled with a time of revolution of less than several thousand years.

The *third* comet had not less than six discoverers. It was found on September 11 by Mr. Klinkerfues at Göttingen; on the 12th, by Mr. Bruhns at Berlin; on the 13th, by Mr. Van Arsdale at Newark, N.J.; on the 18th, by Dr. Donati at Florence, and Miss Mitchell at Nantucket, U.S.; and, lastly, on September 21, by Mr. Gussew at Wilna. The observations, so far as they have been published, extend to the middle of November. The orbit does not appear to differ sensibly from a parabola.

The *fourth* comet, which is still visible, was found at the same hour, on the morning of January 15, by Mr. Winnecke at Berlin and M. Dien at Paris. It is faint, and very unfavourably situate for observations, so that they are not likely to be long continued. The perihelion has been some time passed.

The application of photography to astronomy is making sensible progress. Of Mr. Hartnup's proceedings we have already spoken. Mr. Phillips, at Oxford, has been engaged since the summer of 1853, and has furnished an account of his proceedings, which, it may be hoped, he will enlarge for insertion in the *Monthly Notices*. With an achromatic of $6\frac{1}{2}$-inch aperture, and 11-foot focal length, he first computed the *probable* place of the photographic focus, ·75 to ·80 of an inch beyond the focus. Trial proved that the photographic effect was evanescent within the focus, feeble at the focus, and greatest at about ·75 of an inch beyond the focus,—at least, for the moon's image.

In a letter to Col. Sabine, written in April last, Sir John Herschel strongly recommended that daily photographic representations of the sun should be made in some observatory, or rather in several, with a view to an historical record of the spots. The Kew Committee immediately entertained the suggestions of Sir John Herschel, and, after they had made some inquiries in regard of the probable cost of the necessary apparatus, came to the conclusion that the proposal should be submitted to the Royal Society, with a recommendation for its adoption. The Council of that Society ultimately decided that a photographic observatory should be erected in connexion with the Kew Observatory, and, with the concurrence of Mr. Oliveira, placed at the disposal of the Kew Committee the sum of 150*l*., which that gentleman had liberally offered to the Royal Society, in aid of any scientific object which it might deem desirable to promote.

The Kew Committee having subsequently intrusted the carrying out of Sir John Herschel's views to Mr. De La Rue, one of its members, that gentleman, after deciding on a plan, engaged the services of Mr. Ross (well known for his success in the manufacture of telescopes and photographic lenses) for the construction of the telescope and stand, which are now progressing, and which, it is expected, will be erected in the course of three months.

The diameter of the object-glass will be 3·4 inches, and its focal length 50 inches; the image of the sun will be 0·465 inch, but the proposed eye-piece will, with a magnifying power of 25·8 times and focal length x, increase the image to 12 inches, the angle of the picture being about 13° 45′. The object-glass will be under-corrected in such a manner as to produce the best practical coincidence of the chemical and visual foci.* The eye-piece will consist of two nearly achromatic combinations, their forms, foci, and focal lengths, to be arranged upon the basis of the photographic portrait lens, the conditions being nearly similar.

It is contemplated to form the system of micrometer-wires on a curved surface; and it may ultimately be found to be advantageous also to curve the photographic screen, as the small curvature necessary, namely, about two-tenths of an inch, will present no mechanical difficulties. As in practice it may possibly be found desirable not to produce the sun's image with too great rapidity, a provision is contemplated for the absorption of some of the most energetic active rays by the interposition of coloured media of different tints.

The telescope being for a special object, it will have no appliances, except such as appertain exclusively to that object, so that the only means provided for *viewing* the sun will be through the finder intended for facilitating the adjustment of the sun's image in position, as regards the micrometer. The polar axis will be furnished with a worm-wheel and clock-work driver, and the declination axis with a clamping circle. A shutter for covering

* Mr. Ross has found that if for the greatest intensity of vision, in common lenses, the ratio of the dispersive powers of the two media is 0·65, that the chemical and visual foci will coincide but practically when with the same media the ratio is altered to 0·60; the media he uses being Pellatt's flint and Thames plate.

the object-glass and capable of being rapidly moved by the observer, will be so contrived as to be under his command, whether he be, at the time, near the object-glass or near the screen, eight feet distant.

The telescope will be placed in an observatory, twelve feet in diameter, and provided with a revolving roof; adjoining the observatory, a small room for chemicals will be constructed, so as to facilitate the fixing of the pictures.

The attention of this Society has been directed with interest for several years to the labours of Professor Hansen, and especially to the two greatest works which he has undertaken,—namely, to the formation of new solar and lunar tables. The former of these works has been completed, and the solar tables have been published within the last year; and, as it is probable that many of our members are as yet but imperfectly acquainted with them, a few words on their construction may not be unacceptable.

Throughout this laborious work M. Hansen has been assisted by M. Olufsen, whose name appears on the title-page as one of the authors, and who has contributed elements (for example, the obliquity of the ecliptic) from his own researches.

The elements used in the construction of the tables are based on all the observations available for the purpose which have been made at Greenwich and Königsberg; and a table is added of comparisons of tabular places with the observations made at those observatories in the series of years from 1820 to 1843, which shows that the observations are completely represented within the limits of probable error by the tables.

M. Hansen proposes to give in a separate memoir the details of the calculations by which the various expressions explicitly given in the introduction have been formed, though the introduction, in a very lucid manner, explains the adaptation of these formulæ to the tabular arrangement.

One most important addition in these tables is the introduction of the right ascensions and declinations of the sun, as well as the latitudes and longitudes, for in the daily practice of astronomy it is these quantities which are needed most constantly, and in the formation of ephemerides the advantage derived from them will be found to be very great.

M. Hansen states the objects which he proposed to himself in the arrangement of the tables to be the following:—

1. That they should not only give the tropical apparent longitude, the logarithm of the radius vector, and the latitude of the sun, but also *immediately* the right ascension and declination, because at the present time the latter are of more frequent use in astronomy than the former.

2. To add the tables by which are obtained the mean right ascension, the equation of time, the reduction of the tropical ap-

parent longitude to sidereal longitude, the diameter, the parallax, &c.

3. To construct the tables in such a way that they should give the quantities mentioned above with the same exactness as if they had been calculated immediately by the formulæ.

This great work is, undoubtedly, a valuable boon to modern astronomy; it is a work which has been long desired, and which undoubtedly combines the most remarkable combination of analytical skill and excellence of observations which have ever heretofore been brought to bear on any planetary tables whatever.

Since the last Annual Report was read Admiral Smyth has published his account of the Mediterranean, a work which, considered as an accompaniment to his charts by a nautical surveyor, is probably unique. As a manual of suggestions for the educated seaman, in his inquiries into the history, literature, remains of antiquity, commercial state, hydrography, meteorology, geology, and ichthyology of this most celebrated of all the waters on our globe, Admiral Smyth's work will at once take its place among the books of every traveller. The history of the charts of the Mediterranean will secure it a place in the hydrographer's library of research. To the astronomer it will have the specific value of giving power of ready reference to very many points of physics and geography, as they occur in connexion with the history and literature, as well as the application, of his science. And the scholar and the philologist will find the benefit of many elucidations of points of difficulty in his own pursuits. A general work on the Mediterranean can hardly fail to meet a want, now and then, in each and every branch of knowledge; and, in the present instance, no more of description than is necessary for sufficient announcement will justify the Council in congratulating the Society on the appearance of such a work under the name of one of our Fellows.

Among the publications of the past year which bear upon our branch of science the Council notice with much satisfaction a little work from the pen of Mr. James Breen, senior assistant at the Cambridge Observatory, entitled, *The Planetary Worlds*. One of our most excellent assistants, whose daily duties are sufficiently onerous to excuse the exertion, has taken advantage of his opportunity of access to a good astronomical library, and to one of the finest telescopes in Europe, and has found time to present the public with an interesting collection of descriptive matter, in a simple form, and of a kind frequently inquired for. The numerous woodcuts with which the volume is illustrated are hardly of a quality of execution to do justice to the letterpress, but, with a little correction by the reader's judgment, will be found materially to assist him in forming an idea of the various appearances seen by modern observers under bright optical aid.

Professor Hansen has recently communicated to the President a detailed account of his progress in the construction of the Lunar Tables which for some time past have occupied so much of his attention. By a comprehensive discussion of the Greenwich Observations of the moon he deduced the corrections of the elements of the lunar orbit. A comparison instituted by him between the observations extending from 1824 to 1850, and the results of the theory thus improved, exhibits a most satisfactory accordance. The early observations of Bradley are also well represented by the theory, although, as might be expected, the agreement is not so close as in the case of the more modern observations. In the Tables which Professor Hansen is constructing from his theory the arguments are expressed, not in arcs of the circle, but in time, the unit of the argument being the mean time which elapses between two successive culminations of the moon. This unit is especially adapted to a comparison of the results of theory with a series of meridian observations of the moon; but when the question refers to the calculation of an ephemeris of the moon's place for fractions of a day, similar to that given in the *Nautical Almanac*, its advantages are not so obvious as Professor Hansen candidly admits.

The outstanding differences between observation and theory appearing to Professor Hansen to indicate the necessity of an enlargement of the coefficients of several of the most important inequalities in the moon's longitude, he was led to inquire into its origin, and he found that it might be to a great extent accounted for by supposing that the centre of gravity of the moon did not coincide with its centre of figure. This result is embodied in a very remarkable theorem, to which he has been conducted by his researches on the subject.

A total eclipse of the sun, although of extremely rare occurrence, is accompanied by phenomena of a highly important nature in regard to various questions connected with the physical constitution of the sun. An event of this kind is, therefore, always watched with unusual interest by the astronomer. On the 30th of November, 1853, there happened a total eclipse of the sun; but, unfortunately, it did not admit of being observed by the astronomers of Europe, the obscuration having been confined to the Pacific Ocean and a portion of the west coast of South America. The Chilian Republic, however, with praiseworthy zeal, despatched M. Moesta, the Director of the Observatory of Santiago, to a suitable station in Peru, near the central track of the moon's shadow; and a complete observation of the various phenomena of the eclipse was made by that astronomer, of which an account appeared in the *Monthly Notices* for June last. One of the features of this eclipse, which seems more especially worthy of notice, consisted in an interruption of the contour of the luminous ring usually seen around the dark body of the moon, arising from two apertures