depressions, coming up from the Adriatic, as those of late summer seem to be on the south or south-east border of Atlantic depressions.

BETHNAL GREEN FREE LIBRARY has been doing a large amount of good work in the thickly-populated district in which it is situated, not only by giving facilities for reading books, but by science lectures and science "talks." It is much in want of funds for the extension of operations, and we commend it to the consideration of our readers. The librarian is G. F. Hilcken.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Miss G. M. Fisher; a —— Hedgehog (*Erinaceus* ——) from Madras, presented by Mr. H. R. P. Carter; two Mute Swans (*Cygnus olor*), European, a Common Peafowl (*Pavo cristatus*) from India, presented by Lady Siemens; a Red and Yellow Macaw (*Ara chloroptera*) from South America, presented by Mr. Arthur Daunt; a Grey Parrot (*Psittacus erithacus*) from West Africa, presented by Mrs. Greenwood; five Great Eagle Owls (*Bubo maximus*), European, presented by Mr. Philip Crowley, F.Z.S.; a Common Guillemot *Lomvia troile*), British Islands, presented by Mr. J. H. Gurney, F.Z.S.; two Gambel's Partridges (*Callipepla gambelli*) from California, presented by Mr. W. A Conklin, C.M.Z.S.; a Malabar Green Bulbul (*Phyllornis aurifrons*) from India, received in exchange; five Great Titmice (*Parus major*), four Blue Titmice (*Parus cæruleus*), two Bullfinches (*Pyrrhula europæa*), European, purchased.

OUR ASTRONOMICAL COLUMN

THE ARGENTINE GENERAL CATALOGUE OF STARS.—This Catalogue, containing the mean positions of 32,448 southern stars determined at the National Observatory of Cordoba, has recently been published by Dr. Gould. The observations from which the Catalogue positions are deduced were made with the meridian-circle of the Cordoba Observatory during the years 1872-80. During these years the zone-observations were the chief object of attention, and the present Catalogue contains the places of those stars whose positions were more elaborately determined during the progress of that great work, and constitute an addition to our knowledge of southern stellar positions of perhaps not less importance than the Cordoba Zone-Catalogue. The General Catalogue gives the positions, for the epoch 1875·0, of most of the southern stars brighter than magnitude 8½, the deficiencies in this respect being chiefly found north of the parallel of 23°, at which the zones begin. These omissions will be of comparatively small importance, inasmuch as the new *Durchmusterung* of Prof. Schönfeld comprises all the southern stars within this region, while accurate determinations of the brighter ones will have been made in the re-observation of Lalande's stars now nearly completed at the Paris Observatory.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 DECEMBER 5-11

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on December 5

Sun rises, 7h. 51m.; souths, 11h. 50m. 51·4s.; sets, 15h. 50m.; decl. on meridian, 22° 25′ S.: Sidereal Time at Sunset, 20h. 47m.

Moon (two days after First Quarter) rises, 13h. 30m.; souths, 19h. 35m.; sets, 1h. 51m.*; decl. on meridian, 0° 19′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	7 16	11 32	15 48	19 53 S.
Venus	7 54	11 53	15 52	22 27 S.
Mars	10 19	14 10	18 1	23 45 S.
Jupiter... ...	3 34	8 49	14 4	9 41 S.
Saturn... ...	18 35*	2 38	10 41	21 29 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

Dec.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
5 ...	14 Ceti	6½	16 52	near approach	358 —
10 ...	48 Tauri	6	5 52	6 38	105 339
10 ...	B.A.C. 1526 ...	6	22 29	23 44	78 292

Saturn, December 5.—Outer major axis of outer ring = 45″·4; outer minor axis of outer ring = 17″·7; southern surface visible.

Variable Stars

Star	R.A. h. m.	Decl. ° ′			h. m.	
U Cephei	0 52·2	81 16	N. ...	Dec. 8,	1 46	*m*
Algol	3 0·8	40 31	N. ...	,, 6,	23 15	*m*
				,, 9,	20 5	*m*
ζ Geminorum ...	6 57·4	20 44	N. ...	,, 9,	5 0	*m*
V Geminorum ...	7 16·8	13 19	N. ...	,, 7,		*M*
U Coronæ	15 13·6	32 4	N. ...	,, 7,	0 32	*m*
β Lyræ...	18 45·9	33 14	N. ...	,, 11,	19 0	*M*
S Vulpeculæ ...	19 43·7	27 0	N. ...	,, 6,		*m*
T Aquarii	20 43·9	5 34	S. ...	,, 5,		*M*
δ Cephei	22 24·9	57 50	N. ...	,, 7,	0 0	*M*
				,, 10,	19 0	*m*

M signifies maximum; *m* minimum.

Meteor-Showers

The principal shower of the week is that of the *Geminids;* R A. 105°, Decl. 32° N., but moonlight will interfere with its observation at the time of its maximum, December 10-11.

Stars with Remarkable Spectra

Star	R.A. 1886·0 h. m. s.	Decl. 1886·0 ° ′	Type of spectrum
20 Leporis	5 6 3	11 59·4 S. ...	III.
119 Tauri	5 25 32	18 30·5 N. ...	III.
64*a* Schjellerup ...	5 38 52	20 38·8 N. ...	IV.
α Orionis	5 48 59	7 23·1 N. ...	III.
π Aurigæ	5 51 27	45 55·5 N. ...	III.

THE ROYAL SOCIETY[1]

FOR many years it has been my duty as senior secretary to read at each anniversary the death-roll of the year. The names this year are perhaps slightly fewer than usual, but many recall to us faces once familiar that we shall never see here again. Earliest among them comes Sir Frederick Evans, whose death took place only very shortly after our last anniversary. In the course of the preceding summer he crossed the Atlantic to take part in that International Conference which assembled at Washington, to deliberate among other things on the choice of a common prime meridian for all civilised nations. On his return he was looking ill, and the illness increased until it carried him away. Yet even through his illness he kept on working at science, at a task he had undertaken, and which was almost completed when he died. To this I shall have occasion to refer again. In Mr. Busk we have lost one who has long been among us, and who took an active part in the scientific business of the Society. He repeatedly served on our Council, and both then and subsequently gave us the benefit of his extensive knowledge and sound judgment in the important but laborious task of advising the Committee of Papers as to the proper mode of dealing with papers which they referred to him. In Lord Cardwell we have lost a statesman whose political duties did not prevent him from coming among us and serving on our Council. The public services and singular honesty and straightforwardness of Mr. Forster are appreciated by the nation at large. Quite recently, at no advanced age, we have lost Prof. Guthrie, the occupant of a chair which a great many years ago I held for a time; a man whose genial character drew around him a close circle of friends. Still more recently we have lost the Earl of Enniskillen, whose fine palæontological collections are well known to geologists. Only the other day one passed away whom we seldom missed at our anniversary meeting, and who was frequently with us on other occasions: I allude to General Boileau, whose philanthropic labours will not soon be forgotten, and may, I trust, be recognised in a much needed form.

The Fellows will have noticed with satisfaction a very con-

[1] Anniversary Address by Prof. G. G. Stokes, President, on Tuesday, November 30, 1886.

siderable excess of income over expenditure in the balance sheet for the year. At first sight it might be supposed that as the *Transactions* come out at irregular intervals there might have been fewer parts published than usual ; but it will be found on examination that the past year has borne its proper share of printing expenses. The excess is really due to a substantial improvement in the Society's property, under the careful and judicious management of our Treasurer.

Last year our President informed the Fellows of the munificent offer made to the Society by Sir William Armstrong to give to the Scientific Relief Fund the sum of 6500*l.*, provided an equal sum were raised by subscription from the Fellows, and, if need be, other friends of science who might not belong to the Society. As the Fellows are aware, a circular was sent round by the Treasurer mentioning Sir William Armstrong's generous offer, and inviting subscriptions ; and the Treasurer has also written privately to a number of persons, Fellows and others. The sum subscribed or promised in response to this invitation amounts to about 4200*l.* ; and though the sum thus raised does not amount to what Sir William promised to duplicate if it could be raised, he has most generously not only waived the non-fulfilment of the condition subject to which the former offer was made, but has still further augmented it ; and he now promises not only to duplicate the sum raised in answer to the Treasurer's appeal, but to give the further sum of 3600*l.*, thus raising the capital from the present sum of about 8000*l.* to 20,000*l.* He will be ready to pay the whole sum of 7800*l.* as soon as the subscriptions promised to the Treasurer have been collected. The only condition attached to this princely gift is, that, besides meeting the ordinary objects for which the Fund was instituted, the Council should feel themselves at liberty to apply a portion of the income to defraying the annual subscriptions of Fellows in special cases where such a course might seem desirable.

The path of the total eclipse of September 9 of last year, in any place where it fell on land, was so remote from this country that no expedition went out to observe it. It was visible in New Zealand, and in anticipation of it our Eclipse Committee sent out a memorandum to the colony indicating the points of special interest to look out for. We have received accounts, drawings, and photographs of the eclipse from Dr. Hector and others. One of the most remarkable features of this particular eclipse was the appearance of two white and unusually bright prominences which attracted general notice, and were compared to electric lamps, and which, situated on opposite sides of the sun, were just over the places of two large spots, one close to the limb, and on the point of disappearing, the other not seen before the eclipse but visible next day, having in the meantime come round the limb.

The present year afforded another of those rather rare occasions, always of brief duration, which are afforded for the study of sola physics by a total eclipse of the sun. Calculations made long beforehand showed that a total eclipse was to be expected on August 29. The path of the total phase on the earth's surface is always narrow, say 100 miles or so across, and on this occasion it swept obliquely across the Atlantic Ocean, cutting the Western Coast of Africa about Benguela, and sweeping across some of the West India Islands to a part of the mainland of South America, where it ended.

Though there was a long belt of ocean over which the totality would be visible, and where the imposing spectacle of a total eclipse might be witnessed, this was not available for regular scientific observations, which require land on which to fix the instruments. On the mainland of America the total phase would come on so shortly after sunrise that the sun would be too low for good observations, and therefore the Island of Grenada, which lay within the belt of totality, was much to be preferred.

Of the two available stations, one lay in the British dominions, and was pretty easy of access from England, and accordingly it seemed to be the duty of our country to take a foremost place in the observations, the results of which would be available to the whole scientific world. It was contemplated first to send expeditions to both places—to Benguela as well as Grenada. The cost of this would, however, exceed what could be spared from the Government Grant without unduly curtailing what was available for other objects. Accordingly application was made to the Lords of the Treasury for a grant of 1000*l.* towards the cost of the expeditions. Inquiries were also made as to the probable climate at the two places ; and here I have to express our thanks to the Governor-General of the Windward Islands, who put us in communication with Dr. Wells of Grenada, from whom we obtained valuable information regarding the climate of that island, and to the Consul-General for Portugal, who obtained information for us from the Polytechnic Institution at Lisbon as to the amount of sunshine about the end of August at Loanda, which may be taken pretty well as representing Benguela.

The information we obtained from various sources as to Benguela was rather conflicting, but there seemed a pretty general agreement that even if the sun should be shining at the time of the eclipse the sky was likely to be hazy. This would much interfere with good observations, especially as regards the corona ; and as the expense of the expedition to Benguela would be considerable, and the success very doubtful, we thought it better to give up that part of the project and confine ourselves to Grenada. Being anxious to trench as little as possible on the national expenditure, and finding that a little more could be taken from the Government Grant than we had expected, we wrote to the Treasury reducing our application to 500*l.*, which, with assistance from the Admiralty in the shape of the use of a ship-of-war on the West India station, and supplemented by some money from the Government Grant and from our own Donation Fund, might enable us to meet the expenditure.

The result was that a sum not exceeding 500*l.*, to supplement what could be spared from the Government Grant, was granted, and the expedition, as the Fellows are aware, has sailed and returned. It was fairly successful, the observations having been prevented by clouds at only one of the stations occupied.

There has not yet been time to discuss the observations in full, but two points already appear to have come out pretty clearly. One is that the brightness of the corona, which on this occasion was actually measured, was much less than had been expected, and less apparently than it had been on former occasions. This seems to show that the brightness is liable to great changes in comparing different years, as we know is the case with the form. The other point touches on the question of the possibility of photographing the corona independently of an eclipse. If the photographic brightness of the corona be not overpowered by that of the atmospheric glare immediately around the sun when there is no eclipse, then when the sun is partially eclipsed we might expect to be able to trace the outline of the limb of the moon for some way outside the sun, since the moon would be projected on the background of the corona. The experiment was tried both by Capt. Darwin at Grenada, and by Dr. Gill at the Cape, but in neither case was the limb traceable outside the sun. This throws doubt on, but does not disprove, the validity of the method ; for Dr. Huggins himself has never obtained photographic appearances apparently referable to the corona since the Krakatão eruption. It may be that the finely suspended particles, whether connected with the Krakatão eruption or not, which produced those gorgeous sunsets that were so remarkable, have not yet wholly subsided, and cause a considerably increased atmospheric glare. It may be that the corona has actually been much less bright than usual for the last few years.

The present year has been signalised by that remarkable volcanic explosion in New Zealand, of which we have read accounts in the newspapers. We have received from Dr. Hector a series of photographs of the district, taken at no great length of time after the explosion.

The Krakatão Committee, which was appointed at the suggestion of our late President to collect information relative to the great eruption, have now I may say completed their work. The Royal Meteorological Society had appointed a Committee to get together information respecting the remarkable atmospheric phenomena witnessed after the eruption. It was thought desirable that the two Committees should work in concert, and accordingly our Committee was enlarged by the addition of two members of the Royal Meteorological Society, even though they did not happen to be members of the Royal Society, who undertook that share of the work. The information collected under this head is naturally voluminous, since it requires no special training to describe the atmospheric appearances. Our late Fellow, Sir Frederick Evans, undertook the sea-disturbance, and continued to work at it even in an advanced stage of the disease which carried him off. Another fortnight, it was estimated, would have enabled him to complete it. His account was found to have been written in pencil on separate sheets of note-paper, but his successor in the office of Hydrographer, Captain Wharton, our Fellow, was so good as to take up the work ; and partly by the use of materials left by Sir F. Evans, partly by his own independent labour, he has now completed it. The report on air-

disturbance was undertaken by General Strachey, and is ready. Prof. Judd undertook geology; the materials are ready, and though the actual report is not yet written, the writing would take but very little time. Mr. Scott undertook to collect information as to floating pumice; but as it has been found that the Krakatão pumice does not possess distinctive features whereby it could be recognised, and therefore the origin of the pumice that ships have encountered at a distance from Krakatão remains unknown, little trustworthy information could be obtained under this head, and the report has been handed over to Prof. Judd to embody with the geology. The heaviest part of the report, that relating to sunsets and atmospheric phenomena, has been prepared by the Hon. Rollo Russell and Prof. Archibald, the two Fellows of the Royal Meteorological Society who have been mentioned as having been added to the Committee, and is ready, with the exception of a little revision, and it remains only to prepare an introduction, index, &c. The whole report may therefore be regarded as all but complete in manuscript, and it will be for the new Council to deal with it.

The Circumpolar Committee have now brought their labours to a close, the report on the observations taken by Capt. Dawson at Fort Rae being printed and published. The reports of the expeditions undertaken by Austria, the United States of America, Germany, and Holland are, I understand, complete, and those by France and Russia are in a forward state. Before the accounts of the observations taken at different stations by the observers of different nations shall have been for some time before the public, it would be premature to expect general conclusions to be deduced from this great undertaking.

Very satisfactory progress has been made during the past year with the publication of the Report of the *Challenger* Expedition. The volumes already published and in the Society's Library now amount to sixteen on Zoology, and three introductory on other subjects. Others are in a very forward state, and it is expected that the whole will be published very nearly within the time mentioned by the Committee, probably at the end of the next financial year.

As mentioned in the Presidential Address last year, advantage has been taken of the British occupation of Egypt to make some explorations by way of boring in the Delta of the Nile, to the results of which geologists attach great importance. The War Department has allowed some of the staff of the Royal Engineers, when their services were not otherwise required, to take part in the operations, and has lent the boring apparatus, and the Royal Society voted the sum of 350*l.* out of its own Donation Fund to defray the cost of labour and other incidental expenses. It was contemplated originally to make a chain of borings, but the depth to which it has been found necessary to proceed in order to get through the ordinary deposit has turned out to be so great that it was thought better, instead of attempting many, to try and get if possible down to rock, or to something else which might afford evidence that what could be referred to alluvium from the Nile or drifted sand had really been got through. A deep boring has accordingly been made at Zagazig, under the direction of Capt. Dickenson, R.E. This has now been carried to a depth of 190 feet 6 inches below the surface, or 164 feet 5 inches below the mean sea-level at Alexandria, and yet nothing has been reached but sand and clay with small pebbles. Prof. Judd is now engaged in the examination of the matter brought up. A derangement of the boring apparatus prevented for the present further progress, and the use of a narrower pipe than any at hand would be required for carrying the boring deeper. The Committee considered that it would be more important to extend this boring, so as if possible to get down to rock, or else to Miocene fossils, than to make a fresh boring in a different place, and arrangements are being made accordingly. The inquiry was deemed a proper one to be assisted out of the Government Grant, and the sum of 200*l.* has been voted from this source to supplement the Royal Society's grant already mentioned.

The ordinary meetings of the Society are well known, and are frequently attended by strangers by permission of the Fellows present; and the papers brought before us are known to the world through our publications. But a great deal of scientific work is done of which the outside public knows nothing. There have been thirteen meetings of the Council during the year, and the attendance at our council meetings is remarkably good. There have been more than seventy meetings of committees and sub-committees.

There is further another task on which a great deal of gratuitous and conscientious labour of the highest kind is bestowed. I allude to the examination of papers with a view to advising the Committee of Papers as to their publication. The past year has shown no flagging in scientific activity in relation to papers brought before us.

The preparation of the manuscript for another decade, 1874 to 1883, of the Royal Society's catalogue of scientific papers, is now almost complete. This great work has been extremely useful to men of science in enabling them at once to find where a memoir on a particular subject, written by an author whose name they know, as is usually the case, is to be found. To some extent it enables them also to find what has been written on a particular subject, for there are usually one or two authors, whose names they know, who have made it a special study, and on consulting their papers references are frequently found to the writings of others who have written on the same subject. Nevertheless, it must be confessed that the value of the catalogue would be greatly increased if it could be accompanied by a key, of the nature of an *index rerum*. It was originally contemplated that this should be added, but the magnitude of the undertaking has hitherto prevented the Committee from attempting it. To be well done it would require the long-continued labour of a scientific staff representing different branches of science, and they could not be expected to engage in so heavy a work without adequate remuneration.

A great deal of work has been done during the past year in relation to the library. More than 5000 volumes have been removed to other rooms to make space for the more important works constantly accruing. A list of duplicates and deficiencies has been printed and circulated among corresponding societies. A shelf catalogue is in progress, and is about a third of the way towards completion. Some work has also been done upon a catalogue of miscellaneous literature.

The electric lighting of the Society's apartments, which is now complete, seems to have given general satisfaction.

On August 31 of this year, our distinguished Foreign Member, M. Chevreul, attained his hundredth year. Rarely indeed is it given to any one to see right through a century, more rarely still to retain his powers to such an age, yet both, I am happy to say, have been granted to M. Chevreul. In anticipation of this event, preparations were made for its due celebration. I received an invitation for our Fellows to assist at the celebration; but unfortunately it was at a time of year when most of us were scattered, and moreover time did not permit of making it generally known. I am afraid we had no representative at the actual ceremonial, but I am sure that none the less our hearts were with the veteran *savant*.

This year has also witnessed the celebration of the 250th anniversary of the University of Heidelberg. The Council had appointed our Foreign Secretary as a deputation to represent the Society on the occasion. Unfortunately when the time was close at hand, Dr. Williamson was prevented by the condition of his health from taking part in the celebration; but acting on the emergency on behalf of the Society, I requested our Fellow, Sir Henry Roscoe, to take his place, which he was so good as to do.

In his Presidential Address last year, Prof. Huxley suggested the idea, I may say expressed the hope, that the Royal Society might associate itself in some special way with all English-speaking men of science; that it might recognise their work in other ways than those afforded by the rare opportunities of election to our foreign membership, or the award of those medals which are open to persons of all nationalities alike. This suggestion has been taken up in one of our colonies. We have received a letter from the Royal Society of Victoria, referring to this passage in the Address, and expressing a hope that in some way means might be found for establishing some kind of connection between our own oldest scientific Society and those of the colonies.

The Council have appointed a Committee to take this letter into consideration, and try if they could devise some suitable plan for carrying out the object sought. The Committee endeavoured at first to frame a scheme which should not be confined to the colonies and dependencies of the British Empire, but should embrace all English-speaking communities. But closely connected as we are with the United States by blood and language, they are of course politically a foreign nation, and this fact threw difficulties in the way of framing at once a more extended scheme, so that the Committee confined themselves to the colonies and dependencies of our own country, leaving the wider object for

some future endeavour, should the country concerned seem to desire it. The scheme suggested was laid before the members of the present Council, but there was not an adequate opportunity of discussing it, and it will of course come before the new Council. Should they approve of some such measures as those recommended by the Committee, they will doubtless assure themselves in some way or other that those measures are in accordance with the wishes of the Fellows at large before they are incorporated into the Statutes.

But in connection with this subject there is another suggestion which I would venture to offer, and which I know has been thought of by others.

A good many years ago it was not unusual to elect to the Fellowship men of distinguished eminence in departments other than scientific. More recently a change was made in the Statutes where y Privy Councillors are enabled to become Fellows by a special method, without interfering with the selection by the Council of fifteen from among the candidates whom they recommend to the Society for election. This to a certain extent superseded the necessity of appealing to other than scientific claims, and in some respects the method had special advantages. Those who attained to a place on Her Majesty's Privy Council were sure to be distinguished men, whom we should be glad to welcome among us; and by confining the privilege of special election to these, with whose appointment the Council had nothing to do, all invidious distinctions were prevented. But the method has the disadvantage that it applies only to a particular class of merit. A man, for instance, might be of quite first-rate eminence in poetry or literature, but that would not lead to a seat on the Privy Council. Such a man could only be elected by being placed on the selected list of fifteen. But it seems to me that there is something not quite courteous either to the eminent man himself, or to the scientific man who would have to be passed over to make room for him, in thus putting him in competition with those who seek admission on purely scientific grounds. I cannot help thinking that it might be well if the Council had the power of recommending for special election men of high distinction on other than scientific grounds, whose connection with us would on both sides be felt to be an honour, and who, though not, it may be, themselves scientific, might usefully assist us by their counsel. I do not think it would be difficult to devise means for providing that such a privilege should be accorded only in case of very high eminence.

The application of photography to the delineation of celestial objects has of late years made rapid strides; and, partly owing to the improved sensitiveness of the plates, partly to greater exactness in regulating the motions of equatorially-mounted telescopes, it has been found possible to photograph even minute stars. The question is accordingly now seriously entertained whether we may not trust to photography for the formation of star maps and star catalogues, taking eye-observations on a sufficient number of stars here and there for reference, and trusting to differential measurements taken on the plates for determining the positions of the other stars. Indeed, I think the practicability of this application may now be considered as established, and there only remains the question of the best mode of carrying it out on a uniform plan. In the course of the autumn I had a letter from Admiral Mouchez, Director of the Paris Observatory, in which he informed me that in response to the presentation of specimens of the admirable star photographs taken by the MM. Henry, several of the astronomers to whom they had been sent suggested that it would be well that a conference of astronomers of various nations should be held, with a view to taking concerted action for obtaining on a uniform plan a complete map of the whole starry heavens. He wished accordingly to obtain an expression of opinion on the part of the Royal Society as to the desirableness of holding such a conference; and as it was contemplated, in case the proposal should be favourably entertained by those consulted, that the conference should be held at Paris in the spring, and it would be necessary to give timely notice to the astronomers who live in the southern hemisphere, an early reply was requested.

As it would have defeated Admiral Mouchez's object to wait till the Council should re-assemble after the recess, I wrote at once to consult four of our Fellows specially named by Admiral Mouchez; and on receiving their replies I wrote to Admiral Mouchez, saying that under the circumstances I took it upon me to express in the name of the Royal Society our approval of the suggestion, explaining at the same time that I did so on the understanding, which I fully believed to be in accordance with his intention, that the astronomers who might attend the conference should not be considered as pledged to the adoption of the methods or scale of the MM. Henry, but that the whole subject should be open to discussion. On reporting what I had done to the Council when they met after the recess, I obtained an expression of their approval.

In these photographs a remarkable instance was exhibited of the power of photography to reveal the existence of objects wholly invisible to the eye. One of the stars of the Pleiades was found to be surrounded by a nebula which cannot be seen with telescopes. The reason of the difference of power of the plate and eye is very obvious: with the eye an object is either seen or not seen at once, whereas with the plate, provided there be an absence of stray light, feebleness of intensity can be made up for by length of exposure.

But the MM. Henry are by no means the only persons who have applied photography to the delineation of the stars. Among others, our Fellow, Dr. Gill, who has sent us some excellent specimens of the photographs obtained by his instrument, proposes to take at the Cape Observatory photographs of the whole starry heavens of the southern hemisphere, under such conditions as to include the magnitudes contained in Argelander's "Durchmusterung" of the northern hemisphere, and to subsequently reduce the observations so as to complete Argelander's great work by extending it to the southern hemisphere. Prof. Kapteyn, in Holland, has nobly undertaken to devote his spare time for seven years to superintending the reduction. Dr. Gill has laid the proposal before the Government Grant Committee. Having regard to the magnitude of the undertaking, and the probability of a conference of astronomers being shortly held in Paris to discuss the whole question, the Government Grant Committee suggested to the Council of the Royal Society that they should appoint a committee to take the subject into consideration, and the Council have acted on this suggestion. Dr. Gill intends to come to Europe in the spring, so that the committee will be able to consult him personally.

This morning I received through the Foreign Office an invitation from the Académie des Sciences for myself and some other delegate of the Royal Society to attend the conference to which I have already referred, which is fixed for April 16. I shall take the first opportunity of consulting the new Council as to their wishes.

The Copley Medal for this year has been awarded to the veteran in science, our Foreign Member, Prof. Franz Ernst Neumann, for his researches in theoretical optics and electrodynamics.

Having in his earlier years treated of crystallographic subjects almost half a century ago, he turned his attention to the theory of light. Fresnel had, with his wonderful sagacity, arrived at his celebrated laws of double refraction from the theory of transverse vibrations, aided by conceptions derived from a dynamical theory which was only in part rigorous. Cauchy and Neumann, independently of each other, were the first to deduce from a rigorous dynamical calculation, applied to a particular hypothesis as to the constitution of the ether, laws of double refraction, not indeed absolutely identical with those of Fresnel, but closely resembling them. In this case the laws were known beforehand. But in a very elaborate later paper, Prof. Neumann deduced from theory the laws of crystalline reflection, laws which appear to agree with the observations of Seebeck, and which had not been discovered by Fresnel, though some of them were independently and about simultaneously obtained by MacCullagh.

Prof. Neumann is perhaps still better known in connection with the theory of electro-dynamics, and the mathematical deduction of the laws of induced currents due to the motion of the primary and secondary conductor. He may be said to have completed for the induction of currents the mathematical treatment which Ampère had applied to their mechanical action.

Of the two Royal Medals, it is the usual, though not invariable, practice to award one for the mathematical and physical, and the other for the biological sciences.

One of these medals has this year been awarded to Prof. Peter Guthrie Tait, for his various mathematical and physical researches.

Prof. Tait is well known for his numerous and important papers in both pure mathemathics and physics. The late Sir William Hamilton regarded him as his own successor in carrying on and completing the newly-invented calculus of quaternions, of which Prof. Tait is continually making new applications. Among his investigations in the domain of experimental physics

may be mentioned his determination of the conducting powers of metals for heat by a method which appears to possess special advantages, and his investigation of the effect of extremely great pressures on thermometers, undertaken with a view to deducing correct results for the temperatures at great depths in the ocean from the observations made in the *Challenger* expedition. This latter subject has led him to investigate the behaviour, as to compressibility and development of heat, of liquids and solids under enormous pressures, a subject in which he is still engaged. Before concluding, I must mention his elaborate papers on systems of knots, recently printed in the *Transactions* of the Royal Society of Edinburgh.

The other Royal Medal has been awarded to our Fellow, Mr. Francis Galton, for his statistical inquiries into biological phenomena.

Mr. Galton is well known as an explorer and geographer, and his mind is singularly fertile in the devising of ingenious instruments for various objects. Many years ago he brought before us some remarkable experiments instituted with a view to test a particular biological theory, in which rabbits of a pure variety were so connected with others of a different variety that the same blood circulated through both individuals, and the point to determine was whether this blood-relationship, in the most literal sense of the term, had any effect on the offspring. Contrary to what the theory in question led us to regard as the more probable, the result proved to be negative. It is, however, in accordance with the rules for the award of the Royal Medals, more especially the later investigations of Mr. Galton, in relation to vital statistics, that have been taken as the ground of the award. He has shown that by taking the average of a number of individuals having some condition in common, individual peculiarities apart from that condition are eliminated in the mean, and results are obtained which may be regarded as typical of that condition. One way of doing this is by his method of compound photographs. Thus we may obtain typical features of criminals of a particular kind, of consumptive persons, and so forth. By adhering to the method of averages, he has even succeeded in obtaining a mathematical expression, very closely verified in observation, connecting the mean deviation of some condition (such for example as stature) in a series of individuals, from the general mean of the same condition, with the mean deviations of the same condition in the relatives of those same individuals of different kinds, such as fathers, brothers, &c. Nor is the statistical method applicable to bodily characteristics alone. Mr. Galton has even extended it with remarkable ingenuity and originality to mental phenomena also.

The Rumford Medal has been awarded to Prof. Samuel P. Langley, for his researches on the spectrum by means of the bolometer.

A better knowledge of the ultra-red region of the spectrum, which includes the larger part of the energy of solar radiation, had long been a desideratum when Prof. Langley commenced his work upon this subject. Finding the thermopile insufficiently sensitive for his purpose, he contrived the "bolometer." This instrument depends upon the effect of temperature upon the electrical resistance of metals, a quantity susceptible of very accurate measurement; and, with its aid, Prof. Langley has been able to explore a part of the spectrum previously almost inaccessible to observation.

A result of Prof. Langley's work, very important from the point of view of optical theory and of the ultimate constitution of matter, relates to the law of dispersion, or the dependence of refrangibility on wave-length. Cauchy's formula, which corresponds well with observation over most of the visible spectrum, is found to break down entirely when applied to the extreme ultra-red.

Prof. Langley has given much attention to the important question of the influence of the atmosphere on solar radiation. The expedition to Mount Whitney, successfully conducted by him in face of many difficulties, has given results of the utmost value, pointing to conclusions of great interest and novelty.

The Davy Medal has been awarded to our Foreign Member, M. Jean Charles Galissard de Marignac, for his researches on atomic weights.

M. Marignac's numerous researches on atomic weights, which have been continued for a great number of years, have played an exceedingly important part in establishing and consolidating that ground-work of chemistry. They are remarkable for originality in devising methods appropriate to the respective cases, the most conscientious care in discovering errors which occurred in the respective operations, and indefatigable perseverance in finding means to eliminate the disturbing influences. His labours are all the more valuable because he chose for their field chiefly those elements which are most generally used in chemistry, and are most important to chemists, and on which the determination of new atomic weights is most generally made to depend.

TEN YEARS' PROGRESS IN ASTRONOMY[1]

III.

COMETS.—During the past ten years we have been favoured with an extraordinary number of comets, and while perhaps no single great step has been made, yet it is certain, I think, that our knowledge of these mysterious objects has gained a real and considerable advance.

In 1876, curiously enough, not a single comet appeared; but in 1877 there were 6; in 1878, 3; in 1879, 5; in 1880, 5; in 1881, 8; in 1882, 3; in 1883, 2; in 1884, 3; and in 1885, 6; and so far this year, 3. Forty-four comets in all have been observed during the ten years, six of which were conspicuous objects to the naked eye, and two of them, the great comet of 1881, and the still greater one of 1882, were very remarkable ones.

The first of these will always be memorable as the first comet ever photographed. Dr. Henry Draper photographed both the comet itself and its spectrum; Janssen obtained a picture of the comet, and Huggins of its spectrum.

A number of excellent photographs were obtained of the great comet of 1882, especially by Gill, at the Cape. And it is worth mentioning that in May 1882 a little comet (not included in the preceding list, because no observations were obtained of it) was caught upon the photographs of the Egyptian eclipse.

Two of the bright comets, Wells's comet of 1881 and the great comet of 1882, approached very close to the sun, and their spectra, as a consequence, became very complex and interesting. A great number of bright lines made their appearance. Sodium was readily and certainly recognised; iron and calcium probably, but not so surely. The evidence as to the nature of the sun's corona, derived from the swift passage of the 1881 comet through the coronal regions, has already been alluded to.

The Pons-Brooks comet of 1883-84 is extremely interesting as presenting the first instance (excepting Halley's comet, of course) of one of the Neptunian family of comets returning to perihelion. There are six of these bodies with periods ranging from sixty-eight to seventy years. Halley's comet, the only large one of the group, has made many returns, and is due in 1910. Pons's comet, first observed in 1812, has now returned; Olbers's comet of 1815 is due in 1889, and the three others, all of them small, in 1919-20 and 1922.

I have spoken of them as Neptunian comets, *i.e.* their presence in our system is known to be due in some way to this planet. The now generally received theory is that they have had their orbits changed from parabolas into their present shape by the disturbing action of Neptune. Mr. Proctor has pointed out certain unquestionable, though, I think, inconclusive, objections to this view, and he proposes, as an alternative, the startling and apparently improbable hypothesis, that they have been *ejected* from the planet at some past time by something like volcanic action.

On the whole, however, the most important work relating to comets has been that of the Russian astronomer Bredichin. He has brought the mechanical and mathematical portion of the theory of comet's tails to a high degree of perfection; following out the lines laid down by Bessel, but improving and correcting Bessel's formulæ, and determining their constants by a most thorough discussion of all the accurate observations available.

It is hardly possible to doubt any longer that all the facts can be represented on the hypothesis that the tails are composed of minute particles of matter, first driven off by the comet, and then repelled by the sun. Bredichin's most interesting result, arrived at in 1878, is that the tails appear to be of three, and only three, distinct types—the long straight streamers which are due to a repulsive acceleration about twelve times as great as the sun's attraction; the second and most ordinary class of broad-curved tails for which the repulsive force ranges between one and two and a half times that of the attraction; and, finally, the short,

[1] "Ten Years' Progress in Astronomy, 1876-86," by Prof. C. A. Young. Read May 17, 1886, before the New York Academy of Sciences. Continued from p. 98.