38″·8. This is an increase on the results of the preceding quarter both in the number and height of prominences. Two elaborate plates are included in the *Memorie*, indicating the prominences observed at Rome and Palermo from September to December 1886.

GEOGRAPHICAL NOTES.

THE following news was received a few days ago at St. Petersburg from Colonel Roborovski, the present chief of the late M. Prjevalsky's projected expedition. They crossed the Tian-Shan by the Barskaun and Bedel Passes, and reached the Taushkan-daria. Then they crossed the Kara-teke chain, and when they were on the banks of the Yarkend river, they found out that the Kashgar-daria no longer reaches the Yarkend-daria, but is lost in the irrigation canals of Maral-bash. They followed the Yarkend river, which rolls a mass of muddy water between quite flat banks, covered for some 15 to 30 miles on both sides of the river, by thickets of *Populus euphratica*, *Populus prunosa*, tamarisks, *Halostachus* shrubs, and rushes. Sand deserts spread on both sides,—towards the west to Kashgar, and eastwards to Lob-nor. Many ruins of old cities are met with in the deserts which are never visited by the natives. In the thickets of shrubs which fringe them there are numbers of tigers and wild boars, while amidst the *barkhans* of the deserts the wild camels are freely grazing. From Yarkend, the expedition went south, towards the hilly tracts, where it stayed for a month, and then it moved towards Kotan, whence Colonel Roborovski wrote on October 7. He proposed to winter at Niya, and to search for a pass to Tibet across the border-ridge to which Prjevalsky gave the name of "Russian Ridge." If they succeed they will spend next summer in Tibet.

IN a lecture lately delivered before the Geographical Society of Bremen, Prof. Kuekenthal, of Jena, gave some account of his researches in King Charles Land. Geologically, these islands belong to Spitzbergen, and not, as was formerly supposed, to Francis Joseph Land. During his stay of nearly three months, Prof. Kuekenthal thoroughly investigated this remote district, which is almost unapproachable, the surrounding seas being densely packed with icebergs. The islands are almost entirely without vegetation; only a few mosses struggle for existence on the clay soil. Numerous walrus skeletons are thrown up by the sea. Game is plentiful; Prof. Kuekenthal shot 14 bears (besides bringing back two live specimens), 39 walruses, and as many seals. Many insects and crustaceans were obtained from the land lakes.

THE ANNIVERSARY OF THE ROYAL SOCIETY.

THE President, after giving an account of the scientific work of many Fellows deceased during the past year, addressed the Society as follows:—

On account of the great importance of Joule's labours, both directly, in the advancement of science, and indirectly, through the knowledge thus acquired, in enabling improvements to be made in the practical application of science for industrial purposes, it has been suggested that it might be desirable to raise some public memorial to him, and the Council has appointed a Committee to consider the question.

I have referred, and that very briefly, to some only of the Fellows whom we have lost during the past year, but fuller details both of them, of other Fellows whom we have lost, and of our recently deceased Foreign Members, will be found in the obituary notices which appear from time to time in the Proceedings, according as they are received from the Fellows who have kindly undertaken to draw them up.

Of those who last year were on our list of Foreign Members, we have since lost one who was truly a veteran in science. More than three years have elapsed since the celebration of the centenary of the birth of M. Chevreul, and two more recurrences of his birthday came round before he was called away. He will be known for his researches on the contrast of colours. But his great work was that by which he cleared up the constitution of the fixed oils and fats, and established the theory of saponification. Few scientific men still surviving were even born when this important research was commenced—a research in the course of which he laid the foundation of the method now universally followed in the study of organic compounds, by showing that an ultimate analysis by itself alone is quite insufficient, and that it is necessary to study the substances obtained by the action of reagents on that primarily presented for investigation.

There is one whose name, though he was not a Fellow, I cannot pass by in silence on the present occasion. I refer to Thomas Jodrell Phillips Jodrell, who died early in September, in his eighty-second year. About the time of the publication of the reports of the Duke of Devonshire's Commission, the subject of the endowment of research was much talked of, and Mr. Jodrell placed the sum of £6000 in the hands of the Society for the purpose of making an experiment to see how far the progress of science might be promoted by enabling persons to engage in research who might not otherwise be in a condition to do so. But before any scheme for the purpose was matured, the Government Grant for the promotion of scientific research was started, under the administration of Lord John Russell, then Prime Minister. This rendered it superfluous to carry out Mr. Jodrell's original intention, but he still left the money in the hands of the Society, directing that, subject to any appropriation of the money that he might make, with the approval of the Royal Society, during his lifetime, the capital should, immediately upon his death, be incorporated with the Donation Fund, and that in the meantime the income thereof should be received by the Royal Society. Of the capital, £1000 was several years ago assigned to a fund for the reduction of the annual payments to be made by future Fellows, and the remaining £5000 has now, of course, been added to the Wollaston Donation Fund. By the Fee Reduction Fund the annual payment of ordinary Fellows elected subsequently to the time of the change was made £3 instead of £4, and the entrance fee abolished. As to the Donation Fund, a very wide discretion was, by the terms of the original foundation, left in the hands of the Council as to the way in which they should employ it in the interest of science.

Since the Croonian Foundation for lectures was put on its present footing, it has been made the means of securing for us the advantage of a lecture delivered before the Society by distinguished foreign men of science. In the present year our Foreign Member, M. Pasteur, was invited to deliver the lecture Unfortunately, the state of his health would not allow him to deliver it himself, but at one time he hoped that he would have been able to be present at its delivery. It was ultimately arranged that his fellow-labourer at the Pasteur Institute, Dr. Roux, should deliver the Croonian Lecture in his stead; and several of the Fellows have heard his lucid account, first of the discoveries of M. Pasteur in relation to diseases brought about by microscopic organisms, and then further researches of his own in the same field.

In addressing the Fellows at the anniversary last year, I mentioned that Commandant Desforges had kindly offered to compare that portion of Sir George Schuckburgh's scale, with reference to which the length of the seconds pendulum had been determined by Kater and Sabine, with the French standard metre; and as the ratio of this to the English standard yard was accurately known, the length of the pendulum, as determined by these accurate observers, would thus for the first time be brought into relation with the English yard by direct comparison with accurately compared measures of length. The comparison was shortly afterwards executed, and the scale, which, of course, was very carefully packed for its journey to Paris and back, has long since been replaced in the apartments of the Society. This highly desirable comparison occupied but a few days in its execution; which affords one example of the scientific advantages derivable under an international agreement, from the establishment of the Bureau des Poids et Mesures. Our own country, which for some years held aloof from the Convention, forming the sole exception to the general agreement among nations of importance, joined it some years ago; and we thus have the privilege of availing ourselves, as occasion may arise, of the appliances at the office in Paris for such comparisons of measures of length or weight.

The services of Mr. Arthur Soper, as a special assistant, have been retained during the past session, with advantage to the library. He has completed the much-needed shelf catalogue, and the re-arrangement of the books where necessary. In the course of this work the volumes of a purely literary character

have been collected together, and a selection of the most valuable have been preserved in a properly protected case. Of the remainder, about 150 volumes (in addition to those reported last year) have been presented to various public libraries, and a slip catalogue of the volumes which are retained, containing about 1700 entries, has been prepared.

The manuscripts (other than the originals of ordinary papers read at the meetings) which have accrued to the Society since the publication of Halliwell's Catalogue have been collected from various parts of the building into the Archives Room, with the object of preparing a complete catalogue of the manuscripts at present in the possession of the Society.

Since the last anniversary, twenty-four memoirs have been published in the Philosophical Transactions, containing a total of 753 pages and 33 plates. Of the Proceedings, twelve numbers have been issued, containing 1062 pages and 6 plates. Dr. R. von Lendenfeld's "Monograph of the Horny Sponges," mentioned in my last anniversary address, has also been issued during the year in a quarto volume of 940 pages of text and 51 plates.

The Fellows are aware that for a great many years the Royal Society has devoted a part of its funds to the collection, preparation for the press, and correction of the proofs of a Catalogue of Scientific Papers. We have endeavoured to make the work as complete as possible, and to include scientific serials in all languages. The first part, covering the period 1800-63, is printed in six thick quarto volumes, of which the last appeared in 1872. The decade 1864-73 occupies two more volumes, of which the second was published in 1879. This work, in the preparation of which the Royal Society has spent a large sum, is for the benefit of the whole civilized world, and the sale of it could not be expected nearly to cover the cost of printing, paper, and binding. On a representation to this effect being made to Government, when the first part was ready for the press, the Lords of the Treasury consented that it should be printed at the public expense, the proceeds of the sale of the work, after reserving a certain number of copies for presentation, being repaid to the Treasury. In consideration of the large outlay involved in the preparation, those Fellows of the Society who wished to purchase the work could do so at about two-thirds of the cost to the general public. A similar application to the Treasury with reference to the decade 1864-73 met with a similar response, and we proceeded, as I mentioned at the anniversary last year, with the preparation of the manuscript for the next decade, 1874-83, which was then nearly ready. On making application towards the end of last year to the Treasury for the printing of this decade, our request was not acceded to. While declining, however, to continue any further the printing of this great work, the sum of £1000 was put in the Estimates, and has since been voted by Parliament, to assist us in the publication, and the copies of the work still remaining unsold have been handed over to us. This has enabled us to conclude negotiations with Messrs. Clay and the Syndics of the Cambridge University Press for the printing of the decade last mentioned, and at the same time to make some provision towards the future continuation of the work, without, as it may be hoped, encroaching to a greater extent than hitherto on our own resources.

The utility of the work would obviously be much increased if it could be furnished with some sort of key enabling persons to find what had been written on particular subjects. I am not without hopes that this very desirable object may yet be accomplished, notwithstanding the magnitude of any such undertaking.

Within the last year the Council of the Royal Society has accepted a duty in connection with scientific agriculture, of which it will be interesting to the Fellows to be informed. It is well known that for the last fifty years, or thereabouts, Sir John Lawes has carried out on his estate at Rothamsted an elaborate and most persevering series of experiments on the conditions which influence the growth and yield of crops of various kinds, the effect of manures of different kinds, the result of taking the same crop, year after year, from off the same land without supplying to it any manure, &c. Long as these experiments have already been continued, there are questions, particularly as regards the capabilities of the sub-soil, which require for their satisfactory answers that similar experiments should be continued on the same land for a still longer period. In respect of such questions, the investigator of the science of agriculture is in a position resembling that in which the astronomer is often placed, in having to make observations, the full interest of which it must be left to posterity to enjoy.

To prevent the interruption of these experiments, which it would take a life-time to repeat on fresh ground, and at the same time to provide for the carrying out of researches generally bearing on the science of agriculture, Sir John Lawes has created a trust, securing to the trustees a capital sum of £100,000, and leasing to them for ninety-nine years, at a peppercorn rent, certain lands in his demesne on which the experiments have hitherto been carried on, together with his laboratory. The trust is intended to be for original research, not for the instruction of students. The general direction of the experiments and researches to be carried on is vested in a committee of management consisting of nine persons, of whom four are to be appointed by the President and Council of the Royal Society.

The trustees named in the deed were Sir John Lubbock, Dr. Wells, and our Treasurer, Dr. Evans. One of these is now no more. Lord Walsingham has been appointed a trustee in place of the late Dr. Wells.

The Copley Medal for the year has been awarded to Dr. Salmon for his various papers on subjects of pure mathematics, and for the valuable mathematical treatises of which he is the author. Dr. Salmon's published papers are all valuable. Among others may be mentioned his researches on the classification of curves of double curvature, and on the condition for equal roots of an equation; the very important theorem of the constant anharmonic ratio of the four tangents of a cubic curve; his researches on the theory of reciprocal surfaces; his paper on quaternary cubics. But any notice of his contributions to the advancement of pure mathematics would be incomplete which did not specially mention his invaluable text-books on conic sections, higher plane curves, solid geometry, and the modern algebra—works which not only give a comprehensive view of the subjects to which they relate, but contain a great deal of original matter.

Of the Royal Medals, it is the usual though not invariable practice to award one for mathematics or physics, including chemistry, and one for some one or more of the biological sciences. No distinction is, however, made between the two medals in point of order of precedence, and I will, therefore, take the names of the medallists in alphabetical order.

The Council have awarded one of the Royal Medals this year to Dr. Walter Holbrook Gaskell for his researches in cardiac physiology, and his important discoveries in the anatomy and physiology of the sympathetic nervous system.

In his memoir, "On the Rhythm of the Heart of the Frog" (Croonian Lecture, Phil. Trans., 1882), and in a subsequent memoir, "On the Innervation of the Heart of the Tortoise" (*Journ. of Physiol.*, vol. iv.), Dr. Gaskell very largely advanced our knowledge of the physiology of the heart-beat, more especially as relates to the sequence of the beats of the several parts, the nature of the inhibitory action of the vagus nerve, and the relations of tonicity and conducting power to rhythmical contraction. These memoirs, however, lacked completeness on account of their not taking into full consideration the action of the cardiac augmentor or accelerator fibres, the existence of which had been previously indicated in the case of mammals, and suspected in the case of the frog and allied animals.

By a striking experiment (*Journ. of Physiol.*, vol. v.) Dr. Gaskell subsequently gave the first clear demonstration of the presence in the frog of cardiac augmentor fibres; also he gave a clear account of the nature of the action of their fibres, and the relations of that action to the action of the vagus fibres. Revising his previous work by the help of the light thus gained, Dr. Gaskell was enabled to give the first really consistent and satisfactory account of the nature of the heart-beat, of the modifications of beat due to extrinsic nerves, and of the parts played by muscular and nervous elements respectively.

Important as was this work on the heart, Dr. Gaskell's subsequent work "On the Structure, Functions, and Distribution of the Nerves which govern the Vascular and Visceral Systems" (*Journ. of Physiol.*," vol. vii.) has a far higher importance and significance. In spite of the knowledge which during the past thirty or forty years has been gained concerning vaso-motor nerves and the nerves governing the movements of the viscera, physiologists had up to the time of the appearance of Dr. Gaskell's memoir failed to obtain a clear conception of the nature and relations of the so-called sympathetic nervous system. By his researches, in which the several methods of

gross anatomical investigation, minute histological examination, and experimental inquiry were, in a striking manner, made to assist each other, Dr. Gaskell, by tracing out the course and determining the nature of vaso-constrictor and vaso-dilator fibres, and comparing them with the cardiac augmentor and inhibitory fibres, and with the fibres governing the visceral muscles, has already reduced to order what previously was to a large extent confusion, and has opened up what promises to be the way to a complete understanding of the whole subject.

The results arrived at, besides their great physiological importance, on the one hand promise to be of great assistance in practical medicine, and on the other are eminently suggestive from a purely morphological point of view.

The other Royal Medal has been awarded to Prof. Thomas Edward Thorpe for his researches on fluorine compounds, and his determination of the atomic weights of titanium and gold.

Prof. Thomas Edward Thorpe's experimental work has secured for him a place in the first rank of living experimentalists.

His researches, which are not confined to one department of chemical science, but extend over many branches, are all distinguished both by accuracy and originality of treatment. As examples of the high character of his investigations, those of the determinations of the atomic weights of titanium and gold may be specially cited as permanently settling the value of two most important chemical constants; whilst his researches on the fluorine compounds, including the discovery of thiophosphoryl fluoride, a body capable of existing undecomposed in the state of gas, and his latest work on the vapour-density of hydrofluoric acid, do not fall short of the highest examples of classical chemical investigation.

The Davy Medal has been awarded to Dr. W. H. Perkin for his researches on magnetic rotation in relation to chemical constitution.

Dr. Perkin is well known as the originator of what is now a great industry, that of the coal-tar colours, by his preparation and application to tinctorial purposes of a colouring matter which had previously merely been noticed as affording a chemical test for the presence of aniline. This, however, is now a long time ago, and it is for more recent work, the interest of which is purely scientific, that the medal has been awarded to him.

Dr. Perkin first showed, in 1884, that a definite relationship exists between the chemical constitution of substances and their power of rotating the plane of polarization of light when under magnetic influence; and he pointed out how the "molecular coefficient of magnetic rotation" or "molecular rotatory power" might be deduced.

In 1884 he presented to the Chemical Society a lengthy paper describing his method, and the results obtained for a very large number of paraffinoid hydrocarbons and haloid and oxygenated derivatives thereof; from these he deduced "constants," which he has since shown to be applicable in calculating the magnetic rotatory power of paraffinoid compounds generally. From time to time he has published further instalments of his work, and only quite recently has described the results obtained on examining nitrogen compounds, which exhibit many most interesting peculiarities.

The results are of special value on account of the exceptional care devoted to the preparation of pure substances, and the guarantee, which Dr. Perkin's reputation affords, that everything possible has been done to secure accuracy; and also because the substances chosen are for the most part typical substances, or belong to series in which a simple relationship exists.

HAIL-STORMS IN NORTHERN INDIA.

IN a paper recently published in the Journal of the Asiatic Society of Bengal, Mr. S. A. Hill describes certain severe hail-storms and tornadoes that occurred on April 30 and May 1, 1888, in the Gangetic *doab* and Rohilkand in Northern India.[1] Tornadoes are not very common in India, but they appear to have been somewhat more prevalent than usual in the spring of 1888, the storms in question having been preceded on April 7 by a very destructive tornado at Dacca in Bengal, a full description of which was given by Mr. Pedler and Dr. Crombie in a previous number of the Society's Journal. Like all previously recorded storms of this character, these occurred in the spring, when the seat of minimum pressure is established in the Lower Punjab, and a trough of low pressure extends from this region eastward to the Gangetic plain. To the south of this trough very dry west winds, the hot winds of Northern India, prevailed in Rajputana and Central India, while, to the north of it, damp easterly winds blew up the northern margin of the plain and across the outer slopes of the Himalaya. It is apparently in the meeting of these two winds, where the former blows in an upper, the latter in the lower, stratum, that are generated the thunder squalls that form a normal feature of the spring months in Northern India; and tornadoes, as Prof. Ferrel has shown, are merely an exaggerated development of the thunder squall. In the present instance, ordinary storms of this character, and dust storms, occurred pretty generally over all the north-western districts of the North-West Provinces, simultaneously with the tornadoes in Rohilkand and the Gangetic *doab*.

From the evidence quoted by Mr. Hill, it does not appear indeed to be positively established that any of the storms described exhibited all the characteristic features of tornadoes, as was undoubtedly the case of the Dacca storm. No mention is made in any of the reports of any whirling column having been actually observed; and that whirlwinds were the real agents of destruction seems to be inferred chiefly from the destructive force of the wind, especially its lifting power, and some rather vague reports on the wind's changes during the passage of the storm. On a point of this kind, however, in India, negative evidence goes for little, and the chief subject discussed in Mr. Hill's paper, viz. the conditions which determine these atmospheric disturbances, is of equal interest, whether they were really tornadoes or only remarkably severe hail-storms of the more usual kind.

In the barometric changes of the days preceding the storms there does not appear to be anything that throws much light on their genesis. The relative distribution of pressure shown by the observations on the Indo-Gangetic plain underwent but little variation, and the existence of a slight secondary depression in the immediate neighbourhood of the storm tract, on April 30, is inferred solely on the evidence of two Himalayan stations at elevations of 5300 feet and 6000 feet above the sea, and may be delusive. There had, however, been a general steady fall of the barometer for three days before the storms of April 30—one of those oscillations, apparently, which Mr. Abercromby has termed surges, and a rapid rise set in after the storms. As has been pointed out elsewhere, this is an ordinary recurrent feature of the season.

It is in the changes in the vertical distribution of temperature that Mr. Hill finds the conditions that determined the atmospheric disturbance. Taking as his fundamental data the observed temperatures of the three stations, Roorkee at 886 feet, Dehra at 2233 feet, and Mussooree at 6881 feet, and assuming that these represent approximately the rate of vertical decrease over the neighbouring plain, he computes the fall of temperature for increments of 1000 feet up to 10,000 feet by means of a simple formula of interpolation, and finds that, up to the forenoon of April 30, the condition of unstable equilibrium which results from the diurnal heating of the plains did not extend beyond 3000 or 4000 feet above the ground surface. This would set up a considerable amount of convective interchange between these lower strata, but the cloud-forming strata would still be in a stable condition, at least in a non-saturated atmosphere. On the afternoon of April 30, the conditions were changed. With a great fall of temperature at the lowest and highest stations, as compared with the previous day at the same hour, that of the intermediate station was but little affected, and hence the computed table shows a reduction of the vertical decrement at low levels, a corresponding increase at the higher levels, and a transfer of the condition of unstable equilibrium from the former to the latter. Simultaneously with this change took place that violent disturbance of the atmosphere that resulted in the hail-storms on the plains.

Mr. Hill's conclusions are entirely in accord with what might be expected on *a priori* grounds. But before they can be fully accepted, it is necessary to scrutinize the data, and as the result of this scrutiny we must confess they do not seem to us completely convincing. We may put aside the question whether and to what extent the empirical formula of interpolation adopted by Mr. Hill really expresses the law of decrement of temperature, since, although it would evidently fail for extrapolation much beyond the altitude of 7000 feet, it probably does not involve any very serious error below that limit, provided the numerical values afforded by observation are trustworthy. The

[1] *Op. cit.*, vol. lviii., Part 2, No 2, 1889.