THURSDAY, SEPTEMBER, 9, 1880

ENGLISH AND AMERICAN BEE-KEEPING

The Bee-Keeper's Manual; or, the Honey Bee, its Management and Preservation. With a Description of the most Approved Hives and other Appliances of the Apiary. By the late Henry Taylor. Seventh Edition, modernised and very greatly enlarged by Alfred Watts. (London: Groombridge and Sons, 1880.)

British Bee-Farming, its Profits and Pleasures. By James F. Robinson. (London: Chapman and Hall, 1880.)

Manual of the Apiary. By A. J. Cook, Professor of Entomology in the Michigan State Agricultural College. Fifth Edition, revised, enlarged, mostly re-written, and beautifully illustrated. (Chicago, Illinois: Thomas G. Newman and Son, 1880.)

MR. WATTS' edition of Taylor's "Bee-Keeper's Manual" has been so copiously revised and added to that it is really a new work, embodying all the most recent discoveries and improvements in apiarian practice. For the amateur bee-keeper—as distinguished from the scientific student of bees on the one hand, and the mere honey manufacturer on the other—this volume is a most admirable guide. It is simple in arrangement, very clear in its descriptions, and copiously illustrated by really good woodcuts of every portion of the extensive apparatus used by the modern amateur. Commencing with a short account of the different kinds of honey-bee, and the main facts of its life-history, we are soon introduced to the mode of keeping bees, beginning with the old-fashioned straw hive, and successively pointing out the various improvements that have been effected. We then come to the different kinds of box, frame, and observatory hives, and the various systems of bee-management, all of which are explained and illustrated in the clearest and most intelligible manner. The latter half of the volume is devoted to a detailed account of the summer, autumn, winter, and spring management of bees; and this part is so full and so carefully written that it will prove of the greatest service to all young bee-keepers.

Mr. Watts does not seem quite so confident as most apiarians of the superior qualities of the Ligurian over the common bee. He quotes, as "worthy of the most careful consideration from those interested in the subject," a statement that the former rob the latter of their honey, and that they are also far more liable to disease. The writer—a Scotchman who has closely studied the habits of bees—says:—

"All Ligurian fanciers claim for them that they work in wet or dry earlier and later than do the blacks. Now any one can see that as soon as there is honey in the flower, so soon will the black bee go for it, and so long as there is honey so long will the black remain gathering it. Since the Ligurian can no more make honey than the black, and since it finds honey after the blacks have failed, it must obtain it from some other source than the flowers. Ligurian bee-keepers tell me—and I see no reason to doubt the statement—that the Ligurian thrives amazingly for a time where plenty of black bees are kept, and that nearly in the same proportion to the number of black hives within reach, so will be the honey-producing powers of the Ligurian. I have often seen them coming out of the black hives, and certainly they were not helping the blacks, because in nearly exact proportion as they increased in weight the blacks decreased; and this transfer of the honey is not always accompanied with fighting, the Ligurians having what all successful pilferers generally have—viz. the knack of introducing themselves unchallenged anywhere if what is wanted is to be had."

"British Bee-Farming" is a most excellent and practical work, written in the simplest style, and giving excellent directions to those who wish to keep bees for profit. We have seldom seen a book from which a beginner can obtain such exact information on all the necessary details of bee-management. Mr. Robinson strongly recommends a simple form of bar-hive, which he calls "the bee-farmer's hive," and which is figured so clearly that any village carpenter can make it; and by the use of this, and his equally simple and efficient "bee-farmer's honey extractor," he shows how a constant supply of pure honey can be obtained, week by week, without interfering with the bees' work or destroying any of the comb, the replacement of which in a small hive necessitates the consumption by the bees of twenty pounds of honey. A good deal of miscellaneous information on bees and bee-keeping is given in the second part of the work, but its chief value is that it well justifies its title, by showing in the briefest and clearest manner how bees may become a source of considerable profit as well as a continual pleasure.

Prof. Cook's volume differs considerably from the preceding, and indeed from any other English work on the subject, in its combination of science with utilitarianism, while the amateur pure and simple is hardly recognised at all. More than one-third of the book is devoted to an account of the natural history of the bee, its place in the animal kingdom, its anatomy, physiology, habits, and economy. Then follow the chapters on bee-keeping proper; and the author here addresses himself almost exclusively to those who make bee-keeping a business, and we are led to understand how much this branch of industry is advancing in America, where honey is now being manufactured on almost as large a scale as corn. An article in the *Times* last year informed us that a single bee-farm has 12,000 swarms, and keeps two steam-saws and nine men at work for five weeks in cutting up the timber for the 72,000 boxes in which the honey is packed for exportation. Prof. Cook accordingly has a chapter on "Marketing Honey," and instructs his readers in the art of "invigorating the market," "tempting the consumer," and other mercantile details; and throughout the book we find constant indications that bee-keeping is looked upon as a business rather than a hobby, and that in all its details economy of labour and materials must be studied, and all processes judged by the test of the maximum of production at a minimum of cost. A few extracts will give an idea of the style of the book.

After stating that a queen bee will often lay two or three thousand eggs a day, he remarks that this is nothing to the queen white ant, which lays 80,000 eggs a day, adding:—

"This poor helpless thing, whose abdomen is the size of a man's thumb, and composed almost wholly of eggs, while the rest of her body is not larger than the same in our common ants, has no other amusement; she cannot

walk; she cannot even feed herself or care for her eggs. What wonder then that she should attempt big things in the way of egg-laying? She has nothing else to do, or to feel proud of."

In the account of the formation of the comb the "pressure" theory is very properly rejected, but no reference is made to the complete explanation of the process given by Darwin, Waterhouse, and others. The mathematical accuracy of the cell is however disproved by the observations of Prof. Wyman, who showed by actual measurement that none of them were perfect hexagons, but that they varied in size, sometimes to the amount of one cell's width in ten, and commonly to half this amount. The rhombic bases of the cells also vary, and as this variation occurs gradually in passing from one part of the comb to another, it follows that whenever this happens the cells must diverge from the true hexagonal form. The supposed mathematical instinct of the bee has therefore no foundation to rest upon, and the beautiful explanation given by Mr. Darwin fully meets the actual facts.

An interesting chapter is devoted to "Honey Plants," the principal species from which the bees obtain their honey in America being figured. In the more northern States fruit-trees, willows, and sugar-maples, with basswood and white clover, are the most productive plants, while on the western prairies the thousands of acres of asters, solidagos, and eupatoriums afford an inexhaustible supply of honey not yet appropriated.

The illustrations of this book are often rude, and sometimes inaccurate. The honey-extractor (at p. 189) is described as acting by centrifugal force, but it is drawn square, and the comb so placed in it that it could not possibly revolve; while, at p. 128, the bottom-board described as having a bevelled notch for an opening to the hive, is shown with a triangular projection, owing to bad perspective in the drawing. These, however, are smal faults; and the English bee-keeper will no doubt obtain many useful hints from this excellent little manual of bee-culture as practised by our ingenious and energetic cousins across the Atlantic. A. R. W.

OUR BOOK SHELF

Rainfall of the East Indian Archipelago; First Year, 1879. By Dr. P. A. Bergsma, Director of the Batavia Observatory. (Batavia: At the Government Printing Office, 1880.)

AN extremely valuable system of rainfall observation has been established in the East Indian Archipelago under the superintendence of Dr. Bergsma, the well-known director of the Batavia Observatory, and the results of the first year's observations for 1879 are now before us in this octavo volume of 257 pages.

In the beginning of 1879 sixty rain-gauges were in operation, and by the end of the year the number had increased to 125. To these it is proposed to add other seventy new stations during 1880, thus raising the number of stations for the observation of the rainfall of the East Indian Archipelago to 195. Towards the securing of uniformity the same pattern of rain-gauge is used by all the observers, and the gauges are placed at the same height of 3½ feet above the ground; but greater uniformity in the hour of observing, which is any hour from 6 to 9 a.m., is a desideratum. The stations extend from 95° 20′ to 129° 53′ E. long., and from 5° 53′ N. lat. to 10° 10′ S. lat., and as regards elevation they are at heights varying from the level of the sea to a height of 6,404 feet. Their distribution among the islands is 76 on Java, 25 on Sumatra, 7 on Borneo, 4 on Celebes, and 4 on Billiton, 3 on Madeira, and 1 on each of the islands Riouw, Bangka, Ternate, Amboina, Banda, and Timor.

The daily rainfalls at each of the 125 stations during 1879, so far as observed, are printed *in extenso*, and a table is added showing the amounts and days of rainfall for each month and for the year. The largest rainfall for one day was 11·81 inches at Amboina on July 13; and it may be remarked that at the same place on the four days ending the 15th of the same month, 29·45 inches fell. The least annual rainfall at any station was 53·27 inches at Kotta Radja, and the largest 282·33 inches at Padang Pandjang. Of the 59 stations for which there are returns for the whole year, the amount exceeded 100 inches at 33, and 200 inches at 5 of the stations. The greatest number of days on which rain fell at any station was 274 at Soekawana, and the least 136 at Onrust. It is evident that this system of observation will by and by lay before us the observational data for the determination of the distribution of the important element of the rainfall, horizontally and vertically, over the land surfaces of this portion of the globe which excites so strongly the interest of the biologist, geologist, and geographer.

Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. Herausgegeben von A. Engler. Erster Band, Heft i. ii. (Leipzig: Verlag von Wilhelm Engelmann, 1880.)

IT is a question whether German serials devoted in part or wholly to botanical bibliography are not becoming too numerous, but, be that as it may, this new venture is so circumscribed in its scope that it recommends itself to a large section of botanists in this country whose labours are to a great extent within its scope. Engler's "Botanische Jahrbücher" are to be exclusively devoted to systematical, historical, and geographical botany, and will contain original articles in English, French, or German, as well as a review of current literature. Under Dr. Engler's painstaking editorship we think success should attend the undertaking. The parts are not to appear at fixed intervals, nor necessarily to be uniform in size; but the limit of the interval is from three to six months, and of the size three to four sheets. The contributors to the first part are:—Oswald Heer, on the history of the ginkgo-like trees; Alphonse de Candolle, on some points of botanical nomenclature; Eug. Warming, on the results of recent investigations of the flora of Greenland; O. Beccari, on the phytogeography of the Malayan Peninsula; A. Engler, diagnoses of some new *Burseraceæ* and *Anacardiaceæ*, and a review of the more important botanical works published in 1879. It should be mentioned that the contributions of A. de Candolle and O. Beccari are abstracts of and extracts from what has appeared elsewhere, though this fact does not diminish their value. On the contrary, they are thus brought to the knowledge of many who would otherwise not have an opportunity of reading them. W. B. HEMSLEY

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Conditions Necessary for the Existence of Matter in the Liquid State—Existence of Ice at High Temperatures

NUMEROUS experiments which I have made during the last few weeks on the boiling points of substances under low pres-

sures, the details of which will shortly be published, have led to the following conclusions in reference to the conditions necessary for the existence of any substance in the liquid state. These are two in number, viz. :—

1. In order to convert a gas into a liquid the *temperature* must be *below* a certain point (termed by Andrews the *critical temperature* of the substance), otherwise no amount of pressure is capable of liquefying the gas.

2. In order to convert a solid into a liquid the *pressure* must be *above* a certain point, which I propose to call the *critical pressure* of the substance, otherwise no amount of heat will melt the substance.

If the second of the above conditions be true, it follows that if the necessary temperature be attained, the liquefaction of the substance depends solely on the superincumbent pressure; so that if by any means we can keep the pressure on the substance below its critical pressure, no amount of heat will liquefy it, for in this case the solid substance passes directly into the state of gas, or in other words it sublimes without previous melting.

Having come to this conclusion, it was easily foreseen that if these ideas were correct it would be possible to have *solid ice at temperatures far above the ordinary melting-point.* After several unsuccessful attempts, I was so fortunate as to attain the most perfect success, and have obtained solid ice at temperatures so high that it was impossible to touch it without burning one's self. This result has been obtained many times and with the greatest ease, and not only so, but on one occasion a small quantity of water has frozen in a glass vessel which was so hot that it could not be touched by the hand without burning it. I have had ice a considerable length of time at temperatures far above the ordinary boiling-point, and even then it only sublimed away without any previous melting. These results were obtained by *maintaining* the superincumbent pressure below 4·6 mm. of mercury; *i.e.*, the tension of aqueous vapour at the freezing-point of water. Other substances also exhibit these same phenomena, the most notable of which is mercuric chloride, for which latter the pressure need only be reduced to about 420 mm. On letting in the pressure the substance at once liquefies.

For the success of these experiments in the case of water one or two details of manipulation are necessary, but these will be subsequently described. THOS. CARNELLEY

Firth College, Sheffield, September 6

A Doubtful British Mollusk

I HAVE just observed that I am quoted in Dr. Gwyn Jeffreys' "British Conchology" (vol. v. p. 161) as an authority for the discovery of *Clausilia parvula* (a Continental snail) in Staffordshire. Many years ago, when I was a schoolboy, I found six or seven specimens at Kinver, near Stourbridge. I took them at first for a smooth variety of *C. rugosa*, but noting other differences sent them to Dr. Jeffreys, who identified them as above. I never had another opportunity of visiting the spot, but brother conchologists, who went on my recommendation, failed to find any specimens. The sheep-walk on which I picked them up was close to the grounds of Enville, where there are many foreign shrubs, and I have now little doubt that they were introduced. At the same time the large size of the specimens seemed to indicate that they had been long acclimatised, as northern individuals are larger than southern. GRANT ALLEN

Broad Street, Lyme Regis, Dorset

A Halo

MAY I mention a strange appearance which I saw in the heavens on August 29, and ask for an explanation of it? It was a rainbow without rain, and in the same quarter of the heavens as the sun.

At 5.45 p.m. I observed in a little nearly circular opening in the clouds, at the same height above the horizon as the sun, and about 23° to the north of it, all the colours of the rainbow. They were very vivid, and lasted for several minutes. Two persons who were with me also saw this strange sight, which I cannot account for in any way. Was it seen by any of your readers? And what could be the cause of it? L. SOAMES

Brighton, September 2

[This was probably a portion of the ordinary halo of 22°. If so, it indicates the presence of ice-crystals (not of drops of water) in the upper atmosphere. Such things are common enough in autumn, especially when there is a sudden lowering of temperature by an anticyclone.—ED.]

Tone of Violins

I SAW a little time back, but omitted to note it at the time, a brief notice of some German experiments showing that the strings of good old instruments of fine tone tended far more than in the case of inferior violins to vibrate in closed curves or simple curves. I have searched NATURE in vain for some weeks, but cannot find it, though I thought it was in these columns. I am particularly anxious to recover it for purposes of my own connected with another branch of physics, and shall be obliged if any reader can refer me to the notice, or to the paper, or any translation of it. LEWIS WRIGHT

August 30

ADOLPH EDOUARD GRUBE

BY the sudden death of Prof. Grube of Breslau on June 23, zoological science has been deprived of one of its enthusiastic and veteran cultivators. Born in Königsberg on May 12, 1812, he entered the university of that city in 1831, and graduated in medicine in 1837. Thereafter he became a private lecturer on zoology in Königsberg. In 1844 he was appointed to the Professorship of Zoology in the University of Dorpat, and lastly was transferred, in 1857, to a similar post in the University of Breslau, where he laboured till his death.

He chose for the subject of his inaugural dissertation (in 1837) the structure of *Pleione carunculata*, Pallas, and it is interesting that at this early age he selected one of the group in which his chief work in after-life was accomplished; for though he published various valuable researches in other departments (*e.g.*, those on the Branchiopod Crustaceans), still the Annelida most benefited by his labours during the subsequent forty-three years. Moreover, he observed so carefully, as well as laboured so industriously, that he was *facile princeps* in the department at his death. The bare enumeration indeed of his zoological works and papers is formidable; and their perusal bears imperishable witness to the well-directed energy and great ability of their author. He himself, with great modesty, used to state that his work fell far short of that of the late M. Claparède, who, with a delicate physique, nevertheless accomplished a marvellous amount of valuable work, both with pen and pencil. But though perhaps less of an artist than the talented Swiss, the greater tenacity of constitution in the stalwart German, combined with his indomitable energy and perseverance throughout a longer life, enabled him to overtake a much greater amount of work, especially in descriptive zoology.

The conscientious manner in which he carried on his scientific labours is well shown in his "Familien der Anneliden" (1851), a work which even now is of great value, and indispensable to workers in the department. The same may be said of his "Entwicklung der Anneliden" (1844) and his "Annulata Œrstediana" (1857). In his original papers in the *Archiv für Naturgeschichte* and in the recent admirable series in the *Sitzung der Schlesischen Gesellschaft*, on the families of the Annelida, he demonstrated the encyclopædian and critical knowledge which he had of the whole group in a remarkable manner, just as his "Bemerkungen über Anneliden der Pariser Museums" showed his great experience in discriminating the species described by others. His last large publication (a work of 300 pp., 4to, and fifteen fine plates by his tried assistant Assman) is devoted to the numerous Philippine annelids collected by Prof. Semper, and is a lasting memorial of his accuracy and patient industry.

Nor was he a zoologist who confined his researches to a single group. He was an accomplished carcinologist, and his faunistic treatises, *e.g.*, his "Actinien, Echinodermen u. Würmer des Adriatischen u. Mittelmeers," his "Ausflug nach Triest u. dem Quarnero," as well as his special papers on the Echinodermata, on *Peripatus* and other Arthropods, testify abundantly to the breadth

of his information and his unwearied efforts to advance zoological science. He was no less a thoughtful student of the labours of others than a discover of new forms and an accurate original inquirer.

To one who had worked at the fauna of Siberia, at the collections made during the Novara expedition and those of the German exploring ship *Gazelle*, at the varied stores in the "Museum Godeffroy" of Hamburg, who had made himself familiar with the shores of the Adriatic and the Mediterranean, as well as those of France and Britain, the splendid zoological series made by H.M.S. *Challenger*, under the direction of Sir Wyville Thomson and his colleagues, could not but prove an irresistible attraction; and it was this which tempted him more than anything else to make his last visit to this country in 1876, when he attended the Meeting of the British Association in Glasgow.

Privately Prof. Grube was one of the most amiable and accomplished of men. Of commanding presence (he was a cuirassier in his youth), and frank and manly bearing, his fund of general information, his musical tastes, and great geniality, endeared him to all his friends. Nor was he less beloved as a teacher by his students. Full of life and work, and with an industry that never seemed to flag, he was suddenly cut off in the midst of his labours, and just as he was organising fresh researches.

A full biography of Prof. Grube will appear in the *Leopoldina* in Halle, but, meanwhile, it is well to indicate in this country the sense of the great loss which zoological science has sustained by the death of this eminent investigator and teacher. W. C. M.

THUNDERSTORMS[1]

IV.

ALMOST all the facts to which I have now adverted point to water-substance, in some of its many forms, as at least one of the chief agents in thunderstorms. And when we think of other tremendous phenomena which are undoubtedly due to water, we shall have the less difficulty in believing it to be capable of producing thunderstorms also.

First of all let us think of some of the more obvious physical consequences of a fall of a mere tenth of an inch of rain. Suppose it to fall from the lowest mile of the atmosphere. An inch of rain is 5 lb. of water per square foot, and gives out on being condensed from vapour approximately 3,000 units of heat on the centigrade scale. The mass of the mile-high column of air a square foot in section is about 360 lb., and its specific heat about a quarter. Thus its temperature throughout would be raised by about 33° C., or 60° F. For one-tenth inch of rain, therefore, we should have a rise of temperature of the lowest mile of the atmosphere amounting to 3·3° C., quite enough to produce a very powerful ascending current. As the air ascends and expands it cools, and more vapour is precipitated, so that the ascending current is farther accelerated. The heat developed over one square foot of the earth's surface under these conditions is equivalent to work at the rate of a horse-power for twelve minutes. Over a square mile this would be ten million horse-power for half an hour. A fall of one-tenth of an inch of rain over the whole of Britain gives heat equivalent to the work of a million millions of horses for half an hour! Numbers like these are altogether beyond the limits of our understanding. They enable us, however, to see the full explanation of the energy of the most violent hurricanes in the simplest physical concomitants of the mere condensation of aqueous vapour.

I have already told you that the source of atmospheric electricity is as yet very uncertain. Yet it is so common and so prominent a phenomenon in many of its manifestations that there can be little doubt that innumerable attempts have been made to account for it. But when we consult the best treatises on meteorology we find it either evaded altogether or passed over with exceedingly scant references to evaporation or to vegetation. Not finding anything satisfactory in books, I have consulted able physicists, and some of the ablest of meteorologists, in all cases but one with the same negative result. I had, in fact, the feeling which every one must experience who attempts to lecture on a somewhat unfamiliar subject, that there *might* be much known about it which I had not been fortunate enough to meet with. Some years ago I was experimentally led to infer that mere *contact* of the particles of aqueous vapour with those of air, as they fly about and impinge according to the modern kinetic theory of gases, produced a separation of the two electricities, just as when zinc and copper are brought into contact the zinc becomes positively electrified and the copper negatively. Thus the electrification was supposed to be the result of chemical affinity. Let us suppose, then, that a particle of vapour, after impact on a particle of air, becomes electrified positively (I shall presently mention experiments in support of this supposition), and see what farther consequences will ensue when the vapour condenses. We do not know the mechanism of the precipitation of vapour as cloud, and we know only partially that of the agglomeration of cloud-particles into rain-drops; but of this we can be sure that, if the vapour-particles were originally electrified to any finite potential, the cloud-particles would be each at a potential enormously higher, and the rain-drops considerably higher still. For, as I have already told you, the potential of a free charged sphere is proportional directly to the quantity of electricity on it and inversely to its radius; so when eight equal and equally charged spheres unite into one sphere of double the radius, its potential is four times that of each of the separate spheres. The potential in a large sphere, so built up, is in fact directly proportional to its surface as compared with that of any one of the smaller equal spheres of which it is built.

Now, the number of particles of vapour which go to the formation of a single average rain-drop is expressed in billions of billions; so that the potential of the drop would be many thousands of billion times as great as that of a particle of vapour. On the very lowest estimate this would be incomparably greater than any potential we can hope to produce by means of electrical machines.

But this attempt at explanation of atmospheric electricity presents two formidable difficulties at the very outset.

1. How should the smaller cloud-particles ever unite if they be charged to such high potentials, which of course must produce intense repulsions between them?

2. Granting that, in spite of this, they do so unite, how are they separated from the mass of negatively electrified air in which they took their origin?

I think it is probable that the second objection is more imaginary than real, since there is no doubt that the diffusion of gases would speedily lead to a great spreading about of the negatively electrified particles of air from among the precipitated cloud-particles into the less highly electrified air surrounding the cloud. And if the surrounding air were equally electrified with that mixed with the cloud, there would be no electric force preventing gravity from doing its usual work. This objection, in fact, holds only for the *final* separation of the whole moisture from the oppositely electrified air; and gravity may be trusted to accomplish this. That gravity is an efficient agent in this separation is the opinion of Prof. Stokes. It must be observed that as soon as the charge on each of the drops in a cloud rises sufficiently, the electricity will pass by discharge to those which form the bounding layer of the cloud.

The first objection is at least partially met by the

[1] Abstract of a lecture, delivered in the City Hall, Glasgow, by Prof. Tait. Continued from p. 410.

remark that in a cloud-mass when just formed, if it be at all uniform, the electric attractions and repulsions would approximately balance one another at every point, so that the mutual repulsion of any two water-drops would be almost compensated, except when they came very close to one another.

But there is nothing in this explanation inconsistent with the possibility that the particles of water may be caused to fly about repeatedly from cloud to cloud, or from cloud to an electrified mass of air; and in many of these regions the air, already in great part deprived of its moisture, may have become much cooled by expansion as it ascends, so that the usual explanation of the production of hail is not, at least to any great extent, interfered with.

I may here refer to some phenomena which seem to offer, if closely investigated, the opportunity for the large scale investigations which, as I shall presently show, will probably be required to settle the source or sources of atmospheric electricity.

First, the important fact, well known nearly 2,000 years ago, that the column of smoke and vapour discharged by an active volcano gives out flashes of veritable lightning. In more modern times this has been repeatedly observed in the eruptions of Vesuvius and other volcanos.

Sabine, while at anchor near Skye, remarked that the cloud-cap on one of the higher hills was permanently luminous at night, and occasionally gave out flashes resembling those of the aurora. I have not been able to obtain farther information as to this very important fact; but I have recently received a description of a very similar one from another easily accessible locality.

My correspondent writes from Galway, to the following effect, on the 2nd of the present month:—

"At the commencement of the present unprecedentedly long and severe storm the wind blew from south-west and was very warm. After blowing for about two days it became, *without change of direction*, exceedingly bitter and cold; and the rain was, from time to time, mixed with sleet and hail, and lightning was occasional. This special weather is common for weeks together in March or early April. The air is (like what an east wind brings in Edinburgh) cold, raw, dry, and in every way uncomfortable, especially to people accustomed to the moist Atlantic winds. During these weeks a series of small clouds, whose shadows would only cover a field of a few acres, seem to start at regular intervals from the peaks of hills in Connemara and Mayo. They are all more or less charged with electricity. From high ground, behind the city, I have at one time seen such a cloud break into lightning over the spire of the Jesuits' church. At another, I have seen such a cloud pour down in a thin line of fire, and fall into the bay in the shape of a small incandescent ball. On one occasion I was walking with a friend, when I remarked, 'Let us turn and make a run for it. We have walked unwittingly right underneath a little thundercloud.' I had scarcely spoken when a something *flashed on the stony ground at our very feet*, a tremendous crash pealed over our heads, and the smell of sulphur was unmistakable. I fancy that I have been struck with these phenomena more than others, from the circumstance that they have always interfered with my daily habits. My walks often extended to considerable distances and to very lonely districts. Now these small local spurts of thunderstorms would hardly excite attention in the middle of a town, all the less as the intervening weather is bright, though raw—these spurts coming on every three or four quarters of an hour. Neither would they excite much attention in the country, as, while such a little storm was going on in one's immediate neighbourhood, you would see at no great distance every sign of fine weather. In fact they always seem to me like the small change of a big storm."

My correspondent, though a good observer and eloquent in description, is not a scientific man. But it is quite clear from what he says that a residence of a few weeks in Galway, at the proper season, would enable a trained physicist to obtain, with little trouble, the means of solving this extremely interesting question. He would require to be furnished with an electrometer, a hygrometer, and a few other simple pieces of apparatus, as well as with a light suit of plate armour, not of steel but of the best conducting copper, to insure his personal safety. Thus armed he might fearlessly invade the very nest or hatching-place of the phenomenon, on the top of one of the Connemara hills. It is to be hoped that some of the rising generation of physicists may speedily make the attempt, in the *spirit* of the ancient chivalry, but with the offensive and defensive weapons of *modern* science.

Another possible source of the electricity of thunderstorms has been pointed out by Sir W. Thomson. It is based on the experimental fact that the lower air is usually charged with negative electricity. If ascending currents carry up this lower air the electricity formerly spread in a thin stratum over a large surface may, by convection, be brought into a very much less diffused state, and thus be raised to a potential sufficient to enable it to give a spark.

However the electrification of the precipitated vapour may ultimately be accounted for, there can be no doubt of the fact that at least as soon as *cloud* is formed the particles are electrified; and what I have said as to the immense rise of potential as the drops gradually increase in size remains unaffected. I have tried various forms of experiment, with the view of discovering the electric state of vapour mixed with air. For instance, I have tested the vapour which is suddenly condensed when a receiver is partially exhausted; the electrification of cooled bodies exposed to moist air from a gasholder; and the deposition of hoar-frost from a current of moist air upon two polished metal plates placed parallel to one another, artificially cooled, and connected with the outer and inner coatings of a charged jar. All have given results, but as yet too minute and uncertain to settle such a question. These experiments are still in progress. It appears probable, so far, that the problem will not be finally solved until experiments are made on a scale much larger than is usual in laboratories.

A great thunderstorm in summer is in the majority of cases preceded by very calm sultry weather. The atmosphere is in a state of unstable equilibrium, the lower strata are at an abnormally high temperature, and highly charged with aqueous vapour. It is not easy, in a popular lecture like this, to give a full account of what constitutes a state of stable equilibrium, or of unstable, especially when the effects of precipitation of vapour are to be largely taken into account. It is sufficient for my present purpose to say that in all cases of thoroughly stable equilibrium, a slight displacement *tends to right itself;* while, in general, in unstable equilibrium, a slight displacement tends to increase. Now, if two cubic feet of air at different levels could be suddenly made to change places, without at first any other alteration, and if, on being left to themselves, each would, under the change of pressure which it would suddenly experience, and the consequent heating or cooling, with its associated evaporation or precipitation of moisture, tend to regain its former level, the equilibrium would be stable. This is not the case when the lower strata are very hot, and fully charged with vapour. Any portion accidentally raised to a higher level tends to rise higher, thus allowing others to descend. These, in consequence of their descent, tend still farther to descend, and thus to force new portions up. Thus, when the trigger is once pulled, as it were, we soon have powerful ascending currents of hot moist air, precipitating their moisture as cloud as they ascend, cooling by expansion, but warmed by the latent heat of the vapour condensed. This phenomenon of ascending

currents is strongly marked in almost every great thunderstorm, and is precisely analogous to that observed in the centre of a West Indian tornado and of a Chinese typhoon.

When any portion of the atmosphere is ascending it must be because a denser portion is descending, and whenever such motions occur *with acceleration* the pressure must necessarily be diminished, since the lower strata are not then supporting the whole weight of the superincumbent strata. If their whole weight were supported they would not descend. Thus even a smart shower of rain must directly tend to lower the barometer. [A long glass tube, filled with water, was suspended in a vertical position by a light spiral spring, reaching to the roof of the hall. A number of bullets hung at the top of the water column, attached to the tube by a thread. When the thread was burned, by applying a lamp, the bullets descended in the water, and *during their descent* the spring contracted so as to raise the whole tube several inches.]

In what I have said to-night I have confined myself mainly to *great* thunderstorms, and to what is seen and heard by those who are within their sphere of operation. I have said nothing of what is commonly called *summer-lightning*, which is probably, at least in a great many cases, merely the faint effect of a distant thunderstorm, but which has also been observed when the sky appeared tolerably clear, and when it was certain that no thunderstorm of the ordinary kind had occurred within a hundred miles. In such cases it is probable that we see the lightning of a storm which is taking place in the upper strata of the atmosphere, at such a height that the thunder is inaudible, partly on account of the distance, partly on account of the fact that it takes its origin in air of small density.

Nor have I spoken of the aurora, which is obviously connected with atmospheric electricity, but in what precise way remains to be discovered. Various theories have been suggested, but decisive data are wanting. Dr. Balfour Stewart inclines to the belief that great auroras, visible over nearly a whole terrestrial hemisphere, are due to inductive effects of changes in the earth's magnetism. This is not necessarily inconsistent with the opinion that, as ordinary auroras generally occur at times when a considerable change of temperature takes place, they are phenomena due to the condensation of aqueous vapour in far less quantity, but through far greater spaces, than the quantities and spaces involved in ordinary thunderstorms.

In taking leave of you and of my subject I have two remarks to make. First, to call your attention to the fact that the most obscure branches of physics often present matter of interesting reflection for all, and, in consequence, ought not to be left wholly in the hands of professedly scientific men. Secondly, that if the precautions which science points out as, at least in general, sufficient, were recognised by the public as *necessary*, the element of danger, which in old days encouraged the most debasing of superstitions, would be all but removed from a thunderstorm. Thus the most timid would be able to join their more robust fellow-creatures in watching fearlessly, but still of course with wonder and admiration, one of the most exquisite of the magnificent spectacles which Nature from time to time so lavishly provides.

PHYSICS WITHOUT APPARATUS

IV.

THE science of heat constitutes one of those departments of physics in which both the uninitiated beginner and the advanced student can find food for thought. To follow out the theoretical teachings of the science of heat requires a knowledge of abstruse mathematical formulæ; but, on the other hand, a very large proportion of the fundamental facts of experiment upon which the science depends can be illustrated with the simplest means.

[1] Continued from p. 368.

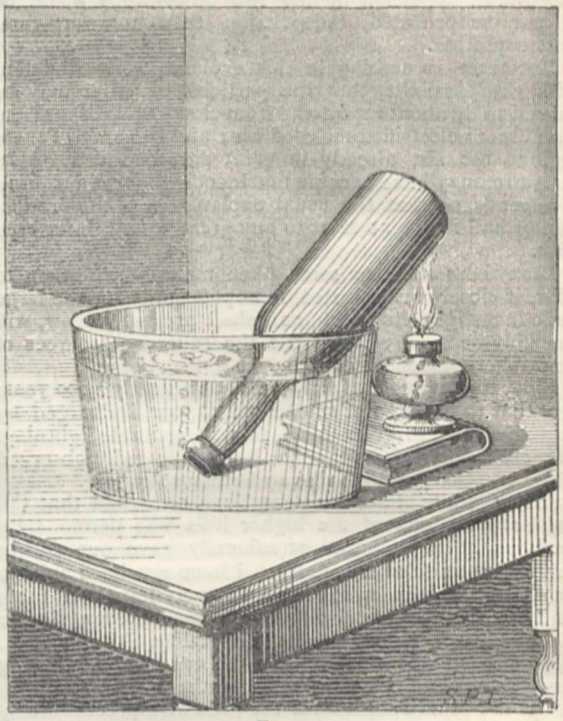

FIG. 11.

The property possessed by almost all material bodies of *expanding* when they are warmed affords us the means

FIG. 12.

of ascertaining the *degree* to which they are warmed. Thus the expansion of the quicksilver in the bulbs of our

thermometers shows us the degree of temperature of the surrounding air. Again, the heat imparted to the air within a paper fire-balloon makes it expand and become specifically lighter than the surrounding atmosphere through which it rises. In general it may be asserted that matter, in whichever state it may be—solid, liquid, or gaseous—expands when heat is imparted to it, and contracts when heat is taken from it. Fig. 11 illus-

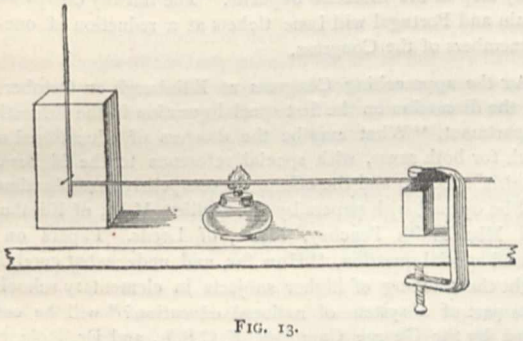

Fig. 13.

trates a very simple manner of showing the expansion of air when heated. An empty wine-bottle is placed with its mouth downwards in a deep dish or jar containing water, the bottom of the bottle projecting over the side of the jar. Heat is then applied by means of a spirit-lamp; or, if this is not available, by burning under it a piece of cotton wool soaked in spirits and held on the end of a fork. The glass of the bottle becomes hot—if

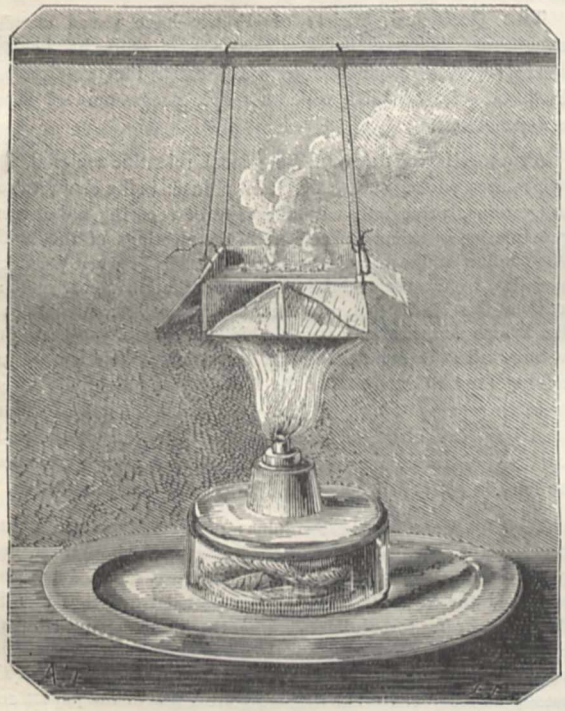

Fig. 14.

too hot it may crack—and the air inside shares its warmth and begins to expand. There being only a limited space inside the bottle, some of the air will be forced out, and will rise in bubbles through the water. If now the flame be removed, the reverse operation of contraction by cooling may be witnessed, for as the air inside the bottle cools it will occupy a smaller and smaller amount of space, and the water will gradually rise up in the bottle-neck. Of course this is seen better with a bottle of clear glass than with one of a dark or opaque tint.

The contraction of a liquid on cooling can be even more simply shown. Take a common medicine bottle. Warm it gently (by rinsing it out with a little hot water) so that it shall not crack by the sudden heating, and then fill it *brimful* of boiling water. Leave it to cool; and in less than half an hour you will find that the water which you poured in to overflowing has shrunk down into the neck of the bottle, having contracted as it cools.

It was mentioned above that the hot air in a fire-balloon raises it, being lighter than the cold air. In the same way hot water will rise through cold, and float on the top of it, being specifically lighter. You may prove this in several ways. Fill a deep jar with water, and then, taking a red-hot poker, plunge about an inch of the tip of it into the surface of the water. Presently the whole of the water at the top will be boiling furiously; but the water at the bottom will be just as cool as before, for the hotter water will not have gone down, but will have

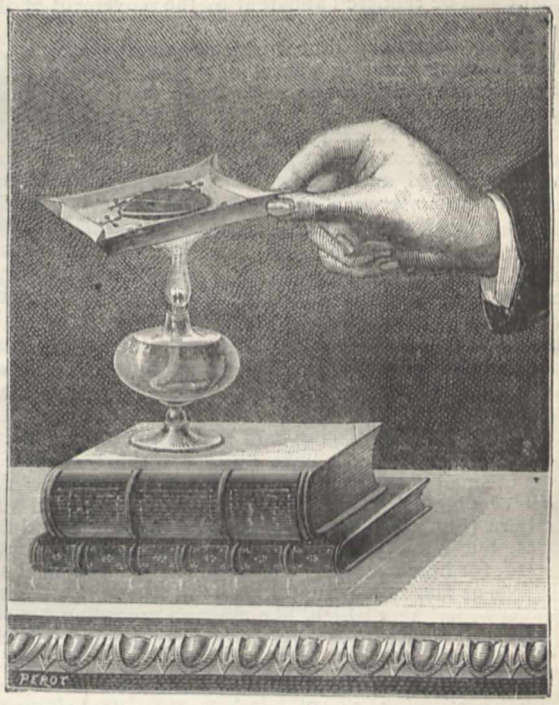

Fig. 15.

floated at the top, being lighter in consequence of expansion. The same thing can be shown very prettily by the following simple experiment. Fill a wide and deep glass jar—the glass of a parlour-aquarium will do excellently—to about half its depth with cold water. Provide yourself also with a kettle full of boiling water, a funnel, a bit of wood about three inches square, and with some ink—red ink if possible. Pour into the kettle enough of the ink to colour it with a perceptible tint; this is simply that you may be able to distinguish between the colourless cold water and the coloured hot water which you are going to cause to float at the top. The only difficulty of the experiment is how to pour out the hot water without letting it *mix* with the cold water. Fig. 12 shows how you may do this with the help of the things you have got together. The bit of wood (or cardboard) is laid on the water as a float, and you must pour the hot water on to this to break the force of its fall. The funnel will also help to break the fall of the hot water, and will aid you to guide the stream on to the middle of the float. With

these precautions you need not fear failure, and you will enjoy the spectacle so seldom seen, though so often actually occurring, of *hot water floating on the top of cold water*.

It is almost as easy to demonstrate the fact that solid bodies, such as wood, iron, and glass, expand when heated. A steel knitting-needle, for example, is both longer and thicker when hot than it is when cold. To prove so minute a quantity as the increase in thickness would require very delicate apparatus indeed, but the increase of *length* may be rendered visible by the following simple arrangement given by Miss C. Martineau in her capital "Easy Lessons in Heat." The knitting-needle must be fixed firmly to the table by a table-clamp (Fig. 13). Against the other extremity rests the end of a straw to serve as an index or pointer. This straw, which should be at least eight or nine inches long, is transfixed by a pin at about a quarter of an inch above the point where it touches the knitting-needle, the pin being stuck into a block of wood or other substantial support. The slightest movement of the end of the steel needle will be rendered apparent by the movement of the straw index.

Another pretty experiment which is easily performed is that of boiling water in a sheet of paper. Take a piece of paper and fold it up, as schoolboys do, into a square box without a lid, as shown in Fig. 14. Hang this up to a walking-stick by four threads, and support the stick upon books or other convenient props. Then a lamp or taper must be placed under this dainty cauldron. In a few minutes the water will boil. The only fear is lest the threads should catch fire and let the water spill into the lamp and over the table. The flame must therefore not be too large. A small taper will give a flame quite large enough. The paper does not burn, because it is wet; and even if it resisted the wet it still would not burn through, because the heat imparted to it on one side by the flame would be very rapidly conducted away by the water on the other. Another experiment of a similar nature, but perhaps even more striking, is as follows:—Twist up the edges of a common playing-card or other bit of cardboard, so as to fashion it into a light tray. On this tray place a layer of small shot or bits of lead, and heat it over the flame of a lamp. The lead will melt, but the card will not burn (Fig. 15). It may be charred a little round the edges, but immediately below the lead it will not be burned, for here again the lead conducts off the heat on one side as fast as it is supplied on the other. Lastly, we give an experiment which, like the two preceding, proves that a good conducting substance may protect a delicate fabric from burning by conducting away the heat rapidly from it. Lay a piece of muslin quite flat upon a piece of metal. A live coal placed on the muslin will not burn it, for the metal takes away the heat too fast. If the muslin is however laid on a bad conductor, such as a piece of wood, it will not be protected, and the live coal will kindle the muslin.

(*To be continued.*)

NOTES

THE International Congress of Anthropology and Prehistoric Archæology, which opens at Lisbon on the 19th inst., promises to be an interesting one. On the mornings of the 21st, 23rd, 25th, and 27th, questions relative to Portugal will be discussed—Cut Flints of the Tertiary, Characteristics of the Palæolithic or Quaternary Age, the Neolithic Period, Kitchen-middens, Sepulchral Caves, Age of Metals, &c. Among the papers to be read on the afternoons of these days are the following:—M. Arcelin, Antiquity of Man in the Valley of the Saone; M. E. Catailhac, Recent Prehistoric Discoveries in the South of France; M. Ernest Chantre, an Exploring Journey in the Caucasus; M. Hildebrand, the State of Prehistoric Studies in Sweden; M. Schaffhausen, Prehistoric Man, &c. Several interesting excursions have been arranged for. Perhaps the most important question to be brought before the Congress will be that of the worked stones said to have been found by M. C. Ribeiro in the Tertiary. The Local Committee have opened numerous cuttings between Carregado and Cercal, and in that distance of twenty kilometres it is stated that worked stones will be met with at every step in the Miocene deposits. The railway companies of Spain and Portugal will issue tickets at a reduction of one-half to members of the Congress.

AT the approaching Congress at Edinburgh on October 6 to 13, the discussion on the first special question in the Educational Department, "What may be the dangers of educational overwork for both sexes, with special reference to the higher class of girls' schools, and the effects of competitive examinations?" will be opened with papers by Dr. Keiller, M.D., of Edinburgh, and Miss Edith Peachey, M.D., of Leeds. Papers on the second special question, "How far, and under what conditions, ought the teaching of higher subjects in elementary schools to form part of a system of national education?" will be contributed by Sir George Campbell, K.C.S.I., and Dr. Robertson, LL.D. Prof. Laurie will read a paper on the third special question, "Is it desirable that public secondary schools should be placed under local authorities and be subject to the supervision of the Committee of Council on Education?"

WE are glad to learn that Mr. Mundella intends, during his sojourn on the Continent, to visit some of the principal foreign technical schools. We have no doubt he will thus get some enlightenment as to what real technical education means.

THE Geological Society of France have issued circulars announcing that an extraordinary session will be held at Boulogne, from September 9 to 19, under the presidency of Prof. Gosselet of Lille, with an ample programme of papers and excursions.

AT a meeting of delegates from local scientific societies, held at Swansea on August 31, Mr. J. Hopkinson in the chair, various suggestions, principally with the view of securing a better representation of scientific societies at the meetings of the British Association and a more intimate relationship between provincial societies, were made, and the following resolutions were passed:—1. That this Conference recommends that at future meetings of the British Association it is desirable that the delegates from the various scientific societies should meet, with the view of promoting the best interests of the Association and of the several societies represented. 2. That Mr. Hopkinson and Mr. Fordham be a committee to carry out the views expressed at this conference, and report to the conference of delegates to be held at York in 1881, in accordance with the foregoing resolution.

To judge from the three volumes of its *Bulletin* which have been sent us, the Philosophical Society of Washington seems to produce some good work. The Society was founded ten years ago, and the volumes embrace the period from 1871 to 1880. The late Prof. Joseph Henry was the first president of the Society, the object of which is stated to be the free exchange of views on scientific subjects and the promotion of scientific inquiry among its members. The following are a few of the papers contained in the volumes before us:—"On the Adopted Value of the Sun's Apparent Diameter," by Prof. E. S. Holden; "On the Delta of the Mississippi," by Prof. Forshey; "On the Zodiacal Light," by Prof. S. Alexander; a detailed report on the unusually brilliant meteor of December 24, 1873; a long and elaborate memoir of Prof. Joseph Henry, with detailed notices of his varied scientific work; also the addresses he delivered during his presidency; "On the 'Prodromus Methodi Mammalium' of Storr," by Mr. Theodore Gill; a curious inquiry on the

Number of Words used in Speaking and Writing, by Prof. E. S. Holden; "New Species of Fossil Plants from Alleghany Co., Virginia," by Mr. F. B. Meek; "The Gentile System of the Omahas," by Rev. J. O. Dorsey. Most of the papers, however, appear in very brief abstracts.

ENGINEERS are engaged daily in making surveys for the purpose of determining the site of the projected tunnel under the St. Lawrence between Hochelaga and Longueil.

THE War Office authorities have detailed a whole company of the Royal Engineers for instruction in the art of military ballooning, in lieu of the small detachment hitherto employed in the experiments. The company selected is the 24th (Field Company) at Aldershot, and it will be placed under the command of Capt. Elsdall, R.E.

ON the anniversary of the Russian Emperor's coronation, the foundation-stone of the Siberian University at Tomsk was laid. The building was projected in the reign of the Emperor Alexander I.

THE *Panama Star and Herald* of the 12th ult. says that the reports received concerning the eruption of the Fuego, the largest volcano in the republic of Guatemala, show that it was preceded by earthquakes of considerable violence, the theatre of whose operations was confined to the country surrounding the volcano, within a radius of some twenty or thirty miles. In Antigua, Amatitlan, Palin, Petapa, and several other points the shocks were of such violence as to occasion serious alarm among the inhabitants and cause them to abandon their houses for several hours. With the commencement of the eruption, however, the earthquake period ended, and the people in the streets of the various pueblos were able to witness in tranquillity the splendid appearance of the burning mountain. During the morning of the day succeeding the eruption the pueblos on the Costa Grande, to the northward of the volcano, were shrouded in gloom, and for some time after sunrise people in offices were compelled to employ artificial light in order to carry on their labours. Ashes and dust fell in great quantities at many miles distance, and people who were at too great a distance from the volcano to witness the eruption were for some time in doubt as to their origin. Happily the disturbance has passed with no more serious matter to record than the alarm which it momentarily occasioned.

AT the last meeting of the Balloon Society of Great Britain the recent balloon voyage out to sea at Cherbourg was referred to. Mr. Simmons stated that when he some years ago made a similar trip at Hull he went twenty miles out to sea and then got into an anticipated return current which he found a few feet above the outward current, and which safely landed him at the desired spot on *terra firmâ*. The president read a letter from a member of the Society who had made one of his ascents in a thunderstorm and found the atmosphere at an altitude of about 200 feet and for a height of 100 feet to be of a dull leaden hue, but as soon as he had risen above this stratum he found the sky quite unclouded, and witnessed perfectly clearly the storm raging below in all its grandeur. On Saturday afternoon a balloon contest took place from various points in the neighbourhood of London, under the auspices of the Balloon Society. Eight balloons were to have started, but only five succeeded in getting away. A silver medal was to be awarded to the balloon that traversed the greatest distance in one hour and a half. The competition seems to have had some connection with Commander Cheyne's proposed Arctic Expedition; but so far as we have ascertained no new scientific results seems to have been obtained. One balloon seems to have attained a height of 14,000 feet.

DURING the Session of the City and Guilds of London Institute, commencing October 4, Prof. Armstrong, F.R.S., and Prof. Ayrton, Inst.C.E., will continue their tutorial and laboratory courses of instruction in Chemistry and Physics as applied to the Arts and Manufactures, at the Cowper Street Schools, Finsbury, in rooms rented from the Middle Class Schools Corporation, pending the erection of the City and Guilds Technical College, Finsbury. Dr. Armstrong will deliver a course of about thirty lectures on "Organic Chemistry, with special Reference to its Industrial Applications," on Mondays, at 8.30 to 9.30 p.m., commencing October 4. He will also deliver a course of about twenty-four lectures on Tuesday and Friday afternoons at 4 to 5 o'clock, commencing October 5. Although the chief object of these lectures is to afford such preliminary training as is necessary for those who may desire later on to study particular branches of Applied Chemistry, more than usual attention will be given to matters of technical importance. There will also be daily Laboratory Classes. Prof. Ayrton will deliver a course of evening lectures on "Electrical Instrument Making," on Tuesdays at 8.30 to 9.30 o'clock, commencing October 5, the first twelve of the lectures being given before Christmas. On Friday evenings, at 8.30 to 9.30 o'clock, commencing October 8, Prof. Ayrton will also deliver a course of lectures, the first twelve being given before Christmas, on "Weighing Appliances and Motor Machinery," adapted to the wants of makers and users of machinery. He will also deliver a course of about twenty-four lectures on Monday and Wednesday afternoons, at 4 to 5 o'clock, commencing October 4, on the "Electric Light."

BY a decree of the French Minister of Public Instruction the Ethnographical Museum at the Trocadéro has been organised. Dr. Hamy and M. Landrin have been appointed conservators.

A LARGE number of rooms have been added to the French Museum of National Antiquities at St. Germains, and are awaiting a formal opening by the President of the Republic. In one of them have been collected a series of relics of Roman age relating to religious ceremonies and inscriptions; in a second room has been disposed a large number of bas-reliefs and statues exhibiting arms and scenes of military life; and in the third room we found many sepulchral monuments showing the arts and trades as practised during the Roman rule in Gaul. Some rooms have been already opened to the public, and in one of them is the celebrated Autun mosaic representing Bellerophon triumphing over Chimæra; execution and preservation are both wonderful.

MR. ROWSELL of King William Street, Strand, has just published a catalogue which includes a large and valuable collection of scientific works, principally biological.

MESSRS. LONGMANS AND CO. announce the forthcoming publication of a new series of "Popular Lectures on Scientific Subjects," by Prof. Helmholtz, translated by Dr. E. Atkinson.

AT a concert given every night in the garden of the Palais Royale, Paris, the orchestra is placed in the vicinity of the fountains, which are illuminated by eight splendid Siemens lamps, which work admirably. Two other Siemens lamps have been placed in the shop of a jeweller in the Galleries, and the experiment may eventually lead to the lighting of the whole palace by the electric light.

THE heat was so intense at Clermont on September 4 last that the ceremony of the inauguration of Pascal's statue, which was to have taken place that day, was postponed to the following morning at 8 o'clock. The principal speech was delivered by M. Bardoux, formerly Minister of Public Instruction, the representative of Clermont in the Lower French House.

THE French Central Society of Agriculture and Insectology has opened in the *Orangerie* of the Tuileries its biennial exhibition of insects. The exhibition is an instructive one, embracing

insects useful and noxious, and the various industries which depend on insects.

WE take the following from the *Electrician*:—"When a little girl is found 'playing at telephone,' and reproducing to the life the 'ways' of those who ordinarily profit by the new means of communication, the circumstance may be taken as an indication that telephony is in some localities becoming really popular. The following sketch of a baby telephonist, 'pretending' to communicate with her papa, is from the *Concord Monitor*:—She was a pretty child, happy-hearted, full of fun, and a great mimic. Only two summers had sent sunshine across her curls and waked to sensuous delight the infantile beauty and form. She dwelt in a pleasant home filled with creature comforts, among them the new innovation, the telephone. She had often watched this wonderful mechanism, and while she neither knew nor cared for the secrets of its operation, she had learned by heart the peculiar and one-sided formula of a telephone conversation. Unheeding that some one was watching her, the other day she put a little hand to the wall and imitated the pushing of the button on the telephone. Up went the other hand to the ear, as if holding the ebony cylinder, and the little miss went on in mimicry of her elders, in the following fashion:—'Hello.' She then paused for an answer from the central office. 'Hello. Please hitch on Mr. —— house to Mr. —— office.' Pause. 'Is 'at you, papa?' Pause. 'When is you coming home?' Pause. (Turning to her dolls, the little one here spoke impatiently, 'Do you keep still; I can't hear a word.') 'Yes.' (Rising inflection.) Pause. 'I don't know.' (In doubt.) Pause. 'Yes.' (Gleefully.) Pause. 'Why papa.' (In surprise.) Pause. And so the little one went on, maintaining perfectly an imaginary conversation, till at last she dropped her hand with a motion indicative of weariness from holding the telephone, and pronounced the conversational 'That's all; good bye,' with all the nonchalance of a veteran."

THE Proceedings of the American Antiquarian Society, No. 74, we learn from the *American Naturalist*, contains a paper by Mr. Philipp J. J. Valentini, on the Katunes of Maya history. The Katunes were a series of notable events that transpired from the time of the departure of the Mayas from their original home until their destruction. Don Juan Pio Perez, a learned Yucatecan, had found an old Maya manuscript containing this account, but failed to discover the author's name. From this precious document Mr. Valentini attempts to reconstruct the Maya chronology in the same manner that he deciphered the Mexican calendar stone. The results at which he arrives are as follows:—1. That the conquerors and settlers of the Yucatecan peninsula, as well as those of the Anahuac lakes, were joint participants in a correction of their national calendar about the year 290 B.C. 2. That about the year 137 A.D., when a total eclipse of the sun took place, the ancestors of both nations set out from their common fatherland, Tula, or Tulapan. 3. That about the year 231 A.D. both nations made their appearance on the coast of Central America, and succeeded in conquering a large portion of the peninsula.

DR. FOREL has issued in a separate form his paper from the *Archives des Sciences* on the Temperature of the Lake of Geneva and other Freshwater Lakes.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. C. Kerry Nicholls; a Common Fox (*Canis vulpes*), European, presented by Mr. E. Schweder; a Gold Pheasant (*Thaumalea picta*) from China, presented by Mr. James McGregor; a Weka Rail (*Ocydromus australis*) from New Zealand, presented by Mr. H. Frank Rose; a Brazilian Cariama (*Cariama cristata*) from Bolivia, presented by Mr. Charles Stanley Barnes; Six Mocking Birds (*Mimus polyglottus*) from North America, presented by Mr. W. Cross; a Gannet (*Sula bassana*), British, presented by Mr. George Edson; a Sloth Bear (*Melursus labiatus*) from India, a Common Squirrel (*Sciurus vulgaris*), European, four Mississippi Alligators (*Alligator mississippiensis*) from the Mississippi, deposited; a White lipped Peccary (*Dicotyles labiatus*), two Boatbills (*Cancroma cochlearia*) from South America, purchased.

THE BRITISH ASSOCIATION

IN addition to the grants in the list which we gave last week, the following were voted at the final general meeting:—Mr. James Glaisher, Luminous Meteors, 15*l.*; Prof. Sylvester, Fundamental Invariants, 40*l.*; Prof. W. C. Williamson, Tertiary Flora, 20*l.*; Prof. Rolleston, Prehistoric Remains in Dorsetshire, 25*l.*

The total sum voted was 1,010*l.*, considerably more than the receipts of the Swansea meeting.

It is expected that the public lectures at the York meeting next year will be given by Prof. Huxley, Prof. Tyndall, and Mr. Spottiswoode.

REPORTS

Report on the best means for the Development of Light from Coal-gas of different qualities, by a Committee consisting of Dr. Wm. Wallace (secretary), Prof. Dittmar, and Mr. John Pattinson, F.C.S., F.I.C. Drawn up by Mr. Pattinson.—If gas be allowed to burn under little or no pressure it gives a smoky flame of little luminosity; when forced out under great pressure it yields a non-luminous blue flame like that of a Bunsen's burner. The aim in constructing a good gas-burner is so to regulate the supply of air and so to control pressure that the maximum amount of light may be obtained. This is best accomplished by an Argand burner.

From series of tables showing the result of experiments, the following conclusions are drawn:—The illuminating power is increased as the gas, issuing with less velocity, is mixed or brought in contact with less air. No increase in illuminating power is produced by heating the gas before its combustion. This confirms the results obtained by the London Gas Referees in 1871. By heating the air admitted to the centre of a standard Argand burner to 520° F., an increase of light amounting to 9 per cent. was produced for a rise of 450° in temperature. The trouble and expense of heating the air would probably prevent the adoption of this means of increasing the luminosity. With ordinary flat-flame burners the greatest amount of light is evolved under a pressure of one inch of water.

After giving measurements of the intensity of light evolved by gas burned in various varieties of burners (Bray's, Silber's, and Sugg's), the author concludes that the luminosity depends, so far as the burner is concerned, on the amount of gas burnt and on the pressure. The only burner presenting undoubted advantages over others, and that owing to more perfect regulation of air-supply, is the Argand burner; but on account of its expense, the trouble of keeping it clean, and the necessity of employing a governor for each burner, it is improbable that it will come into general use. Governors are now constructed for single burners by Sugg, Peebles, Wright, Borradaile, and others. Such governors are of great service, not only in saving gas, but also in regulating supply and giving constancy in luminosity.

Thirteenth Report of the Committee, consisting of Prof. Everett, Prof. Sir William Thomson, Mr. G. J. Symons, Prof. Ramsay, Prof. Geikie, Mr. J. Glaisher, Mr. Pengelly, Prof. Edward Hull, Dr. Clement Le Neve Foster, Prof. A. S. Herschel, Mr. G. A. Lebour, Mr. A. B. Wynne, Mr. Galloway, Mr. Joseph Dickinson, Mr. G. F. Deacon, and Mr. E. Wethered, appointed for the Purpose of investigating the Rate of Increase of Underground Temperature downwards in various Localities of Dry Land and under Water. Drawn up by Prof. Everett (secretary).—Observations have been taken in the Talargoch Lead Mine, Flintshire (between Rhyl and Prestatyn), under the direction of Mr. A. Strahan, of the Geological Survey, and Mr. Walker, Chairman of the Board of Directors of the mine.

The top of the shaft is 190 feet above the level of the sea. The lowest workings are 900 feet below sea-level. The veins run across an angle of Carboniferous Limestone, bounded on both sides by

faults which throw down coal-measure shale; and as the faults have a considerable inclination, the lowest workings run beneath the shale for a considerable distance. The limestone dips at angles varying from 45° to 55°, and is of two kinds, one white and massive, the other thin bedded black with thin shale partings.

There are levels at intervals of about twenty yards vertically, in the vein, most of which have been driven for some years; but all the observations have been taken in newly-opened ground.

They have been taken by boring a hole 24 inches deep at a distance of from 1½ to 5 yards from the fore breast, and either on the same day or on the next day inserting one of the Committee's slow-action thermometers, with a foot of plugging consisting of dry rag and clay behind it. After an interval generally of four days the thermometer was taken out and read, then reinserted, and read again about a week later, the difference between the two readings never amounting to so much as half a degree.

The observations were taken at six different places in the mine, which are designated by the observers Stations I. to VI.; but in one instance, that of Station II., owing to the swelling of newly-exposed shale, the hole became distorted, so that after extracting the dry rag and clay, an hour was expended in working out the thermometer, the reading of which has therefore been rejected. The following is a list of the five remaining stations, arranged in order of depth :—

No. of Station.	Depth from Surface in Feet.	Temperature, Fahr.	Distance and Direction from Mostyn Shaft.
		°	
IV.	465	53·4	190 yds. S.W.
V.	555	52·9	170 yds. S.E.
VI.	636	58·8	840 yds. S.W.
III.	660	54·0	120 yds. S.
I.	1041	60·8	190 yds. N.E.

It will be observed that the order of the temperatures is not the same as the order of the depths; it therefore becomes important to describe the positions with some particularity.

Stations IV., V., and III. are near together in ground plan, IV. and V. being about 250 yards apart, and III. nearly midway between them, and they have all the same rock overhead between them and the surface, namely, black and white limestone.

At Station I. the rock overhead consists almost entirely of sandstones and shales, with thin coal-seams. At Station VI. it consists of white limestone and shale.

It may be mentioned that the temperature at VI. was observed on three several occasions, namely, January 14, January 21, and February 19, and was in each case found to be the same. Mr. Strahan further states that this station is near a large fault, which contains iron pyrites and gives off water charged with sulphuretted hydrogen; the temperature of the water as pumped up Walker's shaft from a depth of 770 feet, being 63° at the top of the lift. It seems probable that the decomposition of this pyrites may be the cause of the exceptionally high temperature at this station.

The comparison of the temperatures will be most clearly brought out by tabulating the rate of increase from the surface down to each station, as calculated from an assumed surface temperature, which may be fairly taken as 48°. As all the depths are considerable, an error of a degree in the surface temperature will not have much influence on the comparison, which stands thus :—

Station.	Depth in feet.	Excess above surface.	Feet per Degree.
		°	
IV.	465	5·4	86
V.	555	4·9	113
VI.	636	10·8	59
III.	660	6·0	110
I.	1,041	12·8	81

Stations V. and III., which give the slowest rate of increase, are both of them in a vein called the "South Joint;" and Stations IV. and I., which agree well with each other, though differing from the rest, are both of them in another vein called the "Talargoch vein;" while Station VI. is in the "Country rock." The horizontal distance between IV. and III. is only 120 yards; but if we attempt to deduce the rate of increase from comparing these two, we have an increase of only 0°·6 in 195 feet. It thus appears that, notwithstanding the proximity of the two veins, their conditions as to temperature are very different.

Widely as the results differ among themselves, they agree upon the whole in showing that the average rate of increase is slow; and this general result is in harmony with what has been found at the nearest localities mentioned in our previous reports, namely, Dukinfield and Liverpool. Here, as at Dukinfield, all the strata are highly inclined.

Some additional observations at Dukinfield have recently been made for the Committee by Mr. Edward Garside, student of engineering in Queen's College, Belfast. The Astley Pit, in which they were taken, has now been carried to a much greater depth than it had extended at the time of Sir Wm. Fairbairn's observations, to which allusion was made in our Report for 1870. The two deepest seams of coal in it are called the "Cannel Mine" and the "Black Mine," the former being the deeper of the two; they both slope downwards at about 15°, the deepest point being the far end of the Cannel Mine. The following is Mr. Garside's summary of the observations; the "surface-depth" being distinguished from the "shaft-depth," because the surface is not level, but slopes slightly in the same general direction as the seams. The shaft-depth gives the difference of levels, but the surface-depth, which is practically the same as the distance of the nearest point of the surface, is what we must use in computing the rate of increase of temperature.

Date in 1880.	Seam Coal.	Surface Depth.	Shaft Depth.	Temperature of Strata.	Temperature in Air Road.	Distance from Main Air Column.
		Feet.	Feet.	Fahr.	Fahr.	Yards.
June 17	Cannel	2,700	2,754	86½	75½	160
,, 19	Black	2,407½	2,631	80	78¼	630
,, 21	Cannel	2,416½	2,482½	81	79	600
July 2	Black	1,987½	2,047½	74	71½	460

The pit is described as being entirely free from water.

Report of the Committee for making Secular Experiments on the Elasticity of Wires, by Mr. J. J. Bottomley.—The wires prepared by the Committee in Glasgow are still under experiment.

Report of the Committee on the Specific Inductive Capacity of a good Sprengel Vacuum, by Mr. W. E. Ayrton.—Boltzmann had estimated the specific inductive capacity at '9994; while Professors Ayrton and Perry had estimated it at '9985. In the experiments of the committee much higher vacua had been obtained, and had found some rather remarkable and not readily intelligible results. With *very* high vacua the inductive capacity of the compound aluminium condenser employed appeared to be less than at slightly lower degrees of exhaustion. The method adopted consisted in applying the aluminium condenser to a modification of a Hughes' induction balance in connection with a sliding condenser, a telephone, and a small induction coil.

Sir W. Thomson criticised the method as not being purely electrostatic in its nature. The discussion was continued by Mr. Gordon and Mr. Fitzgerald, who alluded to a possible connection between the fluctuations of the phenomena observed and those observed in the phenomena of Crookes' radiometer-force.

All the observations were taken with one of the committee's slow-acting thermometers, in holes drilled in the floors at the far ends of newly-opened horse-road levels; the holes being four feet deep and two inches in diameter. All the holes were free from cracks, and were in the same kind of rock—an argillaceous earth called "warren earth." They were allowed to stand for a short time, to allow the heat caused by drilling to escape. The thermometer was then inserted, and the portion of the hole between it and the mouth plugged with cotton waste and the dust which came out of the hole in drilling. After being left for forty-eight hours it was taken out and read.

The data for calculating the rate of increase are given in the first two columns below.

Depth in Feet.	Temperature Fahr.	Feet per Degree from Surface.
1,987½	74	79·5
2,416½	81	75·5
2,407½	80	77·7
2,700	86½	72

The third column shows the number of feet per degree of difference from the surface, assuming the surface-temperature to be 49°.

Comparing the observations at 1,987½ and 2,416½ feet, we have an increase of 7° in 429 feet, which is at the rate of 1° in 61·3 feet; and comparing the two deepest observations, we have an increase of 6½° in 292½ feet, which is at the rate of 1° in

45 feet. It thus appears that the rate of increase in this pit is more rapid as we go deeper. The greatest depth in Sir Wm. Fairbairn's observations was 685 yards, or 2,055 feet, and the temperature which he found for this depth was 75½°, which agrees to half a degree with the observations now reported.

The committee have to express their regret at the loss of two of their colleagues—Prof. Clerk Maxwell and Prof. Ansted—by death, during the past year.

Report on the Ultra-Violet Spectra, by Prof. A. K. Huntington.—The physical portion of the report was read in Section A. Before the Chemical Section Prof. Huntington drew attention to the following points:—The work of former experimenters on this subject is of great interest. The late Dr. Miller, in his experiments, was obliged to conclude that no connection could be drawn between the chemical composition of a substance and its power of absorbing ultra-violet rays. His method of experimentation, however, was deficient, inasmuch as he used layers of varying thickness, and in every case employed saturated solutions. His substances were not so pure as is necessary in such an investigation.

Dr. Miller also investigated the absorption of the ultra-violet rays by reflection from polished metallic surfaces. The results obtained were that gold shows almost total reflection; next best is burnished lead. Other metals present a greater or less absorption. Prof. Stokes' results confirm Dr. Miller's. His process differed from that of Dr. Miller, inasmuch as he passed the light through a layer of the solution of the substance under experiment on to a fluorescent screen, while Dr. Miller photographed the spectrum. His results were of great value, and from a chemical point of view it is of interest to note that glucosides and alkaloids have great absorptive power, and that on addition of acids absorption begins somewhat later than in presence of an alkali.

In 1874 Mr. Sorby constructed a spectroscope with a fluorescent eyepiece, and was thus able to observe the spectra directly. His results, though valuable, are vitiated by the impurity of the material he used.

Mention must also be made of experiments by Prof. Cordieu, who experimented on the influence of the atmosphere in cutting off rays on the ultra-violet end of the spectrum.

Prof. Hartley, one of the members of the Committee, has recently experimented on this subject, and some of the results of his research have been communicated to the Royal Society. His experiments, made with an improved form of Dr. Miller's apparatus, have led to interesting conclusions. He has found that monatomic alcohols of the methyl series exhibit little or no absorption. The first of the series, methyl alcohol, is, when pure, quite as "diaphanous" as water to invisible rays. Fatty acids, containing the same number of atoms of carbon as the alcohols to which they are related, have a higher absorptive power. Increased complexity of the molecule causes increased absorption. All members of the benzene series, in fact all bodies whose constitution is best expressed by the "ring-formula," give absorption-bands of great intensity; the hydrocarbons themselves, however, occupying the lowest position in this respect. Isomeric bodies of this group differ widely in their spectrum, which thus affords a convenient means of identification. Doubly-linked bodies, such as ethene, propene, anylene, give no absorption-spectrum; and in fact the ring-form appears to be a *sine-quâ-non*, for the terpenes and camphor do not absorb ultra-violet rays.

The intensity of the absorption-bands of naphthalene and anthracene is remarkable; a solution of 1 part of the latter body in 50 million times its weight of acetic acid may still be recognised.

On the Spectra of Metalloids, by Dr. A. Schuster, F.R.S.—The author stated that he had considerable difficulty in distinguishing the spectrum of an element from that of a compound. For example, the familiar spectrum of a Bunsen's flame is ascribed by some to carbon, and by others to a hydrocarbon, the argument in favour of the latter view being that the temperature of the flame is not sufficiently high to volatilise carbon as such. The reply to this argument is that during its passage from its compound with hydrogen to CO or CO_2, the element carbon is actually liberated, and then exhibits the band-spectrum; and in confirmation of this theory it has been noticed that gas impregnated with a salt of a metal such as copper or iron, gives in the Bunsen's burner the true metallic spectrum and not the spectrum of a compound. The same argument applies here, for the metal is actually liberated during its passage from (say) the chloride to the oxide. Besides, the band spectrum is seen still more effectively when cyanogen is burned, even when dried as perfectly as possible. This band-spectrum is seen in the sun's rays, and it is highly improbable that cyanogen should be able to resist such an enormously high temperature.

The author then considered the question:—Why should an element give different spectra at different temperatures? Bands are characteristic of compounds, and at low temperatures elements show a banded spectrum. At higher temperatures such spectra become simpler, and the evident conclusion is that complex molecules of the elements are dissociated into those of a simpler order. This view is rendered highly probable by the fact that the spectrum of mercury is a constant one, and that no known increase of temperature alters its character; now, assuming the molecule of hydrogen to consist of two atoms, that of mercury consists of a single atom, and it is evident that no simplification is possible.

The change of the spectra of chlorine, bromine, and iodine, as the temperature is increased would seem to corroborate Prof. Victor Meyer's recent conclusions with regard to the molecular complexity of these elements.

It was also suggested that the spectrum of an element might vary according to the compound from which it is liberated. Were it possible to decompose carbon monoxide and dioxide, and to obtain the spectrum of the single carbon atoms which they contain, it would probably differ from the well-known banded spectrum of carbon which there is reason to suppose is that of at least a two-atom molecule.

Mr. W. Chandler Roberts pointed out that Prof. Wiedemann has undertaken measurements to ascertain whether a change of temperature takes place during alteration of the spectrum, and hoped that interesting results would be obtained.

Report of the Committee on Erratic Blocks, presented by the Rev. H. W. Crosskey. (Abstract.)—Although the destruction of erratic blocks is proceeding with considerable rapidity, the Committee were able to report the discovery and preservation of some important specimens.

One of the most remarkable blocks of Shap granite yet observed is described by Mr. J. R. Dakyns at Seamer Station, near Scarborough. It measures roughly 5 ft. 8 in. × 4 ft. 10 in. × 4 ft. 3 in., and was fairly imbedded in gravel, forming the summit of a well-marked terrace 225 feet above the sea-level. This boulder is specially interesting in that it is the only boulder of Shap granite in the neighbourhood whose position in the beds is known; and this position shows that at the age assigned to the gravels (which is a comparatively recent one) icebergs must have been floating about. It has been preserved in the garden of the Station House.

The report records particulars of boulders discovered in the neighbourhood of Urmston, near Manchester, and also of a large number both of isolated boulders and groups of boulders observed in Leicestershire by Mr. J. Plant.

Mr. Pengelly furnishes a very interesting part of the report in an account he gives of some transported blocks and accumulations of blocks which he has observed in South Devon, the transposition of which it does not seem altogether possible that the action of water alone could have effected. A block of greenstone occurs in the village of Kingston, South Devon, measuring 4 × 2 × 2 feet, and weighing upwards of a ton. There is a mass of greenstone figured on the map of the Survey, extending to about a mile west-north-west of Kingston, where it makes its nearest approach to the village. Blocks of quartzite have been found in great abundance in the parishes of Diptford and Morleigh. They can be traced to their source on the higher levels of the neighbourhood; a bed of quartzite identical in character with the travelled blocks being interbedded conformably with the ordinary slaty Devonian rocks of the district. There can be no doubt that the blocks have been transported from south to north, and from higher to lower ground. The gradient, however, is very slight, and as almost all the blocks are very angular as well as large, it is difficult to suppose that their transportation was the result of nothing more than running water.

A block of greenstone occurs near Diptford Court, weighing fully 1·75 ton. A mass of igneous rock apparently of the same kind is found at a distance of five miles due south of the boulder, and another about the same distance north.

The blocks locally termed in South-Western Devon "Whita-

kers", are described in the report. They are composed of white opaque quartz, having in some cases a laminated structure, and traversed occasionally with veins and crystals of the same material. That the blocks have travelled a considerable distance cannot be doubted; and that their transportation was not effected by the action of water only appears proved. The blocks are all more or less rugged and sub-angular, although without any decided traces of glacial polish or scratches. They occur most plentifully on the higher ground.

They have been so largely utilised by the farmers and for artificial rockeries that it is to be feared, unless care is taken to prevent it, those now remaining on the spots they have so long occupied undisturbed may altogether disappear.

The report concluded with an appeal to local observers to report upon the erratics still unrecorded before the work of destruction is completed, and evidence throwing light on difficult problems of glacial geology is destroyed.

Report on the Exploration of Caves in the South of Ireland, by Prof. A. Leith Adams. Includes a Report by Mr. R. J. Ussher.—Describes caves at Carnigea Gower, four miles south of Middleton. Stalagmite floor on sandy clay; beneath the stalagmite was much charcoal, the roof had an opening to the surface, down which much kitchen rubbish had been thrown, associated with hammer stones, flint flakes, iron implements, and remains of recent animals. A report was read on the implements, by Mr. R. Day, which are of no great antiquity; one piece of pottery was believed to have a Roman (capital) letter inscription.

Report on the Carboniferous Polyzoa, by W. G. R. Vine.—Discusses the character of the genus and species and the views held on them by the earlier workers, and after a comparison of the specific forms he relegates to each of these the precise genera to which they belong.

Report on the "Geological Record," by Mr. W. Whitaker.—Four volumes have been published, each of which gives an abstract of all geological work done throughout the world, for one year; they contain an average number of 20,200 entries in each volume.

Sixteenth Report of the Committee appointed to Explore Kent's Cavern, by Mr. Pengelly.—The deposits passed through in the cavern were:—

Iron and Bronze.		Black Mould. Roman Remains (Ovine).
Palæolithic	Newer Type.	Granular Stalagmite, 5 feet. Extinct Animals.
		Cave Earth. Extinct Animals. (Hyæna).
	Rougher Type.	Crystalline Stalagmite, 12 feet. (Bears).
		Breccia.

Work commenced in March, 1865, by excavating down to 4 feet throughout the whole cavern; finished in November, 1879, the floor had at that time been so excavated, at a cost of 1,850*l.* to the Association. A further grant was then given to lay bare the limestone floor; and subscriptions from private sources amounted to 51*l.* received, which enabled the base of the cave deposit to be excavated for a length of 132 feet. Occasionally stalagmitic fragments occurred on the base of the breccia, resting on the rock. On June 19, 1880, the work was suspended, it having only yielded seventeen finds—amongst them a flint nodule, which had not been touched by the implement maker—which are of greater rarity. Archæological finds were more numerous than remains of animals; the implements correspond to those of the oldest river gravels in type. Referred to the good work done by Mr. George Smerdon, the foreman of the workmen during sixteen years, who has become crippled with rheumatism, brought on by execution of the work, and suggested the desirability of raising subscriptions to purchase for him an annuity of 10*l.* a year.

Report of the Committee, consisting of Mr. James Heywood, Mr. Shaen, Mr. Stephen Bourne, Mr. Wilkinson, the Rev. W. Delaney, and Dr. J. H. Gladstone (Secretary), appointed for the purpose of reporting whether it is important that H.M. Inspectors of Elementary Schools should be appointed with reference to their ability for examining the scientific specific subjects of the Code in addition to other matters.—The Committee nominated at Sheffield for the purpose of considering "whether it is important that H.M. Inspectors of Elementary Schools should be appointed with reference to their ability for examining the scientific specific subjects of the Code in addition to other matters," have received a considerable amount of evidence upon the subject, and beg to report as follows:—

1. It has come to their knowledge that the teaching of the scientific specific subjects is practically discouraged by the incapacity of many of H.M. Inspectors to examine in them.

2. This incapacity is explained by the fact that the Inspectors are not generally chosen so much for their fitness to judge of such educational work, as on account of their high scholarship, or through political patronage.

3. In the opinion of this Committee there might be an examining body for H.M. Inspectors, composed of three of the most experienced of the present senior Inspectors, associated with a similar number of the Science Examiners of the Science and Art Department. The examination should be thrown open to elementary teachers, and the candidates might be tested in the practical work of examination in one of the Central Elementary Schools in London.

4. The Committee believe that the opening of the Inspectorship to fully qualified elementary teachers would tend to raise the *esprit de corps* of the profession, and improve the character of both inspector and teacher.

5. The Committee are further of opinion that while a university degree may be fitly regarded as a test of scholarship, it is not a test of the particular qualifications for an examiner, and therefore is not sufficient in itself to guarantee the holder thereof as worthy the position of Inspector. There appears to be no reason why academical honours should be made an indispensable condition of appointment.

6. The Committee recommend that a memorial be presented to the Lords of the Committee of Privy Council on Education embodying the above conclusions.

Report of the Committee, consisting of Dr. Pye-Smith, Prof. M. Foster, and Prof. Burdon Sanderson (Secretary), appointed for the purpose of investigating the Influence of Bodily Exercise on the Elimination of Nitrogen (the Experiments to be conducted by Mr. North).—During the past year four series of preliminary experiments, each of several weeks' duration, have been made by the Committee on the subject, the expenses of which have been met from other funds. In the course of these experiments unexpected difficulties have been encountered relating to method. The most serious of these difficulties having now been for the most part overcome, we are in a position to proceed with our inquiries next winter, and have therefore to request that the sum of 50*l.*, previously granted to us, may again be placed at our disposal.

SECTION A—Mathematical and Physical

On some Laws which regulate the Succession of Temperature and Rainfall in the Climate of London, by H. Courtenay Fox, M.R.C.S.—The following paper is an attempt to answer the question: Is there to be found any definite relation between extremes of rainfall or temperature in any month or season, and the weather of the month or season next following?

The data used by me are the same as those upon which the foregoing paper on "Synchronisms" is based, viz., the monthly temperature and rainfall for the Royal Observatory for sixty-six years—1815 to 1880. In accordance with the principles explained by me at p. 277 of the Report of the British Association for 1879, each month is distributed under the five heads of temperature—according as it was very cold, cold, average, warm, or very warm; and under the five heads of rainfall—according as it was very dry, dry, average, wet, or very wet.

I have presented three tables, which show, for each month or season which is classed under one or other of the extremes of rainfall or temperature, the character, in these respects, of the month or season next following.

A careful study of these tables enables us (whilst omitting all those results which are of an ambiguous character) to state the following definite propositions:—

1. A *cold* spring is very prone to be followed by a cold summer, a cold summer tends to be followed by a cold autumn, and a cold autumn has a slight tendency to be succeeded by a winter of low temperature.

2. *Warm* summers are generally followed by warm autumns.

3. In no fewer than eight out of the twelve months (that is in every one except February, March, May, and October), very *low* temperature tends to be prolonged into the succeeding month.

4. If June, July, August, or December be *warm*, the next month will probably be a warm one also.

5. Two months, June and July, tend, when very *dry*, to be followed by dry ones. On the other hand, a dry August indicates the probability of a *wet* September.

6. A *wet* December is apt to be succeeded by a wet January.

In addition to the foregoing, there are also a few instances in which the rainfall of certain months appears to be definitely related to antecedent extremes of temperature, and *vice versâ*. Thus

7. If August or September be *warm*, the ensuing September or October inclines to be wet. If, on the other hand, September or November be *cold*, the succeeding October or December is likely to be a dry month.

8. If February, June, or July be very *dry*, the next month has a strong tendency to be warm.

9. If January, March, or April be *wet*, we may also expect the next month to be a warm one. But a wet May or July gives a strong probability of cold weather in June or August respectively.

Mr. W. H. Preece read a paper *On the Best Form to give to Lightning Conductors*. The question was whether the lightning conductor should be a solid rod, or tubular, or flat. Snow Harris, Prof. Henry, M. de Melsens, and M. Guillemin advocated straps of great surface. Faraday strongly maintained that there was no advantage in strap or tube forms, as the surface does nothing in conducting the current. Mr. Preece had obtained the use of Dr. De La Rue's magnificent batteries, and had procured conductors of equal material, length, and weight, but differing in form. A condenser charged from 3,400 cells afforded a very powerful source of electricity, more than forty-two microfarads being thus available to produce an enormous spark. Experiments made by heating and deflagrating wires through the different conductors left no doubt that these discharges do obey the law of Ohm, and therefore that the additional surface of flat and tubular conductors is of no advantage in their conductivity.

Prof. Osborne Reynolds rather doubted the conclusions of Mr. Preece, on account of our not knowing the conditions under which the electricity passes from the air into the surface of the conductor. Prof. Ayrton thought the experiments should be tried with much greater difference of potential. The 3,000 cells would not produce a free spark of more than $\frac{1}{40}$ of an inch long, whereas flashes of lightning might extend over miles.

Mr. Preece, in replying, pointed out that increased surface, though increasing its inductive capacity, did not add to its efficiency, which depended only on its conductivity.

Mr. Preece also communicated an observation on the peculiar behaviour of copper wires. Very powerful discharges of electricity were found to increase the conductivity of newly-drawn copper wires by an appreciable percentage. Leaden wires showed no such changes. In the subsequent debate it appeared that the opinion was that the effect of the first current was to anneal the wire.

On the Necessity for a regular Inspection of Lightning Conductors, by Richard Anderson, F.C.S., A. Inst. C.E.—The author referred to a paper by M. W. de Fonvielle, "On the Advantage of keeping Records of Physical Phenomena connected with Thunderstorms," read before this Association in 1872. M. de Fonvielle recommended to the attention of the members the steps which had been taken by the French Government for obtaining information regarding thunderstorms, and suggested that the Association should institute some organisation for the collection of such data; arguing that it would be of much value to science, as well as to the public. Nothing, however, has been done by the Association since 1872; and the author not only confirmed the conclusions at which M. de Fonvielle arrived as to the desirability of collecting such data, but was of opinion that the organisation should go further, and arrange for a regular inspection of all public buildings which had lightning-conductors applied.

The necessity for this he demonstrated by adducing a number of striking cases where damage, more or less severe, had occurred to buildings, even though having lightning-conductors attached to them. The cases now cited, he explained, were supplementary to those communicated in his paper on a similar subject to the Association in 1878. A few of the cases were as follows :—

In October, 1878, an elevated building situated at the back of Victoria Station, occupied as a furniture repository, was struck by lightning and sustained damage, although furnished with a $\frac{3}{8}$-inch by $\frac{1}{8}$-inch copper band lightning-conductor and a tube of $\frac{3}{16}$-inch diameter rising above the iron crestings on the tower. The lightning shattered the cresting and bent the point of the lightning-rod, besides doing other damage to the building. On testing, the author found the resistance very great, and on opening out the earth-terminal found it imbedded in concrete.

On June 26 last, lightning struck All Saints Church, Lambeth, doing considerable damage, although there was a $\frac{3}{8}$-inch diameter copper-rope conductor on the west gable, with a copper tube rising 18 inches above. A stone cross about 50 feet from the conductor was thrown down, injuring the roof of the north aisle. On testing the conductor, the author found that it had no "earth" whatever, the rope being simply placed in 2 inches of loose rubbish. The copper was of very inferior quality; conductivity being 32·10 per cent., or about double that of iron.

The author quoted also a few cases from his recent work on "Lightning-Conductors, their History," &c :—

In August, 1878, the Powder Magazine at Victoria Colliery, Burntcliffe, Yorkshire, was struck by lightning, though furnished with a conductor, 13 feet above the building, and terminating in 13 feet of clayey soil. The building was blown to pieces. On testing the conductivity of the copper, it was found to be 39·2, instead of 92 to 94 per cent. The conductor was insulated from the building and from a large iron door, which it ought not to have been.

The author concludes from this evidence that it is not sufficient merely that rods of copper should be attached to a building, but it is necessary that after being fixed they should be regularly inspected, to see if they are in good order, so as to be really efficacious.

Sir Wm. Thomson gave a communication *On a Method of Measuring Contact Electricity*. Sir W. Thompson had devised this method at the time when Hankel published his results in 1861. A method identical with it had lately been described by M. Pellat, and consisted in employing a small electromotive force in connection with a dividing resistance slide, to give a counterbalancing electromotive force to that produced by contact.

Sir W. Thomson next described *A Method of Determining without Mechanism the limiting Steam-Liquid Temperature of a Fluid*. This was a simple apparatus, consisting of a closed glass tube containing liquid sulphurous acid filled to a sufficient height to insure that the liquid in the lower half will expand to the top. Prof. W. Ramsay criticised the proposal, and stated that he had found an apparatus in which a screw was employed to produce increase of pressure instead of using the expansion of the liquid itself. With this apparatus he had repeated Andrews' research on a large number of substances.

Mr. G. F. Fitzgerald read a paper *On the Possibility of originating Wave-disturbances in the Ether*. This was a mathematical paper, in which, by comparing the equations of Maxwell's theory of the propagation of electric action through a medium with those of direct action at a distance, he deduced the conclusion that electric currents and systems cannot originate in the ether such disturbances as those of light.

Mr. R. M. Shida gave an account of *A New Determination of the number of Electrostatic Units in the Electromagnetic Unit*. The value V of this ratio he deduced was $294{\cdot}4 \times 10^8$.

M. Wilfrid de Fonvielle exhibited his magnetro-electric gyroscope, which has been already described in our pages.

M. Janssen sent a communication to the Section, which was read by the Secretary, upon his recent researches *On the obtaining Positive Photographs by Prolonged Exposure*.

Mr. Wiesendanger showed a new electromotor, which will be described hereafter in our pages.

Mr. Philip Braham exhibited an ingenious adaptation of lime-light for microscopic illumination, and also described a simple instrument for detecting polarised light.

On the Best Form of Magnet for Magneto Machines, by W. Ladd.—At the British Association meeting at Dundee in 1867, I made some remarks upon different forms of magnets, and exhibited these diagrams, showing, by the "lines of force" naturally arranged, the great superiority of the circular magnet where an armature is to be employed.

Since that time some thousands of that form of magnet have been made for medical, mining, and other purposes.

Some months ago, in conversation with M. Bregnet of Paris, I showed him these same diagrams, and he was very much impressed with their importance; he has since then constructed a machine, using the Gramme armature, and with a smaller quantity of steel in the magnets he has made a far more powerful

machine than hitherto constructed with either the Jamin or the ordinary horse-shoe form. It is also more symmetrical in appearance, and occupies less space.

With this machine I can heat to incandescence nineteen inches of platinum wire by four turns of the handle, while to heat fourteen inches of the same size wire by a machine having a Jamin magnet it took ten turns of the handle.

Mr. Bottomley followed up his report with a paper *On the Elasticity of Wires*. This paper related the effect of adding loads gradually to a wire which carried a load, and which was found to increase in the limit of breaking strain when longer times were allowed to elapse between the successive increments of the load. A charcoal iron wire which bore a load of 41 lbs. when suddenly loaded would support 52 lbs. after having borne the load of 41 lbs. for 790 hours. Some remarks were made by Sir W. Thomson and by Dr. Siemens, who referred to some recent experiments made in Germany of the stretching of wires and rods of steel, which tended to show that protracted tensile strain affected the chemical condition in which the carbon of the steel was combined with the iron in it. Mr. J. E. H. Gordon referred to the connection between the mechanical and magnetic properties of steel under different conditions.

On the Comparison of Declination Magnetographs at various Places, by Prof. W. G. Adams.—This paper was accompanied by diagrams of simultaneous magnetic disturbances at St. Petersburg, Kew, and Vienna, showing that many of the sudden magnetic disturbances occur simultaneously over very great areas, but that in some cases the variations were in opposite directions. In the debate which followed Sir Wm. Thomson spoke of these observations as beginning to open out a glimpse of the true cause of the magnetic storms. He observed that if similar records of the other magnetic elements, inclination and intensity, could be procured, we should know definitely whether these disturbances were due to any changes of the magnetism of the earth itself, or whether they were due to an external magnetic action. Magnetic observations had been going on for forty years, and it was a reproach that more had not hitherto been done. He also referred to the alleged connection between auroræ and magnetic storms. Mr. J. Glaisher and Staff-Commander Creak mentioned cases of sudden magnetic disturbances. Capt. Creak recalled the observations of the Arctic expeditions of 1875-6, when a deflection of 5° was observed within forty minutes, the Kew records showing synchronously a smaller fluctuation. He argued that an observing station in a more northerly latitude was necessary. Mr. W. H. Preece recounted a magnetic and electrical storm which affected Ireland and the west of England on August 12. Magnetic disturbances always were accompanied by earth currents which affect the telegraph-wires. The same storm affected even the Atlantic cables and the Cape cable. He believed they would be found to have affected the whole earth. The electromotive force on this occasion, through the Atlantic cable, was about as great as that of 300 Daniell's cell, or more exactly one volt per 6·6 miles. Capt. Creak also exhibited the new Admiralty charts of the magnetic variation for 1880.

Prof. G. H. Minchin read a communication *On Photoelectricity*. He had obtained feeble currents from two silver plates coated with sensitive films of iodide, chloride, or bromide of silver, dipping into a common fluid, and then one of them exposed to the light. He had also observed that preparations of fluorescent and phosphorescent bodies upon silver plates acted similarly.

Prof. Silvanus P. Thompson gave a paper *On Electric Convection Currents*, pointing out their analogies with true conduction currents, and of currents of electrolytic conductivity in respect of electro-magnetic phenomena. The application to ring-figures produced by disruptive convection and by electrolytic conduction was considered, and their deformation in the magnetic field. It was pointed out that considerations of a similar nature had been advanced by Prof. Ayrton at an earlier date.

Experiments on Thin Films of Water, with regard to the Absorption of Radiant Heat, by the Hon. F. A. R. Russell.—The experiments, the general results of which are given below, were made with the object of ascertaining the diathermancy of water in very thin films, and these experiments afforded incidentally an opportunity of observing the behaviour of films subject to varying conditions.

The arrangement of instruments was similar to that illustrated at p. 383 of Prof. Tyndall's "Heat as a Mode of Motion." The instruments used were: a dead-beat mirror galvanometer and scale, a thermopile, and a screen. The soap film was carried by a piece of a cork sole perforated by a hole slightly larger than the hole in the screen, about 1½ inch in diameter. The sources of heat were (1) a copper or iron ball heated from behind by a small gas flame; (2) a gas flame from a Bunsen burner and (3) a hydrogen flame in air.

The film was mostly made from a solution of about half a drachm of shavings of Castile soap, dissolved five to fifteen minutes in about five cubic inches of water, at 60° F.

The film, soon after being placed perpendicularly at the orifice in the screen, exhibited coloured bands, which descended in regular succession until the last band appeared, which contained a bright blue line. The descentof the bands continued at a slackened rate till the grey, and finally the black, occupied a portion of the upper half of the film, which half was alone subject to experiment. A condition more or less of equilibrium then prevailed, the tension of the black portion counteracting the force of gravity. A light yellow or bronze was always the last colour to appear, and preceded the white or grey, which again was succeeded by black. When there was any black in the film, the bursting of the film was marked by a slight click or snapping sound. The best films lasted frequently between ten and thirty minutes, and sometimes the black portion alone was under observation fifteen or twenty minutes.

The following table shows the absorption per cent. for each of the three sources of heat, and the thickness of the film, as derived from a table in Watt's "Dictionary of Chemistry," giving Newton's thicknesses of thin films of air, water, and glass. A table in Cooke's "New Chemistry" gives the thicknesses of soap-films as considerably greater than those stated in Newton's table. The "light film" of Cooke corresponds to my "grey," and his "grey" to my "fine grey." Newton's "white" corresponds to my "grey." The refractive index of the solution used by me was 1·34 and 1·35, a little higher than that of pure water.

State of Film.	Metal.	Gas.	Hydrogen.	Thickness of Film in millionths of an inch.
Last band alone	9?	8?	—	8·3
Bronze	6	5·7	—	5·2
All grey (white)	4·7	—	4·5	3·9
Fine grey	—	3·4	—	1·8
Half grey, half black...	—	2·9	—	2·3
Two-thirds black, one-third grey	—	1·6	1·6	1·8
Half fine grey, half black	0·7	—	—	1·34
Black and slight fine grey	—	—	1·2	
Fine grey and black, or all black	0·29	—	—	0·75
All black	0·29	1·5	0·6	

SECTION B—CHEMICAL SCIENCE

On the Influence of Water on the Union of Carbonic Oxide with Oxygen at a High Temperature, by Harold B. Dixon, M.A.—The author obtained the curious result that a mixture of carbonic oxide and oxygen in such proportions as to form carbon dioxide, when free, or nearly free, from water, does not explode, either by a direct discharge from a Leyden jar or when sparks are passed through it from a Ruhmkorff coil. By allowing a minute portion of aqueous vapour to mix with the gases, explosion immediately takes place on the passage of the spark. In presence of a very small trace of water, combustion takes place, but slowly, not with explosive energy. The author suggests as an explanation the following equations:—

$$CO + H_2O = CO_2 + H_2$$
$$H_2 + O = H_2O.$$

Prof. Williamson suggested that it would be interesting to determine the inferior limit to the power of water vapour in causing an explosion, and that Mr. Dixon would probably extend his research in this direction.

Prof. Harcourt pointed out that various other similar instances are known, among others the impossibility of causing union of calcium oxide and carbonic anhydride, in absence of water, and the refusal of dry chlorine to act on hot sodium.

Mr. Thomas noticed that in mixtures containing large amounts of marsh-gas the presence of water vapour also influenced the rapidity of explosion.

Prof. Silva remarked that the influence of diluents may have a contrary effect from that of water-vapour, and that the question is worth investigation.

Metallic Compounds containing Organic Radicals, Part I., by J. Sakurai.—The author has succeeded in obtaining a compound of methylene iodide, CH_2I_2, with mercurous iodide, Hg_2I_2, of the formula CH_2IHgI. It is a white crystalline substance, insoluble in water, cold alcohol, ether, chloroform, and ethylic iodide. It is soluble in boiling alcohol and in methylene iodide. It melts at 108°–109° C.

Besides this substance, another, insoluble in all ordinary solvents, is produced, which possesses the formula $CH_2(HgI)_2$. Chlorine and bromine act on these substances, forming methylene chlorides or bromides, and halogen salts of mercury. The author proposes to attempt to produce the zinc and sodium analogues of this body.

On some Relations between the Atomic Volumes of Certain Elements and the Heat of Formation of some of their Compounds, by Walter Weldon, F.R.S.E.—It has been observed that the heat evolved by the union of chlorine with a metal is greater than that of bromine, and that the heat given off by bromine is greater than that by iodine. In a similar manner oxygen gives off more heat than sulphur. Berthelot has observed that positive elements obey the same rule, but that there are some exceptions caused *par diverses circonstances mal connues*. That the heat of combination is inversely proportional to the atomic weights of the reacting elements is sometimes the case, but is not a general law; but on comparing the heat evolved by combination of positive elements with their volumes, a direct numerical proportion is observable. To this law there are two exceptions, viz. cadmium and manganese. Cadmium is usually classed along with zinc and magnesium, although it closely resembles indium. It compares with magnesium, but not with zinc. The atomic volume of cadmium is greater than that of zinc, yet the heats of formation of its chloride, oxide, &c., are less than those of zinc. The heat of formation of indium compounds, which have not yet been observed, should be greater than those of zinc. In the same way the heats evolved during formation of compounds of manganese are greater than those of iron, yet the atomic volume is less. Either this case is exceptional, or manganese does not belong to the iron group.

In over 100 instances it has been observed that molecular heats of formation of elements of the same group divided by the atomic volumes of the electro-negative elements give numbers either identical with, or bearing some simple relation to, each other.

After some complimentary remarks from Prof. Williamson, Prof. W. Ramsay pointed out that the heats evolved by the combustion of allotropic modifications of carbon and phosphorus bore the same relation to each other as their specific volumes, and hinted that the heat evolved by the combination of elements of the same group with other elements bore some remarkably simple proportion to the relation of the number of atoms in the complex molecules of the solid elements.

On the Specific Rotatory Power of Cane and Invert Sugar, by Alfred H. Allen.—The author points out that on inverting sugar its weight is increased by absorption of water, and that allowance is not usually made for this fact. He has therefore calculated the following corrected table for S_J:—

	S_J.
Cane-sugar	+ 73·8
Invert sugar	− 25·6 at 15° C.
Dextrose	+ 57·6
Lævulose	− 108·8 at 15° C.

The deviation for a plate of quartz 1 mm. thick is under similar conditions 24° for its transition tint, and 21·66° for the sodium ray. Hence the corresponding values for S_D may be calculated by multiplication by $\frac{21·66}{24} = 0·9025$.

On the Identification of the Coal-Tar Colours, by John Spiller, F.C.S.—The process recommended is the action of sulphuric acid on the dyeing material, taken in conjunction with the shades produced on, and the tendency to dye silk, wool, or cotton. The most remarkable reactions are the following:—Magdala-red with sulphuric acid gives a blue-black; Saffranin, a grass-green, becoming indigo-blue on strongly heating; Chrysoïdin, deep orange, turning almost to scarlet on heating; Alizarin, ruby red, or maroon; Eosine, golden yellow; Primrose (naphthalene-yellow), first yellow, then colour discharged; Chrysaniline, brown fluorescence; Aurine, yellowish brown; Atlas-orange, rose-colour, changing to scarlet on heating; Atlas-scarlet, no alteration; Biebrich-scarlet, R, blue-black; ditto, B, blue-green; Aniline-scarlet, permanent golden yellow; Indulin, slaty blue to indigo; all violets give a yellow, or brownish yellow; Phenyl and diphenylamine blues, dark-brown solutions; Iodine and malachite greens, bright yellow solutions, the former giving off iodine on heating; lastly, Citronine, a pale cinnamon or neutral tint.

On the Density of Fluid Bismuth, by W. Chandler Roberts, F.R.S., and Thomas Wrightson, C.E.—The density of bismuth, just molten, was determined by a modification of the usual process for determining the specific gravity of liquids devised by Mr. R. Mallet, and was found to be 10·039, as a mean of three experiments. By an apparatus termed the oncosimeter, which admits of the weight of a ball of metallic bismuth being taken in molten bismuth by means of a delicate spring balance, its mean specific gravity deduced from six experiments was found to be 10·055; that of solid bismuth is 9·82.

On Crystals of $HgHSO_4$, by P. Braham.—Mercury, when left in contact with sulphuric acid for two years, deposits extremely deliquescent crystals of the above formula.

On the Treatment of Complex Ores containing Zinc, by E. D. Parnell.—The presence of zinc renders the extraction of lead and copper from their ores so difficult that manufacturers reject them; nor are zinc ores containing less than 25 per cent. of zinc adapted for the extraction of that metal.

Further Notes on Petroleum Spirit and Analogous Liquids, by A. H. Allen.—To distinguish petroleum spirit from shale naphtha and from benzene, mix one volume of boiled carbolic acid with three volumes of these liquids. The carbolic acid refuses to mix with the former, but mixes with the two latter. On similar treatment with coal-tar, pitch, petroleum spirit and shale naphtha do not mix, whereas benzene does. With carbolic acid, burning oil from shale can be distinguished from kerosene, the burning oil from petroleum, for the former is not miscible, whereas the latter turns violet, and partially mixes; and if warmed, crystals of carbolic acid separate on cooling. By treatment with nitric acid and with bromine, it was shown that naphtha from petroleum contains 80 per cent. of paraffins and 20 per cent. of olefines; photogene, 55 to 80 per cent. of paraffins, and that wax consists entirely of paraffins; whereas shale naphtha contains 75 to 90 per cent. of olefines; photogene from the same source, 60 to 65 per cent. of olefines, and that the lubricating oil consists entirely of olefines.

On the so-called Normal Solutions for Volumetric Analysis, by A. H. Allen.—This communication was a recommendation that the various different meanings of the term "normal" be done away with, and that a *normal solution* be understood to be one containing in 1,000 cub. cents. such an amount of reacting body as will combine with, replace, or oxidise one gram of hydrogen.

On the Determination of the Loss of Heat in Steam-boilers, arising from Incrustation, by William Thomson.—This plan consists of evaporating the various waters in vessels exposing an equal surface of each, care being taken to keep the total amount constant by means of a constant supply. After a given time the remainder is measured and the ratio calculated. Deposit of incrustation greatly impedes evaporation.

On the Identification of the Ink used in writing Letters and Documents as Evidence in Cases of Libel, Forgery, &c., by W. Thomson, F.R.S.E.—The author has observed that different specimens of writing give different coloured reactions with various reagents, such as sulphuric, hydrochloric, nitric, or oxalic acid, or by caustic soda, solutions of bleaching-powder, and chlorides of tin. Such differences may be of use in detecting forgery, for the change of colour affords evidence as to whether all the writing has been performed with the same ink.

The Effects of Magnesia on Vegetation, by Major-General Scott, C.B., F.R.S.—The author's conclusion, drawn from numerous experiments, is that there is overwhelming evidence against the notion that soil naturally contains so much magnesia that an extra supply will be of little or no benefit. There are strong grounds for supposing that magnesia, like phosphoric acid, is not only an essential ingredient of plants, and aids in their nutriment, but also that it determines the beneficial action of other ingredients.

On the Action of Oils on Metals, by William H. Watson.—Most oils attack copper and iron, but not to the same extent. Some act much more on copper than on iron, and *vice versâ*.

On Bleaching-Powder Residues, by J. F. W. Hodges.—To extract active chlorine from 10 grains of bleaching powder, so

that it does not react with starch paper, 5,000 cub. cents. of water are required. Even then it reacts with iodine and starch. The amount of residue varied between 22 and 30 per cent. of the total quantity of bleaching powder. This residue, on treatment with acid, evolved a minute amount of active chlorine; the residue, applied to cotton and treated with acid, has no bleaching or injurious action.

On the Coal-seams of the Eastern portion of the South Wales Basin, and their Chemical Composition, by J. W. Thomas.

On the Refraction Equivalent of Diamond and the Carbon Compounds, by J. H. Gladstone, Ph.D., F.R.S.—The specific refractive energy (that is, the refractive index – 1 divided by the density) of numerous compounds of carbon was determined by Gladstone and Dale in 1863. From their experiments it was found that carbon uncombined, as in the diamond, and also in combination with hydrogen and oxygen, has a specific refractive energy of 5·0. Yet in compounds of the aromatic series, where several atoms of carbon are united by more than one bond, the refraction equivalent is raised about 2·0. This does not embrace the facts that the terpenes have a refraction equivalent lying between 2 and 4 over the calculated numbers; that the cinnamyl compounds also show abnormality; and that hydrocarbons containing a greater number of atoms of carbon than of hydrogen increase in refractive energy at a rate more rapid than theory demands. Thus naphthalene shows a surplus of 16·4, anthracene of 31·7, and pyrene of 43·6 over the calculated numbers.

Dr. Bedson, who has been recently investigating the subject in conjunction with Mr. W. Carleton Williams, remarked that sufficient allowance had not been made for dispersion in the last-mentioned instances; that from their experiments they have found the degree of concentration of the solution to exercise a marked influence; and he suggested that in naphthalene, anthracene, and pyrene, the molecules are much more complex than in benzene, for several groupings of carbon atoms are noticeable, among them two groups in which an atom of carbon is united to other atoms of carbon by all four bonds.

On a New Process for the Production from Aluminous Minerals of Sulphate of Alumina from Iron, by J. W. Kynaston.—After a preliminary sketch of the various methods of preparing sulphate of alumina in a state of greater or less purity from various minerals containing it, the author describes his own process for preparing it free from iron from bauxite, a silicate and titanate of alumina and iron. This he does by treating it with a mixture of oxalic and hydrochloric acids, allowing it to stand for a week or ten days. The insoluble portion is freed from oxalic acid by repeated washing, and the residue converted into sulphate of alumina by treatment with sulphuric acid. This product is almost free from iron. The oxalic acid is recovered by precipitation with lime, and subsequent decomposition of the salt with sulphuric acid. The expense of this process has prevented its adoption. The author has now devised a process whereby the iron is precipitated as arsenite, and then by means of carbonate of lime neutralising any free acid, and at the same time producing some tetrabasic sulphate of alumina. The remaining ferrous iron is then removed by addition of ferrocyanide of lime. The blue precipitate is induced to settle by addition of a little sulphate of iron or zinc. Excess of arsenic is precipitated with sulphide of lime. This process is at present in operation at St. Helen's.

On a New Process for separating Silver from Copper Ores and Reguluses, by William Henderson.—This process is applicable to calcined Spanish pyrites containing a large proportion of arsenic before calcination. The "raw regulus," when fused with 20 per cent. of its weight of sodium bisulphate, yields metallic silver in large amount. The iron and copper are converted into oxides, while the silver remains as sulphate, and may be extracted from the residue with water. The process has as yet been worked only on a small scale.

SECTION C.—GEOLOGY

Notes on the Submarine Geology of the English Channel off the Coast of South Devon, by Mr. A. R. Hunt, F.G.S.—Attention was called to the presence of large detached blocks of stone over an area extending from S.S.W. of the Start to S. of the Eddystone. One of these blocks in Torquay was stated to weigh 9¼ cwt., another not landed measured 3 feet 6 inches. They consisted of granite, conglomeritic grit, serpentine, and abbrogubbon.

A paper *On the Site of a Palæolithic Implement Manufactory at Crayford, Kent*, by Mr. F. C. Spurrell, was read by Prof. Dawkins. This occurred in brick-earths containing a large number of extinct mammalia, and on the same horizon with them. They were probably manufactured on the spot, by the old dwellers, and belong to the same type as the implements of St. Acheul. Many of the specimens when found were completely shattered, and the fragments were united by Mr. Spurrell.

On the Island of Torghatten, Norway, and on the Influence of Joints on Denudation, by Prof. W. J. Sollas. Describes a conical or hat-shaped mountain, traversed by a tunnel 600 feet in length, through which the light can be seen. The rock is compact gneiss, *roche moutonées* occur up to the level of the platform, which terminates slightly below the entrances to the tunnel, which are somewhat lower than the centre. Attributes its origin to mechanical disintegration, aided by joints.

On the Contortion of a Quartz Vein in Mica Schist from Bodö, Norway, by Prof. W. J. Sollas. Describes excessively contorted band of quartz between foliation planes.

On the Geological Age and Relations of the Sewalik and Pikermi Vertebrate and Invertebrate Faunas, by W. T. Blanford.—The deposits from these two areas have both been referred to the Miocene, and contain an analogous fauna. The Sewalik beds are a portion of a great Tertiary area crossing India from Assam to Sind. The lower beds are nummulitic and marine, the upper series entirely freshwater. Of 48 genera in the Sewalik fauna, with 93 species in the Siwalik area, 12 are peculiar, 4 genera do not occur higher than the European miocene, 25 genera are recent, including cats, dogs, bears, true elephants, antelopes, and sheep. The lower Manchhar mammalian fossils were shown to be older than the Sewalik series, but are newer than the Upper Miocene, and therefore the Sewalik series is referable to the Pliocene. The Sewalik fauna contains six reptiles, of which three are still living. Ruminants are numerous in both the Sewalik and the Pikermi deposits; the latter rest on a bed with Pliocene marine mollusca. Suggests as the climate grew colder in Pliocene times the Miocene mammals migrated southwards.

On the Relations to be established between Coast-line Direction represented by Great Circles on the Globe and the Localities marked by Earthquakes in Europe, by Prof. J. P. O'Reilly.—Refers to the rectilinear direction of coast-lines as that between Carnsore and Wicklow heads, this if produced and regarded as part of a great circle which passes through the Dykes of Southern Scotland and corresponds to the east coast-line of Scotland north of the Firth of Tay, the Carnsore coast-line direction being strictly parallel to the strike of the rocks west of it, and of the termination of the great masses of granite of Kilkenny. Refers to the linear direction of the limit of earthquake-movement in Southern Sweden, and he suggests the similarity of direction in coast-lines and the boundaries of earthquake-movement have the relation to each other of cause and effect, the coast-line being the result of slips along the lines of weakness produced by earthquakes.

On the Sandstones and Grits of the Lower and Middle Series of the Bristol Coal-fields, by E. Wethered.—These carboniferous sandstones are composed of angular grains, those of the Millstone Grit being the least so. He describes an intermediate stage between grit and soft clay as "hard duns," of a hardness of 7, being a rock that scratches glass. The Brandon Hill grit yielded on analysis 98·5 per cent. of silica; it is used for mining purposes and for brickmaking. The thickness of the Pennant grit is 970 feet, associated with coal-measures of 2,000 feet thickness. He regards the "Pennant grits" as a local deposit, and as occurring on more than one horizon. The "Duns" contain more alumina, and he considers the silicates (except the silicates of alumina) by the action of carbonic acid gas.

A paper *On the Hiatus said to have been found in the Rocks of West Cork*, by Mr. G. H. Kinahan, was read by Mr. Ussher.—The following classification was given:—

Griffiths	Prof. Jukes	Prof. Hull
Carboniferous slate.	Carboniferous slate.	Carboniferous slate and Coomhoola grit.
Yellow Sandstone.	Upper Old Red.	Kiltorcan beds.
Old Red Sandstone.	Lower Old Red.	Glengariff beds (Silurian).
Silurian.	Glengariff grit.	

The author rejects Prof. Hull's view, that an important hiatus and unconformability occurs above the Glengariff beds, and he considers that a complete sequence of formations occurs from the Silurians up to the Carboniferous.

Note on the Range of the Lower Tertiaries of East Suffolk, by Mr. W. H. Dalton, was read by Mr. Whitaker.—Describes sections obtained in deep wells and borings through the drift. One at Yarmouth proved the chalk to be 500 feet from the surface; between the drift and the chalk there being no less than 300 feet of Lower Tertiaries. These wells also prove the surface of the chalk to be an inclined plane beneath the Tertiaries, and the surface of the Tertiaries beneath the drift also obeys the same law. At Brandfield the chalk was found at 48 feet below the mean sea-level.

Proof of the Organic Nature of Eozoon Canadense, by Mr. Charles Moore.—Refers to the opinion of Prof. Moebius, of Kiel, of specimens supplied him by Dr. Carpenter, that the eozoonal structure is referable to the mineral kingdom, which view is also taken by Dr. Otto Hann of Ruthlengen, and describes his own examination of a specimen of Laurentian rock from Canada, supplied him by Dr. Carpenter, and of others by Mr. J. Hind. A specimen weighing twenty grains was decalcified and placed in stoppered bottles in water filtered through asbestos; this when magnified was found to reveal a clear siliceous-looking fibroid growth of organic structure of black gum and olive colours. These curled fibres can only be compared to a bit of polished golden wire. They are formed of three round golden close-set columns. It is not a parasitic shell, for when dry it is rigid; but when moist, curved and curled specimens are flexible. They are not unlike the pedicle to which the capsule of some Rhizopoda are attached; but in such a case they must have been devoured by the eozoon, which is not probable. In addition there is another organic structure, not thicker than a spider's web, like mycelium growth of the present day, and also anomalous bodies, possibly the ova, or gemmules of forams. Refers to a similar mycelium growth, as in Eozoon found on nummalites; also similar structures in the Globigerina of the *Challenger* dredgings from the bottom of the Atlantic.

On the Post-Tertiary and Glacial Deposits of Kashmir, by Lieut.-Col. Godwin-Austen.—Refers to the work done by Mr. F. Drew. The author is of opinion that certain deposits containing human remains were deposed by a lake, still existing, but formerly of larger dimensions. Refers the older beds to the age of the upper conglomerates of the Upper Sewaliks. He referred to the deposits at different heights on the banks of the Indus, extending up to eighty feet above the river, forming cliffs or bluffs with angular, probably glacial, deposits. The next terraces occurred at 120 feet, and these again had still higher beds above them, and the author believes the whole of the series reach not less than 1,000 feet in thickness.

On the Fault-Systems of Central and West Cornwall, by J. H. Collins.—Fifteen distinct fault-systems, and possibly far more; the older system is newer than the Carboniferous; when the earliest was produced, the country was much the same as it is now. The granite juction-faults are always filled up with schist; these oldest faults are succeeded by the elvan veins; these cut a fissure in the slate rock, which has been bent and distorted, and often faulted; these are nearly all of precisely the same age. The tin-lodes are the next, followed by a second system, crossing the older in an oblique direction. Of still newer date are the east and west copper veins. The eighth system is also copper, known as the Caunta copper lodes. Then followed the ninth system, or cross-courses, running north and south, generally only containing oxide of copper and quartz. The later lodes never contained tin; in the last only quartz. The fifteenth set are the "alluvial faults;" the ancient alluvial tin gravels are traversed by them.

On the Geology of the Balearic Islands, by Dr. Phené.—Refers to the cave deposits in the grottos of Antiparos and of the almost mountainous dimensions of the external deposits called Pambuk Kalesi at Hierapolis, in Anatolia. He describes the superb caverns near Artâ, la Cueva de la Hermita, in Majorca. The southern portion of the island is Miocene, the more northern begins on the east with a sea-coast of Devonian, followed by Triassic and Jurassic deposits, again succeeded by Devonian. The cave occurs in a fragment of Miocene cliffs. In its vast size and its magnificent columns of uniform thickness it may be compared with the proportions of Westminster Abbey; its dimensions are exceedingly vast, and its lines resemble Gothic and Moorish architecture in their delicate traceries.

On some Pre-Cambrian Rocks in the Harlech Mountains, by Dr. Hicks.—Describes the Cambrian area of the Harlech Mountains, where he considers rocks occur equivalent to the felsitic group of Bangor of pre-Cambrian age, and he believes the Harlech rocks of Prof. Sedgwick rest on these ancient rocks, which form a part of a very ancient anticlinal, the conglomerates at the base of the Harlech group being derived from the felsitic pre-Cambrian rocks beneath.

On the Action of Carbonic Acid on the Limestone, by Prof. Boyd Dawkins, F.R.S.—Caves in the limestone are to be looked upon as subterranean watercourses, which are produced partly by the dissolving action of the carbonic acid in the rainwater, and partly by the mechanical action of the streams flowing through them. The insoluble carbonate of lime in the rock is changed into the soluble bi-carbonate and carried away in solution. The additional atom of carbonic acid, however, is in a condition of unstable chemical combination, and if it be removed either by evaporation or by the action of the free current of air, the insoluble carbonate of lime is at once deposited. Hence it is that some caverns have their walls covered with a drapery of stalagtite and the little straw-like pendants from the roof formed round the edges of each drop gradually become developed into columns of various sizes. The stalagmitic pedestals also rise from the floor where a line of drops falls from the roof and ultimately unite with the column let down from above. On the surface, too, of the pools an ice-like sheet of stalagmite gradually shoots across from the sides, and sometimes where the water is still covers the whole surface. Admirable illustrations of all these processes are to be seen in the caves of Pembrokeshire, and especially in the Fairy Cave on Caldy Island.

The rate of the accumulation of carbonate of lime depending primarily upon the access of water and the free access of air, both being variable, varies in different places. Sometimes it is very swift, as for example in the Ingleborough Cave, where a series of observations by Prof. Phillips, Mr. Farrar, and the author extending over the years from 1845 to 1873 give the annual rate at ·2946 inch. It is obvious therefore that all speculation as to the antiquity of deposits in cases which are based on the view that the accumulation is very slow is without value.

The mountain limestone ravines and passes are to be viewed in the main as caverns formed in the manner above stated, which have lost their roofs by the various sub-aërial agents which are ever at work attacking the surface of the limestone. If any of these be examined, it will be seen that the tributary caves open on their sides, and in some cases the ravine itself is abruptly terminated by a cavern.

On a Raised Beach with Diluvial Drift in Rhos Sili Bay, Gower, by Prof. Prestwich.—This beach is coextensive with a cliff 1½ mile in length, at the south-west corner of the peninsula of Gower. The cliff is 50 to 80 feet in height, sloping from the top to the parallel range of Old Red Sandstone, consisting of red sandstones and quartz conglomerate. The cliff consist of lenticular, rudely stratified, re-arranged material 40 to 50 feet in thickness; contains neither shells nor bones, and rests on a well-rolled raised beach, with pebble from the Carboniferous limestone, coal-measures, and other measures, its average thickness 8 to 10 feet, but occasionally it is piled up much higher; it contains shell of *Littorinus*, *Purpura lapillus*, *Turritelæ terebra*.

Prof. Prestwich also read a paper *On the Geological Evidence of the Submergence of the South-West of Europe during the Early Human Period*.—Refers to the residual deposits, consisting of gravel, fragments of rock, exhibiting little or no bedding; of this group is the "Warp" of the Rev. Mr. Trimmer, the "Trail" of Rev. O. Fisher, the result of great cold and weathering; "Head," by Mr. Godwin-Austen, derived from cliffs during severe climate; others have referred it to the denudating action of ice and snow, rain action, and to "waves of translation." All these groups the author correlates; in early days all superficial deposits were referred to the "diluvial theory" of Dr. Buckland. Refers to old river terraces proving the gradual wearing away of the valleys; but the author would revive a portion of the old "diluvial theory" for certain other deposits. He groups the Loess, warp, head, trail, and alluvial deposits occupying the centres of broad valleys, into one group, produced by a flood caused by a great temporary submergence of the land and its subsequent re-elevation, which spread material without rounding the fragments. Coarse *débris* always to be traced from higher to lower levels; shells are rare, *débris* is local, and these beds cover all others, at all levels. Refers to the "warp" of the Thames, as difficult to distinguish from London clay, gradually becoming more gravelly on the lower slopes, and merging into the ordinary valley gravels. The trail lying on the gault of Maidstone was then described, capping the hill, and following down the slope of the hill with an increasing thickness on the lower slopes.

The "trail" of the Severn derived from the northern hills is spread over the central flat regions, and forms the Cotswolds to the east. "Head" is stated to cover all the old beaches of the south of England and of Wales, as at Rottingdean, and Berling Gap, near Worthing, the low cliff behind the South-Eastern station at Dover, both sides of the Bristol Channel, between Calais and Blanc Nez, reaching a thickness of 80 to 100 feet, the height being limited only by the heights of the ground between. The beach often contains erratic boulders, and he refers the raised beach to a period during the glacial episode, but at a time when the present coast-line had obtained. Sangatte Cliff contains delicate land shells and the remains of the mammoth; ground palæolithic implements. Others occur at Cherbourg and in the Isle of Ré; between there and Gibraltar none are known to occur, though they possibly may be present.

Refers to the clay-gravel or head overlying the raised beach of Portslade, between Brighton and Chichester as containing land shells, palæolithic implements, and bones of land animals; raised beach and head of Guernsey; these deposits and others on the French chalk, Belgium, and the Rhine country he considers to be due to causes other than the deposition of fluviatile material, marine deposits, ice or snow slopes or ice-cap. The *débris* is not a talus, for it slopes as a small angle and increases in thickness in retreating from the hill and slope. The submergence destroyed the palæolithic man and many of the older animals, and amounted to more than 1,000 feet.

Prof. W. J. Sollas read papers *On a Striated Stone from the Trias of Portishead; On the Action of a Lichen on Limestone*, and *On Sponge Spicules from the Chalk of Trimmingham, Norfolk.*

On the Geological Literature of Wales, by Mr. W. Whitaker, who gave a list of all the publications that have referred to Welsh geology from the seventeenth century to 1873, containing more than 500 entries.

Sketch of the Geology of British Columbia, by Dr. G. M. Dawson, jun., describes littoral deposits of Miocene age, capped by volcanic rocks in the Queen Charlotte Islands. Cretaceous rocks from the Upper Neocomian to the Upper Chalk, equivalent to the Chico group of California, yield the bituminous cols of Manaimo; anthracite occurs at a somewhat lower horizon. The pre-Cretaceous rocks are contorted and disturbed, and those of Vancouver Island are probably of Carboniferous age, and are associated with volcanic deposits; rocks probably Huronian occur in Queen Charlotte Islands. In the Rocky Mountains are Carboniferous and Devonian limestones and Triassic sandstones.

Notes on the Occurrence of Stone Implements in the Coast Laterite, South of Madras, and in High-level Gravel and other Formations in the South Mahratta Country, by Mr. R. Bruce Foote.—The author describes high-level (partly laterite) gravels of fluviated and lacustrine origin in the basin of the Gatpratha, and Malprabha tributaries of the Kistna in the South Mahratta country yielded large numbers of several types. He then alluded to the occurrence of well-shaped implements, chiefly of the pointed oval type, and made of hard siliceous limestone, in a great talus of limestone and Deccan trap block cemented by calcareous tufa into a great breccia-conglomerate. This occurs along the foot of the hills north of Kistna and west of Soorapoor, in the Nijam's territory. The implements were found worked out in gullies.

On the Pre-Glacial Contour and Post-Glacial Denudation of the North-West of England, by Mr. De Rance, F.G.S., Assoc. Inst. C.E.—The country described is that lying between the Silurian mountains of North Wales and the Lake District, and bounded east by the Carboniferous hills of the Pennine chain. The plains of Lancashire and Cheshire lying at their feet are deeply covered with glacial drift, reaching in one instance, near Ormskirk, a thickness of no less than 230 feet. The deep valleys of the Lake District had attained their present proportions before the Glacial epoch, during which the lakes were excavated, in the case of Windermere, to a depth of 230 feet, or deeper than the English Channel between Boulogne and Folkestone, the bottom of the lake being 100 feet beneath the sea-level. In the valleys of the mountain country the marine glacial deposits are not present, having been re-excavated out by later glaciation, where originally present. In Lancashire, Cheshire, and Flintshire the marine drift occupies an extensive area, and valleys like those of the Ribble and the Irwell, nearly 200 feet in depth, have been excavated in and through them; occasionally the bottom of the valley is beneath the sea-level, pointing to the land being higher in pre-glacial times. A terrace of post-glacial deposits fringes the glacial area at, and often below, the sea-level, consisting of peat with a forest at the base, resting on a marine post-glacial deposit; the peat-beads are found beneath the sea-level to an extent, in one case, of about 70 feet, and it was pointed out that an elevation of this amount would connect Lancashire, Cheshire, and much of North Wales with the Isle of Man.

SECTION D—BIOLOGY

Mr. Gwyn Jeffreys moved and Prof. Rolleston seconded a vote of thanks to Dr. Günther for his address, which was supported by Dr. Sclater. Prof. Rolleston suggested that in every large town a small rate should be levied in favour of a local museum, which is actually done in Liverpool. He also insisted on the importance of a lecture-room in connection with the national natural history collections.

On the Classification of Cryptogams, by Alfred W. Bennett.—In the most recent classification of cryptogams, that by Sachs, in the fourth edition of his "Lehrbuch," he divides Thallophytes (including characeæ) into four classes of equal rank, Protophyta, Zygosporeæ, Oosporeæ, and Carposporeæ. It is proposed in the present paper to retain Sachs' class of Protophyta for the lowest forms of vegetable life; but to restore the primary division of the remainder of thallophytes into Fungi and Algæ, as being more convenient to the student, and at least as much in accordance with probable genetic affinities.

Asre gards minor points the characeæ are removed altogether from thallophytes, and again constituted into a separate group of the first rank; the myxomycetes are regarded as presenting a low type of structure, scarcely raised above the protophyta, and not exhibiting true sexual conjugation; volvox and its allies are removed from the zygosporeæ to the oosporeæ; and the phæosporeæ are separated off as a distinct order from the fucaceæ.

The thallophytes are therefore first of all divided into three primary classes:—PROTOPHYTA, FUNGI, and ALGÆ. The protophyta are divisible into two sub-classes, *Protomycetes* and *Protophyceæ*. The protomycetes consist of a single order, the schizomycetes, of which saccharomyces is regarded as an aberrant form. The protophyceæ are composed of the protococcaceæ (including palmellaceæ and scytonemeæ), nostocaceæ, oscillatorieæ, and rivularieæ. The *Myxomycetes* are treated as a supplement to the protophyta. The fungi are made up of three sub-classes, employing in the main the same characters as Sachs, but, in their terminology, using the syllable "sperm" instead of "spore." The first division, the *Zygomycetes* (or zygospermeæ achlorophyllaceæ), is composed of the mucorini only (including the piptocephalidæ). The second, the *Oomycetes* (or oospermeæ achlorophyllaceæ), comprises the peronosporeæ and saprolegnieæ (including the chytridiaceæ). The third, the *Carpomycetes* (or carpospermeæ achlorophyllaceæ), is made up of the uredineæ, ustilagineæ, basidiomycetes, and ascomycetes, the lichenes being included in the last as a sub-order. The algæ are arranged under three corresponding sub-classes. The *Zygophyceæ* (or zygospermeæ chlorophyllaceæ) is made up of the following orders:—Pandorineæ, hydrodictyeæ, confervaceæ (under which the pithophoraceæ may possibly come), ulotrichaceæ, ulvaceæ, botrydieæ, and conjugatæ (the last comprising the desmidieæ, diatomaceæ, zygnemaceæ, and mesocarpeæ). The *Oophyceæ* (or oospermeæ chlorophyllaceæ) includes the volvocineæ, siphoneæ (with the nearly allied dasycladeæ), sphæropleaceæ, œdogoniaceæ, fucaceæ, and phæosporeæ. The *Carpophyceæ* (or carpospermeæ chlorophyllaceæ) is made up of the coleochæteæ and florideæ.

The CHARACEÆ constitute by themselves a group of primary importance. The MUSCINEÆ are unchanged, comprising the *Hepaticæ* and *Musci* (including sphagnaceæ). In VASCULAR CRYPTOGAMS it is proposed to revert to the primary distinction into *Isosporia* and *Heterosporia* as most in accordance with probable genetic affinities. The isosporia consist of the filices (including ophioglossaceæ), lycopodiaceæ, and equisetaceæ. The heterosporia comprise the rhizocarpeæ and selaginellaceæ. In the terminology of the heterosporia the inconvenience and incorrectness are pointed out of the use of the terms "macrospore" and "macrosporangium;" and it is proposed to call the two kinds of spores and their receptacles respectively *microspore, megaspore, microsporangium*, and *megasporangium*; or better, in reference to their sexual differentiation, *androspore, gynospore, androsporangium*, and *gynosporangium*.

A Reformed System of Terminology of the Reproductive Organs of the Cryptogamia, by Alfred W. Bennett and George Murray.

—After giving illustrations of the present chaotic state of cryptogamic terminology, the authors proceed to state that the object they have kept in view is to arrive at a system which shall be symmetrical and in accordance with the state of knowledge, and which shall at the same time interfere as little as possible with existing terms. A few new terms are introduced, but the total number is greatly reduced.

In the fourth edition of his "Lehrbuch" Sachs defines a "spore" as "a reproductive cell produced directly or indirectly by an act of fertilisation," reserving the term "gonidium" for those reproductive cells which are produced without any previous act of impregnation. The practical objections to this limitation of terms are pointed out, and it is proposed to restore the term *spore* to what has been in the main hitherto its ordinary signification, viz., *any cell produced by ordinary processes of vegetation, and not by a union of sexual elements, which becomes detached for the purpose of direct vegetative reproduction*. The spore may be the result of ordinary cell-division or of free cell-formation. In certain cases (*zoospores*) its first stage is that of a naked mass of protoplasm; in rare instances it is multicellular, breaking up into a number of cells (*polyspores*, composed of *merispores*, or breaking up into *sporidia*). Throughout thallophytes the term is used in the form of one of numerous compounds expressive of the special character of the organ in the class in question. Thus, in the protophyta and mucorini we have *chlamydospores;* in the myxomycetes, *sporangiospores;* in the peronosporeæ, *conidiospores;* in the saprolegnieæ, oophyceæ, and some zygophyceæ, *zoospores;* in the uredineæ, *teleutospores*, *æcidiospores*, *uredospores*, and *sporidia;* in the basidiomycetes, *basidiospores;* in the ascomycetes (including lichenes), *conidiospores*, *stylospores*, *ascospores*, *polyspores*, and *merispores;* in the hydrodictyeæ, *megaspores;* in the desmidieæ, *auxospores;* in the volvocineæ and mesocarpeæ, *parthenospores;* in the siphoneæ and botrydieæ, *hypnospores;* in the œdogoniaceæ, *androspores;* in the florideæ, *tetraspores* and *octospores*. The cell in which the spores are formed is in all cases a *sporangium*.

In the terminology of the male fecundating organs very little change is necessary. The cell or more complicated structure in which the male element is formed is uniformly termed an *antheridium*, the ciliated fecundating bodies *antherozoids* (in preference to "spermatozoids"). In the florideæ and lichenes, the fecundating bodies are destitute of vibratile cilia; in the former case they are still usually termed "antherozoids," in the latter "spermatia," and their receptacles "spermogonia." In order to mark the difference in structure from true antherozoids, it is proposed to designate these motionless bodies in both cases *pollinoids;* the term "spermogonium" is altogether unnecessary, the organ being a true antheridium.

A satisfactory terminology of the female reproductive organs presents greater difficulties. The limits placed to the use of the term spore and its compounds require the abandonment of "oospore" for the fertilised oosphere in its encysted stage anterior to its segmentation into the embryo. The authors propose the syllable *sperm* as the basis of the various terms applied to all those bodies which are the immediate result of impregnation. It is believed that it will be found to supply the basis of a symmetrical system of terminology which will go far to redeem the confusion that at present meets the student at the outset of his researches. For the unfertilised female protoplasmic mass, it is proposed to retain the term *oosphere*, and to establish from it a corresponding series of terms ending in *sphere*. The entire female organ before fertilisation, whether unicellular or multicellular, is designated by a set of terms ending in *gonium*.

In the zygomycetes and zygophyceæ, the conjugated *zygospheres*, or contents of the *zygogonia*, constitute a *zygosperm;* in the oomycetes and oophyceæ the fertilised *oosphere*, or contents of the *oogonium*, is an *oosperm;* in the carpophyceæ the fertilised *carposphere*, or contents of the *carpogonium*, constitutes a *carposperm*. In this last class the process is complicated, being effected by means of a special female organ which may be called the *trichogonium* (in preference to "trichogyne"). The ultimate result of impregnation is the production of a mass of tissue known as the *cystocarp* (or "sporocarp"), within which are produced the germinating bodies which must be designated *carpospores*, since they are not the direct results of fertilisation. In the carpomycetes no similar process is at present known. Any one of these bodies which remains in a dormant condition for a time before germinating is a *hypnosperm*. In the cormophytes (characeæ, muscineæ, and vascular cryptogams) the fertilised *archesphere*, or contents of the *archegonium*, is an *archesperm*.

In the basidiomycetes, ascomycetes, and some other classes, it is proposed to substitute the term *fructification* for "receptacle," for the entire non-sexual generation which bears the spores.

In the discussion which followed, Prof. Rolleston and Prof. I. B. Balfour took part, the latter objecting to the proposed alterations in classification and terminology in several points. He believes all the schizomycetes to be degraded ascomycetes, and prefers Sachs' classification of the vascular cryptogams. He also objected to the use of the term "sperm" in the sense proposed.

Further Remarks on the Mollusca of the Mediterranean, by J. Gwyn Jeffreys, LL.D., F.R.S.—At the Bradford Meeting of the Association in 1873 I made some remarks on the Mollusca of the Mediterranean, and gave a list of those species which had not yet been noticed as Atlantic, being then 222 in number. Since that time many of the species have been discovered in the Atlantic, or been ascertained to be varieties of other well-known Atlantic species. This list will be found in pages 113 to 115 of the Report. I will now give a list of those Mediterranean species which are also Atlantic, or varieties of other species, on the authority of the Marquis de Monterosato, the Marquis de Folin, Dr. Fischer, the Rev. Mr. Watson, and myself.

BRACHIOPODA.—*Argiope cordata*, Risso; *Thecidium mediterraneum*, Risso. CONCHIFERA.—*Pleuronectia lævis*, Jeffreys, a monstrosity of *Pecten similis; Mytilus minimus*, Poli; *Nucula convexa*, J. = *L. ægensis*, Forbes, young; *Leda oblonga*, J. = *L. micrometrica*, Seguenza; *L. subrotunda*, J. = *L. minima*, Seg.; *Solenella cuneata*, J. (*Malletia*); *Venus cygnus*, Lamarck = *V. nux*, Gmelin; *Pecchiolia insculpta*, J. (*Verticordia*). GASTROPODA.—*Emarginula adriatica*, O. G. Costa; *Trochus scabrosus*, J. = *T. gemmulatus*, Philippi; *Fossarus costatus*, Brocchi; *Rissoa caribæa*, D'Orbigny; *R. rudis*, Ph.; *R. maderensis*, J.; *Cæcum chiereghinianum*, Brusina = *C. glabrum*, Montagu, variety; *Vermetus triquetra*, Bivona; *Scalaria cantrainei*, Weinkauff; *Odostomia polita*, Biv.; *O. tricincta*, J.; *O. fasciata*, Forb.; *Eulima microstoma*, Brus.; *E. jeffreysiana*, Brus.; *Natica dillwynii*, Payraudeau; *N. marmorata*, H. Adams; *Solarium pseudoperspectivum*, Brc.; *Xenophora mediterranea*, Tiberi; *Cerithium costatum*, Da Costa; *C. elegans*, De Blainville; *Triton seguenzæ*, Aradas and Benoit = *T. nodifer*, Lam., var.; *Lachesis folineæ* (*Delle Chiaje*) Ph.; *Cassidaria echinophora*, Linné; probably *C. tyrrhena*, Chemnitz, is a variety; *Defrancia hystrix*, De Cristofori and Jan.; *Pleurotoma pusilla*, Scacchi = *P. multilineolata*, Deshayes, var.; *Cypræa physis*, Brc.? *Utriculus striatulus*, J.; *Akera fragilis*, J.; *Diphyllidia lineata*, Otto; *D. pustulosa*, Sc. Total 41 species.

This reduces the number of supposed exclusively Mediterranean species from 222 to 181; and it must be borne in mind that the Atlantic Nudibranchs and Cephalopods have never been completely worked out. Philippi's list of Mediterranean Nudibranchs and Verany's list of Mediterranean Cephalopods amount to 58 out of the above residue of 181. When further researches by dredging have been made in the North Atlantic, I believe the difference between the Mollusca in that extensive ocean and in the Mediterranean will be still more diminished, if it do not in time altogether disappear.

THE MEETING OF THE IRON AND STEEL INSTITUTE AT DÜSSELDORF

THE recent meeting of the Iron and Steel Institute at Düsseldorf was peculiarly interesting, as illustrating the international character of the Society, and also because of the opportunity which it afforded to English members of studying German workshops and methods of manufacture. The papers which were read were mostly by German authors, and dealt with many subjects of importance to those interested in the manufacture of iron and steel. Many of them were of too technical a character to be noticed at length in these pages, but as an exception we may mention the paper on "The Dephosphorisation of Iron in the Converter," by Herr J. Massenez of Hoerde in Westphalia.

This subject has received great attention at the recent meetings of the Institute, but not more so than its importance deserves. We referred at length to the basic process of dephosphorising pig iron, when reviewing the proceedings at the spring meeting, and the paper now before us contains a most satisfactory record of results since attained, together with much valuable information as to the chemical changes which take place during the conversion. The method is best known by the names of the

inventors, Messrs. Thomas and Gilchrist, and its great importance lies in the fact that it enables Bessemer steel and a very pure homogeneous iron to be produced from the poor class of phosphoric iron ore which abounds in the Cleveland district and also in the basin of the Saar, and in Lorraine and Luxembourg, which ores have not hitherto been available for the production of steel, on account of the difficulty of eliminating the phosphorus, the presence of which element is well known to be highly detrimental to the quality of the steel. To the Germans this invention is possibly of greater value than to ourselves, on account of the prevalence with them of the poorer class of ore, and the comparative scarcity of hematite.

At the present moment five German companies are working the Thomas-Gilchrist process, and in the course of a few months many others will be in a position to follow suit.

Herr Massenez gives in his paper a series of chemical analyses, showing the composition of the metal at different stages during the blow. The information contained in these tables is also exhibited graphically by diagrams, in which the quantities of the various elements at the different stages are represented by the ordinates of curves. These "show that so long as the silicon is in combustion the phosphorus not only is not attacked, it actually increases. First of all, as is well known, the silicon is attacked, and is reduced to a mere trace at the expiration of two minutes. A portion of the carbon burns off at the same time with the silicon; however, only after the silicon is reduced does the carbon curve descend rapidly. The manganese curve is from the commencement to the end of the blow regularly decensional, showing that this body oxidises but slowly. The small quantity of copper disappears after the end of the first minute's blow. Surprising is the fact that the sulphur-curve slowly rises till the commencement of the after-blow, and then only decreases partially, or very slowly, at the latter end of the same. The phosphorus is energetically consumed in large quantities *after* decarbonisation has taken place, and its combustion is the cause of the high temperature at the end of the process. At the commencement of the blow, and during the time the silicon is oxidising, the phosphorus increases in the metal in the proportion as caused by the lessening of the volume of pig iron through the combustion of silicon, manganese, and carbon. After the reduction of the silicon, and during the period the carbon is reduced from 2·72 per cent. to 0·16 per cent., only a fraction of the carbon disappears (from 1·32 per cent. to 1·18 per cent.); afterwards the very rapid combustion of this body takes place, leaving only a trace of the same, a reaction which characterises the whole process."

It is satisfactory to learn from this paper that the chemistry of the process is now thoroughly understood, and that the only difficulties which remain to be overcome are of a purely mechanical nature, and are principally due to the shortness of life of the converter bottoms. The discussion which followed was fully equal in interest to the paper itself, and was taken part in by most of the leading members of the Institute. It bore principally upon the commercial side of the invention, which has hitherto been its weak point. We learn, however, that well-founded hopes are entertained that this last difficulty in the way of a general introduction of the process is in a fair way of being removed.

In our last review of the proceedings of this Institute we noticed a paper by Prof. Akerman, on "The Hardening of Iron and Steel." This paper, which was taken as read at the spring meeting, was discussed at Düsseldorf. Most of the opinions expressed were necessarily of a rather speculative character, for very little is really known as to the *rationale* of hardening and tempering. Many eminent authorities seemed, however, to be agreed that carbon exists in iron and steel in three separate forms, and not in two only, as has hitherto been supposed, and that the hardening is due only to one of these forms. A point of great practical importance was referred to by Mr. Adamson, viz., the prevalent practice of endeavouring to strengthen steel by tempering in oil. This practice was strongly condemned by Mr. Adamson. He maintains that the dipping in oil, though it may increase the tensile strength of the metal, impairs its elasticity and ductility. We commend this opinion to the attention of the authorities at Woolwich Arsenal. It is well known that the steel barrels of all our guns are tempered by immersion in oil, and if Mr. Adamson's statements be correct, it is not to be wondered at that so many disappointing failures have taken place.

The last paper to which we shall refer dealt with the subject of iron permanent way. It contained an account of the experience obtained on the German state railways of the use of iron instead of timber for sleepers. There are few subjects of greater importance to ironmasters than this substitution of iron for woodwork in the permanent ways of railways, for the amount of metal which would thus be consumed is almost incalculable. The paper, which was read by Privy-Councillor Grüthefein, embodies much valuable information as to the different systems of iron permanent way at present in use. From it we learn that there are at the present moment 1,542 kilometres of line in Germany laid with the new description of sleeper, and that the results obtained are so satisfactory that the system is being continually extended. It is interesting to notice that in Germany the new sleepers are mostly laid on the longitudinal plan, a system which has not given satisfaction in this country. In the discussion which followed, the opinion was strongly stated by English engineers that longitudinal sleepers would be absolutely incapable of withstanding the effects of the very heavy and fast traffic of the main lines in this country.

In conclusion we must congratulate the Iron and Steel Institute on the extended sphere of usefulness and the cosmopolitan character which it has gained by going out of the beaten track, and holding an autumn meeting on the Continent.

ANNUAL CONGRESS OF THE GERMAN ANTHROPOLOGICAL SOCIETY

THE Eleventh General Meeting of the German Anthropological Society was held at Berlin during the past month, Prof. Virchow taking the chair and acting as president at each of the six sittings. At the opening sitting, after speeches by Herr von Gossler and the President, in which they reviewed the past and the present condition of the Society, and notably drew attention to its aims and its achievements, Herr Friedel gave a short exposition of his paper "On Prehistoric Discoveries made in Berlin and its Neighbourhood." This was followed by an interesting address from Dr. Schliemann respecting the site of Troy. He re-stated his now well-known convictions, and gave considerable evidence in support of the belief that Homer's Troy was not merely a mythical town, but that it had once actually filled a place in the world's history. "I wish," said the Doctor, "I wish that I were able to prove Homer to have been an eye-witness of the Trojan war. But unfortunately this is impossible. In his day swords were in general use as a weapon, and iron well known as a metal; in Troy, again, swords were unheard of, while of iron the inhabitants knew nothing whatever. So, too, the manners, the customs and the general civilisation which he describes are of an epoch that is centuries later than the one to which the results of my excavations belong. Homer presents to us the legend of Ilium's tragic fate in the form which it had been handed down to him by the bards who had gone before; and, as we have already seen, he invests the traditional account of the war and of the fall of Troy with the colouring of the time in which he lived. Yet he was not without personal knowledge of the actual localities, for his descriptions (both the general one of Troy itself, as also of the plains of Troy in particular) are, if taken as a whole, quite accurate and truthful." At the close of his address, Dr. Schliemann announced his intention of commencing a series of excavations on the site of Orchomenos in Bœotia, the prehistoric capital of the Minyans, on his return to Athens, the Greek Government having accorded him full permission to do this.

At the second sitting, on August 6, after a short address by the President, Prof. Ranke spoke at some length upon the subject of German ethnology and anthropology, pointing out the distinct advance that these sciences had made, and citing, as helps to study, the several important works which had appeared in the country by Lindenschmit, Arnold, Bracht, Poppe, Genthe, v. Sadowski, and other distinguished anthropologists. He specially called attention to the progress that had been made in the science of craniology, it being now nearly always possible to distinguish between a male and a female skull. Prof. Virchow then briefly put forward the proposition that the next (the twelfth) session of the Society should be held at Ratisbon, a town which, for many reasons, he thought was well fitted to serve such purpose. This proposal was carried unanimously; and after an address by Herr Friedel the meeting was adjourned.

Herr Handelmann, at the third sitting, read a valuable paper upon the prehistoric fortresses and earthworks of which traces remain in the Schleswig-Holstein district. This was followed by an address from Dr. Koehl respecting the excavations and prehistoric discoveries that had been made at Meckenheim, near Bonn. Dr. Mehlis, Herr von Jazdzewski, and others also addressed the meeting.

On the following day, August 9, Dr. Kollmann laid before the Society numerous important statistics with reference to the ethnology of Switzerland, and in connection with the division of blond and brunette types, showing where such division may be found to occur. Dr. Tischler's paper upon recent prehistoric discoveries made at Dolkeim, in East Prussia, was also listened to with very great interest.

At the fifth sitting, Herr Fraas, speaking on behalf of the Cartographical Commission, proceeded to show in how far this institution had been of service to the cause of anthropology; he also dwelt upon the need for drawing up accurate maps of the different districts and localities in which prehistoric discoveries had been or would be made.

Pfarrer Dahlem of Ratisbon afterwards addressed the assembly, his subject being, Ratisbon in its relation to archæology past and present. Speaking of the antiquity of the town, he rejected as fabulous the belief of chroniclers that it had been built before the foundation of Rome, or even of Troy, although its early existence is proved by two old Roman finds, the one a military diploma of the time of Marcus Aurelius, dating from A.D. 166, and the other a large block of stone three metres in length and one metre in height, being a fragment of the *porta principalis* of the city. The inscription on this latter clearly sets forth that Marcus Aurelius and his son Commodus had erected the *vallum cum portis et turribus*. As this inscription, from the titles given to the Emperor, was engraved upon the gate either immediately before or closely following the death of Marcus Aurelius, it is indisputable that in the years preceding that time, between about A.D. 170 and 180, the town was built by one of the three legions that the Roman Emperor had recruited from Italy in order to quell an invasion in that part of Germany now termed Bavaria. That this was the probable date may be inferred from the belief that the inscription would surely not have been added until the whole were completed. The lecturer clearly showed that Ratisbon was a town of very great historic interest; the choice of it as a meeting-ground for the next annual conference of the German Anthropological Society is thus in every way a most desirable one.

At the sixth sitting, Prof. Bastian, who was warmly welcomed by his colleagues upon his return from a two years' period of travel, delivered a very eloquent address, in which he pointed out the many difficulties in connection with the study of ethnology and anthropology, and warned his hearers against drawing *à priori* conclusions in dealing with a science that needed such minute and careful research, where the field was so vast, so limitless a one, and where no clue, however slight, could ever afford to be lightly set aside. "We are occupied to-day," said he, in conclusion, "with a science that as yet is in its cradle, one over which the shadow of many centuries must sweep ere it can reach manhood, but which will then clearly and completely set forth that which has been termed 'the knowledge of man about man,' a science which, though it does not solve the deepest problems of our existence, will yet throw a partial light upon them. And in its construction we are merely builders and masons, content if we may but do our humble part towards this one object, the completion of so great and wonderful a work."

After speeches by Dr. Henning, Dr. Montelius, and others, Prof. Undset of Christiania gave an interesting account of the recently-discovered Viking ship that has been excavated from a large burying-mound at Sandefjörd, in the vicinity of Christiania. The mound in question has always been termed "The King's Mound" (*Königshügel*), and until last winter no excavations had ever been attempted there. Under the superintendence of Prof. Nicolaysen, however, operations were then commenced, which resulted in a most interesting and extraordinary discovery. Beneath the hill was found a large ship, seventy-five feet in length, sixteen feet in breadth, and about seven or eight feet in depth. In it a kind of vault had been built, wherein were deposited the remains of some valiant sea-king who, may be, had won his people's love and reverence. The ship had been buried fully rigged, with masts, cordage, sails and rudder all complete, the entire timbers being in a wonderful state of preservation, owing to the fortunate circumstance that the mound had been constructed of a moist clay. In all its details the vessel appears to have been most beautifully finished, and there is no lack of ornamentation. In the hold, together with the human remains, were found the bones of several horses and dogs that had evidently been buried with their master. Prof. Undset considered that the burial must have taken place some time during the tenth century. The ship was conveyed to Christiania, where it was at once placed in the University Museum for Prehistoric Antiquities in that city. Several photographs have been taken of it, and the results of further investigation and research respecting it will shortly be published in a longer and more detailed form.

Herr Ranke then delivered an address upon the prehistoric discoveries that had been made in the caves of Upper Franconia; and Prof. Schaaffhausen of Bonn also spoke with reference to important researches made in the caves at Gerolstein, at Letmathe, and Eiserfey. The interest of this sitting—the final one—centred in the speech of Herr Brugsch Bey, the distinguished Egyptologist, who, in the course of it, pointed to Egypt as a rich and valuable field for prehistoric research.

OUR ASTRONOMICAL COLUMN

SOUTHERN VARIABLE STARS.—In the *Uranometria Argentina* amongst the large number of stars indicated as variable, we find twelve to which Dr. Gould has applied the letters of Argelander's nomenclature, their fluctuations having been determined with greater certainty than some others. The following is a list of these objects arranged in order of right ascension:—

No.	Name.	R.A. 1875. h. m. s.	N.P.D. 1875. ° ′	Limits of Variation.
1	R Sculptoris	1 21 13	123 11·5	5·8–7·7
2	R Eridani	4 49 42	106 37 2	5·4–6·0
3	S Eridani	4 54 7	102 43·4	4⅝–5¾
4	R Puppis	7 36 2	121 22·3	6½–7½
5	R Carinæ	9 29 6	152 14·2	4⅝–10
6	R Velorum	10 1 27	141 34·8	6½–7½
7	R Antliæ	10 4 22	127 7·1	6½–8
8	S Carinæ	10 5 23	150 56·3	6½–9
9	T Carinæ	10 50 18	149 51·2	6½–6¾
10	R Muscæ	12 34 28	158 43·3	6·6–7·4
11	R Centauri	14 7 35	149 19·8	6–10
12	R Triang. Aust.	15 8 37	156 2·1	6·6–7·5

1. Gould describes this as "one of the most brilliantly coloured stars in the heavens"—an intense scarlet, which remains unchanged through all the stages of its light. Maxima occurred early in December, 1872, and in January, 1874. Period about 207 days with symmetric light-curve.

2. Variation independently shown by the estimates of three observers, to the extent of more than half a magnitude; red.

3. 64 Eridani—"certainly variable;" Bessel calls it 8m. in his zones, which Gould conjectures may be owing to clouds, or ? a misprint.

4. Though appearing to the naked eye and even with the opera glass as a single star is in fact a cluster of faint stars = 3094 of Herschel's Cape Catalogue. There is only one star in it brighter than 8½, and Gould assumes that the variations of brilliancy are due to this star alone. The object is Lacaille 2916.

5. Lacaille 3932, noted by him 7m. on March 3, 1752. The intervals between the maxima determined at Cordoba, are respectively 329, 306, and 323 days; the minimum appears to take place considerably more than half a period later than the maximum; red in all stages even while at the tenth magnitude. No epoch of maximum is given.

6. R Velorum. The variable character is beyond question. It is Lacaille 4156.

7. R Antliæ. Estimated near the brighter limit March 19, 1871, and in May, 1872; near the fainter one April 28, 1873, and June 14, 1874.

8. S Carinæ. A reddish star, Lacaille 4189. On May 21, 1874, it was 6·3, and in May, 1877, 8¾, but sufficient observations have not yet been made to determine the law of variation.

9. T Carinæ. Period not yet ascertained. Lacaille 4530.

10. R. Muscæ. Varies through nearly a magnitude in not far from 21h. 20m., the minima preceding the maxima by nine hours; its period is therefore the shortest yet detected amongst the variables, and it becomes an object of unusual interest. At midnight on September 25, 1872, the star was estimated equal

to Lacaille 5079, corresponding to a maximum, and at the same hour on September 30 it was inferior to *i* Muscæ, or very near a minimum. It is Lacaille 5236.

11. R Centauri. The light-curve appears to be irregular ; a maximum of 6·1m. occurred about June 28, 1878, and one about August 3 in the preceding year ; there would appear to be secondary maxima and minima. A period of 525 days with principal maximum April 18, 1871, and two intermediate maxima following the principal one by 197 and 378 days respectively, reconciles most of the observations, but is incompatible with estimates of 6m. made on June 25 and 26, 1874, with the meridian circle.

12. R Trianguli Australis. Varies between 6·6 and about 8·0 in 3d. 9h. 35m., the minima preceding the maxima by about 48 hours. Well-marked maxima occurred 1871, July 14, at 14h., and September 13 about midnight. Minima were observed 1871, July 12, at 14½h., and September 1 at 8½h. Good determinations were made in 1877, but are not printed in the *Uranometria ;* the period 3d. 9h. 35m. is however deduced from a comparison of the observations in 1871 and 1877.

To these stars may be added S Puppis of Lacaille, which designation falls in with Argelander's (R.A. 7h. 43m. 6s., N.P.D. 137° 48′·3) ; it appears to fall nearly to the ninth magnitude, and to rise to about 7¼, but has never been seen at Cordoba sufficiently bright to be admissible in Gould's Catalogue. It is Lacaille 2999.

Also Lacaille 2691 (L_2 Puppis), a red star varying from 3·6 to 6·3 ; Gould infers a period of about 135 days, with a variation rapid at the maximum and comparatively slow near the minimum, which apparently occurs about six days nearer to the preceding than the following maximum. Remarkably red near the minimum.

Ceraski's New Variable Star.—Prof. Julius Schmidt, favoured by the fine sky of Athens, has already determined approximately the period of this star, which appears to be 4d. 23h. 35m. ; he does not think it probable that this interval can be a multiple of a period. The star is in the same category as Algol, δ Libræ, V Coronæ, λ Tauri, and S Cancri, and is without colour. It may be well to note that for some time to come or until the latter part of December the minima will occur during daylight in this country ; one of the first observable may be expected on December 24 about 17h. Greenwich time. The position of the star in the *Durchmusterung* is in R.A. 0h. 49m. 39s., Decl. + 81° 5′·6.

A New Comet.—The discovery of a faint comet by Mr. Lewis Swift is telegraphed from Washington ; position August 11, apparently in about R.A. 172°, N.P.D. 22°.

GEOGRAPHICAL NOTES

Dr. Matteucci sends home some interesting details of the observations made by him in Kordofan during the march of the expedition under Prince Borghese. In Kordofan, he says, water is as dear as the wine of Barletta. In the rainy season however things are different ; from June to September almost every inch of the country is covered with water, when, if one may not die of thirst, there is a chance of his dying of malaria. Vegetation along the line of march of the expedition was as melancholy and infertile as it could well be ; stunted skeleton acacias alternating with a few euphorbias in constant monotony ; neither mountains nor hills, and not even plains. In Kordofan the ground presents continuous undulations, no doubt in consequence of the geological formation of the soil, which is a bottom of sand slightly mixed with peroxide of iron. The water of the rainy season is husbanded in wells, but so valuable is it that the expedition had often to force the natives to give them access to these wells. Kordofan is about 600 metres above the level of the sea, and 380 above that of the Nile. Not a river, not a torrent, not a brook waters this immense territory, which is about 500 miles long and a little less broad. The mean temperature is not less than 92°. At the surface the ground is so sandy that animals on the march sink to a depth of 30 centimetres. The rains are irregular and never abundant. Some years ago there were no wells in Kordofan ; the want of water was not felt, for the natives, in the rainy season, collected the water in large reservoirs, and a sufficient quantity was found in them at each station and village. But the seasons, even in Africa, tend to change. Eight years ago there was no rainy season in Kordofan, and for several months the people feared they would all die of thirst. Then they thought of digging wells, which gave very good results. Everywhere water was found at a depth of 20 inches. But things have sadly changed during the past eight years, and now, instead of finding water at a depth of 20 inches, it is often not found at a depth of 160 feet. In all the wells Dr. Matteucci found the following succession of strata :—From 50 to 30 metres of depth, sand with traces of sulphate of lime ; above 30 extends the granite, with a great abundance of quartz in proportion to feldspath and mica. The granitic mass rarely exceeds one metre in thickness, and above is again found the sand.

By letters from Senegal published in the French papers we learn that the survey of the country between the Senegal and the Niger is in progress. Three different topographical parties have been formed to determine the position of the intended ports and the route of railway intended to connect the two streams. The work must be quite finished by the month of May, 1881.

Recent letters from Ladakh, according to the Indian papers, state that some Yarkand traders have arrived there, having accomplished the journey from Yarkand to Leh, a distance of 515 miles, in thirty-two days. These men report that they met Mr. Ney Elias, the well-known traveller, on the ascent of the Sasser Mountain. The Sasser Pass, which lies at an elevation of 17,500 feet, is nine stages distant from Leh, on the summer route to Yarkand, by way of the Karakoram. The traders also report that the road beyond the Sasser Pass was in good condition and free from snow early in May. They state that the Chinese are quietly established in Yarkand and Kashgar.

M. De La Motte has published as a quarto pamphlet the address which he delivered before the French Geographical Society on July 16, respecting his studies in the basins of the Niles. He has devoted several years to the subject, and has had a special map constructed to illustrate his researches on a scale of 1 : 1,200,000.

Messrs. Cassell, Petter, and Galpin will publish at the end of September the first monthly part of Prof. Ebers' "Egypt : Descriptive, Historical, and Picturesque ;" translated by Clara Bell, with notes by Dr. Birch, of the British Museum. The work will be profusely illustrated, and will occupy about three years in publication.

SCIENTIFIC SERIALS

The *Journal of Anatomy and Physiology, Normal and Pathological*, vol. xiv., part 4, July.—Dr. H. S. Wilson, on the rete mirabile of the narwhal (two plates).—W. J. Walsham, observations on the coronary veins of the stomach (a plate).—Note on the same, by Prof. Turner.—F. W. Bennett, a communication between the air-bladder and the cloaca in the herring.—Prof. M. Watson, the curvatores coccygis muscles of man.—Dr. G. A. Gibson, valvular hæmatoma (plate).—R. Maguire, a contribution to the pathology of macroglossia and hygroma (plate).—Dr. J. Dreschfeld, the changes in the spinal cord after amputation of limbs (plate).—Dr. B. C. Waller, the morbid anatomy of certain forms of post-scarlatina nephritis in relation to their bearing on the histogeny of granular kidney (plate).—Dr. J. G. Naismyth, the antagonism of opium and belladonna illustrated by a case of attempted suicide.—Dr. R. J. Anderson, on an astragalo-scaphoid bone in man.—Dr. Foulis, the mode of healing in wounds under antiseptic dressings.—Prof. M'Kendrick, the respiratory movements of fishes (plate).—G. B. Hones, some points in the anatomy of the porpoise (plate).—Prof. Turner on two masks and a skull from islands near New Guinea (plate).—Dr. D. Newman, the effect of certain anæsthetics on the pulmonary circulation.—H. Bendall, a new method of preserving the colour of tissues.—J. Macdonald Brown, variations in myology.—Dr. G. A. Gibson, anatomical and physiological notes.

Bulletin de l'Académie Royale des Sciences (de Belgique), No. 6.—On the application of the second principle of thermodynamics to the variations of potential energy of liquid surfaces, by M. Van der Mensbrugghe.—Structure of the ovary, ovulation, fecundation, and the first phases of development in Cheiroptera, by MM. Van Beneden and Julin.—An original Ctenides of Brazil found at Liége, by M. Van Beneden.—Account of a case of cestodic tuberculosis, with some observations on the eggs of *Tænia mediocanellata*, by the same.—Difference of appreciations of the apparent size of microscopic objects by different observers, by M. Montigny.

Brain, a Journal of Neurology for July, 1880, contains: Original articles, by Prof. J. C. Dalton, on the form and topographical relations of the *corpus striatum*.—R. P. Oglesby, on nystagmus (gives some very interesting facts relative to symptomatic nystagmus).—Dr. A. Waller, on muscular spasms, known as "tendon reflex."—Dr. J. Hughlings-Jackson, on right- or left-sided spasm at the onset of epileptic paroxysms, &c.—Dr. W. Ireland, on left-handedness.—With critical digests and notices of books, clinical cases, and several abstracts of British and foreign journals; among these latter a note by Allen Thomson on Prof. Carlo Giacomini's method of preserving the brain by chloride of zinc, alcohol and glycerine, which he thinks most valuable.

Rivista Scientifico-Industriale, No. 11, June 15.—Concentrated sulphuric acid is volatile at ordinary temperatures, by Prof. Marangoni.

No. 12, June 30.—On a new apparatus for collecting rain and atmospheric dust, by Prof. Sylvestri.—On the development of the *Forficula auricularia*, Linn., by Prof. Camerano.—Some experiments on the discharge in rarefied gas, by Prof. Righi.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, August 23.—M. Wurtz in the chair.—The following papers were read:—Meridian observations of small planets at the Greenwich and Paris observatories during the second quarter of 1880, communicated by M. Mouchez.—Distinctive character of the pulsation of the heart, according as the right or left ventricle is examined, by M. Marey. During a stoppage in respiration the right heart shows a diminution in amplitude of pulsations, owing to pulmonary resistance, while the left heart shows a slight increase. If through any influence lowering the arterial tension (such as muscular exercise, inhalation of nitrite of amyl, &c.), waves be produced in the aorta, these waves cause in the tracing of pressure of the left ventricle a bifurcation or trifurcation of the summit (according as two or three have occurred during systole). The right ventricle does not show these waves, unless in vestige, and by propagation from the neighbouring part.—Remarkable example of vertically-ascending lightning, by M. Trécul. This was during a storm on Aug. 19. The sparks appeared to come from some lightning conductors in the place. Some rose singly and disappeared at a small height, expanding into a magnificent, nearly circular flash, the light of which diminished from centre to circumference. In one case two luminous columns rose simultaneously and parallel, and at a certain height precipitated themselves against each other at a right angle.—The death of M. Godron, correspondent in botany, was announced.—The sun would act inductively on the earth even if its magnetic power were simply equal to that of our globe. Induction of the moon by the earth and diurnal lunar variation of terrestrial needles, by M. Quet. The induction of the earth by the sun could be insensible only if the magnetic power of the latter were much below that of the former, which is not probable. The induction of the moon due to its revolution round the earth produces an electromotive force twenty-one times less than that the effects of which are rendered sensible by an experiment made on the earth, and consequently is itself sensible. As the induction of the satellite by rotation of the earth is about twenty-seven times greater than the foregoing, the resultant will be a sensible force with sensible reaction on particular earth-currents, leading to a daily variation of needles according to lunar hours.—On the variations of the coefficient of dilatation of glass, by M. Crafts.—On tungstoboric acid, by M. Klein.—On the products of distillation of colophony, by M. Renard.—On the project of establishment of a station for hospitable purposes at the sources of the Ogôoue, by the French Committee of the African Association, by M. Mizon.

August 30.—M. Wurtz in the chair.—The following papers were read:—On *Vitis berlandieri*, a new species of American vine, by M. Planchon.—M. de Lesseps reported the proceedings at the inauguration of the statue to Denis Papin at Blois, on August 29 (when he represented the Academy).—On the dilatation and compressibility of gases under strong pressures, by M. Amagat. He gives a series of laws to which his researches have led.—Observations of a solar protuberance on August 30, 1880, by M. Thollon. A thin, very brilliant jet was observed (about 11 a.m.) to rise near the equator, and nearly at right angles to the sun's limb; its velocity was estimated at 35 km. per second, and its height 343,000 km. It rapidly attained prodigious dimensions, while its brightness diminished, especially near the base. About 1 p.m. it was hardly visible. Curiously, while the lower and middle part of the protuberance gave a deflection of the line C towards the violet, the summit presented a nearly equal deflection towards the red.—On the amylamines of inactive amylic alcohol, by Mr. Plimpton.—The star-fishes of the deep regions of the Gulf of Mexico, by M. Perrier. This is a study of star-fishes dredged by Mr. Alexander Agassiz on board the *Blake* in two consecutive years.—Influence of alkaline or acid media on Cephalopoda, by M. Yung. M. Richet's law regarding crayfish (that acid or basic liquids are not toxical in direct ratio of their acidity or basisity); M. Yung verifies for Cephalopoda. The latter are extremely sensitive to mineral acids. With 0·5 cc. sulphuric, nitric, hydrochloric, or oxalic acid in a vessel holding two litres of water, the respirations of four *Eledone moschata* were raised from twenty-four to numbers varying from thirty to fifty-six per minute. Double the quantity of acid was fatal, except in the case of oxalic acid. Of the other three sulphuric acid is least poisonous. Of the much less powerful organic acids, tannic acid acts most rapidly. The alkalies act in the order given by M. Richet. The action of ammonia is extremely rapid.—Influence of coloured lights on the development of animals, by M. Yung. He confirms for marine animals (at the Naples station) the results he formerly obtained with fresh-water animals. The development of eggs of *Loligo vulgaris* and *Sepia officinalis* is stimulated by violet and blue light, retarded by red and green. Yellow light in this respect comes nearest to white. Contrary to former results, the development, though retarded, is well accomplished in red and green vessels.—On the vaso-dilator nerves of the sides of the mouth, by MM. Dastre and Morat.—On a particular mode of asphyxia in poisoning by strychnine, by M. Richet. The asphyxia first relieved by artificial respiration, is due to two causes, viz. contraction of the tetanised respiratory muscles, and exhaustion of the nervous centres of respiration. But there is another asphyxia resulting from the enormous interstitial combustion in the tetanised muscles, shown by the dark hue of the blood. Hence the necessity of practising artificial respiration very energetically so long as there is convulsive tetanus, so as to replace the oxygen that has disappeared. Substances preventing tetanus (such as chloroform, alcohol, or curare) should also be introduced.—On the intensity of some phenomena of atmospheric electricity observed in the north of the Sahara, by M. Amat. Without insulating himself he could, by passing a pocket-comb through his hair or beard, produce sparks 0·05m. to 0·07m. in length. This was best in the evening after a long ride on the arid plains, in hot, dry weather. Horses present even more striking electrical phenomena in their tails, &c. The electricity liberated by the tails is positive. Man in direct communication with the ground does not show much accumulation of the electric fluid, and friction is necessary to develop it. The fluid accumulates much more on the horse, the horn of the hoofs acting as insulators.

CONTENTS