THURSDAY, SEPTEMBER 24, 1885

PUBLIC OPINION AND STATE AID TO SCIENCE

ALTHOUGH Sir Lyon Playfair's address was probably listened to by a large number of members of the British Association as that of a man of science, there can be no doubt that to the vast majority of people outside it came as the utterance of a practical statesman. It was the Chairman of Committees of the House of Commons, the member of Parliament, the man of affairs who spoke, and the address was largely in keeping with these characters, for, as one writer has expressed it, it smells not so much of the laboratory as of the House of Commons. The subject of the endowment of research, of State aid to science, has been before the public for many years, and has been discussed under various circumstances, but it has never attracted at any one time the same earnest and general attention that it has since Sir Lyon Playfair's address. This is due not less to the pedestal on which the speaker was placed, than to the character and career of the speaker himself. The result has been that the guides and instructors of public opinion all over the country have felt it necessary to address themselves to the subject, and it is therefore possible now to gain some idea of the general drift of the public mind on the question of the claims of science on the State, and of the manner in which these claims should be met. Happily it is a question which men of all shades of opinion can consider without having their vision obscured by party passion and prejudice. As we go on it will be seen that the advocates of the doctrine of *laissez faire* are not absent; but, on the whole, those who have for so long maintained that the country, for the sake of its own happiness and prosperity and in order to maintain its place amongst other nations, must bring the teachings of science to its aid, have every ground for satisfaction.

To gauge public opinion on this question, in some measure, we have taken many of the leading journals of the metropolis, and propose to state briefly their views on this particular part of the Presidential Address. As will be seen, all shades of opinion are represented.

The *Times* acknowledges the reproach that countries less wealthy than our own make efforts to encourage science, by the side of which the encouragement afforded in England to science by the State sinks into insignificance; but it urges that, after all, the State is very much what the individuals who compose it choose to make it. Until public opinion exists in an organised and effective shape, the demand for the encouragement of science by the State will be addressed, for the most part, to a faithless and unbelieving generation. It points, as do a large number of other writers, to our ancient endowments for the benefit of education, and says that, although it may be conceded that they are still largely misapplied, they could be almost indefinitely increased, without direct assistance from the State, if vested interests and lack of intelligent initiative did not so often stand in the way. Until these obstacles are removed by the pressure of an active and enlightened public opinion, the State itself can hardly be expected to do much more than it does. The *Times*, therefore, acknowledges the need, and suggests that it should be met by the proper application of our existing educational endowments.

The *Standard* is as anxious as the President to see our Universities fully, and even lavishly, equipped for the prosecution of research; but it will not allow that they are so miserably starved as he would lead us to believe:—

"Sir Lyon Playfair falls into the vulgar error of reckoning as national expenditure on a given object only the outlay provided from taxation. Our Universities have resources which ought to be set against the State provision made in other countries for the same purposes. We are not, therefore, disposed to join in the outcry against the results of our English system. We believe that private benefactions and private enterprise have done much and are capable of doing more, and doing it better, than the State can do. We are not ashamed of the condition of scientific studies in England, and we claim for our countrymen a leading place among those who have built up the fabric of knowledge and promoted the well-being of man."

The *Daily Telegraph* likewise refers to private munificence which in the past has done in this country what State aid has to do at present in Continental countries, and it urges that scientific people should set before themselves, as their proper aim, to convince public opinion that the teaching of a far greater amount of science is necessary in our schools which are richly enough endowed.

The *Morning Post* maintains that Sir Lyon Playfair has conclusively demonstrated that we do not in respect to scientific education keep abreast of other countries, and in the same proportion as we allow ourselves to be distanced do we deny ourselves the means and the opportunities of developing our industrial and physical resources The money laid out in the manner indicated by Dr. Playfair, it says, would be well expended, and would in time be returned a hundredfold to the Imperial Exchequer.

The *Daily News* regards the address as singularly interesting and practical. It is a powerful and, as many will think, a conclusive plea for giving science a larger and a better place in modern life. Sir Lyon Playfair is a practical statesman, and suggests only practical measures. We must not only greatly enlarge our educational machinery, but must at the same time modernise it and bring it into direct relation to modern needs.

The *Morning Advertiser* eulogises the address because every word of it is directed to the one moral, "Educate, educate, educate." Never has the cause of scientific education been urged in a manner which commends itself more to common sense and conviction than in the singularly well-reasoned monologue wherein Sir Lyon Playfair, from the platform of the British Association, hits a national danger at the same time that he shows the means of correcting it.

The *Pall Mall Gazette* pronounces a verdict in favour of Sir Lyon Playfair as clearly and decidedly as the *Morning Post*. It says:—

"No one will be surprised that Sir Lyon Playfair should have selected for the subject of his address the 'Relation of Science to the State,' and when that is once explained it goes without saying that he made a very cogent plea for an establishment and endowment of science. This plea, it is perfectly certain, cannot be much longer refused. The Laissez-faire Society must add a new section to it betimes, for it is inevitable that the liberty of ignorance, which is impoverishing the life of the country at home and letting its trade slip through its fingers abroad, should soon be very rudely interfered with by the State. At present it is a case in this matter of Great Britain *contra mundum*. Every other civilised country has come to the conclusion by this time that the competition of the world is now a competition of intellect, and has taken steps accordingly. Either we or they must be wrong; and that it is we is now being brought home to us by the conclusive 'argument to the pocket.' John Bull's one ambition, according to Mr. *Punch*, is to 'guard his pudding;' but then he is beginning to find out that he can only fill his stomach by first filling his head. From the recognition of the vital importance of science to its establishment by the State—in a much less half-hearted fashion than at present—is in these days a short and inevitable step. The same considerations by which State interference has been justified elsewhere—its greater certainty, its ampler resources, its wider range—are all equally applicable here, and will come to be equally applied."

The *Globe* says the "argument" of the address may be conceded. Science deserves from the State all that the State can do for her. Minerva is a sort of alien deity in our intellectual Pantheon, and it is certain that the tendency and pressure of modern conditions impose upon all civilised States, an increasing obligation to learn or to lag. But it questions whether we really are in the evil plight depicted by the President, and points to "the magnificent private endowments of our insular foundations"—a source of revenue comparatively non-existent abroad, which, it states, Sir Lyon Playfair strangely ignores.

The *St. James's Gazette* thinks that reformers might bend some of their energies to seeing that more technical science and more arts likely to be useful to the craftsman and the mechanic, were brought within the curriculum of the Board Schools. For them we could easily spare some of the literary subjects:—

"With the moral of Sir Lyon Playfair's scientific sermon, and the journalistic lectures based on it, most people will agree. This is an age of science, and you can do nothing effectual in the practical way, from building ironclads to catching mussels, without a knowledge of what are called 'the laws of nature.' If you do not want your ironclads to be sunk by those of other navies, or your mussel trade to be ruined by foreign competition, you will do well to see that the 'laws of nature' are properly studied in your schools and colleges. That technical education in this country is not so good as it might be, and as it possibly is elsewhere, may be admitted."

But it does not think that this is due to superabundance of classics in our system of middle and higher-class education.

The *Guardian*, at the conclusion of a lengthy article devoted to the address, sums up its conclusions on the subject of the relations of the State to science thus:—

"On the whole we are inclined to think that the best service the State can render to education is to continue to help it in the unsystematic and irregular way which has hitherto proved so useful, considering each case as it arises, and adapting its measures to the particular needs which are brought before it. Much more may, no doubt, be done for Science, but it may be done in the same way as before, by grants for special purposes, by expeditions fitted out for costly investigations, perhaps by the foundation of professorships and scholarships. But it would be a misfortune if the free action of individual thought were repressed by being obliged to conform to the rules of a State-imposed system, or if individual exertion and private munificence were discouraged by the habit, already growing upon us too much, of looking to the State rather than to ourselves for the removal of every difficulty and the promotion of every useful end."

The *Athenæum*, refers to what has been done by the State for science since the last meeting of the British Association at Aberdeen twenty years ago, and instances the Science and Art Department, the Natural History Museum, grants to the Royal Society, &c., proceeds:—

"All this—and much more might be added—shows that British statecraft is not altogether disposed to frown coldly upon science and its devotees. And yet, after all, how little—how miserably little—has been officially done for the promotion of science compared with the magnitude of our scientific interests and the wealth of our country! It is only by looking abroad and observing what has been accomplished in other lands that we realise our own shortcomings. Germany and France, Switzerland, and some of the other small continental States, have displayed a zeal for scientific progress and a liberal recognition of science which strikingly contrast with our own parsimony. Even when we have undertaken a good work our heart has often failed us in carrying it through with dignity and liberality. As a striking and recent example we may refer to the *Challenger* expedition. Here was an expedition splendidly equipped for scientific work at the expense of the nation; and yet, when the results of the expedition come to be published as voluminous reports, they are distributed with so sparing a hand, and are published at so high a price, as to be practically inaccessible to most men of science."

The *Saturday Review* says that Sir Lyon Playfair's words are tempered by the consciousness that he may some day be called upon to make them good, and this adds the greater force to the adverse verdict which he is compelled to give, the censure which he cannot help pronouncing on the action of the State towards science in England. The reply to the question, What has the State done directly for science? the answer is, But little compared with the need, and that little often in the wrong way. As the pocket is said to be the most sensitive part of our race, it is to be hoped that when the British Association next meets in Aberdeen its future president will not be forced to repeat Sir Lyon Playfair's assertion: "English Governments alone fail to grasp the fact that the competition of the world has become a competition in intellect."

The *Spectator* speaks of the address as like a sermon preached by a popular clergyman on behalf of science, and wants to know why this branch of thought needs help so much more than art, literature, or pursuits like archæology, or the study of the historic past. It doubts whether in science, as in an army, honourable poverty does not conduce to the highest efforts; and whether richly endowed schools will produce the most successful professors, even in the inferior domain of applied science Wheatstone was great, and was paid? but how much a year, it asks, did Friar Bacon get? or did any body ever pay that early expert in natural science who discovered fire?

"And remembering what the history of thought has been, we cannot but deprecate that spirit of sordidness in which for some years past the claims of science have been pressed—the desire for salaries which has been so conspicuous whenever professors have descanted on the merits of research. We have not the slightest objection to scientific departments, and quite agree with Sir Lyon Playfair that if the State wants fishes it could learn how to get them better by inquiring of the fishes—who, at least, tell no lies—than of the fishermen, who often do; but still the picture he draws of the United States Government, with its dozen departments of inquiry into geology, palæontology, ichthyology, chemistry, and the rest, does not inspire us with enthusiasm. It is all very excellent, no doubt; but it was all consistent with slavery. France may be handed over to Paul Berts and its judges still take bribes."

The *Glasgow Herald* pronounces Sir Lyon Playfair's address a signal success. Those pedantic persons who fail to see the uses of science might find in the address an admirable lesson against the perpetual sneering at what they are pleased to term the abstractions of scientific teaching. Sir Lyon, in a word, has emphasised the teaching that the safety and the progress of every country are one with scientific advance and the growth of scientific precision.

On the whole, then, it may be pronounced that the movement in favour of State aid to science, in the interest of the State itself rather than of any particular branch of human knowledge, has advanced and has taken a hold of the public mind. The need is universally acknowledged; in many quarters it is proposed to meet it by the application of endowments, ancient and modern, to the changed requirements of the present day; in others—and these amongst the influential—it is boldly declared that the State must link itself, at whatever cost, with science if this country is to hold its high place amongst nations. "The same considerations by which State interference has been justified elsewhere—its greater certainty, its ampler resources, its wider range—are all equally applicable here, and will come to be equally applied."

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 insure the appearance even of communications containing interesting and novel facts.*]

The New Star in Andromeda

On seeing the report in yesterday's *Standard* of the remarkable change in the nucleus of the nebula of Andromeda, I decided to write to you to mention that, accidentally noticing the nebula on Sunday evening, the 6th, I was struck by its conspicuousness, and set wondering how the ancients came to overlook an object so prominent. As frequent watching for meteors has made that region very familiar to me, it seems likely that an increase in general brightness has occurred, and made me specially notice its appearance.

What is of far more interest, however, I have learnt this morning that one of our scholars, Lawrence Richardson, noted and *recorded* an apparent change in the nebula, as he saw it in our 4¼ inch Cooke's refractor, about 9 p.m. September 1. I append a *verbatim* copy from his diary of what is perhaps the first English observation of this remarkable phenomenon.

J. Edmund Clark

Friends' School, Bootham, York, September 9

(Copy) "Sept. 1 . . . As a beginning [of the season's work] looked at Polaris, ε Lyræ and the great nebula of Andromeda. Noticed a small star in the centre of the latter which I do not remember having seen before, and which is not down in a small drawing I made on September 15, 1884.

Norwegian Testimony to the Aurora-Sound

How widespread in our days is the belief in the sound of the Aurora in Norway, the following may show. In March, 1885, I despatched some thousand circulars to all parts of the country containing different queries regarding the aurora, and amongst these also the following:—Have you or your acquaintances ever heard any sound during aurora, and, in this case, when and in what manner? Up to this date I have received answers to these queries from 144 persons in different parts of the country. Of these there are not less than 92, or 64 per cent., who believe in the existence of the aurora-sound, and 53 (36 per cent.) of these again state they have heard it themselves, whilst the other 39 cite testimonials from other people; only 21 (15 per cent.) declare they never have heard the sound or know anything about it, and the other 31 (22 per cent.) have not noticed the query at all. There are thus 92 affirmations against 21 negations.

The sound is described in these answers in the following manner:—

Sizzling (3)
Creaking or sizzling
An intermediate sound between sizzling and whizzing, sometimes as if a piece of paper were torn
A kind of sound as when you tear silk
Sizzling, th—ss
Soft whizzing, alternative with sizzling
Soft crackling, sizzling
Hissing and crackling
Partly hissing, partly as a kind of rushing whiz
Whispering and glistering
Strong whiz (3)
Whiz or whispering
Whiz, or distant, soft, continuous whizzing
A rather heavy rush, as from a distant waterfall
Quiet whizzing, hissing
Hissing, or hoy! hoy! hoy!
Whiz (2)
Rush, as from a stream
Soft but distant crackling, as from a lighted match-cord
Whizzing (5)
Whizzing in the air
Rush, as when sheep are chased
Soft whiz or hissing
Soft whiz
Soft hissing, soft whiz
Whizzing or whistling
Rippling
Crackling (4)
Hissing
Hissing noise in the air
Crack in the air
Din in the air
Continuous sounding, rolling din in the air
Clashing
Flapping, as a flag before the wind
Partly as rustling or flapping of sails hanging loose fore the wind, partly as hissing from fire
Like the noise from a distant, before the wind-flapping flag, which now and then sends out a creaking sound
Like the sound from sails of a ship hanging loose in stormy weather
Monotonous whizzing and creaking, as when a sheet flaps before the wind
Like burning juniper-boughs
Brustling or crackling as if burning juniper
As from a feeble burning flame
Like burning dried juniper
As from the flames of a conflagration
Cutting, hissing as from flames
Crackling and creaking, a noise as from a large fire-flame—as, for instance, burning dried boughs
Like the sound from a flight of birds
Noise as when a bird flaps in the air
Strong flapping noise, as when a bird passes very near you
Crackling from fire and flapping from wings
As of a bird flying through the air with great velocity
Whizzing noise, as when striking the air with a whip
Noise as from the dart of an arrow
Like the buzzing of a bee
Roaring noise, as when strong gushes of wind dart through the tree-tops of the wood
Creaking sound as from the blowing of the wind
Distant roar, as from a storm
Roaring as from a storm
Roaring as from a whirlwind
As from a soft-blowing wind
Soft breeze
Like the soft breeze through a wood
Whipping with whisk-brooms
Fanning
Soft noise, as when fanning with a piece of paper from a distance
Soft flapping with a piece of cloth
Roaring of the sea
Heavy, hollow roar from the sea
Sweeping sound, as when dry snow is sweeping over an ice-field
As when one holds a cloth by two corners and flaps with it

Creaking, at other times, as when a sail strikes against the mast or flaps before the wind	As when a thunder-clap passed over us from west to east
	Soft crackling, as from electric sparks from an electrical machine
Partly whizzing, partly as when a sail flaps before the wind	As when stroking a cat's back against the hairs
As when a sail flaps before the wind	

Christiania, September 16 SOPHUS TROMHOLT

A White Swallow

DURING our walk to-day on the Kendal Road, near Heversham, my brother and I were very much surprised to see a white swallow amongst a number of the ordinary kind. The bird's plumage was entirely white, except the lower part of the breast, which was greyish.

We are quite sure of its identity, as it flew around us several times.

Can you tell us whether a white swallow is really an uncommon sight? MARY BRIGGS

Sandside, near Milnethorpe, Westmoreland, September 4

THE HUME COLLECTION OF ASIATIC BIRDS

FOR some time past the interest of ornithologists has been aroused by the rumour that Mr. A. O. Hume, of Simla, had offered, or intended to give, his celebrated collection of Asiatic Birds to the Trustees of the British Museum; and I am glad to be able to inform the readers of NATURE that the whole of this collection is now safely housed in the Natural History Museum, the second half having been delivered by the P. and O. Company on the 18th of last month.

Those of our readers who are not ornithologists may wish to learn something in the first place about the collection itself and its generous donor.

Mr. A. O. Hume, C.B., occupied formerly a high position in the Bengal Civil Service, and devoted for many years his leisure hours to the study of ornithology, and especially of the birds of India. His aim was to form a collection of birds of every part of the British Asian Empire, in which every species should be represented by a complete series of specimens illustrating its range and its variations of colour according to age, season, or locality. For this purpose he organised a system under which a great number of local observers and collectors (in some years numbering nearly 100) worked for and with him. He fitted out expeditions with a staff of collectors and taxidermists, under his own leadership or that of his able former curator, Mr. Davison, into Scinde, Coorg, Manipur, the Malayan Peninsula, Tennasserim, and the Andaman and Nicobar Islands; he acquired by purchase or donation the Mandelli collection from Sikkim and Tibet, Brook's beautiful series from North-Western and Central India, Adam's Sambhur birds, Bingham's collections from Delhi and Tennasserim, Scully's collection from Turkestan. The expense incurred in forming this collection was in proportion to the enthusiasm with which Mr. Hume worked. He had built at Simla a museum for the reception of the collection which should finally form the basis for the preparation of a comprehensive work on the avifauna of the vast region which he was exploring. But whilst thus engaged Mr. Hume, with his wonderful activity and ready pen, which had rendered him *facile princeps* in all matters regarding Indian ornithology, published numerous papers in an ornithological periodical, *Stray Feathers*, which he founded and conducted for ten or eleven years, as well as several separate works—viz. "Notes on the Indian Raptores," "Nests and Eggs of Indian Birds," "List of the Birds of India," "Game Birds of India, Burmah, and Ceylon," and others.

However, during the last few years naturalists, to their great regret, became aware that Mr. Hume's interest in ornithology began to yield to other important matters of social and political nature; and finally, the grievous loss by theft of an enormous mass of ornithological manuscripts, comprising his materials for "The Birds of the British Asian Empire," and the whole of his Museum Catalogue, contributed to his determination to abandon his intention of working out his collection, and to present it to some museum where others might utilise the materials he had collected.

It is very gratifying that Mr. Hume, "considering the British Museum as the one that has most claims upon him, and Mr. Sharpe as the man most capable in Europe of doing justice to the collection," offered to present it to the Trustees of that institution. The Trustees, fully aware of the scientific importance of the collection, had no hesitation in accepting the offer. Still, before actually transferring the collection, Mr. Hume was desirous of completely rearranging and placing it in thorough good order, and also of preparing at the same time a Catalogue of the Birds of the Indian Empire containing the results of his long and careful studies. Unfortunately this project could not be carried out owing to the difficulty of finding a competent coadjutor in the work, or rather of obtaining the means of properly remunerating such a person. And as there was great risk in leaving the collection without due curatorial supervision exposed to the deteriorating influences of another rainy season in India, the Trustees obtained Mr. Hume's consent to transmitting the collection without further delay to England.

Mr. Sharpe, who is always ready to sacrifice his personal comfort to duty, started for Simla almost at a moment's notice, and although, unseasoned as he was, he had to travel and work during the hottest part of the year, he seems to have infused his energy into all who had to help him in the gigantic task of packing the collection. He started on April 25, arrived in Simla on May 21, completed his work by the end of June, and returned to the Museum on August 15, having the satisfaction to find on his return the half of the collection which had preceded him safely lodged in the Museum, while the other half was delivered a week later without loss of, or damage to, any of the cases.

The collection comprises about 400 skins of mammals, 63,000 skins of birds, 300 nests, and 18,500 eggs. It was packed in eighty-two cases, the majority with a capacity of 30 cubic feet. Even to those who are used to the inspection of large collections, these figures can hardly convey a correct idea of the magnitude of this addition to the National Museum. Mr. Hume may truly say that such a collection has never been made before; and such will probably never be made again. Each specimen is enveloped in a brown paper wrapper with the name of the species and locality written on the outside, proper labels being, besides, attached to the specimen. The skins themselves are in excellent condition, and, thanks to the precautions taken by Mr. Sharpe, they are not likely to harbour or to develop destructive inmates. Specimens which had suffered from damp or insects and to which no special interest was attached, were eliminated during packing.

The scientific value of the collection, of course, is not to be measured by the number of specimens only, but by the judgment which determined their selection, by the history attached to many of them, and by the completeness of the series. We may reasonably assume that it contains about 2000 species, so that on an average each species is represented by some thirty specimens, which number in the majority of the cases would not go beyond a fair illustration of its range and variation. Therefore the number of duplicates which will be eliminated by Mr. Sharpe during the progress of the examination will probably be much smaller than one might anticipate on a superficial inspection; and I need not say that Mr. Hume's earnest wish that the series which he has brought together with so much discrimination and care should remain intact, will be strictly carried out. No doubt a considerable number of duplicates will be eliminated, and, according to the wish of the donor, of these a complete set has to be transmitted to the Museum of Comparative Zoology of Harvard College, whilst the remainder are to be utilised for the benefit of the ornithological collection generally.

Ornithologists need not go many years back in recalling to their memory the extent of the collection which the late Mr. G. R. Gray had arranged in such a handy fashion in and about his study in the old building at Bloomsbury. What was then regarded a good reference collection has since been enriched by the addition of the Wallace collection from the Indian Archipelago, Capt. Pinwill's Malayan birds, Sharpe's African collection, the Gould collection, Salvin and Godman's European, Australian, and American collections, the Sclater collection, and now by this immense collection from every part of the Indian Empire. Years of unremitting labour will be required to get these vast materials into order and to work them out in a manner which will satisfy the aims of so advanced a branch of science as ornithology is at the present day.

ALBERT GÜNTHER

THE FORSTER HERBARIUM

BOTANISTS will learn with pleasure that this herbarium, a portion of the collections of Cook's second voyage, has been acquired by exchange from the Liverpool Corporation for the Kew Herbarium; and it will be incorporated in the general collection. From the introduction to the "Catalogue of Plants" in the Botanic Gardens at Liverpool, published in 1808, it appears that the proprietors of that establishment possessed, at that date, about 3000 specimens of dried plants, "collected by the late Dr. Forster in his voyages to the South Seas, with large and valuable contributions from his friends and correspondents." How these plants came into their possession is uncertain, but they could hardly have been presented to them by Mr. Shepherd, the Curator, as stated by Sir Joseph Hooker in the introductory essay to his "Flora Novæ-Zealandiæ," or his name would almost certainly have been mentioned as the donor. At least this may be inferred, because on the very next page a very high tribute is paid to Mr. John Shepherd for his services to the Garden. Be that as it may, the collection will shortly be accessible to botanists generally, thanks to the perseverance of Sir Joseph Hooker and the sensible view of the matter taken by the present members of the Corporation when it was represented to them that these dried plants were practically useless where they were, but would be valuable at a botanical establishment like Kew. This act of the Corporation deserves to be recorded, because some thirty years ago, when Sir Joseph Hooker was engaged writing his "Flora Novæ-Zealandiæ," he applied to the then custodians of the collection to transmit it temporarily to Kew for comparison and publication, and his request was refused.

Botanical investigations in connection with the *Challenger* expedition again brought to mind the existence of this interesting collection at Liverpool, and it was determined to make another effort to rescue it from oblivion, which was fortunately successful. A few words respecting the botanical collections of Cook's voyages generally, and of this one in particular, will be welcome to those interested in botany. Sir Joseph Banks and Dr. Solander accompanied Capt. Cook on his first voyage round the world; John Reinhold Forster and George Forster, father and son, were the botanists of the second voyage (1772–75), and Mr. Anderson, the surgeon of the expedition, collected a little on the third voyage. From a statement in Sparmann's "Travels in South Africa," it seems that Forster the elder undertook the duties of naturalist to the expedition for the sum of 4000*l.*, and he took his son with him, then only seventeen years old, as an assistant. On arriving at the Cape of Good Hope they fell in with Sparmann, who, at the instance and expense of Forster, was added to the scientific staff, and continued with them until the return to the Cape in 1775. Considerable collections of plants were made in New Zealand, many parts of Polynesia, and the extreme south of America, and smaller collections in some of the Atlantic Islands, including St. Helena, Cape Verd Islands, and Canaries. On returning to England the Forsters soon commenced publishing the botanical results of the expedition, and an authenticated set of all the published plants at least was deposited in the British Museum. The Cape plants, however, which they did not publish, are apparently not represented there. The first botanical work, "Characteres Genera Plantarum," appeared in 1776, and the title-page bears the names of both father and son, and this was the only one published in England. For the rest, the botany was done by the son alone. His "Florula Insularum Australium Prodromus" appeared at Göttingen in 1786, and "De Plantis Esculentis Insularum Oceani Australis" at Berlin in the same year, followed by "De Plantis Magellanicis et Alanticis" at Göttingen in 1787.

These works, we believe, constitute the whole of the published botany of the expedition, and, though very meagre, are extremely interesting, being the foundation of our knowledge of New Zealand, Antarctic, and Polynesian vegetation. The collection now acquired for Kew is excellently preserved, and the plants mostly named and localised. It comprises altogether 1359 species, 785 of which were collected on the voyage with Cook, and the rest, from various parts of the world, are probably some of those alluded to above as having been presented to Forster by his friends. The collection includes a large proportion of the plants published by the Forsters, but it is not complete. Roughly, there are 187 species from Polynesia, 119 from New Zealand, 21 from the extreme south of America, 23 from the Atlantic Islands, including all those described by Forster from St. Helena, and 9 from Australia. Besides the foregoing, which are all phanerogams, there are 36 ferns, but they include only a small portion of the species described by Forster.

In addition to this botanical work George Forster's name appears on the second title-page of the Narrative of the second voyage as joint author with James Cook. He died, a violent death, we believe, at Paris in 1794, four years before the decease of his father. The philosophical writings of the latter, entitled "Observations made during a Voyage round the World," London, 1778, deserve special mention. W. BOTTING HEMSLEY

THE INTERNATIONAL METEOROLOGICAL COMMITTEE

THIS Committee held its third meeting in Paris at the Ministry of Public Instruction on September 1 to 8. The Meeting was attended by the President, Prof. Wild (Russia); the Secretary, Mr. R. H. Scott; Profs. Buys Ballot (Holland), Hann (Austria), Mascart (France), Mohn (Norway), Dr. Neumayer (Germany), and Prof. Tacchini (Italy). M. de Pinto Capello (Portugal), the only remaining member, was unfortunately unable to be present.

In addition certain gentlemen were present by invitations at some of the meetings, among these we may mention Brigadier-General Hazen (Chief Signal Officer, U.S.A.), Prof. Hildebrandsson (Upsala), and M. Leon Teisserenc de Bort.

The following is a brief notice of the most important subjects discussed, with the action taken on each.

A valuable report on cirrus observations by the Committee appointed at Copenhagen (1882), MM. Capello, Hildebrandsson, and Ley, was submitted, and will be printed.

The subject of Atlantic telegrams was discussed with General Hazen. It was decided to maintain the present system of reports from ships' logs which has been carried on since Christmas by the Meteorological Offices of France and this country, and to endeavour to improve it.

At the same time a proposal made by M. L. Teisserenc de Bort for the telegraphic transmission of a daily *résumé* of the weather in the New England States was considered. General Hazen expressed perfect readiness to furnish such reports, and it was resolved to procure such telegrams provided the cost of the service could be guaranteed by the European offices which would participate in it.

It was decided to recommend that barometrical observations should be corrected for the force of gravity at lat. 45°.

A letter from General Hazen respecting the reduction of barometer readings to sea-level, which has been lately circulated, was considered, and two memoranda on the subject from Hamburg and St. Petersburg respectively were handed in and will be printed.

It was considered *desirable*, as absolute synchronism in weather observations appears to be unattainable in Europe, that the same hours of local time should be adopted in each country (which would mean a change from 8 a.m. to 7 a.m. in this country).

It was decided that each of the International Reduction Tables (proposed by the Committee at its meeting at Berne in 1880) as did not involve any question which is still in an undecided state (such as, *e.g.*, hygrometrical tables, or tables of sea-level reduction) should be published.

It was decided to recommend that the next Congress should not take place till 1889, and Prof. Mascart stated that probably the French Government would propose that it should be held in Paris.

THE BRITISH ASSOCIATION

JUDGED by the quantity of work which the sections have put through their hands the Aberdeen meeting has been successful almost beyond precedent. Moreover much of this work has been of the best quality. The addresses come up to a very high standard, and in the first four sections, at least, not a few of the papers were really important original contributions to science, while the discussions in Sections A and B on certain great questions in physics and chemistry were a marked and commendable feature—a feature which, it is hoped, will in time become common to all the sections. Mr. Murray's lecture on deep-sea research has been justly considered one of the leading events of the meeting; a full report will appear in our columns.

At the concluding general meeting a deservedly hearty vote of thanks was accorded to the Aberdonians for their abundant hospitality. Birmingham seems determined to make next year's meeting a memorable one; and we may remind our readers that Sir William Dawson, of McGill College, Montreal, will be the President.

The total number of persons who attended the Aberdeen meeting was 2203.

The following is a synopsis of grants of money appropriated to scientific purposes by the General Committee at the Aberdeen meeting. The names of the members who would be entitled to call on the General Treasurer for the respective grants are prefixed :—

A—*Mathematics and Physics*

*Foster, Prof. G. Carey—Electrical Standards	£40
*Stewart, Prof. Balfour—Solar Radiation	20
*Stewart, Prof. Balfour—Meteorological Observations at Chepstow	25
Darwin, Prof. G. H.—Instructions for Tidal Observations	50
*Stewart, Prof. Balfour—Comparing and Reducing Magnetic Observations	40
*Forbes, Prof. G.—Standards of Light	20
*Brown, Prof. Crum—Ben Nevis Observatory	100
*Armstrong, Prof.—Physical and Chemical Bearings of Electrolysis	20

B—*Chemistry*

M'Leod, Prof.—Silent Discharge of Electricity into Atmosphere	£20
*Williamson, Prof. A. W.—Chemical Nomenclature ...	5

C—*Geology*

*Blanford, Mr. W. T.—Fossil Plants of the Tertiary and Secondary Bed	20
Hughes, Prof. T. McK.—Caves of North Wales ...	25
*Etheridge, Mr. R.—Volcano Phenomena in Japan ...	50
*Grantham, Mr. R. B.—Erosion of Sea Coasts	20
*Bannerman, Mr. H.—Volcanic Phenomena of Vesuvius	30
*Evans, Dr. J.—Geological Record	100
*Etheridge, Mr. R.—Fossil Phyllopoda	15

D—*Biology*

*Stanton, Mr. H. T.—Zoological Record	100
*Murray, Mr. J.—Marine Biological Station at Granton..	75
*Lankester—Prof. Ray—Zoological Station at Naples ...	50
Cleland, Prof.—Researches in Food Fishes at St. Andrew's	75
*Cordeaux, Mr. J.—Migration of Birds	30
Cleland, Prof.—Mechanism of Secretion of Urine ...	10

E—*Geography*

Walker, General J. T.—New Guinea Exploration ...	150
Walker, General J. T.—Investigation into Depth of Permanently Frozen Soil in Polar Regions	5

F—*Economic Science and Statistics*

Sidgwick, Prof.—Regulation of Wages under Sliding Scales	10

G—*Mechanics*

Barlow, Mr. W. H.—Effect of Varying Stresses on Metals	10

H—*Anthropology*

Garson, Dr.—Investigation into a Prehistoric Race in the Greek Islands	20
*Tylor, Dr. E. B.—Investigation into North-Western Tribes of Canada	50
*Galton, Mr. F.—Racial Characteristics in British Isles..	10
	£1195

* Reappointed.

REPORTS

Report of the Committee, consisting of Mr. Robert H. Scott (Secretary), Mr. J. Norman Lockyer, Prof. G. G. Stokes, Prof. Balfour Stewart, and Mr. G. J. Symons, appointed for the purpose of co-operating with the Meteorological Society of the Mauritius in their proposed publication of Daily Synoptic Charts of the Indian Ocean from the year 1861. *Drawn up by Mr. R. H. Scott.*—The Committee forward, for the inspection of the members of the Association, a copy of the charts for the month of March, 1861, with some specimens for January of the same year, and the complete number for February which appeared some years ago. These documents have recently arrived from the Mauritius. As the work has now made decided progress the Committee have applied for and obtained the grant of 50*l.* placed at their disposal by the General Committee. As soon as the requisite documents are received from Dr. Meldrum the Committee will submit a formal account of their expenditure with the necessary vouchers.

Second Report of the Committee, consisting of Prof. Schuster (Secretary), Prof. Balfour Stewart, Prof. Stokes, Mr. G. Johnstone Stoney, Prof. Sir H. E. Roscoe, Capt. Abney, and Mr. G. J. Symons, appointed for the purpose of considering the best methods of recording the direct Intensity of Solar Radiation.—The Committee have come to the following conclusions :—(1) It seems desirable to construct an instrument which would be a modification of Prof. Stewart's actinometer adapted for self-registration—the quantity to be observed being, not the rise of temperature of the enclosed thermometer after exposure for a given time, but the excess of its temperature when continuously exposed over the temperature of the envelope. (2) As the grant to the Committee will not admit of the purchase of a heliostat, it will no doubt be possible to procure the loan of such a instrument, and, by making by its means sufficiently numerous comparisons of the instrument proposed by the Committee with an ordinary actinometer, to find whether the arrangement suggested by the Committee is likely to succeed in practice. The Committee would therefore confine their action for the present to the carrying out of such a series of comparisons. (3) The size of the instrument might be the same as that of Prof. Stewart's actinometer. (4) The instrument should have a thick metallic enclosure, as in the actinometer above-mentioned, and in this enclosure there should be inserted a thermometer to record its temperature. Great pains should therefore be taken to construct this enclosure so that its temperature shall be the same throughout. (5) The interior thermometer should be so constructed as to be readily susceptible of solar influences. It is proposed to make it of green glass (a good absorber), and to give it a flattened surface in the direction perpendicular to the light from the hole. (6) It seems desirable to concentrate the sun's light by means of a lens upon the interior thermometer, as in the ordinary instrument. For if there were no lens the hole would require to be large, and it would be more difficult to prevent the heat from the sky around the sun from interfering with the determination. Again, with a lens there would be great facility in adjusting the amount of heat to be received by employing a set of diaphragms. There are thus considerable advantages in a lens, and there does not appear to be any objection to its use.

Third Report of the Committee, consisting of Profs. G. H. Darwin and J. C. Adams, for the Harmonic Analysis of Tidal Observations. Drawn up by Prof. G. H. Darwin.—"Record of Work during the past Year." The edition of the computation forms referred to in the second report is now completed, and copies are on sale with the Cambridge Scientific Instrument Company, St. Tibbs' Row, Cambridge, at the price of 2*s.* 6*d.* each. Some copies of the first report, in which the theory and use of these forms are explained, are also on sale at the same price. A few copies of the computation forms have been sent to the librarians of some of the principal scientific academies of Europe and America. In South Africa, Mr. Gill, at the Cape, and Mr. Neison, at Natal, are now engaged in reducing observations with forms supplied from this edition. A memorial has been addressed to the Government of the Dominion of Canada, urging the desirability of systematic tidal observation, and the publication of tide-tables for the Canadian coasts. There seems to be good hope that a number of tide-gauges will shortly be set up on the Atlantic and Pacific coasts, and in the Gulf of the St. Lawrence. The observations will probably be reduced according to the methods of the British Association, and the predictions made with the instrument of the Indian Government. Major Baird has completed the reduction of all the tidal results obtained at the Indian stations to the standard forms proposed in the Report of 1883, and Mr. Roberts has similarly reduced a few results read before the Association by Sir William Thomson and Capt. Evans in 1878. All these are now being published in the *Proceedings* of the Royal Society, in a paper by Major Baird and myself. A large number of tidal results have been obtained by the United States Coast Survey, and reduced under the superintendence of Prof. Ferrel. Although the method pursued by him has been slightly different from that of the British Association, it appears that the American results should be comparable with those at the Indian and European ports. Prof. Ferrel has given an assurance that this is the case; nevertheless, there appears to be strong internal evidence that, at some of the ports, some of the phases should be altered by 180°. The doubt thus raised will probably be removed, and the paper before the Royal Society will afford a table of reference for all—or nearly all—the results of the harmonic method up to the date of its publication. The manual of the tidal observation promised by Major Baird is now completed, and will be published shortly. This work will explain fully all the practical difficulties likely to be encountered in the choice of a station for a tide-gauge, and in the erection and working of the instrument. Major Baird's great experience in India, and the success with which the operations of which he has had charge have been carried out, render his advice of great value for the prosecution of tidal observation in other countries. The work also explains the method of measuring the tide diagrams, entering the figures in the computation forms, and the subsequent numerical operations.

Second Report of the Committee, consisting of Prof. Balfour Stewart (Secretary), Mr. J. Knox Laughton, Mr. G. J. Symons, Mr. R. H. Scott, and Mr. Johnstone Stoney, appointed for the purpose of cooperating with Mr. E. J. Lowe in his project of establishing a Meteorological Observatory near Chepstow on a permanent and scientific basis.—Since their re-appointment in 1885 this Committee have met twice, and have placed themselves in correspondence with Mr. Lowe, to whom the following letter was written by their Secretary: "The Committee request me to point out to you that the main feature of your proposal, which interests the British Association and the scientific public generally, is the prospect which it holds out of the establishment of a *permanent* institution, by means of which meteorological constants could be determined, and any secular change which may take place therein in the course of a long period of years be ascertained. It will be for you and the local authorities to decide what amount of work of *local interest* should be contemplated, and on this will the scale of the observatory mainly depend. The Committee are therefore unable to say what amount of capital would be required. They would point out four conditions which they hold to be indispensable:—(1) The area of ground appropriated should be sufficient to ensure freedom from the effects of subsequent building in the neighbourhood. (2) A sufficient endowment fund of at least 150*l.* annually should be created. (3) The control should be in the hands of a body which is in itself permanent as far as can be foreseen. (4) The land for the site shall be handed over absolutely to the above-mentioned governing body. Until the precise amount of the local meteorological requirements is ascertained and further progress is made in the scheme the Committee consider that they would not be justified in any more prominent action than that which they have already taken.

Report of the Committee, consisting of Profs. A. Johnson (Secretary), J. G. MacGregor, J. B. Cherriman, H. T. Bovey, and Mr. C. Carpmael, appointed for the purpose of promoting Tidal Observations in Canada.—The Committee, in order to strengthen their representation to the Canadian Government on the necessity of establishing stations for continuous tidal observations, deemed it well to get the opinions of Boards of Trade and ship-owners and ship-masters. On inquiry it appeared that the Montreal Board of Trade were at the very time considering the question, which had been brought independently before them. On learning the object of the Committee they gave it their most hearty support, and addressed a strong memorial on the subject to the Dominion Government. The Boards of Trade of the other chief ports of the Dominion also sent similar memorials. The ship-owners and masters of ships, to whom application was made, were practically unanimous in their testimony as to the pressing need for knowledge on the subject. The representations were made through the Minister of Marine, with whom an interview was obtained, at which a memorial was submitted. Copies of the answers of the ship-masters (a large number of which had been received) were submitted at the same time. The reply of the Minister of Marine stated that, owing to the large outlay on the Georgian Bay Survey and on the expedition to Hudson's Bay during the past summer (1885), the Government did not propose to take action in the matter of tidal observations at present. The Committee have reason to believe that if the financial prospects improve by next session of Parliament the Government will take the matter into earnest consideration; they therefore suggest that the Committee be reappointed.

Seventeenth Report of the Committee, consisting of Profs. Everet and Sir W. Thomson, Mr. G. J. Symons, Sir A. C. Ramsay, Dr. A. Geikie, Mr. J. Glaisher, Mr. Pengelly, Prof. Edward Hull. Prof. Prestwich, Dr. C. Le Neve Foster, Prof. A. S. Herschel, Prof. G. A. Lebour, Mr. Galloway, Mr. Joseph Dickinson, Mr. G. F. Deacon, Mr. E. Wethered, and Mr. A. Strahan, 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).—The present Report is for the two years since the summer of 1883. Observations have been taken in a deep bore at Richmond, Surrey, by Mr. Collett Homersham, C.E., the engineer of the boring, on the premises of the Richmond Vestry Waterworks, on the right bank of the Thames, and about 33 yards from high-water mark. The surface is 17 feet above Ordnance datum. The upper part consists of a well 253 feet deep, with an internal diameter of 7 feet at top and 5 feet at bottom, which was sunk in 1876 for the purpose of supplying water to the town of Richmond, and carried down to the chalk. From the bottom of the well a 24-inch bore-hole was sunk to the total depth of 434 feet, thus penetrating 181 feet into the chalk. This portion of the work was completed in 1877. Above the chalk were tertiaries, consisting of 160 feet of London clay, 60 feet of the Woolwich and Reading beds, and some underlying sands. The water yielded at this stage was about 160 gallons a minute, and, when not depressed by pumping, was able to rise 4 or 5 feet above the surface. Its ordinary level, owing to pumping, was about 130 feet lower. In 1881 the Richmond Vestry determined to carry the bore-hole to a much greater depth, and the deepening has been executed under the direction of Mr. Homersham. The existing bore-hole was first enlarged and straightened, to enable a line of cast-iron pipes, with an internal diameter of 16½ inches, having the lower end driven water-tight into the chalk at a depth of 438 feet, to be carried up to the surface. The total thickness of the chalk was 671 feet. Below this was the upper greensand, 16 feet thick; then the gault clay, 201½ feet thick; then 10 feet of a sandy rock, and a thin layer of phosphatic nodules. Down to this point the new boring had yielded no water. Then followed a bed 87½ feet thick, consisting mainly of hard oolitic limestone. Two small springs of water were met with in this bed at the depths of 1203 and 1210 feet, the yield at the surface being 1¼ gallons a minute, with power to rise in a tube and overflow 49 feet above the ground. A partial analysis of this limestone rock showed it to contain 2·4 per cent. of sulphide of iron in the form of pyrites. At the depth of 1239 feet this limestone rock ended, and hard red sandstone was found, alternating with beds of variegated sandy marl or clay. After the depth of 1253 feet had been attained, the yield of water steadily increased as the boring was deepened, the overflow at the surface being 2 gallons a minute at 1254 feet, 8 gallons at 1363 feet, and 11 gallons at 1387 feet. It rose to the top of a tube carried 49 feet above the surface, and overflowed; and a pressure-gauge showed that it had power to rise 126 feet above the surface. The diameter of the bore was 16¼ inches in the chalk, 13½ inches in the gault, 11¼ inches in the oolitic limestone, and at the depth of 1334 feet it was reduced to a little under 9 inches. At 1337 feet the method of boring was changed, and, instead of an annular arrangement of steel cutters, a rotary diamond rock-boring machine was employed. The bore-hole, with a diameter of 8½ inches, was thus carried down to 1367½ feet, at which depth, lining tubes having to be inserted, the diameter was reduced to 7¼ inches, and this size was continued to 1447 feet, at which depth the boring was stopped. The bore-hole was lined with strong iron tubes down to the depth of 1364 feet; and those portions of the tubes that are in proximity to the depths where water was struck were drilled with holes to admit the water into them. Three observations of temperature taken with an inverted Negretti maximum at the depth of 1337 feet, when the bore-hole was full of water, recorded 75½° F. In the first observation, March 25, 1884, the thermometer was left for an hour and a quarter at the bottom of the bore-hole, and three weeks had elapsed since the water was disturbed by boring. The second observation was taken on March 31, when the thermometer was 5½ hours at the bottom. In the third observation special precautions were taken to prevent convection. The thermometer was fixed inside a wrought-iron tube, 5 feet long, open at bottom. The thermometer was near the lower end of the tube, and was suspended from a water-tight wooden plug, tightly driven into the tube. There was a space of several inches between the plug and the thermometer, and this part of the tube was pierced with numerous holes to allow the escape of any cold water which might be carried down by the tube. The tube was one of a series of hollow boring-rods used in working the diamond drill-machine. By means of these it was lowered very slowly, to avoid disturbance of the water as much as possible; and the tube containing the thermometer was gradually worked through the sand at the bottom of the bore-hole. The lowering occupied five hours, and was completed at noon on Saturday, June 7. Cement, mixed with sugar, for the purpose of slow setting, was immediately lowered on to the surface of the sand, and above this a mixture of cement and sand, making a total thickness of 3 or 4 feet of cement plugging. The thermometer was left in its place for three full days, the operation of raising being commenced at noon of Tuesday, June 10, and completed at 5 p.m. The thermometer again registered 75½° F., exactly the same as in the two previous observations which were taken without plugging. It would therefore appear that the steady upflow of water in the lower part of the bore prevents any downward convection of colder water from above.

The boring has since been carried to the depth of 1447 feet, with a diameter reduced to 7¼ inches, and Mr. Homersham lowered the thermometer to the bottom without plugging. It remained down for six days (February 3 to 9, 1885), and gave a reading of 76¾° F. The water overflowing at the surface had a temperature of 59° F. To deduce the mean rate of increase downwards, we shall assume a surface temperature of 50°. This gives for the first 1337 feet an increase of 25½°, which is at the rate of 1° F. in 52·4 feet, and for the whole 1447 feet an increase of 26¾°, which is at the rate of 1° F. in 54·1 feet. These results agree well with the Kentish Town well, where Mr. Symons found in 1100 feet an average increase of 1° in 55 feet.

Mr. Galloway has furnished observations taken during the sinking of a shaft to the depth of 1272 feet in or near the Aberdare valley, Glamorganshire. The position of the shaft is on the slope on the east side of the valley, about midway between the bottom of the valley and the summit of the hill which separates it from the Merthyr valley. The mouth of the shaft is about 800 feet above sea-level. Observations were taken at four different depths—546 feet, 780 feet, 1020 feet, and 1272 feet—the thermometer being in each case inserted, and left for twenty-four hours, in a hole bored to the depth of 30 inches at a distance not exceeding 2½ yards from the bottom of the shaft for the time being. About eight hours elapsed between the completion of the hole and the insertion of the thermometer. The strata consist mainly of shales and sandstone, with a dip of 1 in 12, and the flow of water into the shaft was about 250 gallons per hour. The first of the four observations was taken in the fireclay under the Abergorkie vein; the second in strong "clift" (a local name for argillaceous shale) in disturbed ground; the third in bastard fireclay under a small rider of coal previously unknown; the fourth in "clift" ground two yards above the red ash vein, which overlies the 9-foot seam at a height of from 9 to 12 yards. The observations were as follow:—At 546 feet, 56° F.; 780 feet, 59½° F.; 1020 feet, 63° F.; 1272 feet, 66½° F. Comparing consecutive depths from 546 feet downwards, we have the following increments of temperature:—3½° in 234 feet, giving 1° for 67 feet; 3½° in 240 feet, giving 1° for 69 feet; 3½° in 252 feet, giving 1° for 72 feet; showing a remarkably regular rate of increase. A comparison of the first and fourth observations gives an increase of 10½° in 726 feet, which is at the rate of 1° F. in 69·1 feet. As a check upon this result we find that this rate of *decrease* reckoned *upwards* from the smallest depth (546 feet) would give a surface temperature of (56 − 7·9 =) 48°·1, which, as the elevation is 800 feet, is probably very near the truth.

Mr. Garside has sent an observation of temperature taken by himself in the roof of the Mersey tunnel in August, 1883. The temperature was 53°, the depth below Ordnance datum being 92 feet. A great quantity of water from the river was percolating through the sides of the tunnel. On August 13, 1854, he verified his previous observation in Denton Colliery (15th Report). The second observation was made at the same depth as the first (1317 feet), in the same pit and level, and under the same circumstances, except that the thermometer was allowed to remain fourteen days in the hole bored for it, instead of only six hours. The temperature observed was the same as before—namely 66°. Mr. Garside has also supplemented his previous contribution to our knowledge of the surface temperature of the ground in the East Manchester coal-field (16th Report) by two more years' results from the same observing stations. The difference between them agrees well with the generally accepted rate of 1° for 300 feet, and indicates about 48° as the surface temperature at small elevations, such as 30 feet. The pits in the East Manchester coal-field from which we have observations—namely, Astley Pit (Dukinfield), Ashton Moss, Bredbury, Denton, and Nook Pit, are all sunk in ground at elevations of between 300 and 350 feet. It would therefore appear that the assumption of a surface temperature of 49°, which we made in reducing these observations, is about 2° in excess of the truth. A very elaborate paper on "Underground Temperature" has recently been communicated to the Royal Society by Prof. Prestwich. He is disposed to adopt 1° F. in 45 feet as the most probable value of the normal gradient.

Report of the Committee, consisting of Mr. W. T. Blanford and Mr. J. S. Gardner (Secretary), on the Fossil Plants of the Tertiary and Secondary Beds of the United Kingdom. Drawn *up by Mr. J. S. Gardner, F.G.S., F.L.S.*—The report opens with a list of all the principal works on the British Tertiary flora down to the year 1880. The number of species that had been more or less described were :—From the Thanet beds, 3 ; from the Reading beds, 9 ; from Sheppey, 108 ; from Alum Bay, &c., 43 ; from Bournemouth (deducting those not peculiar), 11 ; Bovey Tracy, 50 ; Upper Eocenes, 13 ; Mull, 9 ; Antrim, about 16 ; making a grand total of 262 species, not a tenth part of which, Mr. Gardner anticipates, would survive a rigorous examination. The study of only one group of plants—the Gymnosperms—has been the serious business of the past three years ; for not only have I had to study, but in the majority of cases to find the specimens as well. I trust that the results attending the expenditure of the grant I have been favoured with may be considered satisfactory, and these I now proceed to detail.

Bracklesham Flora.—Two visits have been made to Selsey. The beds, it is well known, are marine, but a few terrestrial fruits are from time to time procured from them. I was able to make a large collection of fossil shells while looking for plants, which, being from the highest beds, are less known, and are interesting as illustrating the passage from the Bracklesham to the Barton fauna, which is more gradual, I think, than is supposed. The surface of one of these beds is dotted over with fossil *Posidonias*, a marine monocotyledonous plant identical with the species now inhabiting the Mediterranean. It had not been previously recorded as a British fossil, though another species is abundant in the contemporary beds of the *Calcaire grossier* of the Paris basin. In our species the rhizomes radiate from a centre, whilst in the French and other European fossil species they are long and branching. They are found among beautiful *Tellina* shells, preserving, to a large extent, their banded colours. The only other fossil plant to record here is a *Nipadites*, which, unlike those of the Bournemouth beds, is large, flattened, and oval.

Reading Beds.—A considerable portion of the grant has been expended in working these beds with, I am pleased to report, the happiest results. The flora is found in the Katesgrove pit, on the banks of the Kennet, immediately beneath the mottled clay. The matrix is a fine porcelainous fuller's earth interstratified with sand, and the beds seem very local. The limit of the pit being reached, it is not probable that any part of the beds will be exposed for long. I have illustrated a beautiful specimen—one of several—of *Anæmia subcretacea*, Sap., from these beds. This fern is highly characteristic of the lower Eocenes in France, but had only previously been found in the middle Bagshot beds of Bournemouth in this country. I have also illustrated another fern (?) from these beds, of which I have only as yet found a small fragment. The figures are therefore taken from specimens found many years ago by Prof. Prestwich. Other valuable additions to the Reading flora are some splendid specimens of a conifer, which I can see no ground for distinguishing from *Taxodium heterophyllum* of China. Another interesting specimen from Reading is a pine leaf of two needles, about the size and substance of those of *P. maritima*, the first pine foliage, I believe, ever found in the English Eocene. One leaf bed is almost wholly made up of leaves of *Plutonis*, and a bed above is fairly sprinkled with fruits of the same. Fruits are very abundant, and include four kinds of leguminous pods, and there are many flowers. As a result of this work the Reading flora no longer appears so completely distinct from that of Bournemouth.

Woolwich Beds.—I regard these as thoroughly distinct in age from those of Reading. I have not found, in the course of two visits paid for the purpose, any bed worth collecting from, though I think such must exist at Lewisham.

Studland Beds.—We were able to reach a leaf bed in the Lower Bagshot at Studland, and to obtain a great number of specimens, nearly all of which are quite new to me. They are mostly dycotyledonous leaves and fruits, which will require time to determine. There are no Coniferæ among them, and I am only able to add one fern—a *Lygodium*, very near to that of Bournemouth—to the *Chrysodium langæanum*, procured abundantly by me ten years ago in a different bed at the same locality.

Hordwell Beds.—I have to add *Salvinia* to the flora, not previously found fossil in England, and exclusively confined to the Miocene in Austria and Switzerland.

Barton Beds.—A new species of pine from Highcliff was discovered quite unlike those hitherto found at Bracklesham. The beds are rapidly assuming an angle of repose, and becoming deeply buried under *débris*, so that some of them are no longer visible except by making excavations. Though the Barton series is one of the most interesting of our Eocene formations, the detailed bedding has not been worked out like that of the Bracklesham series below and the Headon series above, and the greatest misconceptions seem to prevail as to the number of species of fossils that it contains.

Bournemouth Beds.—Five series of leaves were obtained this year by Mr. Keeping and myself, the most noteworthy of which are some specimens of *Godoya* which exceed any I had previously seen. I have illustrated a new and very distinct species of *Adiantum*, a fragment of what may be *Gymnogramma*, and a trifid group of *Polypodium* leaves, which seem to be different from either of the species previously recorded.

The London Clay.—Mr. Shrubsole has kindly sent me some of the best of the fruits that have been found. I have not made any complete studies of them yet, but they promise to afford results of the highest value. Among a few recognised is the very unmistakable seed of *Verschaffeltia*, a genus of palms from Seychelles quite new to fossil floras.

Gurnet Bay Beds.—I have been able to ascertain that another fern rivals *Anæmia subcretacea* in range, *Chrysodium langæanum*, which extends from the town of Bagshot upwards into the Bembridge beds. The plants are as a rule dreadfully macerated and chopped up. Among them are small fragments of a *Gleichenia*, which, though not very beautiful, is a very important fern, coming from the horizon. By far the most important discovery, however, is that of *Doliostrobus*, the first really extinct conifer that I have met with in British Eocenes. It belonged to the tribe of *Araucarieæ*, and its identification has been thoroughly confirmed by correspondence and the interchange of specimens with Dr. Marion, the well-known botanist of Marseilles. It is certain that during the Eocene period, as the temperature increased from the base upward to the Middle Bagshot, when the maximum of heat seems to have prevailed, there was a tendency for the plant world to move northward. It is equally certain that in the later half of the Eocene, as the temperature began to decrease, the movement was in the opposite direction, and we find in the European Miocenes of Switzerland and Italy a number of plants that at an earlier period were growing in the far north.

Report of the Committee, consisting of H. Bauerman, F. W. Rudler, and Dr. H. Johnston Lavis, for the Investigation of the Volcanic Phenomena of Vesuvius, by H. Johnston Lavis, M.D., F.G.S., Reporter.—The unfortunate outbreak of cholera in Naples and the stringent local quarantine measures prevented work on Vesuvius being carried out during the autumn of 1884. Nevertheless, daily observations were made of the variations in the activity of the volcano, of which a careful record has been kept. All important changes of the crater-plain, and in the cone of eruption, have been photographed. Descriptions of the small eruption of May 2 of 1883 have already been given in NATURE, and the results of a microscopical examination of the sides of the remarkable hollow dyke then formed will soon be published. The Naples section of the Italian Alpine Club have generously undertaken to publish a journal of Vesuvius, which will contain reproductions of the photographs exhibited. The third sheet of the geological map of Vesuvius and Monte Somnia (scale 1 : 10,000) has been completed by the reporter, and is exhibited at the meeting. The relationship of the varying activity of a volcano in a Strombolian state of activity to barometric pressure, the lunar tides, and rainfall, cannot but be regarded as important in solving some questions of vulcanology. Instrumental means of measuring such present so many practical difficulties that a scale of activity has been drawn up, which requires only a few minutes to learn, can be practised by any one with good eyesight and moderate intelligence who is within visual range of the volcano, and, above all, requires no further outlay than pen, ink, and paper. The objections will be mentioned after describing the process. 1st degree, a faint red glimmer above the main vent interrupted by complete darkness ; 2nd degree, the glimmer is continuous, but the ejection reaches hardly above the central crater rim at the most ; 3rd degree, glimmer continuous and well marked ; the ejections are distinctly discernible as they rise and then fall on the slopes of the cone of eruption and roll down its slopes ; 4th degree, the ejections reach a considerable height, are brilliant, and light up the top of the great cone ; 5th degree, verging on an actual paroxysmal eruption, the ejections are shot up very high, being only very slightly or not at all influenced in their course by a strong wind. Each explosion follows with much rapidity, and corresponds with the "boati" heard all around the west, south, and south-east slopes of the mountain. The objections to this method of registering the variations in the activity of a volcano are: (*a*) cloud-cap, which may for days cut off the view; (*b*) after a great eruption, resulting in a deep crater, the changes of activity would be invisible from the neighbourhood of the mountain; (*c*) it is only applicable after dark, so that usually only one observation a day can be made; (*d*) should lava be flowing from a lateral outlet, as is often the case, the level of the fluid in the chimney would vary as the outflow took place with greater or less rapidity, dependent on its blocking the passage more or less. The reporter thinks it desirable to introduce a description of this method into the report, so that it may be made use of in the case of other suitable volcanoes.

Report of the Committee, consisting of Prof. Ray Lankester, Mr. P. L. Sclater, Prof. M. Foster, Mr. A. Sedgwick, Prof. A. M. Marshall, Prof. A. C. Haddon, Prof. Moseley, and Mr. Percy Sladen (*Secretary*), *appointed for the purpose of arranging for the occupation of a Table at the Zoological Station at Naples.*—In the Report read last year at Montreal it was announced that a scheme was on foot for the building of a large physiological laboratory in connection with the Zoological Station at Naples, and for the purchase of a new sea-going steamer, to be equipped as a floating laboratory. Your Committee are now able to report that both these projects are steadily advancing towards attainment. For the physiological laboratory the Municipality of Naples has made a grant of 400 square metres of ground, and the Italian Parliament has voted the sum of 50,000 lire towards the cost of building. In addition to this assistance from the Italian Government, a union of the maritime provinces of South Italy is about to be formed for the purpose of contributing towards the cost of the new laboratory, and of maintaining two tables there for the use of natives of the provinces concerned. The new steamship, which it is hoped will shortly be in the possession of the station, will form a further addition to the capabilities of the establishment. This undertaking is in the hands of an influential committee in Germany, organised for the purpose of collecting subscriptions, and by whom the vessel will be presented to the station. It is intended that the steamer should be of 300 to 400 tons burden, with engines of 150 to 200 horse-power, and be fitted up in all respects as a floating laboratory. With such a vessel it will be perfectly practicable to remain weeks or months in any desired locality, and distance from home will be no obstacle, as naturalists will live and work on board. Concurrent with these strides of the Zoological Station, improvements in the general management, in methods of work, and in instruments of research are constantly being made. The general efficiency of the establishment is so well known that it will suffice to say that the whole organisation of the station is in a state of active and prosperous vitality. The best evidence of this is furnished by the accompanying lists:—(1) of the naturalists who have occupied tables during the past year, and (2) of the publications resulting from work carried out at the station.

The General Collections.—Additions have been again received from Capt. Chierchia, who has, since the last Report, sent two collections of specimens from the Pacific and Indian Oceans. Other collections have been likewise received from Lieut. Cercone, Lieut. Orsini, and Lieut. Colombo, from the Atlantic, the Red Sea, and the Mediterranean respectively. Some of the material previously obtained by Capt. Chierchia has already been utilised by Count Béla Haller in a paper on the molluscan kidney, recently published; and the same author is at present preparing a monograph on the Patellæ. In like manner the Pteropoda have been investigated by Dr. Boas, of Copenhagen, whose monograph upon the subject is now in the press. Since the last Report the British Association table has been occupied by Mr. Wm. E. Hoyle, who, although limited in time, was enabled to prosecute researches on the embryology of the Cephalopoda, and to collect material from which important results may be expected. The report forwarded by Mr. Hoyle is appended:—

Report on the Occupation of the Table, by Mr. William E. Hoyle.—I reached Naples on April 6, 1885, and left on the 28th of the same month. In so short a time it was obviously impossible to make anything of the nature of a complete investigation in a subject of such magnitude and difficulty as the embryology of the Cephalopoda; it seemed, herefore, that the opportunities afforded me could best be utilised by collecting material for subsequent examination. Of this I had an abundant and immediate supply, thanks to the kindly forethought of your secretary, who had given notice to the authorities of the station of the nature of the work I had undertaken, so that they had a quantity of ova ready for my use. The greater part of my time was spent in extracting embryos from the egg and preserving them in various fluids, and a fairly complete series of developmental stages of *Loligo* and a good many embryos of *Sepia* were thus obtained. When the young Cephalopods have reached a stage at which the rudiments of the arms are clearly visible, it is moderately easy, after a little practice, to extricate them by making an incision into the egg-membrane with a fine scalpel; but previously to this period they so nearly occupy the whole interior of the egg that it is almost impossible to obtain them uninjured. A quantity of such eggs I preserved whole by a method suggested to me by Dr. Jatta, who is at work upon a monograph of the Cephalopoda of the Bay of Naples. The strings of eggs are placed whole in weak solution of chromic acid (about 0·25 per cent.) for a few hours, and then in distilled water for twenty-four hours, after which they are preserved in alcohol. The embryos can then be extracted much more readily than when fresh. Some time was devoted to examining and drawing the embryos in the fresh condition, and in watching the process of segmentation in *Loligo* and *Sepia*. I observed the presence of the "Richtungsbläschen" in the former, which, so far as I am aware, has only been noted in a Russian memoir on the development of *Sepiola* by Ussow. A number of blastoderms in process of segmentation were preserved according to a method proposed by Ussow, for the knowledge of which I am indebted to Dr. Edward Meyer, who kindly translated it for me from the original. The egg, without removal of the membranes, is placed in 2 per cent. solution of chromic acid for two minutes, and then in distilled water, to which a little acetic acid (one drop to a watchglassful) has been added, for two minutes longer. If an incision be now made into the egg-membrane the yolk flows away and the blastoderm remains; if any yolk still cling to it, it may be removed by pouring away the water and adding more. The blastoderms thus prepared show, when appropriately stained, fine karyokinetic figures, of which I hope shortly to publish an account. The reduction of the collected embryos to serial sections and their examination will of course occupy some time, but I hope in a few months to prepare some account of the results obtained from them.

Report of the Committee, consisting of Prof. Huxley, Mr. Sclater, Mr. Howard Saunders, Mr. Thiselton Dyer, and Prof. Moseley (*Secretary*), *appointed for the purpose of promoting the Establishment of Marine Biological Stations on the Coast of the United Kingdom.*—The Committee has received the sum granted (150*l.*) from the Treasurer of the Association, and has paid it to the funds of the Marine Biological Association of the United Kingdom, as the most direct means of promoting the speedy establishment of a marine laboratory in a most favourable situation on the British coast—namely, Plymouth. An excellent site for a laboratory has been granted to the Marine Biological Association by Government, at Plymouth. A sum of 8000*l.* has been raised by subscriptions and donations, the Government has promised to aid the working of the laboratory by an annual subsidy, and there is every prospect of success. It is probable that the building of the laboratory will commence in November.

Report of the Committee, consisting of the Rev. Canon Tristram, the Rev. F. Lawrence, and Mr. James Glaisher (*Secretary*), *appointed for the purpose of promoting the Survey of Palestine.*—The Survey of Eastern Palestine has been carried on during the last year privately by Herr G. Schumacher, C.E., assisted by Mr. Laurence Oliphant, who has also furnished the Committee with valuable notes of personal exploration in the district now called Junlau—the ancient Gaulanitis. The portion surveyed by Herr Schumacher consists of about 200 square miles, and covers an area previously quite unknown. The map, which is now in the hands of the Committee, is accompanied by voluminous memoirs and a great number of sketches, drawings, and plans of ruins figured for the first time, which it is proposed to publish, with the memoirs, in October. The map of the Wady Arabah has been laid down in the Society's sheets; the geological memoirs compiled by Prof. Hule after his expedition of 1883-84 are nearly ready, and will be issued before the end of the year; and the Society has been enabled to secure Mr. Chichester Hart's

Natural History memoir, made from new observations during the same journey. In addition the Committee have received from Mr. Guy Le Strange, and published, observations and notes made by him during a recent journey east of Jordan. The results of the survey, so far as it has been completed, will appear in a map reduced to a scale of about three miles to an inch, showing the country on both sides of the river Jordan, instead of on the western side only. This portion of the work is under the direction of Col. Sir Charles Wilson, K.C.M.G., F.R.S. The Society has also issued during the last year a popular account, by Prof. Hule, of his recent journey, called "Mount Seir," and reprints of Capt. Conder's popular books, "Tent Work in Palestine" and "Heth and Moab." Finally, the Committee have completed the issue of their great work, the "Survey of Western Palestine," with the last volumes of "Jerusalem," the "Flora and Fauna," and a portfolio of plates showing the excavations and their results.

SECTION H

ANTHROPOLOGY

Opening Address by Francis Galton, F.R.S., etc., President of the Anthropological Institute, President of the Section

The object of the Anthropologist is plain. He seeks to learn what mankind really are in body and mind, how they came to be what they are, and whither their races are tending; but the methods by which this definite inquiry has to be pursued are extremely diverse. Those of the geologist, the antiquarian, the jurist, the historian, the philologist, the traveller, the artist, and the statistician, are all employed, and the Science of Man progresses through the help of specialists. Under these circumstances, I think it best to follow an example occasionally set by presidents of sections, by giving a lecture rather than an address, selecting for my subject one that has long been my favourite pursuit, on which I have been working with fresh data during many recent months, and about which I have something new to say.

My data were the Family Records entrusted to me by persons living in all parts of the country, and I am now glad to think that the publication of some first-fruits of their analysis will show to many careful and intelligent correspondents that their painstaking has not been thrown away. I shall refer to only a part of the work already completed, which in due time will be published, and must be satisfied if, when I have finished this address, some few ideas that lie at the root of heredity shall have been clearly apprehended, and their wide bearings more or less distinctly perceived. I am the more desirous of speaking on heredity, because, judging from private conversations and inquiries that are often put to me, the popular views of what may be expected from inheritance seem neither clear nor just.

The subject of my remarks will be "Types and their Inheritance." I shall discuss the conditions of the stability and instability of types, and hope in doing so to place beyond doubt the existence of a simple and far-reaching law that governs hereditary transmission, and to which I once before ventured to draw attention, on far more slender evidence than I now possess.

It is some years since I made an extensive series of experiments on the produce of seeds of different size but of the same species. They yielded results that seemed very noteworthy, and I used them as the basis of a lecture before the Royal Institution on February 9, 1877. It appeared from these experiments that the offspring did *not* tend to resemble their parent seeds in size, but to be always more mediocre than they—to be smaller than the parents, if the parents were large; to be larger than the parents, if the parents were very small. The point of convergence was considerably below the average size of the seeds contained in the large bagful I bought at a nursery-garden, out of which I selected those that were sown.

The experiments showed further that the mean filial regression towards mediocrity was directly proportional to the parental deviation from it. This curious result was based on so many plantings, conducted for me by friends living in various parts of the country, from Nairn in the north to Cornwall in the south, during one, two, or even three generations of the plants, that I could entertain no doubt of the truth of my conclusions. The exact ratio of regression remained a little doubtful, owing to variable influences; therefore I did not attempt to define it. After the lecture had been published, it occurred to me that the grounds of my misgivings might be urged as objections to the general conclusions. I did not think them of moment, but as the inquiry had been surrounded with many small difficulties and matters of detail, it would be scarcely possible to give a brief and yet a full and adequate answer to such objections. Also, I was then blind to what I now perceive to be the simple explanation of the phenomenon, so I thought it better to say no more upon the subject until I should obtain independent evidence. It was anthropological evidence that I desired, caring only for the seeds as means of throwing light on heredity in man. I tried in vain for a long and weary time to obtain it in sufficient abundance, and my failure was a cogent motive, together with others, in inducing me to make an offer of prizes for family records, which was largely responded to, and furnished me last year with what I wanted. I especially guarded myself against making any allusion to this particular inquiry in my prospectus, lest a bias should be given to the returns. I now can securely contemplate the possibility of the records of height having been frequently drawn up in a careless fashion, because no amount of unbiassed inaccuracy can account for the results, contrasted in their values but concurrent in their significance, that are derived from comparisons between different groups of the returns.

An analysis of the records fully confirms and goes far beyond the conclusions I obtained from the seeds. It gives the numerical value of the regression towards mediocrity as from 1 to $\frac{2}{3}$ with unexpected coherence and precision, and it supplies me with the class of facts I wanted to investigate—the degrees of family likeness in different degrees of kinship, and the steps through which special family peculiarities become merged into the typical characteristics of the race at large.

The subject of the inquiry on which I am about to speak was Hereditary Stature. My data consisted of the heights of 930 adult children and of their respective parentages, 205 in number. In every case I transmuted the female statures to their corresponding male equivalents and used them in their transmuted form, so that no objection grounded on the sexual difference of stature need be raised when I speak of averages. The factor I used was 1·08, which is equivalent to adding a little less than one-twelfth to each female height. It differs a very little from the factors employed by other anthropologists, who, moreover, differ a trifle between themselves; anyhow it suits my data better than 1·07 or 1·09. The final result is not of a kind to be affected by these minute details, for it happened that, owing to a mistaken direction, the computer to whom I first entrusted the figures used a somewhat different factor, yet the result came out closely the same.

I shall explain with fulness why I chose stature for the subject of inquiry, because the peculiarities and points to be attended to in the investigation will manifest themselves best by doing so. Many of its advantages are obvious enough, such as the ease and frequency with which its measurement is made, its practical constancy during thirty-five years of middle life, its small dependence on differences of bringing up, and its inconsiderable influence on the rate of mortality. Other advantages which are not equally obvious are no less great. One of these lies in the fact that stature is not a simple element, but a sum of the accumulated lengths or thicknesses of more than a hundred bodily parts, each so distinct from the rest as to have earned a name by which it can be specified. The list of them includes about fifty separate bones, situated in the skull, the spine, the pelvis, the two legs, and the two ankles and feet. The bones in both the lower limbs are counted, because it is the average length of these two limbs that contributes to the general stature. The cartilages interposed between the bones, two at each joint, are rather more numerous than the bones themselves. The fleshy parts of the scalp of the head and of the soles of the feet conclude the list. Account should also be taken of the shape and set of many of the bones which conduce to a more or less arched instep, straight back, or high head. I noticed in the skeleton of O'Brien, the Irish giant, at the College of Surgeons, which is, I believe, the tallest skeleton in any museum, that his extraordinary stature of about 7 feet 7 inches would have been a trifle increased if the faces of his dorsal vertebræ had been more parallel and his back consequently straighter.

The beautiful regularity in the statures of a population, whenever they are statistically marshalled in the order of their heights, is due to the number of variable elements of which the stature is the sum. The best illustrations I have seen of this regularity were the curves of male and female statures that I obtained from the careful measurements made at my Anthropometric Laboratory in the International Health Exhibition last year. They were almost perfect.

The multiplicity of elements, some derived from one progenitor, some from another, must be the cause of a fact that has proved very convenient in the course of my inquiry. It is that the stature of the children depends closely on the average stature of the two parents, and may be considered in practice as having nothing to do with their individual heights. The fact was proved as follows:—After transmuting the female measurements in the way already explained, I sorted the children of parents who severally differed 1, 2, 3, 4, and 5, or more inches into separate groups. Each group was then divided into similar classes, showing the number of cases in which the children differed 1, 2, 3, &c., inches from the common average of the children in their respective families. I confined my inquiry to large families of six children and upwards, that the common average of each might be a trustworthy point of reference. The entries in each of the different groups were then seen to run in the same way, except that in the last of them the children showed a faint tendency to fall into two sets, one taking after the tall parent, the other after the short one. Therefore, when dealing with the transmission of stature from parents to children, the average height of the two parents, or, as I prefer to call it, the "mid-parental" height, is all we need care to know about them.

It must be noted that I use the word parent without specifying the sex. The methods of statistics permit us to employ this abstract term, because the cases of a tall father being married to a short mother are balanced by those of a short father being married to a tall mother. I use the word "parent" to save a complication due to a fact brought out by these inquiries, that the height of the children of both sexes, but especially that of the daughters, takes after the height of the father more than it does after that of the mother. My present data are insufficient to determine the ratio satisfactorily.

Another great merit of stature as a subject for inquiries into heredity is that marriage selection takes little or no account of shortness or tallness. There are undoubtedly sexual preferences for moderate contrast in height, but the marriage choice appears to be guided by so many and more important considerations that questions of stature exert no perceptible influence upon it. This is by no means my only inquiry into this subject, but, as regards the present data, my test lay in dividing the 205 male parents and the 205 female parents each into three groups—tall, medium, and short (medium being taken as 67 inches and upwards to 70 inches)—and in counting the number of marriages in each possible combination between them. The result was that men and women of contrasted heights, short and tall or tall and short, married just about as frequently as men and women of similar heights, both tall or both short; there were 32 cases of the one to 27 of the other. In applying the law of probabilities to investigations into heredity of stature, we may regard the married folk as couples picked out of the general population at haphazard.

The advantages of stature as a subject in which the simple laws of heredity may be studied will now be understood. It is a nearly constant value that is frequently measured and recorded, and its discussion is little entangled with considerations of nurture, of the survival of the fittest, or of marriage selection. We have only to consider the mid-parentage and not to trouble ourselves about the parents separately. The statistical variations of stature are extremely regular, so much so that their general conformity with the results of calculations based on the abstract law of frequency of error is an accepted fact by anthropologists. I have made much use of the properties of that law in cross-testing my various conclusions, and always with success.

The only drawback to the use of stature is its small variability. One-half of the population with whom I dealt varied less than 1·7 inch from the average of all of them, and one-half of the offspring of similar mid-parentages varied less than 1·5 inch from the average of their own heights. On the other hand, the precision of my data is so small, partly due to the uncertainty in many cases whether the height was measured with the shoes on or off, that I find by means of an independent inquiry that each observation, taking one with another, is liable to an error that as often as not exceeds $\frac{3}{5}$ of an inch.

It must be clearly understood that my inquiry is primarily into the inheritance of different degrees of tallness and shortness. That is to say, of measurements made from the crown of the head to the level of mediocrity, upwards or downwards as the case may be, and not from the crown of the head to the ground. In the population with which I deal, the level of mediocrity is $68\frac{1}{4}$ inches (without shoes). The same law, applying with sufficient closeness both to tallness and shortness, we may include both under the single head of deviations, and I shall call any particular deviation a "deviate." By the use of this word and that of "mid-parentage," we can define the law of regression very briefly. It is that the height-deviate of the offspring is, on the average, two-thirds of the height-deviate of its mid-parentage.

If this remarkable law had been based only on experiments on the diameters of the seeds, it might well be distrusted until confirmed by other inquiries. If it were corroborated merely by the observations on human stature, of which I am about to speak, some hesitation might be expected before its truth could be recognised in opposition to the current belief that the child tends to resemble its parents. But more can be urged than this. It is easily to be shown that we ought to expect filial regression, and that it should amount to some constant fractional part of the value of the mid-parental deviation. It is because this explanation confirms the previous observations made both on seeds and on men, that I feel justified on the present occasion in drawing attention to this elementary law.

The explanation of it is as follows. The child inherits partly from his parents, partly from his ancestry. Speaking generally, the further his genealogy goes back, the more numerous and varied will his ancestry become, until they cease to differ from any equally numerous sample taken at haphazard from the race at large. Their mean stature will then be the same as that of the race; in other words, it will be mediocre. Or, to put the same fact into another form, the most probable value of the mid-ancestral deviates in any remote generation is zero.

For the moment let us confine our attention to the remote ancestry and to the mid-parentages, and ignore the intermediate generations. The combination of the zero of the ancestry with the deviate of the mid-parentage, is that of nothing with something, and the result resembles that of pouring a uniform proportion of pure water into a vessel of wine. It dilutes the wine to a constant fraction of its original alcoholic strength, whatever that strength may have been.

The intermediate generations will each in their degree do the same. The mid-deviate of any one of them will have a value intermediate between that of the mid-parentage and the zero value of the ancestry. Its combination with the mid-parental deviate will be as if, not pure water, but a mixture of wine and water in some definite proportion had been poured into the wine. The process throughout is one of proportionate dilutions, and therefore the joint effect of all of them is to weaken the original wine in a constant ratio.

We have no word to express the form of that ideal and composite progenitor, whom the offspring of similar mid-parentages most nearly resemble, and from whose stature their own respective heights diverge evenly, above and below. He, she, or it, may be styled the "generant" of the group. I shall shortly explain what my notion of a generant is, but for the moment it is sufficient to show that the parents are not identical with the generant of their own offspring.

The average regression of the offspring to a constant fraction of their respective mid-parental deviations, which was first observed in the diameters of seeds, and then confirmed by observations on human stature, is now shown to be a perfectly reasonable law which might have been deductively foreseen. It is of so simple a character that I have made an arrangement with one movable pulley and two fixed ones by which the probable average height of the children of known parents can be mechanically reckoned. This law tells heavily against the full hereditary transmission of any rare and valuable gift, as only a few of many children would resemble their mid-parentage. The more exceptional the gift, the more exceptional will be the good fortune of a parent who has a son who equals, and still more if he has a son who overpasses him. The law is even-handed; it levies the same heavy succession-tax on the transmission of badness as well as of goodness. If it discourages the extravagant expectations of gifted parents that their children will inherit all their powers, it no less discountenances extravagant fears that they will inherit all their weaknesses and diseases.

The converse of this law is very far from being its numerical opposite. Because the most probable deviate of the son is only two-thirds that of his mid-parentage, it does not in the least follow that the most probable deviate of the mid-parentage is $\frac{3}{2}$, or $1\frac{1}{2}$ that of the son. The number of individuals in a population who differ little from mediocrity is so preponderant, that it is more frequently the case that an exceptional man is the somewhat exceptional son of rather mediocre parents, than the average son of very exceptional parents. It appears from the very same table of observations by which the value of the filial regression was determined, when it is read in a different way, namely, in vertical columns instead of in horizontal lines, that the most probable mid-parentage of a man is one that deviates only one-third as much as the man does. There is a great difference between this value of $\frac{1}{3}$ and the numerical converse mentioned above of $\frac{3}{2}$; it is four and a half times smaller, since $4\frac{1}{2}$, or $\frac{9}{2}$, being multiplied into $\frac{1}{3}$, is equal to $\frac{3}{2}$.

Let it not be supposed for a moment that these figures invalidate the general doctrine that the children of a gifted pair are much more likely to be gifted than the children of a mediocre pair. What it asserts is that the ablest child of one gifted pair is not likely to be as gifted as the ablest of all the children of very many mediocre pairs. However, as, notwithstanding this explanation, some suspicion may remain of a paradox lurking in these strongly contrasted results, I will explain the form in which the table of data was drawn up, and give an anecdote connected with it. Its outline was constructed by ruling a sheet into squares, and writing a series of heights in inches, such as 60 and under 61, 61 and under 62, &c., along its top, and another similar series down its side. The former referred to the height of offspring, the latter to that of mid-parentages. Each square in the table was formed by the intersection of a vertical column with a horizontal one, and in each square was inserted the number of children out of the 930 who were of the height indicated by the heading of the vertical column, and who at the same time were born of mid-parentages of the height indicated at the side of the horizontal column. I take an entry out of the table as an example. In the square where the vertical column headed[1] 69– is intersected by the horizontal column by whose side 67– is marked, the entry 38 is found; this means that out of the 930 children 38 were born of mid-parentages of 69 and under 70 inches, who also were 67 and under 68 inches in height. I found it hard at first to catch the full significance of the entries in the table, which had curious relations that were very interesting to investigate. Lines drawn through entries of the same value formed a series of concentric and similar ellipses. Their common centre lay at the intersection of the vertical and horizontal lines, that corresponded to $68\frac{1}{4}$ inches. Their axes were similarly inclined. The points where each ellipse in succession was touched by a horizontal tangent, lay in a straight line inclined to the vertical in the ratio of $\frac{2}{3}$; those where they were touched by a vertical tangent, lay in a straight line inclined to the horizontal in the ratio of $\frac{1}{3}$. These ratios confirm the values of average regression already obtained by a different method, of $\frac{2}{3}$ from mid-parent to offspring, and of $\frac{1}{3}$ from offspring to mid-parent. These and other relations were evidently a subject for mathematical analysis and verification. They were all clearly dependent on three elementary data, supposing the law of frequency of error to be applicable throughout; these data being (1) the measure of racial variability, (2) that of co-family variability (counting the offspring of like mid-parentages as members of the same co-family), and (3) the average ratio of regression. I noted these values, and phrased the problem in abstract terms such as a competent mathematician could deal with, disentangled from all reference to heredity, and in that shape submitted it to Mr. J. Hamilton Dickson, of St. Peter's College, Cambridge. I asked him kindly to investigate for me the surface of frequency of error that would result from these three data, and the various particulars of its sections, one of which would form the ellipses to which I have alluded.

I may be permitted to say that I never felt such a glow of loyalty and respect towards the sovereignty and magnificent sway of mathematical analysis as when his answer reached me, confirming, by purely mathematical reasoning, my various and laborious statistical conclusions with far more minuteness than I had dared to hope, for the original data ran somewhat roughly, and I had to smooth them with tender caution. His calculation corrected my observed value of mid-parental regression from $\frac{1}{3}$ to $\frac{6}{17 \cdot 6}$, the relation between the major and minor axis of the ellipses was changed 3 per cent., their inclination was changed less than 2°. It is obvious, then, that the law of error holds throughout the investigation with sufficient precision to be of real service, and that the various results of my statistics are not casual determinations, but strictly interdependent.

In the lecture at the Royal Institution to which I have referred, I pointed out the remarkable way in which one generation was succeeded by another that proved to be its statistical counterpart. I there had to discuss the various agencies of the survival of the fittest, of relative fertility and so forth; but the selection of human stature as the subject of investigation now enables me to get rid of all these complications, and to discuss this very curious question under its simplest form. How is it, I ask, that in each successive generation there proves to be the same number of men per thousand who range between any limits of stature we please to specify, although the tall men are rarely descended from equally tall parents, or the short men from equally short? How is the balance from other sources so nicely made up? The answer is that the process comprises two opposite sets of actions, one concentrative and the other dispersive, and of such a character that they necessarily neutralise one another, and fall into a state of stable equilibrium. By the first set, a system of scattered elements is replaced by another system which is less scattered; by the second set, each of these new elements becomes a centre whence a third system of elements are dispersed. The details are as follows:—In the first of these two stages, the units of the population group themselves, as it were by chance, into married couples, whence the mid-parentages are derived, and then by a regression of the values of the mid-parentages the true generants are derived. In the second stage each generant is a centre whence the offspring diverge. The stability of the balance between the opposed tendencies is due to the regression being proportionate to the deviation; it acts like a spring against a weight.

A simple equation connects the three data of race variability, of the ratio of regression, and of co-family variability, whence, if any two are given, the third may be found. My observations give separate measures of all three, and their values fit well into the equation, which is of the simple form—

$$v^2 \frac{p^2}{2} + f^2 = p^2,$$

where $v = \frac{2}{3}$, $p = 1 \cdot 7$, $f = 1 \cdot 5$.

It will therefore be understood that a complete table of mid-parental and filial heights may be calculated from two simple numbers.

It will be gathered from what has been said, that a mid-parental deviate of one unit implies a mid-grandparental deviate of $\frac{1}{3}$, a mid-ancestral unit in the next generation of $\frac{1}{9}$, and so on. I reckon from these and other data, by methods that I cannot stop to explain, that the heritage derived on an average from the mid-parental deviate, independently of what it may imply, or of what may be known concerning the previous ancestry, is only $\frac{1}{2}$. Consequently, that similarly derived from a single parent is only $\frac{1}{4}$, and that from a single grandparent is only $\frac{1}{16}$.

The most elementary data upon which a complete table of mid-parental and filial heights admits of being constructed are (1) the ratio between the mid-parental and the rest of the ancestral influences, and (2) the measure of the co-family variability.

I cannot now pursue the numerous branches that spring from the data I have given, as from a root. I will not speak of the continued domination of one type over others, nor of the persistency of unimportant characteristics, nor of the inheritance of disease, which is complicated in many cases by the requisite concurrence of two separate heritages, the one of a susceptible constitution, the other of the germs of the disease. Still less can I enter upon the subject of fraternal characteristics, which I have also worked out. It will suffice for the present to have shown some of the more important conditions associated with the idea of race, and how the vague word "type" may be defined by peculiarities in hereditary transmission, at all events when that word is applied to any single quality, such as stature. To include those numerous qualities that are not strictly measurable, we must omit reference to number and proportion, and frame the definition thus:—"The type is an ideal form towards which the children of those who deviate from it tend to regress."

The stability of a type would, I presume, be measured by the

[1] A matter of detail is here ignored which has nothing to do with the main principle, and would only serve to perplex if I described it.

strength of its tendency to regress; thus a mean regression from 1 in the mid-parents to $\frac{2}{3}$ in the offspring would indicate only half as much stability as if it had been to $\frac{1}{3}$.

The mean regression in stature of a population is easily ascertained, but I do not see much use in knowing it. It has already been stated that half the population vary less than 1·7 inch from mediocrity, this being what is technically known as the "probable" deviation. The mean deviation is, by a well-known theory, 1·18 times that of the probable deviation, therefore in this case it is 1·9 inch. The mean loss through regression is $\frac{1}{3}$ of that amount, or a little more than 0·6 inch. That is to say, taking one child with another, the mean amount by which they fall short of their mid-parental peculiarity of stature is rather more than six-tenths of an inch.

With respect to these and the other numerical estimates, I wish emphatically to say that I offer them only as being serviceably approximate, though they are mutually consistent, and with the desire that they may be reinvestigated by the help of more abundant and much more accurate measurements than those I have had at command. There are many simple and interesting relations to which I am still unable to assign numerical values for lack of adequate material, such as that to which I referred some time back of the superior influence of the father over the mother on the stature of their sons and daughters.

The limits of deviation beyond which there is no regression, but a new condition of equilibrium is entered into, and a new type comes into existence, have still to be explored. Let us consider how much we can infer from undisputed facts of heredity regarding the conditions amid which any form of stable equilibrium, such as is implied by the word "type," must be established, or might be disestablised and superseded by another. In doing so I will follow cautiously along the same path by which Darwin started to construct his provisional theory of pangenesis; but it is not in the least necessary to go so far as that theory, or to entangle ourselves in any questioned hypothesis.

There can be no doubt that heredity proceeds to a considerable extent, perhaps principally, in a piecemeal or piebald fashion, causing the person of the child to be to that extent a mosaic of independent ancestral heritages, one part coming with more or less variation from this progenitor and another from that. To express this aspect of inheritance, where particle proceeds from particle, we may conveniently describe it as "particulate."

So far as the transmission of any feature may be regarded as an example of particulate inheritance, so far (it seems little more than a truism to assert) the element from which that feature was developed must have been particulate also. Therefore, wherever a feature in a child was not personally possessed by either parent, but transmitted through one of them from a more distant progenitor, the element whence that feature was developed must have existed in a particulate, though impersonal and latent, form in the body of the parent. The total heritage of that parent will have included a greater variety of material than was utilised in the formation of his own personal structure. Only a portion of it became developed; the survival of at least a small part of the remainder is proved, and that of a larger part may be inferred by his transmitting it to the person of his child. Therefore the organised structure of each individual should be viewed as the fulfilment of only one out of an indefinite number of mutually exclusive possibilities. It is the development of a single sample drawn out of a group of elements. The conditions under which each element in the sample became selected are, of course, unknown, but it is reasonable to expect they would fall under one or other of the following agencies: first, self-selection, where each element selects its most suitable neighbour, as in the theory of pangenesis; secondly, general co-ordination, or the influence exerted on each element by many or all of the remaining ones, whether in its immediate neighbourhood or not; finally, a group of diverse agencies, alike only in the fact that they are not uniformly helpful or harmful, that they influence with no constant purpose—in philosophical language, that they are not teleological; in popular language, that they are accidents or chances. Their inclusion renders it impossible to predict the peculiarities of individual children, though it does not prevent the prediction of average results. We now see something of the general character of the conditions amid which the stable equilibrium that characterises each race must subsist.

Political analogies of stability and change of type abound, and are useful to fix the ideas, as I pointed out some years ago. Let us take that which is afforded by the government of a colony which has become independent. The individual colonists rank as particulate representatives of families or other groups in the parent country. The organised colonial government ranks as the personality of the colony, being its mouthpiece and executive. The government is evolved amid political strife, one element prevailing here and another there. The prominent victors band themselves into the nucleus of a party, additions to their number and revisions of it ensue, until a body of men are associated capable of conducting a completely organised administration. The kinship between the form of government of the colony and that of the parent state is far from direct, and resembles in a general way that which I conceive to subsist between the child and his mid-parentage. We should expect to find many points of resemblance between the two, and many instances of great dissimilarity, for our political analogy teaches us only too well on what slight accidents the character of the government may depend when parties are nearly balanced.

The appearance of a new and useful family peculiarity is a boon to breeders, who by selection in mating gradually reduce the preponderance of those ancestral elements that endanger reversion. The appearance of a new type is due to causes that lie beyond our reach, so we ought to welcome every useful one as a happy chance, and do our best to domicile and perpetuate it. When heredity shall have become much better and more generally understood than now, I can believe that we shall look upon a neglect to conserve any valuable form of family type as a wrongful waste of opportunity. The appearance of each new natural peculiarity is a faltering step in the upward journey of evolution, over which, in outward appearance, the whole living world is blindly blundering and stumbling, but whose general direction man has the intelligence dimly to discern, and whose progress he has power to facilitate.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

THE meeting of 1885 of the American Association for the Advancement of Science was held at the Ann Arbor University. The total attendance (according to *Science*) of members was not a large one, the number reaching only to 365; the number of papers was 176. Two changes in the organisation were made; by one, the section of histology and microscopy was abolished, as it has been urged for some time that a special science of microscopy does not exist, the microscope being rather a tool to be used by scientific men in various branches. The other change was in the name of the section of mechanics, the words "and engineering" being added to the title, that it may be more clearly understood by Americans that those interested in all branches of engineering are invited to take part in the proceedings. As this was the first meeting since the action of the Government in regard to the Coast Survey, the question was generally discussed. The matter was referred to a committee, which offered to a general session of the Association the following resolutions, which were unanimously accepted:—

WHEREAS, The attention of this Association has been called to articles in the public press, purporting to give—and presumably by authority—an official report of a Commission appointed by the Treasury department to investigate the condition of the U.S. Coast Survey Office, in which report the value of a certain scientific work is designated as "meagre."

AND WHEREAS, This Association desires to express a hope that the decision, as to the utility of such scientific work, may be referred to scientific men.

Resolved, That the American Association for the Advancement of Science is in earnest sympathy with the Government in its every intent to secure the greatest possible efficiency of the public service.

Resolved, That the value of the scientific work performed in the various departments of the Government can be best judged by scientific men.

Resolved, That this Association desires to express its earnest approval of the extent and high character of the work performed by the U.S. Coast Survey—especially as illustrated by the

[1] For early copies of the addresses and papers we are indebted to the editor of *Science*.

gravity determinations now in progress—and to express the hope that such valuable work may not be interrupted.

Resolved, That this Association expresses, also, the hope that the Government will not allow any technical rule to be established that shall necessarily confine its scientific work to its own *employés*.

Resolved, That in the opinion of the American Association for the Advancement of Science, the head of the Coast Survey should be appointed by the President, by and with the advice and consent of the Senate, should have the highest possible standing among scientific men, and should command their entire confidence.

Resolved, That copies of these resolutions shall be prepared by the general secretary, and certified by the President of the Association and by the permanent secretary, and shall be forwarded to the President of the United States, the Secretary of the Treasury, and given to the press.

Various improvements with the object of securing a more rapid despatch of business were either suggested or adopted; thus members are to be elected by a standing committee instead of in general session, and it is proposed to restrict general sessions of the Association to the beginning and close of the meeting, and to limit the public reading of committee reports in general session to such as seem to the standing committee specially desirable from their interest or importance. The next meeting will be held at Buffalo, beginning August 18, 1886, under the presidency of Prof. Edward S. Morse, of Salem.

We regret much that it is impossible for us to reproduce in full the President's address and the sectional reports; the obvious pressure on our space at the present time will only enable us to refer to a few salient topics. The President's address was delivered by Prof. J. P. Lesley, of Philadelphia. We find the following striking observations on the "dead-work" of science:—

There is a topic which I think should be frequently considered by all who engage in scientific pursuits, and by none so earnestly as by those who are ambitious to reach the higher points of view, from which to survey and describe those systematic combinations of phenomena which are more or less panoramic: I allude of course to generalisers or discoverers of natural laws, and the professional teachers of such laws: while those who deal in itemised science, the mere observers of isolated facts, discriminating specimens and naming genera and species in the animal, vegetable, or mineral worlds, and especially such as occupy themselves with geographical and geological studies in detail, stand in less need of having it pressed upon their attention, because in their case it insists upon its own necessity.

I allude to what is technically known among experts as "dead-work."

This topic has to be treated in the most prosaic style. To describe dead-work is to narrate all those portions of our work which consume the most time, give the most trouble, require the greatest patience and endurance, and seem to produce the most insignificant results. It comprises the collection, collation, comparison and adjustment, the elimination, correction, and reselection, the calculation and representation—in a word, the entire first, second, and third handling of our data in any branch of human learning—wholly perfunctory, preparatory, and mechanical, wholly tentative, experimental, and defensive—without which it is dangerous to proceed a single stage into reasoning on the unknown, and futile to imagine that we can advance in science ourselves, or assist in its advancement in the world. It is that tedious, costly, and fatiguing process of laying a good foundation which no eye is ever to see, for a house to be built thereon for safety and enjoyment, for public uses or for monumental beauty. It is the labour of a week to be paid for on Saturday night. It is the slow recruiting, arming, drilling, victualling, and transporting of an entire army to secure victory in one short battle. It is the burden of dead weight which every great discoverer has had to carry for years and years, unknown to the world at large, before the world was electrified by his appearance as its genius. Let us examine it more closely: it will repay our scrutiny. Those of you who have been more or less successfully at work all your lives may get some satisfaction from the retrospect: and those who have commenced careers should hear what dead-work means, what its uses are, how indispensable it is, how honourable it is, and what stores of health and strength and happiness it reserves for them.

My propositions, then, are these:—(1) That, without a large amount of this dead-work, there can be no discovery of what is rightly called a scientific truth. (2) That, without a large amount of dead-work on the part of a teacher of science, he will fail in his efforts to impart true science to his scholars. (3) That, without a large amount of dead-work, no professional expert can properly serve, much less inform and command, his clients or employers. (4) That nothing but a habitual performance of dead work can keep the scientific judgment in a safe and sound condition to meet emergencies, or prevent it from falling more or less rapidly into decrepitude; and (5) That in the case of highly-organised thinkers, disposed or obliged to exercise habitually the creative powers of the imagination, or to exhaust the will-power in frequently-recurring decisions of difficult and doubtful questions, dead-work and plenty of it is their only salvation; nay, the most delicious and refreshing recreation; a panacea for disgust, discouragement, and care; an elixir vitæ; a fountain of perpetual youth. . . .

First, then, is it so that scientific truths cannot be discovered without a large amount of preliminary dead-work? Surely no one in this assembly doubts it who has established even one original theory for himself, or won for it the suffrages of judges capable of weighing evidence. Now the immense disproportion in numbers between theories broached and theories accepted is the best proof we could have, not only of the value and necessity of dead-work, but of the scarcity of those who depend upon it as a preparatory stage of theorising. And, moreover, not theories only, but simple statements of fact believed and disbelieved—that is, finally accepted or finally rejected—exhibit the like numerical disproportion, and betray a general carelessness or laziness of observers; at all events their manifest lack of appreciation of the value and necessity of the dead-work part of observation, which imperatively must precede any clear mental perception of the simplest phenomenon, before the attempt is made to establish its natural relationships, and present it for acceptance as a part of science.

No; dead work cannot be delegated. The man who cannot himself survey and map his field, measure and draw his sections properly, and perfectly represent with his own pencil the characteristic variations of its fossil forms, has no just right to call himself an expert geologist. These are the badges of initiation; and the only guarantees which one can offer to the world of science that one is a competent observer and a trustworthy generaliser. Nor has one become a true man of science until he has already done a vast amount of this dead work; nor does one continue in his prime, as a man of science, after he has ceased to bring to this test of his own ability to see, to judge, and to theorise, the working and thinking of other men. But enough of this.

My second proposition was that no teacher of science can be successful who does not himself encounter some of the dead work of the explorer and discoverer; who does not discipline his own faculties of perception, reflection, and generalisation, by field-work and office-work, independently of all text-book assistance; who does not himself make at least some of the diagrams, tables, and pictures for his class-room, in as original a spirit and with as much precision of detail as if none such had ever been made before, and these were to remain sole monuments of the genius of investigation. What the true teacher has to do first and foremost is to wake up in youthful minds this spirit of investigation *ab initio*. The crusade against scholastic cramming promises to be successful; but the crusade against pedagogic cramming has hardly yet been organised. How is the scholar to be made an artist if the teacher cannot draw? The instinct of imitation in man is irresistible. Slovenly drawing on the blackboard—sufficient evidence of the teacher's imperfect information and inaccurate conception of facts, the nature of which he only thinks he understands—can do little more than raise a cold fog of suspicion in the class-room, by which the tender sprouts of learning must be either dwarfed or killed. But even slovenly diagrams are preferable to purchased ones; for whatever diminishes the dead-work of a teacher enervates his investigating, and thereby his demonstrating, powers, and lowers him toward the level of his scholars.

Were I dictator I should drive all teachers of science out into the great field of dead-work; force them to go through all the gymnastics of original research and its description, and not permit them to return to their libraries until their notebooks were full of their own measurements and calculations, sketch-maps and farm-drawings, severely accurate and logically classified, to be then compared with those recorded in the books. What teachers fail to keep in mind is this: that learning is not knowledge; but as Lessing says: Learning is only our knowledge of the experience of others; knowledge is our own. No man really comprehends what he himself has not created. Therefore we know nothing of the universe until we take it to pieces for inspection, and rebuild it for our understanding. Nor can one man do this for another; each must do it for himself; and all that one can do to help another is to show him how he himself has morsellated and recomposed his small particular share of concrete nature, and inspire him with those vague but hopeful suggestions of ideas which we call learning, but which are not science.

My third proposition was that an expert in practical science can command the respect and confidence of his professional fellows, and through their free suffrages build up his own reputation in the learned and business worlds, only in exact proportion to the amount of good dead-work to which he voluntarily subjects himself. For, although the most of it is necessarily done in secrecy and silence, enough of it leaks out to testify to his honest and diligent self-cultivation; and enough of it must show in the shape of scientific wisdom to make self-evident the fact that he is neither a tyro nor a charlatan. More than once I have heard the merry jest of the Australasian judge quoted with sinister application to experts in science. When a young colleague, just arrived from England, asked him for advice, he answered: Pronounce your decisions, but beware of stating your reasons for them. Many an ephemeral reputation for science has been begot by this shrewd policy; but the best policy to wear well is honesty; and honesty in trade means selling what is genuine, well-made, and durable; and honesty in science means, first, facts well proved, and then conclusions slowly and painfully deduced from facts well proved, in sufficient number and order of arrangement to exhaust alike the subject and the observer. Reap your field so thoroughly that gleaners must despair. Fortify your position, that your most experienced rival can find no point of attack. Lay your plans with such a superfluity of patient carefulness that fate itself can invent no serious emergency. Demonstrate your theory so utterly and evidently that it shall require no defender but itself. Die for your work, that your work may live for ever. Forget yourself, and your work will make you famous. Enslave yourself to it, and it will plant your feet upon the necks of kings, and your mere Yes or No will become a law to multitudes. This is what the dead-work of science, when well done, does for the expert in science.

My fourth proposition—that only the habitual performance of dead-work can preserve the scientific intellect in pristine vigour, and prevent it from becoming stiffened with prejudices, inapt to receive fresh truth, and forgetful of knowledge already won—hardly needs discussion. Human muscles become atrophied by disuse. Men's fortunes shrink and evaporate by mere investment. I pray you to imagine what I wish to say, for it all amounts to this—that the grass will surely grow over a deserted footpath. Let me hurry to the close of this address, which I have found too serious a duty for my liking, and perhaps you also have found it too personal a preachment for yours. One more suggestion, then, and I have done.

My fifth proposition was that the wearied and exhausted intellect will wisely seek refreshment in dead-work.

The physiology of the brain is now sufficiently well understood to permit physicians to prescribe with some assurance for its many ills, and to regulate its restoration to a normal state of health. Its tissues reproduce themselves throughout life if no extraordinary over-balance of decay takes place, if there be no excessive and too long-continued waste. For the majority of mankind, nature provides for the adjustment between consumption and reproduction of brain matter, by the alternations of day and night, noise and silence, society and solitude; and also by the substitution of the play of fancy in dreams, for the work of the judgment and the will in waking hours. We follow the lead of nature when we seek amusement as a remedy for care. We bring into activity a rested portion of the brain, to permit the wearied parts of it to restore themselves unhindered.

In Section A Prof. Newton, of Yale, read a paper upon "The Effect of Small Bodies passing near a Planet upon the Planet's Velocity."

The former researches of Prof. Newton upon meteors are recognised among astronomers as our principal source of knowledge about the character, distribution, and motion of these minute bodies with which the solar system is filled, especially those which strike our atmosphere and are burned up as meteors. The possible effect of these upon the rotation of the earth, and the revolution of the earth and moon in their orbits, has been subjected to elaborate investigation at the hands of several mathematical astronomers. The recent publications of Mr. Denning, of Bristol, claiming the fixity of long-continuing radiant points of meteor streams, have raised the question of the existence of broad streams of meteoroids moving swiftly through stellar space outside of solar attraction; and any new investigation bearing upon any of these points is more than usually timely. In this paper Prof. Newton has discussed the effect upon the earth's motion of those bodies which do not pass near enough to the earth to be drawn into its atmosphere, but still near enough to be drawn out of their course, and swung for a time in hyperbolic orbits around it. He began by saying that the results of the investigation might perhaps be considered negative as far as measurable quantities in the solar system are concerned, but that they had a mathematical interest, and might possibly have a bearing upon somewhat similar questions in molecular physics, like the kinetic theory of gases. The mathematician and astronomer must be referred to the paper itself, and the results of popular interest may be briefly summarised as follows:—Considering, first, the case of a cylindrical stream of small bodies evenly distributed, and all moving in the same direction with a common velocity past the earth supposed to be in the axis of the cylinder, it is shown that they will communicate to the earth in each unit of time a velocity along the axis: (1) that is proportional to the density of the group; (2) that decreases as the velocity increases nearly inversely as the square of the velocity; (3) that increases as the logarithm of the radius of the cylinder, the radius being measured by a unit differing from the earth's radius by a small quantity, which is a function of the velocity. Second, in the case of a widely-extended group of small bodies evenly distributed in space, and having speeds all equal, but directed towards points evenly distributed over the celestial sphere with the earth moving in a right line through them, it is shown that, for those which do not strike the earth, but only affect it by their attraction, the effect will be an exceedingly minute acceleration of the earth's motion, if the latter *is less than that of the bodies*, even though the group is infinite in extent. If the earth's velocity *is greater than that of the bodies*, their total effect will consist of two parts: a very minute retardation of the earth's motion, depending in amount upon the absolute velocity of the bodies; and another retardation depending upon the assumed extent of the group. In conclusion, the effect of bodies *striking* the earth or moon is manifold greater than that of those only *passing near*; and since it has before been shown that any admissible magnitude of meteroids would make the effect upon the moon's mean motion of those which strike it only a minute fraction of the observed acceleration, still less can any action of those passing near the moon have any appreciable effect.

Papers were also read by Prof. Harkness on the flexure of transit instruments; by Prof. Hough, describing some improvements recently introduced in the printing chronograph, first designed and brought into use by himself at the Dudley Observatory in 1871, by Prof. Burkitt Webb, describing a method of using polar coordinates, by transferring the origin from the centre to the end of the unit radius, thus substituting $(r-1)$ for r, and then using the length of the arc and the distance out from its end upon the radius vector, as x and y are used in rectangular coordinates. He found this a very convenient transformation in the application of polar coordinates to the discussion of Amsler's planimeter; and, pointing out, that by substituting infinity for unit-radius in the equations thus transformed, they were reduced to those of rectangular coordinates, he thought this transformation of polar coordinates might be found generally useful.

In this section also Mr. Rockwell presented some results of his observations for time and latitude with the almucantar, an instrument devised by Mr. Chandler, of the Harvard College Observatory, a year or two ago, which promises at least to furnish an entirely new and radically different method of attacking the question of absolute positions of the stars, and very probably far to surpass all others in accuracy, on account of its freedom from systematic errors. The results thus far published by Mr. Chandler seem fully to confirm all that was expected of the instrument; and it is probably not too much to say, that it is the most important addition of the present century to the instruments and methods used in the determination of absolute star positions.

The sources of systematic error would seem to be almost wholly reduced to those of varying personal equation in the observation of transits at all speeds and at all inclinations and directions over horizontal wires, and to possible systematic difference in atmospheric refraction in different azimuths. Mr. Rockwell exhibited some results, simply copied from his observing-books, illustrating the methods of reduction for time and latitude observations, and showing the degree of accuracy that can be attained by the instrument in both these directions. They served to show that the instrument when duplicated will give equally good results with the one first constructed; and their consideration gave rise to a very interesting discussion, participated in by many members, as to the character of work the instrument might be expected to do, in the course of which Mr. Rockwell answered, in a very entertaining way, many questions, put by various members, as to the details of observing and reducing, which were not before clearly understood on account of the novelty of the work. One of the most important problems which the instrument is specially adapted to investigate, and one which we hope Mr. Chandler will soon find time to undertake, is the determination of the declination of fundamental stars south of the equator, tying them to northern stars at corresponding zenith-distances below the pole. This would seem to be by far the best, perhaps the only, method of connecting these together in a way that shall be free from systematic error.

In the Physical Section, the first paper read was by Prof. Langley, on the spectra of some sources of invisible radiations, and on the recognition of hitherto unmeasured wave-lengths. This was followed by one by Mr. Brashear on a practical method of working rock-salt surfaces for optical purposes.

Prof. H. S. Carhart presented a paper on surface transmission of electrical discharges, which was an ingenious revision of work by Prof. Henry. Prof. E. L. Nichols presented some further notes on the chemical behaviour of magnetic iron, a continuation of work described in a paper at the Philadelphia meeting. Major H. E. Alvord of Mountainville, New York, presented the results of telemetric observations at Houghton Farm. This is a method by which changes in temperature are transmitted and recorded electrically; and Major Alvord's results show that, with increasing experience, the records followed more and more satisfactorily the observations made on the mercurial thermometer.

Prof. T. C. Mendenhall called attention to the modifications and improvements already made or desired in electrometers, especially with reference to their use in observations on atmospheric electricity. Observations of this kind have been made regularly for the last year or two; but, as Prof. Mendenhall well said, the meaning of the variations recorded is still a mystery. Prof. A. E. Dolbear read three papers: in one he described a method of studying contact-theory of electricity by means of the telephone. He has found that a click is produced in the telephone every time the circuit is broken between two heterogeneous materials, as copper and zinc. In another paper he referred to his success in employing a Bernstein incandescent lamp for projection purposes; and in the third he described a new galvanic element of high electromotive force and great constancy, consisting of carbon in a saturated solution of bichromate of potash, and sulphuric acid and zinc in a saturated solution of ammonic chloride; nitric acid could be used in place of sulphuric. Mr. A. J. Rogers presented a paper on electrolysis of the salts of the alkaline earth.

Prof. E. D. Nicholls has, by means of a spectro-photometer, described at a previous meeting, compared the spectrum of the unclouded sky with that of the light reflected by magnesium carbonate, illuminated by direct sunlight.

Prof. Wead exhibited a combined spectro-photometer and ophthalmospectroscope.

In the Chemical Section Prof. Nichols delivered an address on chemistry in the service of public health. Amongst the papers are:—Prof. Noyes, on para-nitrobenzoic sulphuride; Dr. Wiley, on a method of estimating lactic and acetic acid in sour milk or *koumiss*; Mr. Young, on the thermo-chemical reaction between potassic hydrade and common alum. A general discussion took place on the question of what is the best initiatory work for students entering upon laboratory practice, and also, To what extent is a knowledge of molecular physics necessary to one who would teach theoretical chemistry?

In the Section of Mechanical Science Prof. Webb delivered an address on the second law of thermo-dynamics. Mr. Wagner presented an elaborate paper on electric light tests, giving an account of his work in testing the efficiency of two electric-light plants. Prof. Cooley explained and illustrated a method of testing indicator-springs. Prof. Thurston's paper on cylinder condensation is described as being of great scientific and practical value.

In the Section of Geology and Geography the address was by Prof. Edward Orton, and the subject, Problems in the study of coal, with a sketch of recent progress in geology. There were, in all, twenty-seven papers in this Section, none being geographical. Stratigraphy received the lion's share of attention, the most important paper on this subject being one by Prof. Henry S. Williams.

The address to the Biological Section was by Dr. Wilder, on Educational Museums of Vertebrates.

The Section opened with two papers by Prof. L. E. Sturtevant as the result of observations and experiments at the New York agricultural experiment station. The first, on the hybridisation and cross-fertilisation of plants. In the second—"Germination Studies"—the author gives, as a result of many trials with commercial seeds of our common plants, that very extended series of trials must be made with each species in order to obtain the desired accuracy in results.

An interesting paper on the biological deductions from a comparative study of the influence of cocaine and atropine on the organs of circulation, by Dr. H. G. Beyer, U.S.N., was read before the Section.

"On the Brain and Auditory Organs of a Permian Theomorph Saurian" was the title of an interesting paper by Prof. E. D. Cope. The author called special attention to the morphology of the brain, the character of the cranial walls and the auditory apparatus.

The disputed question of the bisexuality of the pond-scums (Zygnemaceæ) was discussed by Prof. C. E. Bessey, of the University of Nebraska, who concluded that these organisms do not possess true bisexuality.

"On the Process of Cross-fertilisation in *Campanula americana*" was the title of a paper presented by C. R. Barnes.

A paper on aquatic respiration in soft-shelled turtles (Aspidonectes and Amyda) was presented by Profs. Simon H. and S. Phelps Gage as a contribution to the physiology of respiration in vertebrates.

Prof. C. E. Bessey read a paper on the inflorescence of *Cuscuta glomerata*.

Prof. Gage addressed the Section (G) on Microscopy and Histology on the limitations and value of histological investigation, and Mr. Dall discoursed to the Anthropological Section on the native tribes of Alaska. The papers in this section were very numerous, many of great interest, and all naturally devoted to anthropological questions connected with the North American continent.

NOTES

THE National Sanitary Congress commenced its autumn meeting at Leicester on Tuesday, when the president, Prof. De Chaumont, F.R.S., gave an address on the work of the Sanitary Institute.

THE portrait of the late George Bentham, subscribed for by several of his friends, has been presented to the Herbarium, Royal Gardens, Kew, on behalf of the subscribers, by Sir John Lubbock. The picture is a successful reproduction, by Miss Merrick, of the original in the possession of the Linnean Society.

WE regret to notice the death of M. Breton des Champs, one of the French Government engineers, a mathematician and scientific writer who played a prominent part in connection with the Newton forgeries. In combination with his friend Leverrier, M. Breton des Champs exploded these frauds, which were so disgraceful to the good name of the French Academy of Sciences. He discovered the books from which the so-called "forger with long ears" had copied the assumed letter sold to M. Chasles.

THE Essex Field Club will hold its sixth annual cryptogamic and botanic meeting in Epping Forest on Friday and Saturday, October 2 and 3. On the Saturday afternoon and evening there will be an exhibition of fungi and other plants, fresh and preserved, with micro-objects; and papers will be read by Dr. Wharton and Mr. Worthington Smith. The following botanists, among many others, are expected to be present, and will act as "referees" in various departments of plant-lore:—Prof. Boulger, Dr. Braithwaite, Dr. M. C. Cooke, Rev. J. M. Crombie, Rev. Canon Du-Port, Messrs. J. L. English, Henry Groves, F. J. Hanbury, E. M. Holmes, David Houston, A. Vaughan Jennings, Frederick Oxley, W. W. Reeves, Worthington G. Smith, C. A. Wright, Dr. Spurrell, Dr. H. T. Wharton, &c. Those wishing to attend should communicate with the hon. secretary, Mr. W. Cole, Buckhurst Hill, Essex, who will forward programmes giving full particulars.

THE Trustees of the Gilchrist Lectures Fund have arranged for courses of six lectures in each of five Lancashire towns—Blackburn, Lancaster, Chorley, Colne, and Padiham, and for similar courses in Greenock, Paisley, Stirling, Alloa, and Kilmarnock—all to be delivered during October and December. No lectures will be given during November in consequence of the General Election in that month. The lecturers entrusted with the work are: Prof. R. S. Ball, Rev. W. H. Dallinger, Prof. W. C. Williamson, Dr. Andrew Wilson, and Mr. W. Lant Carpenter. Each course includes three lectures on biological and three on physical subjects, oxyhydrogen lantern illustrations being freely used, and in some cases experiments also. As usual the charge for admission will be one penny, and the largest available rooms are secured for the lectures, special measures being taken to insure the attendance of working men. There will probably be similar courses in five Midland towns in the spring.

WE are informed that the vacant Chair of Physics and Engineering in University College, Bristol, has been filled by the appointment to the post of Prof. John Ryan, M.A., King's College, Cambridge, D.Sc. London, and Member of the Institute of Mechanical Engineers. Dr. Ryan, who is a practical engineer, has hitherto held the appointment of Professor of Mechanics and Engineering in University College, Nottingham. At Bristol he succeeds Prof. Thompson, now Principal of the Finsbury Technical College, and Prof. Hele Shaw, recently appointed to the Professorship of Engineering in University College, Liverpool.

MR. F. C. LEHMANN, a German botanist, who has travelled or over ten years in Central and South America for the purposes of scientific researches, has arrived safely at Panama, from Europe, which he lately visited in order to arrange with other scientific colleagues to assist him in the classification of his extensive collection of objects of natural history. Mr. Lehmann was about to proceed to the Cauca, where he intends to remain for several years, with his domicile in Popayan. He proposes the continuation of former labours and minute researches into the botanico-geographical conditions of the Flora of Tropical America.

THE exceedingly unusual character of the following announcement, coming from the United States, will attract attention. We take it from *Science*:—"On account of the lack of funds necessary to maintain its activity, the Astronomical Observatory of Beloit College, Wisconsin (Prof. J. Tatlock, jun., director), has been closed."

THE experiments for the electrical illumination of the Palais Royal are very successful. The number of incandescent lights used is 150. The Théâtre Français, Théâtre du Palais Royal, and Council of State have agreed to the deed of agreement signed by the shopkeepers, so that thousands of lamps will soon be in operation. But before taking a final decision, the subscribers are trying every description of incandescent lamp.

A SERIES of science lectures has commenced at the Royal Victoria Hall, Waterloo Bridge Road, and promises to be as successful as any previous one. On September 29, W. J. Harrison, F.G.S., will lecture on "Stone Tools and the Men who used them." On October 6, Mr. A. H. Fison will lecture on "Some Other Worlds." On October 13, Prof. H. G. Seeley, F.R.S., will lecture on "Coal."

WE learn from the *London and China Telegraph* that a work on which Dr. Dudgeon of Peking has been engaged for upwards of ten years, has just been issued in eighteen Chinese volumes. It comprises a translation of Gray's "Anatomy" and Holden's "Osteology." There are in addition two volumes of plates, comprising 600 cuts, which have occupied the time of two men for two years and a half. The whole of these cuts have been made at the expense of the Chinese Foreign Office, and the work has been published in a series issued by the Foreign Language College at Peking. It is proposed to establish in connection with this college a medical school and hospital to provide proper practitioners for the service of the army, navy, and palace.

A REPORT on carp-culture in China has been made by Dr. Macgowan to the Carp-Culture Association of the United States. Pisciculture, it appears, was cultivated at a very early period, being regarded as a branch of agriculture. The carp is, of all fish, the most frequently reared by artificial means in China, but nearly every species of *Cyprinidæ*, bream, tench, roach, gold-fish, &c., is so raised. A treatise on fish-rearing has been attributed to a Minister of the fifth century before our era, but it it appears to have been really written eight centuries later. The work says that of the five modes of rearing animals by far the most productive and valuable is fish-breeding. The pond used for this purpose (it goes on) should be an acre in extent (the depth is usually less than eight feet), and nine stone islets, each having eight inlets or bays, a yard below the surface of the water, should be constructed in it; then twenty gravid carp and four males, each three feet long, are to be deposited in it noiselessly in the month of March. Two months later a turtle should be placed in the pond, two months later a couple, and after a like period three more. By this time there will be 360 carp. The turtles are to prevent their being transformed into dragons and flying away. The object of the islets and bays is to afford greater space for the fish in their sinuous voyages, for the more a fish travels the fatter and bigger he becomes. The Chinese author then makes the following calculation: in the following year the pond will be found to contain 150,000 carp 1 foot in length, 450,000 3 feet, 10,000 2 feet. In the third year 100,000 1 foot, 50,000 2 feet, 50,000 3 feet, and 40,000 4 feet. A thousand of those that are 2 feet in length should be retained for replenishment, and all the rest be sent to market. In another year their number will exceed all calculation, and they require no feeding, hence the value of carp culture. All the varieties, we are told, come from the black species. Those destined to become white change to silver or yellow, while the others turn first red and then golden. Some of the white sort are so nearly transparent that their viscera are visible. Much of the art of rearing them consists in affording due amounts of shade and sunshine in the course of their growth, and in changing their water, not more than half of which is to be removed every fourth day. In the earliest times the practice, which continues to-day, was introduced of planting mulberries on the margins on which apiaries were placed, the droppings from which fed the fish, while the leaves of the trees first nourished silkworms and then goats. These droppings are said to impart a peculiar flavour to the fish.

A CONSIGNMENT of soles and brill has lately been despatched by the National Fish Culture Association to the American

Government as a slight recognition of the presentations of ova made by them to this country. There is a great dearth of flat fishes in the United States, and at the instigation of the Commissioners of Fish and Fisheries many attempts have been made to forward young specimens for propagation from England. Hitherto these efforts have not met with success, it being exceedingly difficult to transmit live soles, as they are less tenacious of life than their congeners. We hope that Prof. Baird, who has received notice of the despatch of this valuable gift, will not be again disappointed. The fish have been placed in charge of an experienced pisciculturist, who will accompany the s.s. *Republic*, by which vessel they have been sent, and who will bring back a number of American species with a view to acclimatising them in this country.

THE Royal Commissioners of the Colonial Exhibition, to be held next year at South Kensington, have issued circulars to the Governors of our Colonies requesting them to send the various species of fish indigenous to their respective countries for exhibition. Special preparations will be made at the close of October for receiving them. The arrangements will necessarily be of an elaborate nature, as the tanks will have to be constructed in such a manner as to provide for the exigencies of each species and the regulation of high and low temperatures according to the climatal necessities of the fish.

SPECIAL interest is just now centred at the Aquarium in the incubation of the ova of some of the dogfish which have recently spawned. The eggs, which resemble filbert nuts in shape, are to be seen in a special tank, which presents a sight of much edification. The formation of the fish inside the ova is plainly perceptible, every part of them being apparent. The fish in the Aquarium are now being fed at 6 o'clock, partly on a new dietary specially invented by Mr. W. Burgess, of Malvern Wells.

THE Marquis of Lorne has successfully planted some whitefish in a specially constructed lake on the Isle of Mull. The fish form part of those reared by the National Fish Culture Association this year. His Lordship reports that the fish are doing well.

AT a lecture delivered by Mr. W. Oldham Chambers, F.L.S., at the Hull Town Hall last week on fish culture, living specimens of the whitefish and other foreign species of fish were exhibited, and excited much interest amongst the audience.

A RECENT *Bulletin* of the United States Fish Commission contains the following interesting account of the destruction of young trout by mosquitoes: "In the middle or latter part of June, 1882, I was prospecting on the head-waters of the Tumichie Creek, in the Gunnison Valley, Colorado. About 9 o'clock in the morning I sat down in the shade of some willows that skirted a clear but shallow place in the creek. In a quiet part of the water where their movements were readily discernible, were some fresh-hatched brook or mountain trout, and circling about over the water was a small swarm of mosquitoes. The trout were very young, still having the pellucid sack puffing out from the region of the gills, with the rest of the body almost transparent when they would swim into a portion of the water that was lighted up by direct sunshine. Every few minutes these baby trout—for what purpose I do not know, unless to get the benefit of more air—would come to the surface of the water, so that the top of the head was level with the surface of the water. When this was the case a mosquito would light down and immediately transfix the trout by inserting its proboscis, or bill, into the brain of the fish, which seemed incapable of escaping. The mosquito would hold its victim steady until it had extracted all the life juices, and when this was accomplished, and it would fly away, the dead trout would turn over on its back and float down the stream. I was so interested in this before unheard-of destruction of fish that I watched the depredations of these mosquitoes for more than half an hour, and in that time over twenty trout were sucked dry and their lifeless bodies sent floating away with the current. It was the only occasion when I was ever witness to the fact, and I have been unable by inquiry to ascertain if others have observed a similar destruction of fish. I am sure the fish were trout, as the locality was quite near the snow line, and the water was very cold, and no other fish were in the stream at that altitude. From this observation I am satisfied that great numbers of trout, and perhaps infant fish of other varieties in clear waters, must come to their death in this way; and if the fact has not been heretofore recorded it is important to those interested in fish-culture."

A TELEGRAM from Rome, September 21, states that repeated shocks of earthquake have occurred in Benevento. The inhabitants are terror-stricken, and are encamped in the open country.

THE Russian *Official Messenger* states that the city of Namangan, in Ferghana, has been visited all through the summer by repeated shocks of earthquake, which have hitherto been of very rare occurrence there. The strongest shocks took place on April 17 and August 4, but no very serious consequences resulted.

ON September 12, at 9.30 p.m., a magnificent meteor passed over the city of Stockholm, going from south to north. Its light was very brilliant. On account of the limited area of observation it was impossible to tell whether it burst near the city or not.

DURING the month of August enormous swarms of ants passed over the town of Solothurn in Switzerland. They came from the Jura mountains, and formed a cloud, consisting of seventy-five perpendicular columns, in which the ants circled around in spiral form. The swarm lasted for twenty minutes, the height of the cloud being upwards of ninety feet. Millions of them fell to the ground, however, without making any visible change in the phenomenon.

ACCORDING to the *Bergen Adresseblad*, fishermen at the island of Mögster, on the coast of the province of Bergen, on the west coast of Norway, have lately seen large floating blocks of ice at sea, which are believed to be parts broken off from icebergs in the North Atlantic. Such a phenomenon has never before been observed in these parts.

THE Swedish journal *Norrbottens Kuriren* states that the water is falling rapidly in the Gulf of Bothnia, a phenomenon to which we have on several occasions referred. As a further proof of this the journal states that a stone in the archipelago by the coast which fifty years ago at lowest tide was barely visible above water is now at mean tide three feet above it.

WE have pleasure in noticing the issue of No. 43 of the first part and Nos. 29–31 of the second part of the well-known "Encyklopædie der Naturwissenschaften" from the house of Eduard Trewendt, Breslau. The former brings forward Dr. A. Reichenow's "Handwörterbuch der Zoologie, Anthropologie, und Ethnologie," from article "Heteronereis" to "Icteridæ." Among other articles embraced within this interval are valuable contributions on the development of the organs of hearing by Prof. Griesbach; on "Hypnotismus," by Prof. Gustav Jäger; on "Januten," "Japaner," "Javanen," by Dr. von Hellwald; on "Hissarlik," "Hohlefels," "Hohlkeit," by Prof. Mehlis. Nos. 29 and 31 of the second part, again, continue the "Handwörterbuch der Chemie," while the 30th number continues the "Handwörterbuch der Mineralogie, Geologie, und Paläontologie." The two chemical numbers treat with all the fullness and thoroughness characteristic of this estimable work "Dichte," "Didym," "Diffusion," "Dinte," "Diphenylverbindungen," "Dissociation," "Dünger," and "Eisen," and the accompanying woodcuts illustrating any difficult experiments in the text add materially to the practical value of the articles. The new number, finally, of the Mineralogical, Geological, and Palæontological Dictionary contains important contributions on "Reptilien" and "Rhizopoden," by Rolle; on "Salze," by Kenngott; on "Schichtenlehre" and "Schwankungen im Niveau vom Meer und Festlande," by von Lasaulx—articles distinguished not more by fullness and compactness of matter than by clearness of dan. ne

WITH unflagging vigour and learning the new Italian quarterly, *La Nuova Scienza*, prosecutes the mission it has undertaken of building up an exact philosophy on the foundation of the natural and historical sciences. In the last number for June, 1885, the articles of chief interest, all contributed by the indefatigable editor, Prof. Enrico Caporali, are: Modern Italian thought, German anticlerical evolution, and the Pithagoric formula in cosmical evolution. The last-mentioned paper deals with the evolution of gravitation, of heat, of electricity, chemical affinity, lower organic force, higher organic force, sentient force, social authority; fatalist and free evolution. It is held in general that all evolution is due more to internal energy than to outward conditions, in opposition to Herbert Spencer's theory of mechanical causes.

THE address of Mr. W. H. Dall, vice-president to the Anthropological Section of the American Association for the Advancement of Science at Ann Arbor, last month, has been printed as a separate pamphlet. The subject of the address was "The Native Tribes of Alaska."

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. A. Cornet; a Red Kangaroo (*Macropus rufus* ♀) from Australia, presented by Mr. G. Wylie; a Bonelli's Eagle (*Nisaetus fasciatus*) from North Africa, presented by Capt. W. R. Taylor, s.s. *Empusa*; two Tawny Owls (*Syrnium aluco*), European, presented by Mr. H. Lee; a Nightjar (*Caprimulgus europæus*), European, presented by Mr. Cuthbeth Johnson; a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; seven Blue-bearded Jays (*Cyanocorax cyanopogon*) from Para, purchased; a Beisa Antelope (*Oryx beisa* ♀), born in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *SEPTEMBER* 27 *TO OCTOBER* 3

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

At Greenwich on Sept. 27

Sun rises, 5h. 56m.; souths, 11h. 50m. 51·3s.; sets, 17h. 46m.; decl. on meridian, 1° 48′ S.: Sidereal Time at Sunset, 18h. 13m.

Moon (three days after Full) rises, 19h. 0m.*; souths, 2h. 1m.; sets, 9h. 13m.; decl. on meridian, 10° 42′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	4 29	11 1	17 33	5 36 N.
Venus	9 34	14 12	18 50	16 17 S.
Mars	0 19	8 11	16 3	19 47 N.
Jupiter	4 33	11 1	17 29	4 46 N.
Saturn	22 1*	6 9	14 17	22 19 N.

* Indicates that the rising is that of the preceding day.

Occultations of Stars by the Moon

Sept.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image °	°
28	48 Tauri	6	21 56	22 45	33	273
28	γ Tauri	4	23 46	0 43†	36	279
29	75 Tauri	6	4 41	5 41	149	268
29	θ¹ Tauri	4½	4 48	5 26	54	1
29	B.A.C. 1391	5	5 41	6 51	109	324
30	111 Tauri	5½	3 2	4 17	73	268
30	117 Tauri	6	5 15	6 5	53	341
Oct.						
2	λ Geminorum	3½	0 38	1 32	30	248

† Occurs on the following day.

The Occultations of Stars are such as are visible at Greenwich.

Sept.	h.	
27	9	Mercury in conjunction with and 0° 52′ north of Jupiter.
Oct.		
1	11	Saturn in conjunction with and 4° 15′ north of the Moon.
3	19	Mars in conjunction with and 5° 4′ north of the Moon.

THE ASTRONOMICAL ASSOCIATION

THE Astronomical Association held their eleventh general meeting this year at Geneva from Aug. 19 to 22 inclusive, and the representatives of so many nations were present that the meeting fully bore out the character of an international one. Among the fifty members, or thereabouts, attending were: Struve, from Pulkowa; Newcomb, from Washington; Christie, from Greenwich; Dunér, from Lund; Pechule, from Copenhagen; Tietjen, from Berlin; Krüger, from Kiel; Schur, from Strassburg; Tisserand, from Paris; Spörer, from Potsdam. The office-bearers were: Auwers, from Berlin, President; Schönfeld, from Bonn, and Seeliger, from Munich, Secretaries; Bruns, from Leipzig, Treasurer: while Bakhuyzen, from Leiden, Gyldén, from Stockholm, and Weiss, from Vienna, were honorary members of the Committee. Prof. Oppolzer, who was also a member of the Committee, was unable to attend.

The first sitting was opened by President Auwers in the aula of the University at 10 in the forenoon of the 19th. Among the scientific reports of the Committee the full communications of Prof. Weiss on the present state of the computations of the orbits of the comets were of special interest. Of the 12 periodical comets returned at different times to their perihelion, 8 had again been regularly determined by the same calculators. Of the remaining four three were removed from our present care: Biela's, which, as was known, had been lost to observation, and the comets of Halley and Pons-Brooks, whose next perihelion lay too remote in the future. There was, consequently, but one periodical comet—Brorsen's—to be taken account of. As to the remaining non-returning comets, of the 168 which had appeared in this century 41 were to be regarded as settled, 23 had their orbits pretty well determined; in the case of 58 comets a new calculation of the orbit was desirable for various reasons, and in all 46 had yet to be calculated definitely. There was, therefore, a wide field of labour open. Prof. Weiss accordingly sought to commend to the Society the establishment of a common calculation bureau for the settlement of the questions at issue, while the exact detailed treatment of a particular comet should in future, as hitherto, be left to the initiative of a single calculator. In the discussion following this address, Staatsrath Struve argued against the founding of such a bureau on the ground that the comets were of too peculiar a nature to accommodate themselves to the methodic treatment of a calculation bureau. No resolution was taken on the question.

This report was followed by communications of a business character on the great zone undertaking of the Society. These communications were of no great extent, the undertaking being already in near prospect of completion. The photometric survey of the heavens by Prof. Pickering, of Harvard College, read by Prof. Auwers, was heard with special interest.

Next followed the scientific addresses. Dr. Schram, Observer in the Austrian Triangulation, communicated a table calculated by him, which would shortly be published, a table which materially lightened the approximate calculation of an eclipse for a particular spot on the surface, according to Oppolzer's elements.

Prof. Weiss then communicated the publication of the second volume of the *Annals* of the Vienna Observatory, and followed this up with the remark that the meridian circle, which was sixty years old, was now very much in need of repair; but, unfortunately, there was no money at disposal for this purpose.

After the President had opened the second sitting at ten o'clock on August 20, he communicated a report on the photographic mapping of all the stars of the "Bonner-Durchmusterung" which Gill (of the Cape Observatory) had begun, and of which about 100 plates were already to hand. The time taken for the exposure of each plate amounted on an average to one hour.

After various deliberations of a more private character the discussion turned on Resolution VI. of the Meridian Conference of Washington. The President declared emphatically that the question could be considered in this assembly only from an astronomical standpoint. The question was simply whether it were desirable for the astronomer to transfer the beginning of the day to midnight, and to this question the discussion should be restricted. At the outset the President announced that the Committee of the Society, with the exception of one member not present (Oppolzer)—that is, in the proportion of seven to one—had voted against the adoption of the proposal.

Staatsrath Struve (from Pulkowa) at once opposed the restriction advanced by the President, which, he thought, involved a one-sided treatment of the matter. It was to their advantage, he asserted, not to seclude themselves from the rest of the world. Magnetic and meteorological observers, he said, counted their day from midnight. Many astronomers, moreover, he continued, worked by day, and most observations were made between six and twelve in the evening. The change was defended by men eminent in science. The reform assuredly met a deeply-felt want. The question was "Should they make this sacrifice or not?"

Prof. Spörer, of Potsdam, mentioned that he always counted his observations from midnight.

Prof. Newcomb, of Washington, spoke at considerable length on the question, and rather against than in favour of the adoption of the proposal of universal time.

Prof. Weiss, of Vienna, was of opinion that the sacrifices demanded of astronomers by this reform were too great, and that the advantages were more than counterbalanced by the disadvantages. He laid stress on the fact that astronomers were wont to make their calculation of time from the moment when the time-determining object—the spring point—the mean sun—passed the meridian. That was also the true point of commencement. The observations which were of interest to the public at large, might be given in universal time, whereas with their more esoteric observations they might adhere to the old reckoning. The astronomer should keep by himself, and pay no attention to claims of intercourse.

Prof. Safárik, of Prague, said, "Why should we make a sacrifice on behalf of the public that feels no concern with our labours?"

Prof. Krüger, of Kiel, thought that altogether there were but few necessary points of relation between the astronomer and the public—points, however, which could be readily taken account of if the public desired it.

Dr. Dunér, from Lund, argued that by a change of date it would be impossible not to make a sudden break in astronomical labours that had hitherto been carried on uninterruptedly, to whatever time of day or night the commencement of the day was transferred. He concluded by expressing his opinion that the sacrifices demanded were too great.

Geheimrath Auwers expressed himself as personally opposed to the change, principally in order to avoid a discontinuity in the calculation of time which might, later on especially, lead to sensible errors.

Prof. Bakhuyzen, of Leiden, was refused a hearing, because he wanted to speak of seamen, who have the reform specially at heart.

Staatsrath Struve remonstrated against this proceeding, and argued that the question ought not to be treated onesidedly. At the Washington Conference seamen had the majority of representation, and opinion had there been almost unanimously expressed in favour of the reform. He was swayed by the desire of rendering astronomy useful to the rest of the world.

Prof. Gyldén, of Stockholm, argued that the change must give rise to vexatious errors unless it were universally carried out on one line. As the realisation of this idea was, however, more than could be looked for at present, he would now have to vote against the universal time. He believed, nevertheless, that in twenty or thirty years hence the majority of astronomers would be in favour of the universal time.

Prof. Tietjen, of Berlin, thought that in the Berlin Year-Book at all events, no such change would find place before 1900.

Staatsrath Struve maintained that in the Royal Astronomical Society the majority were in favour of the universal time.

Dr. Pechule, of Copenhagen, was also of opinion that it would be well for astronomy to accommodate itself to the rest of the world; but only when all were of one mind should the innovation be simultaneously and universally introduced.

Prof. Folie, of Brussels, thought that in all reforms there were some stragglers, and in his opinion it was the duty of astronomers energetically to take the initiative in the good cause.

After some recapitulatory observations of the President the discussion closed. No resolution whatever was passed on the subject.

It may be worth while mentioning here in respect of this subject that in the reading of the protocol it was affirmed that all the members of the Committee who were present were opposed to the adoption of the universal time. Objecting to this declaration, Dr. Pechule stated that Prof. Gyldén had only voted against the *immediate* adoption, while he entirely approved the *principle* of the proposed reform. The protocol had accordingly to be altered so as to give effect to this statement.

The series of scientific addresses was resumed by Dr. Mittag-Leffler, from Stockholm, who communicated the mathematical prize exercises which, under the auspices of King Oscar II., had been instituted by a special Commission.

Staatsrath Struve handed, for circulation, photographs of the great refractor of 30 inches aperture, which a short time ago had been mounted in Pulkowa, and expressed his complete satisfaction with the result.

Prof. Newcomb had thoroughly studied the instrument for seven days continuously, and corroborated Staatsrath Struve's views regarding the value of the instrument, entering into various details on the matter.

Prof. Tisserand, of Paris, spoke of a purely theoretical examination of the rotation of the earth.

Dr. Steinheil spoke on the calculations of Galileo's telescopes of new construction.

Prof. Spörer, of Potsdam, gave a somewhat long address on the new views regarding the physics of the sun.

The following day was devoted to a common trip around the Lake of Geneva, Col. Emile Gautier, at present Director of the Geneva Observatory, engaging at his own cost the saloon steamship *Winkelried* for this purpose. The dinner, which was served on board ship, gave opportunity for expressing the warmly-felt thanks of so many guests to their generous host for the entertainment he had provided them during the continuance of the Congress.

On the last day of the meeting, Saturday, August 22, the proceedings of a business character were brought to a close. The statutory order respecting the raising of the fee for life-membership to 185 marks was adopted. As the place of meeting for 1887, Kiel was fixed on. The new election of a committee made no change in its former composition.

The scientific addresses were opened by Prof. Gyldén, who spoke of a graphic representation of planetary orbits.

Prof. Newcomb followed with an address on perturbations and their numerical calculation.

Prof. Bakhuyzen made communications respecting his treatment of Schröter's observations of Mars. He came to the conclusion that since Schröter's time "Huggin's Inlet" had probably changed considerably, whereby the hypothesis that Mars is in large part covered with fluid received material support.

Dr. Müller, of Potsdam, spoke on modern photometric apparatuses, and examined in particular those of Zöllner, Pickering, and Pritchard, entering into a searching criticism of them. The sources of error of the most considerable systematic deviations in the results obtained with these instruments were not yet sufficiently known, and it would therefore be well to mark out a number of stars of which thorough observations should be taken by the different observers with the use of all the three instruments.

Prof. Seeliger, of Munich, spoke of theoretical, and in part also practical, investigations he had commenced, which for the present had shown that the Lambert law respecting the reflective power of illumined surfaces, the basis hitherto of all photometric experiments, was entirely false. He reserved his more complete exposition of the matter till the close of his labours in this direction.

Prof. Safarik observed that some astronomers to whom he had communicated his "fluorescence plates," whose intermediate junction of eye-piece annulled the secondary spectrum, had given him a favourable report regarding their use. He was always ready, he said, to place other plates at the disposal of any who desired them.

Prof. Weiss announced that he was engaged in the preparation of a catalogue of 4500 stars which had formerly been observed at Geneva, a catalogue which was now approaching its completion.

President Auwers once more expressed thanks for the friendly reception the Association had met with at Geneva and proposed to the meeting that they should rise from their seats in honour of Col. Gautier. The proceedings were then declared to be concluded.

EDUCATION IN THE UNITED STATES

THE pride taken in popular education in the United States makes any digest of their experience valuable; and education, as carried on in their cities, the subject of a recent Circular of Information from the Bureau of Education, is necessarily the branch of it most interesting in our crowded island. Dr. Philbrick, the writer of it, has been, in Boston, a most successful school superintendent, an officer who undertakes the active duties of both School Board and Government Inspector, and one without whose services cities are here said to be behind the times. The uncertainty of a good choice of members for a School Board by popular election in the United States makes this office the more important; women having, as a rule, declined to counteract corrupt votes by their own. Every branch of education is treated upon here. Technical instruction, both as provided in Paris and in the United States, is largely and systematically considered; from the shape it takes in the school, where it simply replaces the gymnasium to boys over thirteen years of age, to the apprentice school which really attempts to supersede the worn-out system from which it gets its name by a more scientific and intelligent teaching of a few trades, among which building in its various branches, necessarily so important in a new country, is always one chosen. School museums are recommended, both of natural history and of technology; the decoration also of schoolrooms with statuary, &c., now provided for the purpose at low prices, a list of which is appended. The rules to be observed in building are a digest of both European and American experience, valuable to every one concerned with the architecture of schools of any class; and we may just note Dr. Philbrick's conclusions—that increased centralisation and permanency are found desirable; that *speaking* French or German is unnecessary to 90 per cent. of secondary scholars; and that high school education is bad for girls. "Free and uniform" is Dr. Philbrick's ideal. He believes that the work of elementary schools can be so revised that the higher subjects will be a simple continuation of the lower; so that a complete elementary course shall be just the same as the first few years of a university education. Higher stages are never to be commenced till after the age of fourteen. Free high schools, "the most truly democratic of all our institutions," are being used by youths who go back to farm work, contending that in no way does a classical education unfit a man for manual labour and attending meetings of "old boys" whose common interest in the school helps to obliterate social distinctions. Such schools are to be provided for the mechanic to carry on his studies therein in the evening; while for higher students manual labour, especially the use of carpenters' tools, is to replace the gymnasium, and be pursued afterwards in evening technical schools; and thus study and labour will complement each other, and the daily toil of the poor man is raised to the level of the rich man's recreation. Military and fire drill are to be taught, and replace out-door games. We fear that an elementary course complete in itself and different from university rudiments, although perpetuating class distinctions, will probably be a necessary evil for some time yet, and also that paralysis for lack of competition must be incurred where pupils are required to attend the school in their own district of their own city—this necessitating uniformity of books for the sake of families removing.

A PREHISTORIC CEMETERY

A DUNFERMLINE correspondent writes that another cemetery of prehistoric times has been discovered on the estate of Pitreavie. About two and a half miles to the north-east of the former discovery a number of workmen were, some days ago, engaged in collecting rough stones to form an embankment. Ere the work had proceeded far it was noticed that the stones, which lay on a moor, formed a circle, partly covering a mound 200 feet in diameter. In the centre of the mound, and about 36 inches below the surface, a cyst measuring 46 inches in length and 24 inches in width was found. The cyst was three-parts filled with a dark mould, and in it was discovered a beautifully-formed urn which stands 5 inches in height and measures 6 inches across the mouth. There was nothing in the urn but soil, but in the cyst some large calcined bones were found. Explorations were continued in the vicinity of the cyst and within the stone circle, with the result that no fewer than eleven other urns were found. All these urns contained calcined human bones and much vegetable charcoal, both in dust and in pieces, and numerous pieces of burnt bones were also found in the mound—a circumstance which indicates that a good many interments had taken place without urns. The urns measured from 5 to 12 inches in height, are hand-made, and of the type usually known as "food-vessels." They have everted rims, and are ornamented with varied designs, formed by oblique lines and dots on the upper part, and encircling projecting rings at the bulged part. The urns are of a reddish colour, but the pottery section shows a black interior with a mixture of coarse sand. There are several interesting features attached to the discoveries. In the first cemetery a row of cysts with an urn in each were discovered—circumstances which unmistakably indicate the predominance of inhumation over that of cremation. No bones were found in the urns. In the second discovery only one cyst was found, and eleven of the urns were simply buried in the mounds, and all contained burnt bones—facts suggestive of cremation. The second discovery corresponds more than the first with most of the prehistoric local cemeteries which have been laid bare in the county of Fife. The chronological relationship between the two kinds of interment—inhumation and cremation—as presented to us in the two Pitreavie cemeteries, opens up a most interesting field of inquiry to the enthusiastic archæologist. Dr. Worsaae, the late distinguished archæologist, says cremation was the outcome of higher and more advanced religious principles than characterised the people of the Stone Age, who were in the habit of burying their dead in dolmens and other megalithic tombs, with food-vessels, weapons, ornaments, and such articles as were supposed to be serviceable beyond the grave. Founding upon Dr. Worsaae's idea, it is not unreasonable to assume that the two discoveries under notice belong to the Stone and Bronze ages. The urns are all in the hands of the proprietor of the estate, Mr. Beveridge, and are likely to be handed over to the National Society of Antiquaries.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 8, July 15.—This contains the following:—On the time-relations of the formation of the electric residuum in paraffin, by C. Dieterici.—On the quantity of electrical elementary particles, by E. Budde.—On the theory of thermo-electric forces, by the same.—On a deduction from the laws of electro-dynamic points, suggested by Gauss, by the same.—On some applications of theory of change of form in a body when it is magnetically or dielectrically polarised, by G. Kirchhoff.—Determination of some coefficients of friction and experiments on the influence of magnetisation and electrification on the friction of liquids. The values obtained from swinging disks were always greater than from an outflow-apparatus. Experiments in which sulphate of manganese solution was let flow from a capillary tube placed between magnetic poles, and others in which the capillary tube, of flint glass coated with shellac, was brought into the field of a condenser (the liquid being sulphide of carbon), showed no alteration of the coefficient of friction.—On the solubility of salt mixtures, by F. Rüdorff. Of the pairs of salts examined, some were found to be forced from their common solutions when an excess of one or the other salt acted on these, but in other cases only those pairs of salts were forced out which separate from the common solution either in double salts or in mixed crystals.—On the theory of fluorescence, by E. Lommel. He answers some objections of Herr Wüllner to his theory.—Spectral photometric researches on some photographic sensitisers. He finds the sensitising colouring-matters divisible into: (1) those which gradually absorb the spectrum from the violet onwards, and are like the ordinary photographic; (2) those which have a regular absorptive action over great parts of the spectrum from the violet, but photographically show a maximum of sensitisation in the yellow; and (3) those which show an absorption band in the spectrum and a local increase of sensibility to light thereabouts (coincidence not exact).—Correction of new formulæ, by W. Wernicke.—Remarks on Herr Melde's acoustic experimental researches, by A. Else.—Alteration of the influence machine, by E. Lommel. He gets a spark of 12 cm.—On an inaccuracy of the theory of the gold-leaf electroscope, by T. Häbler.

Proceedings of the Boston Society of Natural History, vol. xxiii., part 1.—Mr. Bouvé contributes notes on gems, especially the garnet, hiddenite (an unnamed gem of a light yellow colour, a representative of the mineral spodumene, of which hiddenite is a green variety), and others.—Dr. S. Kneeland read a paper, illustrated by the stereopticon, on the subsidence theory of earthquakes as evidenced by the Ischian catastrophes of 1881 and 1883.—Prof Crosby has a long paper on the relations of the conglomerate and slate in the Boston Basin; Mr. Bouvé on the genesis of the Boston Basin and its rock formations; Messrs. Dickerman and Wadsworth on an olivine-bearing diabase from St. George, Maine; Prof. Shaler on the origin of kames, a kind of gravel deposit, also known as Eskers, and often called in America, Indian ridges. He supposes that at the close of the glacial period the re-elevation of the land must have been accomplished with very great suddenness.—Finally, Prof. Hyatt contributes a lengthy paper on the larval theory of the origin of cellular tissues.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 7.—M. Bouley, President, in the chair.—Researches on isomerism in the aromatic series: Action of the alkalis on the phenols of mixed function, by M. Berthelot.—Studies on the mode of action of the subnitrate of bismuth in the staunching of sores, by MM. Gosselin and Hérat.—Note on the fluorescence of some rare earths, by M. Lecoq de Boisbaudran. The author arrives at conclusions differing in several respects from those of Mr. Crookes, but reserves for the present an exposition of the grounds which induce him to infer that yttria is not the efficient cause of the fluorescence —On apparent anæsthesis and retarded sensations in hysterical, epileptic, and other nervous subjects, by M. V. Revillont.—Letter announcing the discovery of a new star in the nebula of Andromeda, by M. Lajoie.—Note on the changes recently observed in the nebula of Andromeda, by M. G. Bigourdan.—Observations of Brooks's new comet and of the new planet, 250, made at the Paris Observatory (equatorial of the west tower), by M. G. Bigourdan —Table of the chief elements of the ten regular polyhedric figures, one illustration, by M. Em. Barbier. — A new map of the solar spectrum, by M. L. Thollion. This work, which has occupied four years of incessant labour at the Observatory of Nice, comprises the whole of the solar spectrum between A and *b*—that is, about one-third of the prismatic spectrum. It is over ten metres long and includes 3200 lines, or double the number contained in Angström's Atlas. In the preparation of this plan the author's aim has chiefly been to determine as far as possible the present state of the solar spectrum, to serve as a starting-point for future observation. The physicist will by its means be able to record subsequent changes in the spectrum with the same certainty that the astronomer determines the changes taking place in stellar regions.—Account of the "Anemogene," an apparatus invented for generating aërial currents analogous to those of the terrestrial atmosphere, by Mgr. Rougerie, Bishop of Pamier. This instrument takes the form of a miniature globe, which, by rotating around its axis in the air, is made to produce by its mechanical action currents resembling those observed on the greater part of the oceanic basins. The currents are indicated by vanes placed at intervals of 5°, like the compass-cards of the thirty-two winds prepared for the French navy by M. Brault. A list is given of all the trade winds, ascending and descending currents, and other normal atmospheric phenomena reproduced with more or less accuracy by this apparatus.—On the period of latent excitation of some smooth muscles in the invertebrates, by M. Henry de Varigny.—On the so-called "vidian" nerves in birds, by M. F. Rochas.—On the anatomy and vital functions of *Truncatella truncatula*, by M. A. Vayssière.—On the marine annelids of the Bay of Algiers, by M. C. Viguier.—On the anatomical structure of the Ascidians (genera Saracenia, Darlingtomia, and Nepenthes), by MM. Edouard Heckel and Jules Chareyre.—Note on the black rot recently introduced from the United States into the vineyards of Hérault, by MM. P. Viala and L. Ravaz.—On the earthquake-shock felt at Orleans on August 16, by M. E. Renou.—M. H. Gadeau de Kervill announced that he had obtained a hybrid from a tame pigeon and a ring-dove, presenting in a modified form nearly all the special features of both parental types.

September 14.—M. Bouley, President, in the chair.—Discourses pronounced at the obsequies of the late M. Bouquet on September 11, by MM. J. Bertrand and Hermite.—On the fluorescence of some rare earths, continued, by M. Lecoq de Boisbaudran.—Description of the model of a new integraph serving to trace an integral curve ($y = \int f(x)\,dx + C$), any curve ($y = f(x)$) being given, one illustration, by MM. D. Napoli and Abdank-Abakanowicz. This integraph is capable of numerous applications, and may render great services to the engineer's art. It traces mechanically and with great precision the funicular curves or polygons which play so large a part in the problems of statics. Such problems as the centre of gravity, momenta of inertia, elastic curves and the like, are solved with great rapidity and accuracy.—On submarine countermines, by M. A. Trève.—On the new star in the nebula of Andromeda. Observations of Brooks's comet made at the Observatory of Paris (equatorial of the West Tower), by M. G. Bigourdan.—Numerical tables intended to facilitate the calculation of the ephemerides of the minor planets, by MM. O. Callandreau and L. Fabry.—On the mixed haloid and other derivatives of methylene, by M. Louis Henry.—On the fermentation of bread-stuffs, by M. Aimé Girard. From numerous researches instituted to determine the true character of the phenomenon by which the dough is changed into bread, the author concludes that the transformation is the result of alcoholic fermentation.—Researches on the morphology and anatomy of ferns, by M. P. Lachmann.—Disposition of the artesian waters in the Wed Rir' and throughout the Lower Sahara in general, by M. G. Rolland. In this paper the author sums up the results of observations continued for a period of six years on the underground supplies in the vast depression of the Shott Melrir in Algeria and Tunis.—Application of the laws of thermo-chemistry to geological phenomena: ores of manganese, by M. Dieulafait.—Note on a therapeutic operation, to which the name of "dielectrolysis" has been given, by M. A. Broudel.—Trigonometric study of a pyramid whose base is the triangle of Pythagoras, by M. G. Petrowitsch. The sides of the base being respectively related as the number 3, 4, 5, the faces of the pyramid satisfy the relation $3^3 + 4^3 + 5^3 = 6^3$, the number 6 being the measure of the right-angled triangle of the base.

BERLIN

Physiological Society, July 17.—In consequence of a doubt expressed on a former occasion in the Society, Dr. H. Virchow had examined more minutely the eye of the frog, and had come to the conviction that it possessed a beautiful ciliary muscle with long fibres, which, as in the case of all other animals, composed the posterior and outer part of the ciliary body. The ciliary body, as was known, filled out the corner arising from the choroid, which closely adjoined the sclerotic, curving itself round to the iris at the point where the sclerotic passed into the cornea, and, besides the muscle, consisted of the pigmentary fold and a network of fibres, the ligamentum pectinatum iridis, which Dr. Virchow had searchingly investigated in a large number of animals. This network of fibres was so little developed in man as hardly to merit any consideration there. In other classes of animals, however, it attained a very remarkable development. The speaker gave a more detailed description of the course of the fibrous lines of the network, which presented a great multiplicity in the different animals. The fibres separated by larger interstices now pursued a principally posterior direction, now spread radiating from their place of origin at the union of the sclerotic and cornea, now they were developed more anteriorly, reaching far into the iris. By means of numerous diagrams and several preparations these anatomical relations were illustrated in greater detail. In regard to the physiological significance of this network of fibres the speaker was of opinion that they performed a mechanical function, but he dissented from the assumption put forth by some authors that the ligamentum pectinatum was the tendon of the ciliary muscle. Such an assumption was at variance with the fact that in the case of man, whose eye possessed powerful ciliary muscles, the ligamentum pectinatum was but weakly developed, whereas in other animals with a very weak ciliary muscle it was strongly developed. The fibres of the ligamentum pectinatum might operate as antagonists to the ciliary muscles in those cases in which they were especially directed posteriorly. In such cases, on the other hand, in which the fibres were developed more to the anterior side and passed into the iris, they would probably serve as antagonists to the musculus sphincter pupillæ. It was still more probable that by their radiation towards the membrana limitans they afforded support and hold to the fibres of the ligamentum suspensorium of the lens, establishing themselves at the other side of this membrane. This relation was brought very close by the course of the fibres, particularly in the case of the anthropoids.—Herr Aronsohn made some additions to his former communications on the physiology of the sense of smell. The most minimal quantities of clove oil and bromine, which dissolved in 0·6 per cent. of common salt solutions, he was yet able to smell distinctly, tallied very well with the most minute quantities which Valentin had found perceptible by the sense of smell in the air. By electrical stimulation of the olfactory nerve he had also been able to call forth distinct sensations of smell in some other trustworthy persons. The physiological common salt solution of the temperature of 40° C. he had previously found to be entirely indifferent to the olfactory nerves. Were a part of the common salt replaced by other salts, then, according to the nature of the salt, different, mostly somewhat large, quantities of the salt (osmodic equivalents) had to be taken in order to form an indifferent solution. These osmodic equivalents Herr Aronsohn had now exactly determined for a series of salts. Finally, in order to demonstrate that there were special fibres in the olfactories for special smells, he had hebetated his own sense of smell for a certain quality of smells, that, namely, of sulphuret of ammonium, and had convinced himself that, though, indeed, no longer able to perceive this smell, he was yet very well able to smell ethereal oils.—Dr. Benda spoke of a series of preparations of sensory and motory nerve-endings which he had exhibited in the Demonstrating Hall. They were prepared according to a new process recommended by Dr. Meys. The process consisted in adding arsenic acid to a chloride of gold and potassium. By means of this reagent the nerve-endings were made very beautifully visible, but in this way the epithelia were destroyed, and in order to preserve these likewise, Dr. Benda had further added to the fluid either chromic acid or alcohol. The exhibited preparations showed very clearly that the medullary motory nerves ended in Kühne's terminal plates, besides which in one case a marrowless, and certainly sensory, nerve-fibre, ending in a bifurcated ramification, could be distinctly traced. Marrowless fibres ended in an umbellate form, each single fibre on the muscle passing into a button-like swelling. These fibres, Dr. Benda held to be motory. There were further shown the nerve-endings in the papillæ of the tongue, in the Paccinian corpuscles, in the cornea, and in the skin of the neck.—Dr. Kossel spoke of some important chemical relations of the cell nucleus, of that constituent of it, namely, which morphologists denoted as chromatine, and chemists as nucleine. As products of decomposition of the nucleine he had formerly obtained three nitrogenous bases: xanthine, hypoxanthine, and guanine. Quite recently he had obtained, though, to be sure, only in very small quantities, from the nucleine, a fourth base, namely, adenine, discovered by him some time ago in the glands of the abdomen. After he had prepared 3 g. of this substance, he treated it with nitrous acid, and received as a product of the decomposition of adenine, hypoxanthine. When he treated guanine in the same manner he received xanthine. It was therefore probable that the first products of decomposition of the nucleine were adenine and guanine, and that from these, first hypoxanthine and then xanthine were formed. The chemical relations of these four bases were best rendered evident by their chemical formulæ:—

Adenine ...	$= C_5H_5N_5$	Guanine ...	$= C_5H_5N_5O$
Hypoxanthine	$= C_5H_4N_4O$	Xanthine ...	$= C_5H_4N_4O_2$

All the four bases stood in intimate relation to prussic acid, CHN, which by the action of caustic alkali was obtained from them in very large quantities, while other albuminous bodies under similar treatment yielded very little prussic acid, or none at all. It was doubtless of great importance that nucleine stood in such intimate relation to cyanogen. What part, however, the cyanogen bodies played in the cell nucleus was as yet unknown.

VIENNA

Imperial Academy of Sciences, June 5.—On the determination of the halogens of organic bodies, by K. Zulkowsky.—On the products of reduction of the nitro-azo-compounds and on azo-nitrolic acids, by T. V. Janovsky.—On the action of rock-crystal in the magnetic field, by T. Tumlirz.—On the distribution of heat on the earth's surface, by R. Spitaler.—Mycological researches, by H. Zukal.—Ideas on the prophylaxis and therapeutics of cholera, by L. Kastner.—On the fossil chalk-elements of the Alcyonidæ and Holothuridæ and other recent forms, by Ph. Pocta.—On the temperature of the Austrian alpine regions, by T. Hann.—Determination of the trajectory of the Comet VIII. 1884, by S. Oppenheim.

June 11.—On the behaviour of liquid and gaseous bodies under the greatest variations of atmospheric pressure, by C. Puschl.—On the electrical resistance of copper at the lowest temperature, by S. Wroblewski.—On the formation and dissolution of white blood-corpuscles (a contribution to the theory of leukœmia), by M. Loewit.—On the basalt of Kollnitz (in the Lavant valley, Carinthia), and on its vitreous cordierite-enclosures, by K. Prohaska.—Report on the experiments on the use of boiling oxygen, nitrogen, carbon oxide, and atmospheric air as refrigeratives, by K. Olscewski.—On the destruction of tartaric acid at higher temperatures under the presence of glycerine, by K. Tavanovitsch.

June 18.—Experiments on the chemical action of light, by T. M. Eder.—On the volumetric determination of phenol by bromine, by K. Weinreb and C. Bondi.—On the anatomy of Tyroglyphidæ, by A. Nalepa.—On the decomposition of didymium into its elements, by C. Auer von Welsbach.

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