THURSDAY, SEPTEMBER 16, 1875

THE SCIENCE COMMISSION REPORT ON THE ADVANCEMENT OF SCIENCE*

WE pass now to the fourth and last head, which deals with

The Central Organisation which is best calculated to enable the Government to determine its action in all questions affecting Science.

The Commissioners discuss two questions separately under this head. (1) The appointing of a Minister of Science. (2) The establishing of a Council of Science.

Extracts from the Evidence relating to the Appointment of a Minister of Science.

The Commissioners observe—

"We have received a large amount of evidence in favour of the appointment of a Minister of Science. There has been almost complete unanimity among the witnesses on this point."

Indeed, the necessity for such a minister is the one theme never lost sight of throughout the bulky volume of evidence. Scarcely a proposal is made which does not either involve or imply this necessity. Expunge all the recommendations that a Minister of Science should be appointed, and there will scarcely remain a recommendation that can be practically carried out, or that is not, on its face, almost a confessed absurdity.

The extracts which we append from evidence on this question form but a very small portion of the representations submitted to the Royal Commission, of which they must be considered only samples.

Prof. Owen :—

"I conceive that the recommendation by Bentham in the last century of such a minister can hardly fail to be practically adopted before the close of the present century, and that the necessity of having a minister for such a purpose will be recognised."

Sir W. Thomson :—

"Would you contemplate that a new department of the State should be constituted for directing the scientific work of the Government?—It would be quite necessary to have a Minister of Science; it is indeed, I think, generally felt that a Minister of Science and scientific instruction is a necessity."

"Not a minister of other instruction?—Specially of scientific instruction, and not under any national education board, but a minister of science and scientific instruction. The minister would necessarily be in Parliament and a political man, but it would be very rare that he could also be a scientific man, and perhaps not desirable that he should be a scientific man, but he must have able scientific advisers always at hand."

"Could any such duties be well assigned to any existing department of the State?—I believe not."

"You spoke of the necessity for having a Minister of Science; do you conceive that it would be requisite to have a cabinet minister for education and a second cabinet minister for science, or would you contemplate that the minister for education should be the minister for science?—I do not wish absolutely to fix it beforehand; on the whole I think, however, that the title of Minister of Education would not suffice. If there is to be a minister it must be a minister of science and education. There might be a minister of science and education, with a chief secretary or under minister for national and elementary education, and another for the advancement of science and for the higher scientific instruction. But naturally the minister of education must act for the masses; that must be his great duty, and however much he might wish to act for science, he has still a great duty to the masses. On the whole I think it would be preferable to have a distinct minister of science and scientific instruction. A minister of science and scientific instruction, as a subordinate to a chief minister of science and education, might probably be a very good arrangement.

"The Minister of Science administers knowledge to the whole country."

Col. Strange :—

"It seems to me that in the first place there should be some means of bringing science fully before the nation through Parliament. I know of no means of doing this that is in accordance with our constitutional procedure, except through a minister of State; and therefore assuming science to be a matter of enormous national importance, I think it is essential that it should be all brought under one minister of State, who should be responsible to Parliament for everything which is done in the name of the nation to further science, and who should frame his own estimates and keep them distinct from those of departments which have little or nothing to do with science. . . . . I think that there should be an estimate for science just as there is an estimate for the army and for the navy. . . . .

"What I should be glad to see would be a minister for science; but I dare say that if proper assistance were given to such a minister, he might superintend other departments as well; for instance, as on the Continent, he might superintend education and the fine arts. I think it would be preferable that he should be for science only. I think there is quite enough for him to do in England, for it to be done thoroughly; but rather than have no minister I would assign to him also education and the fine arts."

"There would be a difficulty, would there not, in defining the boundaries between the duties of the minister for science and the minister for education?—I think not. I think one would relate to education, which is quite a distinct thing from national research, and I think that they should be kept as distinct as possible. I think one great evil now existing is the mixing up of those two things. Throughout my evidence I have here and there expressed the same opinion that they should be kept distinct, one being the means, the other the end; instruction I conceive to be the mode of growing a certain number of persons fit to investigate."

Mr. De la Rue :—

"I think that science ought to be recognised in the Ministry by the appointment of a Science Minister, in order that all matters relating to science might come properly under the cognisance of the Government, and that whenever the Government sought the aid of scientific men it should be through the intervention of the Science Minister. . . . ."

Mr. John Ball :—

". . . . If science is to be aided effectually, and at the same time controlled effectually, there should be some permanent officer in the department of the Government that has its relation with science, whose duty it should be and who should be responsible for making himself generally aware of the state of science and the doings of its cultivators, and who should be the proper person to advise the Government, not as to the best mode of deciding a strictly scientific question, but as to where the means for solving it are to be had. I look upon it at present as being a wholly haphazard matter how questions of science or connected with science and affecting the progress of science are decided in the public offices, and I speak from

* Continued from p. 392.

some slight personal acquaintance with the matter during the short time that I was in the public service in Parliament."

"You stated, did you not, that you thought it desirable that there should be some permanent official to represent and advise the Government in its relations to science?—Decidedly."

General Strachey:—

"The first conclusion that I arrive at is that all questions relating to scientific matters that arise in the operations of the Government should be dealt with by one of the chief ministers of the Crown, and the officer at the head of the Education Department seems to be the most suitable of such officers. It has been, I know, suggested by some persons that it would be better if there were a separate department for science. That I venture to doubt. . . . .

"Under such an education and science department there would be a natural division of the duties, which would probably lead to the appointment of some permanent officer in the position of an under secretary of State, who would have specific charge of the scientific duties of the department as distinguished from the educational duties, which constitute a distinct branch of administrative work. . . . .

"The principal officers in the proposed scientific branch of the department should be, by their scientific qualifications, capable of disposing of the ordinary current business under their charge. . . . ."

Dr. Sclater:—

"Do you agree with [Col. Strange's] views as to the creation of a Minister of Science and a Council of Science?—Yes, I agree generally with his views; I think that it would be very desirable for the interest of science."

"Do you think it would be desirable that the existing State scientific institutions should be removed from the control of the Admiralty, the Office of Works, and other departments under which they are now placed?—I think it would be a very great advantage that they should be removed from those departments and placed under one minister."

"Have you any opinion as to whether the work could be done by a Minister of Education, supposing such a minister were appointed?—I think it would hardly be expected that a minister should be appointed only for science; and as I believe it is the case in continental countries that that department is given to the Minister of Education, I think that we could not follow a better example here."

Prof. Balfour Stewart:—

"I think it [the Ministry of Science] might form a division, perhaps, of the Ministry of Education."

Mr. Farrer:—

"I dislike very much the idea of establishing new departments of the Government. If it were possible that this business could be placed upon the Minister of Education, who is becoming more and more important, I think that would be much better than establishing a separate department for the purpose."

Sir George Airy is perhaps the only witness of authority who does not seem able to perceive that any advantages would follow the creation of a Science Minister. The following is his evidence on the question:—

"Do you see any inconvenience arising from the several scientific institutions that are more or less connected with the Government being under different departments?—Not that I am aware of."

"You are content that the Royal Observatory at Greenwich should remain under the Board of Admiralty. You do not require to have a Minister of Science, or a Minister of Education?—No; we are naturally connected in these respects with the Admiralty. . . ."

The Astronomer Royal appears to have confined his attention to the wants of the great Observatory of which he has so long been the distinguished director. It is to be regretted that he abstained from enunciating his views on the larger question of the administration which an extension and systematisation of national science would render necessary.

The Proposal to establish a Council of Science.

A proposal to establish a Council of Science was brought before the Government by the Royal Society in 1857, upon a Report from the Government Grant Committee of that society.

The object of the Committee was (evidence of Sir E. Sabine, qu. 11,117) to determine "whether any measure could be adopted by the Government which would improve the position of science or its cultivators in this country."

This Report, after enumerating the various matters connected with science which should properly come under the supervision of the Government, concludes by naming two bodies under whose advice that supervision might be conducted. They say:—

"11. Assuming that the above proposal should meet with the approval of her Majesty's Government, it will be desirable to ascertain what mode of constituting such a board would inspire them with most confidence in its recommendations. Two modes may be suggested in which such a board might be organised. First, the Government might formally recognise the President and Council of the Royal Society as its official adviser, imposing the whole responsibility on that body, and leaving it to them to seek advice when necessary in such quarters as it may best be found, according to the method now pursued in the disposal of the Parliamentary grant of 1,000*l*. The second method would be to create an entirely new board, somewhat after the model of the old Board of Longitude, but with improvements. The question as to which alternative shall be adopted is properly a subject for the consideration of the Government."

Upon this the Commissioners state as follows:—

"The proposal to establish a Council of Science has recently been revived by Col. Strange.

"Amongst the witnesses who recommend the appointment of a Council, there is a great diversity of opinion as to its constitution and limits of action. As regards its constitution, it will be seen from the summary of evidence which we shall give subsequently, that while some of the witnesses are in favour of a Council very limited in numbers, others would desire to have it sufficiently numerous to include representatives of nearly every branch of science, as well as men of known administrative ability.

"In regard to its limits of action, the main difference arises on the two questions, whether the Council should or should not have the power of initiating inquiries, either directly or by suggestion to the Minister, and whether or not it should itself undertake the actual work of investigation required for State purposes.

"As to the mode of remuneration, the opinions vary between those which advocate annual payments to permanent officials, and those which are in favour of payments for attendance at meetings.

"The opinions of the witnesses who are opposed to any such Council are based, in the main, upon one or more of the following objections:—

"1. That Government can get the best advice without it.

"2. That it would be liable to come into collision with Ministers.

"3. That it would not work harmoniously with our general system of administration.

"The evidence of three eminent statesmen possessing great administrative experience—Lord Derby, Lord Salisbury, and Sir Stafford Northcote—is in strong contrast (so far as the proposal to establish a Council of Science is concerned) with that which we have received from many persons holding official positions in various branches of the public service. The opinions of these latter, as to the inefficiency of the organisation of their respective services in regard to questions affecting science, we have already quoted in the first part of this Report, and it will be seen from the quotations we are now about to give, that they in general consider the creation of a Council to be the proper remedy."

The Commissioners preface their extracts from the evidence laid before them on this subject by saying :—

"We fear that no mere extracts from the evidence of Col. Strange would represent in an adequate manner the views which have led him to recommend the formation of a large and highly-paid Council of Science. It would scarcely be fair to him, as the most prominent advocate of the proposed measure, to do otherwise than refer to his evidence at length, pp. 75 to 92, and 125 to 135, vol. ii. of Evidence."

When we say that Col. Strange's evidence constitutes a complete and carefully arranged scheme for the scientific administration of the country, it will be readily understood why the Commissioners refer to it as a whole, rather than cite detached portions of it from which no conception of its systematic and comprehensive character could be formed. With respect to the Council, Col. Strange first points out its necessity and then defines its functions. His next step is to so construct it as to fit it for performing these functions satisfactorily. And finally, he enters fully into the mode of its election, its remuneration, and its relation to the Minister of Science and to the various departments and institutions concerned with scientific questions.

Though, like the Commissioners, we find it impossible to give a just idea of this scheme by means of extracts, we think that as the composition of the Council suggested by Col. Strange was made by the Commission the foundation of their examination of almost every witness who spoke on that subject, it is desirable that the sketch of Col. Strange's Council should precede the short extracts from evidence on the subject which we shall lay before our readers. It stands thus :—

Sketch of Proposed Council.

Pure Mathematician (the Professor of Mathematics at Oxford and Cambridge alternately. These should be "Regius Professorships")	1
Mixed ditto (Astronomer Royal for the time being)	1
Chemists (one to be the Director of the proposed Chemical Laboratory)	2
Meteorologist (Director of Meteorological Department)	1
Physical Astronomer (Director of proposed Physical Observatory)	1
Metallurgist (Director of proposed Metallurgical Laboratory)	1
Geologist (Director of Geological Survey)	1
Physicists (one to be an Electrician)	2
Naturalist (Head of Natural History Department of British Museum)	1
Physician (Medical Officer of the Privy Council)	1
Surgeon	1
Physiologist	1
Naval Architect	1
Civil Engineer	1
Mechanical ditto	1
Mining ditto	1
Statist	1
Royal Engineer Officers	2
Royal Artillery ditto (one for Field Artillery, the other for heavy Ordnance)	2
Royal Navy ditto (one for Navigation, the other for Gunnery)	2
Infantry Officers	2
Merchants (one a shipowner)	2
Agriculturist	1
	30

Colonel Strange remarks on the above :—

"Of course I give that sketch of the Council as a mere indication of the sort of Council that I think is desirable. It is something that I put before the Commission in order to be torn to pieces and put into shape ; it is a mere sketch of a possible Council. I have given it a great deal of thought, and it does not appear to me that there are any superfluous members in it, nor do I know of any that have been omitted. I may say generally that one of my great objects was to place in this Council the heads of institutions, in order that they might be concerned in the directions given to their various institutions. I think it would hardly do (in a former part of my evidence this matter was alluded to) to have a separate body directing men of eminence as heads of institutions ; it would be felt to be an interference, but if those heads were part of the governing body, then the interference would not be felt."

Though Colonel Strange's sketch was freely discussed and criticised, no witness pointed out specifically its omissions or redundancies, nor was any definite counter-proposal submitted to the Commission.

Sir W. Thomson's evidence with reference to the establishment of a Council of Science contains the following :—

"Do you think that a single body would be better than a number of small committees for advising the Government on the great variety of questions which from time to time would be likely to arise? Yes, certainly."

"The questions which might be referred to such a Council would differ very much from one another, and extend over a wide range, would they not? Yes, but there would be an unity of design and action, with a multiplicity of knowledge and skill at command, secured by a single Council, and those conditions cannot, in my opinion, be secured at all by occasional committees, or committees working separately and independently of each other. . . .

"A scientific Council would relieve the Government of all responsibility in such matters, and would be responsible itself in a general way for all its proceedings to a political chief and to Parliament. . . ."

"Would you be so good as to inform us whether you have formed any opinions as to the best system of appointing such a Council ?—The Council ought to represent the different branches of science and the practical applications of science. Pure mathematics ought to be represented in the Council ; mixed or applied mathematics, according to the old-fashioned nomenclature as generally understood, ought also to be represented ; chemistry cannot be shut out ; physics must of course be represented, and ought to be represented separately ; astronomy, both what was formerly called physical astronomy and of course the new science of astronomical physics, ought to be represented. I do not believe that astronomy could be properly represented under one head ; astronomical physics must, in my opinion, be separately represented. Geology should be separately represented, and also the various branches of natural history ; physiology also, and medical practice in general, should be represented. I have spoken of applied mathematics, I meant rather mathematical dynamics than applications to art and mechanical operations. Then practical applications should be represented, mechanics and mechanical engineering; then again civil engineering and geodesy, mining engineering, statistical inquiries, and the scientific branches of her Majesty's service ought to be thoroughly represented. Engineer and Artillery officers and the navy should be represented both in its navigation department and in the department of seamanship, and the department of gunnery. The mercantile interests of the country and the agriculture of the country ought certainly to be represented. The universities ought to be represented amply—the English universities, the Scotch universities, and the Irish universities. Also practical telegraphy, which is a very distinct branch of engineering, civil engineering or mechanical engineering would not sufficiently represent it."

"Do you think that the functions which are proposed to be assigned to the scientific Council would not interfere in any way with the existing scientific departments of the Government; for example, the Medical Department of the Privy Council, or some of the other Government scientific departments?—I think it would relieve the departments from pieces of scientific work at present given to them, because there is no other body to whom they can be given, and for which they are by their organisation and *personnel* almost necessarily ill fitted and insufficiently competent."

"You would leave to these departments their administrative functions, but give them the advantage of consulting with the Council upon higher questions of science on which they desired information?—Yes, certainly; every question of science that falls under the notice of any department of the Government would naturally be referred to the scientific Council."

Dr. Frankland thus deals with Col. Strange's proposal:—

"Are you acquainted with Col. Strange's proposal for the establishment of a consultative council of science?—Yes, I have heard from him some of the chief ideas that he entertains on that subject."

"Are you disposed to consider that such a Council would be desirable?—I think so. I am not prepared to say that it should be constituted exactly in the way that Col. Strange mentioned, but a Council of that description would be exceedingly desirable, on many grounds, for furnishing the Government with trustworthy scientific opinions in cases requiring them. . . ."

"Are you of opinion that the advice of such a Council, even on matters to which the larger proportion of the members of the Council had not paid special attention, would be valuable?—Yes, I think it would, because those members of the Council who were thoroughly acquainted with the subjects would be expressing their opinion to men conversant with scientific methods, and they would be able to convince their colleagues with respect to the opinion that the Council generally ought to give upon the matter. It would be a very different thing from that of convincing a Parliamentary Committee, for instance, upon a scientific point, because all the men upon the Council would have received a scientific training and would understand the bearing of scientific arguments."

"Have you considered at all how such a Council could best be appointed, whether would you leave it to one of the Ministers to appoint and select the proper persons to serve on the Council?—I should think that it must ultimately fall upon the Minister, but he might be assisted by the presidents of different learned societies or by the Council of the Royal Society, in whom I think everyone would have confidence."

(*To be continued.*)

THE IRON AND STEEL INSTITUTE

EVERY friend of science and true patriot must heartily welcome the sound and steady progress of the Iron and Steel Institute. The proceedings at the Manchester meeting last week, as also its Journal, just received, containing the papers read at the last London meeting, show that it is doing exactly the kind of work which is now becoming quite necessary for the maintenance of the dignity and prosperity of British industry. It also displays a very important feature of industrial progress. One need not be grey-headed to be able to remember when iron-workers and iron-masters, in common with other artificers, were nearly unanimous in believing that their trade interests were best served by each man hugging up to himself every bit of newly acquired trade information, and keeping his competitors as much as possible in the dark respecting it. Indentures of apprenticeship still describe our common trades as "mysteries," and bind the pupil to abstain from revealing the secrets of the craft which his master solemnly agrees to communicate in return for the premium and seven years' servitude. The ceremonials, secrets, and degrees of freemasonry are based on the old practice of hoarding the arcana of a "craft" and communicating them in various degrees of profundity to certain privileged individuals, who were bound under dreadful penalties to reveal these sacred mysteries to none but the initiated.

Contrasted with these lingering shadows, these penumbral fringes of the old passing darkness, the meetings of the Iron and Steel Institute are full of hopeful suggestion, by displaying the magnitude of the revolution which modern science is gradually effecting. In the still older and still darker times all knowledge was made a mystery and a craft, and was selfishly held by the initiated few who used it for the oppression of their fellow-men. Abstract or pure science was first thrown open; learned societies were formed for the discovery and diffusion of natural truth by the open and world-wide co-operation of philosophers; their discoveries threw new light into the dark mysteries of trade, and now we see the craftsmen themselves emulating the philosophers, and offering freely to all the world the best results of their technical knowledge, their laborious investigations, and hard-earned technical experience. This is the true chivalry of trade, that only needs its full development in order to place industry fairly upon the throne of its natural and proper dignity.

The Manchester meeting, under the presidency of Mr. W. Menelaus, has been as successful as could possibly have been wished. Although the papers read were too purely technical to be referred to at length in NATURE, still they are all evidences that the iron and steel industries are being more and more rigidly conducted on scientific methods. The papers read were few, but they were all of a thoroughly practical kind, and along with the discussions which generally followed, were well calculated to promote the objects for which the Institute has been established. The first paper read, and which gave rise to a warm discussion, was by Mr. Daniel Adamson on "The Application of High-pressure Steam to Quadruple Engines." Mr. I. Lowthian Bell's paper on "The use of Caustic Lime in Blast Furnaces" is likely to prove of great value to those interested in the subject. The object of the paper was to show that for high furnaces it was unnecessary to calcine the limestone before using it.

Mr. W. Hackney read a paper on the designing of ingot moulds for steel rail ingots. Mr. Hackney has designed a mould in which the outside is rounded, the thickness of the metal being so adjusted at different parts of the circumference that the expansion under heat should be equal all round. This form has given satisfactory results, one proof of its correctness being that when it becomes heated to redness by an ingot of steel cast in it, the temperature of the outside is apparently equal all round.

Mr. Charles Wood described some improvements made by him in the hearths of blast furnaces. Another paper by Mr. Lowthian Bell described Mr. W. Price's retort furnace. In Mr. Price's furnace the temperature of the air, as well as that of the gaseous and fixed constituents of the coal, is raised by the waste heat before it enters the chimney. Mr. Price cannot compete with the Siemens furnace as regards intensity of temperature, but he avoids the loss which occurs in the gas-producers of the regenerative furnaces.

A paper by Mr. C. J. Horner, on the North Staffordshire Coalfields, had to be considerably curtailed, and two other papers had to be taken as read, in order that the excursion programme might be carried out. Indeed, one of the chief objects of the autumn meeting of the Institute is to visit places of interest from an industrial point of view, and hence the number of papers read is generally limited. This year the visits and excursions were very numerous indeed to industrial establishments in and around Manchester, and all of them seem to have been completely successful. Our space does not permit us to give a detailed account of these excursions, although many of the processes witnessed by the visitors were of considerable scientific interest. The meeting was brought to a successful termination on Friday by a visit, which formed, indeed, a hard day's work, to the North Staffordshire iron and coal district. From first to last the members of the Institute have good reason to be satisfied with the Manchester meeting.

In conclusion, we must express a hope that ere long our other great industries will follow the example of the iron and steel trade in forming their own special technological Institutes and holding meetings and publishing records of similar character and value to those of the Iron and Steel Institute.

RUTHERFORD'S "PRACTICAL HISTOLOGY"

Outlines of Practical Histology. By William Rutherford, M.D. (London: J. and A. Churchill, 1875.)

OF the different methods whereby the standard of scientific education is capable of being elevated, few will not place foremost the extension of theoretical studies into first principles and collateral branches which have a bearing, ever so little as it may appear to be, on the main subject. How much, for instance, does physiology suffer from a deficiency in mathematical and physical knowledge on the part of many of its most enthusiastic devotees. A wider general acquaintance with chemistry would, also, not be out of place. Practical aptitude and experience no doubt stand next in importance. A mastery of the methods by which what is already known has been arrived at cannot but be one of the best trainings for original investigation. How many a valuable suggestion has been allowed to drop undeveloped, simply because of a want of manipulatory skill on the part of the deviser, whose love for the conception of his own brain is the only sufficient stimulus towards the realisation of its importance, and the working out of its details. All attempts to raise the standard and develop facilities for practical education deserve special attention. The work before us is one of the best of these.

The Notes on Practical Histology were published originally in the *Quarterly Microscopical Journal* for January 1872. Several additions have been made, and various fresh methods have been introduced. As it stands, the work contains all the information on the subject necessary for the student of medicine; and we are certain that anyone who has mastered its details will be in a fit position to undertake high special investigation under favourable auspices. It is evident in every page that Prof. Rutherford is thoroughly master of every method he explains, as much from the minuteness of the detail into which he enters, as from the manner in which matter the least irrelevant is omitted. This is nowhere better seen than in the sections devoted to the "preparation of tissues previous to their examination," which, within a few pages, states exactly what is to be done in the way of preparation and preservation with the body of an animal, such as a guinea-pig, in order that all its tissues and organs, extending to such minutiæ as the structure of the cochlea, shall be in a condition most favourable for detailed investigation.

The book is divided into two parts. The first of these treats of the microscope itself, together with the method of using it; which account is followed by a series of histological demonstrations, explaining the manner in which each tissue and organ of the body must be manipulated in order to show its minute anatomical features. The following is an example under the head of *Nerve Tissue.* "The fibrillar structure of the processes of nerve-cells may be shown as follows. Cut the fresh spinal cord of a calf into pieces about a quarter of an inch in length. Place these for a month in a one per cent. potass. bichrom. solution. Remove a thin slice of the grey matter of the anterior horn with scissors, tease with needles, stain with carmine, and mount in glycerine." Among other special processes described, we find a novel one devised by Dr. William Stirling for exhibiting the structure of skin, which consists in partly digesting it, when stretched, in an artificial peptic fluid, and then staining. By so doing "the white fibrous-tissue swells up and becomes extremely transparent, thus permitting of a clear view of the other tissues." Dr. Urban Pritchard's method of exhibiting the structure of the organ of Corti is also fully explained.

The second part of the book consists of general considerations regarding histological methods. In it the relations of the tissues to surrounding media, the methods of hardening tissues (including the employment of the excellent freezing microtome introduced by the author) and of softening them, are fully explained; as well as are the composition of the best staining fluids, and the most efficient means of preserving microscopic preparations.

One of the most important novel points of manipulatory detail which we notice, is the value of mucilage as an imbedding agent when the microtome is employed for freezing, as suggested by Dr. Pritchard. It depends on the fact that "frozen mucilage can be sliced as readily as a piece of cheese," a most valuable property, as all who have had any experience will acknowledge.

Prof. Rutherford has supplied a deficiency. He has given us a manual which will meet the requirements of a large class of students who will never find it necessary to enter into the details of practical histology so minutely as they are discussed in larger works, such as the "Handbook for the Physiological Laboratory," or the still deeper manual of Stricker.

OUR BOOK SHELF

A Yachting Cruise in the South Seas. By C. F. Wood. With six photographic illustrations. (London: King and Co., 1875.)

MR. WOOD'S narrative is so interesting that we wish it had been very much longer. He has made several voyages among the Pacific Islands during the last eight years, and, judging from this and what he tells us in the work before us, he must possess much valuable information concerning these islands, and especially with regard to their puzzling populations, which he would do well to publish in detail, and which would be welcomed especially by ethnologists. Mr. Wood is evidently a careful observer, and has the power of describing what he observes interestingly and clearly.

The present volume contains a narrative of a cruise which the author made, starting from New Zealand, from May to December 1873, among some of the most interesting groups of the Pacific Islands. Among the islands visited during this time were Rotumah, to the N.E. of Fiji, Futuna, Savaii, and Upolu, in the Samoan group; Niuafu, some of the islands in the Fiji group, the New Hebrides, the Solomon Islands, the Caroline Islands, Oualan, the Mulgrave Islands, and the Ellice group. Concerning every island which he visited, Mr. Wood has some interesting and valuable information to give, either about its physical condition, its products, its people, its history, or its antiquities. One of the main objects of his cruise was the collection of native implements and weapons, and in this he seems to have succeeded to his heart's content. His observations concerning the people seem to us especially valuable; he has gathered many traditions as to their migrations, and gives some specimens of folk-lore. In many of the islands the natives seem restless and discontented, and Mr. Wood was frequently petitioned to give them a passage from one island to another. Like many other Pacific voyagers, he has but a poor opinion of the results of the attempts which have been made to Christianise the natives. Not that he disapproves of attempting to civilise them and to raise them in the scale of humanity, but he thinks the methods which are generally adopted are quite abortive. The unmodified European garment of civilisation evidently cramps and enervates the Pacific Islander.

The information which Mr. Wood gives concerning the Rotumans, their traditions as to their predecessors in the island, their migrations, customs, superstitions, folk-lore, &c., is especially valuable. He refers briefly to the remarkable mounds among the hills in Bonabi, or Ascension Island, in the Caroline group, about which them have no tradition, but which would be likely to repay a careful examination. Quite as interesting, and still more wonderful, are the remains of large buildings of stone in the same island, some of the blocks of which are of immense size, and concerning which also the natives seem to have no traditions. Mr. Wood believes these ruins to be the work of a people that have passed away, and it is very unlikely that the original buildings were the work of passing Spaniards, as has been supposed. We have certainly much yet to learn concerning the history and relationships of the Pacific Island populations, and it is a subject well worth careful investigation. Mr. Wood's modest volume is a valuable, though small, contribution to our knowledge of the subject; he must, we should think, have a great deal more to tell as the result of his long intercourse with these islands. The few autotype illustrations are appropriate and well executed.

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.*]

Living Birds of Paradise in Europe

WE have just received at the Zoological Gardens of Dresden two living Birds of Paradise, viz., *Paradisea papuana*, from New Guinea, and *Paradisea apoda*, from the Aru Islands, both males, in excellent health and fine condition. Mr. von Below, Assistant-Resident of Makassar, in Celebes, brought them home in a three-months' passage from Makassar, *viâ* Java, Suez, Gibraltar, London, and Hamburg to Dresden, where he intends to spend the winter, and has deposited the birds in the Zoological Gardens. They have already been about three years in captivity with him at Makassar, where I saw them when passing through that place to New Guinea in 1873. The birds, therefore, are accustomed to cage-life, and as the conditions under which we have placed them are most favourable—consisting chiefly in a large space to allow free movement, and in an equal temperature of about 20° Réaumur—there is some hope of our being able to keep them alive. Mr. von Below got these birds through native traders who have their home at Makassar and trade to New Guinea and the Aru Islands. He fed the birds in India with grasshoppers, bananas, and rice, and on board the steamers with the same, cockroaches being substituted for grasshoppers. In Dresden we try to feed them with bread, rice, and worms (*Mehlwürmer*). Both are very active, and cry their well-known "wôk, wôk" with much force; the specimen of *Paradisea apoda* especially is not the least shy, and takes the worms out of one's hands. Their fine plumage suffered, of course, on the voyage, but I was astonished to see that it was not damaged more. As they probably will moult from about November till April, the plumage will not be at its finest condition till the month of May, and, supposing that the readers of NATURE will be interested in the further fate of these Birds of Paradise, I shall report in time how they are getting on.

I believe I am not mistaken in saying that a living specimen of *Paradisea apoda* has never before been alive in Europe. The two Birds of Paradise which Mr. Wallace brought home, which he had bought at Singapore, were *Paradisea papuana* (if I remember correctly, having no books at hand here); Mr. Cerrutti, some years ago, brought over a specimen of *Seleucides alba*, but I did not hear how long it lived in Europe. No other species of Birds of Paradise have yet been brought alive to Europe, so far as I know, and we may therefore felicitate Mr. von Below on having increased the number of these at least to three.

The inhabitants of those parts of New Guinea which I visited in 1873 are not accustomed to catch *Paradisea papuana* alive, as Mr. Wallace states is the case with *Paradisea apoda* from the Aru Islands; they only know how to kill the bird with the arrow, and I did not succeed in teaching them otherwise, but I suppose that the Papooas of the south-west coast of New Guinea know how to catch the Birds of Paradise alive, and that Mr. von Below's specimen is from that part of New Guinea.

Wildbad Gastein, Sept. 11 A. B. MEYER

Source of Volcanic Energy

MR. W. S. GREEN, like others of Mr. Mallet's supporters, takes wider ground than he did himself in his original paper. It is obvious that he regarded his experiments conclusive as to the amount of heat that could be produced by rock crushing

His advocates, however, and he himself in his later papers, appeal to pressures within the earth enormously greater than those obtained by the mechanical contrivances used, and consider that proportionately greater heat may be evolved.

My "Remarks" at the Geological Society, now published in *The Journal*, were primarily framed with reference to Mr. Mallet's paper as it stood, although I think they are a tolerably satisfactory reply even to the theory as now extended. I have, however, lately gone into the question on first principles, and have satisfied myself that, accepting the conditions lately assumed by Mr. Mallet as a basis, the theory can be shown to be untenable. I hope that a paper containing the grounds of my conclusion will shortly appear.

I am unable to understand how Mr. Green proposes to account for the development of forces as productive of heat through means of "the gravitation of the whole mass" (of the earth) "to itself," otherwise than by "the gravitation of the surface upon a retreating nucleus;" because, unless room be given by a retreating nucleus for the parts to descend, there can be no motion, and consequently no heat. O. FISHER

P.S.—Upon further consideration of Mr. Green's letter, it strikes me that he has misunderstood my meaning in a way that I did not at first perceive. He says that I "object to the possibility of assuming high *local* temperatures to be produced by the transformation of tangential forces into heat within the earth's crust;" as if I objected to any localisation. What I did object to was, not a localisation of work and heat, but a localisation within a localisation, such that the heat of crushing a certain localised volume should fuse a further localised portion of the crushed volume.

Harlton, Cambridge, Sept. 11

Important Discovery of Remains of *Cervus megaceros* in Ireland

DURING 1847, when draining a bog at Kellegar among the Dublin mountains, as many as thirty heads of *C. megaceros*, together with a perfect head and antlers of a Reindeer, were discovered in a cutting of about 100 yards, by 3 yards in breadth. They were found as usual in the marl and clay under the bog. I visited this locality in March last, and from the aspect of the ground and evidence of a farmer who remembered the spot where the above were dug up, it seemed probable that by running a series of trenches parallel with the original ditch made in 1847, fresh exuviæ might be discovered. The subject was accordingly brought to the notice of the Royal Irish Academy, and a grant of 25*l*. obtained. The result has been the finding of about thirty additional heads of *Cervus megaceros*, besides numerous detached bones not yet fully determined.

Mr. R. J. Moss, Keeper of Minerals in the museum of the Royal Dublin Society, who volunteered to conduct the explorations, writes to me that he found the remains embedded in about two to three feet of clay, and often either lying on or impacted between blocks of granite as if they had been drifted into the above situation. A log of oak three feet in length was discovered among the bones in the same stratum of clay. In this instance, as generally obtains in Ireland, the cervine exuviæ are met with around the margins of the bogs, and not in the middle, as if the animals were mired in shallow water, or else their carcases had drifted with the winds or currents to the sides and outlets of the lake. Mr. Moss had to stop excavations in consequence of the grant having become expended, so that doubtless many more remains await further explorations.

This is not the only case known to me of the accumulation of carcases in a small space. I just lately examined a large assortment of skulls and bones of *C. megaceros* dug out of a bog on the property of Mr. R. Usher, of Cappagh, near Dungarvan. These were collected in a space of about 100 yards in length and 70 yards in breadth. They include heads and cast antlers of no less than fifteen individuals of the great horned deer (*i.e.* thirteen male and two female skulls), besides the cast antler of a Red Deer. The above were likewise found more towards the side than the centre of the marsh.

It seems difficult to account for these accumulations of deers' carcases, unless we suppose that a herd was mired on attempting to cross the lake. The fully developed burr of the antler so generally observed on this deer's horns discovered in the mud of ancient lakes might indicate that their owners perished in autumn during the rutting season, when doubtless many far grander scenes than those depicted in the "Challenge" and Wolf's "Race for Life" occurred along Irish lakes. The Bear and Wolf being the only large carnivores in Ireland during the Pleistocene period may account for the abundance of *C. megaceros*; moreover, we have it on historical evidence that the Wolf was extremely common during the seventeenth century, and it is probable, having neither the Hyæna nor the large Felidæ to compete with, that it might have hunted the great horned Deer into the lakes, where many would have got mired in the deepening mud along their margins. A. LEITH ADAMS

Magnus's "Elementary Mechanics"

WITH reference to the favourable notice of my "Elementary Mechanics" which appeared in last week's NATURE, I shall be glad if you will permit me to state that the second edition of my book is already in the printers' hands, and that the few errors, chiefly clerical, in the answers to the examples, which you were good enough to point out, are therein corrected.

London PHILIP MAGNUS

Sanitary State of Bristol and Portsmouth

YOUR correspondent, Dr. Black, in accounting for the uniformly low death-rate of Portsmouth, has, I venture to suggest, omitted two somewhat important coefficients. The one is a thorough and well-planned system of drainage and outfall, completed some few years since at a cost of about 150,000*l*.; the other is the presence of a floating population of several thousand healthy adult males in the shape of the garrison and the sailors.

E. J. E.

Lancaster Gate, W., Sept. 11

OUR ASTRONOMICAL COLUMN

BINARY STARS.—Mr. J. M. Wilson has communicated measures of Σ 2107, 44 Bootis, and ζ Aquarii, made at the Temple Observatory, Rugby, in 1871-75, from which the following are selected:—

Σ 2107	1872·49	Pos.	210°·0	Dist.	0″·77	
	1873·48	,,	207 ·5	,,	0 ·7	est.
	1874·65	,,	208 ·4	,,	0 ·7	est.
	1875·58	,,	215 ·5	,,	0 ·5	est.
44 Bootis	1873·25	,,	240 ·6	,,	5 ·3	
ζ Aquarii	1873·79	,,	335 ·1	,,	3 ·58	

The binary character of the first of these stars is well supported by Mr. Wilson's measures; the angular velocity appears to have regularly increased since about the year 1850, due allowance being made for the difficulty of the object. Struve's first epoch (a correction being made to the time as printed in "Mensuræ Micr.") is

1829·01 Pos. 148°·6 Dist. 1″·127

A discussion of the elements of the orbits of σ Coronæ, τ Ophiuchi, γ Leonis, ζ Aquarii, and 36 Andromedæ, by Dr. Doberck, of Col. Cooper's Observatory, Markree, forms Part 19 of volume xxv. of the *Transactions of the Royal Irish Academy*. Dr. Doberck employs the graphical method proposed by Sir John Herschel, which has been so generally applied, at least in the earlier part of the work. Correction of the approximate elements thus obtained by equations of condition will lead to satisfactory results where there are reliable single epochs, or a sufficient number of contiguous ones, to enable us to form normals. It may be questioned whether the additional labour of calculation which some of the methods of calculating double-star orbits that have been proposed necessarily involve, is rewarded by more satisfactory results than can be obtained by the application of Herschel's graphical process in the first instance, following up by equations of condition.

THE ZODIACAL LIGHT.—During the past week has appeared *Zodiacallicht-Beobachtungen in der letzten 29 Jahren* 1847-1875, by Prof. Heis, forming the first special publication of the Royal Observatory of Münster. It contains in considerable detail, but on a systematic plan, the particulars of the numerous observations made by

Heis himself, with a large number by Eylert, Weber, and others, and is a most valuable addition to the observational results bearing upon this, as yet, little-understood phenomenon. We may remind the reader who is desirous of fully acquainting himself with the literature of the subject, that Dr. Julius Schmidt, now Director of the Observatory at Athens, published in similar detail his observations of the zodiacal light in the years 1843-55 (*Das Zodiacallicht*, Braunschweig, 1856).

THE NEXT RETURN OF ENCKE'S COMET.—The appearances of this comet at nearly ten-year intervals in 1819, 1829, 1838, 1848, 1858, and 1868 took place under circumstances which were more or less favourable for observation in this hemisphere; these conditions, however, will not attend the ensuing return to perihelion, which, with the mean motion found by Dr. von Asten for 1875, neglecting the small effect of perturbation, would occur about the 27th of July, 1878; and if the path in the heavens be calculated on this assumption, it will appear that observations will hardly be practicable except in the southern hemisphere in August. The nearest approach to this track is that which the comet followed in 1845, when a few observations only were obtained with difficulty at Rome, Washington, and Philadelphia. With regard to the effect of perturbation upon the length of this comet's period since the year 1819, when its periodicity was first detected, it may be remarked that the longest revolution was that from 1842-45, which extended to 1215·6 days, and the shortest, that from 1868-71, 1200·2 days; difference of extremes, 15½ days.

COMET 1874 (III.), COGGIA.—A third computation of the orbit of this fine comet, founded upon observations between April 20 and July 16, by Herr Geelmuyden, of Lund, has resulted in an ellipse with a period of 10,445 years, confirming the great length of the revolution which resulted from the calculations of Prof. Tietjen and Herr Schulhof. There appears to be no probability of the comet having previously visited these parts of space within historical times.

THE LATE PROF. ARGELANDER.—The last part of the *Vierteljahrsschrift der Astronomischen Gesellschaft*, x. Jahrgang, Drittes Heft, contains an interesting memoir of this distinguished astronomer by his successor, Prof. Schönfeld. As an authoritative summary of his long and laborious services to sidereal astronomy in particular, this memoir will be found a useful reminder. Argelander was born at Memel on March 22, 1799, and died at Bonn on February 17, 1875. His first astronomical observation is stated to have been one of the occultation of the Pleiades on August 29, 1820.

NOTES ON A SUPPOSED MARRIAGE EMBLEM OF AMERICAN INDIAN ORIGIN

A REMARKABLE form of "Indian relic," varying somewhat in details, but having much in common, and never approaching any other stone implement or ornament, is occasionally met with in the "finds" of the Atlantic coast States and westward to the Mississippi. In New Jersey they are less abundant, I believe, than in the States west and south, but a sufficient number of them have been gathered by myself and others to indicate their having been, at one time, a marked feature in the dress of our aborigines.

This "relic," however varied in its outline, always suggests a brooding bird, especially when in the position in which it is placed in Fig. 1. So far as I have made examination of these specimens, and met with notices of them in various publications, they are all manufactured from comparatively soft stone, are accurately outlined, highly polished, and drilled diagonally at the lower corners.

Of the many suggestions made as to their significance, as knife-handles, corn-huskers, idols, &c., I have met with but one that seemed at all probable; and this, I think, is rendered the more probable from circumstances connected with the discovery of various specimens, and certain peculiarities of the fragment of one here figured (Fig. 2).

Writing of one of these relics, Mr. Henry Gillman, in the Smithsonian Annual Report for 1873, p. 371, states: "I have learned, through an aged Indian, that in olden

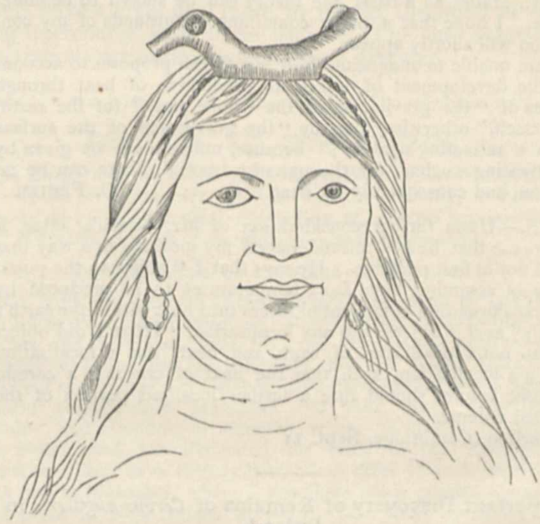

FIG. 1.

time these ornaments were worn on the heads of Indian women, but only after marriage. I have thought that these peculiar objects, which are always made of some choice material, resemble the figure of a brooding bird; a familiar sight to the 'children of the forest;' that thus they are emblematic of maternity, and as such were designed and worn."

Fig. 2 represents the "tail end" of one of these "brooding birds." Probably broken by accident, whether the head was lost or both halves preserved, it will be seen that the specimen has been considered of considerable value, inasmuch as this half has been carefully squared and polished at the point of fracture, and a hole drilled through it, to enable its owner to suspend her rude bracelet or her necklace. Surely, had the unbroken implement (?) been a knife-handle or corn-husker, the fragment such as is here figured would not subsequently have been utilised as an ornament. If put to so commonplace a use in its entirety, a half of one would have no beauty in it, even in

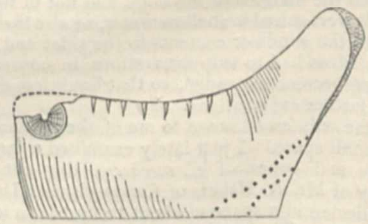

FIG. 2. Natural size.)

the eyes of a Stone-Age savage. A second noticeable feature of this broken specimen is the series of eight deeply cut notches along the "back," or upper margin. These are cut entirely across the narrow ridge forming the back, and extend equally down either side, as seen in the illustration. If an entire specimen, such as is represented on the woman's head (Fig. 1), is or was worn on the head of an Indian woman, but only after marriage, and so emblematic of maternity, then is it not reasonable to presume that these marks are records, not merely ornamental lines, and if records, of children born? Such a carved stone, once proudly worn by an Indian of high rank, if broken, as this has been, would naturally be preserved; and that it is but the half of such an one, as seen in Fig 1, is proved by the fact of a hole being drilled in the lower corners, as shown by the dotted lines; a hole that became of no use when the specimen was broken, or at least was less well placed than that subsequently drilled in order to suspend the relic as an ornament, as an ear-ring, or addition to a necklace, as previously suggested.

The traces, as they really are now, of the graves of our aborigines occasionally contain a single specimen of the above-figured relic. So far as I have been able to examine these graves, such relics are never associated with the stone axes and spear-heads characterising the graves of adult males, but simply with other forms of stone ornaments, and a single small mortar and pestle, or earthenware vase. In one instance the "brooding bird" was so placed with reference to the narrow strip of discoloured earth that marked where the body had been laid, as to show conclusively that the relic was attached to the hair, as shown in Fig. 1.

If we examine a series of these relics, it will be at once seen that every one has holes drilled at the lower corners. Such specimens could only be worn upon the top of the head, without being upside down, as would necessarily be the case had they been suspended. It must, too, be borne in mind that these relics are nowhere very abundant, but on the other hand, nowhere unknown north of Mexico. Had they been knife-handles, as suggested by Schoolcraft, or corn-huskers, as suggested by various writers, certainly they would be much more abundant than they really are. Indeed, in considering them as ornaments for married women, I am forced, in consideration of the scanty number that have been collected, to restrict them to women prominent in their tribes, the wives of kings, chiefs, and eminent warriors. If this be true, then the eight birth-records on Fig. 2 are those of "Indian princes," it may be. I must admit, however, that this broken specimen is the only one that I have seen having like marks cut upon it; but such record marks, as I believe them to be, are quite common upon other forms of stone ornaments, particularly those stone tablets and crescents that I have elsewhere (Smithson. Ann. Rep. for 1874) called "breast-plates."

These facts considered, I think that the suggestion of Mr. Gillman, based upon information received from an aged Indian, truly explains what this much-discussed relic truly is—an ornament for married women, an emblem of maternity. CHARLES C. ABBOTT

Trenton, New Jersey, U.S.A.

THE BRITISH ASSOCIATION

REPORTS.

Report of the Committee on Luminous Meteors, by Mr. James Glaisher.—The report related, as usual, to meteors doubly observed, and to aërolites, the portion having reference to the latter being the more interesting, as the falls of aërolites which have been placed on record since the last report were more than ordinarily numerous and interesting. A mass of meteoric iron fell on Aug. 24, 1873, at Maysville, California, and is one of the very few metallic irons the actual descent of which has been witnessed. In the following month a number of meteorites fell near Khairpur, in the Punjaub; and it is also related that in the month of December, when the British army halted on the banks of the Prah, an aërolite fell in the market-place of Coomassie, and was regarded by the native population as a portent of evil. On the 14th and 20th of May, 1874, aërolites fell at Castalia, in North Carolina. The last stone-fall of the past year took place near Iowa city on the 12th of February, 1875, and of this meteorite also special analyses were made in the United States, of which some unforeseen results were lately announced by their author, Mr. A. W. Wright. In England no detonating meteor has been observed this year; and the brightest meteor recorded since the last report occurred on the 1st of September last, taking its course over the north of England, or Scotland, where clouded skies must have prevailed, as its flash was like that of lightning. Other bright meteors occurred on the 2nd and 16th of September, 11th of October, 17th of December, 9th of March, 12th of April, and 2nd and 4th of May in this year. A meteor burst with a loud detonation over Paris and its neighbourhood on the 10th of February; it was of great size and brilliancy, and left a cloud-like streak of light on its track for more than half an hour. No duplicate observation of it was obtained in England. Another fireball fell at Orleans on the 9th of March, and of this two good observations appeared to have been obtained in England, which may assist to determine its real height. During the annual meteor showers of the past year very unfavourable weather generally prevailed for recording meteor tracks, and few meteors were seen on those nights when the usual expectations of their appearance were entertained. A thorough examination of all the observations collected by the committee since the publication of the Meteor Atlas in 1867, with the view of extending and correcting the list of general and occasional meteoric showers which it embraced, has been continued with satisfactory results under the direction of Mr. Greg. The report also contained a *résumé* of the contents of the recent publications on the subject of meteoric astronomy. Mr. Glaisher remarked that the report was the result of considerable labour performed by Prof. A. S. Herschel, but he pointed out that the work of properly treating meteor observations had now become so great as to be beyond the power of the Association to grapple with, and alluded with satisfaction to the arrangements being carried out by M. Leverrier. A discussion took place on the connection of comets and meteors, in the course of which Sir William Thomson said that there was nothing to justify the assertion that the mass of comets was so small as was sometimes supposed, and he considered there was good evidence for believing that the comet's tail was really a train of meteors.

The Report of the Committee on British Rainfall, by Mr. G. J. Symons, began by giving an epitome of the rainfall work done in connection with the British Association during the last fourteen years. It then referred to the steps taken after the meeting at Belfast to obtain additional stations in Ireland, which were so successful that the committee received 190 offers of assistance. The acceptance of all these offers would have involved an expenditure far beyond the funds at the disposal of the committee, and they were therefore reluctantly compelled to make a careful selection, resulting, however, in the establishment of sixty-six stations, many of them in localities of extreme importance. In the past fifteen years the number of stations had been raised from 241 to nearly 2,000. The influence of size and shape on the indications of rain gauges had been experimentally examined, and also the effect of height above ground. The laws which regulate the seasonal distribution of rainfall had been to a certain extent ascertained. The secular variation of annual fall had been approximately determined. A code of rules had been drawn up for observers. Nearly 250 stations have been started at the cost of the Association, and 629 stations have been visited, and the gauges examined by the secretary. They had obtained and supported observations on mountain tops, and places difficult of access where no observations had been made, in Cumberland, Westmoreland, Wales, and Scotland, and also an extensive series in Ireland. When the works actually in hand are completed, they will furnish an index to all the observations hitherto made.

The committee appointed to examine and report upon the reflective powers of silver, gold, platinum, and speculum metal did not present any report, but was reappointed at its own request, with the addition of Prof. Ball.

Owing to the absence of Col. Babbage in India, the committee for estimating the cost of Mr. Babbage's analytical engine had not met, but it requested to be reappointed. No report was received from the committee for the determination of the mechanical equivalent of heat, but it was stated that Prof. Joule's experiments were making good progress. The committee on teaching physics in schools was reappointed. Also the committee for considering the possibility of improving the methods of instruction in elementary geometry was reappointed, with the addition of Prof. Henrici and Mr. J. W. L. Glaisher, and requested to consider the syllabus of the Association for the improvement of geometrical teaching, and to report thereon.

Mr. W. C. Roberts read a note from the committee which had been appointed to investigate *the methods of making gold assays and stating the results.* It stated that the standard gold plate had now been finished, and that portions of it had been forwarded to different mints for the purpose of being assayed. The reports read were very satisfactory, as was shown by the fact of M. Stas, of Brussels obtaining 999·95 parts of pure gold out of 1,000 as the result of an analysis. The same plate had also been examined by Mr. Lockyer by means of the spectroscope, and the lines having been compared with the solar lines, it had been shown that silver, copper, and iron were absent, and that therefore the purification of the metal had been very great.

Mr. A. H. Allen read the *Report of the committee appointed for the purpose of examining and reporting upon the methods employed in the estimation of potash and phosphoric acid in commercial products, and on the mode of stating the results,* in which he stated the object of this committee was to examine all the known methods of analysis of manures and potassium salts. They had hoped to be able now to present to the Section some practical and easy process as a neutral standard of reference by which the present discrepancies might be avoided. The plan adopted by the committee was to draw up a printed list of queries which were sent round to all the members of the Chemical Society, with the request that they would send back answers; this plan had been found to work well with very few exceptions, who declined to give up the processes which they alone employed. The report ended by the committee desiring to be re-appointed, and expressing a confident expectation that by the end of another year some really good results would be obtained.—The President remarked, at the conclusion, that the estimation of potash seemed to present much less difficulty than that of phosphoric acid.

Second Report of a Committee, consisting of Prof. A. S. Herschel and G. A. Lebour, on Experiments to determine the Thermal Conductivities of certain Rocks, showing especially the Geological Aspects of the Investigation.—The experiments during the past year were directed chiefly to a re-examination, with improved apparatus (fully described in the report), of the rocks observed last year. With the exception of Kenton sandstone, which was misplaced in the last table, all the rocks have, under the new mode of treatment, kept the same *relative* positions, and the absolute conductivities given in the present report are believed to leave little or nothing to be desired on the score of accuracy. Quartz has been added to the list, and proves to have less resistance to the passage of heat than any of the other substances examined. Slate has been tried both in the line of cleavage and across it, showing *less* resistance in the latter position than in the former. Some rocks have been experimented on wet as well as dry, the addition of the water giving an increased conductivity of a tolerably constant value. It is intended to continue the experiments in the direction foreshadowed by these results. A full table of absolute conductivities and resistances, with the results of both series of experiments compared, forms part of the report. Coal still maintains its position with the greatest resistance yet found.

SECTIONAL PROCEEDINGS

SECTION A—Mathematics and Physics

Captain Abney read a paper *On the Increase of Actinism due to difference of Motive Power in the Electric Light,* in which he stated that having been called upon by the War Office to undertake the photometric measurements of certain magneto-electric lights, he had determined to carry out actinic measurements of their value at the same time, believing that the eye observations would be closely checked by such an independent method. In the first comparison of the results obtained by both kinds of measurement, a considerable discrepancy was found to occur in the values given to the different lights. The photographic records could not err except through gross carelessness in the chemical preparations, and against this every precaution had been taken. At first it seemed likely that the eye observations were in fault, but a more critical examination convinced Captain Abney that both were correct; and that though the curves obtained for the values of the lights did not coincide, yet that they did act as a check, the one on the other. In all there were six different machines to examine, each of which was driven by a ten-horse power engine. Several were driven at varying speeds that the difference in the light caused by the variation might be tested.

The eye observations were made by a little instrument called by Captain Abney the Diaphanometer, and described in the *Monthly Notices* of the Astronomical Society for last June. The method adopted for registering the actinic power of the light was by exposing uniformly sensitive chloride of silver paper to the action of its rays. Two registrations were carried out with each light: first, paper was exposed to the naked light at a fixed distance from the carbon points for three minutes; and secondly, a strip of the same paper was exposed beneath black wedges of slight taper for sixteen minutes. The eye observations were carried on simultaneously with the latter exposure of the sensitive paper, in both cases obtaining an integration, as it were, of the light during that period. Between ten and twenty observations were taken for each light at the beginning, middle, and end of each trial. Diagrams of the steam pressure were taken in the usual manner, and diagrams were also taken of the steam pressure when driving the machine without exciting a current, at the same speed as that at which the light was produced. They were also taken in many cases when the machines were what may be called short circuited. The data were thus obtained for calculating the power necessary to produce a light of a certain value.

Diagrams were exhibited showing the mean of the results of a series of experiments with one instrument; one curve, deduced from eighty readings, giving what may be called the optical value; another, deduced from 450 readings, giving the actinic value; whilst a third showed the ratio of the actinic to the optic value—the abscissæ being in all these cases measures of the horse power. The curves are interesting as showing the rapid decrease of the optical value, and still more of the actinic value, of the light when worked with a low motive power. They also show that each machine has a point beyond which the increase in motive power is not compensated for by increase in light, the curves apparently becoming asymptotic.

Captain Abney stated that he was not at all prepared for the great diminution of the value of actinic power in the lights, though he expected it in a smaller degree. The early experiments of Draper and others had shown that with increase of temperature the more refrangible portions of the spectrum appear after the least refrangible, but there seemed to be no measurements which would have been applicable to the present set of experiments. The curves must evidently be some function of the wave-lengths, and the author hoped to carry out other experiments in fixed portions of the spectrum in order to ascertain if the formula which he thought should hold good could be employed.

SECTION B.

Chemical Science.

Opening Address by A. G. Vernon Harcourt, M.A., F.R.S., F.C.S., President.

To the privilege of presiding over this Section custom has added the duty of offering some preliminary remarks upon the branch of science for whose advancement we are met.

In discharge of this duty some of my predecessors have reviewed the progress of chemistry during the previous year; and until a few years ago there was no more needful service that your President could render, though the task of selection and abstraction was one of ever-increasing difficulty. But a few years ago the wisdom and energy of Dr. Williamson transformed the Journal of the Chemical Society into a complete record of chemical research, and this Association materially promoted the advancement of science when it helped the Chemical Society in an undertaking which seemed at one time hopelessly beyond its means. The excellent abstracts contributed to the Journal err, if at all, on the side of brevity, and yet the yearly volume seems to defy the bookbinder's press. I shall not venture to attempt further abstraction, nor to put before you in any way so vast and miscellaneous an aggregate of facts as the yearly increment of chemistry has become. The advancement of our science—to borrow again the well-chosen language of the founders of this Association—is of two kinds. The first consists in the discovery and co-ordination of new facts; the second in the diffusion of existing knowledge and the creation of an interest in the objects and methods and results of scientific research. For the advance of science is not to be measured only by the annual growth of a scientific library, but by the living interest it excites and the number and ardour of its votaries. The remarks I have to offer you relate to the advancement of chemistry in both aspects.

One fact has been brought into unpleasant prominence by the Journal of the Chemical Society in its present form, namely, the small proportion of original work in chemistry which is done in

Great Britain. All who are ambitious that our country should bear a prominent part in contributing to the common stock of knowledge, and all who know the effect upon individual character and happiness of the habit and occupation of scientific inquiry, must regret our backwardness in this respect. The immediate cause is easily found. It is not that English workers are less inventive or industrious than their fellows across the Channel, but that their number is exceedingly small. How comes it that in a country which abounds in rich and leisurely men and women —for neither the reason of the case, nor the jealousy of the dominant sex, nor partial legislation excludes women from sharing this pursuit with men—there are so few who seek the excitement and delights of chemical inquiry? Moralists tell us that the reason why some men are content with the pleasures of eating and drinking and the like is, that they have never had experience of the greater pleasure which the exercise of the intelligence affords. I am not about to represent it as the moral duty of those who have means and leisure to cultivate chemistry or any branch of science ; but no taste for a pursuit can be developed in the absence of any knowledge of its nature. A taste for chemistry is often spoken of as a peculiar bias with which certain men are born. No doubt there are differences in natural aptitudes and tastes, but the chief reason why it is so rare for men of leisure to addict themselves to scientific pursuits is, that so few boys and young men have had experience of the pleasure which they bring. Much has been done during the last twenty years, both at the Universities and at the Public Schools, to provide for the teaching of science. To speak of what I know best, the University of Oxford has made liberal provision for the teaching of science, and for its recognition among the studies requisite for a degree ; nor have the several colleges been backward in allotting scholarships and fellowships as soon as and whenever they had reason to believe that those elected for proficiency in science would be men equal in intellectual calibre to those elected for proficiency in classics or mathematics. But the result is somewhat disappointing, and under a free-trade system science has failed to attract more than a small percentage of University students. Excellent lectures are delivered by the professors to scanty audiences, and the great bulk of those educated at the University receive no more tincture of science than their predecessors did twenty years ago.

The recognition of science among the subjects of University examinations is by no means an unmixed advantage to those concerned. Examinations have played and will continue to play a useful part in directing and stimulating study, and in securing the distribution of rewards according to merit ; but they produce in the student, as has often been pointed out, a habit of looking to success in examination as the end of his studies. This habit of mind is peculiarly alien to the true spirit of scientific work. Only such knowledge is valued as is likely to be producible at the appointed time. Whether a theory is consistent or true is immaterial, provided it is *probable*, that is to say, advanced by some author whose authority an examiner would recognise. All incidental observations and experimental inquiry lying outside the regular laboratory course, which are the natural beginnings of original work, must be eschewed as trespassing on the time needed for preparation. The examination comes; the University career is at an end ; and the student departs, perhaps with a considerable knowledge of scientific facts and theories, but without having experienced the pleasure, still so easily gained in our young science of chemistry, of adding one new fact to the pile of knowledge, and, it may be, with little more inclination to engage in such pursuit than have most of his contemporaries to continue the study of Aristotle or Livy.

However, examinations have their strong side, to which I have referred, as well as their weak side ; and although it is the natural desire of a teacher to see his more promising pupils contributing to the science with whose principles and methods they have laboured to become acquainted, the younger, like the elder branches of knowledge, must be content to serve as instruments for developing men's minds. Chemistry can only claim a place in general education if its study serves, not to make men chemists, but to help in making them intelligent and well-informed. If it is found to serve this purpose well, the number of chemical students at the Universities ought to increase ; and if the number increases, no rigour of the examination system will prevent one or two, perhaps, in every year adopting chemistry as the pursuit of their lives. But the Universities have little power to determine what number of students shall follow any particular line of study. With certain reserves in favour of classics and mathematics, their system is that of free-trade. Young men of eighteen or nineteen have tastes already formed, some for the studies which were put before them at school, in which, perhaps, they are already proficient and have been already successful, some for games and good fellowship. It is, from the nature of the case, with the masters of schools that the responsibility rests of fixing the position of science in education. During the last ten years provision has been made at most of the larger schools for the teaching of some branches of science ; and those who recall the conservatism of schoolboys, and their consequent prejudice in favour of the older studies, will understand a part of the difficulties which have had to be encountered. The main and insurmountable difficulty is what I may call the impenetrability of studies. A new subject cannot be brought in without displacing in part those to which the school-hours have been allotted. It is the same difficulty which occurs again and again in human life. There are so many things which it would be well to know and well to follow ; but life, like school-time, is too short for all. From the educational phase of this difficulty the natural difference of tastes and aptitudes provides in some degree a way of escape. I think that wherever a school can afford appliances for the teaching of chemistry, all the boys should pass through the hands of the teacher of this subject. Two or three hours a week during one school-year would be sufficient to enable the teacher to judge what pupils were most promising. There may be instances to the contrary, but I no not think it likely that any boy who attended chemical lectures for a year without becoming interested in the subject would ever pursue it afterwards with success. Suppose that out of one hundred boys who have gone through this course, five are selected as having shown more intelligence or interest than the rest ; they should be permitted to give a considerable part of their time, while still at school, to studying science without suffering loss of position in the school, or forfeiting the chance of scholarships or prizes. If any such system is possible and were generally adopted, each school sending annually to the Universities, or other institutions for the education of young men, its small contribution of scientific students, the professor's lecture-rooms and laboratories would be filled with young men who had already learnt the rudiments of science. Laboratories of research as well as of elementary instruction would find a place at the English Universities, and the reproach of barrenness would be rolled away.

Some of the defects or difficulties to which I have adverted are perhaps peculiar to our older schools and universities. The introduction of the study of natural science has borne earlier fruit in schools whose celebrity is of more recent date, such as the excellent college in this neighbourhood. Oxford and Cambridge ought to possess, but are far from possessing, such laboratories as have lately been built at the Owens College, Manchester. It is proposed to constitute in this city a College of Science and Literature, similar to Owens College and in connection with two of the Oxford colleges. The scheme set forth by its promoters appears thoroughly wise and well-considered, and all who are interested in scientific education must wish it success.

I have placed first among the modes in which science, and in particular chemical science, may be advanced, the assignment to it of a more prominent and honoured place in education ; but owing, as I do, my own scientific calling and opportunities of work to a bequest made to Christ Church by Dr. Matthew Lee more than a hundred years ago, I cannot forget or disbelieve in the influence of endowments.

I have spoken of the leisurely class in this country as that to which scientific chemistry must look for its votaries. In our social conditions and in the absence of endowments it is hard to see where else they can be found. Men who have their livelihood to make cannot afford to spend money, and still less to bestow their time and energy, on the luxury of scientific inquiry. Even if they have the opportunity of earning their livelihood by scientific teaching, and with it the command of laboratory and apparatus, no leisure may remain to them for original work, and the impulse to such work (often, it must be admitted, of a feeble constitution) is starved in the midst of plenty. The application of endowments to the promotion of original research is a difficult question. I am inclined to think that posts, constituted chiefly with this object, should be attached in every case to some educational body, and should have light educational duties assigned to them. The multiplication of such posts in connection with the many colleges and schools in this country, where there is some small demand for chemical teaching, with the provision in each case of a sufficient laboratory and means of work, would probably do more than any centralised scheme for the promotion of chemical research.

To the advancement of chemistry by the formation of public opinion on the questions of scientific education and the endowment of original research, the Chemical Section of the British Association may reasonably hope to contribute. But doubts have been expressed as to the serviceableness of this or any such organisation for the direct advancement of our science itself. No doubt we cannot accomplish much. Chemical inquirers at the present time may be compared to a party of children picking wild flowers in a large field: at first all were near together, but as they advanced they separated, till now they are widely scattered, singly, or in groups, each busy upon some little spot, while for every flower that is gathered ten thousand others remain untouched.

That the science of chemistry would advance more rapidly if it were possible to organise chemists into working parties, having each a definite region to explore, cannot, I think, be doubted. Is such organisation in any degree possible?

The experiments of which Bacon has left a record, though curious historically, have no scientific value. But in one respect his "Physiological Remains" furnish an example which we might follow with profit. "Furthermore," he writes, "we propose *wishes* of such things as are hitherto only desired and not had, together with those things which border on them, for the exciting the industry of man's mind." I will quote further, as an example, a part of one of his "wishes," which has very recently been fulfilled. "Upon glass four things would be put in proof. The first, means to make the glass more crystalline. The second, to make it more strong for falls and for fire, though it come not to the degree to be malleable."

I do not know that the industry of M. de la Bastie's mind was excited by Bacon's mention of glass more strong for falls and for fire among things hitherto only desired and not had; but the conception of such an enumeration seems to me worthy of its author. Much fruitless and discouraging labour might be saved, a stimulus might be given to experimental inquiry, and chemical research might become more systematic and thus more productive, if Bacon's example were followed by the leaders of chemistry at the present day.

The Council of the Pharmaceutical Conference, whose meeting has just preceded our own, has published a list of subjects for research which they commend to the attention of chemists. Where one of these subjects has been undertaken by any chemist his name is appended to it. Might not the representatives of scientific chemistry issue a similar list?

Perhaps two or three of the distinguished English chemists who are members of this Association might be willing to serve on a committee which should put itself into communication with the leaders of chemical inquiry abroad, and should make and obtain and publish suggestions of subjects for research. Such a list so got together would, I think, find a welcome place in all scientific journals, and would thus be widely known and easily accessible to every student.

That which chiefly makes the organisation of chemical inquiry desirable is the boundless extent of the field upon which we have entered. Not every fact, however laboriously attained and rigorously proved, is an important fact, in chemistry any more than in other branches of knowledge. Our aim is to discover the laws which govern the transformations of matter; and we are occupied in amassing a vast collection of receipts for the preparation of different substances, and facts as to their composition and properties, which may be of no more service to the generalisations of the science, whenever our Newton arises, than were, I conceive, the bulk of the stars to the conception of gravitation.

It may, however, be urged that the growth of chemical theory keeps pace with the accumulation of chemical facts. It is so, if the elaboration of constitutional formulæ is leading us up to such a theory. But at present, however useful and ingenious this mode of summarising chemical facts may be, it does not amount to a theory of chemistry.

Two objections to regarding such formulæ as anything more than a chemical short-hand, as it has been termed, seem worth recalling. The first is mentioned at the outset in most textbooks in which these formulæ are employed, but sometimes, I venture to think, lost sight of afterwards. The arrangement of the atoms of a molecule in one plane is equally convenient in diagrams, and improbable as a natural fact. But is not this arrangement used as though it were a natural fact when the possible number of isomeric bodies is inferred from the number of different groupings of the atoms which can be effected on a plane surface? The conceptions of plane geometry are much simpler than those of solid geometry (which is another recommendation of the present system of formulæ); but so far as I am able to follow the similar theories which have recently been propounded independently by MM. Le Bel and van't Hoff, the consideration of the possible isomerisms of *solid* molecules leads to new conclusions.* Wislicenus has found that paralactic acid undergoes the same transformations as ordinary lactic acid when heated and when oxidised. The two acids differ in their action on polarised light. His conclusion is that paralactic acid does not differ in its atomic structure from the lactic acid of fermentation, and that the kind of isomerism which exists between the two acids is not connected with the difference in the reciprocal arrangement of the atoms, but rather with a difference in the geometric structure of the molecule. To this difference he gives the name of "geometric isomerism."† The authors named above agree in supposing that the action of substances in solution on polarised light results from an unsymmetrical arrangement of atoms and radicles in three dimensions around a nucleus-atom of carbon.

The second objection relates to the statical character of the account which "developed" formulæ give of the differences between different kinds of matter. The modern theory of heat supposes, not only that the molecules which constitute any portion of matter are in constant rapid motion, but that the atoms which constitute each molecule are similarly moving to and fro. Such movement might be an oscillation about the position assigned to the several atoms in the constitutional formula of the molecule. Since, however, the modes of formation and decomposition of substances are the principal facts upon which the formulæ are based, it is to be considered whether these facts may not depend altogether upon the nature or average nature of the motion impressed upon the atoms—that is, upon dynamical and not upon statical differences.

Many substances are known whose existence is contrary to the theory of valency and saturation, such as nitric oxide and carbonic oxide; others, which transgress the theory of isomerism, such as chloride of dichlordibromethane ($C^2 Cl^2 Br^2, Cl^2$) and bromide of tetrachlorethane ($C^2 Cl^4, Br^2$), which should be identical, but are isomeric:‡ yet these theories are simply an expression of the statement that certain substances can exist or can differ, while others cannot. It is true that in the vast majority of cases the theoretical limitation seems to hold good. But just as the absence of any fossil remains of the connecting links between species is only significant if the geologic search has been sufficiently thorough, so it is with chemical theories depending upon the non-existence of certain classes of bodies. Indeed, in our case, where investigation is guided by theory, and, as a rule, only those things which are looked for are found, the limitation may be partly of our own making. A chemist who should depart from the general course, and set himself to prepare substances whose existence is not indicated by theory, would perhaps obtain results of more than the usual interest.

Among chemical inquiries, if ever such a list as I have ventured to suggest should be drawn out, I hope that many would be included relating to the most familiar substances and the simplest cases of chemical change. The thorough study of a few reactions might perhaps bring in more knowledge of the laws of chemistry than the preparation of many new substances.

I believe that if any chemist not content with a process giving a good yield of some product examines minutely the nature of the reaction, observing its course as well as its final result, he will find much more for study than the chemical equation represents. He will probably also find that the reaction and its conditions are of a formidable complexity, and will be driven back towards the beginnings of chemistry for cases sufficiently simple for profitable study.

In concluding my remarks, I desire briefly to refer to another branch of chemical science, to the advancement of which this Association seeks to contribute, I mean applied or technical chemistry. One of the principal differences between the papers read before this Section, as a class, and those which the Chemical Society receives, is the larger proportion in our list of papers on technical subjects. Whatever chemists may hold, there can be no doubt that the estimation of our science by the outside world rests largely on the well-founded belief that chemistry is useful. Indeed, though scientific chemists are justly eager to vindicate the value of investigations remote from any application to the arts, they cannot feel a livelier sense of triumph when the suc-

* Bull. de la Soc. Chem. de Paris, t. xxii. p. 337, and t. xxiii. p. 295.
† Ann. Chim. et Phys., 5me série, t. l. p. 122.
‡ Bull. de la Soc. Chim. de Paris, t. xxiv. p. 197.

cessful synthesis of a vegetable principle yields at the same time a product of great technical value, as in the case of the production of artificial alizarin.

By visiting in turn the principal centres of British industry, this Association brings together men engaged on pure and on applied chemistry. We who come as visitors may hope that our papers and discussions here may bring fresh interest in the science, if not actual hints for practice, to those whose art or manufacture is based on chemistry. In return, the most interesting communications the Section has received have not unfrequently been the descriptions of local industries; and there is no part of our hospitable reception more welcome and more instructive to us than the opportunities which are provided of seeing chemical transformations on a large scale, effected by processes which observation and inventiveness have gradually brought to perfection and with the surprising familiarity and skill which are engendered by daily use.

SECTION D.—BIOLOGY.

Department of Zoology and Botany.

Dr. Hector, chief of the New Zealand Survey, gave a most interesting account of the modes of occurrence of the Moa bones in New Zealand. He used the term Moa in preference to that of Dinornis, because the bones of the New Zealand birds were now divided among so many genera. He demonstrated most conclusively that the knowledge of their former existence was not communicated to the Maoris by the Europeans, who deduced their structure from their remains, but, on the contrary, was imparted to the latter by the former. Up to recent times there had been a constant fulfilment of the statements made by the Maoris concerning the localities in which the bones would be found. He believed there was no hope of ever finding the birds alive, for he himself had been over the whole of the islands very thoroughly without seeing them. Dr. Hector exhibited a map of New Zealand on which were denoted all the areas in which Moa bones had been found, and all the localities in which considerable finds of bones had been made, with indications of their condition or surroundings. He found that the country occupied by primeval forests before the advent of Europeans was that in which Moa bones did *not* occur. His deduction was that they lived in the open and low scrub, in which they could walk. In all this region, within his own memory, the Moa bones were extremely abundant in the South Island, all over the ground; but these bones were very rarely found in collections, for they were usually decomposed and split and warped. In the enormous extent of Sub-Alpine country in the South Island, which was covered by only a light vegetation, large quantities of well-preserved Moa remains had been recently found, associated with remains or reliques of natives. It appeared to him that the natives had pressed up the country for the purpose of capturing, killing, and eating the Moas; and as the natives could not follow them through the sharp bayonet-grass and other underscrub, they seemed to have got at them by setting portions of it on fire, which collected the animals together, often killed them, and accounted for so many of their bones being accumulated in particular spots. And in some of these localities where the Moas were destroyed by fire, little heaps of chalcedonic quartz pebbles, which were their crop-stones, were found, each heap associated with the remains of one bird. And this fact, of their being the crop-stones, had been conclusively proved by the discovery of a carcase crushed and decayed so as to be unfit for anatomical purposes, but containing within the thorax just such a little heap of pebbles as had been described. The second chief mode of occurrence of Moa bones was in the turbary deposits and desiccated swamps, occurring in almost all the valleys leading to the east coast. One notable deposit was at Glenmark, where the remains of a terrace at a higher level had been cut through by the stream, leaving a large turbary deposit on the shoulders of the hill on both sides. Here were found a great number of Moa bones, without any associated Maori implements. Out of this place had been got bones sufficient to cover twice the area of the Section Room. They occurred mixed together, and above, below, and among great accumulations of drift-wood, which were ten or twelve feet deep over many acres. The bones got out of that deposit indicated at least 1,700 individuals, which had either been carried down and smothered in floods or which had died naturally and been carried down by the water. Similar deposits occurred in caves, and in turbary deposits on the coast, which were exposed below high-water mark, showing that there had been comparatively modern submersion; but there were no marine deposits above, and they rested on a denuded surface of the latest Tertiary beds. There seemed to have been an uninterrupted submergence of New Zealand since the time when the Moas were first developed in such large numbers; and there had been no considerable re-emergence of the land since then. Another mode of occurrence of Moa bones was wherever the country was favourable for Maori camps, on the sheltered grassy plots and links, or among the sand-hills near. They were associated with their cooking-hollows, and with stone implements, which, however Neolithic in aspect, were similar to those used now by Maoris. It had been said that the oldest Moa remains were those associated with the ancient moraines of the upper valleys, but these were the great natural roads up which it was very likely that some Moas would travel and leave their remains there. In caves the Moa bones were found resting on the stalactitic shelves, perhaps cemented by a little carbonate of lime. They were hardly ever found on the lower surfaces of the caves; and he believed they had mostly gained access to the caves by falling through the upper chasms. He had evidence that sheep in modern days fell through in the same way, and their bones were found similarly situated in the caves. The earliest traces of the Moas that had been found were footprints at Poverty Bay, occurring in a soft pumice sandstone, within six or eight inches of the upper surface. Many blocks had been procured with these undoubted footprints. The lower surface of each depression was formed of very fine micaceous sand, but it was filled up with much coarser green quartzose sand. After the birds had passed, the impression had been filled up by blown sand. Undoubtedly a true bird-bone had been found in Tertiary deposits in New Zealand, but he was inclined to think it belonged to a gigantic extinct Penguin.—The President testified to the value of Dr. Hector's address by saying that he had never till that time really understood the modes of occurrence of Moa bones.—Prof. W. C. Williamson said that scientific workers who had advice and sympathy readily accessible to them could know little of the energy and enthusiasm required to sustain the solitary individual who had to labour without meeting a scientific or even an educated man for weeks and months. Dr. Hector was a conspicuous example in this respect, and deserved all the honour his fellow-workers in England could give him.

Dr. Carpenter gave a summary of the results of his investigations into the nervous and generative systems of comatula. He described as a nervous cord the cord existing in the axial hole of the skeletal segments, which Müller had described as a vessel. No cavity was to be found in it, and in a favourable plane of section branches from it to the tentacular muscles were detected. Although this cord was destitute of the ordinary structure and insulating material of nerves, that was explicable by the fact that only one kind of muscle had to be affected, and that all the muscles acted simultaneously, in flexion of the arm. The cord to each arm came off from the curious five-lobed organ in the calyx below the perivisceral cavity. This was determined to be the central nervous mass by the following experiment. A living comatula was taken, and the visceral mass was turned out. A needle was thrust into the supposed nervous organ, and instantly all the arms were coiled up to their full extent, and were gradually relaxed. This was repeated several times. A curious generative axis had also been discovered in the shape of a cord passing through the middle of the nervous centre, and through the visceral mass to spread into a plexus around the mouth. Thence branches were given off to the arms and pinnules, and the ovaries and testes were directly connected with these cords as axes. Dr. Carpenter said that these facts were such as to necessitate the separation of the crinoids much further from the rest of the echinoderms than hitherto. In fact, he considered they had little in common beyond the calcareous network of the skeleton. In conclusion he said that he had learnt from a trustworthy observer that after a recent hurricane in the West Indies a vast number of Pentacrini had strewed the shore of Barbadoes, in all stages of growth, from one inch to eighteen inches in length; but unfortunately no naturalist was at hand to reap the rich harvest.

Dr. I. Bayley Balfour read a paper *On the Flora and Geological Structure of the Mascarene Islands.* He said that in Bourbon there was a great contrast between the flora of the older north-western portion and that of the south-eastern district within the area formed by the volcano now acting. Here the soil was very barren, with only a few composites and other plants that flourished in a dry soil. The flora was not most closely allied to that of Africa, but rather to that of India and the Indian Archipelago.

There was a great profusion of ferns, mosses, and lower crypto-gams; and evergreens were abundant. The species were few in proportion to the genera, and the genera in proportion to the orders. The proportion of indigenous plants and of species to any area was generally small; but in Bourbon there was the great number of 1,700 species. The most remarkable genus in the group, perhaps, was Pandanus, the screw-pine, which had species peculiar to each island, though the commonest, *P. utilis*, occurred on all three islands. Certain genera were found to be endemic to the group, especially in the Rubiaceæ and Compositæ. In addition, in each island there were certain genera endemic to that island alone. In North-western Bourbon, although, as in Mauritius, settlers had produced much alteration by cutting down trees, &c., there was still an abundance of plants which flourished in a moist climate. The flora of Mauritius exhibited affinities with that of N. W. Bourbon, although possessing endemic genera. Perhaps no place in the world had had its flora so much altered by settlers, especially by means of fires through carelessness. The original flora had been almost exterminated. The few plants now remaining included one new genus; and there were certain peculiar Pandani, but the general type was allied to that of Mauritius. In many of the small volcanic and coral islands which surround Mauritius and Rodriguez, very often little more than rocks, there were genera which were peculiar to those islands, or else species that were representatives of other species existing on the main islands. Round Island, a mere cone near Mauritius, had three genera of palms represented by different species, which were found nowhere else; and exhibited many other peculiarities in its flora. Dr. Balfour reserved his opinion on the vexed question of the origin of these islands by independent volcanic action or by the submergence of an ancient continent connected with Africa; but stated that soundings taken between Mauritius and Rodriguez, about fifty miles west from the latter, gave a depth of 2,000 fathoms; while 100 miles S. W. of Mauritius the depth was 2,700 fathoms.—Prof. Williamson remarked on the parallel between these facts and those first brought to light by Mr. Darwin relative to Galapagos. It appeared that these modifications of species and genera were such as must necessarily have resulted from modifications in a long course of time; and they compelled naturalists to accept Mr. Darwin's views whether they liked them or not. Coupled with the facts derived by Mr. Wallace from the Indian Archipelago, he thought considerable probability was given to the submergence theory.—Prof. Dickson could not see that the occurrence of representative forms on different oceanic islands was any stronger proof of evolution than the facts relating to the grouping of plants about geographical centres; but Prof. Williamson maintained that the occurrence of distinct yet analogous species on contiguous islands of very recent geological age was a striking evidence of modification produced by new physical conditions, unless indeed distinct new creative acts were admitted within a comparatively modern period.

Prof. Williamson gave an account of his recent discoveries among the fossil seeds of the coal measures, and partly confirmed and partly controverted Brogniart's views on some of the same seeds. He (Prof. Williamson) gave the name Lagenostoma to a form of seed larger and more bulky than a grain of rice, which had a flask-shaped cavity above the nucleus, between it and the micropyle. This cavity was surrounded by a membrane quite distinct from that investing the nucleus. Prof. Williamson believed that he had found pollen grains in this cavity, and that the only difference between this and an ordinary coniferous seed consisted in the presence of this chamber, which protected the pollen and brought it into contact with the nucleus. Another seed of the same general type had the upper part of the nucleus contracted, forming a sort of mammilla: thus the cavity above became of a different shape. He named it Physostoma. Another type he called Æthiotesta. All these were from the Lancashire coal-field. A specimen from Burntisland showed a transition from the extremely small and narrow micropyle of ordinary angiospermous seeds, and the large chamber of Lagenostoma. Prof. Williamson also referred to Cardiocarpum, which he found to have the nucleus thickened, and to have a prolonged spur containing the micropyle. Antholithes and Cardiocarpum were but portions of the same flowering plant. He found that Trigonocarpum had really a long projection at the end, of a similar nature, but from some Newcastle specimens he inferred that it had a large investing sarcocarp. The type was not at all dissimilar to Cardiocarpum.

Prof. Balfour, in a *Notice of Rare Plants from Scotland*, drew attention to the discovery of *Naias flexilis* in Perthshire, hitherto only found in Ireland. He exhibited the original specimen of *Salix sadleri* and *Carex frigida*, discovered in Scotland last year by Mr. Sadler.—Dr. I. Bayley Balfour contributed some notes on Turneriaceæ from Rodriguez, especially referring to one new form.—Prof. A. Dickson exhibited a *Primula vulgaris* with interpetaline lobes, and pointed out its relations to Soldenella and other Primulaceæ; he also described a monstrosity in *Saxifraga stellaris*, in which there occurred a calyx, no corolla, many stamens, and many carpels. Two specimens were found, each with a single terminal monstrous flower.

It is to be regretted that there was a paucity in the attendance of distinguished zoologists and botanists, and that the number and importance of the papers read was not so great as to furnish any idea of a widespread existence or encouragement of research in natural history. It might be well for naturalists to put themselves in evidence a little more strongly, and to show the value of their results more prominently, if they desire to be aided in their researches by public funds, or to win general sympathy, especially when geologists and anthropologists make such vigorous displays of their conquests.

Department of Anatomy and Physiology.

Prof. Rolleston, in moving a vote of thanks to Prof. Cleland for his presidential address to the department, said he had rarely spent an hour with more pleasure than in listening to that address. He would show the value he set upon it by saying that Prof. Cleland's old master, the great John Goodsir, would have been glad to hear it. He believed much of what the President had said would take its date from that meeting as of permanent authority and value.

Dr. McKendrick read the important report *On the Physiological Action of Light*, by himself and Prof. Dewar. We hope to publish it in full in an early number.

Mr. W. J. Cooper, in a paper *On the Physiological Effects of various Drinking Waters*, referred to the experiments of M. Papillon on various animals, described before the French Academy of Science in 1870–73, by which it was shown that not only the ash of the food eaten affects the composition of the bones, but also that mineral matter in dilute solution is capable of being assimilated. Consequently, alterations in the composition of the water supply of a community might be of very great importance to the organic structure of the human body, if the very composition of the bones is affected by the quality of the water. The inorganic impurities of water had been too much overlooked, notwithstanding the serious consequences which sometimes follow. Mr. Cooper insisted that one of the first conditions in the inauguration of a water-supply should be to ensure perfect freedom from excess of any mineral except those comparatively harmless ingredients, chloride of sodium and carbonate of lime.

Mr. T. G. P. Hallett read a paper *On the Conservation of Forces*, devoted to a long argument against this principle being extended to vital phenomena. He endeavoured to prove that life, whether tested by its origin or its effects, was a force, and that the laws of that force were not such as the conservation principle required and declared. Dr. Allen Thomson, at the close of the discussion which followed, thought it best to suspend judgment on the points that had been mooted, and to continue the quiet investigation of physical phenomena; his impression, derived from long observation, being that the more the phenomena of life were attended to, the more fully they were explained by known laws.

Among other papers may be mentioned Messrs. L. C. Miall and F. Greenwood's, *On Vascular Plexuses in the Elephant and some other Animals*, and Mr. Greenwood's *On the Preservation of the Larger Animals for Anatomical Examination*.

If the papers read before the Department of Anatomy and Physiology had to be taken as an index of the activity of research and thought concerning these subjects in Great Britain, we should have to confess ourselves to be at a low ebb. The department only sat on three days out of five, and those three days were certainly not crowded with valuable papers. The physiological investigations of Drs. McKendrick, Lauder Brunton, and Pye-Smith, and Prof. Dewar, were of high interest and great value; but the subjects they referred to cover only a very small part of the wide domain of Physiology. Morphology was represented most worthily by the President's address, but there was a plentiful lack of memoirs on descriptive anatomy, morphology, embryology, and histology. It is of course difficult to make the details of morphological investigation interesting in a spoken narration, but expositions of new or improved principles, and results of research in all departments, could be usefully brought forward at these meetings and receive illumination from discussion by those in authority. Are our anatomists and physiologists less willing to make such efforts than other scientific men, or have they a greater fondness for remaining in their own special haunts without emerging on any common ground?

Department of Anthropology.

Miss A. W. Buckland, of Bath, read a paper *On Rhabdomancy and Belomancy*, in which she endeavoured to show that rhabdomancy, or divination by means of a rod, still practised in England in some localities, was a survival of a very ancient superstition, originating in the use of rods as symbols of power.

Mr. John Evans described fully the proposed code of symbols for archæological maps which has been drawn up by a committee of leading archæologists on the continent of Europe, and will probably be extensively used. Suggestive crude symbols are adopted for the leading varieties of ancient remains, and a series of modifications of each chief form is to be used, to denote as far as possible the exact nature of the remains.

Mr. Hyde Clarke furnished a notice of the prehistoric names of weapons, in continuation of a note laid before the British Association in 1873, which showed that there was a community of aboriginal names of weapons in the prehistoric epoch. He now added that further research had confirmed these views.

Mr. Hyde Clarke also read a paper *On Prehistoric Culture in India and Africa.* After referring to his investigations as to the evidence of the successive migration and distribution of languages in Asia, Africa, North, Central, and South America, and in some cases in Australia, he proceeded to give the result of later special investigations as to the community of culture in India and Africa. The philology of the aboriginal languages of India could only be effectually studied from those of Africa, and Mr. Hyde Clarke suggested that it would be a great advantage if some of the missionaries of the two regions could interchange stations.—Prof. Rolleston remarked upon the desirableness of a complete work being prepared on the present ethnology of India, under the superintendence and at the cost of the Indian Government.

Dr. Phené, in his paper *On the Works, Manners, and Customs of the Prehistoric Inhabitants of the Mendip Hills*, adopted the theory of a similarity of race in the people who formerly occupied the caves on the Atlantic seaboard of Europe and of Britain; and identified the inhabitants of the Mendips with them.

Mr. D. Mackintosh read a paper *On Anthropology, Sociology, and Nationality*, which referred especially to distinctions of race in the British Isles, and defended his previously expressed views. He believed that the various colonising tribes had either continued in certain localities with little interblending, or that the process of amalgamation had not been sufficient to prevent the persistence of the more hardened characteristics. He tried to show that between the north-east and south-west the difference in the character of the people, irrespectively of circumstances, is so great as to give a semi-nationality to each division—restless activity, ambition, and commercial speculation predominating in the north-east, and contentment and leisurely reflection in the south-west.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—DETROIT MEETING.

LAST week we gave a general account of the meeting of the American Association, from an American correspondent. The following are brief notices of some of the principal papers read.

We have already referred to the presidential address of Prof. Le Conte, and to the address of Prof. Dawson, both of which were anti-evolutionary, the latter more distinctly so than the former. Prof. Dawson's views are so well known that we need not refer at length to his Association address.

Prof. Augustus R. Grote, Director of the Museum of the Buffalo Academy of Sciences, undertook the task of throwing light upon past geological eras by showing the present distribution of certain North American insects. He described the glacial epoch as occurring at the close of the Tertiary by a continuous loss of heat. The winters gradually lengthened, the summers shortened. The tops of mountains that now bear foliage were then covered with snow, which, in time consolidating, formed glacial ice that flowed into the valleys. Gradually an icy sea extending from the north spread southward, even over the Southern States and down the Valley of the Mississippi. Existing insects of the Pliocene, no matter how gradually they were affected by the change, must have eventually left their haunts, and doubtless many species were exterminated. At the present day there are found in the tops of the White Mountains, and in the lofty ranges of Colorado, certain species of butterflies and moths which are completely isolated. To find others of the same kinds we must explore the Plains of Labrador and the northern portions of our continent; there and there only do we find similar or analogous species. A White Mountain butterfly, *Oeneis Semidea*, was cited as an instance in point, and other butterflies and moths were mentioned, whose isolated habitats served to prove the general proposition. The retirement of the glacial seas at the close of the epoch was then considered. Then the summers were lengthening, while the winters were shortened. Then ice-loving insects, such as the White Mountain butterfly, hung on the edge of the ice sheet which supplied their food, and followed its retreat—not all, but some of their forms surviving. Straying upon the local glaciers of the mountain ranges, they were left behind in some instances, while the main body followed the retiring ice sheet to the far north. Those that were left behind still find the conditions of their existence in the snow-covered summits of the present day. As the valleys became warmer and glaciers fewer, the chances of their escape from their isolated positions gradually diminished till their removal became impossible.

Prof. E. S. Morse, of Salem, Mass., has for a long time made a study of the bones of embryo birds. At this meeting he recalled briefly the evidence he had shown last year regarding the existence of the intermedium in birds by citing the embryo tern, in which he had distinctly found it. This year he made a visit to Grand Menan expressly to study the embryology of the lower birds, and was fortunate in finding the occurrence of this bone in the petrel, sea-pigeon, and eider duck. This additional evidence showed beyond question the existence of four tarsal bones in birds, as well as four carpal ones. In these investigations he had also discovered embryo claws on two of the fingers of the wing—the index and middle finger. Heretofore in the adult bird a single claw only had occurred in a few species, such as the Syrian blackbird, spur-winged goose, knob-winged dove, jacana, mound bird, and a few others, and in these cases it occurred either on the index or middle finger or on the radial side of the metacarpus. All these facts lent additional proof of the reptilian affinities of birds.

Prof. S. P. Langley, of Alleghany Observatory, detailed some of the conclusions at which he had arrived after years of study of the solar surface. Prof. Langley first showed by comparative experiments that an absorptive atmosphere surrounds the sun. Little attention has in recent years been paid to the study of this atmosphere. The earlier efforts to tabulate its absorptive power, produced with different observers, though men of eminence, strangely discordant results. Their methods and deductions were given in detail. Secchi's results, making the neighbourhood of the edge of the sun about half the brightness of the centre, are probably near the fact. Prof. Langley applied well-known photometric methods to the problem. By attaching a circle of cardboard to the equatorial telescope, a solar image is received on the board, plainly showing spots, penumbræ, &c., if the image be one foot in diameter. From holes in this cardboard, pencils of rays issue, which being caught on a screen give a second series of images. If these images are caught upon separate mirrors, instead of a screen, their relative light can be made the subject of comparison with that of a disc of flame from Bunsen's apparatus, and thereby their relative intensity determined. Between each aperture and its respective mirror a lens was interposed which concentrated the pencil of rays. By suitable additions this apparatus can be converted to a Rumford photometer, and in this form it proved most available in Prof. Langley's hands. He found a value for the brilliancy of the umbra in sun-spots, considerably higher than that hitherto computed. The blackest umbra, he finds, is betweeen 5,000 and 10,000 times as bright as the full moon. The light of the sun is absorbed by its atmosphere not in the same, but in a greater proportion than its heat. A long series of experiments shows that not much more or less than one-half of the radiant heat of the sun is absorbed or suffers internal reflection by the atmosphere of the sun itself. Observations indicate that this atmosphere is (speaking comparatively) extremely thin; Prof. Langley is inclined to regard it as identical with the "reversing layer" observed by Dr. Young, of Dartmouth, at the base of the chromosphere, though the chromospheric shadow should perhaps be taken into the account. The importance of a study of this absorbent atmosphere becomes evident if we admit that the greater part of the 500° which separate the temperature of the temperate zone from absolute zero is principally due to the sun's radiation. To this atmosphere new matter is constantly being added and taken away by the continual changes of the interior surface. Any alteration in the capacity for absorption—say a difference of 25 per cent., which could hardly be recognised by observation—would alter the temperature of our globe by 100°. The existence of life on the earth is clearly dependent on the constancy of the depth and absorption of this solar envelope. Hitherto we have chiefly confined calculations to the diminution of solar heat by contraction of the sun's mass—an operation likely to go on with great uniformity. But here is an element of far more rapid variation. If changes in the depth of this solar envelope are cyclical, they would be accompanied by cyclical alterations of earth's temperature. This may serve alike to explain the characteristics of variable stars and the vast secular changes on earth indicated by geology. If the law of alterations in that envelope can be ascertained, new light may be shed on the history of the globe and the near future of life upon it.

Prof. Thomas Meehan, of Germantown, Penn., made an attack on Darwinian theories in a paper which disputed the assumption that insects are a material aid in the fertilisation of plants. He drew the following conclusions: (1) That the great bulk of coloured flowering plants are self-fertilisers. (2) That only to a limited extent do insects aid fertilisation. (3) Self-fertilisers are in every way as healthy and vigorous, and are immensely more productive, than those dependent on insect aid. (4) That when plants are so dependent they are the worse fitted to engage in the struggle for life—the great underlying principle in natural selection.

Prof. Morse described the evident characteristics of insects which seemed not only fitted for fertilisation, but were found actually engaged in the process. He was not prepared to abandon the vast mass of facts already obtained on account of the few and doubtful experiments detailed by Prof. Meehan. Prof. Riley thought that the fact that insects were absolutely essential to the existence and perpetuation of many plants, had been proved by experiments and observations so numerous and convincing that it could no longer be denied. He mentioned his own experiments with the *Yucca;* and he met and combated the theory that self-fertilisation, like interbreeding, did not tend to deterioration. Prof. Meehan, in explanation of his views, stated that he regarded the present dependence of plants upon insects as an evidence of weakness and accident, or of deformation in the plant. Prof. Riley said that it was a mistake to suppose that insect life was scarce in the Rocky Mountains.

A paper was presented *On some New Fossil Fishes and their Zoological Relations*, by Prof. J. S. Newberry, of Columbia College, giving brief descriptions of interesting fish remains found during the past year in the Devonian and Carboniferous rocks of Ohio. Of these, the most important "find" was that of nearly the entire bony structure of a single individual of *Dinichthys Terrellii*, the hugest of all the old armour-plated Ganoids. Life-size drawings of most of these bones were exhibited to the Association, and copies of them will appear in the second volume of the "Geology of Ohio," now going through the press. Drawings of another species of *Dinichthys* was shown (*D. Hertzeri*) in which the maxillaries and mandibles are set with teeth instead of being sharp-edged. The remains of both these monsters have been found only in the upper Devonian rocks of Ohio. Prof. Newberry also exhibited to the Association teeth of *Dipterus Glenodus*, and those of a new genus belonging to the same family.

Prof. E. D. Cope, of Philadelphia, made a communication *On the Indications of Descent exhibited by North American Tertiary Mammalia.* The gradual development from one form to another by changes in the foot bones was traced through a long series from extinct Tertiary animals to those of the present day. A similar process of change was traced in the teeth of animals, the simpler forms of teeth in the Eocene being a crown with four tubercles. The human skeleton, Prof. Cope declared, retained many more ancient types than other Mammalia.

A paper from Prof. Daniel Kirkwood, of Bloomington, Ind., *On the Distribution of the Asteroids*, was read by Prof. Langley. Prof. Kirkwood stated that twenty years ago, when the number of known asteroids did not exceed fifty, it was inferred from purely physical considerations that there must be great irregularity in their distribution, and that gaps would be found in their zone where their periods were commensurable with those of the planet Jupiter. In 1866, when the number of asteroids amounted to eighty-eight, the agreement of theory and observation in this matter was the subject of a paper from Prof. Kirkwood, read at the Buffalo meeting of the Association, and the evidence was again summed up in a paper at Indianopolis in 1871. Since then thirty-one asteroids have been added to the group. It is now proposed to show that the truth of the theory advanced in 1866 is now more than ever determined. The Professor proceeds to divide the space between the asteroids into six zones by orbits whose periods would be commensurate with those of Jupiter. Then taking the members of the group in the order of their mean distances, it is found that the widest intervals between them are at these gaps where orbits would coincide with certain multiples of Jupiter's revolution. He remarks that it is a notable fact in the development of the solar system that the largest planet, Jupiter, should be succeeded by a space so nearly destitute of matter as the zone of the asteroids, the ratio of masses being as 1 to 5180. An explanation of the disproportion was given in a paper read in 1870; but it may be asked what might have been the result if the density of the asteroidal group had been equal to that of the other planetary rings. For reasons which he assigns, Prof. Kirkwood believes that if the asteroidal group had possessed a total density half that of Jupiter, they would when nebulous have been brought so closely into contact by the great planet's attraction as to fuse into one, instead of remaining as separate bodies. A similar result he regards as having taken place in the case of Uranus. A formation of the same kind would result where the period of a planet was one-third that of Jupiter; corresponding to the ratio between the periods of Jupiter and Saturn. The rare instances of great inclination among asteroids' orbits he is inclined to believe may have been occasioned by comets, when the minor planets were themselves in a cometary or nebulous condition.

The Hon. L. H. Morgan, of Rochester, read papers *On Ethnical Periods and the Arts of Subsistence.* The discussion of ethnology would be much facilitated by the use of a certain number of ethnical periods representing conditions in the advance of man from his earliest to his higher conditions. Mr. Morgan proposes the following :—

1. A period of savagery.
2. The opening period or lower status of barbarism.
3. The middle period of barbarism.
4. The closing or upper period of barbarism.
5. The period of civilisation.

The ages of stone, bronze, and iron have served a useful purpose in archæology, but the progress of knowledge has rendered more definite subdivisions necessary. The use of stone implements began far back in savagery, which extended even to the introduction of tools of iron. The successive arts of subsistence offer distinctions of more value. The period of savagery begins with the human race. The invention or practice of the art of pottery may enable us to draw the line between savagery and barbarism.

The transition from the lower to the middle stages of barbarism is marked in the eastern hemisphere by the domestication of animals; in the western by the cultivation of maize and succulent plants by irrigation, together with the use of adobe and stone in house architecture. The upper status of barbarism is cut off from civilisation by the invention and use in the latter of a phonetic alphabet and the art of writing.

In respect to the effect of arts of subsistence in modifying the improvement of mankind, Mr. Morgan takes very broad views. He is of the opinion that success in multiplying the sources and amount of food decided the question of man's supremacy on earth. His advance has been identified with improvement in this particular.

Prof. Burt G. Wilder, of Cornell University, read papers on the following natural history subjects :—Notes on the American Ganoids (*Amia*, *Lepidosteus*, *Acipenser*, and *Polyodon*); The Use and Morphological Significance of the Caudal Filament of the young *Lepidosteus*; The Embryology of Bats; The Affinities and Ancestry of the existing Sirenia. This paper was based upon three specimens which were exhibited. First, a fœtal Dugong, 2½ feet long, obtained from Australia through Prof. H. A. Ward. Second, a fœtal Manatee, between three and four inches long (as if extended), obtained from South America through Prof. James Orton. Third, a fœtal Cetacean (probably

Porpoise), three inches long (as if extended), lent to Prof. Wilder by Mr. Alex. Agassiz, Curator of the Museum of Comp. Zoology at Cambridge. The last two specimens are believed to be the smallest of their kind hitherto recorded.

Prof. Wm. S. Barnard, of Canton, Ill., read a paper *On the Development of the Opossum, Didelphys virginiana.*—Prof. Barnard read another paper, in which he compared the muscles of man with those of the higher apes, showing the points of similarity as well as of difference. An interesting point made in this paper was the statement that one of the buttock muscles supposed to be peculiar to the higher apes, distinguishing them from man, really existed in the human body and in a similar position. It was shown that the muscle thus described by Traill, and afterwards by Wilder as in the chimpanzee, and by Owen and Bischoff as in the orang, and by Coues as in the opossum, is also found in man, and offers no distinction in this respect. Three new muscles about the hip-joint, found in the orang and some other apes, were also made the subject of description; these muscles have no homologues in man. Two of these act to rotate the leg and draw it inward; the other seems too small to have any functional value and is probably a rudiment, but is interesting as occurring also in some of the lower apes and the opossum. The other muscles in this region of the body were like those of man, but in the case of an orang the short head of the biceps of the thigh was found entirely separated. This is only occasionally the case with the orang, and this peculiarity is not known to exist in any other animal. The two large external muscles of the calf do not unite with each other to form a single tendon Achillis, consequently in the orang this tendon is double, which sometimes occurs with marsupials. These investigations, which were explained in much technical detail, tend to prove that all the muscles possessed by man can be traced backward in the lower forms of animals, through the apes to the lemuroids.

Prof. Barnard gave a detailed account of his observations on the *Protozoa*, made in the anatomical laboratory of Cornell University, Ithaca, N.Y., where the specimens described were also seen by Prof. Wilder and others than the investigator himself.

Prof. George F. Barker, of Philadelphia, read a paper *On the Cause of the Relative Intensity of the Broken Lines of Metallic Spectra.* The purpose of this paper is to give the general result of a series of measurements made to ascertain, by Vierordt's method, the relative intensity of these various lines, and to compare these with their lengths measured micrometrically. Vierordt's method consists in measuring the intensity of a coloured light by the amount of white light necessary to extinguish it. By means of a third telescope attached to the spectroscope, a bright slit of light may be thrown upon any portion of the spectrum, and by varying the distance of the source of this light, until it extinguished the various spectrum lines in the order of their brightness, a series of numbers was obtained which, by the law of the inverse squares, gave the relative intensity of the different spectrum lines. The metals experimented upon were copper, gold, silver, antimony, bismuth, and magnesium. The general result is, that in no case does the length of the spectrum line follow the law of brightness. Hence some other hypothesis must be suggested to account for the phenomena. The author suggested one which seemed to him to be at least possible, and to be sustained by the prevalent views on molecular and atomic physics. The constitution of a gas is simple; the molecules composing it move in straight lines, and encounter each other and the walls of the containing vessel in so complex a way that Prof. Maxwell doubts if mathematics can follow their paths. The oscillations of the atoms within the molecule, are, however, less complex; they either are simple harmonic motions themselves, or they may be resolved into such. It is these harmonic vibrations which, communicated to the ether, cause the spectrum lines; the number of the different forms of oscillation constituting the number of lines in the spectrum, the period of any one oscillation determining the wave length of the corresponding line, and the amplitude fixing the brilliancy of that line. These things being granted, we have only to suppose what is perfectly conceivable, that the amplitude of the vibration, the only point we are now concerned with, varies with the temperature differently for each of the different kinds of vibration in the molecule, or, what is the same thing, with the wave length. If, for example, the peculiar harmonic vibration of the atoms of a copper molecule which gave the longest line in the green, diminished the amplitude of its oscillation less rapidly than the one in the blue, then this is a sufficient reason why it should be the longest. We may, therefore, by inspection of a broken spectrum, conclude at once on the rapidity with which the amplitude of the different harmonic vibrations of the atoms within the molecule decreases with decreasing temperatures, this being simply in the order in which the lines are arranged as to their length. This is offered as a working hypothesis to be proved or disproved by special investigation. From the facts already known it may be regarded as antecedently probable. It seems to be a step taken into the great field lying between chemistry and physics, at present a great and unexplored gulf. Work done here cannot be thrown away even if done to test an untenable hypothesis. It must bear fruit, though it may be very different in kind from that anticipated.

REPORT ON THE PROGRESS AND CONDITION OF THE ROYAL GARDENS AT KEW DURING THE YEAR 1874

FROM Dr. Hooker's recently issued report on the progress and condition of the Royal Gardens, Kew, for 1874, we learn that a series of lectures, or, as they are called in the report, "practical lessons," have been given to the gardeners during the evenings, after working hours. These "lessons" embrace the elements of structural, systematic, and physiological botany; of chemistry, physical geography, and meteorology, in their application to horticulture; of economic botany, forestry, &c. They are given, some in the young men's Library, others in the Garden or Museum. Notes of these lessons have to be taken by those attending them, which, after being fairly written out in notebooks, are examined periodically by the teacher and corrected, or more explicit instruction given if necessary. The attendance at these lessons is voluntary, but the fact of "good attendance" is recorded in every gardener's certificate of conduct and proficiency on his leaving the service of the establishment.

These lessons have been instituted with the view of the better education of the gardeners in subjects bearing upon their profession, so as to qualify them for "Government and other situations in the Colonies and India, where a scientific knowledge of gardening, arboriculture, &c., is required." Most of the colonial gardens and Government plantations are at the present time under the superintendence of able men, who received at some time or another instruction at Kew.

The liability of *Coffea arabica* to the attack of both insects and fungi have been abundantly proved of late by the visitation of the so-called blights in Dominica, Southern India, and more recently in Ceylon. In consequence of this a good deal of interest is attached to the prosperity of the Liberian Coffee, which has been distributed from Kew. On this subject Dr. Hooker says: "A large stock of true Liberian Coffee has been obtained through the kind efforts of Messrs. Irvine and Woodward, of Liverpool. This is a larger and perhaps different variety from that received from Cape Coast. . . . Large quantities of both have been sent to the coffee-growing British possessions, and have arrived in excellent condition. Dr. Thwaites states that the Cape Coast Coffee, the safe arrival of which in Ceylon I mentioned in the report of last year, is, notwithstanding that it was immediately attacked by the leaf disease, doing well. He also remarks that 'the Cape Coast and Liberian Coffees, although they would seem to differ much as regards size of their respective seeds, yet in the matter of foliage there is great resemblance between them. In this latter respect they differ considerably from the ordinary coffee plant of Ceylon, their leaves being a good deal larger, more firm in texture, and tapering more gradually to the base.'"

The increased cultivation of coffee, and the introduction of varieties better suited to resist the attacks of disease, has, it appears, attracted the attention not only of the British Government, but also of the Colonial Governments, so that a good deal of correspondence has arisen with Kew on the subject. Dr. Hooker says: "My attention has in consequence been directed (1) to obtaining accurate reports as to the nature of the disease, of which several are confounded under one common epithet; (2) to recommending measures for the cultivation of coffee in colonies once famous for its production where it has been almost abandoned, as well as in others where the cultivation has been scarcely attempted; and (3) to the cultivation of new and improved varieties."

The Blue Gum Tree (*Eucalyptus globulus*), which has now become so popular that plants some twelve or fourteen feet high may be seen growing in the open air in some of our London parks, is recommended for planting by Dr. Hooker, simply on account of its quick growth and its value as a timber tree, the wood being exceedingly hard and durable. With regard to its supposed beneficial effects in malarious districts, Dr. Hooker says he is "still unable to endorse the views of those who regard the tree as capable of cultivation in tropical swamps and as a prophylactic against ague and fever."

The prospects of the Ipecacuanha cultivation in India is, we are told, not very encouraging, owing rather to the slow growth and small yield of the underground root stock from which the drug is obtained, than to the want of success in growing and propagating the plants. "Nevertheless the cultivation must be persevered in. The causes that retard the progress of this valuable herb under cultivation are those that raise the price of it in its native country. Were it a plant that increased rapidly, it would be with difficulty eradicated from the forests which it inhabits."

One very important matter mentioned in the report is that referring to the new Herbarium, the site for which is not yet, however, determined upon. It is, moreover, satisfactory to learn that when erected it will, through the liberality of Thomas Philip Jodrell, Esq., M.A., the founder of the Jodrell Professorship (of Physiology) in University College, London, be associated with a laboratory for physiological botany. The contributions to the Gardens of living plants and seeds, to the Herbarium of dried plants, and to the museums of economic specimens, have been exceedingly numerous and interesting.

NOTES

M. JANSSEN's appointment as the head of a new French Physical Observatory, which we intimated some time ago, has been gazetted. The French Government, we believe, wishes to give M. Janssen the choice of having the Observatory built at Fontenay, as was originally decided upon, or at Vincennes, which is at a less distance from Paris.

MR. WATSON, at Monday's sitting of the French Academy, read a long and interesting paper on the observations of the Transit of Venus made at Peking station, of which he was the chief. The question of the atmosphere of Venus and the difficulty of determining the exact time of real contact were examined at full length. M. Leverrier expressed his decided opinion that the determination of the parallax of the sun by this method was useless unless some unexpected service should be rendered by photography for solving the difficulty raised by Mr. Watson. Mr. Watson tried to discover to what height the atmosphere of Venus was liable to cause optical disturbances by its illumination by the sun, and he found it to be fifty-five miles, about 1-70th the diameter of the planet.

THE Kirtland Summer School of Natural History (named in honour of Dr. Jared P. Kirtland) was inaugurated July 6, 1875, in Cleveland, Ohio (U.S.) The session this year extended through five weeks, closing August 9, with appropriate exercises. The school was founded on behalf of the Kirtland Society of Natural Sciences, by Prof. Theo. B. Comstock and Dr. Wm. K. Brooks. Instruction was given in botany and entomology by Prof. Theo. B. Comstock, of Cleveland; in general invertebrate zoology by Dr. Wm. K. Brooks, of Cambridge, Mass.; in microscopy and protozoa by Prof. Albert H. Tuttle, of the Ohio Agricultural and Mechanical College, Columbus, Ohio; and a short course of lectures on geology was given by Dr. J. S. Newberry, of Columbia College, New York City, Director of the Ohio Geological Survey. The work was all done in the laboratory and in the field, text-books being wholly discarded. Twenty-five enthusiastic pupils, many of them lady teachers, availed themselves of the advantages afforded for the small fee of ten dollars. The expenses were paid by a subscription fund, the instructors receiving but slight compensation by a division of the small balance in hand. The session was very profitable, and it is hoped that the school will be continued year after year.

THE French Department of the International Maritime Exhibition contains a large number of apparatus intended for the raising of wrecks from the bottom of the sea. Working models of these have been sent in by M. Bazin, an engineer. This inventor has organised an immense submarine observatory which enables the bottom of the sea to be inspected with perfect security. M. Roselli, an Italian engineer, exhibited a self-moving gigantic grapnel, which being worked by steam could render great service to raise even such heavy weights as the *Vanguard*. M. Bazin has also invented a ship for dredging at small depths when it is necessary to open a channel for a port. Several ships of this kind have been constructed for the Russian Government, and are now at work in Russian waters. The principle involves the use of syphons, which are let down to the bottom and are so worked as to send mud, sand, and water into the main hold of the vessel, from which they are taken out by powerful steam-engines.

A UNIVERSITY is to be founded at Tomsk, one of the chief towns of Siberia. The new establishment will have only two faculties, one of Law and the other of Medicine. The want of doctors in Siberia may be inferred from the fact that there are only fifty-five of them in a country which is as large as the whole of Europe, and whose population amounts to more than 6,000,000 inhabitants. The Russian Minister of Finance has granted a credit of 40,000*l*. on the revenue of the State for the new establishment, which will raise the number of Russian Universities to eight, seven others being already in existence, viz., St. Petersburg, Moscow, Kiew, Kazan, Kharkow, Odessa, Varsovie, besides two foreign Universities—a German one in Dorpat, and a Swedish one in Helsingfors. A new University is also to be established in Vilna.

CAPTAIN WATERHOUSE writes that he has verified Dr. Vogel's discovery of the influence of certain dyes in increasing the sensitiveness of bromide of silver to the less refrangible rays of the spectrum.

AN examination will begin at Merton College on Tuesday, October 12, for the purpose of electing to one Mathematical and one Physical Science Postmastership. The postmasterships are of the annual value of 80*l*., and are tenable for five years from election, or so long as the holder does not accept any appointment incompatible with the pursuance of the full course of University studies. After two years of residence the College will raise by a sum not exceeding 20*l*. per annum the postmasterships of such postmasters as shall be recommended by the tutors for their character, industry, and ability. Further information may be obtained from the Mathematical and Physical Science Tutors.

MR. E. J. MILLS, D.Sc., F.R.S., has been appointed Young Professor of Technical Chemistry in Anderson's College, Glasgow, on the resignation of Prof. Gustav Bischof.

WE would direct the attention of zoologists to a sketch and description by Prof. Wilder, of Cornell University, in the *American Journal of Science and Art* for last month, of a fœtal Manatee whose total length is 3·7 inches. "The head (which is somewhat pig-like) is strongly flexed upon the chest, and the tail forms a right angle with the trunk;" a contour very different from the adult animal being the result. The specimen was obtained at Pebos, Peru, upon the Marañon, a tributary of the Amazons, by Prof. James Orton.

IN a letter to yesterday's *Times*, Mr. W. L. Watts gives a long description of a volcanic eruption which he witnessed last month on the Myvatns Orœfi, in Iceland.

THE Berlin Geographical Society has received a telegram from Lisbon, dated the 11th inst., announcing that Dr. Pogge and Lieut. Lux, with their African Exploring Expedition, were on their way from Cassandje to Lunda. Major von Homeyer was still on the coast.

SOME of our readers may be glad to learn that the *Philosophical Magazine* for the present month contains, in full, Mr Croll's paper on "The *Challenger* Crucial Test of the Wind and Gravitation Theories of Oceanic Circulation," read before the British Association.

THE second number of Mr. Flemming's *Veterinary Journal* maintains its promised standard of excellence. The original articles are instructive, and the manner in which the most recent home and foreign investigations are placed before the reader will add greatly to the facilities for acquiring advanced information. We would direct special attention to the translation, from the German, of Prof. Siedamgrotzky's observations on the Thermometry of the Domesticated Animals.

A NEW American fossil Crustacean from the Water Lime Group, named by its discoverers, Mr. A. R. Grote and Mr. W. H. Pitt, *Eusarcus scorpionis*, is described and illustrated by an excellent photograph in the last number of the *Bulletin of the Buffalo Society of Natural Science*. It is allied to *Eurypterus* and *Pterogotus*, but is peculiar in the narrowness of the cephalo-thoracic portion, and the sudden constriction of the terminal segments.

MR. WILLIAM LONGMAN has reprinted in a separate form his interesting article in the August number of *Fraser's Magazine*, "Impressions of Madeira," containing some interesting notes on the natural history, scenery, climate, and life of the island. A good map accompanies the paper.

THE Report of the Council of the Leicester Literary and Philosophical Society speaks hopefully of its position and prospects. The Society is now in its fortieth year, has more than 250 members, and is regarded as "the leading institution for the cultivation of literary and scientific tastes" in the town and county. The Society has resolved to commence the publication of Transactions by bringing out gradually a brief but complete history of the proceedings of the Society from the date of its formation. In speaking of the decreasing attendance on the lectures by eminent outsiders, the Report gives a hint to scientific lecturers which we reproduce here for the sake of those whom it may concern:—"It must be acknowledged that the professors have sometimes relied too much upon their reputation, and given to a critical audience mere badly arranged notes, or information which any handbook would supply. And it is not too much to say that the quality of the lectures delivered gratuitously by the Society's own members and friends is of such a character that the advantage on the side of the professors is not always very striking." We hope the Society will go on with increased vigour when it enters upon its new premises, and especially that the various sections will set themselves to organise really valuable practical work.

FROM the Third Report of the Leicester Town Museum, we notice that several important additions have been made during the year, and that the Committee are in earnest to make the collection serve a really educational purpose. We hope that when the new premises are ready and the Museum transferred, that it, like the Leicester Society, will take a decided step forward. We are glad to see that the gratuitous lectures in connection with the Museum have been fairly well attended.

WE have received the Fifty-fourth Annual Report of the Board of Direction of the Mercantile Library Association of New York. This library is the fourth largest in the United States, and contains upwards of 155,000 volumes, with a membership of upwards of 8,000. The library seems to be well administered and to serve a very useful purpose, and, to judge from the report of books added during the past year, contains a fair amount of scientific literature.

FROM the Forty-first Annual Report of the York School Natural History, Literary, and Polytechnic Society, we are glad to see that the first-named branch obtains a fair amount of attention.

THE night of July 7–8, 1875, will be long remembered in Switzerland for the thunderstorms, several of them of almost unexampled severity, which occurred in Val de Travers, Liestal, Lucerne, Argovie, Zurich, and St. Gall (Rapperswyl), Langenthal, Grisons, Valais, Fribourg, and Geneva. Of these, the thunderstorm which broke over Geneva was unprecedentedly severe and disastrous. A detailed account of the phenomenon has been sent us under the title "L'Orage du 7 au 8 Juillet, 1875. Extrait du *Journal de Genève*, du 9 au 12 Juillet." It appears to have originated to westward in the department of Ain, and took an easterly course up the valley of the Rhone to Geneva, on reaching which it spread over a wider area, and thence directed its course over Savoy. As midnight came on, though the heat was suffocating and not a breath of wind stirred below on the streets, light objects on the roofs of the houses began to be whirled about and carried off as by a tempest of wind. At the same time a dull rumbling sound, resembling neither that of wind nor that of thunder, announced the approach of the thunderstorm, and at 12 midnight exactly it burst over Geneva in all its fury. An avalanche of enormous hailstones with no trace of rain was precipitated from the sky, and shot against opposing objects by a tempest of wind from the south-west. In a moment the street lamps were extinguished, and in a brief interval incredible damage was inflicted, the glass and tiles of houses smashed to powder, trees stripped of their bark on the side facing the west, and crops of every sort were in many places all but totally destroyed. The smallest of the hailstones were the size of hazel-nuts, many were as large as walnuts and chestnuts, and some even as large as a hen's egg. Some of the hailstones measured four inches in diameter, and six hours after they fell weighed upwards of 300 grammes. For the most part the hailstones were of a flattish or lenticular form, with a central nucleus of 0·16 to 0·40 inch diameter, enveloped in several concentric layers of ice, generally from 6 to 8, alternately transparent and opaque. An interesting map accompanies the description, showing the districts where the storm was felt as well as the degree of its intensity in each locality. The electrical phenomena were very remarkable; the flashes of lightning succeeded each with so great rapidity from midnight till a few minutes after 1 o'clock in the morning, that a mean of from 2 to 3 were counted each second, or from 8,000 to 10,000 per hour. Electrical phosphorescence was remarkably intense before and during the hail. The ground, animals, prominent objects, as well as the hailstones, were strongly phosphorescent. Immediately after the hail, ozone was greatly developed, the smell being so pronounced as to be compared by nearly all observers to garlic. The incessant electrical discharges passed from cloud to cloud over a central point from which the hail fell, but thunder was very rarely heard.

THE additions to the Zoological Society's Gardens during the past week include a Syrian Fennec Fox (*Canis famelicus*) from Persia, presented by Mr. Edwyn Sandy Dawes; two Glaucous Gulls (*Larus glaucus*) from Greenland, presented by Capt. Loftus F. Jones; two Fork-tailed Jungle Fowl (*Gallus varius*) from Java, presented by Mr. W. Fraser; a Royal Python (*Python regius*) from West Africa, presented by Capt. H. T. M. Cooper; a Dotterell (*Charadrius morinellus*), European, presented by Dr. C. R. Bree; a Weeper Capuchin (*Cebus capucinus*), a Golden-crowned Conure (*Conurus aureus*) from South-East Brazil, eleven Blackish Sternotheres (*Sternothœrus subniger*) from Madagascar, deposited; a Malabar Parrakeet (*Palæornis columboides*) from South India, a Blue-crowned Conure (*Conurus hæmorrhous*) from Brazil, two Burrowing Owls (*Pholeoptynx cuniculata*) from America, purchased.

SCIENTIFIC SERIALS

THE *American Journal of Science and Arts*, August.—The article on the observation of the corona and red prominences of the sun, by E. S. Holden, we have already reprinted. The other original articles are :—A note on Walker's Statistical Atlas of the United States, prepared by order of Congress. This is based on the census of 1870. Formerly the results of a census have been given in numerical form only; now much information is set forth in ingeniously contrived maps, of which there are sixty-five. Ten of the maps are prepared from data not derived from census returns, but which are of especial interest in such a work. The work is divided into three parts, the first relating to physical features of the United States. The relations of some of these maps to each other are very instructive. For instance, the relation between woodlands and rainfall and other climatic conditions has of late been the subject of much dogmatic theorising. A comparison of these maps shows that the forests of Washington Territory are in regions having an annual rainfall of sixty inches and upward. The magnificent forests found from Minnesota to Maine are in regions of twenty-eight to forty inches, a rainfall precisely identical with that of the nearly treeless prairies which extend westward from Chicago. The northern part of the Michigan peninsula with its heavy timber is marked with precisely the same rainfall as large portions of Southern Minnesota lying in the same latitude and nearly treeless. In the second section the interesting question of the "centre of population" is discussed. In 1790 it was about twenty-three miles east of Baltimore. It has travelled westward, keeping curiously to the 39th degree of latitude, never getting more than twenty miles north nor two miles south of it. In the eighty years it has travelled only 400 miles, and is still found nearly fifty miles eastward of Cincinnati.—On the chondrodite from the Tilly-Foster Iron Mine, by E. G. Dana. The chondrodite forms the gangue of the magnetite, being everywhere disseminated through it in varying proportions; it is identical with humite in chemical composition, and alike in crystalline form. The humite crystals are of three types, but until now the correspondence of the minerals has been known only for the second type. The Tilly-Foster mine affords crystals of all three types, and the comparisons between humite and chondrodite form the subject of this long article.—On an easy method of producing di- and tri-nitrophenetol, by P. T. Austen.—On a fœtal Manatee and Cetacean, with remarks on the affinities and ancestry of the Sirenia, by Prof. B. G. Wilder. There is added a list of writers on the subject.—On tidal waves and currents along portions of the Atlantic coast of the United States, by J. E. Hilgard.—On ancient glaciers of the Sierra Nevada, by Prof. Joseph Le Conte. The paper consists of a description of Fallen Leaf Lake Glacier, Cascade Lake Glacier, and Emerald Bay Glacier, a map of which district is given. Among the questions of a general nature discussed are :—Evidences of the existence of the great Lake Valley Glacier; Origin of Lake Tahoe; Passage of Slate into Granite; Glacial Deltas; Parallel Moraines; and Glacial Erosion.—Certain methyl and benzyl compounds containing selenium, by C. Loring Jackson.—Description of the Nash County meteorite which fell in May 1874, by J. Lawrance Smith.

Reale Istituto Lombardo, Rendiconti (vol. 8, fasc. xv.)—From this part we note the following papers :—On a supposed reform of the theory of electrostatic induction (second paper), by G. Cantoni.—On preventative measures against Phylloxera, by V. Trevisan.—On the intersections of a cone by a plane curve of the fourth order, by G. Jung.—On the central nucleus, and on the curves of resistance to rotation, through the flexion of transversal sections of prisms, by Antonio Sayno.

THE *Archives des Sciences Physiques et Naturelles* (No. 210, June 15) contains an elaborate review of M. Becquerel's work just published, "Des Forces physico-chimiques et de leur interprétation dans la production des phénomènes naturels."—A note by M. Hermann Fol, on the first origin of sexual products.—On the viscosity of saline solutions, by M. Ad. Sprung; the author first considers the influence of temperature, and then describes the relation existing between the velocity of effluence of a salt and its chemical composition.—A letter from M. E. Liais, dated Rio Janeiro, May 1st, 1875, and relating to the next oppositions of Mars with regard to the determination of the sun's parallax; and on the remarkable coincidence of the parallax obtained in 1860, with the new measurement of the velocity of light by M. Cornu.—On the determination of the sun's paraliax by observations of the planet Flora, by M. Galle.

Poggendorff's Annalen der Physik und Chemie, No. 7 (1875).—This part contains the following papers :—On friction and conducting of heat in rarefied gases, by A. Kundt and E. Warburg.—Spectral analytical researches, by R. Bunsen (second paper.) This paper treats of spark spectra, flame spectra, and absorption spectra of elements, and is accompanied by several tables.—On the diathermancy of moist air, by J. L. Hoorweg.—On the experimental determination of the dielectricity constant of some gases, by L. Boltzmann.—On crystallisation products in ordinary glass, by Dr. Otto Schott.—On the penetration of gases through thin layers of liquids, by Dr. Franz Exner.—On a simple method to compare two sounding columns of air by means of sensitive flames, by Dr. Bresina.—An experiment on the electro-dynamical effect of the current of polarisation, by N. Schiller and R. Colley, of Moscow.—On a peculiar case of magnetisation, by J. Jannin (translated from the *Comptes Rendus*).—On the magnetic properties of iron prepared by electrolysis, by W. Beetz.—Spectro-electric tube or fulgurator, an apparatus serving for the observation of spectra of metallic solutions, by MM. B. Delachanal and A. Memet.—A reply by Dr. K. Heumann to Herr R. Schneider's remarks on the decomposition of cuprous sulphide by nitrate of silver.—On the sudden breaking of glasses, by Ed. Hagenbach.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Sept. 6.—M. Frémy in the chair.—The following papers were read :—On the application of a new theorem of the calculus of probability, by M. Bienaymé.—Researches on the cold bands in dark spectra, by MM. P. Desains and Aymonet.—Eleventh note on the electric conductibility of bodies which are known to be only indifferent conductors, by M. Th. du Moncel.—Results from palæontological researches at Durfort (Gard), by M. P. Cazalis de Fondouce, made for the Museum of Natural History, by M. P. Gervais.—New nautical charts of meteorology, giving both direction and intensity of probable winds, by M. Brault.—On the superficial radiations of the sun, by Mr. S. P. Langley—Observations of the August meteors in 1875 by M. C. Wolf.—A note on Bernouilli's numbers, by M. E. Catalan.—On the larva forms of Bryozoa, by M. J. Barrois.—On two thunderstorms with hail observed on July 7 and 8, in some parts of Switzerland and the South of France, by M. Colladon.

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ERRATUM.—P. 404, Col. 2, delete line 55.