THURSDAY, JULY 16, 1896.

THE ZOOLOGICAL RESULTS OF THE HORN SCIENTIFIC EXPEDITION TO CENTRAL AUSTRALIA.

Report on the Work of the Horn Scientific Expedition to Central Australia. Part ii. Zoology. 4to, pp. 431, plates 29. (London: Dulau. Melbourne: Melville, 1896.)

IT is becoming quite the fashion, we are glad to say, nowadays for private individuals who possess the necessary means, to send out scientific expeditions at their own cost. This laudable practice has long been prevalent in the United States, where, many years ago, the expense of Louis Agassiz's journey to South America was borne by a friend interested in science. In England we have at present the "Jackson-Harmsworth Expedition" to Franz-Josef Land generously sustained by Mr. Harmsworth; and other examples of similar munificence are well known. Our more advanced colonies are now following these excellent precedents, and the entire cost of the successful expedition into Central Australia, of which some of the results are now before us, has been borne by Mr. William Austin Horn, of Adelaide, who, we believe, also devised the plan of it. But not only was the plan Australian and the means to carry it out provided in Australia, but the members of the expedition were Australian, the results have been worked out in Australia by Australians, and the reports on the results printed, illustrated, and published in Australia. Australia may therefore be well proud of the Horn Expedition, and thankful to Mr. Horn for having projected it and carried it out.

It having been suggested by scientific men that in the last geological epoch, when the rest of the continent was submerged, the MacDonnell Ranges in Central Australia existed as an island, and that, consequently, older forms of life might still be found in their more inaccessible parts, Mr. Horn determined to try and solve this question in a practical manner. His proposal was received with great favour all over Australia, and Mr. Horn was fortunate enough to secure the services of Prof. Spencer of Melbourne, Mr. Watt of Sydney, and Prof. Tate and Dr. Stirling of Adelaide to carry it out. Mr. Winnecke was selected as surveyor and meteorologist. The party, completely equipped and accompanied by camel-drivers, collectors, prospectors, and others—sixteen in all, with twenty-six camels and two horses—left Oodnadatta, the northern terminus of the railway from Adelaide, on May 6, 1894. Mr. Horn himself escorted them to a point 1000 miles north of Adelaide. Here he left them to proceed into the recesses of the "Eremian region," where they devoted about three months to their explorations. The greater part of this time was spent in what is termed the "Larapintine" district, where the MacDonnell Ranges run up to an altitude of 5000 feet, and are drained by the Finke River, of which the native name is the Larapinta. We will now proceed to examine the results arrived at from the study of the zoological collections made by the expedition in this district.

The volume before us contains articles on the Mammals, Amphibians and Crustaceans, by Prof. Spencer; on the Birds, by Mr. North; on the Reptiles, by Messrs. Lucas and Frost; on the Fishes, by Mr. Zietz; and on the Molluscs, by Prof. Tate. Various leading groups of Insects are reported on by Mr. Lower, the Rev. T. Blackburn, Mr. Tepper, Mr. Sloane, and Mr. Froggatt. Mr. H. R. Hogg writes on the Spiders, and Mr. Waite specially on the difficult group of Mice (Muridæ). There are some additions made in an appendix.

From Prof. Spencer's report on the Mammals we learn that examples of twenty-six species, representing all the five orders of Mammals met with elsewhere in Australia, were secured, of which the Marsupials were naturally the most numerous, twelve of the species being referable to this group. Four of these are assigned to new specific forms, which Prof. Spencer has named *Phascologale macdonnellensis*, *Sminthopsis larapinta*, *S. psammophilus*, and *Dasyuroides byrnei*. The so-called "Marsupial Mole" (*Notoryctes typhlops*) is the single representative of the only family of Marsupials confined exclusively to the "Eremian region." This little animal is still extremely rare and difficult to obtain, but more than forty specimens have passed through Prof. Spencer's hands, and some interesting details are given about it. Dr. Stirling, its original discoverer, and Prof. Spencer are now engaged upon an investigation of its teeth, fur, and reproductive organs.

As regards the latter, Prof. Spencer has already come to the conclusion that *Notoryctes* is "merely a Marsupial modified so as to adopt the burrowing habits," and is "in no manner whatever an intermediate form between Monotremes and Marsupials."

The bird skins obtained during the Horn Expedition by Mr. G. A. Keartland are reported upon by Mr. North, the ornithologist of the Australian Museum, Sydney. They are referred to seventy-eight species, amongst which are five novelties already described in *The Ibis* for 1895. Mr. Keartland's useful field-notes are given, as also his remarks on twenty-two other species observed, but of which no specimens were obtained. As a rule, the species belong to well-known Australian genera. One of the most remarkable is the Alexandrine Parrakeet (*Polytelis alexandræ*), described by Gould in 1863, of which little, however, was known until recently. This beautiful bird appears to be a characteristic inhabitant of the Eremian district, and was met with in abundance at Glen Edith. Mr. North has made a new genus of it—*Spathopterus*—which appears to be quite unnecessary. We may add that living specimens of it, of both sexes, are now to be seen in the Zoological Society's parrot-house.

The Reptiles of the Horn Expedition consist of Lizards and Snakes. The former are referred by Messrs. Lucas and Frost to forty species, amongst which, however, are counted some specimens obtained by Prof. Spencer during a second visit to the same district in the winter of 1895. In the dry and hot interior of Australia, Lacertine life is, as was to be expected, abundant, both in individuals and in species, and eight forms are described by the authors as new and characteristic of the Eremian district. The Geckos, Agamids, and Skinks are the prevailing families here, as in the rest of Australia. Besides these no less than six species of

Varanus were met with, of which two are believed to be previously unrecognised. The remarkably ugly *Moloch horridus* was met with "in the open, during the day," throughout the expedition. The Snakes were not so numerous as the Lizards, but *Hornea pulchella*, a new genus and species of Elapidæ, was amongst the discoveries.

It would hardly be supposed that Central Australia would be a likely place for Amphibians, but wherever there were water-holes frogs were found in fair numbers, and Prof. Spencer gives us some very interesting remarks on them. Almost all of them belonged to two species—*Hyla rubella* and *Limnodynastes ornatus*. On visiting Charlotte Waters immediately after a heavy rainfall, Prof. Spencer found the "creeks and clay-pans swarming with frogs." As the waters dry up, the frogs disappear in their burrows, and remain hidden until rain comes again. Certain species of them (*Chiroleptes platycephalus* and others) gorge themselves with water before they go into their retreats, and in times of drought the natives dig them out and secure water enough from their bodies to satisfy thirst. Prof. Spencer gives a figure (Pl. xiv., Fig. 9) of a specimen of the above-named species with its "body swollen out with water."

As the frogs, so the fishes of the Eremian district hide themselves in the deeper water-holes, but they are not known to burrow. Examples of seven species were obtained, five of which, representing four genera, are new to science, and are described as such by Mr. Zietz.

Prof. Tate, one of the members of the expedition, himself describes the Mollusca. Before the advent of the party, the published information respecting the land-shells of this region was limited to three species, which number is now increased to twenty-five—nearly all of them new to science. The facies of this part of the Fauna approximates rather to that of West Australia, than to any other part of the continent.

"The limited number of genera represented, together with the facts of their distribution, seem to indicate a primitive population which has been maintained in isolation by climatic and geological changes."

One genus (the Central-Australian Mollusca) was previously known only from New Caledonia. Mr. Hedley adds to Prof. Tate's article notes on the anatomical structure of some of the species.

For an account of the Crustacea of the Horn Expedition, we are again indebted to Prof. Spencer, who remarks that the rate of growth of some of the species must be very great. Not more than two weeks after rain had first fallen, and probably in only a few days, numberless specimens of an *Apus*, measuring from two to three inches in length, were swimming about in the water-holes, whereas before the rainfall not a single one could be found. Ten species of Crustacea in all were met with, *Estheria packardi* being the most widely distributed; whilst two (*Limnadopsis squirei* and *L. tatei*) are, so far as is yet known, confined to the central region.

We need not go deeply into the various groups of insects which are the subjects of most of the remaining pages of the volume. Butterflies are rare in Central Australia, and examples of only five (already known) species were met with, and of moths specimens of only about fifteen species were captured. On the other hand, 800 specimens of Coleoptera, representing 145 species, were obtained, and of these sixty-two are new, and four of them belong to new genera. The Coleoptera were worked out by the Rev. T. Blackburn, of the South Australian Museum, except the Carabidæ, which Mr. Sloane undertook. Mr. J. G. O. Tepper informs us that the Orthoptera brought back by the expedition present few novelties, but that the knowledge acquired as to the distribution of the species is valuable. As regards the Formicidæ, a special essay is contributed by Mr. Froggatt on the Honey-ants. It is perhaps little known, except amongst professed entomologists, that certain species of this group have adopted the curious plan of "turning some of their fellows into animated honey-pots." Instead of placing honey in a comb as the busy bees do, the ants select a certain number of workers, and disgorge the honey obtained from the Eucalypti (on which it is deposited by Coccidæ and other insects) into the throats of their victims. The process being continually repeated, causes the stomachs of these workers to be distended to an enormous size. This extraordinary habit was first discovered in the case of certain ants in Mexico, and subsequently shown by Mr. M'Cook to prevail also in Colorado. It has been found to exist in Australia also, and Mr. Froggatt describes and figures three ants of the genus *Camponotus* that pursue this remarkable practice. The enormous size of the abdomen thus acquired by the unfortunate worker is shown in the central figure of Plate xxvii. These ants are a favourite food of the hungry native.

To sum up, we may repeat that this volume, which is well printed on good paper and excellently illustrated, does the greatest credit to Australia and to its enterprising citizens. They may well be pleased with Mr. Horn, who has not only planned and executed this important piece of work, but has also exerted himself so successfully on a point that is too often neglected in such undertakings — that is, on having the results thoroughly well worked out, and thus made known to science all over the world.

THE WATER SUPPLY OF NEW YORK.

The Water Supply of the City of New York, 1658–1895. By Edward Wegmann, C.E. (New York: J. Wiley and Sons. London: Chapman and Hall, 1896.)

THIS work consists of a quarto volume of nearly 200 pages, with appendices and 148 plates, in addition to seventy-three figures in the text.

It was not until the year 1842 that the citizens of New York were able to celebrate the completion of their first water-works of importance. The works then constructed soon proved inadequate to the supply, and have had to be supplemented from time to time from other sources.

In view of the agitation which is now going on for improving the water supply of London, the particulars given in this book, of the various steps which have been taken for providing an adequate supply to the City of New York, are of considerable interest.

In 1875, the then source of supply being found in-

sufficient, the Department of Public Works submitted plans for new water-works. The reports on these plans were submitted by the Mayor to the Legislature. The Senate requested the Mayor to nominate five citizens who, in conjunction with himself, were to report on the best scheme to be adopted. After holding thirty-three public meetings, at which eminent engineers and citizens expressed their views with reference to the proposed works, a scheme was approved and adopted, the source of supply being the Croton River, from which the water hitherto in use has been obtained. They also advised that the works should be entrusted to "an unprejudiced Commission selected from the best citizens of the city." The Committee drew up a draft Bill embodying these recommendations, which formed the basis of "An Act to provide new reservoirs, dams, and a new aqueduct with the appurtenances thereto for the purpose of supplying the City of New York with an increased supply of pure and wholesome water," which was passed by the Legislature in 1883. An "Aqueduct Commission" was appointed, consisting of the Mayor, the Comptroller, the Commissioner of Public Works *ex officio*, and three citizens, the salary of each of the Commissioners being fixed at 8000 dollars (£1680) a year. The works carried out will be referred to later on.

The book under notice, which has been prepared by Mr. Wegmann, one of the engineers of the Water Commission, gives the history of the water-works of the City of New York from the sinking of the first public well in 1658 to the present time, and full technical details of the new works. This description cannot fail to be of interest to engineers engaged in water supply, and the great number of illustrations of the details of the construction, as showing the difference between English and American practice, are instructive, and may even give hints for the adoption of new methods of carrying out works of a similar character in this country.

Within about 300 years the population of New York has increased a thousand-fold, the number of inhabitants in 1664 being 1500, and now 1,515,301.

The first attempt at a public water supply was in 1658, when "the Burgomasters resolved to communicate with the Herr General relative to having a public well made in Heere Street," and subsequently six public wells were sunk. As the population increased, the well-water became polluted, and the inhabitants had to send to springs situated on the outskirts of the city for pure water. One of the most noted of these springs was known as the "Old Tea-water Pump," which is thus described in the diary of a traveller in 1748.

"There is no good water in the town itself, but at a little distance there is a large spring of good water, which the inhabitants take for their tea and for the uses of the kitchen. Those, however, who are less delicate on this point, make use of the water from the wells in the town, though it be very bad."

When the population had increased to 22,000, the Common Council of the city accepted a proposal of an English engineer, Christopher Colles, to construct a reservoir on Manhattan Island for supplying the city with water. The water was pumped up by one of Newcomen's atmospheric engines, and distributed through mains consisting of hollow logs. Owing, however, to the insufficiency of the supply, and the confusion caused by the Revolution, this enterprise became abandoned. The next scheme for supplying the city with water was due to an Act of the Legislature, which, under the guise of incorporating a company for supplying the city with pure water, really was for the purpose of establishing the Manhattan Bank, the company being authorised by the Act to raise a large amount of capital, and employ it "in any other moneyed transactions or operations not inconsistent with the constitution and laws of the State." Only enough was done in introducing water to maintain the charter, the real object of the incorporation being the formation of the bank, to which there had been very strong opposition. For several years after this the water supply of the city remained in a very unsatisfactory state, and numerous schemes for providing a better supply were brought forward. From documents published in 1832 it appears that the quality of the water then used did not conduce to temperance, as one of the arguments used in favour of a new supply was: "By thus supplying the inhabitants with fine pure rock water, it will remove the popular pretext for using alcohol to correct the impurities of the water now in general use, and will be the most effectual means of promoting the great and noble cause of temperance in this city." The temperance cause seemed to occupy a considerable amount of public attention at this time, as in one of the contracts made for the construction of the new water-works was a clause to the effect that the contractor should not sell or allow to be sold any ardent spirits to their workmen, or to any person near the line of the works.

In 1834 an Act was passed forming a permanent Water Commission, and providing for the raising of £325,000 for constructing water-works. The Croton River was decided on as the source of supply. This river is situated thirty-three miles from the city. The water-shed above the dam has a ridge line of 101 miles, and an area of 532 square miles. Within this area are contained thirty-one natural lakes and ponds. The length of the river is thirty-nine miles, and its minimum flow above the dam 33,804,000 gallons. The average rainfall is 42·68 inches, the minimum being 38·52 inches.

The first, or "Fountain," reservoir was formed by constructing a dam across the river six miles above its mouth. The lake is four miles long, and has a width of about a quarter of a mile. Its area is 400 acres, and storage capacity 600 million gallons. The water was conveyed to the city by a masonry aqueduct a distance of thirty-three miles. The masonry conduit is 7 feet 6 inches in diameter with upright sides, and has an area of 53·34 feet. When the water was first admitted in 1842, a boat containing four persons was placed in the current, and arrived almost simultaneously with the water at the Harlem River, the velocity of the current being at the rate of one mile in forty minutes. The mean fall of the invert is at the rate of 0·6 feet per mile. The aqueduct is capable of discharging ninety-five million gallons in twenty-four hours. The distributing reservoir, situated three miles from the city, was constructed almost entirely above ground, by means of walls thirty-six to forty-nine feet above the surface. This reservoir is 420 feet square, and has a depth of water of thirty-six feet, the capacity being twenty-four million gallons. After the works became in

full operation, no restriction being placed on the quantity used, the daily consumption amounted to seventy-eight gallons per head of the whole population, or ninety gallons for each water consumer.

From time to time the works have had to be enlarged and additional reservoirs built, until in 1875 it was determined to build a second aqueduct connected with a new reservoir to hold 1900 millions of gallons.

The new aqueduct, including a short length of pipe line, is thirty-four miles long, twenty-nine miles of which are in tunnel through gneiss rock. This aqueduct is lined throughout with masonry. The standard shape, where not under pressure, is of horseshoe section with a diameter of fourteen feet, the sectional area being equal to a circular masonry culvert having an internal diameter of fourteen feet. The available head is 33·70 feet, which is absorbed in overcoming friction through the conduit and pipes. The grade is at the rate of 0·7 feet per mile, and the velocity of the flowing water 3·27 feet per second. It is capable of discharging 300 millions of gallons in twenty-four hours.

The "Cornell" reservoir, now under construction, will contain when completed 32,000 million gallons. The central masonry dam is 600 feet long, with an earthen continuation of the same length. The maximum height of the masonry dam is 260 feet, the height above the river-bed being 159 feet, the top being 10 feet above the water-line. It is to be 18 feet wide at the top, and 185 feet at the base.

The total capacity of the conduits now supplying the city, which has a population at the present time of one and a half millions, is 425 millions of gallons. The total storage capacity of the reservoir is 75,000 millions of gallons, equal to a minimum supply in the driest years of 280 millions of gallons.

Mr. Wegmann's book is almost entirely of an historical and descriptive character, and is confined entirely to the works carried out for the water supply of New York. The details of these various works are, however, so copiously illustrated that they give the book an eminently practical character, which renders it of value to any engineer engaged in water-works construction.

A NEW CHEMICAL DICTIONARY.

A Dictionary of Chemical Solubilities. Inorganic. By Arthur Messinger Comey, Ph.D. Pp. xx + 515. (London: Macmillan and Co., Ltd., 1896.)

THIS is a book about which it is impossible to get up any feeling of enthusiasm; but one cannot resist a sense of wonder and admiration at the patient, plodding spirit in which the compiler must have set about his weary task, and carried it on through months or years of labour to the dreary end. Of course he is an American. In no other nation of the earth using or abusing the English tongue would a man have been found to undertake such an enterprise; but why the busy, rushing life of that great country across the Atlantic should breed so many compilers of catalogues and bibliographies and indexes, especially of physical science, of books which Charles Lamb would have called no books, *biblia a-biblia*, it seems hard to say. The world ought to feel grateful to them, but usually it does not. It often uses such cyclopædias, though ready enough to grumble if it finds them less than perfect. In this volume the only smack of literary flavour is to be found in the preface, wherein the extract from "Peter Shaw's Chemical Lectures, publickly read at London in 1731 and 1732," shows that the plan of such a book was foreshadowed long before its accomplishment. For, according to the author, the first work that undertook to carry out the idea in its entirety was produced by Prof. F. H. Storer in 1864. All chemists are familiar with Storer's "First Outlines of a Dictionary of Solubilities of Chemical Substances," though long since out of print. It will at once be noticed that there is an important difference in the titles of the two works. Dr. Comey is, however, justified in using the expression "chemical solubilities," inasmuch as he does not confine his work to data concerning solutions in water and alcohol or other neutral solvents, but includes the action, for example, of acids upon metals, and the effects of various liquids, such as solutions of potash and aqueous acids. Moreover, certain physical facts are mentioned, such as changes of temperature on dilution, also any data obtainable regarding the boiling-points of solutions, and tables giving the specific gravities of aqueous solutions.

After all, the more modest title—"First Outlines"—adopted by Storer, seems to assume quite enough; for the materials for such a work amount at present to little more than a most miscellaneous collection of more or less inaccurate estimations of solubilities, without any clue as to the cause of solubility, and theories as to the condition of the dissolved substance still in conflict. This, however, has not deterred the compiler, who, on the whole, has done his work carefully and well. It would, perhaps, help the users—we can hardly speak of readers—of the Dictionary if in a future edition the general statements were somewhat amplified, and gathered together into an introductory chapter apart from the alphabetical array of details concerning particular cases. For example, it is obvious in regard to salts that the solubility in water is determined more by the nature of the negative radicle than of the metal. We can say truly that all nitrates are soluble in water except a few basic compounds, but we cannot predicate anything general concerning the solubility of the compounds, say, of lead. Some of these broad statements are given in the Dictionary, but they might be extended with advantage. A classification of the metals according to the action of water and of acids upon them might be given; it might also be worth while to state what is known of the colours of dissolved inorganic substances, concerning which there are some very curious facts which probably have an important significance could we only find the clue to their explanation.

From what has been said, it is obvious that this volume contains a mass of information brought together from a great variety of sources. It will certainly be found useful not only in the chemical laboratory, but also by the manufacturer and practical man to whom time is money. It may therefore be fairly described as one of those books which no chemist's library should be without.

OUR BOOK SHELF.

A Concise Handbook of British Birds. By H. Kirke Swann. Pp. 210. (London: John Wheldon and Co., 1896.)

THIS is a handy and serviceable reference book on British birds. It includes descriptions of the characteristics, distribution, and habits of every species on the British list, and the information, though brief, is generally sufficient for identification. The classification and nomenclature followed is practically that of the British Ornithologists' Union. The specific names of first describers are, however, adopted, and sub-species or races are distinguished by sub-numbers and trinominals. Ornithologists, and bird-lovers generally, will find Mr. Swann's book of practical value in the field, and very useful for ready reference in the study.

Practical Radiography. By H. Snowden Ward; with Chapters by E. A. Robins and A. E. Livermore. Pp. 80. (The Photogram, Ltd., 1896)

THERE may be persons who furnish themselves with an outfit for Röntgen photography without having a knowledge of either electricity or photography. For such individuals, possessing aspirations without education in physical principles, this book has been written. The history of kathode rays and Röntgen's discovery occupies seven pages of the book. There is a chapter on the manufacture of an accumulator, and another describing how to make an induction coil. The remaining five chapters are taken up with descriptions of the apparatus and methods of Röntgen photography.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Are Specific Characters useful?

WITH the above title Mr. Alfred Russel Wallace brought before the Linnean Society on June 18 an important communication, which derived additional interest from the fact that he himself was present in full health and vigour, as well as from the presence of a large number of naturalists who have given attention to the questions arising from the consideration of the theory of the origin of species by natural selection.

In the course of the remarks which were offered by his audience at the conclusion of Mr. Wallace's paper, I ventured to point out that the consideration of the class of phenomena which Mr. Darwin had described under the title "correlation of variation," seemed to me to lead necessarily to the conclusion that very often characters which are obvious and distinctive marks of species may be not useful but useless, since such obvious species marks may be only superficial and non-significant phenomena "correlated" (as Mr. Darwin used that term) with other less obvious but really important life-saving peculiarities, which might quite well escape the observation of the describer of "specific characters." As instances of the phenomenon of "correlation," I referred to those cited by Mr. Darwin, such as the concomitance of a development of feathers on the feet with the webbing of the toes in certain breeds of pigeons, the concomitance of abnormal dentition with hairlessness of the body-surface in Chinese dogs, the concomitance of deafness with blue eyes in male white cats. A case which seemed to me most striking and suggestive in connection with the utility of specific characters was cited by me. It was that which had led Wells to propound a doctrine of "natural selection" many years before Darwin and Wallace had placed their views in 1858 before the Linnean Society—a case which Mr. Darwin cited in later editions of the "Origin of Species," and is familiar enough. Wells pointed out in a memoir communicated to the Royal Society in 1813, that persons with dark pigment in the skin are relatively immune to tropical fevers, as compared with fair-complexioned individuals. He argued that owing to this property of dark-skinned varieties of men, there would be a survival selection in tropical regions of such varieties, and that probably, or at any rate possibly, in this manner the black colour of tropical races might be accounted for. I mention this more or less hypothetical case as showing that an obvious and striking character, namely, that of black pigment in the skin, might become predominant, and conceivably might become a "specific character," although the blackness was not in itself a "useful," that is, a "life-preserving or progeny-ensuring" character, but merely the *accompaniment* of a power of resisting malarial germs, which we now have reason to believe consists in a special chemical activity of the leucocytes (phagocytes) of the blood and other tissues. From the consideration of this and other similar cases, I argued that many "specific characters" (that is to say, as defined by Mr. Wallace, characters which individually or in definite association with other characters constantly occur in one species and not in the other species of a genus) must be devoid of utility themselves, and appear merely as the "correlatives" or "concomitants" of really effective life-preserving or progeny-ensuring characters. I insisted, finally, on the very great importance of the correlation of parts in animal organisms, and the necessity of regarding animals (and presumably also plants) as most highly-wrought mechanisms in which no part can vary without the accompaniment of variation in some remote and (in our present state of knowledge) unexpectedly correlated part, and to a degree often excessive and (in our present state of knowledge) unaccountable. Thus, as Mr. Darwin himself pointed out, the selection of a given favourable variation may lead to excessive variation in a remote region of the organism, which in its turn will very often (but not necessarily always or at once) become the subject of further selection. Mr. Darwin appears to have deprecated, in conversation with Mr. Thiselton-Dyer (according to the latter's interesting statement in the debate on Mr. Wallace's paper), the invocation of this theory of "correlation" as an explanation of cases of apparently useless parts in animals or plants when under investigation, holding that our ignorance of the modes in which parts may be serviceable to an organism is so great that we should rather experiment and observe as to their possible utility than advance a theory which dismisses further inquiry. Whilst agreeing with Mr. Thiselton-Dyer as to the "immorality" (as he termed it) of a naturalist who favours theories which paralyse his activity as an observer and experimentalist (on which subject see the last paragraph of this letter), I yet think that, as seekers after true knowledge, we are bound to face the complex problem in all its aspects. The obvious character, as well as many less obvious characters, which we note as distinguishing one species from another, are not improbably, it must be admitted, in many cases concomitant phenomena of some other phenomenon which alone among them is effective in determining the preservation of the life, or the production of progeny in the case of the individuals so characterised.

At the same time I think that it may well be maintained that such secondary or concomitant characters are not long allowed to remain non-significant, and that sooner or later they fall under the moulding action of natural selection, becoming as they increase in volume either useful or injurious.

My chief object in writing this letter is to draw attention to the views of Prof. Weldon, who has for some time, as all zoologists know, been occupied in tabulating a very large series of measurements of growing crabs. When I had stated my views as to the importance of "correlation of variation," with which Mr. Meldola and Mr. Wallace subsequently expressed their complete agreement, Prof. Weldon declared, with some expressions of reluctance and regret—due, as he was good enough to say, from an old pupil to the teacher whom he is about to denounce and demolish—that to attempt to say which of two or more correlated growths is the cause of survival is unreasonable, and that when I suggested, even as a matter for consideration, that a certain germ-slaying quality in phagocytes accompanying a pigmented skin, rather than the pigment itself in the skin, is the cause of the survival of dark-skinned people in malarial regions, I was "absolutely illogical." "It is," said Prof. Weldon, "impossible logically to separate these two correlated phenomena. The coloured skin is as much a cause of the survival of the dark man as is the germ-destroying property of his blood."

I was at the time entirely unable to appreciate the drift of Prof. Weldon's thought. I was not prepared for an empty

wrangle in regard to the proper uses or improper uses of the word "cause." But I did remember that Mill says that the most vulgar form of "the fallacy of generalisation" is that which is expressed by the phrase "*post hoc* or *cum hoc, ergo propter hoc.*" I could not imagine how or why my friend Prof. Weldon had been led to make himself the defiant, not to say jubilant, champion of this fallacy. I have, on reading Prof. Weldon's paper in the *Proceedings* of the Royal Society, vol. lvii. 1894-95, found matter which throws light on the problem. It would appear that Prof. Weldon, in discussing his measurements of crabs, had already publicly adopted the logical position which so much astonished those who heard him at the Linnean Society. It appears that the fallacious process, which consists in ignoring the possibility of two concomitant phenomena being two independent consequences of one set of antecedents, gives an apparent value to the laborious measurement of crabs which, it seems, they would not possess if treated in a rational way. Prof. Weldon says (*loc. cit.*, p. 380): "It is the object of the present remarks to discuss the *effect* of small variations, as it may be deduced from the study of two organs in a single species. The case chosen is the variation, during growth and in adult life, of the dimensions of female *Carcinus mœnas.*"

Further on he speaks of "the *effect* of small variations upon the chance of survival," and in close proximity occurs this passage: "The law of growth having been ascertained, the rate of destruction may be measured, and in this way an estimate of the *advantage* or *disadvantage* of a variation may be obtained." And again: "Knowing that a given deviation from the mean character is associated with a greater or less percentage death-rate in the animals possessing it, the *importance* of such a deviation can be estimated without the necessity of inquiring how that increase or decrease in the death-rate is brought about so that all ideas of functional adaptation become unnecessary." The title of the paper drawn up by a Committee, of which Prof. Weldon is a member, and in reference to which his own paper is written, stands: "An attempt to measure the death-rate due to the *selective* destruction of Carcinus mænas *with respect to* a particular dimension."

(The italics in these citations are mine.)

It appears to me that the language which I have italicised indicates that Prof. Weldon—in his interpretation of the fact ascertained by him, viz. that crabs with a particular proportion of frontal breadth are commoner in the adult condition than in younger stages—has deliberately departed from the simple statement which his observations warranted, viz. that such-and-such a proportion of frontal measurement accompanies survival, and has unwarrantably (that is to say unreasonably) proceeded to speak of the "effect" of this frontal proportion, to declare it to be a *cause* of survival, to estimate the "advantage" and "disadvantage" of this same proportion, and finally to maintain that its "*importance*" may be estimated without troubling ourselves to inquire how it operates, *or whether indeed it is operative at all.*

Such methods of attempting to penetrate the obscurity which veils the interactions of the immensely complex bundle of phenomena which we call a crab and its environment, appear to me not merely inadequate, but in so far as they involve perversion of the meaning of accepted terms and a deliberate rejection of the method of inquiry by hypothesis and verification, injurious to the progress of knowledge. E. RAY LANKESTER.

Oxford, June 30.

Are Specific Characters the Result of "Natural Selection"?

THE last meeting—on June 18—of the Linnean Society was one of very exceptional interest, because the survivor of the two illustrious naturalists who, on the same night—more than thirty-seven years ago—first enunciated in that Society's rooms the doctrine of the origin of species by "natural selection," read a highly interesting paper on that very subject.

The title of the paper, by Dr. Alfred R. Wallace, F.R.S., however, was "The Problem of Utility: Are specific characters always or generally useful?" But the author, in treating the question, expressly took for granted (as might surely have been expected of him) the doctrine common to him and the late Mr. Darwin. So the question was implicitly answered at once; for if species arise by "natural selection," then those characters which constitute them species must be due to the same cause, *i.e.* to utility. Thus the question really raised by Dr. Wallace was the old one, "Do species arise through 'natural selection'?"

This old question having been thus again started by its oldest advocate, a few words in reply to it may be permitted to one of its oldest opponents. Not that I was always an opponent. The doctrine of Messrs. Darwin and Wallace, as advocated by the late Prof. Huxley, was held by me from 1860 onwards for several years. There was no antecedent reason why it should be unwelcome to me, and, in fact, it was not at all so. It was whilst working at Lemuroids that doubts first suggested themselves, which afterwards became, for me, certainties.

It is one of those animals—the Potto—which has a specific character, the least likely of any that I know of to have been produced by "natural" or "sexual" selection—one which I cannot believe was ever occasioned by "utility," though it may have been so by another now suggested cause. It appears to me to be an indisputable fact that in certain groups of animals there are, somehow, present, innate tendencies to development along certain lines; different degrees of the realisation of which tendencies are characteristic of different species; and this without affecting the preservation of life. Thus amongst the Lemuroids there appears to be a tendency to diminish the size of the index finger, and this tendency culminates in the Potto.

In a section of the *Marsupialia* there seems to be a similar tendency to diminish the size of two digits of the foot, though I cannot believe that life has been saved at either the initial or the extreme stages of this progressive degradation.

Our own species supplies another example similar in character. The penial bone of the lower apes is a considerable structure, but in the Anthropoids it becomes so rudimentary, that the chimpanzee was believed to have none till the late Mr. Crisp exhibited the rudimentary representative of that structure at a meeting of the Zoological Society, as I well remember. In man it has, at least normally, entirely disappeared, and yet it is impossible to suppose that its progressive disappearance has been progressively useful as regards any form of "natural selection."

The existence of a latent tendency in a group of animals seems to us peculiarly well marked in the Birds of Paradise. The exceptional abnormalities of their plumage are so different in different species, that these could never have sprang from a common origin, but must have independently arisen in different modes in different species.[1]

Dr. Wallace said: "Accessory plumes and other ornaments originate at points of great nervous and muscular excitation." But the points of origin of abnormalities of plumage in these birds are so numerous and diverse, that such local excitations seem a very inadequate cause to account for them. Yet even if they were adequate, what would account for such varied localities of excitation in this particular group of birds alone?

But Dr. Wallace affirmed that such characters were utilised "for purposes of recognition," . . . "each ornament being really a 'recognition mark,' and therefore essential to both the first production and subsequent well-being of every species."

Let us suppose that a certain group of birds (A) have begun to vary in such a way that the males have acquired incipient secondary sexual markings or growths in their plumage, and that another group of birds (B) have begun to vary so that new tints, or plumage growths, appear equally in both sexes. The change must be small at first, and, indeed, Dr. Wallace said "the transition" is an "almost imperceptible process." But what influence can, at the same time, induce the males of the group (A) to seek for females newly modified but different from themselves, and the males of the group (B) to seek for females newly modified but like themselves? Why should the slightly modified new varieties object to mate with members of the hardly different parent stock? Yet if they did not so object in a majority of cases the new variety would soon disappear. Dr. Wallace told us that such marks must have been specially needed during the earlier stages of differentiation, yet at such early stages the much-needed "recognition marks" must have been at their minimum. This innate spontaneous impulse to breed together, thus supposed to arise in members of every incipient new variety whence every new species has arisen, is surely a very mysterious impulse. No doubt Dr. Wallace has evidence that it does in fact exist; but if so, we must admit that somehow a quasi voluntary process—a psychical character—has been precaused (if we must not say pre-ordained), which is a *sine qua*

[1] I called attention to this fact in my "Genesis of Species" in 1870. Since then the discovery of new species with new abnormalities has intensified the force of the argument.

non for the origin of new species, but the origin of which character is as mysterious as the origin of a species itself!

Dr. Wallace affirmed that "no other agency" than "natural selection" has been shown as a probable cause of specific characters—and therefore of species. Possibly not. But if an asserted cause (X) has been shown to be incapable of producing a certain effect, it is no use to say: "It must be (X) because you cannot bring forward any definite (not X) as efficient to produce that effect." Surely it is enough to reply: "The cause you assert is insufficient, and we must therefore still remain in an attitude of doubt and expectancy."

Dr. Wallace, however, in his recent paper did admit that the distinctive characters of some exceptional species might not have been due to "utility" or "natural selection"; but such an admission seems to me a fatal one, for if an unknown cause may have given origin to some species, why may not such cause have been the really efficient agent in the production of all species?

But Dr. Wallace years ago made (and he has never since repudiated his act) a truly important exception to the action of "natural selection."

A survey of the organic world cannot certainly be a scientific one if the highest of animals (man) be left out of the account, nor can man be said to be scientifically treated if his highest characteristics be altogether neglected.

Dr. Wallace cannot be accused of such neglect, and therefore with a survey of the organic world thus scientifically defective. Taking account of man's highest intellectual powers, he has declared that "natural selection" must have been incompetent to produce them, and agreed with me in the conviction that they require some further and higher explanation.

A recent number of NATURE has contained a review of Prof. Weismann's paper read at Leyden. Therein, that ardent Darwinian appears to have made several notable concessions which bear upon the question treated by Dr. Wallace. One of these is that "mimicry" cannot be accounted for by accidental, individual variation; he appears to say the same concerning certain co-adjustments of instinct and structure, and he fully concedes the truth asserted by Mr. Herbert Spencer and by myself—the truth, namely, that *panmixia* cannot explain the annihilation of rudimentary organs.

He, however, reaffirms his dictum that the idea of "teleological contrivances is inadmissible in science." But why? Who can deny to reason its right to investigate truth on all sides, and affirm that which appears to be evidently true with respect to any, including vital, processes? I adhere to the pronouncement of the world-renowned John Müller: "Physiology is no true science if not in intimate union with philosophy." Once more I must urge that man and his highest intellectual powers cannot be excluded from a scheme of nature which is truly scientific. Man has intelligence, and acts more or less frequently with intelligent purpose—"teleological contrivance"—and he exists in a universe which, as a whole, can never have been submitted to the action of "natural selection." The universe, therefore, even if eternal, cannot have unreason for its cause, or any power devoid of intelligence and purpose.

I believe the indisposition to accept such truths as a part of science is largely due to our common tendency to permit the intellect to be fettered by the imagination, thus giving rise to anthropomorphic mental images, the absurdity of which is assumed also to belong to those intellectual conceptions with which they have infinitely less to do than have the signs of the zodiac with the coherence of the solar system.

Saltburn-by-the-Sea, June 29. ST. GEORGE MIVART.

"The Reminiscences of a Yorkshire Naturalist."

WHEN reading this very interesting record of my old friend and colleague (of which you gave such an excellent review in your issue of June 25), I found that, in his recollections of the days when we were both professors at the Owens College, Manchester, Dr. Williamson has been mistaken as to the details of Principal Scott's retirement. Mr. J. Holme Nicholson (late Registrar of this College) confirms my memory as to dates, and, at Mrs. Williamson's request, I ask you to kindly insert, in your forthcoming number, the following correction in her late husband's graphic account of the early struggles through which Owens College had to pass on the way to its present high position as an institution for sound instruction in natural science and original research.

At page 140 of the "Reminiscences," there occurs the following passage: "Dr. Scott's resignation (May 28, 1857) robbed Manchester of a man of rare culture, and his death a few months later is said to have taken from the world more Dantesque learning than was left behind." There are two errors in this passage: in the first place, Dr. Scott did not sever his connection with Owens College in 1857; he resigned his principalship, but not his chairs of Logic, Moral and Mental Philosophy, and of Comparative Grammar and English Language and Literature, which he continued to hold until his death. Secondly, he died on January 12, 1866, and therefore not *a few months*, but *nearly nine years* after his resignation of the principalship. Consequently, it is a mistake to infer that Manchester was robbed of his presence and the advantages of his learning in 1857.

This correction is the more important because Dr. Williamson's words, above quoted, and their context, seem to convey, I am sure quite unintentionally, the impression that Dr. Scott's death was hastened by his resignation of the principalship; whilst, on the contrary, his relief from one of his many arduous duties probably prolonged his interesting and valuable life.

E. FRANKLAND.

The Tsetse Fly.

IN the excellent review of the Tsetse fly-disease, which appeared in NATURE of April 16, Mr. Walter F. H. Blandford accepts with some reserve the observation made by Dr. David Bruce, that the fly is *viviparous* "as the fly has not yet been bred from the puparium."

I pointed out to Dr. Bruce, while he was investigating the disease, that, with the systematic arrangement of Diptera now followed, I could hardly conceive the *Glossina* being viviparous; and I suggested the possibility of another fly being taken for the Tsetse. Dr. Bruce has not only been most emphatic in his reassertion, but I have myself since bred from three puparia, sent by him for that purpose, what is most certainly *Glossinæ morsitans*, Westwood. L. PÉRINGUEY.

South African Museum, Cape Town, June 15.

MY hesitation in accepting unreservedly Dr. Bruce's account of the reproduction of *Glossina* was due to a suspicion, not that he had mistaken some other fly for it, but that the extruded larvæ might turn out to be those of a parasitic form, probably Tachinid. Mr. Péringuey's letter is most welcome as supplying the final proof of an extremely important fact, both economically and zoologically, in the insect's life-history.

There is much variety in the larval life of *Muscidæ*; and in *Stomoxys*, the genus most nearly allied to *Glossina*, the larvæ are normally scatophagous, but that of *S. calcitrans* has been occasionally found mining the leaves of burdock, coltsfoot and deadly nightshade.

Unfortunately, till proof is complete that Nagana is contracted under natural conditions from Tsetse-infection only, which is as yet far from being the case, we cannot console ourselves with the idea that the progressive extinction of African wild game must soon render the disease a thing of the past.

July 6. WALTER F. H. BLANDFORD.

The Salaries of Science Demonstrators.

I SHOULD be glad if you would allow me the opportunity of endorsing Dr. Baker's protest contained in his letter in your issue of July 2, against the totally inadequate salaries offered by University Colleges to demonstrators and assistant lecturers in science.

Taking the subject of chemistry only: on looking over the official returns for the year 1893-4, made by eight of the University Colleges participating in the Treasury grant of £15,000, it will be seen that whereas the average salary paid to the professor is over £700, that of the assistant lecturers and demonstrators is under £150, and in several cases below £100 per annum.

No one acquainted with what is required of them will maintain that the professors are overpaid, but all must admit that the remuneration of the lecturers and demonstrators is absurdly out of proportion.

Compare for a moment the work done by the two classes of teachers. The occupant of a chair of Chemistry in a University

College is too often bound down by the exigencies of examinations to the delivery of certain set lecture courses, and these, together with his own researches and the performance of the many administrative duties that fall to his lot, occupy almost the whole of his time. Let him possess the master-mind of a Hofmann, his hurried visits to his laboratory afford comparatively slight opportunity for the exercise of its full effect on the student. The demonstrator, on the contrary, bears the brunt of the difficult and harassing tutorial work in his close contact with the student in the laboratory, and upon the demonstrator's ability and manner of teaching will depend, in great measure, the student's future style of work. For this a grateful University College gives him rather less than it pays to its janitor, and much less than half the amount received by its travelling dairy-maid!

I am afraid that the cause of this very real injustice will be found, in part, in the influence of our older universities, where until recently lectures were everything and practical work was naught. Members of these universities on college councils still seem to cling to the old idea, and the majority of the remaining members, probably excellent men of business or affairs, have somewhat hazy notions of scientific educational work; the Professors, who alone of the teaching staff obtain representation on the governing body, are, after all, but human, and can scarcely be expected to labour to disabuse them.

I fear that, as a body, demonstrators and lecturers are scarcely influential enough to approach the Chancellor of the Exchequer with a view to his imposing such conditions that the renewal of the Treasury grant shall be made to depend upon the redress of their wrongs; still the injustice of their treatment is undeniable, and perhaps some of your readers can suggest a remedy.

SAVILLE SHAW.

A Solar Halo.

SHORTLY after 7 o'clock in the evening of July 2, a solar halo was observed from Putney Bridge, West London.

The appearance consisted of portions of the inner halo (22° from the sun) situated just at the same height above the horizon as the sun. The halo was of a distinct red on the inside of the circle, followed by yellow and by a faintly bluish white light on the outside. There was also a faint parhelion on the right side, just outside of the halo.

Above the sun, at a point where the vertical through the sun would have cut the circular halo, there was, instead of the latter, an inverted arch of somewhat hyperbolic shape, the arms of the hyperbola extending upwards and enclosing an angle greater than a right angle. The faint prismatic colours of this arch were placed so that the red was nearest to the sun, and the apex of the inverted arch must have been 22° distant from the sun. The height of the sun above the horizon was estimated to be about 14°, and the phenomenon lasted ten minutes after it had been first observed. The sky was somewhat cloudy.

West Kensington. H. WARTH.

An Optical Illusion.

WHILE doing some photographic work with a light from a Welsbach burner, which shone through a small ground glass window in a dark-room, I noticed that when a lamp emitting red rays from its vertical sides was placed in a position so that its top was illuminated by the white light from the window, and while in this light it was then moved by hand to and fro in a horizontal plane, the top appeared to be loose, or displaced in opposite directions to the red sides. The top was of bright tin and its surface sufficiently irregular to cast slight shadows, which rendered the effect very marked.

This illusion is no doubt due to a physiological action at the retina, in which the impression produced by the white or grey light persists longer than that from the red, causing an apparent lag of the top. The persistency may be still further accounted for when the fact is borne in mind that the lag could only be obtained with weak lights in a dark-room, and therefore with the pupil of the eye largely expanded, and in consequence a relative increase of intensity of the white over the red light upon retinal areas of different sensibility.

Lamplight or daylight can be used instead of a Welsbach. I found it convenient to vary the intensity and colour of the lights by superposing sheets of coloured tissue-papers.

New Rochelle, N.Y. F. H. LORING.

Food of Chameleons.

I DO not know whether you care to insert a modest natural history communication, for I apprehend but few of your readers are country naturalists. If you do, it is to this effect.

It is not easy to keep chameleons alive long in this country, owing to the difficulty of procuring their proper diet.

I am keeping a Madagascar one, and he thrives very well. The food he seems to prefer to all other is the common green fly with a metallic lustre; these he takes at once in preference to the finest bluebottles, and when he protrudes his curious long tongue, armed with some glutinous matter, the direction is unerring, and woe to the fly. The chameleonic colour changes are most interesting. E. L. J. RIDSDALE.

Rottingdean.

Röntgen Rays.

MANY tubes for Röntgen ray researches have the edge of the kathode mirror opposite the short neck, and in such cases the expedient described by Mr. Porter in your issue of the 18th ultimo, can very easily be carried out by fitting an india-rubber ring on this neck, winding two coils of copper wire round it, and leaving two or three inches free at one end, which is then bent so as to bring the point sufficiently near to the kathode loop.

An application of the Röntgen rays has been made in the small local museum here, which promises to make it more generally attractive and useful. Skiagrams of suitable specimens have been taken, and prints from these placed alongside the specimens, so that their external form and the bony structure which supports it may be compared at a glance.

Keith, N.B., July 3. ALEX. THURBURN.

A Curious Connection.

IF new, perhaps the following fact, observed by me, may be worth publishing. In my kitchen I have a mantle on the gas-burner. At present the mantle is in a dilapidated state, and the light defective. I find, however, that, when the water-tap over the kitchen sink is running, the light greatly increases in brilliancy, maintaining that brilliancy as long as the water is running. MARGARET MCEVOY.

THE INTERNATIONAL CATALOGUE CONFERENCE.

THE International Conference organised by the Royal Society to consider the preparation and publication of an International Catalogue of Scientific Literature was opened in the apartments of the Society at Burlington House on Tuesday. Upon the importance of such a catalogue it is unnecessary to comment here. The Royal Society has steadily attacked the problem of recording and indexing scientific literature, since the middle of this century, when the great author-index was commenced. More than thirty years ago the Council of the Society resolved that the catalogue according to authors should be followed by an index according to subjects, and a start was made in 1893. But, as Lord Kelvin pointed out in his last anniversary address, "the continuation of such a work was almost beyond the resources of the Royal Society, and therefore about two years ago a Committee was appointed to take into consideration a suggestion that the preparation of complete indexes should be effected by international co-operation." The conference now being held is the outcome of this conclusion. Only by securing international co-operation could such a work as that contemplated by the Royal Society be satisfactorily carried out. It is therefore a matter of extreme congratulation that the proposal has been so warmly supported by Governments and Scientific Societies in all parts of the world, as shown by the distinguished men who have been delegated to take part in the conference. The enterprise is one in which all men of science are interested, but of the magnitude of which it is only possible to have a faint conception. To develop a comprehensive and practicable scheme will be a difficult task, but with a conference constituted like that now

sitting the work will be well considered, and we may confidently expect as a result the outlines of a system which will have international confidence and support.

From the following list of delegates to the Conference it will be seen that nearly all the Governments of civilised countries are represented, and most of the leading scientific societies of the world.

The delegates in attendance are :—AUSTRIA—Prof. Ernest Mach (Member of the Kaiserliche Akademie der Wissenschaften, Vienna) ; Prof. Edmund Weiss (Member of the Kaiserliche Akademie der Wissenschaften, Vienna). BELGIUM—M. H. La Fontaine (Membre, Institut International de Bibliographie, Brussels); M. Paul Otlet (Membre de l'Institut International de Bibliographie) ; M. de Wulf (Membre de l'Institut International de Bibliographie). DENMARK — Prof. Christiansen (Universitet, Copenhagen). FRANCE—Prof. G. Darboux (Membre de l'Institut de France) ; Dr. J. Deniker (Librarian, Muséum d'Histoire Naturelle, Paris). GERMANY—Prof. Schwalbe (Berlin) ; Prof. Dziatzko (Göttingen) ; Prof. Walther Dyck (Mitglied der K. Bay. Akad. der Wiss. zu München) ; Prof. Van't Hoff (Mitglied der K. P. Akademie der Wissenschaften zu Berlin) ; Prof. Möbius (Mitglied der K. P. Akademie der Wissenschaften zu Berlin). GREECE—M. Avierinos M. Averoff (Greek Consul at Edinburgh). HUNGARY—Prof. August Heller (Librarian, Ungarische Akademie, Buda-Pesth) ; Dr. Theodore Duka (Membre, Academie Hongroise des Sciences, Buda-Pesth). ITALY—General Annibale Ferrero (Italian Ambassador in London). JAPAN—Assistant Professor Hantaro Nagaoka (University, Tokio) ; Assistant Professor Gakutaro Osawa (Medical College, Tokio). MEXICO—Señor Don Francisco del Paso y Troncoso. NETHERLANDS—Prof. D. J. Korteweg (Universiteit, Amsterdam). NORWAY—Dr. Jörgen Brunchorst (Secretary, Bergen Museum). SWEDEN—Dr. E. W. Dahlgren (Librarian, Kongl. Svenska Vetenskaps Akademie, Stockholm). SWITZERLAND—M. C. D. Bourcart (Swiss Minister in London) ; Prof. Dr. F. A. Forel (Président du Comité Central de la Société Helvétique des Sciences Naturelles). UNITED KINGDOM — Representing the Government : Right Hon. Sir John E. Gorst, Q.C., M.P. (Vice President of the Committee of Council on Education). Representing the Royal Society of London : Prof. Michael Foster (Sec. R.S.) ; Prof. H. E. Armstrong, F.R.S. ; Prof. Liversidge, F.R.S ; Mr. J. Norman Lockyer, C.B., F.R.S. ; Dr. Ludwig Mond, F.R.S. ; Prof. A. W. Rücker, F.R S. UNITED STATES—Dr. John S. Billings (U.S. Army) ; Prof. Simon Newcomb, For. Mem. R.S. (U.S. Nautical Almanac Office). CANADA—The Hon. Sir Donald A. Smith, G.C.M.G. (High Commissioner for Canada) ; CAPE COLONY—Mr. Roland Trimen, F.R.S. ; Dr. David Gill, F.R.S. INDIA—Lieut.-General Richard Strachey, R.E., F.R.S. NATAL—Walter Peace, Esq., C.M.G. (the Agent-General for Natal). NEW SOUTH WALES—(Awaits confirmation). NEW ZEALAND—The Hon. W. P. Reeves (Agent-General for New Zealand). QUEENSLAND—The Acting Agent-General for Queensland.

Subjoined is the official report of the preliminary proceedings on Tuesday.

Prof. Foster (Sec. R.S.) moved that Sir J. Gorst act as provisional President for the purpose of organising the Conference.

The resolution, having been unanimously accepted, Sir John Gorst welcomed the delegates.

Prof. Armstrong gave a brief account of the work done by the Royal Society in arranging for the conference, as well as of the work to be accomplished.

The following resolutions were then agreed to.

(*a*) That each delegate shall have a vote in deciding all questions brought before the Conference.

Que chaque délégué aura un vote pour décider toutes les questions soumises à la Conférence.

Dass jeder Delegirte eine Stimme haben soll bei Entscheidung aller Fragen die vor die Conferenz gebracht werden.

(*b*) That English, French and German be the official languages of the Conference, but that it shall be open for any delegate to address the Conference in any other language, provided that he supplies for the *procès verbal* of the Conference a written translation of his remarks into one or other of the official languages.

Que l'Anglais, le Français, et l'Allemand seront les langues officielles de la Conférence, mais que chaque délégué pourra s'adresser à la Conférence dans n'importe quelle autre langue, pourvu qu'il remettra pour le procès verbal de la Conférence une traduction écrite de ses observations dans l'une des langues officielles.

Dass Englisch, Französisch und Deutsch die offiziellen Sprachen der Conferenz sein sollen, dass es aber jedem Delegirten freistehen soll, bei die Conferenz in einer andern Sprache zu sprechen, vorausgesetzt, dass er für das Protocoll der Conferenz eine schriftliche Uebersetzung seiner Rede in einer der offiziellen Sprachen liefert.

General Ferrero moved that Sir John E. Gorst be the President of the Conference. The motion having been unanimously accepted,

Sir John Gorst nominated as Vice-Presidents : General Ferrero, Prof. Darboux, Prof. Mach, Prof. Möbius, and Prof. Newcomb.

It was further resolved—

(*c*) That Prof. Armstrong be the Secretary for the English language ; that Prof. Forel be the Secretary for the French language; and that Prof. Dyck be the Secretary for the German language.

(*d*) That the Secretaries, with the help of shorthand reporters, be responsible for the *procès verbaux* of the proceedings of the Conference in their respective languages.

The President and Council of the Royal Society gave a reception to the delegates on Monday ; and on Tuesday evening the delegates were entertained at a banquet at the Hôtel Métropole. The chair was taken by the President, Sir Joseph Lister, and there were also present Sir F. Abel, Agent-General for British Columbia, Agent-General for Cape of Good Hope, Agent-General for Natal, Agent-General for New South Wales, Agent-General for New Zealand, Agent-General (acting) for Queensland, Agent-General for Western Australia, Prof. Armstrong, M. Averoff, Prof. Ayrton, Prof. Barker, Belgian Minister, Mr. Bidder, Dr. J. Billings, Sir F. Bramwell, Mr. H. Brown, Dr. Brunchorst, Dr. Brunton, Mr. Burbury, Dr. Champneys, Prof. Christiansen, Mr. Clough, Dr. Dahlgren, Prof. Darboux, Dr. Deniker, M. De Wulf, Dr. T. Duka, Prof. Dyck, Prof. Dziatzko, Dr. Elgar, Mr. C. E. Fagan, Dr. Fick, Mr. Fletcher, Sir W. H. Flower, Prof. Forel, Prof. Forsyth, Prof. M. Foster, Dr. Frankland, Sir D. Galton, Sir Robert Giffen, Dr. Gill, Dr. Gladstone, Sir John Gorst, Greek Chargé d'Affaires, Prof. Greenhill, Mr. Harrison, Prof. Heller, High Commissioner for Canada, Italian Ambassador, Japanese Minister, Prof. J. V. Jones, Mr. Keltie, Lord Kelvin, Mr. Kempe, Prof. Kennedy, Prof. Korteweg, M. La Fontaine, Prof. Lapworth, Prof. Liversidge, Mr. Lockyer, Mr. MacAlister, Mr. McClean, Prof. Mach, Mr. Mackey, Prof. McLeod, Major MacMahon, Mexican Minister, Dr. Mill, Prof. Möbius, Dr. Mond, Mr. R. L. Mond, Dr. Mott, Mr. Moulton, Prof. Nagaoka, Dr. Neale, Prof. S. Newcomb, Prof. Osawa, M. Otlet, Senor Don Paso y Troncoso, Prof. Perry, Portuguese Minister, Prof. Poulton, Mr. Preece, Pres. Soc. Chem. Industry, Lord Rayleigh, Prof. Roberts-Austen, Prof. Rücker, Mr. H. Saunders, Herr Schwalbe, Dr. Sclater, Prof. Sherrington, Prof. Sprengel, Sir Gabriel Stokes, Swedish and Norwegian Minister, Swiss Minister, Capt. Swithinbank, Rev. S. Thompson-Yates, Mr. Spencer

B. Todd, Treasurer Roy. Soc., Mr. R. Trimen, Prof. Unwin, Prof. Van't Hoff, Gen. Walker, Prof. Weiss, Mr. C. Welch, Dr. Wynne.

Sir Joseph Lister, in giving the toast of "Science in all Lands," remarked that it would be impertinent in such company to dwell on the advantages which science conferred upon humanity or upon the pleasures which she gave to those who had the privilege of cultivating her various branches. They were agreed that if the mighty project upon which the conference had met was brought to a successful issue it would very greatly promote the advance of science.

The toast was responded to by the Italian Ambassador (General Ferrero), who said that England had always taken a leading, sometimes the first, place in science from the days of Newton to those of Lord Kelvin, and the Royal Society had worthily represented the nation in its work for the advancement of science.

Prof. Mach also responded, remarking that men of science recognised no distinction of race or nationality, and they were all glad to co-operate with Englishmen in a work in which all men of science were interested, especially as the work was done under the auspices of the Royal Society.

Dr. Billings proposed "Success to the Conference and the Catalogue" in a humorous speech. He suspected that classification began in the Ark. Science was now getting so large and various that the projected summary would be of extreme value; but he did not quite know to what it would lead. If their object in carrying out this catalogue were achieved, they might anticipate a time when men and things and thoughts also would be catalogued. They might look forward down the vista of years to the time when a stranger in Hyde Park would see a passer-by with such a number as 26·053, and would then at once appreciate his status in every respect, and when the novelist would proudly show that his heroine had twenty-six points in her character, while a rival writer had only achieved nineteen.

Prof. Darboux, Prof. Möbius, and Prof. Forel briefly acknowledged the toast.

The Treasurer of the Royal Society (Sir John Evans) proposed "The Guests," and expressed the hope that the deliberations of the conference would be ultimately successful.

Sir Donald Smith, High Commissioner for Canada, responded.

The Belgian Minister proposed "The Royal Society," which he said, was the mother and model of all similar societies in Europe, and was based on the principle that science knew nothing of nationality. The president was a great master of antiseptic surgery; if he could only introduce the principles by which he was so distinguished into the realm of politics and international relations he would be one of the greatest benefactors of the human race.

The President, in response, said the society was proud to take the lead in so important a work as that of the Conference. It had given him personally much satisfaction to learn that the Conference on the first day had been exceedingly successful, and there was no doubt that if this movement was carried out, as they hoped it would be, it would prove of great help to science in all its branches.

ON THE MOTION OF A HETEROGENEOUS LIQUID, COMMENCING FROM REST WITH A GIVEN MOTION OF ITS BOUNDARY.[1]

I USE the word "liquid" for brevity to denote an incompressible fluid, viscid or inviscid, but inviscid unless the contrary is expressly stated. A finite portion of liquid, viscid or inviscid, being given at rest, within a bounding vessel of any shape, whether simply or multiply continuous; let any motion be *suddenly* produced in some part of the boundary, or throughout the boundary, subject only to the enforced condition of unchanging volume. Every particle of the liquid will instantaneously commence moving with the determinate velocity and in the determinate direction, such that the kinetic energy of the whole is less than that of any other motion which the liquid could have with the given motion of its boundary.[1] This proposition is true also for an incompressible elastic solid, manifestly; (and for the ideal "ether" of *Proc. R.S.E.*, March 7, 1890; and Art. xcix. vol. iii. of my Collected Mathematical and Physical Papers). The truth of the proposition for the case of a viscous liquid is very important in practical hydraulics. As an example of its application to inviscid and viscous fluid and to elastic solid consider an elastic jelly standing in an open rigid mould, and equal bulks of water and of an inviscid liquid in two vessels equal and similar to it. Give equal sudden motions to the three containing vessels: the instantaneous motions of the three contained substances will be the same. Take, as a particular case, a figure of revolution with its axis vertical for the containing vessel and let the given motion be rotation round this axis suddenly commenced and afterwards maintained with uniform angular velocity. The initial kinetic energy will be zero for each of the three substances. The inviscid liquid will remain for ever at rest; the water will acquire motion according to the Fourier law of diffusion of which we know something for this case by observation of the result of giving an approximately uniform angular motion round the vertical axis to a cup of tea initially at rest. The jelly will acquire laminar wave motion proceeding inwards from the boundary. But in the present communication we confine our attention to the case of inviscid liquid.

The now well-known solution[2] of the minimum problem thus presented, when the bounding surface is simply continuous, is, simply: that the initial motion of the liquid is irrotational. That the *initial* motion *must be irrotational*[3] is indeed obvious, when we consider that the impulsive pressure by which any portion of the liquid is set in motion is everywhere perpendicular to the interface between it and the contiguous matter around it, and therefore the initial moment of momentum round any diameter of every spherical portion, large or small, is zero. But that irrotationality of the motion of every spherical portion of the liquid suffices to determine the motion within a simply continuous boundary having any stated motion, is not obvious without mathematical investigation.

Whether the boundary is simply continuous, or multiply continuous, irrotationality suffices to determine the motion produced, as we now suppose it to be produced, from rest by a given motion of the boundary.

Now in a homogeneous liquid acted on by no bodily force, or only by such force (gravity, for example) as could not move it when its boundary is fixed, the motion started from rest by any movement of the boundary remains always irrotational, as we know from elementary hydrokinetics. Hence, if at any time the boundary is suddenly or gradually brought to rest, the motion of every particle of the liquid is brought to rest at the same instant. But it is not so with a heterogeneous liquid. Of the following conclusions Nos. (1), (2), (3) need no proof. To prove

[1] Read at the Royal Society of Edinburgh, by Lord Kelvin, on April 6.

[1] *Cambridge and Dublin Mathematical Journal*, February 1849. This is only a particular case of a general kinetic theorem for any material system whatever, communicated to the Royal Society, Edinburgh, April 6, 1863, without proof (*Proceedings*, 1862-63, p. 114), and proved in Thomson and Tait's "Natural Philosophy," sec. 317, with several examples. Mutual forces between the containing vessel and the liquid or elastic solid, such as are called into play by viscosity, elasticity, hesivity (or resistance to sliding between solid and solid), cannot modify the conclusion, and do not enter into the equations used in the demonstration.

[2] Thomson and Tait's "Natural Philosophy," sec. 312.

[3] That is to say, motion such that the moment of momentum of every spherical portion, large or small, is zero round every diameter.

No. (4) remark that as long as there is any motion of the heterogeneous liquid within the imperfectly elastic vessel the liquid must be losing energy; and the energy cannot become infinitely small with any finite spherical portion of the liquid homogeneous.

(1) The initial motion of a heterogeneous liquid is irrotational only at the first instant after being *quite suddenly* started from rest by motion of its boundary. Whatever motion be subsequently given to the boundary the motion of the liquid is never again irrotational. Hence

(2) If the boundary be suddenly brought to rest at any time, the liquid, unless homogeneous throughout, is not thereby brought to rest; and it would go on for ever with undiminished energy if the liquid were perfectly inviscid and the boundary absolutely fixed. The ultimate condition of the liquid, if there is no *positive* surface tension in the interfaces between heterogeneous portions, is an infinitely fine mixture of the heterogeneous parts.[1] And, if there were no gravity or other bodily force acting on the liquid, the density would ultimately become uniform throughout. Take, for example, a corked bottle half full of water or other liquid with air above it given at rest. Move the bottle and bring it to rest again: the liquid will remain shaking for some time. An ordinary non-scientific person will scarcely thank us for this result of our mathematical theory. But, when we tell him that if air and the liquid were both perfectly fluid (that is to say perfectly free from viscosity), the well-known shaking of the liquid surface would, after a little time, give rise to spherules tossed up from the main body of the liquid; and that the shaking of the liquid, left to itself in the bottle supposed perfectly rigid, will end in spindrift of spherules which would be infinitely fine if the capillary tension of the interface between liquid and air were infinitely small, he may be incredulous unless he tends to have faith in all assertions made in the name of science.

(3) If the boundary is an enclosing vessel of any real material (and therefore neither perfectly rigid nor perfectly elastic), and if it is laid on a table and left to itself, under the influence of gravity, the liquid, supposed perfectly inviscid, will lose energy continually by generation of heat in the containing vessel, and will come asymptotically to rest in the configuration of stable equilibrium with surfaces of equal density horizontal and increasing density downwards.

(4) With other conditions as in (3), but no gravity, the ultimate configuration of rest will be infinitely fine mixture (probably, I think of equal density throughout). Consider, for example, two homogeneous liquids of different densities filling the closed vessel, or a single homogeneous liquid not filling it. As an illustration, take a bottle half full of water, and shake it violently. Observe how you get the whole bottle full of a mixture of fine bubbles of air, nearly homogeneous throughout. Think what the result would be if there were no gravity, and if the water and air were inviscid and the bottle shaken as gently as you please; and if there were perfect vacuum in place of the air; or, if for air were substituted any liquid of density different from that of water.

THE RETURN OF BROOKS'S COMET.

ON July 6, 1889, Mr. W. R. Brooks, of Geneva, New York, U.S.A., discovered a somewhat faint, telescopic comet at R.A. 356°, Dec. 9° south, in the southern region of Pisces. It had a short spreading tail, and was moving slowly to the E.N.E.

Observations in a few days enabled the orbit to be computed, and the small inclination (6°) intimated that the comet was probably one of short period. This proved to be the case after further observation, and the time of revolution was determined as about seven years. Otto Knopf, from three positions obtained at Mount Hamilton on July 8, at Dresden July 30, and at Vienna on August 19, deduced the period as 7·286 years. The comet was followed until January 1890, and from the whole series of observations Prof. S. C. Chandler found a period of 7·073 years, and that the orbit at aphelion approaches very closely to the orbit of the planet Jupiter. From March to July 1886, the distance of the comet and planet appears to have been less than 10,000,000 miles. The theory was suggested by Prof. Chandler that the comet may be identical with Messier-Lexell's comet of 1770; but Dr. C. L. Poor, on reinvestigating the matter, found little evidence in support of the idea.

The possible connection of the comet with that of 1770 is by no means the only interesting feature of this object. On August 1, 1889, Prof. E. E. Barnard observed that the comet was broken up into several detached fragments. It had previously been seen single, and had been submitted to pretty general observation without anything remarkable having been detected; but on the night of August 1, it appeared to have been suddenly shattered by some extraordinary forces or vicissitudes of a very mysterious character. One of the smaller fragments, together with the largest mass, remained visible for several months, moving in concentric paths, and forming a very interesting and rare telescopic spectacle.

The comet was a fairly conspicuous object in telescopes, but it was not visible to the unaided eye. Its apparent motion was very slow, for early in November its position was only seven degrees north of the place it had occupied four months before.

Dr. Poor fixed the next perihelion passage for November 4, 1896, and an ephemeris was prepared by Bauschinger for the spring and summer of 1896, as it was expected the comet might be picked up some months before its arrival at perihelion. This expectation has been fully realised, for the comet was re-discovered on the night of June 20 by M. Javelle, using the 30-inch refractor of the observatory at Nice. Its place was almost identical with that given in the ephemeris, and the re-discovery of the comet may therefore be regarded as another triumph for mathematical astronomy.

This comet should prove an extremely interesting object in regard to its physical appearance and changes of aspect. At the present time it is in Aquarius a little west of *Delta* in that constellation, and its position during the next few weeks will be nearly stationary. The ephemeris by Bauschinger is as follows:—

1896.	R.A. h. m. s.	Decl. ° ′ ″	Log. Δ	Brightness.
July 15 ...	22 39 1 ...	−18 9 53 ...	0·1124 ...	1·14
19 ...	39 58 ...	12 28 ...	0·0992 ...	1·22
23 ...	39 44 ...	16 28 ...	0·0866 ...	1·31
27 ...	39 24 ...	21 49 ...	0·0746 ...	1·40
31 ...	38 38 ...	27 52 ...	0·0633 ...	1·50
Aug. 4 ...	37 26 ...	34 44 ...	0·0529 ...	1·59
8 ...	35 50 ...	41 51 ...	0·0436 ...	1·68
12 ...	33 51 ...	48 48 ...	0·0353 ...	1·76
16 ...	22 31 34 ...	−18 55 2 ...	0·0284 ...	1·84

Thus the comet is likely to be visible throughout the present summer and ensuing autumn, for its brightness is gradually increasing, and it will remain in a favourable position all the time. Its southern declination of more than 18° is, however, rather unfortunate, as its altitude is only about 20°, so that observers will require to watch it from a position commanding a good open view of the southern sky.

W. F. DENNING.

[1] "Popular Lectures and Addresses," by Lord Kelvin, vol. i. pp. 19, 20, and 53, 54. See also *Philosophical Magazine*, 1887, second half-year: "On the formation of coreless vortices by the motion of a solid through an inviscid incompressible fluid"; "On the stability of steady and of periodic fluid motion"; "On maximum and minimum energy in vortex motion."

NOTES.

DR. N. BUSCH, of Dorpat, has undertaken, at the request of the University of Dorpat and the Russian Geographical Society of St. Petersburg, a botanical investigation of the Caucasus. He proposes to visit the hitherto unexplored sources of the rivers Teberda and Maruch in Northern Caucasus.

THE Goldsmiths' Company has contributed a second donation of £1000 to the special funds of the research department of the Imperial Institute, to be applied to the extension of the laboratories and to their better equipment. The Salters' Company has established a Research Fellowship of the value of £150 per annum, in connection with the scientific department, tenable by chemists thoroughly qualified to undertake the investigation of new or little-known natural products received by the Institute from the colonies and India.

A ROYAL Commission has been appointed "to inquire and report what administrative procedures are available and would be desirable for controlling the danger to man through the use as food of the meat and milk of tuberculous animals, and what are the considerations which should govern the action of the responsible authorities in condemning for the purposes of food supplies animals, carcasses, or meat exhibiting any stage of tuberculosis." The Commissioners are Sir Herbert Maxwell, Dr. Richard Thorne Thorne, C.B. (medical officer of the Local Government Board), Mr. George Thomas Brown, C.B., Mr. Harcourt Everard Clare, Mr. Shirley Forster Murphy (member of the Royal College of Surgeons), Mr. John Speir, and Mr. Thomas Cooke Trench.

THE death is announced of Prof. E. Curtius, the distinguished Professor of Archæology in the Berlin University.

PROF. AUGUST KEKULÉ V. STRADONITZ, Professor of Chemistry in the University of Bonn, died on Monday, at the age of sixty-six.

THE Vienna Academy of Sciences announces as the subject of the Baron von Baumgartner prize of 1000 florins, "Extension of the Knowledge of the extreme Ultra-violet Rays." The prize will be awarded in 1899.

FROM a special number of their *Atti*, we learn that the Reale Accademia dei Lincei (of Rome) has made the following awards: Of two prizes given by the King of Italy, one for chemistry and the other for philosophical science, the first has been divided equally between Prof. Luigi Balbiano, of the University of Rome, for his monograph on certain compounds of the pyridine series, and Prof. Raffaele Nasini, of the University of Padua, for a series of twenty-seven papers on chemical physics. The prize for philosophy has not been awarded. Two prizes of 1500 lire, given by the Minister of Public Education, have been awarded—one for mathematics, the other for philology. For the mathematical prize eight candidates have submitted essays, and the prize has been adjudged to Prof. Geminiano Pirondini, of Parma, in consideration of eleven printed and written papers on geometry. The philological prize has been divided between Profs. Filippo Sensi, Silvio Pieri, G. B. Camozzi, Antonio Fiammazzo, and Oreste Antognoni. Of a further prize, given by Signor Enrico Santoro (an Italian residing in Constantinople), for mechanical inventions relating to weaving or spinning, the award has been postponed for a couple of years. These awards were announced at the twenty-first anniversary commemoration of the revival of the Academy on June 7, in presence of the King and Queen of Italy.

THE prize awards of the French Société d'Encouragement, for 1896, were announced at the recent annual general meeting. The Prix Giffard, for distinguished services to French industry, is of the value of 6000 francs; but this year, on account of exceptional merit, it has been increased to 10,000 francs and divided equally between D. Legat, for his mechanical works, and the family of the late A. Martin, renowned for his optical researches. The Grand Gold Medal, awarded each year to the author whose works have exercised the greatest influence on the progress of French industry in the preceding six years, was this year in the gift of the Comité des Arts mécaniques, who have voted it to F. G. Kreutzberger, the inventor of numerous improvements in machinery. M. Effront has been awarded the Prix Parmentier of 1000 francs for his works on alcoholic fermentations. The prize of 1000 francs for an oil motor has been gained by the Priestman motor. M. Lefèvre has obtained the prize of 2000 francs for a publication useful to chemical industry, by his remarkable "Traité des matières colorantes," reviewed in these columns on April 30 (vol. liii. p. 603). The Prix Melsens, for the author of an application of physics or chemistry to electricity, ballistics, or hygiene, has been awarded to Dr. Castaing for his works on ventilation. The prize of 2000 francs for an incandescent lamp of one-candle power, 100 volts, 1/20 ampere, has not been awarded, but an *encouragement* of 1000 francs has been given to MM. Javaux and Nysten, and a similar sum to M. Solignac. The prize of 2000 francs, for the best investigation on the comparative physical and chemical constitution of agricultural land in France, has also not been awarded, but 1500 francs have been granted to MM. Beuret and Brunet, and 500 francs to M. Waldmann. Grants of 1000 francs have been made to Prof. Zipcy and M. Jaffler as *encouragements* in connection with the prize of 2000 francs for pisciculture.

THE great sea-wave which accompanied the recent earthquake in Japan appears to have been even more destructive to life and property on the north-east coast than was at first reported. A dispatch received by the Japanese Legation, from Tōkyō, says:—"The loss of life and property caused by the tidal wave, which visited the north-east coast of Japan on June 15, is as follows, according to the official returns received up to the 22nd of that month. In the Prefecture of Aomori 346 lives lost, 840 houses washed away; in the Prefecture of Iwate, 23,309 lives lost, 5920 houses washed away; in the Prefecture of Miyagi, 3344 lives lost, 715 houses washed away. Besides the above, the number of persons injured is as follows: 213, 23,840, 1184 in the above Prefectures respectively."

DR. BROWN GOODE makes the following comparison in a Report of the U.S. National Museum, lately issued:—"There is not a department of the British Government to which a citizen has a right to apply for information upon a scientific question. This seems hard to believe, for I cannot think of any scientific subject regarding which a letter, if addressed to the scientific bureaus in Washington, would not receive a full and practical reply. It is estimated that not less than 20,000 such letters are received each year. The Smithsonian Institution and National Museum alone receive about 6000, and the proportion of these from the new States and Territories, which have not yet developed institutions of learning of their own, is the largest. An intelligent question from a farmer of the frontier receives as much attention as a communication from a Royal Academy of Sciences, and often takes more time for the preparation of the reply." It is little to the credit of British Governments that Dr. Goode's comparison should be so much to our disadvantage.

ACCORDING to the last report of the British Consul at the Piræus, a Pasteur Institute has been in existence in Athens for more than a year. During this period 201 cases have been treated, with only one death; in that case the patient had delayed submitting himself to treatment for fifteen days after

the infliction of the bite. The Institute was founded by Dr. Pampoukis, who studied for a time under M. Pasteur in Paris. He established the Institute at his own expense, but after a time the municipality and the Government granted him a small annual subvention. The Consul goes on to say: "It is practically impossible to over-estimate the value of such an establishment in the Levant, which is overrun with ownerless dogs. A muzzling order does exist in Attica, but it is not enforced, and the distribution of poisoned meat in the streets of Athens and the Piræus is apparently the only attempt made by the authorities to deal with an increasing amount of rabies."

IN view of the numerous applications of aluminium in the manufacture of water-bottles for military use, cooking utensils, and other articles where there is a necessity for lightness combined with resistance to corrosion, several researches on the behaviour of this metal towards liquids have been recently carried out. Mr. J. W. Richards, who has just published the latest contribution to this subject in the *Journal of the Franklin Institute*, has studied more especially how far the power of resisting the attack of corrosive liquids can be increased by alloying with small quantities of other metals. The general result of the experiments is to show that pure aluminium resists the action of alkaline solutions better than any of the alloys examined. This also holds true for solutions of nitric acid and of common salt; but an alloy containing 2 per cent. of titanium appears to be the best for liquids containing free hydrochloric acid. All the alloys tried offer great resistance to the action of acetic and carbonic acids.

MR. HENRY DEANE referred to the late Sir William Macleay's bequest for the endowment of a lectureship in bacteriology, in his presidential address to the Linnean Society of New South Wales, a copy of which has just reached us. It may be remembered that the Senate of the Sydney University decided to relinquish the bequest, and to return the money to the executors. This was done about a year ago, and the sum, amounting to £12,704, was afterwards paid into the Linnean Society of New South Wales. By the terms of the bequest, it has devolved upon the Council of the Society to invest the money, and use the interest to pay a competent bacteriologist, and maintain a suitable laboratory with appliances for bacteriological research. The result is that the Council has decided to appoint a bacteriologist at the close of the hot season 1896–97, provided that one can be engaged on what are practically the terms and emoluments offered to University demonstrators. A number of other subjects were passed in review by Mr. Deane in his address. His remarks upon forestry will perhaps do something towards checking the depletion of the forests of New South Wales.

AN important point dealt with by Mr. Deane in the address referred to in the foregoing note, is the origin of the vegetation of Australia. Prof. Ettingshausen's observations and conclusions are adversely criticised; and it is stated that at present the known facts seem to afford grounds for concluding: (1) That many, if not all, the typical Australian floral types originated in Australia or in some land connected with it, but now submerged. (2) That the assumption of the existence of a universal flora of mixed types at any epoch is unfounded. (3) That the fossil plant-remains of Tertiary age in Eastern Australia indicate a vegetation in all respects similar to that existing on the coast in the same latitude at the present day. To these Mr. Deane thinks may be added a fourth conclusion of less certain character, but of high probability, that the *Proteaceæ* represent a most ancient type which had their origin at a time when not only extensive areas of land existed in the southern hemisphere, but when some kind of connection, more or less lasting, existed between Australia and South Africa. Mr. Deane concluded his address with an account of the work of the Horn expedition to Central Australia.

MUCH attention has been paid in recent years to the prediction of the minimum night temperature, on account of its importance to agriculture, especially in spring-time, when late frosts are detrimental to delicate plants, and various important papers have been written upon the subject, *e.g.* by M. Kammermann, of the Geneva Observatory, and M. Lemström, of Helsingfors. Reference to the matter may also be found in some text-books of meteorology, where it is pointed out that if the dew-point is determined in the evening, it will rarely be found that the air temperature will fall much below that point during the night. In the current number of *Ciel et Terre*, M. Lancaster draws attention to the fact, which, if known, is not generally acknowledged, that as long ago as 1824 this relation between the night minimum and the temperature of the dew-point was indicated by Dr. A. Anderson, in a note entitled "On the influence of the hygrometric state of the atmosphere upon the minimum temperature of the night," printed in vol. xi. pp. 161–9 of the *Edinburgh Philosophical Journal*. The same author also refers incidentally to the subject in a short note "On the Dew-point," presented to the British Association in 1840. As M. Lancaster says, this is one of many instances presented by the history of science, of problems being studied, which have been long since solved.

THE Council of the Scottish Meteorological Society presented their report at the annual general meeting held yesterday. From the report we learn that a large work, which has been in course of preparation for some time, has just been completed, viz. averages of mean temperature and mean barometric pressure for the forty years ending with December 1895 have been calculated for each of the Society's 145 stations. It is not possible to over-estimate the importance of these averages in carrying on several of the more important departments of the Society's work, more particularly in the preparation of the monthly and quarterly report of Scottish weather. The very heavy work of recopying, on daily sheets, the hourly observations of the two Ben Nevis Observatories has now been virtually completed down to date. This result has been mainly secured by the aid of the grant of £100 obtained from the Government Research Fund last year. The large inquiry carried on by Dr. Buchan and Mr. Omond for some years on the influence of fog, cloud, and clear weather respectively, on the diurnal fluctuations of the barometer, has been extended into other regions, particularly the Arctic regions and Portugal, which furnish data of the utmost importance to the inquiry. Among the questions more immediately raised, as the investigation proceeds, is the influence on the pressure at the two observatories of the vertical distribution of temperature and humidity through the intervening stratum of air between the top and bottom of the mountain. The Council referred to the handsome donation of £1875 made to the Ben Nevis Observatories by the Trustees of the late Earl of Moray; they have by means of it been enabled to engage an additional clerk for the office, so that, for the next two or three years, Dr. Buchan's time may be largely set apart for the discussion of the Ben Nevis observations. It has further been resolved to establish a temporary station during the summer and autumn on the top of Meal an' Suie, situated at a height of 2322 feet, and in the line of the two observatories. The object sought to be attained by this new station is a better knowledge of the vertical distribution, particularly during anticyclonic periods, of temperature and humidity through the aërial stratum between Fort-William and the top of Ben Nevis.

THE meteorological department of the library of Harvard College Observatory has become, by recent large accessions, one of the most complete collections of meteorological works in the United States. In the early history of the Observatory, many such works were collected by the first and second directors of the institution, Profs. W. C. Bond and G. P. Bond; and since

then the collection has continued steadily to increase. More recently, states the Harvard College Observatory *Circular*, No. 8, three large additions have been made to it: the general library of Harvard University has placed at the Observatory a great number of the meteorological works formerly kept at Gore Hall; the Blue Hill Meteorological Observatory has made a similar transfer; and the New England Meteorological Society, which has lately dissolved its organisation, has deposited the works contained in its library, and also the remaining copies of its own publications. Special efforts are now in progress to render still more complete the large collection which has resulted from these additions. It is hoped that the meteorological department of the library may be made so complete as greatly to increase its present value in aiding the studies of meteorologists.

IN spite of its limited resources, the British School at Athens contrives to initiate and carry out very valuable archæological work. The report read at the annual eeting of the supporters of the school, held on Monday, gave an encouraging account of the work of exploration and excavation accomplished during the past year. The financial position of the school, though still below that of its rivals, is now upon a footing which is comparatively satisfactory. The subscriptions, together with the Government grant of £500 per annum for five years, lead the Committee to believe that they may reckon upon an annual income of £1400 for some years to come. Of this it is estimated that about £1000 will be required for the current expenses of the school (including studentships), leaving about £400 per annum for excavations. But though the school stands in a better financial position than it has ever been before, its revenue is still modest as compared, for example, with the £3100 a year of the French school, which has, in addition, received a special grant of £30,000; the £2400 of the Germans, to whom also the Government has made the contribution of £40,000 for the excavations at Olympia; and the United States school, which enjoys £2000 a year. The school is, however, doing its best on its modest resources, and the archæological discoveries made in connection with it are valuable contributions to human knowledge.

PROF. H. A. NEWTON has been making a comparison between the mortalities of Yale graduates in the years 1701–1744 and 1745–1762, to see whether the changes of mode of living and comforts had any effect upon the vital statistics of the two groups of men (Yale, *Biographies and Annals*). By arranging the mortalities in decades of years from 15 to 75 years of age in the case of each group, it was seen that the group 1745–1762 showed a distinct increase of mortality per thousand lives between the ages of 15 and 35; an equality of mortality during the next ten years, and a decided diminution for the ages 46 to 75, when compared with corresponding periods in the group 1701–1744. It is a marked feature of the mortality statistics of American college graduates that there is excessive mortality in the years immediately following graduation. This, Prof. Newton thinks, is no doubt due to the strenuous efforts of young graduates to attain a good position in their profession. The later favourable experience in the ages from 45 to 75 is presumably due to the fact that they have by that time gained position, or else lost ambition. It would seem that this early strain was experienced by the graduates of the years 1701–1744 distinctly less than it was by the graduates of the eighteen years following. It would also seem that the corresponding strain for men between the ages 45 and 75 was much greater than for the later graduates, and perhaps that there had been a decided gain in the modes and comforts of life during the quarter of a century, which on an average separates the two groups of men.

THE literature of water-bacteriology is fast assuming well-nigh unwieldy proportions; almost the latest contribution to hand is an elaborate memoir in Spanish, from the Municipal Chemical Laboratory of Valparaiso, on an epidemic of typhoid fever in this city. Dr. Mourgues, who is responsible for the report in question, claims to have successfully tracked this serious outbreak to the water supplying the city. The chemical analyses already showed it to be badly polluted with sewage; and in this condition, without undergoing filtration, it was distributed for dietetic purposes. By resorting to all the most efficient methods at present at our disposal for the discovery of the typhoid bacillus in water, Dr. Mourgues tells us that he "discovered a bacillus which, according to the majority of the bacteriologists, is the cause of typhoid fever." He exhibits, however, some degree of caution in accepting his own conclusions, for he tells us that if it was not the typhoid bacillus, it was the *B. coli communis*, which, according to Rodet, G. Roux, and Vallet, is also capable of inducing typhoid fever. Dr. Mourgues has produced an able and interesting report quite apart from the credit attaching to his investigations; for he has brought together, in a brief and handy form, most of the principal work which has been done in recent years on the bacteriology of water in relation to the typhoid bacillus.

IN a letter communicated to the *Comptes rendus* (June 22), M. Moureaux gives a short account of some recent measurements of the magnetic elements which he has made in South Russia. In the neighbourhood of a village called Kotchetovka, at latitude 51° and longitude 6° 8′ east of Poulkowa, the extreme values of the elements determined in fifteen different stations, scattered over an area of about a square kilometre, were as follows:—

Declination	...	...	+58° to −43°
Dip	...	...	79° to 48°
Horizontal force	...	...	0·166 to 0·589

In addition to the extreme largeness of these differences, it is interesting to note that the horizontal force attains in this region a greater value than that found at the equator. Since the dip is not less than 48°, it follows that the value of the total force in some parts of this region is extremely large. At another village (Potrovshojé), about fifteen kilometres to the south of the first, the values of the elements were:—Declination, +52° 56′; dip, 81° 45′; horizontal force, 0·09. A series of measurements showed that the dip attained a maximum value of 82° 13′ near this point, the value of the horizontal force corresponding to this maximum being 0·079.

THE Metopic Suture is the name given by anthropologists to the persistence of the frontal suture. Several investigators have attacked the problem of the significance of this suture, but the most thorough study is that by Dr. G. Papillault in the current number (tome ii. 3 sér. 1 fasc.) of the *Mémoires de la Soc. d'Anth. de Paris*. After a very detailed investigation, the author comes to the following general conclusions:—It has no sexual significance. The brain is the primary cause of metopism; not that metopics have an intellectual superiority over other people, but a superiority in the relative weight of their brain. There is a preponderance of complicated sutures and wormian bones in metopic crania, but these are less marked in the races in which the weight of the skull increases equally with that of the skeleton; in other words, in what one generally terms the lower races. Civilisation, in multiplying and knitting the bonds of social union, in augmenting in the struggle for life the power of the intelligence and in diminishing the preponderance of brute force, permits those who are intellectually endowed to live and prosper despite their muscular weakness, and thus it also becomes one of the most important factors of metopism.

THE publication of a special journal to care for the specific interests of physical chemistry, will commence in October of this year. This *Journal of Physical Chemistry* is to be issued upon the first of every month, except that in July, August, and September no number will appear. It will contain articles embodying original research in all branches of experimental and theoretical physical chemistry; and this matter will be supplemented by reviews of the current literature of the subject. All communications concerning articles should be addressed to the *Journal of Physical Chemistry*, Ithaca, N.Y. The editors are Wilder D. Bancroft and Joseph E. Trevor, assistant professors of physical chemistry in Cornell University.

IN a recent number of the *Comptes rendus* (June 22), MM. Lortet and Genoud give an interesting account of their experiments on the effect of Röntgen rays on tuberculosis. Although still incomplete, these experiments seem to indicate that we may have in the new light a remedy for tuberculosis. Eight guinea-pigs were inoculated with the virus of tuberculosis. Three of these were exposed daily for at least an hour to the influence of powerful Röntgen radiations, from April 25 to June 18. The other five were not so treated. In the latter, abscesses were produced and the health deranged. In the three treated with Röntgen rays no abscesses were formed, the health remained good, and the animals increased in weight.

THOUGH examinations of the contents of stomachs of crows have shown that these birds feed very largely upon noxious insects and other injurious animals, the result apparently does not prove that the crow is a friend to the farmer. A note in the *North British Agriculturist* reports that much damage has been committed in turnip fields in Annandale during the past few days by crows. The crows, in their search for wire-worms, pull up the young turnips, probably finding a worm at the root of one out of 150 or 200 pulled up. The fact shows the importance of avoiding conclusions as to the usefulness of a bird merely from determination of food habits. The farmers of Annandale would probably have been better pleased if the crows had fed upon the young turnips instead of wire-worms, for the destruction would not then have been so great.

THE third part of Mr. John W. Taylor's valuable "Monograph of the Land and Freshwater Mollusca of the British Isles" has just been published by Messrs. Taylor Brothers, Leeds. It deals with the morphology and anatomy of the animal inhabitants of shells, and is illustrated just as clearly and liberally as the previous parts, in which the shells and their auxiliary appendages were described. Conchologists should be grateful to Mr. Taylor for the pains he is taking to provide them with a trustworthy and instructive work upon British Land and Freshwater Molluscs.

MESSRS. TRUSLOVE AND HANSON have in the press an illustrated work on "The Natives of Sarawak and British North Borneo," by Mr. Ling Roth. The work will be published in two volumes, and the edition will be limited to seven hundred copies. No complete work dealing with the natives of British Borneo exists, though the history of that very interesting colonial possession could furnish material for a dozen romances. How very completely Sir James Brooke, and his nephew and successor as Rajah (Sir Charles Brooke), have changed the customs of the Dyaks, should be known to all who are interested in methods of establishing British colonies, and of improving the condition of the people who inhabit them. Mr. Ling Roth's work will deal with the people of British Borneo from many points of view, and it promises to be a valuable contribution to anthropology.

THE South London Entomological and Natural History Society has sent us the abstract of the *Proceedings* for 1895, together with the address of the President, Mr. T. W. Hall. Though unpretentious in character, the Society has assisted in the diffusion of biological knowledge by its meetings and collections, and its publications always contain material of interest to every one interested in natural history. Another Society, which has just sent us its Report for 1895, is the Manchester Microscopical Society. First among the contents of this publication is an address by the President, Prof. F. E. Weiss, on "The Influence of External Conditions on Reproductive Processes in Plants." The subjects of other papers are: some insect pests, by Mr. A. T. Gillanders; the organs and function of reproduction in insects, by Mr. F. Paulden; notes on Hydrozoa and Polyzoa, by Mr. J. Smith; photo-micrography, by Mr. E. H. Turner; and the animal life of the Coal-measures, by Mr. Herbert Bolton. May such Societies as these of South London and Manchester long exist to stimulate and encourage biological and microscopical research.

WE have on our table several new editions of scientific books. First among these is the seventh edition of Dr. Benjamin Williamson's "Elementary Treatise on the Integral Calculus" (Longmans, Green, and Co.). The chapter on the calculus of variations has been considerably enlarged, and a brief discussion added on the application of that calculus to double and multiple integrals. A short chapter on the sign of substitution has also been introduced. Messrs. A. and C. Black have published the second edition of "Rheumatism: its Nature, its Pathology, and its successful Treatment," by Dr. T. J. Maclagan. Twenty years ago the author introduced salicin to the medical profession as a remedy in acute rheumatism. In the first edition of this work, published in 1881, he expounded the miasmatic theory of rheumatism, and offered an explanation of the manner in which the salicyl compounds produce anti-rheumatic effects. In the present edition the whole subject of the pathogenesis of rheumatism, and the curative action of the salicyl compounds, is gone over again. The book thus contains the history of a remarkable and beneficial change in the treatment of a disease which was the despair of a past generation of physicians. A fifth edition of a "Coloured Vade-mecum to the Alpine Flora, for the use of Tourists in Switzerland," has been published by Albert Raustein, Zürich. The book contains 170 coloured illustrations of Alpine flowers, accompanied by descriptive text in English, French, and German, by L. Schröter and Prof. C. Schröter. The book should be in the hands of every lover of Alpine flowers; and it will be found a pleasant companion to the many tourists who, during the next few months, will wander about the Alps. The pleasing and elegant "Ros Rosarum, ex Horto Poetarum," by E. V. B., the second edition of which has been published by Mr. Elliot Stock, contains a wealth of poetic extracts having the rose for their theme. The quotations show that the rose has been honoured and admired in almost all times and places. The twenty-eighth edition of "Skertchly's Physical Geography," revised by Mr. J. H. Howell, has been published by Mr. Thomas Murby. Mr. Howell has made a number of requisite alterations in the text, but the book is still badly illustrated.

THE annual Report (1894-95) of the Director of the Field Columbian Museum, Chicago, has been received. A large number of accessions to the collections have resulted from the expeditions sent out by the Museum. In October 1894, Mr. Allison V. Armour, of Chicago, invited Dr. Millspaugh, of the Department of Botany, and Prof. Holmes, of the Department of Anthropology, to accompany him on his yacht to Havana, Progreso, the islands on the east coast of Yucatan, Laguna di Terminos and Vera Cruz. On this expedition, Dr. Millspaugh's work resulted in the acquisition of nearly eight hundred speci-

mens in botany, which formed the types included in his "Flora of Yucatan," and considerable material for exchange to augment the small herbarium in his department. He also secured about four hundred specimens in zoology, principally conchology, and a number of excellent negatives relating to geology, botany, ethnology and travel. Prof. Holmes secured altogether about one thousand specimens in archæology from Yucatan, Chiapas, Oaxaca, Vera Cruz and the valley of Mexico, and made a number of important observations. An expedition to San Domingo, conducted by Mr. Geo. K. Cherrie, Assistant Curator in the Department of Ornithology, resulted in the collection of 1958 bird skins, 16 mammals, 80 reptiles, and a number of specimens of fish and Crustacea. Among the birds, two species proved new to science, and a number of others are very interesting as representing rare and little-known forms. Captain Miner W. Bruce was fitted out by the Museum for an expedition to Alaska and Siberia in June 1894, and he acquired valuable ethnological material from North Alaska. A number of minor expeditions were also organised in the interests of the Museum, and they have resulted in numerous additions to the collections in different departments, as well as the acquisition of information of great scientific value, which information is made known through the admirable series of publications issued by the Museum.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, a White-throated Monitor (*Varanus albogularis*) from South Africa, presented by Sir Gilbert Carter; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. Henry Russell; a Diana Monkey (*Cercopithecus diana*) from West Africa, presented by Mr. E. Kirby; a Striped Hyæna (*Hyæna striata*) from Arabia, presented by Mr. C. A. Osborne; a Hamster (*Cricetus frumentarius*), European, presented by Miss Hilton; three Yellow-bellied Liothrix (*Liothrix luteus*) from India, presented by Mr. Robert E. Graves; an Iceland Falcon (*Hierofalco islandus*) from Iceland, eight Horsfield's Tortoises (*Homopus horsfieldi*) from Central Asia, two Giant Toads (*Bufo marinus*) from Brazil, a Reticulated Python (*Python recticulata*) from Malacca, deposited; two Lettered Aracari (*Pteroglossus inscriptus*) from Para, a Black-necked Swan (*Cygnus nigricollis*) from Antarctic America, purchased; a Burrhel Wild Sheep (*Ovis burrhel*), two Glossy Ibisis (*Plegadis falcinellus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE CLUSTER IN COMA BERENICES.—The results of a triangulation of the more conspicuous stars in this group have been recently issued from the astronomical observatory of Yale College. This contribution to a class of observations that is now receiving much attention, has been made with the heliometer by Mr. F. L. Chase at the suggestion of Dr. Elkin. The instrument employed is the same that Dr. Elkin used in his measurements of the Pleiades group, and the method of reduction follows generally the same lines that were then adopted; but the different configuration of the fundamental stars on which the measures are based, has enabled the observer to dispense in some degree with measures of position angle, the less trustworthy coordinate in heliometer observations, and to rely upon measures of distance from six selected stars, five of which form nearly an equilateral pentagon, the sixth being approximately in the centre. Two lines of stars roughly crossing the pentagon at right angles, and extending some six degrees, have been utilised for determining the scale value. The final result is to give the coordinates of thirty-three stars (Equinox 1892·0) limited to about the 8·5 mag., below which magnitude the most satisfactory observations cannot be made with the Yale instrument. An examination of the probable errors of the measures, classified according to the magnitude of the stars, does not disclose any law dependent on brightness, so that Mr. Chase has not overstepped prudence in this respect. At the same time the position of so many well-scattered points of reference has been determined, that it should be an easy task, and one worthy of accomplishment, to derive the places of the remaining and fainter stars of the group by means of photography.

OBJECTIVE GRATINGS.—Messrs. Hall and Wadsworth describe in the June number of the *Astrophysical Journal* the results of a fairly successful application of an objective grating, constructed on the original Fraunhofer method, and attached to a 12-inch photographic object-glass, whose ratio of aperture to its focal length is as 1:18. Two screws 27 cm. long, and with 63 threads to the centimetre, were cut in two along their axes, and the half-screws mounted, parallel to each other, on the opposite sides of rectangular frames. Copper wire was wound across in the successive threads, and soldered to the screws so as to produce a grating. When applied to the telescope, photographic spectra of both the first and second order could be obtained, and cases are quoted showing the agreement of the deduced wave-length with Rowland's values. One of the difficulties experienced in the use of this form of grating arises from the wind disturbing the lines of the grating, an annoyance which, it is suggested, might be prevented by soldering light rods across the wires parallel to the half-screws. The time required for exposure with objective gratings is of course longer than with the objective prism; but against these two disadvantages is to be set the comparative small cost of construction. In the one used in the experiments at Chicago, the cost was only one-thirtieth of that of an equally large objective prism of small angle, and evidently the advantage on the side of economy increases as the aperture increases. In the case of the Yerkes telescope, it is computed that the grating would cost about the two-hundredth part of the prism of the same size.

DISTORTION OF THE EARTH'S SURFACE.—Under the title of "An Earth-bending Experiment," Prof. H. H. Turner gives a description of a series of observations undertaken at Oxford by Prof. J. Milne (*Observatory*, July). In his investigation of terrestrial disturbances in the Isle of Wight, Prof. Milne found evidence of their being due to several causes. For instance, some are due to real local earthquakes on a small scale, some owing to faint echoes of very distant earthquakes, while it appears that others may have their origin in the various states produced on the surface of the ground by meteorological causes. These last have specially attracted attention, as it is quite possible that the considerable load represented by a shower of rain or snow, or a heavy fall of dew, may be capable of bending the surface of the ground to such a degree as to affect the stability of any astronomical instruments not having very deep foundations. In looking for these effects, it might be expected that tilts due to rainfall, though irregular, would show some evidence of an *annual* periodicity, while those produced by dew would show a *diurnal* variation. To test whether any of these causes might have an appreciable disturbing effect, the University Observatory at Oxford was chosen as being particularly suitable, standing alone in a grassy park. The instruments for detecting and recording any difference of level consisted of one of Prof. Milne's horizontal pendulums and the level of the Barclay transit circle. The effect of a sudden shower was imitated by securing the services of seventy-six people, who were marched, in various degrees of compactness, up to and away from the slate slab supporting the registering apparatus. The result of these experiments was that a small depression was observed, always towards the crowd, the maximum value, however, being only 0″·5, when the load was concentrated and close to the instrument. The load employed being estimated greater than is likely ever to be produced by rain, &c., it is concluded that on that particular site at least no disturbance due to meteorological causes need be feared.

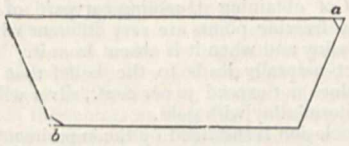
ON THE LIQUATION OF CERTAIN ALLOYS OF GOLD.[1]

THE molecular distribution of the metal in alloys of gold and of metals of the platinum group has been described by me in several papers, the most important of which has been published in the *Philosophical Transactions*. New

[1] Abridged from a paper read before the Royal Society, May 7.

interest in the subject has however arisen in connection with the extraordinary development in various parts of the world, and especially in South Africa, of certain processes which are now employed for extracting gold from its ores. Their use has been attended with the introduction into this country of a series of alloys of gold and of the base metals, which have hitherto rarely been met with in metallurgical industry. The base metals associated with the gold in these cases are usually the very ordinary ones lead and zinc; but their presence in the gold has given rise to unexpected difficulties, as the distribution of the precious metals in the ingots which now reach this country is so peculiar, that it is not possible to estimate the value of the ingots by taking the pieces of metal required for assay, by any of the well-known methods at present in use.

Investigation of the cause of the singular molecular arrangement of the ingots, has revealed many facts of scientific as well as industrial interest, which the author describes at length. The following case of an ingot of gold may be taken as typical.



Four assays were made on a portion of metal cut from the points marked *a*, at the top of the ignot; the highest of the results of assay indicated that 664 parts of gold were present in 1000 parts of the alloy, while the lowest assay gave only 465 parts. On the other hand, three assays on a piece of metal cut from the bottom of the ingot, at *b*, gave 652 parts of gold in 1000 as the highest, and 332·5 as the lowest. Clearly, therefore, the action of gravity does not explain the distribution of the precious metal.

The ordinary course, where divergent results of assay are obtained on portions of metal cut from such an ingot, would be to melt the entire mass, and take a "dip" assay piece, that is, to remove a portion of metal from the well-stirred fluid mass. This was done in all the cases cited in the paper here abridged, and as regards the mass of gold to which reference has just been made, assays on the portion of metal removed from the fluid mass gave results which were still very conflicting, the lowest assay showing the presence of 562·3 parts of gold, and the highest 653·5. It was evident therefore, that rearrangement could take place within the limits of a fragment of metal which did not weigh more than a few grammes.

The only method of ascertaining the value of the ingot consisted in separating the precious and base metals in mass, and the result of this operation showed the value of the ingot to be £1028, while the value, as calculated from the average of the assays previously made, would only have been £965, or a difference in value of £63 on an ingot weighing 12·223 kilograms. The importance of the question from an industrial point of view will at once be recognised when it is remembered that gold to the value of many millions sterling of the quality represented by the above results, now reaches this country annually.

Coming now to the scientific side of the problem, analysis of the ingot, to which reference has been made above, showed that it contained the following metals in addition to gold:

Silver...	8·1	per cent.
Lead	16·4	,,
Zinc	9·5	,,
Copper	4·0	,,
Iron	·3	,,

Suspicion at once fell on the lead and zinc as disturbing elements, and their influence was systematically investigated by a lengthy series of experiments, in the course of which gold alloys, containing different proportions of gold and of impurities, were cast in spherical moulds two and three inches in diameter, the solidified masses being explored by assays made on metal representing all parts of the mass. The general result of these experiments was to show that lead exerts a greater disturbing influence than zinc. The problem was then attacked from a different point of view. I availed myself of Roberts-Austen's method of fixing the solidifying points of metals on "cooling curves" obtained by the aid of thermo-junctions connected with autographic recorders. Such curves showed that a triple alloy of lead, gold, and zinc has three "freezing points." The mass sets as a whole at a single main point of solidification, but the lead and the zinc associated with some gold retain a certain amount of individual independence, and by falling out of solution, separately destroy the uniformity of the mass, even though the mass itself be small.

After a long series of experiments, a metallic solvent which would enter into union with the gold, the zinc, and the lead was sought. Silver proved to be such a solvent, and solidified alloys of gold containing not more than 30 per cent. of lead and of zinc, may be made practically uniform in composition by adding 15 per cent. of silver to the mass when fluid. The result is singular, as it shows that there are cases in which the uniformity of a gold alloy may be improved by lowering its standard fineness; and another proof of scientific interest is afforded of the fact that alloys behave like saline solutions.

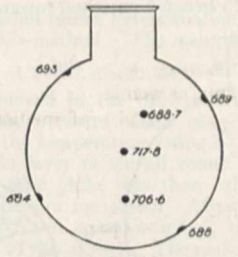


FIG. 1.—Gold 700 parts, lead 300 parts; weight about two kilograms.

The result shows a decided tendency of the gold *to liquate to the centre of the mass.*

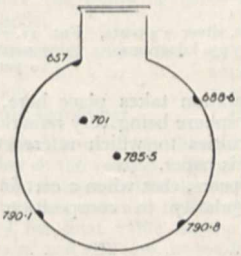


FIG. 2.—Gold 75 parts, lead 15 parts, zinc 10 parts; weight about two kilograms.

There is evidence of rearrangement by liquation in this case which sends gold to the centre, but the result is complicated, as gravity appears also to send gold to the lower portion of the spherical mass.

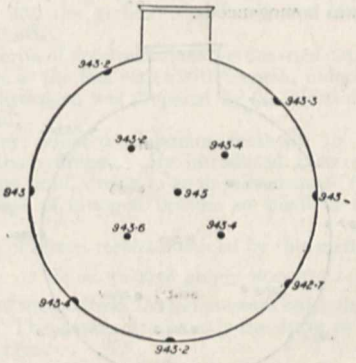


FIG. 5.—Gold 95 parts, zinc 5 parts; weight 4·430 kilograms.

A slight but decided tendency of liquation of gold towards the centre.

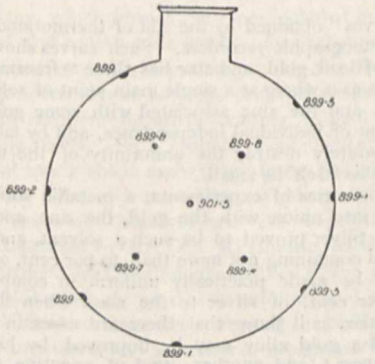


FIG. 7.—Gold 90 parts, zinc 10 parts; weight 4·200 kilograms.

This shows that there is still a tendency in this gold alloy with 10 per cent. of zinc to become enriched towards the centre.

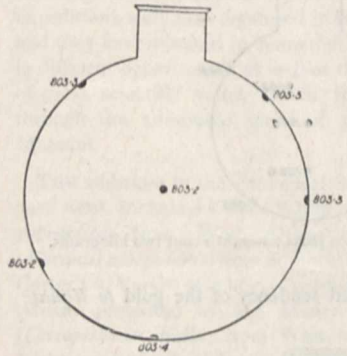


FIG. 9.—Gold 77·5 parts, silver 7·5 parts, zinc 15 parts; weight 3·930 kilograms.

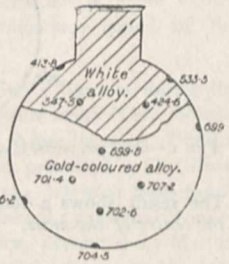


FIG. 11.—Gold 63 parts, silver 7 parts, lead 20 parts, zinc 10 parts.

Very marked separation takes place here, the difference at various points of the sphere being very remarkable, and forcibly illustrating the difficulties to which reference is made at the commencement of this paper.

As, however, it appears, that when a certain amount of silver is present, the irregularity in composition disappears, this mixture of—

Zinc...	10
Lead	20
Silver	7
Gold	63

was alloyed with more silver, so that it contained 15 per cent. of silver (nearly half the united amounts of zinc and lead present in the alloy).

This, cast into the 3-in. spherical mould, showed the following results at the points indicated. In *appearance*, the metal, when sawn in two, was homogeneous.

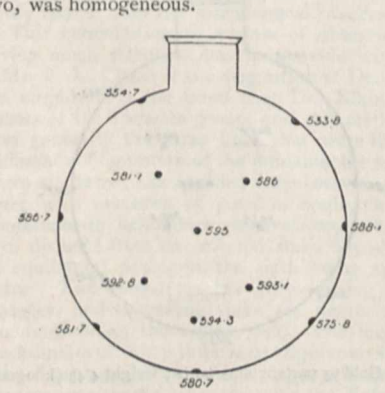


FIG. 12.—Alloyed so as to contain 15 per cent. silver; weight 3·450 kilograms.

There is here still evidence of liquation of gold towards the centre, but comparison of Fig. 12 with that which immediately precedes it will show how greatly the arrangement of the alloy has been modified by the presence of the additional 8 per cent. of silver. The proportion of silver in this alloy was proved by assay to be 15·5 per cent.

As there was still evidence of liquation, the metal was cast with still more silver, making 20 per cent. of silver in all. The alloy, when cast into a mould, proved to be almost uniform in composition, the difference between the centre and the extreme portions being very slight.

Liquation had practically ceased, a fact which proves incontestably that silver is the solvent for the base metals, zinc, and lead, when they are alloyed with gold.

Conclusions.—(1) Alloys of gold with base metals, notably with lead and zinc, now often met with in industry, have the gold concentrated towards the centre and lower portions, which renders it impossible to ascertain their true value with even an approximation to accuracy.

(2) When silver is also present these irregularities are greatly modified.

The method of obtaining "cooling-curves" of the alloys shows that the freezing points are very different when silver is present in the alloy and when it is absent from it.

(3) This fact naturally leads to the belief that if the base metal present does not exceed 30 per cent., silver will dissolve it and form a uniform alloy with gold.

(4) This conclusion is sustained by the experiments illustrated by Figs. 9, 11 and 12, which, in fact gradually lead up to it, and enable a question of much interest to be solved.

EDWARD MATTHEY.

THE ATOMIC WEIGHT OF OXYGEN.[1]

THIS monograph embraces a complete collection of the results obtained by Dr. Morley while working on this subject, and gives a detailed account of the various apparatus used. The experiments described extended over a very lengthened period. They consisted of the determination of the ratio between oxygen and hydrogen by two distinct methods, viz. by actually weighing the gases and by synthetising water. In all his experiments Dr. Morley dealt with far larger volumes of purer gases than previous experimenters had used, and in weighing them he reduced with surprising completeness every possible source of error. In his work on the synthesis of water, Dr. Morley succeeded in weighing the hydrogen and oxygen burned, and also the water produced thereby, achieving an exactness not attained by any previous experimenter, as none before had weighed all three factors. All experiments dealing quantitatively with gases are naturally extremely difficult, but Dr. Morley has, by paying attention to every detail, brought each process to a great pitch of accuracy.

The major corrections that were introduced into the determinations were as follows.

(1) The expansion of the glass of the globes.

(2) The errors of the mercurial thermometers.

(3) The deviation of the mercurial from the hydrogen thermometer.

(4) The difference between the coefficients of expansion of oxygen and hydrogen.

(5) The elevation of the cistern of the barometer above the centre of the globe when reading pressure.

(6) The correction of the scale of the barometer.

(7) The force of gravity at the laboratory.

In weighing the gases Dr. Morley employed large glass globes varying in capacity from nine to twenty-one litres. All data connected with the capacity of these were accurately determined. As the globes were so large it was found impossible to weigh them full of water to measure their capacity, and a different method had to be adopted. The globes were first weighed in air, then sunk in water, the weights being determined to keep the globes immersed; lastly the globes were filled with water, and again weighed in water. From these were obtained the external volume, the solid contents, and the capacity within ·02 per cent. In introducing a correction for the compression of the globes when exhausted, Dr. Morley devised an exceedingly ingenious plan. The compression itself was determined by placing the globe in a copper cylinder, which was then closed

[1] "On the Densities of Oxygen and Hydrogen, and on the Ratios of their Atomic Weights," by Dr. E. W. Morley. *Smithsonian Contributions to Knowledge*, No. 980. (Washington, 1895.)

and filled with water. A small tube led from the cylinder to a burette containing water. When the globe was exhausted the compression was measured by the amount of water run into the cylinder from the burette. Each globe was provided with a counterpoise of equal external volume when exhausted. A pair of small flasks were then made, the difference between whose volumes was equal to the amount of compression just measured, and whose weights in vacuo were equal.

For example, the actual compression of one globe was 1·27 cc. The two small flasks were made 2·08 and ·81 cc. in volume and of the same weight when weighed in vacuo; therefore when weighed in air they differed in weight by the weight of 1·27 cc. of the air at the time, taking into account the true value of the weights employed. When the globe was exhausted it was weighed against the counterpoise which had the same volume. When it was full of gas it was tared with the ·81 cc. flask against the counterpoise and the 2·08 cc. flask; the *true* weights of the globes therefore suffered equal additions, with the result that the *apparent* difference in weight would be the *true* difference as expressed by brass weights in air.

The measurement of pressure and temperature, Dr. Morley took especial pains to make as accurate as possible. In the many series of experiments which are comprised in this great research, different methods were adopted of measuring these values. When thermometers were used great care was taken in determining their errors, and in the calculation of the pressures the value of the force of gravity as actually determined at Dr. Morley's laboratory was used.

Dr. Morley's determinations are divided into four series.

The first series consists of the determination of the weight of one litre of oxygen.

The second series consists of a similar determination for hydrogen.

The third series contains some experiments to determine the volumetric composition of water.

The fourth is a series of syntheses of weighed quantities of water from weighed quantities of oxygen and hydrogen.

The first series of determinations are those of the weight of a litre of oxygen under standard conditions. Three different methods were adopted.

In the first the temperature and pressure were directly determined by use of thermometers and a manobarometer.

In the second method the temperature and pressure were not directly determined, but made equal to those of a standard volume of hydrogen.

In the third method the pressure was alone read, the temperature being that of melting ice.

The oxygen for this series of experiments was obtained from potassium chlorate. The salt was placed in a hard glass tube in a combustion furnace; this tube was joined to the rest of the apparatus by means of a ground joint cemented with wax. Dr. Morley made a point of using no rubber connections in any of his experiments, rightly observing that even though the leakage may be exceedingly small, still the extra trouble entailed by fusing all joints together is worthily bestowed. Dr. Morley says there is no reason to doubt the purity of this oxygen; nitrogen he sought for particularly, and found quantities varying from 1/12,000th to 1/5,000,000th, which are quite negligible, considering the closeness of the atomic weights of the two gases.

Dr. Morley discusses the question of mercury vapour, and reasons from his experiments on hydrogen that the error is not greater than the ten- or twenty-thousandth part of the density of oxygen.

The pressure in these experiments was measured by means of a manobarometer, which consisted of a barometer and two gauges mounted in the same trough of mercury. One of these gauges was used for oxygen and the other for hydrogen, the experiments on which were carried out at the same time. The barometer and gauges were placed in a cistern of water with plate-glass sides. In front of each tube, and in contact with it, was a glass millimetre scale. The three scales were adjusted so that their zero points were all on the same level. The cathetometer used for reading had two telescopes, each with a micrometer eyepiece. The accuracy of reading was found to be within 1/100th mm.

In weighing the globes Dr. Morley met at first with great difficulty, owing to currents of air disturbing the globes. Their effect was, however, almost destroyed by hanging the globes in a sheet-iron box, which was in its turn placed in a non-conducting chamber under the balance. The balance was one of Becker's make, and had never been used for any other purpose.

The mean of nine determinations by this method of the weight of a litre of oxygen is

$$1\cdot42879 \text{ gr.} \pm \cdot000034.$$

In the second method of weighing oxygen, the pressure and temperature were made equal to those of a standard volume of hydrogen. The preliminary part of this process was to fill a globe with pure hydrogen, and measure the pressure exerted by the gas on one leg of a differential manometer. This instrument was of the ordinary U shape, adjustment of the mercury being made to two needle-points, one in each limb. The globe containing the oxygen was then attached to the opposite limb, and the pressure adjusted till exactly equal to that of the hydrogen. A new balance was employed in these determinations, purchased especially for this work, and lent Dr. Morley by the Smithsonian Institution. Weighing was performed by reversal, the relative position of globe and counterpoise being changed by mechanical means.

Dr. Morley publishes fifteen determinations of the weight of a litre of oxygen by this method. The mean is

$$1\cdot42887 \text{ gr.} \pm \cdot000048.$$

The method employed in the third series of determinations was to determine the pressure of the oxygen by means of the syphon barometer, the temperature being 0° C. The globe was immersed in ice, the layer of ice all round the globe being 30 centimetres thick. The globe was then exhausted and oxygen admitted, and its pressure measured. After weighing the globe was again exhausted and again weighed, the difference being taken as the weight of the oxygen. The reason for this procedure was the fact of the globe being exposed to the action of water for such a long time.

As a mean of twenty-four experiments, Dr. Morley gives

$$D = 1\cdot42917 \text{ gr.} \pm \cdot000048.$$

We have, therefore, the following three mean results by the three different methods.

By use of thermometer and manobarometer	1·42879 ± ·000034
By compensation	1·42887 ·000048
By use of ice and barometer ...	1·42917 ·000048

In computing a final mean from these, Dr. Morley discusses the relative reliability of the results. He gives double weight to the third method, for, though involving more accidental errors, it involves no constant error common to the other methods.

Dr. Morley gives his final value for the weight of 1 litre of oxygen measured at 0° and 760 mm. at sea-level, and 45° lat., as 1·42900 gr. ± ·000034.

The second part of Dr. Morley's paper deals with his determinations of the weight of 1 litre of hydrogen under standard conditions.

Five series were made. In the first, pressure and temperature were measured; in the second, pressure only was measured, the temperature being equal to that of melting ice; in the third, the hydrogen was weighed in combination with palladium before introduction into the globe. The fourth and fifth were repetitions of the third.

The first series of determinations were carried out in exactly the same manner as the first series with oxygen, indeed at the same time. The hydrogen was prepared by the electrolysis of dilute sulphuric acid.

Dr. Morley adopted elaborate methods to measure the impurity in the hydrogen. He introduced a correction for the nitrogen found until, owing to an improvement of the apparatus, this percentage of nitrogen became so small as to be entirely negligible.

The mean of fifteen results obtained by this method is

$$D = \cdot089938 \text{ gr.} \pm \cdot000007.$$

The second method was to read pressure only, the temperature being 0° C. The details are exactly the same as in the similar case with oxygen.

The mean of nineteen experiments is

$$D = \cdot089970 \pm \cdot000011.$$

The third method, that of weighing the hydrogen contained in palladium, is one that is far more likely to prove accurate than methods depending on the weighing directly of a known volume

of hydrogen. For in the best case the weight of the globe was 600 times the weight of the hydrogen contained in it. The great advantage, however, to be gained from this method is the absence of any error introduced by mercury vapour, for it would have no effect on the weight of the hydrogen, and the volume and pressure of the residual mercury vapour are far too small to influence results. Dr. Morley has given especial attention to this method, and has brought it to a very great pitch of accuracy.

The palladium was placed in a tube which could be connected with the apparatus by a ground-glass joint. When the palladium was charged with hydrogen the tube was weighed. Connection being now made, a fusible metal plug, which took the place of a stop-cock, was melted, and the hydrogen passed into the globes. The tube was afterwards weighed, the difference giving the weight of hydrogen, usually about 3·7 grammes. This was found sufficient to fill three globes.

The mean of eight results in one series is

$$D = \cdot089886 \pm \cdot0000049.$$

The mean of four results in a second series is

$$D = \cdot089880 \pm \cdot0000088.$$

The mean of eleven results with a new apparatus,

$$D = \cdot089866 \pm \cdot0000034.$$

Dr. Morley gives as his final result for the weight of one litre of hydrogen under standard conditions,

$$\cdot089873 \pm \cdot0000027 \text{ gr.}$$

The third part of the paper deals with the determination of the volumetric composition of water. The electrolytic gas was produced in a voltameter, whose loss of weight gave the weight of gas used. This gas was admitted into globes of known volume, plunged in ice, where its pressure was measured. From these it was transferred to an eudiometer and exploded. The weight of gas usually dealt with was about 23 grammes. The explosion of the gases was carried on in a eudiometer, where all but 1/100th or 1/1000th part of the gas could be exploded out of contact with mercury. In all Dr. Morley's results he found excess of hydrogen, due to secondary reactions in the voltameter.

The mean value determined by ten experiments of the ratio of the excess of hydrogen to the whole combined volume of hydrogen and oxygen is ·000293. This value × 3 = ·00088 gives a correction to be applied to the ratio of hydrogen and oxygen, in order to obtain the ratio of volumes of hydrogen and oxygen that would combine without residue.

The mean of the ten experiments gives the value of the density of the electrolytic gas as

$$= \cdot535510 \pm \cdot000010.$$

In calculating the ratio of combining volumes, Dr. Morley takes into account the deviation of the mixed gases from the density computed by Boyle's law, and also the values of the constant a in Van der Vaals's equation. He obtains the ratio of mixture to be 2·000357, which, corrected for known excess of hydrogen, gives ratio of combining volumes to be

2·00269.

The fourth and last portion of the experimental portion of the paper deals with the syntheses of water from weighed quantities of oxygen and hydrogen. The hydrogen was weighed, absorbed by palladium, the oxygen weighed in a globe, and the two were combined together in a combustion apparatus, whose gain in weight gave the weight of water produced. The quantity of hydrogen used was about 42 or 43 litres; the measured residue of uncombined gas varied from 1/100th to 1/10,000th of quantity concerned. The combustion apparatus was plunged in water during the union of the two gases, in order to keep it cool. This process took about one and a half hours, and was carried on as far as possible. The remaining gas in the various parts of the apparatus was pumped out and analysed, the combustion apparatus being kept in a freezing mixture, to keep as low as possible the vapour pressure of the water. The rest of the process needs no description.

As regards two possible sources of error which have been suggested, Dr. Morley proved conclusively that his hydrogen from palladium contained no water, and that his phosphorus pentoxide absorbed no oxygen.

As the mean of twelve experiments, Dr. Morley gives the atomic weight of oxygen to be very nearly

15·879.

In collating all the results of his experiments, Dr. Morley gives the following values:

Weight of one litre of oxygen	1·42900
Weight of one litre of hydrogen	0·089873
Atomic weight of oxygen (chemical method) ...	15·879
Molecular weight of water (chemical method)...	15·879
Atomic weight of oxygen (physical method) ...	15·879

The probable accuracy of Dr. Morley's work appears to be exceedingly high, for he has in several cases spent especial trouble and time in eliminating hitherto constant sources of error. The extremely ingenious forms of apparatus he used for his many determinations are especially worthy of remark; and these, together with the extraordinary care bestowed in their use, combine to make the whole rank among the finest investigations of modern science. E. C. C. BALY.

SCIENCE IN THE MAGAZINES.

THE relation of complexion to disease is discussed by Dr. John Beddoe, F.R.S., in the course of a paper in *Science Progress*. Baxter's great work on the medical statistics of the Civil War contains evidence as to the greater liability of blonds to certain classes of disease (in America at least). It follows from this that the blonds in America have less chance than the brunets of contributing their due proportion to the next generation, and therefore the blonds ought to diminish relatively, and the brunets to increase.

As bearing upon this, it appears that of accepted soldiers from among the white natives of the United States, 66 per cent. were light and 34 dark complexioned, but the proportion for English, Irish, and Germans is 70 to 30. Thus, Dr. Beddoe points out, the men of American birth yielded a larger proportion of brunets than those of any of the nations that had contributed to their ancestry, which is nearly equivalent to saying that the Americans are more generally dark complexioned than their ancestors were. Statistics as to the colours of school children of Germany, Austria, Switzerland, and Belgium, and of adults in Italy and the British Isles, seem to furnish sufficient evidence that in a great part of Europe the citizens are darker than the peasantry. Why the blond type should be more susceptible than the brown to the malign influences of urban life is a difficult question to decide.

Other articles in *Science Progress* are:—"Prehistoric Man in the Eastern Mediterranean," by Mr. J. L. Myres; "The Graptolites," by Mr. J. E. Marr; "Insular Floras," by Mr. W. B. Hemsley; and "Recent Discoveries in Avian Palæontology," by Mr. C. W. Andrews.

There are several articles in the *Contemporary* to which attention may be directed here. Mr. Phil Robinson describes "The First Nest of a Rookery," in a pleasantly-written paper, but the interpretations of his observations are made too much from the humanistic point of view. Dr. Lennox Browne attacks "The Antitoxin Treatment of Diphtheria," his criticism being based mainly upon the Report of the Metropolitan Asylums Board, summarised in these columns in April last (vol. liii. p. 524). He claims that the mortality of cases treated by antitoxin at the London hospitals in 1895 is but a trifle lower than that of the previous year, and is in excess of what has been obtained in individual hospitals of the series whence the Report is issued; and, also, that this improvement has not been due to the serum treatment, but rather to increased vigilance and nursing care. Some "Girls' Technical Schools on the Continent" are described by Marion Mulhall. The article shows how the technical instruction of girls now takes a front rank in the cares and duties of many municipal authorities in Holland, Belgium, Germany and Austria.

Sir W. M. Conway describes in *Scribner* his walk of "A Thousand Miles through the Alps," and concludes his narrative with a comparison between Switzerland and the Tyrol from a traveller's point of view, much to the advantage of the latter. He says, and there are many ready to corroborate his statements, "Whereas travel in Switzerland is exploited by hotel-keepers and organised in their interests, the Tyrol is, through the agency of the powerful German and Austrian Alpine Club, organised by travellers themselves in their own interests. In Switzerland, traps are laid for the tourist's francs; in the Tyrol, every effort is made to spare his pocket." The Tyrol is far ahead of Switzerland in climber's food, in mountain huts,

and in all other facilities for mountaineering away from crowds of tourists. "In fine," concludes Sir Martin Conway, "no part of the Alps now forms a better training-ground for the youthful would-be mountaineer, none a less vulgarised holiday resort for the man of moderate physical capabilities, simple tastes, or restricted means, than the region comprised in the Austrian and Bavarian Tyrol."

In *Scribner* there is also an article on scientific taxidermy, under the title "A Lost Art," by Mr. J. Carter Beard. The reform in taxidermic methods is said to have begun fifteen years ago. As instances of successful work are cited Mr. W. T. Hornaday's "Fight in the Tree-Tops," illustrating a characteristic episode in the lives of orang-utans, whose habits he had studied in their native forests, and whose skins and skeletons he had himself collected; Mr. Hornaday's group of flamingoes, and groups of bison, in the U.S. National Museum, and New York Museum of Natural History; a group of Rocky Mountain goats, by Prof. L. L. Dyche; a young camel, by Mr. Rowley, in the latter Museum, and the rehabilitation of "Chico," a large ape, done for the same museum by the same taxidermist. Nothing is said of any of the specimens in our own Natural History Museum.

The *Geographical Journal* contains the address delivered by Sir Clements Markham at the recent anniversary meeting of the Royal Geographical Society. There are also contributions on "The Pamirs and the Source of the Oxus," by the Right Hon. George N. Curzon; "Admiralty Surveys during the Year 1895"; "The Indian Surveys 1894-95," by Mr. C. E. D. Black; and "Geography at the Universities." In the *Contemporary*, Mr. A. E. Pease has a short article on the political geography of "Africa North of the Equator." The *Century* contains "Glimpses of Venezuela and Guiana," by Mr. W. N. King; a short paper on Eskimo life, entitled "An Arctic Studio (77° 44′ N. lat.)," by F. W. Stokes; and "Impressions of South Africa," by Mr. James Bryce.

A passing mention must suffice for the remaining articles of scientific interest in the magazines and reviews received. Under the title "Stray Thoughts on South Africa," Olive Schreiner contributes to the *Fortnightly* some facts as to the crossing of races in South Africa and the results of the mixture of blood; Prof. Max Müller's paper on "Coincidences," read before the Royal Society of Literature in May last, appears in the same review. Dr. Louis Robinson discusses, in the *National*, some aspects of "The Science of Change of Air," and offers a few sensible and seasonable suggestions on the subject. Mr. F. E. Hewitt has in the *Westminster Review* a historical study entitled "How the First Priests, the long-haired Shamans, and their successors, the Tonsured Barber-Surgeons, measured Time." To *Longman's Magazine* Mr. Grant Allen contributes a popular paper on "Lobsters at Home." Mr. James Buckland describes in the *English Illustrated Magazine* the remarkable mode of nidification of the hornbills, and makes a conjecture why the male bird plasters up the nest and keeps the female a prisoner until the eggs are hatched. Finally, *Chambers's Journal* contains its usual complement of instructive articles, among the subjects being Mr. Carey Lea's work on modifications of silver, and artificial perfumes of flowers.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An examination in natural science (chemistry and physics) will be held on Wednesday, October 7, for the purpose of filling up a Bristol scholarship (open *pro hac vice*) of the annual value of £100 and tenable (under the usual conditions) for five years; the successful candidate to commence residence immediately upon election.

DR. T. M. LEGG has been appointed Professor of Hygiene in Bedford College, London.

THE widow of the late Dr. Arthur Jackson, of Sheffield, has presented £5000 to the Sheffield School of Medicine to endow a chair of Anatomy, to be named after her late husband.

THE Council of University College, London, have instituted a new Professorship of Pathological Chemistry, and have appointed Dr. Vaughan Harley to the professorship.

THE Cornell University has issued, in the form of a slender *brochure*, its programme of courses of instruction in physics for the session 1896-97. The Department of Physics occupies a large building known as Franklin Hall, and the equipment is valued at 50,000 dols. Prof. E. L. Nichols has the services of an efficient staff, consisting of three assistant professors and seven instructors. The curriculum includes elementary courses for senior and junior students, advanced work both for undergraduates and graduates, and courses given in the summer school from July 6 to August 16. Among other encouragements for research, one university fellowship and one graduate scholarship in physics are awarded each year. With a view to affording still further stimulus for research, the University, three years ago, founded the *Physical Review*, which is the only journal in America devoted exclusively to physics. Such enterprise furnishes an example which our older English universities would do well to emulate.

THE Duke of Bedford has placed at the disposal of the Technical Instruction Committee of the Bedfordshire County Council a farm of 275 acres, 149 of which are arable land and the rest grass. In addition to this his Grace has erected the necessary lecture-rooms, dormitories, and other buildings for the accommodation of twenty students. Twenty boys are granted free scholarships by the County Council, entitling them to two years' board, residence, and instruction in the science and practice of farming. On Tuesday, June 30, the members of the Bedfordshire County Council were able, at the invitation of the Duke, to pay a visit of inspection to the farm, and are able to report that every branch of farm and garden practice is efficiently taught by means of models and specimens in school and of actual work on the farm, in the dairy, poultry-yard, and garden. The institution is modelled on the lines of similar school farms on the continent, which were inspected and reported upon by the Organising Secretary of Technical Instruction some time ago.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 4.—"On the unknown Lines observed in the Spectra of certain Minerals." By J. Norman Lockyer, C.B., F.R.S.

In the first note of the series "On the New Gases obtained from Uraninite," by the distillation method, the author remarked[1] "I have already obtained evidence that the method I have indicated may ultimately provide us with other new gases, the lines of which are also associated with those of the chromosphere."

In a subsequent paper "On the Gases obtained from the Mineral Eliasite," he gave a list of several unknown lines, and suggested that they might indicate the existence of a new gas or gases in that mineral, and added[2] "Although the evidence in favour of a new gas is already very strong, no final verdict can be given until the spectra of all the known gases, including argon, have been photographed at atmospheric pressure, and the lines tabulated. This part of the inquiry is well in hand."

The inquiry above referred to has now been completed and in the following manner:—

Photographs were taken of the spectra at atmospheric pressure of nitrogen, oxygen chlorine, carbonic anhydride, coal gas, sulphuric anhydride, phosphoretted hydrogen, and argon, these being the gases which, from the experience thus far acquired are likely to be associated with those given off by minerals. In addition to these the lines of mercury, potassium, and platinum, were also photographed. The lines of platinum are always present in the spectra for the reason that the spark is passed between platinum poles, while the lines of mercury or potassium frequently appear according as the gases are collected over mercury or potash.

For the wave-lengths thus obtained no greater accuracy than one indicated by four figures is claimed. It was the author's intention, in the first instance, to give five figures from the more elaborate tables of some of the elements given by other observers, but this had to be abandoned in consequence of the considerable variations found in the tables between the results as given by different observers.

A list is given of sixty lines which have been observed and photographed in the spectrum of the gases from eliasite which do not appear in the spectra of the old gases.

[1] *Roy. Soc. Proc.*, vol. lviii. p. 70.
[2] *Ibid.*, vol. lix. p. 3.

UNKNOWN LINES OCCURRING IN VARIOUS MINERALS

Wave-length (*s*) determined by four-prism Steinheil.	Bröggerite.	Eliasite.	Samarskite.	Gummite.	Uranocircite.	Monazite.	Yttro-Gummite.	Orangite (thorite).	Calco-uranite.	Gadolinite.	Manganese nodule.	Thorite.	Euxenite.	Sun. Chromosphere (Young).	Sun. Eclipse 1893.	Stars.
3898·2	...	×														
3899·0	...	×	×													
3905·8	...	×		...	...	...	...	...	...	...	...	...	...			
3907·0	...	×	×	...	...	...	...	...	...	...	...	...	...	3905·6	...	3906·2 α Cygni
3915·0	...	×	...	...	...	×	...	...	...	...	...	...	...	...	3907·7	
3929·0	...	×	...	...	...	...	...	...	...	...	...	...	...			
3961·4	...	×	...	...	...	...	...	...	...	...	...	...	...	3928·1	3929·4	3929·4 δ Orionis
3972·0	...	...	...	...	...	×	...	...	...	...	...	...	...	...	3961·7	3961·6 α Cygni
3979·9	...	×												3971·0 (2)		
4002·0	..		×	...	...	...	...	...	...	...	...	...	...			
4015·0	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	4002·9 α Cygni
4035·2	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	4015·7 α Cygni
4056·0	...	×	×											...	{ 4034·64 { 4035·88	
4058·6	...	×	...	...	...	...	...	...	...	...	...	...	...			
4071·0	...	...	...	...	...	×	...	...	...	...	...	...	...	...	4859·1	
4072·8	...	×	...	...	...	...	...	...	...	...	...	...	...	...	4071·90	4070 Bellatrix, δ Orionis, α Virginis
4082·0	...	...	...	...	...	×								...	...	4072·2 α Cygni, Bellatrix
4114·0	...	×	×	...	...	...	...	...	...	...	...	...	...			
4128·3	...	×	...	...	...	...	...	...	...	...	...	...	...	...	4115·0	4115 δ Orionis
4131·4	...	×	...	...	...	...	...	...	...	...	...	...	...	...	4127·9	4128·6 α Cygni, Rigel
4224·0	...	×	..	...	...	...	...	...	...	...	...	...	...	...	4131·4	4131·4 α Cygni, Rigel
4255·7	...	×	...	...	...	...	...	...	...	...	...	...	...	...	4224·3	
4264·0	...	×	...	...	...	...	...	...	...	...	...	...	...	...	4256·0	
4277·0	...	×	×											...	4264·5	
4283·0	...	×	...	...	...	...	...	...	...	...	...	...	...			
4292·0	...	×	...	...	...	...	...	...	...	...	...	...	...	...	4282·8	
4309·3	...	×	×	...	...	...	...	...	...	...	...	...	...	...	4291·5	
4312·2	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	4309·4 α Cygni
4338·5	...	×	×	...	...	...	...	...	...	...	...	...	...	...	4313·2	4312·8 α Cygni
4427·3	...	×	...	...	...	...	...	...	...	...	...	...	...	4339·0 (10)	...	4338·0 α Cygni
4442·5	...	×	...	...	...	...	...	...	...	...	...	...	...	4426·6 (2)	4427·3	
4483·0	...	...	...	...	...	×	...	...	...	...	...	...	...	4443·5 (10)		
4953·0	...	...	...	...	×									...	4482·2	
5014·0	...	...	...	×												
5165·0	...	...	...	...	...	...	...	...	...	...	×					
5175·0	...	...	...	...	...	...	...	...	...	...	×					
5188·0	...	...	...	...	...	...	...	...	...	...	×	...	...	5188·1 (1)		
5202·0	...	...	...	...	...	...	...	...	×	...	...	...	...	5202·48 (5)		
5215·0	...	×	...	...	..	...	...	...	..	...	...	...	...	5215·35 (2)		
5220·0	...	...	...	...	...	...	...	×								
5380·0	×	...	...	...	...	...	...	...	×							
5404·1 (*s*)	...	×	...	...	...	...	...	...	...	...	...	...	...	5404·1 (5)		
5429·9 (*s*)	...	×	...	...	...	...	...	...	...	...	...	...	...	5429·9 (8)		
5485·0	×	×	...	×	...	×	...	...	...	...	...	...	×			
5505·0	...	×	...	...	..	×										
5515·0	×															
5575·0	...	...	...	...	...	×	..	...	×		...	×				
5598·0	...	×														
5630·0	...	...	...	...	...	...	...	×								
5660·0	..	...	...	...	...	...	...	...	×	...	..	×				

Wave-length (*s*) determined by four-prism Steinheil.	Bröggerite.	Eliasite.	Samarskite.	Gummite.	Uranocircite.	Monazite.	Yttro-Gummite.	Orangite (thorite).	Calco-uranite.	Gadolinite.	Manganese nodule.	Thorite.	Euxenite.	Sun. Chromosphere (Young).	Sun. Eclipse 1893	Stars.
5676·0	...	...	...	...	×	...	...				×					
5715·0	...	...	...	...	...	...	×	..	...	...						
5777·0	...	×														
5780·9 (*s*)	...	×														
5785·0	...	×														
5846·8 (*s*)	...	×														
5915·0	...	...	...	...	×	...	...	...	...	...	...	.	....	5914·38 (2)		
5984·0 (*s*)	...	×														
5991·6 (*s*)	...	×	...	...	...	...	...	...	...	...	...	...	...	5991·6 (10)		
6000·0	...	...	...	...	...	...	...	...	...	×						
6025·0 (*s*)	...	×	×													
6030·0	×.	×	×													
6035·0	...	×														
6043·0	...	×														
6047·1 (*s*)	×	×														
6060·0	...	...	...	...	...	...	...	...	...	×						
6064·0	...	...	...	...	×	×										
6065·7 (*s*)	...	×	×	...	...	...	...	...	...	...	...	...	....	6065·71 (5)		
6066·1 (*s*)	.	...	...	...	...	×										
6070·0 (*s*)	×	×	...	...	...	×										
6071·6 (*s*)	×	...	...	...	×											
6080·0	...	...	...	...	...	...	..	×								
6090·0	...	×														
6098·9 (*s*)	...	×														
6105·0	...	×														
6110·0	×															
6112·0	...	×	...	...	...	...	...	...	...	...	...	...	....	6111·29 (2)		
6114·5 (*s*)	...	×														
6115·9 (*s*)	...	×	...	×	...	...	...	...	...	...	...	×				
6122·43 (*s*)	...	×	×	×	×	×	×	...	...	...	...	...	....	6122·43 (5)		
6140·0 (*s*)	...	×														
6141·9 (*s*)	...	...	...	×	...	...	...	...	...	...	...	...	....	6141·93 (25)		
6162·4 (*s*)	...	...	×	...	...	...	...	...	...	...	...	...	....	6162·38 (8)		
6215·0	...	×	...	...	...	...	...	...	...	...	...	...	....	6215·3 (3)		
6218·3 (*s*)	...	×														
{ 6219·0 { 6220·0	...	×	...	...	...	...	...	..	...	..	..	...	....	6219·49 (3)		
6278·0	...	×														
6295·0	...	×														
6313·5 (*s*)	×	×														
6347·4 (*s*)	×	...	×	×	×	..	×	...	...	...	...	...	....	6347·3 (10)		
6350·1	×	...	...	×												
6371·1 (*s*)	×	...	..	×	...	...	...	...	...	.	...	...	....	6371·6 (5)		
6415·0	...	×														
6452·0	...	..	...	×												
6465·0	...	×														
6475·0	×															
6485·0	...	...	...	...	...	...	...	×								
6489·0	...	...	...	×												
6500·0	...	...	...	...	...	...	...	...	...	...	...	×				
6640·0	...	...	...	×												
6740·0	..	...	...	×												

The author also gives a complete list of the unknown lines so far as the observations have at present gone, indicating their mineral origins, and whether or not lines nearly coincident in position have been observed in any celestial body.

This table includes about a hundred lines, a large number of which have celestial coincidences.

June 18.—"Complete Freezing-point Curves of Alloys containing Silver or Copper and another Metal." By C. T. Heycock and F. H. Neville.

From a study of dilute solutions of metals in copper, the authors arrive at 50 calories as a probable value for the latent heat of fusion of copper. The freezing-point curve of alloys containing silver and copper does not indicate the existence of any chemical compounds of these metals; but the eutectic alloy has exactly the composition Ag_3Cu_2. Lead copper alloys have a freezing-point curve characteristic of substances which are partially soluble in each other. The tin copper curve is remarkable for a singularity near $SnCu_6$, and another at exactly $SnCu_4$. The compound $SnCu_3$ is not clearly indicated in the curve.

For alloys whose composition is between $SnCu_6$ and $SnCu_4$, the freezing-point curve is perfectly straight, a feature that may be due to the separation of isomorphous mixtures of these bodies. Nickel and iron raise the freezing-point of copper, whilst gold and silver depress it.

Geological Society, June 24.—Dr. Henry Hicks, F.R.S., President, in the chair.—The President referred to the death of Sir Joseph Prestwich, and a resolution was passed assuring Lady Prestwich of the Society's heartfelt sympathy with her in the sad and irreparable loss that she has sustained.—Sir William Dawson, F.R.S., exhibited specimens and lantern-slides illustrating the general form, arrangement of laminæ, and distribution of the canals and tubuli in characteristic specimens of *Eozoon canadense*. He pointed out that an examination of these specimens and photographs might prevent mistakes likely to arise from the study of imperfect specimens, or from supposing that laminated rocks resembled *Eozoon*, and also that they exhibited additional peculiarities observed since the original publication of the description of *Eozoon* in the *Quarterly Journal* of the Society in 1865. He did not wish to enter upon any argument as to the nature of *Eozoon*, but merely to show the appearance of the principal structures on which the conclusion that it was of animal origin had been based. He also pointed out that these structures might be misunderstood when studied in imperfectly-preserved specimens, and that the wonder was not that so many specimens were imperfect, but that any structure had been preserved. He also shortly noticed the growing probabilities in favour of the existence of a rich marine fauna in pre-Cambrian times, and some of the discoveries in this direction already made or in progress.—Notes on the glacial geology of Arctic Europe and its islands. Part II. Arctic Norway, Russian Lapland, Novaya Zemlya, and Spitzbergen, by Col. H. W. Feilden; with an appendix by Prof. T. G. Bonney, F.R.S. The author gave an account of observations made in Arctic Norway, which tended to prove that the shell-bearing terraces were true marine deposits indicating uplift since their formation, and that they were not formed by ice-dams. He then described terraces recently formed in Kolguev Island, which illustrated the combined influence of pack-ice, sea-waves, and snow on the formation of terraces in a rising area. The glacial geology of the Kola Peninsula was next considered, and the distribution of the boulders noticed. There was no doubt that these boulders had been derived from local rocks, and that no ice-sheet from the North ever passed through Barents Sea or impinged on the northern coast of Europe. The author saw no evidence of the former extension of an ice-sheet over the now frost-riven rocks of Novaya Zemlya. He found wide-spread deposits of boulder-clay with marine shells in this region, which he attributed to the action of floating ice. In the Kostin Schar many of the islands were connected by ridges covered with rounded stones pushed up by floe-ice, with solid rock beneath glaciated by the floe-ice. Several minor phenomena connected with the glacial geology of Novaya Zemlya were also described. The raised beaches of Franz Josef Land were noticed, and immense deposits occurring in Spitzbergen, which were originally formed under water in front of glaciers, alluded to. These, as well as other submarine deposits of glacio-marine origin seen elsewhere by the author, showed no signs of stratification. Prof. Bonney described specimens brought by Col. Feilden from Norway, the Kola Peninsula, and Novaya Zemlya. From an examination of the rocks obtained *in situ* in the latter region, Prof. Bonney confirmed Col. Feilden's suggestion that the Kolguev erratics may have come from Novaya Zemlya.—Extrusive and intrusive igneous rocks as products of magmatic differentiation, by Prof. J. P. Iddings. The author, after pointing out the propositions concerning differentiation of magmas, upon which he is in agreement with Prof. Brögger, discussed the points of difference, and described the relation of the igneous rocks at Electric Peak to all of those which took part in the great series of eruptions which occupied almost the whole Tertiary period, and spread themselves over a vast territory in Montana, Wyoming, and Idaho. The author enunciated the principle that in a region of eruptive activity the succession of eruptions in general commences with magmas representing a mean composition and ends with those of extreme composition.

EDINBURGH.

Royal Society, July 6.—The Hon. Lord M'Laren in the chair.—An obituary notice of the late Prof. James D. Dana was read by Prof. Geikie.—Dr. R. H. Traquair, F.R.S., read a paper on fossil-fishes from the Lower Devonian (*Hunsrückschiefer*) of Gmünden, Germany. Two species were described of which the first, *Drepanaspis Gmündenensis*, though named and briefly described by Schlüter in 1887, has hitherto been very imperfectly known. It has a hard and bony carapace composed of many tuberculated bony plates, a tail covered with rhombic sculptured scales, a heterocercal caudal fin bordered above and below with strong fulcra, but so far as can be seen there is no dorsal. There are no pectoral appendages. The position of mouth and eyes is still undetermined. The fish belongs undoubtedly to the *Ostracodermi*, and will form the type of a new family, *Drepanaspidæ*, whose position seems to be not far from that of the *Pteraspidæ*. The other species, *Coccosteus angustus*, Traq., was described as new—the ventral carapace is rather narrow, and the median dorsal plate shows evidence of an elevated median crest.—In the absence of Prof. Tait, Prof. Crum Brown briefly indicated the nature of his paper, a further communication on the kinetic theory of gases.—Dr. A. Lockhart Gillespie made a preliminary communication on digestion in some carnivorous plants. He gave a short *résumé* of the different classes of carnivorous plants, noting that the chief characteristic of all of them was not the power of converting native proteids into albumoses and peptones, but the complexity of the apparatus devoted to that end. In many plants, perhaps in all plants, peptonising ferments were present, especially in the seedlings, by which native proteids were resolved into diffusible forms which could be utilised in their nutrition. Darwin and others had shown in the case of *Pinguicula* and *Drosera* that many nitrogenous substances caused the glands of these plants to secrete an actively digestive juice. The author had investigated the action of the individual lower proteids on them, and also some of the lower derivatives of proteid digestion. He found that *Pinguicula* grew faster if fed once a week with a small quantity of proto-albumose than if nothing were given it, while raw egg-albumin, deutero-albumose, and peptone rather retarded its growth, especially the last. In fact, peptone (pure peptone, free from albumoses) killed the part of the leaf to which it was applied, after a few hours, however small the quantity. This was probably due to over-feeding. Serum globulin was slowly absorbed. Fibrin, coloured with carmine after Grützner's method, was not digestible; but egg albumin, coagulated in a weak solution of carmine, was slowly digested, and the glands could be seen coloured by the ingested carmine. He gave notes of the different times taken to absorb these various substances. *Drosera rotundifolia* reacted in a similar manner to these bodies. Its behaviour towards urea, kreatinin, tyrosin, nucleic acid, glycogen, and asparagin, was also investigated. Of these, only urea and asparagin were absorbed. Crystals of kreatinin were dissolved, but in a few days the leaf dried and the kreatinin could be seen crystallised out again on its surface. Crystals of urea, if very small, were readily absorbed; but, if large, speedily killed the leaf. Large quantities of asparagin were absorbed without detriment to the leaf, but these experiments were still in an unfinished state. With regard to the aggregation of protoplasm, as described by Darwin, Gillespie found that a very good way of obtaining permanent records of the process was to place the whole plant in a solution of some proteid weakly coloured with methylene blue, the protoplasm taking on the stain while the plant

continued to live. Under these circumstances the small sessile glands of *Drosera* stained deeply, showing that they became active in the presence of proteid material. Plants similarly treated with gentian-violet stained red where the glands were active, violet where they were only reflexly stimulated. The paper was illustrated by a number of lantern-slides and microscopic preparations.—Dr. C. G. Knott gave a summary of two papers by Mr. J. C. Beattie. The first was on the relation between the Hall effect and thermo-electricity in bismuth and in various alloys. That there was a connection was established, but what the precise nature of that relation was could not be determined till more definite knowledge of the Hall effect in alloys and with different temperatures, was arrived at. The second paper was on the curves of magnetisation for films of iron, cobalt, and nickel. The films were deposited on platinised glass and oscillated in the magnetic field. The results agreed with those already obtained for these metals in a solid condition.

PARIS.

Academy of Sciences, July 6.—M. A. Cornu in the chair.—The Secretary announced that the Institute would be able to award the Jean Jacques Berger Prize in 1897; the prize will be at the disposal of the Academy of Sciences in 1899.—Remarks by M. Albert Goudry on presenting a work on Philosophical Palæontology.—General laws of uniform flow in channels of large section, by M. J. Boussinesq.—Researches on tungsten, by M. H. Moissan. The pure metal is readily obtained by the reduction of tungstic acid with carbon in the electric furnace. With a large excess of carbon the carbide CW_2 is formed, which, in the fused state, readily dissolves more carbon, graphite crystallising out on cooling. Pure tungsten can be readily filed and forged, it welds easily, has no action upon a magnetic needle, and has a melting point higher than chromium and molybdenum.—On the solubility of carbon in rhodium, iridium and palladium, by the same. These three metals dissolve carbon with ease at the temperature of the electric furnace, and give it on solidifying in the form of graphite. No combination to form a carbide appears to take place.—Physiological action of high frequency currents; practical means for their continuous production, by M. A. d'Arsonval. When animals are placed within a solenoid traversed by currents of high frequency, the respiratory changes go on more rapidly. This was shown very simply by measuring the loss of weight in a given time.—Therapeutic effects of high frequency currents, by M. A. d'Arsonval. Since these currents have been found to cause a large increase in the rate of production of carbon dioxide in the body, it was thought that the application of such currents might give relief in diseases such as diabetes, gout and rheumatism, in which the rate of combustion is reduced. In two cases of diabetes the treatment produced marked relief.—On five photographs of the region round η-Argus, by Mr. David Gill.—Verification of Van der Waals's law of corresponding states, by M. E. H. Amagat.—Mr. Christie was elected Corresponding Member in the Section of Astronomy, in the place of Mr. Hind.—On a new capillary theory, by M. Marcellin Langlois.—A sealed note, by M. D. Loiseau, was opened: On some properties of raffinose, serving to estimate this substance in sugars.—On ordinary differential equations of the first order, by M. A. Korkine.—On the local attractions observed in Eastern Europe, by M. Venukoff. An account of the deviation of the pendulum in the neighbourhood of mountains in Bulgaria and in the Crimea.—On the refraction and diffraction of the X-rays, by M. Gouy. For the substances examined, the index of refraction, if not exactly unity, differs from it by a quantity less than the errors of experiment (·000001). As regards diffraction, none could be established with certainty, and the wave-length must be smaller than ·005 μ, or 1/100 of the wave-length for green light.—Composition of pendular movements, by MM. Jean and Louis Lecarme.—Comparative experiments on the pitch of cylindrical tubes vibrating transversely, by M. C. Decharme.—Action of zinc on the photographic plate, by M. R. Colson. The action has been traced to the vapour of zinc; it is most energetic after the surface has been cleaned with emery paper, but falls off as the surface oxidises. The practical conclusion is drawn that metallic zinc should not be used in the construction of the camera or dark box.—Action of nitrogen peroxide upon antimony trichloride, by M. V. Thomas. There appears to be no true compound formed, but only a solution of the gas in the trichloride.—The effect of a high temperature upon some sulphides, by M. A. Mourlot. In the electric furnace the amorphous sulphides of lead, antimony, zinc and cadmium are converted into galena, stibine, wurtzite, and greenockite respectively. The antimony sulphide gave some metallic antimony, but no trace of a sub-sulphide.—On two isomers of anethol (propenylanisol), by M. C. Moureu.—Action of ethoxalyl chloride upon naphthalene in presence of aluminium chloride, by M. L. Rousset. Two naphthylglyoxylic acids are obtained, the oximes of which on distilling *in vacuo* give (α) and (β)-naphthonitriles.—On amorphous greenockite of Laurium, by M. Christomanos.—Experimental researches on the effects of intravenous injections of saline solutions. Determination of their value in therapeutics, by MM. Bosc and Vedel.—Cutaneous evaporation in the rabbit; action of pilocarpine, by M. Lecercle.—On some points in the histology of the muscles of the Cirrhipedes, by M. A. Gruvel.—On an accidental parasite in man, belonging to the order of the *Thysanoures*, by MM. Frêche and Beille.—Influence of the composition of the water of lakes upon the formation of sublacustrine ravines, by M. A. Delebecque.—On a new sounding machine; portable apparatus with steel wire, by M. E. Belloc.

BOOKS RECEIVED.

BOOKS.—Year-Book of the U.S. Department of Agriculture, 1895 (Washington).—An Index to the Genera and Species of the Foraminifera: C. D. Sherborn, Part 2 (Washington, Smithsonian Institution).—Thirteenth Annual Report of the Bureau of Ethnology, 1891-92 (Washington).—Aus den Alpen: R. von Lendenfeld, 2 Vols. (Wien, Tempsky).—Report of the Chief of the Weather Bureau, 1894 (Washington).—Elementary Practical Chemistry, &c.: Prof. F. Clowes and J. B. Coleman (Churchill).—An Inquiry into the Alleged Liability of Wood Charcoal to Spontaneous Combustion, 3rd edition (A. Gardner).—Flora der Ostfriesischen Inseln: Dr. F. Buchenau (Leipzig, Engelmann).—Grundriss einer Geschichte der Naturwissenschaften: Dr. F. Dannemann, i. Band (Leipzig, Engelmann).—The Collected Mathematical Papers of Arthur Cayley. Vol. x. (Cambridge University Press).—The Official Guide to the Norwich Castle Museum: T. Southwell (Jarrold).—Grundriss einer Exacten Schöpfungsgeschichte: H. Habenicht (Wien, Hartleben).—A Geographical History of Mammals: R. Lydekker (Cambridge University Press).—Solutions to the Examples in Loney's Plane Trigonometry, Parts 1 and 2 (Cambridge University Press).—Wild Life of Scotland: J. H. Crawford (Macqueen).

CONTENTS.