THURSDAY, JANUARY 13, 1887

SCIENCE AND THE JUBILEE

II.

IN our article last week we referred to two directions in which the Jubilee memorial could in our opinion be made to fulfil functions of the highest importance which none of our existing institutions could take up, and we pointed out that one of them would be almost exclusively scientific.

The fact that so distinguished a man of science as Sir Frederick Abel has been appointed the organising secretary of the new institution amounts almost to an assurance that these possible high purposes will not be lost sight of. Sir Frederick Abel has proved himself to be not only a brilliant and patient investigator of new problems in science, but also one of those men whose indomitable energy and administrative power peculiarly fit him for a post in which sympathy with science in its highest aspects must be associated with a keen knowledge of and interest in affairs.

It is not merely a coincidence, but rather a sign of the times, that this week we refer in our columns to two other apparently distinct subjects, which in fact are most germane to the one we are discussing. The first is an article by Mr. Morris on the botanical federation of the West Indies, and the second is the recently issued Report of the Committee appointed by the Government to consider the question of the national science collections. Mr. Morris's article is connected with the proposed Jubilee memorial in this way: it shows that already, by the nature of things, the West India Islands are associating themselves with the mother country in things botanical, as, according to our view, all our colonies should in things scientific generally. The necessity, the thoroughness, and the economy which obviously must result from such an arrangement are well stated by Mr. Morris, than whom we know no higher authority. It should be a subject of pride to our men of science that, thanks to the broad views taken by three successive Directors of the Royal Gardens, Science is ahead of politics on a line where politics is bound to follow her; for the political federation of the West India Islands is a thing of the not very distant future. This reference to the West Indies induces us, almost compels us, to return for one moment to another matter touched on in our article last week. We then pointed out that topography, geology, and botany would not be the only arts of peace to which we need confine ourselves. Now, we are inclined to believe that any money which might be spent in federating the West Indies meteorologically by means of the telegraph, even if new cables had to be laid here and there, would be saved over and over again in twenty years by the protection afforded to shipping by forecasts during the hurricane season. Now, supposing such a system as this at work in one of the most interesting regions of the world from a meteorological point of view, and controlled, if need be, from the mother country, represented by the Meteorological Council, good would come all round; the Meteorological Council would gain a larger and closer view of the phenomena which it is its duty to study, and the federated colonies would obviously gain by the reduction in the yearly loss of life and capital.

We now pass to the Report on the National Science Collections. The connection between this Report and the proposal for the Institute can be gathered from the following statements.

We showed in our last article that the Committee appointed by the Prince of Wales were driven to South Kensington for a site by stress of money, even supposing that South Kensington was the worst possible site that could be selected. Our opinion is that South Kensington is the best site that could be selected for any institution which is to be anything more than an expanded Chamber of Commerce or Mart. But, however this may be, the fact remains that the Institute buildings, if erected at all, will be erected at South Kensington. Further the building must have a frontage.

It will be gathered from the Report of the Government Committee on the Science Collections that it is proposed to house them, including the historical and other objects recently transferred from the Patent Museum, in a building to run from Prince's Gate to Queen's Gate, at the back of the Museum of Natural History. Now, why should not the Royal Commissioners and the Government arrange matters so as to enable the Science Museum, which thus must be geographically associated with the Institute, to be commenced at the same time? In this way, it appears to us that the Royal Commissioners would have fully discharged their functions as regards the southern part of the land for which they are trustees, provided always that the Institute is really to promote the progress of science and art.

One word now as to the real place of this Science Museum among our national institutions for the promotion of knowledge. The student of literature in this country—the man who has to make new books, or whose desire it is to obtain any of the knowledge contained in old ones—finds in the British Museum library and reading-room the most magnificent organisation to supply him with what he wants. In this respect the British citizen to-day is as well off as, but perhaps no better off than, the citizen of Alexandria was in olden times; and now, as then, it is conceded that it is the duty and glory of a State which makes any pretence to civilisation to have such an institution as this among its resources. It is one of the arsenals of peace.

Turn to another line of intellectual activity: take the student of the biological sciences. The British Museum of Natural History is a library no longer containing books merely, but things which have to be studied to obtain new knowledge. Here, as among the books, the student is allowed to examine, to study, to collate, and to describe without stint, microscopes and other apparatus being provided for him; facilities are afforded to him in order that he may learn, and that the field of knowledge may be enlarged through his labours.

Yet another region of activity: take Art in all its branches. Our National Gallery and the art collections at the British Museum and South Kensington show that in past times, at all events, the State has considered it its duty to bring together collections for the benefit of the student, and even for the delight of the eye of the uninformed.

These institutions are not merely depositories for loans, in which the State enables its citizens to be benefited provided only that the process costs nothing, or next to nothing; but fabulous sums have at times been given, and willingly given, by the nation in order that we shall not be behind others in the opportunities afforded of cultivating the arts of peace.

We now come to the newest developments of human activity. We leave the ground common to us and Greece and Rome, and we approach the modern world, the world which is as it is because physics and mechanics and chemistry have been developed since those earlier days to which we have referred. These developments form the glory of our modern civilisation, and are the pith and marrow of our national life.

What do we find in our national collections representing these in this our England, where till a few years ago physics, mechanics, and chemistry had been most, and most successfully, applied?

Nothing, or practically nothing. The State, which has absorbed greedily some two millions nett in patent fees which have come into its coffers in consequence of these developments, has given nothing, or practically nothing, back. It is true that the generosity of private individuals has enabled the nation to possess and exhibit some of the most interesting among the historical apparatus illustrating the applications of those branches of science to which we refer. It is true also that the Science and Art Department has done its best to make bricks without straw, and the state of things is better now than it was ten years ago. We say ten years ago, because it is about that period since the Duke of Devonshire's Commission pointed out in the clearest and most emphatic way this great and damaging gap in our national resources, and pointed out, too, the various evils which would arise from it. Since that time other Committees have reinforced the Commission's suggestions. Those who know best know how well for the country it would be if the modern developments of knowledge were illustrated as well as the older ones. It is true that after ten years the thing has gone so far that a Treasury Committee has been appointed to consider how such a national collection could be housed. But it is not impossible that another ten years may elapse before anything is done, unless some special and extraneous reason be urged for the doing of it.

Then why should not the men of science in this year of Jubilee urge upon the Government that it also should not be lacking in commemorating this year? If the citizens of Greater Britain contribute a quarter or half a million in commemorating the year, why should not the Government contribute some 25,000*l.* (as an instalment of 100,000*l.*, which is all such a Museum need cost) in starting an institution which all students of science or its applications know will be the most important of ll in fifty years time, most important, that is, in everything that relates to the development of the resources of Greater Britain?

So much then for what the Government might well do in the year of Jubilee. It remains for us to consider what men of science as such can do. We believe that the keynote of what they can best do was struck by Prof. Huxley as President of the Royal Society. To this matter we shall probably take another opportunity of referring.

MARINE ENGINEERING

Die Schiffsmaschine; ihre Construction Wirkungsweise und Bedienung. Bearbeitet von Carl Busley. (Kiel: Verlag von Lipsius und Tischer, 1886.)

THE concluding volume of this important work on marine engineering equals in merit and style the portion previously published, of which a notice appeared in NATURE, vol. xxix. p. 426. It is a most laborious and well-digested compilation of all that is best worth preserving in relation to the resistance and propulsion of ships. The author with true German industry has sought far and wide for his materials, drawing from the writings of French, German, Dutch, American, and English authorities. But it may be stated with some satisfaction that the most recent and valuable investigations to which reference is made are those of our own countrymen. The labours of the late Mr. Scott Russell, Prof. Rankine, and Mr. W. E. Froude, have given an impulse and direction to the theoretical and experimental investigations of the problems of resistance and propulsion, of which the practical value cannot well be over-estimated. The action of the Admiralty in assisting the late Mr. Froude, and in now establishing, under the able direction of Mr. R. E. Froude, experimental works on an enlarged and permanent basis, has yielded substantial advantages to the Royal Navy, and benefited the science and practice of shipbuilding generally. One private firm on the Clyde has, for its own purposes, created a similar experimental establishment; another was established in Holland by the late Chief Constructor, Dr. Tideman; France has done something in the same direction; and Russia and the United States have given attention to the matter. Everywhere it is now recognised that the resistances of full-sized ships may be closely approximated to by means of experiments with models; and in this manner the problems of ever-increasing difficulty incidental to the attainment of higher and yet higher speeds are being dealt with confidently and successfully. Pure theory cannot master these problems, although it has suggested the best experimental procedure. The older theories of resistance summarised by Mr. Busley have given place to the "stream-line" theory, and upon it has been based the "law of comparison" between ships and models independently laid down by the great French teacher, M. Reech, and the late Mr. W. Froude.

Mr. Busley shows full appreciation of the value of these modern experimental methods, while he also describes the more or less "rule-of-thumb" methods which formerly prevailed and have still their uses. It is not possible for most shipbuilders and marine engineers to have model experiments for new ships, and they therefore depend largely upon the analysis of the results of speed trials made with other ships. Carefully conducted trials on what is called the "progressive" principle—that is, at a number of different speeds from the maximum speed attainable down to four or five knots per hour—are of the greatest value to future designs of ships and machinery. For a long time they have been made occasionally in the Admiralty practice; but Mr. W. Denny deserves great credit for bringing the system into general use and establishing its practical value. Associating progressive trials with the "law of comparison" for the resistances of ships of different dimensions but similar forms, a designer can feel great confidence of success in most of his practice. If he has the *data* for small ships propelled at relatively high speeds, he has the means of approximating closely to the performances of larger ships up to much higher speeds, and this is of enormous value under present conditions.

Methods of *propulsion* and details of *propellers* occupy a large section of the volume under review. The paddle-wheel, the screw, and the water-jet propeller all receive full discussion in their theoretical and practical aspects. Probably no such summary of facts relating to modern practice has been made before by any writer. Under paddle-wheels, for example, there are descriptions constituting practical data for designing paddles at the *sides* of steamers (the ordinary plan), at the *stern*, as in light-draught river-steamers, and at the *centre*, between twin hulls, as is the fashion in some American river-steamers. Under the jet-propeller appears a great mass of information as to the fittings and performances of a number of vessels, including the English gunboat *Waterwitch* and Thornycroft's torpedo-boat of recent construction, the German *Hydromotor*, described in NATURE, vol. xxvi. pp. 18 and 247, and a Swedish experimental boat. Naturally the greatest attention is bestowed upon screw-propellers, which are most generally employed. To the theory of the screw-propeller laid down by Rankine, many valuable additions have been made by the Froudes, father and son, Mr. R. Froude being still engaged in the investigation of the subject experimentally. Up to the present, however, it cannot be said that any complete, acceptable theory has been put forward. Experience shows that by the choice of proper screws enormous economies of power or sensible increases in speed may be secured. The first trials of H.M.S. *Iris*, nearly ten years ago, were fortunately most disappointing, for they compelled a close study of the screw question in her case, with the result that the speed was increased from 16½ to 18½ knots per hour simply by a change of screws. Similarly striking results have been obtained in ships and boats of the torpedo flotilla, and in vessels of the mercantile marine. Much yet remains to be done before a satisfactory practice can be insured in choosing a suitable propeller for a ship of novel type or exceptional speed. Probably here also experiment with models of screws will come in to assist full-scale operations. Attempts in that direction have been made for many years past in the Admiralty Experimental Works, but the task is one of great delicacy and difficulty, and is far from having been completed.

Mr. Busley goes over this ground very carefully, and gives practical rules, based on experience for the most part, for fixing the sizes and pitch of screws. One of the best of these is that published by Mr. S. Barnaby and based on the extensive experiments of the Messrs. Thornycroft, whose success in the construction of exceptionally swift vessels results in part from the close attention given by them to screw-propellers. Mr. Busley has an interesting chapter on the geometry of screw-propellers; and his remarks on the most suitable materials for propellers are important.

The illustrations to this volume are numerous and well executed. The letterpress and general style of production leave nothing to be desired. It may be anticipated that the work now completed will speedily become a standard book of reference for German marine engineers.

W. H. W.

AN ARCTIC PROVINCE

An Arctic Province: Alaska and the Seal Islands. By Henry W. Elliott. Illustrated by many Drawings from Nature, and Maps. (London: Sampson Low and Co. 1886.)

MANY accounts of Alaska and of the wonderful seal-rookeries to be met with on some of the islands in its Arctic seas have been published, but none which have given in so interesting and succinct a manner the history of these far-off northern solitudes as the present volume. The author's personal knowledge of these regions, and his intimate acquaintance with the very numerous writings of others on the subject, have enabled him to write a volume that will long remain a standard one; while the illustrations from his own pencil are full of life and vigour, and add immensely to the value of the work.

The volume contains, of course, an account of the discovery, in 1741, of the Alaskan Province by Veit Bering, and of his shipwreck and sad death. The survivors spread the news of the wealth of fur and ivory that was to be found there, and soon came the rush of Russian traders. Fierce struggles took place between the individual traders and the natives, and much blood was shed, but at last a Russian American Company was established with supreme powers; and for a time, under the supervision of that very remarkable man, Governor Alexander Baranov, it flourished. Its decadence, however, proved to be as rapid as its rise; and after various vicissitudes, lasting during the first half of the present century, the district was, in 1867, acquired by the United States Government by negotiation from Russia. The name of Bering was given to the Straits connecting the Pacific with the Arctic Ocean by our Capt. Cook.

The features of the Sitkan region are treated of in a special chapter. Were it not for the damp and extensive rainfall, the climate would be endurable. A great deal of the scenery is most picturesque. The aboriginal life of the Sitkans is glanced at, but this portion of the work contains nothing very new or profound, as the author does not profess to know as much about the natural history of the human race as about that of the marine mammalia. In separate chapters, the alpine zone of Mount St. Elias, Cook's Inlet and its people, and the great Island of Kodiak, are treated of. The quest of the otter has a whole chapter devoted to it. Few ladies realise how many men are engaged in deeds of hazardous peril to obtain for them the ebony sea-otter trimming to their dainty sealskin sacques. These otters would seem to be on the eve of extirpation, so ruthlessly are they hunted and destroyed. All the world's supply comes from the North Pacific and Bering Sea. The chase and capture of the otter furnish the only employment possible for several thousands of the semi-civilised natives of Alaska, so that the destruction of this trade would be very disastrous to the hunters.

The chapter on the great Aleutian Chain tells us of the volcanic island of Oonimak, the cone-shaped crater of Shishaldin, and Oonalashka Island, with its smoking volcano of Makooshin. The chief interest of the volume centres, however, in the chapters relating to the wonderful Seal Islands, and on the modes of capture of the seals, and on their habits. The Pribylov Islands of Bering Sea were discovered just a century ago by Pribylov, the commander of a Russian sloop. He called them Subov Islands, but the Russians seem unanimously to have elected to call them after their discoverer. Sketch-maps of St. Paul and St. George are given, and there are very full and minute details of each, and of the few neighbouring rocky islets, including Walrus Island, which would appear to teem during the summer season with bird life. The history of the progress made from the earliest to the present times by the various villages on these islands is also given, and the writer alludes to the fact that the natives may be expected in the end to adopt the English rather than the Russian tongue.

The longest chapter in the volume is that devoted to the history of the habits and manners of the fur seal, which in myriads frequents these islands, and this chapter will well deserve perusal. From the economic point of view the author seems satisfied that, should the laws and regulations made by the United States Government be acted on in the future as they are now, 100,000 male seals under the age of five years and above the age of one year may be safely taken each year without the slightest injury to the regular birth-rate, or the natural increase thereof. Calculating the pups at 1,000,000 a year, of this number half are males. Of these, say one-half are lost during their first year of infancy. Owing to the polygamous habits of the males and the great age to which the adult males live, not one-fifteenth of this number is ever needed on the rookeries, and on this showing it is better that they should be killed to supply the fur trade with their skins, than that they should be allowed to live to consume millions of cod and wolf-fish.

The sea-lion (*Eumetopias stelleri*) is also a characteristic pinniped of these islands, but, having no fur, is for its naked skin valuable only to the natives. Mr. Elliott gives a graphic account of the habits of these enormous beasts, the adult males of which will measure 10 to 11 feet in length, with a girth of 8 to 9 feet around the chest and shoulders.

In the chapter on "Innuit Life and Land" a good deal of information is given as to an immense northern area, where the dwelling-houses are approached by underground passages, and where moose and reindeer abound. Still more northern wilds are described in a chapter on "Lonely Northern Wastes," while one on "Walrus and Walrus-hunting" concludes the volume. These morse are perhaps of all animals the most difficult subjects that an artist can find to reproduce from life. There are no angles or elbows to seize hold of; the outlines of the body and limbs are all rounded, free, and flowing. Some life studies of the young made by artists no doubt are good; but, until the appearance of Mr. Elliott's drawings of the fully mature animal, we had nothing in the way of portraits much better than caricatures of these strange beasts.

One interesting fact is mentioned in connection with Norton's Sound: on its shores are many low clayey bluffs, which, as they are annually undermined by the surf and chiselled by frost, fall in heavy masses on the beach, thereby exposing deposits of the bones and tusks which apparently belong to the mammoth. From time immemorial the Innuits have used this ivory for tipping their spears, lances, and arrows.

The illustrations, as we have before said, form a very prominent feature in this volume, which we commend to the reader's notice as both interesting and pleasant reading.

ANTIQUITIES OF SPAIN AND PORTUGAL

Les Ages préhistoriques de l'Espagne et du Portugal. Par M. Émile Cartailhac. Imperial 8vo, with 450 cuts and 4 plates. (Paris: Reinwald, 1886.)

ANTHROPOLOGISTS and archæologists will gladly hail this handsome volume from the pen of the editor of the "Matériaux pour l'Histoire primitive de l'Homme." It relates to two countries of the primæval antiquities of which but little is generally known, and the literature concerning whose early relics has hitherto been but scanty. It is true that we have various essays on the prehistoric antiquities of Portugal by Carlos Ribeiro, Delgado, and the Geological Commission; while those of Spain have been treated of by Signor Tubino and Dr. Vilanova y Piera, and, so far as Andalusia is concerned, by Signor Gongora y Martinez; and, as to some of the caves, by Mr. MacPherson and the late Mr. Busk. The work, however, of M. Cartailhac is far more general and comprehensive than that of any previous author. It will be well perhaps to give some sort of summary of the contents of his book.

After some preliminary considerations, he attacks the subject of the quartzite and flint flakes, which have been considered by some to prove the existence of man in Portugal in Tertiary times, but after a fair examination of the facts, not only in Portugal but in France, he regards the proofs as not sufficiently convincing, and remarks that unexceptionable traces of Tertiary man remain still to be discovered. Probably not a few of those who visited the plain of Otta on the occasion of the Prehistoric Congress at Lisbon in 1880 will agree in this verdict of M. Cartailhac.

The existence of Quaternary man in Spain has evidence in its favour of a far more satisfactory character. Sections of the remarkable valley-gravel deposits of the Manzanares at San Isidro, near Madrid, are given, as well as cuts of some of the implements there found, which, so far as form and material are concerned, might have come from the valley of the Somme. Some other implements of the same class have also been found in Portugal. Instruments both in flint and bone similar to those from the caves of the Dordogne, including needles and the peculiar barbed harpoons, have been found in caverns in the north of Spain; but at present no remains of reindeer have been found associated with them. Notwithstanding this fact, the caves would appear to be of about the same age as those of La Madelaine.

The remains of Neolithic age found within the Iberian Peninsula form the subject of the next portion of M. Cartailhac's book. Foremost among these he places the shell-mounds, which in some parts of the valley of the Tagus attain to considerable dimensions. Those at Mugem were visited by many of the members of the Prehistoric Congress, and it is somewhat remarkable that the mollusks, of the shells of which the *Kjökken möddings* principally consist, no longer are occupants of the Tagus near the mounds, but are only to be found much lower down the river, where the waters are more salt.

The principal worked flints that occur in the mounds have much the appearance of having been chisel-shaped arrow-points. Curiously enough, the mound which was thrown up as a refuse-heap by the living has been also utilised as a cemetery for the dead—intramural interments having probably not been forbidden. Some of the caves have furnished remains of pottery covered with a raised reticulated pattern, as well as objects in stone, bone, and shell. Many of them have also been the site of Neolithic interments, and the Casa da Moura has furnished one of those remarkable skulls on which trepanation has been begun but not finished. Large flat lance or javelin points of flint were found in this cave, having both faces polished after the manner of some Irish specimens. Indeed, there is a considerable resemblance in the *facies* of the flint antiquities of Portugal with what prevails in Ireland, and this somewhat corroborates the view of there having been in ancient times Iberian settlers on the shores of Hibernia. The resemblance between some of the bronze implements of the two countries is also worthy of notice. A number of ornamented pendants of slate, some of peculiar plume-like form, have also been found in the caves, the devices upon them being formed of notched and plain triangles and zigzags of almost identical character with the ornaments upon some of the Irish bronze celts.

Some imitations of stone or possibly bronze celts mounted on handles, as adzes, are very remarkable. They are carved in marble or soft stone, so that they could hardly have been used as cutting tools, but they may have had some symbolical meaning. The most interesting of the burial-places are the *Antas* or dolmens, of which a considerable number exists, some of large dimensions. In their general character they much resemble the megalithic monuments of France and Britain. Chambered barrows and *allées couvertes* are also known. In them have been found arrow-heads not unlike some of the Danish forms, with very long curved barbs and no central stem, as well as others of more simple triangular forms. In the dolmens also some of the chisel-shaped tips like those from the shell-mounds have occurred.

Traces of the old copper-mining industry of Spain have been found in the shape of large mauls of stone, with a groove or channel around them destined to receive the withe which formed the handle. The bronze swords and daggers much resemble those of Southern France and Italy, while the flat celts of bronze and of copper are like those of Ireland. The palstaves, however, or flanged hatchets, have frequently a loop on either side, instead of one only as is commonly the case in most European countries. The socketed celts have also frequently two loops, a peculiarity which is more common in parts of Russia than in other countries of Europe.

Coming down to what our author calls protohistoric times, various weapons and ornaments of the Early Iron period are figured, as well as some slabs of stone inscribed with what are apparently Phœnician letters. Of these, however, no interpretation is given. The concluding chapter is devoted to anthropological remarks, and full particulars are given of a series of skulls from some of the caves, together with photographic illustrations.

The preface to the work is from the pen of M. A. de Quatrefages, who, however, goes far in advance of M. Cartailhac in his acceptance of the discoveries of Tertiary man.

Those who are interested in the early history of mankind, and in comparative archæology in general, will do well to consult M. Cartailhac's book, in which they will find many other points of interest besides those which have been summarised in this brief and imperfect notice.

J. E.

OUR BOOK SHELF

Educational Exhibits and Conventions at the World's Industrial and Cotton Centennial Exposition, New Orleans, 1884-85. Special Report by the Bureau of Education. Part I. Catalogue of Exhibits. (Washington: Government Printing Office, 1886.)

THE extensive collection of everything connected with education which was to be made at the Exhibition held at New Orleans, and also the remarkable success of the United States Bureau in obtaining and dispersing educational information, have been referred to more than once in this journal. The Hon. John Eaton, Commissioner of Education, accepted the post of Superintendent, and the Government encouraged him to do everything in his power for the success of the undertaking; and this not unwisely, for the excellence or otherwise of the education exhibits of any locality is regarded as an attraction or warning by the most valued class of emigrants. Accordingly he made use of a visit to France, Belgium, and England to gain exhibitors, and in France he was very successful. At the Exposition he addressed large assemblies of teachers, and to himself as well as to the Bureau which he represented were awarded "Grand Diplomas of Honour" for valuable contributions. An illustrated catalogue of apparatus lent by the Bureau for experiments in the leading departments of physics is given in the Report. Among these the electrical instruments, as also a solar microscope, were particularly attractive at the Exhibition. Each State was urged to send specimens of the work, as also any objects which illustrated the growth and present condition, of its University; of its normal schools; of its schools of each grade; the work, on uniform paper, of children in every subject and standard; photographs and ground-plans of its best schools; school literature published in the State; technical work also, and both the methods and the performances of special schools, as for the blind, &c. Though not many States responded fully to this wide invitation, yet the fact that over nine thousand specimens (many of them *volumes* of school-work) were exhibited by Ohio alone, with regrets that a more complete set from all cities could not be got together, shows hat a worthy response was made in some cases.

As much school *matériel* was exhibited as manufacturers could be induced by a circular from the Bureau to show gratis, and naturally the smaller articles were profusely sent in. Where specimens were deficient, as in the case of heavier furniture, heating and ventilating apparatus, &c., they were not unfrequently purchased and supplied by the Bureau, as was also a fully equipped laboratory arranged so as to economise space in schools.

Among the objects supplied by American exhibitors, were statistical charts of every educational subject. Manual training, a matter of special value in the Southern States, was carried on in the building, and the boys' products attracted particular interest. An effort was made that household industry, in its four departments of nursery, kindergarten, kitchen-garden, school of cookery, with sewing, &c., should be fully illustrated, but the first and fourth were not found practicable. A model kindergarten, in which sixteen children were being taught by means of choice objects in each important department of knowledge, instead of with books, and so furnished that it looked the brightest and pleasantest room in the building, was exhibited by the Commissioner; and kitchen-"garden" instruction, *i.e.* in domestic servants' work, was given on four afternoons a week during March and April.

Gymnastics and physical education with apparatus for exercises of various degrees of severity were shown, with lessons and illustrations several times a day. Library appliances, as well as every description of educational works, were largely exhibited in this land of the free library. Specimens of work from reformatory schools, boots, brushes, wood-work, and clothing made by boys had their place beside photographs, publications, kindergarten work, sewing and fancy work done by girls. Washington exhibited a collection of apparatus for showing the simpler scientific experiments, made by public school pupils, the illustrations of which, given in the Report, show how brain and fingers have worked together there. From the same city also was sent a miniature copy of a school recently erected there, set up as a "model" school in both senses of the word, but plans of it are not given in this Report.

One of the most important exhibitors was Prof. Ward, of Rochester, N.Y., of whose museum of natural history, though it comes under the head of commercial department, a full-page ground-plan is given. It consists of a well-balanced collection of specimens of recent stuffed and extinct restored animals; specimens of minerals found in the United States; and models of the most important geological features from all the best known parts of the globe.

An item worth notice in grammar-school, *i.e.* second-grade, education, is a collection of maps made by the boys under the master's instructions, showing countries in relief, with their natural productions denoted by little pieces of minerals, or grains of rice or corn.

A Text-book of Pathological Anatomy and Pathogenesis. By E. Ziegler. Translated and edited by Donald MacAlister, M.A., M.D. Part II. Special Pathological Anatomy, Sections IX.-XII. (London: Macmillan & Co., 1886.)

THIS, the third volume of the work, fully justifies the high opinion we expressed of its predecessors. In point of excellence of treatment, lucidity of description, general arrangement of the subject, fullness of detail, and abundance of excellent illustrations, it gives to the work as a whole a completeness and thoroughness which, we believe, have not been attained by any previous work, in English or foreign tongues. The pathology of the urinary organs is described in Section IX. (Chapters lxiv.-lxxv.); Section X. (Chapters lxxvi.-xc.) treats of the diseases of the respiratory organs, the thyroid and thymus glands; Sections XI. and XII. (Chapters xci.-ciii.) of the pathology of the central and peripheral nervous system. If amongst all that is good in the volume we had to choose what is best, we should name the chapters on the pathology of the lung and central nervous system. The classification and the detailed description of the morbid changes of these two organs are most excellent in every respect.

As in the previous volumes, so also in this, a carefully collected summary of the more recent references is given in connection with each subject. A useful index, both of the names of authors cited and of the subjects treated, concludes the volume. The illustrations are copious, representative, and well-chosen. Those illustrating the pathology of the kidney and respiratory organs are in point of printing far above the illustrations one is accustomed to see in English text-books.

As a text-book for students, and a book of reference to workers in pathological anatomy, it is unequalled.

E. KLEIN

Hours with a Three-Inch Telescope. By Capt. Wm. Noble, F.R.A.S., F.R.M.S. (London: Longmans, Green, and Co., 1886.)

THE present volume, which is to a great extent a reprint, is designed for the help and instruction of those who, possessing a small telescope, are at a loss as to how best to use it. On the whole, the book well fulfils its author's purpose. Clear, simple, straightforward, and practical, it gives just that elementary instruction in the use of a small instrument which so many require, and which has hitherto been provided for them nowhere else, and it will undoubtedly serve as a good introduction to more advanced books, such as Webb's "Celestial Objects." Occasionally a rash statement needing correction is met with—*e.g.* the footnote on p. 84—but for the most part the book has been carefully written. It is illustrated by a good map of the moon, and by over one hundred woodcuts. The latter are clear, but possess no special merit otherwise; indeed, the representations of Jupiter and Saturn are poor; but, despite a few such slight blemishes in detail, the volume cannot fail to be useful.

Lunar Science. By the Rev. Timothy Harley, F.R.A.S., Author of "Moon-Lore," &c. (London: Swan Sonnenschein, Lowrey, and Co., 1886.)

THIS little book contains a clear and interesting account of the essential facts known about the moon in ancient and modern times. Having referred, in the introduction, to some of the more general aspects of his subject, the author proceeds to discuss, in separate chapters, the moon's distance, its size, shape, substance, formation, condition, surface, and motions. In the chapter on the moon's motions, the writer has a good deal to say about the use which has been made of the moon as the measurer of time. "The etymology of the word," he says, "is full of meaning. 'Moon' and 'Month' are twins, whose parentage was Sanskrit." The truth, of course, is, not that "their parentage was Sanskrit," but that "Moon" and "Month" and the Sanskrit word "Mâs," the measurer, have the same root. As kindred words appear in several other Aryan languages, it may be assumed that the moon served as a chronometer to the Aryans before they dispersed. The Athenians began their year upon the first new moon after the summer solstice, and this year they divided into twelve months, containing alternately thirty and twenty-nine days. Each month, again, was divided into three decades. The Romans also divided their months into three parts, and, says Mr. Harley, "the first day was called *Calendæ*, from an old verb meaning 'to call out,' because a pontiff then made proclamation to the people that it was new moon. These *Calendæ* have given us our word 'calendar.'" Among the North American Indians, time is computed by moons or months, and they talk of the "beaver moon," the "buck moon," the "buffalo moon," and so on, exactly as the Greeks used to talk of the "planting moon," the "reaping moon," the "wine moon," and the like.

LETTERS TO THE EDITOR

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

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

Mr. Wallace on Physiological Selection

In the September issue of the *Fortnightly Review*, Mr. A. R. Wallace published an article criticising the theory of physiological selection, and subsequently published a letter in NATURE conveying the substance of that criticism. Having now replied to all my critics in the current issue of the *Nineteenth Century*, I will here give the substance of my answer to Mr. Wallace.

"(1) Mr. Romanes makes a great deal of the alleged 'inutility of specific characters,' and founds upon it his extraordinary statement that, during his whole life, Darwin was mistaken in supposing his theory to be 'a theory of the origin of species,' and that all Darwinians who have believed it to be so have blindly fallen into the same error. I allege, on the contrary, that there is no proof worthy of the name that specific characters are usually useless, and I adduce a considerable series of facts tending to prove their general utility."

Now, in this matter I not only "allege," but prove, that I have upon my side Darwin himself ("Origin of Species," pp. 171, 176, 421; "Descent of Man," p. 61) and more or less "all Darwinians." Moreover, I have shown that the arguments whereby Mr. Wallace seeks to justify his own individual views are quite unworthy of their distinguished author.

"(2) In support of his view as to the swamping effects of intercrossing, Mr. Romanes objects to the assumption of Darwin, 'that the same variation occurs simultaneously in a number of individuals,' adding: 'Of course, if this assumption were granted, there would be an end of the present difficulty'; and his whole argument on this branch of the question rests on the assumption being false. I adduce evidence—copious evidence—that the supposed assumption represents a fact, which is now one of the best-established facts of natural history."

The "copious evidence" here alluded to consists merely in a reference to the well-known observations of Mr. J. A. Allen upon the kinds and degrees of individual variation exhibited by certain species of American birds. I am able to show that none of these observations have any bearing upon the "difficulty" in question; and that so far from the "assumption" in question representing "a fact which is now one of the best-established facts of natural history," even so accomplished an ornithologist as Mr. Seebohm displays so sublime an ignorance of its establishment as to affirm, in his criticism of my paper, that "it is seldom that the difficulties of natural selection from fortuitous variations have been so clearly, so impartially, but so candidly set forth." And he adds, *speaking specially of birds*, "So far as is known, no species has ever been differentiated without the aid of geographical isolation," *i.e.* without some check upon free intercrossing.

"(3) Mr. Romanes states, as the special feature of his physiological varieties, that 'they cannot escape the preserving agency of physiological selection.' He gives no particle of proof of this, while I show that, on the contrary, it is hardly possible for them to survive to a second or third generation."

The objection here is that the chances must be greatly against the "physiological complements" (or the suitably varied individuals of opposite sexes) happening to mate, and, even if they did, that their progeny should likewise do so often enough to start a permanent variety.

In answer to this objection I first of all adopt my critic's assumption, namely, that in all cases physiological selection must depend on the chance unions of physiological complements, relatively very few in number, and scattered over areas occupied by large species. Upon this assumption I agree that the sexual variation, "whenever it occurs, is almost certain to die out immediately," after which the paper proceeds as follows:—

"Granting it is shown that the union of these physiological varieties of opposite sexes is a matter of enormously rare occurrence, is it not also true that *the origin of a new species is an enormously rare event?* Not a few existing species have remained unchanged from remote geological time; the life of all species is incalculably long as compared with that of their constituent individuals; and in every generation of individuals there are, in the case of most species, millions of fertile unions. Therefore, so far as we can form any estimate on a subject where all proportion seems to fail, we may safely conclude that the ratio between the number of species which have appeared upon this earth, and the number of fertile unions between their constituent individuals, can only be represented by unity to *billions*.

"In view of this fact I am not afraid of any calculation that can be made, in order to show how many chances there are against the confluence of those conditions on the occurrence of which my theory supposes the origin of a species to depend. According to Mr. Wallace's estimate, the chances against the suitable mating of these physiological varieties 'may be any number of *thousands* to one'; so that, in view of the considerations above given, and the large number of species existing at any one time, we might conclude that Mr. Wallace supposes the birth of a new species to be an event of almost daily occurrence. Therefore, looking to what we all know are the real facts of the case, even if it were true that whenever one of these physiological varieties occurs, 'it is almost certain to die out,' this *almost* may be here quite sufficient for all that is required. Thus, upon the whole, and under my temporary acceptance of Mr. Wallace's assumptions, I confess it appears to me a somewhat feeble criticism to represent that the conditions which my theory requires for the origin of a new species are probably about as rare in their occurrence as is the result which they are supposed to produce.

"So much, then, for my first answer. My second answer simply is that from its beginning to its end this criticism is wholly in the air. Hitherto I have been considering his assumptions merely for the sake of argument. But they are not *my* assumptions; they form no part of my theory; and, therefore, I repudiate them *in toto*. The paper which Mr. Wallace is criticising clearly and repeatedly sets forth that I do *not* suppose the mating of physiological varieties to be wholly a matter of chance. Whether or not it is a matter of chance will depend on the causes which determine the variation. When these causes are of a kind which act simultaneously on many, on most, or even on all individuals occupying the same area, the element of chance is proportionally excluded. One very obvious, and probably frequent, instance of what may be termed collective variation in the reproductive system—or a variation due to a common cause acting on many individuals simultaneously—is actually quoted from my paper by Mr. Wallace himself, namely, changes in the season of flowering or of pairing, which insure that any section of a species so affected shall be fertile only within itself. Collective variation of this kind may be directly due to the incidence of some common cause, such as changed conditions of life with respect to food, climate, station, &c.; or, as in the case of bud-variation, it may be due to a single 'sport' affecting all the blossoms growing *upon the same branch*. But besides such *direct* action of a common cause, it is easy to see that natural selection, use and disuse, &c., by operating in the production of organic changes elsewhere, may not unfrequently react on the sexual system *indirectly*, and so induce the sexual change required in a number of individuals simultaneously. All the parts of an organism are so intimately tied together, and the reproductive system in particular is known to be so extraordinarily sensitive to slight changes in the conditions of life, or to slight disturbances of the organic system generally, that in their work of adapting organisms to changes of their environment all causes of an 'equilibrating' kind must be calculated more or less frequently to affect the reproductive system in the way required. . . .

"If I have succeeded in making myself intelligible, it will have been seen that Mr. Wallace's objection to my theory admits of a twofold answer. In the first place, it is impossible for him to 'show' that the origin of a species is any more frequent than it ought to be, even upon the assumption which he has imputed to me—namely, that such origin is always due to the chance mating of more or less extremely rare varieties. And, in the next place, this assumption on his part is wholly gratuitous—or rather, I should say, directly opposed both to my own statements and to all the probabilities of the case.

"From which it is easy to perceive the inevitable inference, or, if not, by stating it I will furnish a cue to future critics. *The real difficulty against my theory is precisely the opposite of that which Mr. Wallace has advanced.* This real difficulty is that the differentiation of specific types has not been of nearly so frequent occurrence as upon the theory of physiological selection we should have antecedently expected. Looking to the great sensitiveness of the reproductive system, to the many and the varied causes which affect it, to the frequency with which these causes must have been encountered under Nature, to the fact that whenever a collective variation occurs of the kind which induces physiological selection it must almost certainly leave a new species to record the fact—looking to all these things, the only real difficulty is to explain why, if physiological selection has ever acted at all, it should only have done so at such comparatively rare intervals, and therefore have produced such a comparatively small measure of result. If my critics had adopted this line of argument I should have experienced more difficulty in meeting them. But, as the case now stands, it seems enough to remark that I do not know of any way in which an adverse criticism admits of being more thoroughly exploded, than by showing that the difficulty which it undertakes to present is the precise opposite of the one with which an author is in his own mind, and at that very time, contending.

"Seeing how remarkable has been the misunderstanding displayed by such competent readers as Mr. Wallace and Mr. Seebohm—a misunderstanding on which they both found their only objection to my theory—I should have been compelled to suppose that my paper failed in clearness of expression, were it not that (as above shown) they have disregarded the literal construction of my sentences. Nevertheless, it is probable enough that I may not have sufficiently guarded against a misunderstanding which it never occurred to me that any one was likely to make. For I supposed that all readers would have perceived at least that the main feature of the theory is what my paper states it to be—namely, that sterility with parent forms is one of the *conditions*, and not always one of the *results*, of specific differentiation. But, if so, is it not evident that all causes which induce sterility with parent forms are comprised by the theory, whether these causes happen to affect a few individuals sporadically, a number of individuals simultaneously, or even the majority of an entire species?"

GEORGE J. ROMANES

Meteor of December 28, 1886

THE meteor referred to by your correspondent "J. M. H." (NATURE, January 6, p. 224) was also observed at Bristol at 10h. 28m. The path was from $95° + 9\frac{1}{2}°$ to $106\frac{1}{2}° - 6°$. A train of sparks was thrown off from the nucleus as it slowly fell.

Comparing the apparent course of the meteor as recorded at Sidmouth and Bristol, it is evident that its radiant-point was at about $77° + 30°$, near β Tauri. It belonged to a shower which appears to have a very extended duration, and has been specially referred to, with diagrams, in NATURE, vol. xxxi. p. 463.

This recent meteor affords unmistakable proof that the radiant near β Tauri continues active until the end of the year. The relative paths at Sidmouth and Bristol show that the meteor was about 97 statute miles high at its first appearance over a point in the English Channel some 28 miles off the Isle of Wight. Moving with a very slight inclination west of north, it disappeared 10 miles south-west of Niton, Isle of Wight, when 39 miles high. It traversed a path of 62 miles at an inclination of 69° to the earth's surface.

The duration of the meteor was about three seconds, so that its velocity appears to have exceeded 20 miles per second, which is greater than that of a body moving in a parabola, though the difference may quite possibly have been induced by observational errors. As regards visible effect, the meteor can lay no claim to the dignity of a fire-ball, but it is one of considerable interest as belonging to the remarkable display of β Taurids.

Bristol, January 7 W. F. DENNING

The Production of Ozone

I SHALL be much obliged if you can inform me through your paper—

(1) What apparatus would be most conveniently and easily worked by ordinary persons for the production of ozone in a room? I have tried a four-cell Smee's battery with a Siemens' ozone tube. This produces the required quantity of ozone, and works well in the hands of people used to scientific apparatus, but the general manipulation (especially as regards keeping the battery in working order) is above most people.

(2) Is there any battery you know that would give good results and be easily worked by people wholly unused to scientific apparatus (domestic servants for instance)? The quantity required is what would keep the air of an ordinary sitting-room, say $18 \times 16 \times 11$ feet so charged, that ozone would be always just sensible to the smell.

I see by the advertisements of the hotels in the Engadine, that the air in their corridors is kept constantly ozonised. (3) Could they adapt their electric light dynamos for this purpose? (4) If so, how?

I may say I have no "trade purpose" in making these queries. I am a sufferer from phthisis, and find relief in the inhalation of ozone, but I want an apparatus that I could leave to my servants to manage. W. H.

"Brading," Madeira Road, Bournemouth

JOHN ARTHUR PHILLIPS, F.R.S.

BY the sudden death of this chemist and metallurgist on the 5th inst. geology loses one of its ablest leaders in a department where the labourers are not very numerous here, and at the same time one of the kindliest and most helpful among the students of science. Mr. Phillips was born in Cornwall, and among the metalliferous rocks of that county began the scientific researches which he has since prosecuted with so much success. Having early shown his taste for mining and metallurgy, he was sent to obtain his training in these subjects at the École des Mines of Paris. As far back as 1841 he began to contribute papers to the scientific journals. His early essays were almost wholly devoted to chemical and metallurgical subjects. His studies among the Californian gold-fields, however, led him to investigate wider questions in physical geology. By degrees he turned into the domain of petrography, and for the last sixteen years it has been mainly in that branch of science that his original researches have been carried on. His papers on the eruptive rocks of the south-west of England are admirable illustrations of the value of the union of chemical and mineralogical qualifications in petrographical inquiry. Most of his time during the last two or three years had been devoted to the production of large and important treatises. Of these his volume on "Ore Deposits," published in 1884, has taken its place as a standard English work of reference. At the time of his death he was busy with the preparation of a new edition and expansion of a work on "Metallurgy," which he had published when still a young man. In this task he had associated Mr. Bauerman with himself, in whose competent hands the volume is sure to see the light in a form worthy of its author's reputation. Those who were personally acquainted with Mr. Phillips, while they lament the loss to science which his sudden death has inflicted, mourn still more the extinction of a life of singular simplicity, earnestness, and kindliness. He was a large-hearted and open-handed man, fond of taking every chance that came in his way of doing a good deed and helping every one to whom his help could be of service.

BOTANICAL FEDERATION IN THE WEST INDIES

IN the nearest of our tropical colonial possessions, which comprise the group of islands generally known as the West Indies, the dominant industry for the last hundred years has been that of the sugar-cane. Sugar and rum are indissolubly connected with these islands, and, under the circumstances which existed fifty years ago, there is no doubt that lowlands in the West Indies were better suited for the remunerative culture and growth of the sugar-cane than any other plant. Owing to a variety of causes, among which the abolition of slavery and the extension of sugar plantations in other lands are the chief, sugar-growing in the West Indies has suffered numerous reverses of fortune. Latterly, the difficulties of planters have been greatly increased by the improved production of beet-sugar in Europe.

The chief sugar islands at present are Barbados, Antigua, St. Vincent, Trinidad, St. Lucia, and Tobago. At Jamaica, sugar and rum are still the staple industries, and form 39 per cent. of the exports, the balance being made up by other industries, such as coffee, fruit, and dye-woods. At Trinidad cacao is largely grown, and the export value of this article is nearly two-thirds that of sugar. Grenada, once a large sugar-growing colony, is now almost entirely devoted to cacao. Montserrat is becoming noted for its lime plantations, and exports of lime-juice; while Dominica exports concentrated lime-juice, cacao, cocoa-nuts, and tropical fruits. The Bahamas have a large tropical fruit trade with America, supplemented by the export of sponges, to the value of £60,000 annually. In spite of these smaller industries, however, there is no doubt that the chief business of the West Indies is still that of sugar. A capital of something like fifty millions sterling is invested in it, and the people are naturally reluctant to relinquish an industry which has, in the course of a century, become thoroughly established, and which is familiar in its details to all classes of the community. But, after all, it is impossible to overcome the logic of facts: and it is admitted on all sides that sugar, under present circumstances, can with difficulty be grown and manufactured to pay a profit. Hence it is not surprising that there is a strong desire to enter upon other cultivations; and it is well for the future prosperity of the West Indies that this should be so. The depression in the past and the comparative poverty of the present are no doubt due to the exclusive cultivation of one plant; for under such circumstances, when the sugar-market is depressed, everything is depressed. If improvements in cultivation were adopted, and if such high scientific skill as is applied to the manufacture of beet-sugar were applied to the manufacture of cane-sugar, it is the opinion of many that the planters would again become prosperous. But something more is necessary. With the exception of two islands in the whole group—namely, Antigua and Barbados—it is estimated that more than one-half of the actual surface of the West Indian Islands is suitable for other cultivations than sugar-cane. This being so, the people injure their best interests by neglecting the resources at their disposal.

In purely sugar islands, such as Barbados and Antigua, permanent improvement is to be sought in more economic and improved systems of cultivation, added to which there should be a concentration of all purely manufacturing processes under what is known as the *Usine* system. This latter system is already in existence at Trinidad, St. Lucia, British Guiana, and in the French island of Martinique; and it is proved beyond question that where the manufacture of sugar is treated as a highly specialised industry, finer and better qualities are produced, and the expenses are considerably diminished. Planters are therefore recommended to confine themselves as much as possible to the cultural operations of a sugar estate. Under such a division of labour there would follow a more careful trial of different varieties of the sugar-cane, adapted to the different soils, a more scientific application of special manures, and such general regulation of all cultural operations as would produce canes of the highest saccharine richness. In Barbados, Trinidad, and Jamaica, there are already Government analytical chemists, who are qualified to give valuable information to planters as regards soils and manures; and from a report recently prepared at Barbados by Prof. Harrison it is evident that much good would result from a larger utilisation of chemical knowledge as applied to sugar cultivation, both in the interest of the individual and of the general community.

During the last five or six years efforts have been made to increase the efficiency of West Indian industries by a wider and more general application of scientific methods not only to the sugar-cane but to all other plants which may be found suitable to the circumstances of the several islands. Hitherto two botanical establishments have been maintained for the West Indies—one at Jamaica and the other at Trinidad. From these centres, but especially from that of Jamaica, economic plants and information by means of annual reports and other publications have been regularly furnished, and such agencies have greatly assisted in enlarging the scope of experimental culture.

In the Report of the Royal (West Indian Finance) Commission, appointed in 1883, it was stated that there was a growing inclination on the part of the planters in other West Indian colonies to apply for seeds and plants to the Botanical Establishment in Jamaica, which could supply each island with what it required in the most economical manner. Sir Joseph Hooker, commenting on this report, expressed the opinion that there could be no doubt that the future prosperity of the West Indies would be largely affected by the extension to other islands, unprovided with any kind of botanical establishment, of the operations so successfully pursued in Jamaica. And it was suggested by Mr. Thiselton Dyer that, in addition to the distribution of plants, there might be organised a regular system of botanical bulletins, containing practical hints as to the treatment of economic plants, and the conditions under which they might be best utilised as objects of remunerative industry.

At the instance of the Secretary of State for the Colonies, it was ultimately decided that the whole of the West India Islands should be asked to co-operate in a systematic endeavour to promote and extend the cultivation of economic plants, and thus to develop more fully than heretofore their natural resources. This proposition was duly laid before the Governments of Barbados, the two groups of the Leeward and Windward Islands, and the colony of British Honduras. On account of the want of direct and regular communication, it was found impossible to include the Bahamas, while British Guiana is already supplied with its own botanic garden. The conditions on which the islands lying within the West India group were asked to join in this industrial federation were, first, the provision of an annual grant for the maintenance of a local station to discharge the functions of a scientific outpost and a nursery; and secondly, the contribution of small sums towards the support of operations at the central establishment. These small sums were intended to cover the special expenses incurred in behalf of each island in maintaining a depot for seeds and plants, and to pay the cost of publishing the botanical bulletins, which were intended to form an important feature in the scheme. The Legislative Council of Jamaica has recently expressed its willingness to give effect to the principle of the scheme as regards making the Botanical Establishment in that colony one of the central points of action; and it is anticipated that, while granting valuable aid to the smaller islands, Jamaica itself will derive, both directly and indirectly, considerable benefit from such vigorous and systematic working as would naturally arise in its own area, as well as from a larger interchange of plants and seeds with the neighbouring islands.

It is hardly necessary to observe that, in reply to the Secretary of State's despatch, the smaller islands were not slow to express their desire to be included in the scheme, and steps were taken in several to give effect to this desire by the establishment of local stations. Barbados was fortunate in possessing favourable means for starting a botanical station in connection with the Boys' Reformatory at Dods, where land was already under experimental cultivation in canes and in food-plants suitable to the district. This station is now at work, under a committee whose business is to supervise operations, and to communicate directly with the central establishment.

Grenada, which is in a fairly prosperous condition, has enlarged the original idea of a botanic station by making provision for a small botanic garden, which is now in course of being laid out under the charge of a trained superintendent (originally from Kew, but with Jamaica experience) at the Paddock, within easy reach of the town of St. George. At St. Vincent the proposal to utilise the old botanic garden of the colony as a botanical station has been adopted, but the provision at present made is insufficient for the purpose, and will require to be slightly increased.

St. Lucia, to the north-west of Barbados, has shown a spirit of commendable energy in taking up the idea, and has given practical effect to it through the operations of its well-organised agricultural society. An experienced curator, also from Jamaica, has recently been appointed to the charge of the station, and good results are anticipated. At Dominica the botanical station has not yet assumed a practical form owing to the depressed state of the finances; but there is little doubt that ultimately such a station will be established, and the resources of this fertile island more largely developed.

Further north, Antigua, more especially concerned in the cultivation of the sugar-cane, has joined the scheme, and apparently is only waiting the completion of final arrangements at the central establishment. British Honduras, which has already benefited by its intercourse with the Botanical Establishment in Jamaica, has the site for a station, and a managing body has been appointed to begin operations at an early date.

To give a certain cohesion and uniformity of action to these several agencies, it was thought very desirable that a visit should be made to the islands concerned by the head of the Jamaica Department. This was accomplished in the early part of last year by the writer of these notes, who was happy to devote a short holiday, on retirement from Jamaica, in visiting the islands at his own expense.

During this visit sites for stations were examined and discussed, and suggestions made for their working on the lines best suited to local circumstances. As a practical instance of the feasibility of a botanical federation of the West Indies, it may be mentioned that recently an inquiry has been made, by general consent of the local Legislatures, into the condition of the indigenous forest growths of these islands, by Mr. E. D. M. Hooper, of the Madras Forest Department.

The Reports on Jamaica and St. Vincent are already published, and they are of such a practical and useful character that they cannot fail to have an appreciable effect upon the treatment and management of the forests both as reserves of timber to supply future wants, and as a means of maintaining a due humidity of climate and protecting the sources of springs and rivers. These Forest Reports, when completed, will add greatly to our knowledge of West Indian timbers, their nature, extent, and distribution; and they will also afford for the first time in history the actual economic and meteorological conditions of the interior of several islands beyond the confines of the present areas under cultivation.

In many instances the natural forest trees, as at Barbados, the Virgin Islands, and some of the islands of the Grenadines, have been nearly exterminated; those once very common, and represented largely in collections of botanical travellers of the last century, are now almost unknown. If the botanical stations are carried on with due regard to the industrial wants of the community, and are not allowed to degenerate into mere nurseries for ornamental plants, they will indirectly do much to enlarge knowledge as regards local floras, and bring to light many indigenous plants likely to prove useful on account of such medicinal and economic properties as they may possess. In the year 1824 it was laid down as one of the objects of the then Botanical Garden, at Jamaica, that it should devote attention "to the investigation of many unknown native plants of the island, which, from the properties of those already known, it is reasonable to infer would prove highly beneficial in augmenting internal resources by supplying various articles either for food, for medicine, or for manufacture, . . . by means of which great commercial advantages might be obtained; among others, the various vegetable dyes claim particular attention, as promising a fruitful field of discovery." As indicating the direct bearing which this one field of inquiry (vegetable dyes) among many others had upon the future of Jamaica, it is interesting to note that while no dye-woods whatever were exported from the island in 1824, a small trade of the value of 1859*l.* was started in 1833, which since that time has steadily increased, until now it has assumed relatively large dimensions. The exports of dye-woods in 1870 reached a gross value of 112,313*l.* ("Jamaica Handbook," 1884-85, p. 375).

Similar results in more recent times have attended the increased attention given to the cultivation of fruits that had been neglected in Jamaica. The export of these in 1875 amounted to 14,912*l.*, in 1884 the total value had increased to 273,534*l.*

Results such as these, although obviously of a special character, justify any attempt that may be made to improve the circumstances of the West India Islands; and they afford also a striking instance of what is capable of being accomplished in these islands when careful investigation and judicious and enterprising effort are made to fit local circumstances to the demands of the outer world.

As regards the carrying out of a scheme of local enterprise in the West Indies, it may be mentioned that the recent appointment of Mr. William Fawcett, a highly-qualified botanist, to the post of Director of the Botanical Department in Jamaica, and the transfer of Mr. Hart, late senior Superintendent at Jamaica, to the post of head of the Botanic Garden at Trinidad, appear to offer every hope of success to a botanical federation of the West India Islands. Jamaica and Trinidad, as the two foci of operations, could very well group round them the lesser islands, and the full realisation of such a scheme as is here indicated only requires such working out of details as may well take place at an early period.

It is important, however, to bear in mind that the success of the Jamaica Botanical Department, which has acted for several years as the centre of botanical and economical operations in the West Indies, has been in a great measure due to the valuable suggestions and the moral and material support which for many years it has received from Kew. It was from Sir William Hooker that Jamaica received its first supplies of seed of the several species of Cinchona, which have laid the foundation of the only English Cinchona enterprise in the New World. It was from his illustrious son and successor at Kew, Sir Joseph Hooker, that Jamaica received its tea plants and seeds, india-rubber plants, coca plants, fibre plants, and regular and large supplies of all the economic and medicinal plants which have flowed through Kew for distribution to various portions of the British Empire. Few can realise the eminent services which have been rendered by Kew in this direction, both by its correspondence and contributions, but there is every reason to believe that the results will ultimately be apparent in the greater prosperity of the inhabitants of the West Indies, and in the larger development of their rich and varied resources.

D. MORRIS

ART AND SCIENCE IN A NEW LIGHT

MR. BRETT is an artist of reputation and of remarkable industry. His pictures are popular, and meet with appreciative purchasers. He is enrolled among the Associates of the Royal Academy, and no doubt looks forward to be in due time raised to the dignity of Academician. At the request of the Fine Art Society he has this winter allowed a series of about fifty sketches painted by him on the west coast of Scotland last summer to be exhibited in the New Bond Street rooms. These sketches show that he has recently spent a long holiday among some of the most delightful scenery in the British Isles. As a man who has evidently got on in the world, looking back upon a distinguished past and forward to perhaps a still more distinguished future, he might reasonably be expected to smile pleasantly on the world that has used him so well. If the keen eyes that stand him in such good stead in landscape-painting reveal to him the weaknesses and frailties of his fellow-men, one might at least anticipate that they would wink hard at these shortcomings and rather turn to the good side of men and of things. But apparently Mr. Brett sees only too vividly what he conceives to be the impostures and ignorances around him, and his soul is stirred within him at the sight. The exhibition of his last year's sketches has furnished him with the occasion for discharging the vials of a wrath which, like that of Tam o' Shanter's wife, he must have been nursing for a long while to keep it so warm.

The Exhibition (now closed) was illustrated by a pamphlet, which on the title-page is described as "An Explanatory Essay," and on the first page is more emphatically designated as "The Commentaries." Mr. Brett, apparently with some presentiment that this literary effort of his might not meet with the same kind reception that attends his pictorial labours, stipulated expressly, as he tells us in a "Prefatory Note," that his paper should be published exactly as it left his hands. We cannot therefore plead for him that his essay was hurriedly thrown off in a fit of ill-temper. He ostentatiously goes out of his way to accept the responsibility of its matter and its style. A description of each picture, from the artist's point of view, with a running commentary on his method of working, the difficulties in Nature to be overcome, and his way of grappling with them, would have been interesting to the general public and valuable to artists and students of art. He seems to have started with the idea of writing some such commentary. But by the time he gets to the second page he catches sight of the red rags of imposture and ignorance, and without more ado rushes madly at them. The first victims of his fury are press critics of art. Nothing is too contemptuous to be said of them. Mr. Brett looks on them as a set of ignorant charlatans, too idle to work, too proud to beg, but who are glad to earn the slender pay allowed to them by careless editors. Some wretched scribbler had pronounced his work to be "laborious," which we would have thought rather a complimentary epithet; but Mr. Brett cannot forgive it. The writer who used it he stigmatises as a "bell-wether," and those who blindly followed his lead are described as "enlightened tom-tom players, who have gone on sounding the same note for a quarter of a century or more."

After this onslaught the painter tries to find his way back to where he was, and for a little while the reader begins seriously to entertain the hope that the promised commentary is coming. But the author gets upon the subject of clouds, and instantly a bigger bunch of red rags looms in front of him. Down goes the head, and with one triumphant howl of derision the infuriated writer rushes at scientific men in general, and the Royal Society in particular. After this second outburst he hardly calms down again till the end of the performance. No sooner does he turn from the treatment of the clouds to the ground beneath us than geological theories in all their hideous deformity and crass ignorance stare him in the face. The text is not roomy enough to contain all that he has to say about the misdoings of the geologists, so that he has to overflow into a footnote. Next comes the turn of those misguided astronomers who have led mankind wrong about the moon and the planet Mars.

One is tempted to ask what is the meaning of all this sound and fury. What relation has it to the pictures it is meant to preface? What object can the writer have had in indulging in it? Men of science are, no doubt, often wrong. But at least they take the trouble to try to be right. Their greatest aim is to get at the truth, and they welcome whatever will lead them nearer to that goal. They will even willingly learn from Mr. Brett if he has anything to teach them, though he laughs them to scorn, and derides them as "scientific Johnnies," "lovers of jargon," makers of "real gibberish," by whom various "forms of silliness are palmed off as science disguised in Greek or Latin." If the meteorologist turns for suggestions to Mr. Brett's essay, he there learns that "the fundamental phenomena of evaporation have always been misrepresented," and that he and his gaping fellow-students of Nature will learn more about clouds from the pictures of a well-known landscape-painter "than from all the Transactions of the Royal Society put together." If the geologist inquires what Mr. Brett has to say for his consideration regarding the "laws of the rocks," he is told that water is a "recent formation," that upheaval is a "childish conception," and that geologists "ignore the moon." If the astronomer in turn asks what the author of "The Commentaries" has to say in his department of knowledge, he is informed that Mr. Brett defies him "to point out a single instance of a volcano or a volcanic crater in the whole disc" of the moon. The "jargon" and "real gibberish" of modern science not only afflict the artist's own soul, but they disturb the peace of his family. "One professor the other day," he indignantly exclaims, "learnedly instructed my boy that aqueous vapour was formed by evaporation!" Hapless youth! Let us hope that his father has found time to instruct him in "the fundamental phenomena of evaporation."

After such a tirade against scientific men, one might suppose that Mr. Brett would be disposed rather to avoid them, or at least not to show himself ostentatiously in their company. And yet the reader will be amused to discover him, in the midst of these rabid denunciations, contriving to find room for a statement that he himself has written a scientific paper which has been published in a scientific journal, and that this important fact may not be missed, he quotes the paper in a footnote! Is Saul also among the prophets? There would be something pathetic, were it not so ludicrous, to see the proud paternal way in which the artist brings forward his feeble little scientific bantling. We should not be surprised if he thought more of it than of some of the pictures that have made his fame. His contempt for "lovers of jargon" and "real gibberish" is apparently equalled by his profound satisfaction with his own achievements. Not content with indicating the artistic value of his work, he claims that, "if these sketches have any distinct peculiarity worthy of notice, it is that they are optically correct, or at least are intended to be so, and that intention, strange to say, is new in pictorial art"! It would be interesting to hear the painter's defence of the "optical correctness" of some of the pictures. Did he ever see, for instance, a castle standing as he has depicted one in No. 22? Of his peculiar greens and blues we need not speak. They are part of his "confirmed mannerism," to use his own phrase, and are characteristic of his canvas, no matter under what skies and among what seas and rocks he may paint.

The pamphlet to which reference has been made in this article would not, of course, have been noticed here but for the name of its author. Science owes much to art, as art in turn lies under many obligations to science, and it should be the aim of each to help forward the other. That a man of Mr. Brett's artistic attainments should have gone out of his way to pen this "form of silliness" is to be regretted chiefly for his own sake. He has injured his reputation for common-sense, and this even a great genius cannot afford to do.

THE NATIONAL SCIENCE COLLECTIONS

THE following Report of a Committee appointed by the Government to consider the housing of the objects illustrating the physical sciences belonging to the nation has recently been printed and circulated. The Committee consisted of Sir F. Bramwell (Chairman), Lord Lingen, Colonel Donnelly, C.B., and Mr. Mitford, C.B.:—

1. We, the Committee appointed by the Lords Commissioners of Her Majesty's Treasury to consider certain questions that have arisen in regard to the Scientific and Technical Collections at South Kensington, now beg leave to present to their Lordships our Report thereon.

2. The appointment of the Committee included the name of Sir Francis Sandford, K.C.B.; but this gentleman, in consequence of the pressure of other public business, has been unable to attend any of our meetings, and he has authorised the other members to proceed with the inquiry, and to report, in his absence.

3. Our instructions were conveyed in a letter, dated January 14, 1884, and a memorandum accompanying it, from Lord Richard Grosvenor to the Chairman, and were to the following effect:—

"It will be the duty of the Committee (1) to consider and report upon the scope of the Scientific and Technical Collections, including the Patent Museum, and the space required for them, immediately and prospectively; (2) to suggest plans for housing these Collections in the existing galleries to the south of the Horticultural Gardens, or in new galleries to be built upon their site, and the adjacent ground now the property of the Government."

PRESENT DISPOSAL OF THE SCIENCE COLLECTIONS

4. Before we enter on the consideration of these questions, it will be convenient to explain how the collections are at present housed.

They are contained in five buildings which are shown on the accompanying Plan, Drawing No. I., and are marked A, B, C, D, E; whereof A, B, C, and D are on the west, and E is on the east side of Exhibition Road.

The buildings A, B, E, coloured yellow on the plan, and their sites, are the freehold property of the Government; the buildings C, D, coloured blue, and their sites, are the property of the Royal Commissioners of 1851, from whom they are rented by the Government.

5. C is a block forming the centre portion of the galleries to the south of the Horticultural Gardens. It is about 292 feet long, 55 feet wide, and two stories high. It contains 22,000 square feet of available floor-space.

This building is the property of the Royal Commissioners of 1851, and is at present leased from them by the Government for 1500*l.* per annum. The lease terminates in 1890 or 1897, with a power up to January 1888 of purchase for the sum of 30,000*l.*, or, at the option of the Commissioners, for such sum, not exceeding 35,000*l.*, as may be fixed by the President of the Institute of British Architects.

6. A and B are the southern wing-galleries, the former on the east, and the latter on the west side of the central block C, and having short returns or spurs, A′ and B′, to the northward, at their external ends.

These wing-galleries extend about 280 feet in length on each side of the central block; they are about 26 feet wide, and two stories high.

The returns at each end are each 72 feet long, and one story high.

The whole contain about 29,500 square feet of available floor-space.

These buildings, and their sites, are the property of the Government.

7. D is a building known by the name of the Western Gallery. It is 600 feet long, 33 feet wide, and two stories high. It contains about 36,560 square feet of available floor-space.

This building is the property of the Royal Commissioners of 1851, and is at present rented from them by the Government for the sum of 2000*l.* per annum. We believe, however, it is desired to give up the tenancy if possible.

8. E is a temporary building one story high, abutting on the south end of the permanent buildings of the Museum on the eastern side of the Exhibition Road. It contains 7500 square feet of available floor-space.

It is the property of the Government, but we understand it must be pulled down before long, to make way for more permanent erections.

9. These buildings are not altogether devoted to the Science collections.

The National Portrait Gallery at present occupies 19,040 square feet, partly in the two floors of the eastern wing A (a portion of the freehold), and partly in the eastern section of the central block C (the leasehold portion), of the south galleries. A space of 7500 square feet in the upper floor of the central leasehold block C, is also reserved for examination-rooms.

A portion of the ground floor of the western gallery, D, has been, up to the present time, occupied by the Pitt-Rivers Loan Collection, but this collection is in course of removal to Oxford.

10. The Science collections are now contained in the western part of the ground floor of the leasehold central block C; in the ground floor and in part of the upper floor of the western freehold wing B; in the northern end spurs A′ and B′; in the two floors of the western gallery D; and in an unsightly wooden passage K.

This passage runs outside the southern wall of the south gallery, and forms the only approach from Exhibition Road to the Science collections, it not being possible to allow the public to use the Portrait Gallery as a thoroughfare.

The "Patent Museum" is contained in the temporary building E.

11. The total floor-space now occupied by the Science collections is therefore about as follows:—

		Square feet
Total space in C		22,000
,, ,, A, B, and A′, B′		29,500
,, ,, D		36,560
,, ,, E		7,500
		95,560
Deduct Portrait Gallery	19,040	
,, Examination-Rooms ...	7,500	
		26,540
Total occupied by the Collections ...		69,020

12. The Drawing No. I. also shows (marked G and coloured red) the area of land which belongs to the Government south of the present south galleries, which land is implied in our instructions to be available for buildings to house the collections.

SCOPE OF THE COLLECTIONS, AND SPACE REQUIRED FOR THEM

13. We may now proceed to report on the first subject submitted to us, namely:—

The scope of the Scientific and Technical Collections, including the Patent Museum, and the space required for them, immediately and prospectively.

14. A Museum of Science was contemplated as an integral part of the Science and Art Department from its creation in 1853.

Objects were gradually collected, and when the Department was removed to South Kensington in 1858 these objects were, for the first time, arranged together in the Museum for public inspection. They were mentioned by a House of Commons Committee in 1860 as "well worth preserving."

These collections, however, were not developed as much as the Art collections. Some objects were sent away to other establishments; and for want of space in the South Kensington Museum, the greater portion of the remainder were removed to the galleries on the western side of the Exhibition Road, where they have remained till now.

But public attention was frequently called to the subject.

The Royal Commission on Scientific Instruction and the Advancement of Science, in their Fourth Report (1874), treated somewhat largely of these collections; they noticed many interesting objects which they contained, but they pointed out the striking contrast between them and other British National collections. They expressed their regret that there was no National collection of the instruments used in the investigation of mechanical, chemical, or physical laws, although such collections were of great importance to persons interested in the experimental sciences. This defect in our collections was, they said, already keenly felt by teachers of science, and high authorities had assured them that, on the Continent, collections of scientific apparatus, when combined with lectures accessible to workmen, had exerted a very beneficial influence on the development of the skill of artisans.

The Commission suggested, in conclusion, that the collections should be completed and consolidated, and placed under the authority of a Minister of State.

In 1876 a Loan Collection of Scientific Instruments and Apparatus was exhibited in the galleries of the Horticultural Gardens. It excited much attention, and a memorial was presented to the Lord President, signed by 140 of the best known men of science in the country, suggesting that it might be utilised in the formation of a National Science Museum. Some of the objects were left in the care of the Department, but no general action was taken.

The question of the development of the Science Collections of the Department remained in abeyance till 1881, when the Lord President, Earl Spencer, stating that "the importance of having a Museum for Scientific Apparatus was amply established," set on foot a series of inquiries to which we proceed to refer.

15. For the purpose of these inquiries, the existing collections were divided into six heads:—Objects for the illustration of Science generally; Naval Models; Objects illustrating Building Construction; Objects bearing on Fish Culture; Educational Objects; and Mechanical Objects.

Committees, composed of persons having specific knowledge in each of these branches, were appointed to examine the several collections, and expressed opinions on their condition, on the development which it would be advisable to give to them, and on the space required.

As copies of the Reports on each head are reprinted in an Appendix (B), it will suffice to give here a general outline of the opinions and recommendations they contain.

Collections of Objects for the Illustration of Science generally

16. The Committee consisted of Mr. Wm. Spottiswoode, President of the Royal Society, Professors Frankland, Goodeve, Guthrie, Huxley, Judd, Chandler Roberts, and Warington Smyth, Mr. Norman Lockyer, and the chief officers of the Science Department. They expressed the opinion that this question was of great importance in relation to the education, the industry, and the science of the country; they reported that the present collection was suitable for a nucleus of the contemplated Museum, and they recommended an examination, by the several Professors and other members of the Council of the Normal School, of the various classes of apparatus and appliances relating to their own subjects respectively.

This examination was afterwards undertaken by a Committee of the various Professors, and the results, as already stated, are given in the Reports. Recommendations were made as to the objects in each department of science, and the following estimate was given of space necessary to be provided:—

	Square feet
Chemistry	6000
Physics	6000
Mechanics	5000
Metallurgy	2500
Geology and Mineralogy	2500
Astronomy, Meteorology, and Geography ...	7000
Agriculture	4000
Biology	4000
	37,000

The Committee also estimated that a further space of 3000 square feet (making 40,000 in all) would probably be sufficient for any reasonable increase within ten years.

Naval Models

17. A Committee consisting of Lord Ravensworth, Sir E. J. Reed, K.C.B., M.P., Mr. W. Baskcomb, Mr. J. H. Morrison, and Mr. Joseph D. A. Samuda, considered this collection, and reported on it on March 1, 1883. They expressed a strong opinion as to the utility of such a collection, gave some general suggestions upon it, and proposed to have it carefully examined in detail.

This examination was carried out, and on April 4, 1883, the Committee based upon it a statement that a space of 10,500 square feet was at once required, and that 10,000 square feet additional should be provided for the increase during the next ten years, making 20,500 square feet in all.

Structural Collection

18. The Committee for this consisted of Mr. (now Sir) Charles Hutton Gregory, Past-President of the Institution of Civil Engineers, Mr. G. E. Street, President of the Royal Institute of British Architects, Mr. James Abernethy, President of the Institution of Civil Engineers, and Major H. C. Seddon, R.E., Examiner for the Science and Art Department in Building Construction. They reported, in 1881, that this collection was of great value in many respects, and recommended its maintenance, revision, and development.

In July 1883 another Committee, consisting of Mr. C. H. Gregory, Mr. Horace Jones, President of the Royal Institute of British Architects, Mr. James Brunlees, President of the Institution of Civil Engineers, and Major Seddon, took up the matter. They put forward detailed proposals in regard to the constitution and arrangement of the collection, and gave an estimate of 15,000 square feet of floor-space for it, to be increased to 25,000 square feet in ten years.

Fish Culture

19. The Committee for this collection were Prof. Huxley (Government Inspector of Fisheries), Sir J. R. G. Maitland, Bart., Mr. E. Birkbeck, and Dr. Francis Day.

They expressed the opinion that it was highly desirable that the existing specimens should be developed into an economic Fish Museum, and they estimated about 5000 square feet as the space required.

Educational Objects

20. The Committee for this were Dr. J. H. Gladstone, Rev. J. W. Sharpe, Mr. J. S. Fitch, Mr. J. Iselin, and Mr. H. A. Bowler.

They stated that the collections would be of great value to School Boards, managers, and teachers, and they estimated 7000 square feet of surface as necessary, not including any allowance for the library.

Mechanical Collections

21. The Committee appointed to consider these collections were Mr. John Slagg, M.P., Sir W. G. Armstrong, Sir J. W. Bazalgette, Mr. James Brunlees, Mr. E. A. Cowper, Prof. T. M. Goodeve, Sir Charles Hutton Gregory, Mr. John Hick, Mr. James Howard, M.P., Mr. Charles Manby, Mr. J. Hinde Palmer, Sir E. J. Reed, M.P., and Mr. (now Sir) B. Samuelson, M.P.

They carefully examined the collections, including the "Patent Museum" (which, under the Patent Act, 1883, had been transferred to the care of this Department on January 1, 1884), and made a comprehensive report, embodying suggestions for the improvement and the arrangement of the whole.

They estimated that from 40,000 to 50,000 square feet of space would be required.

22. Considering that the members of these Committees were selected, on the responsibility of the Government, for their competence as authorities in their respective branches of science, and considering the detailed nature of their inquiries, we assume their conclusions as the basis of our recommendations.

We may also add that similar Committees are permanently retained, under the name of "Committees of Advice and Reference" for the several collections.

23. We need not enlarge on the desirability that such a country as Great Britain should possess a thoroughly good and complete National Collection of Scientific and Technical objects, any more than that it should possess a Museum of objects of Art or of Natural History.

When it is considered how much the prosperity of the nation is bound up with industrial enterprises and occupations, and how largely these depend, for their success, on practical applications of science, it needs no elaborate reasoning to prove that the public exhibition of well-selected and judiciously arranged scientific and technical collections, particularly when used in connection with efficient courses of instruction, justifies its cost.

24. There has long been a National Scientific and Technical Museum in France, well known under the name of the Conservatoire des Arts et Métiers, and this has often been referred to as a type of the institution of a similar nature which ought to be established in England.

We reprint, in Appendix C, an article published in the *Times* newspaper of October 5, 1876, which gives a full account of the nature and scope of the Conservatoire, and we have also received, through the courtesy of the Directors, full information as to the present contents and arrangements of the Museum.

The premises are situated in an area contained between the four streets, Rue St. Martin, Rue Vaucanson, Rue du Vert Bois, and Rue Réaumur. This area is about 200 metres wide by 140 metres deep, thus containing 28,000 square metres, or about 7 acres. These 7 acres are not at present entirely occupied by the Conservatoire, but an enlargement of the buildings is in progress, which will extend them, including the necessary courtyards, passages, &c., over the whole area.

The objects exhibited belong to a great variety of subjects, the following being only a brief indication of their general classification :—

Motors.—Horse-machines, water-motors, wind-motors, steam-engines, hot-air engines. Details and accessories.

Hydraulic Machines.—Pumps, &c.

Descriptive Geometry.—Forms of curves; teeth of wheels. Machines for producing special forms.

Metallurgy.—Working of mines. Minerals. Metallurgical processes. Metals.

Calculating and Counting Machines.

Instruments for Surveying.

Astronomy, &c.—Almanacs and Calendars.

Chronometry, ancient and modern ; movements ; tools.

Arts of Construction.—Materials, processes, workmen's tools, &c. Constructions under water.

Kinematics.—Machinery. Mechanism. Elements of machines.

Dynamometers and instruments for mechanical observations.

Cranes and other constructions for lifting and removing weights.

Machine Tools of various kinds. Presses, &c.

Engraving, Lithography, Typography, Printing, &c., and paper-making.

Porcelain, Glass, and Pottery.

Physics.—Mechanics. Molecular actions. Heat. Magnetism. Electricity. Acoustics. Optics. Meteorology. Electro-chemistry. Telegraphy.

Agriculture.—Apparatus of all kinds.

Weights and Measures.—French and foreign. Weighing-machines. Instruments of comparison.

Locomotion and Transport on ordinary roads, on railways, and on rivers, canals, and the sea.

Manufactures, various.—Gunpowder. Arms. Chemicals. Bread. Sugar. Cements. Cutlery. India-rubber.

Spinning and Weaving.—Textile manufactures generally.

Preparation, Dyeing, and Printing of Fabrics.

Chemical Arts and Products.—Preservation of Timber. Gas. Distilling. Brewing. Tanning, &c.

Industrial and Fine Arts.—Prints ; designs. Photography.

Pictures and Drawings, illustrative of Scientific and Technical matters ; a very large collection.

There are in all about 10,000 objects. The collection is remarkably rich, both in historic apparatus and in the most recent inventions. The machinery is shown in motion two days in the week. The objects are used, when required, for the lectures given in the Conservatoire.

Nothing is added unless it can be utilised for teaching ; sometimes orders are given for models to be made, and sometimes objects are purchased. When anything is offered as a gift, it is not accepted unless one of the professors will state that it is really required.

The collection is not in any way a Patent Museum. Formerly certain models of patented inventions were exhibited there, but this is no longer done.

(*To be continued.*)

NOTES

THE meetings held yesterday at St. James's Palace and the Mansion House, to which we have not time to refer at length this week, indicate that from the Prince of Wales downwards all interested in the proposed memorial are willing to allow the necessity of making the Institute one on a broad scientific basis. An admirable speech by Prof. Huxley at the Mansion House, following that of the Prince of Wales at the first meeting, shows that there is now no chance of the importance and of the necessity of collecting and arranging *knowledge* being overlooked.

FRENCH geologists have cause to regret the blow which their science has received in the premature death of the well-known geologist of Lyons, C. F. Fontannes, on December 29, at the age of forty-eight. He is best known by his important monograph on the "Stratigraphy and Palæontology of the Tertiary Deposits of the Basin of the Rhone"—a work of laborious research and of great value from the minuteness and accuracy of its details. He established a claim on the gratitude of geologists by the infinite pains he took in the organisation and working of the International Geological Congress, the success of which has been in large measure due to his active help. His pleasant smile and cheery way of smoothing over personal friction will long be remembered by those who witnessed them at the meetings of the Congress.

SIR FRANCIS BOLTON died at Bournemouth on Wednesday, the 5th inst. He was born in 1831, and entered the army at the age of twenty-six. For some time he served on the staff as Deputy-Assistant Quartermaster-General, and in 1881 he retired with the rank of colonel. He was the inventor of the system of telegraphic and visual signalling which was introduced into the army and navy in 1863, and for these services and other improvements and inventions in regard to warlike material he received in 1883 the honour of knighthood. In 1870 he founded the Society of Telegraph-Engineers and Electricians.

LAST year some of the leading statisticians of Europe combined to form a new Society, the International Statistical Institute. If we may judge from its aims, as set forth in the first article of its statutes, the Institute is likely to do work which will be of the highest service to Governments. It proposes to foster the progress of administrative and scientific statistics: "(1) by introducing as much as possible uniformity of method and classification and of handling statistical material, in order to make the results obtained in different countries comparable; (2) by calling the attention of Governments to those questions which require to be solved by statistical observation, and requesting from them information on subjects which have not yet been treated statistically, or have been only insufficiently treated; (3) by creating international publications intended to establish permanent relations among statisticians of all countries; (4) by striving, through its publications, and, if possible, by public instruction and other means, to promote the spread of sound ideas as to statistics, and to interest Governments and peoples in the investigation of the phenomena of society." The Institute intended to have held its first general meeting in Rome in September last, but was compelled by the spread of cholera in Italy to abandon its design. It has now decided to hold its first meeting in Rome in Easter week of this year, from April 12 to 16. Nearly fifty members have expressed their intention of being present, and it is expected that the attendance will be considerably larger. The Italian Government deserves the greatest credit for the generous and enlightened manner in which it is supporting the Institute. It allows Prof. Boris, the Director-General of the Statistics of the Kingdom of Italy, to act as Secretary, and in this capacity to use the services of his official staff. With the sanction of the Italian Parliament, it has granted a sum equal to 600*l.* to aid the Institute in printing its publications, and another sum of 400*l.* has been contributed to the expenses of the approaching meeting. Moreover, it has been arranged that for the benefit of members who attend the meeting the fares on the public railways to and from Rome shall be reduced by one-half. Signor Grimaldi, the Italian Minister of Commerce, is trying to induce other Governments to act in a similar spirit, and it may be hoped that his efforts will not be wholly unsuccessful.

ON Saturday evening last, Sir John Lubbock delivered, at Toynbee Hall, a lecture on "Savages," the first of a new course. He pointed out that modern savages do not in all respects reproduce the condition of our ancestors in early times. Even the Australians hold now a system of complex rules and stringent customs, which have grown up gradually, and cannot have existed originally. From the study of modern savages, however, we may gain a fairly correct idea of man as he existed in ancient times, and of the stages through which our civilisation has been evolved. The lecturer gave a remarkably vivid and interesting account of some of the leading facts known about the customs, beliefs, and institutions of savage races.

ON Friday evening last the Drapers' Company set an admirable example to other City Companies by entertaining at its Hall in Throgmorton Street the students associated with the Whitechapel centres of the University Extension Scheme. The classes connected with this Scheme at Toynbee Hall are attended by no fewer than 631 students, who receive instruction in physiology, astronomy, history, and English literature. The fee for a course of twelve lectures is one shilling.

THE presidential address delivered at the annual meeting of the American Neurological Association in June last by Dr. Burt G. Wilder has been reprinted from the *Journal of Nervous and Mental Disease*. In this address Dr. Wilder discusses the question as to the need of some improvement in the nomenclature of the brain. He is convinced that the current nomenclature is to a large extent an obstacle rather than an aid to the advancement and dissemination of knowledge concerning a complex organ; and, with regard to the encephalic cavities in particular, he holds that it would be better for the student if the incongruous and misleading *quasi*-descriptive terms, *first*, *second*, *third*, *fourth*, and *fifth ventricle*, could be displaced by totally meaningless, but easily remembered, Chinese monosyllables, like *pran*, *pren*, *prin*, *pron*, and *prun*. Dr. Wilder has obtained an alphabetical list of nearly all the names which have been applied to the parts of the central nervous system, and, allowing for some omissions and duplicates, the numbers are as follows:—Latin, 2600; English, 1300; German, 2400; French, 1800; Italian and Spanish, 900; total, 9000. The number of parts designated by these names is considerably less than 500.

REFERRING to the death of Sir W. W. Heughes, which took place near London on New Year's Day, the *Colonies and India* mentions that practically he initiated the Adelaide University by contributing 20,000*l.* in 1872 for the endowment of two professorships. He also contributed largely to the expedition under Colonel Warburton for the exploration of the interior of the Australian continent. He received the honour of knighthood in 1880.

M. JANSSEN, the Director of the Meudon Observatory, who has been nominated Vice-President of the Paris Academy of Sciences for 1887, will be President in 1888, according to the constant rule.

IT is said that M. Chevreul will resign his membership of the Academy of Sciences, and will return to his native place to spend the last years of his life in retirement. He has already sent in his resignation of the Directorship of the Museum.

ONE of the last letters written by M. Paul Bert was read at the meeting of the French Academy of Sciences on the 3rd inst. In this letter M. Bert complained of the darkness in the town of Hanoï at night. Gas was too dear, and he had tried the use of petroleum. This, however, was a barbarous expedient, and he was anxious to know whether it would not be possible for him to make the Red River, which flows past Hanoï, produce the required illumination. "Would the expense be great?" he wrote. "Only think, if we succeeded we should be ahead of England and Japan!" "Answer," he added, "and answer quickly; my days are numbered." The Academy decided that the letter should be preserved among its archives.

A LARGE number of French scientific Societies are anxious that a building should be erected in Paris for their common use. A circular on the subject has been issued. The lead in the matter is being taken by the Geographical Society.

A GOOD deal of canvassing has been going on recently in Paris, in the Sorbonne, the Medical School, and the Academy of Sciences, for professorships and seats in the Institute of France. Many superannuated professors have been removed, in consequence of the enforcement of a recent law; others have died. In the Medical School, Prof. Sappey's place has been given to M. Farabeuf, a distinguished anatomist, although entirely devoid of philosophical tendencies. Prof. Gavarret, whose well-known researches, conducted many years ago with Audral, have been of the utmost importance for the physiology of respiration, has seen his place filled by M. Gariel, who has been his assistant for a long time. Prof. Peter has taken the place of M. Hardy, in the Professorship of Clinical Medicine. He is an obstinate opponent of M. Pasteur's theories, but, nevertheless, a good physician, well trained, and skilled in his part of science. Prof. Pagot, the well-known Professor of Obstetrics, resigned his appointment on the day of his seventieth anniversary, and it is likely that M. Pinard will be his successor. M. Pinard is an able obstetrician, a good teacher, an original worker, and is much liked by students and professors. The vacancy caused at the Sorbonne by the death of Milne-Edwards has been filled by the appointment of M. Yves Delage, who has been for a short time Professor of Zoology in Caen. M. Yves Delage, although a very young man, has done a good deal of excellent personal work. His principal investigations bear upon the circulatory system of Crustacea, the life-history and anatomy of Sacculina, a parasitic Crustacean, and the anatomy of the whale. In the Academy of Sciences, M. Sappey was elected soon after his removal from the Medical School. His personal work has been good, and bears upon human anatomy, upon the anatomy of the lymphatic vessels, of the air-reservoirs of birds, and many other points of comparative anatomy. M. Ranvier, the able histologist of the Collège de France, will very likely be elected to the seat of Ch. Robin. One of the competitors for Paul Bert's seat is M. Ch. Rochet, the physiologist, and editor of the *Revue Scientifique*.

A VERY good little guide to the most picturesque streets and buildings in the capital of Egypt, by Major E. T. Plunkett, R.E., has just been published. It is entitled "Walks in Cairo." Major Plunkett's object is to call attention to "sights" which have hitherto been neglected by the writers of guide-books, —out-of-the-way mosques, in which the most graceful Arabesque forms may be found, with choice bits of marble mosaic and fine specimens of cabinet-work, and street corners made picturesque by minarets, overhanging stories, and windows of lace-like lattice-work. If any visitor is in doubt whether he would or would not enjoy the "Walks" described, he is advised to try one of them, and if he finds that uninteresting to try no more.

ON July 28 last, Miss Eleanor A. Ormerod, F.E.S., Consulting Entomologist to the Royal Agricultural Society, received from Revell's Hall, Hertford, specimens of injured barley, which on examination precisely corresponded with the condition caused by attack of the *Cecidomyia destructor*, commonly known as the Hessian fly. A paper setting forth the results of her observations, with the opinions of high authorities in England and America, was read at the Entomological Society of London on December 1 last. An abstract of this paper will be found in the *Entomologist* for January.

IN the January *Zoologist* there is a very good representation of the Greater Horse-shoe Bat (*Rhinolophus ferrum-equinum*). It illustrates an article on "Horse-shoe Bats" by the editor, who remarks that as few really good figures of bats are accessible, those in Bell's work being almost too small to be of much use, it is very desirable that no opportunity should be lost of obtaining correct drawings of the rarer species whenever they can be procured alive or in a fresh condition, so as to secure an accurate delineation of the natural features before they become distorted or shrunk in the process of drying. The plate which he offers as a first contribution to such a series is from a living specimen obtained by the Rev. H. A. Macpherson in South Devon in August last. This specimen weighed little more than half an ounce the day after death.

SEVERAL Arctic species of birds, which do not breed in England or Ireland, breed in Scotland. This fact is explained by Mr. Henry Seebohm in an article in the January *Zoologist*. Most, if not all, of the species in question breed in July, and, roughly speaking, they draw the line a few degrees below 60° F. They do not breed in any locality where the mean temperature for July is as high as 60°, the reason probably having relation to the supply of food. Now, in a map of the world, in Keith Johnston's "Physical Atlas," giving the mean temperature for July in various parts of the earth, the isothermal line of 59° is drawn. This line separates England and Ireland from Scotland, passes north of the Gulf of Bothnia, through the town of Archangel, extends nearly straight across Russia and Western Siberia, but, east of the valley of the Yenesei, again rises until it almost reaches the coast near the delta of the Lena. Farther east in Siberia it plunges south again, much more rapidly than it rose in Western Europe, and, passing south of Kamchatka, it embraces the Kurile Islands in the latitude of the Pyrenees. This line is almost exactly parallel with what is known of the southern breeding-ranges of the various Arctic birds under consideration. It is not, therefore, surprising that these birds should breed in Scotland; and there is no reason, Mr. Seebohm concludes, for attempting to explain by any other causes than the ascertained climatic cause, the interesting fact that British ornithologists are able to study the breeding habits of so many species which their Continental fellow-students can only observe by travelling 500 miles or more farther north.

THE Journal of the Society of Arts prints an interesting letter from Mr. T. F. Peppe, on the cultivation of the so-called wild silks of India. Mr. Peppe points out that in many parts of India the jungle consists of the plants on which the tussur worm feeds, and that the supply of labour is practically unlimited. At present the work is carried on only by a few tribes who have been accustomed to it from time immemorial; but nearly all the aboriginal tribes of India might be available, if their services were in demand. The chief obstacle to the rapid development of the industry is the difficulty of procuring seed-cocoons, which have to be sought for in the wild state in the jungles. This difficulty, however, Mr. Peppe thinks, will be gradually overcome, since in every cultivated tract there are always a few cocoons which escape detection and collection, and which add to the number of wild cocoons found in the next brood. The industry is precarious, but there are several crops in the season, and if one fails the others may succeed. Mr. Peppe has cultivated tussur for three years, yet he is not prepared to say how many broods are possible in a year. Each brood so overlaps the succeeding one, that it is very difficult to distinguish one brood from another.

A COURSE of five lectures on "Molecular Forces" will be delivered by Prof. A. W. Rücker, M.A., F.R.S., at the Royal Institution, beginning on Thursday, the 20th inst. The remaining lectures will be delivered on the 27th inst., and on February 3, 10, and 17.

MESSRS. W. WESLEY AND SON have issued the seventy-ninth number of their "Natural History and Scientific Book Circular." The most important part of the Catalogue appears under the heading "Ornithology."

WE have received the "Year-book of Photography and the Topographic News Almanac for 1887," edited by Mr. Thomas Bolas, F.C.S It contains, besides a calendar for the year and lists of photographic societies, a large number of notes and articles likely to be interesting and useful both to beginners in photography and to advanced practitioners.

The Severn Fishery Board has issued an Almanac for the year 1887, which is intended to show the law as to fishing in the Severn fishery district, and to indicate to water-bailiffs, fishermen, and others interested in fishing, what they may look for in different months of the year. The information on which the statements in the Almanac are based was collected by the Board's officers.

The seventh volume of the Transactions of the Sanitary Institute of Great Britain, 1885-86, presents a full report of the proceedings of the Congress of the Institute held at Leicester from September 22 to 26, 1885. The papers read at the Congress were divided into three sections—(1) Sanitary Science and Preventive Medicine; (2) Engineering and Architecture; (3) Chemistry, Meteorology, and Geology. Mr. John F. J. Sykes, Honorary Secretary for the first section, recommends that a special day, or part of a day, should be devoted to the consideration of domestic sanitation and ambulance. In both of these subjects ladies take great interest, and Mr. Sykes is of opinion that his suggestion, if adopted, would add immensely to the success of future Congresses.

The amount of the rainfall at Ben Nevis Observatory during 1886 was 107·85 inches, the greatest monthly fall being 14·57 inches in November, and the least 2·84 inches in February. In 1885 the annual rainfall was (see vol. xxxiii. p. 347) 145·50 inches, the largest monthly fall being 24·33 inches, and the least 4·97 inches, the rainfall of 1886 being thus very much less.

We understand that complaints have been made to the Fishery Board for Scotland that steam-vessels have been recently prosecuting beam-trawling overnight in the waters closed by the Board's by-law against this mode of fishing. Some time since the Board instituted legal proceedings against parties who had infringed the by-law, some of whom were fined, and they also posted placards at the different harbours and creeks in the prescribed waters giving notice of the terms of the by-law, and it was hoped that the illegal practice would have been thereafter discontinued. The Board's cruiser *Vigilant* has done what she could to protect these waters, but owing to her being a sailing-vessel she cannot do this so effectively as a vessel with steam power. In the circumstances the Board have instructed H.M.S. *Jackal*, at present cruising on the west coast, at once to proceed to the east coast and protect the inclosed areas there, as well as to take a general superintendence of the fisheries. The prescribed waters include the Firth of Forth, St. Andrews Bay, and Aberdeen Bay. The present *Jackal* is a new, powerful, and swift vessel, and is provided with the electric light, which will enable her to sight vessels at a considerable distance on dark nights. The Board's cruiser *Vigilant* will at once proceed to the west coast and take up fishery duty there, assisted by H.M.C. *Daisy* tender.

The Report of the Swiss Commission for the Reform of Gymnasial Instruction has just been issued. The Commission recommend that the teaching of Latin shall begin in the fifth class, and shall be continued, for five hours weekly, up to the highest class; that instruction in Greek shall depend upon the expressed desire of parents or guardians, and shall begin in the fourth class; and that all scholars who do not learn Greek shall learn either English or Italian. Two spare hours gained by pupils in English or Italian are to be spent in the study of natural science and mathematics.

Mr. Edison, the electrician, of New York, is reported to be seriously ill.

The additions to the Zoological Society's Gardens during the past week include two Barn Owls (*Strix flammea*) from South Africa, presented by Mr. E. Hume; a Black-headed Gull (*Larus ridibundus*), British, presented by Mr. W. S. Rawlinson; two Eyed Lizards (*Lacerta ocellata*), European, deposited; four Bramblings (*Fringilla montifringilla*), British, purchased.

OUR ASTRONOMICAL COLUMN

The Six Inner Satellites of Saturn.—Appendix I. to the volume of Washington Observations for 1883 contains an important memoir by Prof. Asaph Hall on the orbits of the six inner satellites of Saturn. Of these, the two innermost have been known to us about 100 years, but the other four for more than 200. Owing, however, to the difficulty of making accurate observations of them, their orbits were but rough approximations until the publication of Bessel's work on the orbit of Titan, which appeared in vols. ix. and xi. of the *Astronomische Nachrichten*, and from which that value of the mass of Saturn was derived which has been generally used up to the present time in computing the perturbations produced by this planet. Bessel likewise commenced, but did not live to complete, a memoir on the "Theorie des Saturns Systems," of which Prof. Hall justly remarks that it "is still the most comprehensive investigation we have of the differential equations of this system, and of the various forms of the perturbative function arising from the figure of the planet, the ring, the action of the satellites on each other, and the action of the sun." M. Tisserand has shown, however, in a short but important paper, "Sur le mouvement des absides des satellites de Saturne et sur la détermination de la masse de l'anneau," that Bessel's determination of the mass of the ring from the motion of the line of apsides of the orbit of Titan was seriously in error, since he neglected the influence of the figure of the planet. We were, therefore, ignorant of the true value of the mass of the ring, but if the inner satellites moved in orbits which were decidedly eccentric, so that the motions of the lines of apsides could be accurately determined, the mass of the ring and figure of the planet could be deduced. It was therefore a matter of great interest to determine these orbits as accurately as possible; and Prof. Hall therefore undertook the observation of those satellites with the great refractor of the Naval Observatory, Washington. The observations of Titan, given in Prof. Hall's paper, were made at Washington during the eleven years, 1874 (in which year Prof. Newcomb observed the satellite) to 1884. During the years 1875, 1876, and 1877, Prof. Hall observed differences of R.A. and declination of Saturn and Titan at the same time and in the same manner as he observed Iapetus, to which satellite he found the method well adapted. Rhea, Dione, and Tethys were observed by Prof. Newcomb in 1874 and by Prof. Hall in 1875, whilst for Mimas and Enceladus observations extending over the years from 1874 to 1879 have been used. In the reduction of the observations of Rhea, Dione, and Tethys, the observed places have been compared with places computed from the elements for these satellites given by Dr. W. Meyer, of Geneva, and corrections to his elements are deduced therefrom. The corrected orbits show in each case a practically insensible eccentricity, and the observations of Mimas and Enceladus also can be satisfied within the limits of their probable errors by circular elements. Prof. Hall, however, draws attention to the fact that for the three innermost satellites the eccentricity of the orbit, and consequently the position of the line of apsides, cannot be determined with any certainty from the observations at his disposal. Some more accurate method of observation than that of the filar micrometer should be adopted; possibly observing the conjunctions of the satellites with the ends of the ring, the Cassinian division, and with the sides of the ball, might prove more efficient. A heliometer, if one existed of sufficient aperture, would probably furnish the most satisfactory means of all.

The orbits of the five inner satellites being thus sensibly circular, any consideration of the motions of their lines of apsides is placed out of the question. These five satellites also appear to move in the plane of the ring. It is therefore easy to furnish tables of their motions, and Prof. Hall supplies them for the period 1875-1950, together with the elements of the ring, at the close of his paper. For the mass of Saturn, from the motions of Titan, Rhea, Dione, and Tethys, he finds the reciprocal to be $3478·7 \pm 1·10$. The best previous determinations have been as follows:—Bessel 3501·6, Leverrier 3529·6, Meyer 3487·45, and Prof. Hall, from the motion of Iapetus, 3481·3 ± 0·54.

Prof. Hall carefully searched for additional satellites moving in the remarkable gaps between Rhea and Titan, and Hyperion and Iapetus, but without result.

STELLAR PARALLAX.—The second Appendix to the Washington Observations for 1883, contains a second memoir by Prof. Asaph Hall, not less interesting and valuable than the above. It will be remembered that Prof. Hall published a volume in 1882, containing determinations of the parallaxes of Vega and 61 Cygni from observations made by himself with the great 26-inch refractor at the Washington Observatory. Prof. Peters, of Clinton, U.S.A., has since pointed out to Prof. Hall that the temperature correction to his observations had been applied with the wrong sign. Prof. Hall has therefore now reduced his observations afresh, and given a new solution of the equations of condition. For 61 Cygni, Prof. Hall now finds a parallax of 0″·270 ± 0·0101 from 101 observations extending from October 24, 1880, to January 26, 1886. This value is notably smaller than he obtained before, viz. 0″·4783, or than most other investigators have deduced. Thus Sir R. S. Ball had found 0″·4756, Auwers 0″·564, and Struve, Woldstedt, and others values closely according. Prof. Hall appears, however, satisfied with his results, and it should be remembered that Dr. C. A. F. Peters obtained 0″·349 for his absolute value of the parallax, the others being only relative parallaxes. Prof. Hall's value for Vega is also rather small, viz. + 0″·134 ± 0·0055 from 128 observations, but agrees very much better with other modern determinations; Brünnow in 1869 from the same comparison-star, but by measures of distance and position, and not of differences of declination only, having obtained π = 0″·212 ± 0″·0098. Prof. Hall also attacked the parallax of two other stars, 6 (Bode) Cygni, the parallax of which has recently been determined at Dunsink, being one, and the curious star 40 (o^2) Eridani the other. For the former he finds a negative value, whereas Sir R. S. Ball gave π = + 0″·422 ± 0″·054, but only as a "merely provisional" value. The parallax obtained for 40 Eridani, π = + 0″·223 ± 0″·0202 is in fairly close agreement with Dr. Gill's, viz. π = 0″·166. In the early part of this important paper Prof. Hall gives a full discussion, in his usual thorough and painstaking manner, of the value of a revolution of the micrometer-screw employed in the observations.

ASTRONOMICAL PRIZES OF THE ACADEMY OF SCIENCES. The Paris Académie des Sciences have decreed the Lalande Prize to M. O. Backlund for his labours on the motion of Encke's comet; the Valz Prize to M. Bigourdan for his researches on personality in the observation of double stars; and the Damoiseau Prize, for the revision of the theory of the satellites of Jupiter, to M. Souillart, with an *encouragement* to M. Obrecht of a thousand francs from the Damoiseau fund.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 *JANUARY* 16–22

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

At Greenwich on January 16

Sun rises, 8h. 1m.; souths, 12h. 9m. 58·8s.; sets, 16h. 19m.; decl. on meridian, 20° 56′ S.: Sidereal Time at Sunset, 0h. 2m.

Moon (at Last Quarter) rises, 23h. 47m.*; souths, 5h. 41m.; sets, 11h. 24m.; decl. on meridian, 4° 14′ S.

Planet	Rises	Souths	Sets	Decl. on meridian
	h. m.	h. m.	h. m.	° ′
Mercury ...	... 7 23	... 11 13	... 15 3	... 23 55 S.
Venus ...	... 8 39	... 12 55	... 17 11	... 19 54 S.
Mars ...	... 9 4	... 13 42	... 18 20	... 16 24 S.
Jupiter ...	... 1 23	... 6 27	... 11 31	... 11 42 S.
Saturn ...	... 15 29	... 23 35	... 7 41*	... 22 1 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

Jan.	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
16 ...	65 Virginis ...	6 ...	2 5 ...	3 5 ...	61 193
16 ...	66 Virginis ...	6 ...	2 48 ...	3 57 ...	44 221
16 ...	l^2 Virginis ...	5 ...	7 44 ...	8 35 ...	44 318

Jan.	h.	
16 ...	21 ...	Mars at least distance from the Sun.
17 ...	3 ...	Jupiter in conjunction with and 3° 40′ south of the Moon.
17 ...	4 ...	Mercury at greatest distance from the Sun.

Variable Stars

Star	R.A.	Decl.		
	h. m.	° ′		h. m.
U Cephei	0 52·3 ...	81 16 N. ...	Jan.	16, 23 2 *m*
			,,	21 22 40 *m*
Algol	3 0·8 ...	40 31 N. ...	,,	16, 2 41 *m*
		and at intervals of		2 20 48
λ Tauri	3 54·4 ...	12 10 N. ...	Jan.	16, 22 48 *m*
			,,	20, 21 41 *m*
δ Libræ	14 54·9 ...	8 4 S. ...	,,	20, 2 42 *m*
U Coronæ	15 13·6 ...	32 4 N. ...	,,	20, 21 39 *m*
W Herculis	16 31·2 ...	37 34 N. ...	,,	18, *m*
U Ophiuchi	17 10·8 ...	1 20 N. ...	,,	20, 2 44 *m*
		and at intervals of		20 8
β Lyræ	18 45·9 ...	33 14 N. ...	Jan.	22, 21 0 m_2
δ Cephei	22 25·0 ...	57 50 N. ...	,,	18, 23 0 *M*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor-Showers

Near γ Orionis, R.A. 72°, Decl. 4° N. From Coma Berenices, R.A. 181°, Decl. 35° N.; swift streak-bearing meteors. Near χ Cygni, R.A. 295°, Decl. 53° N.; somewhat slow meteors.

GEOGRAPHICAL NOTES

THE opinions of Dr. Junker, who is now in Cairo, as to the best route by which to reach Emin Pasha do not help us much. Indeed, Dr. Junker does not commit himself further than to suggest that by the shortest route, through Masai Land, there would be difficulties as to food. Not more, we are inclined to think, than by any other route. Mr. Thomson passed through the country at an exceptionally bad time, when the cattle of the Masai were dying by hundreds from disease. The country is one of the richest game regions in Africa, and by any route an expedition must, as far as possible, be independent of local supplies. For an expedition of hundreds of men to attempt to cross the Victoria Nyanza in boats would be extremely hazardous. Meantime it is evident both from what Dr. Junker says and from the letter of Mr. Ashe, who has just returned from Uganda, that Emin Pasha is in an exceedingly perilous condition, and that every week's delay risks his life and the lives of those who are with him, for he has no ammunition. We hear, on good authority, that Mr. Stanley has decided to go by the Masai Land route; if so, it seems a pity that the only white man who has explored this route will not be in the expedition.

IT is said that great administrative changes are about to be made in Russian Central Asia. According to the St. Petersburg Correspondent of the *Times*, the whole system of arbitrary military mixed with native government, formerly considered necessary for high political purposes of further conquest, is to be gradually modified and almost abolished by the introduction of Russian civil administration and justice, and the subordination of the various departments to the Ministers in St. Petersburg. There is a proposal that Turkestan and the new Transcaspian province should be amalgamated, the reason alleged being that they will be closely connected by the Transcaspian railway, which, after passing through Bokhara, will terminate at Tashkend. The Transcaspian province will therefore, it is considered, be nearer to Turkestan than to the Caucasus. The scheme is said to have been suggested by General Rosenbach, the Governor-General at Tashkend. It is opposed by General Shepeleff, Director of the Chancery of the Governor-General of the Caucasus, who is of opinion that it would be highly inconvenient to remove the Transcaspian further from the control of the central Government, and that, if alterations are considered necessary, it would be better to make the newly-acquired territory an independent province.

ACCORDING to the *Novoe Vremya*, the trading caravan lately despatched by the Central Asian Commercial Company Koudrine has passed through Kashgar and entered Tibet. This company is likely to play an important part in Central Asia. It has established permanent agencies at Merv and Askabad and in the Persian cities of Kutchan and Meshed, and now it proposes to do the like in Tibet. It has received from the Ameer of

Bokhara a large tract of land on the banks of the Amu-daria, near the Chardjui station of the Transcaspian Railway, for the cultivation of cotton. In the Transcaspian there seems to be a great district suitable for cotton-growing, and there is a general opinion among the commercial classes of Russia that the development of this industry ought to be steadily encouraged by the Government.

The *Bollettino* of the Italian Geographical Society for November contains an account of a second expedition by Signor E. Modigliani to Nias, which has proved much more successful than his first visit to that island, reported in NATURE, November 16, 1886, p. 60. His primary object was to discover and ascend the Mount Matsua, 600 metres high, seen by Von Rosenberg from the west coast, and figured on his map as the culminating point of the island. But, although no trace could be found of this mountain, the hitherto unexplored south-western district was traversed from Serombu on the west to Lagundi Bay on the south coast. This district was carefully surveyed, and the explorer succeeded in making rich zoological, botanical, and ethnological collections, most of which have been forwarded to the Natural History Museum of Genoa. They include no less than twenty-six human skulls (fifteen of which were obtained at Hili Horo in exchange for a rifle), about 120 birds, 2000 butterflies, 1500 other insects, monkeys, fishes, reptiles, and plants. The journey was made during the summer of 1886, Signor Modigliani's last communication being dated August 10, and forwarded to Europe from Gunung Sitoli, in the north of Nias, where he was then stationed with the intention of continuing his scientific researches in the island.

On Tuesday evening last Captain Cameron delivered at the London Institution a lecture on "Urua: its People, Government, and Religion." In closing his lecture Captain Cameron said that Urua would shortly come into great prominence, for lately some of the officers of the Congo Free State had followed the river due east, across the great bend of the Congo, showing that it was a navigable river, and that if followed up it would lead to Kasongo's capital. They were frequently hearing of the London Missionary Society's agents pushing up the new great tributary of the Congo on the south, so there could be little doubt that in a short time the Somami would be followed up to Urua, and that traders, missionaries, and others would soon come into the great kingdom of Urua, where there was a great work before them. However, they would have to bear in mind that they would not have to do with a little chief ruling over 200 or 300 natives, but with a powerful monarch who ruled absolutely over his people, and who would allow of no agreement which had not been approved by him. It was to be hoped that, as Stanley had been successful before, he might be successful in his expedition for the relief of Emin Pasha, and also that those who went into Urua would bring civilisation and peace, and be able to do away with the horrors of the slave trade which obtained there owing to the Portuguese and the Arabs. Urua was rich in many kinds of minerals and other products, and the people were a fine race. When the Europeans came into constant contact with them, if they were wisely managed, there would be a great future for them.

WAR AND BALLOONING[1]

THE object which stimulated the practical invention of the balloon was its use in war. I say practical invention, because in theory the balloon was invented before the experiment of Montgolfier. Theory is ever the soil of practice. The idea of the balloon has its starting-point in the principle of the pressure of fluids elucidated by Archimedes, of Syracuse, 200 years before the Christian era. The discovery of hydrogen gas by Mr. Henry Cavendish, in 1760, led Joseph Black, the Professor of Chemistry at the University of Edinburgh, to suggest in one of his lectures that a weight might be lifted from the ground by attaching to it a sphere of hydrogen gas. A fruitful idea once expressed is rarely lost, however casual its first expression. Some years later, Tiberius Cavallo, an Italian merchant, remembered the remark of Dr. Black, and, in 1782, tested its truth by experiment. He first manufactured some paper bags, which he filled with hydrogen gas: to his disappointment, the subtle gas escaped through the pores of the paper. He then collected the gas in soapy water, and the bubble of gas ascended. A soap-bubble filled with hydrogen was therefore the first balloon. The experiment seems to have been repeated by Cavallo at one of the meetings of the Royal Society, and described in the Transactions of that Society; but neither Cavallo nor his colleague pursued the experiment further, and there was still to be found the peculiar kind of energy that would transform the laboratory experiment into a practical reality. Books are indeed the carriers of thought. It is probably due to a work of Priestley, in which were described those discoveries of Cavallo, and which was translated into French, that Montgolfier, the paper-maker of Annonay, was fired to perform an experiment that is historical. He, as most of you know, filled a paper bag with heated air, the consequence being that the bag rose to the ceiling of the room. Montgolfier was not content with such trifling efforts: a patriotic motive stimulated him to attain greater results—the desire to make the invention of use to France in her wars; and the paper bag of 40 cubic feet capacity was succeeded by one of 680 cubic feet; this, again, by one of 23,000 cubic feet. Montgolfier seemed on the high-road to a brilliant success. There was, however, another brain actively employed in eclipsing the fame of Montgolfier—that of Charles, the Parisian, who realised that heated air would never become a satisfactory method of filling balloons, heated air being three-fourths the weight of the air at the ordinary temperature. He therefore took up the experiments with hydrogen gas where Cavallo had left off. Hydrogen gas being thirteen times lighter than air, its superiority in filling balloons was, to his mind, indisputable. He succeeded in making a material gas-proof, and consequently produced the first practical gas-balloon.

From the efforts of Montgolfier and Charles began the history of ballooning. I do not propose to discuss its general history this evening, with its startling incidents of adventure, nor to enumerate the good service the balloon has rendered to science in the hands of such men as Benedict de Saussure, Robertson, and Glaisher, but to make a few remarks upon its use as an adjunct of war.

By many persons, those who advocate its use in war are looked upon as enthusiasts. With many persons, an enthusiast is synonymous with a fanatic. Now, I agree that enthusiasm is sometimes expended on improper subject-matter—on wild incoherent schemes; but give enthusiasm proper subject-matter, truth, and coherency, and it becomes a noble thing; it is, in fact, the life-blood of science and art. It is, in other words, earnestness of purpose. I think the use of balloons in war is worthy of this earnestness of purpose.

I have to bring before your notice this evening, in particular, a somewhat new departure in balloons, in which electricity is so combined with a captive balloon as to render it valuable for signalling-purposes. Before I describe this special use for balloons in war, which I have had the honour of introducing to the English Government, and for which I hold patents in the principal foreign countries, I will say a few words concerning the general use of balloons in time of war.

The way in which balloons have been chiefly utilised in war is for taking observations of the enemy. In such cases the balloons are captive. As early as 1793 the French Government adopted the use of captive balloons. Such balloons were employed with great success in those wars which the French Goverment carried on soon after the French Revolution. There was a regular company formed, called "Aërostiers," and it seems to me that more practical work with captive balloons was done in actual war at this period than has been accomplished since. It was Napoleon who put an end to their career of usefulness in France, and who closed the Aëronautical School at Meudon.

It is this use of captive balloons for observations that has lately been revived by the English Government, and experiments are frequently carried on at Chatham under a Committee of the Royal Engineers. Notably amongst those who have been prominent in the revival of balloons for war purposes we may mention the names of Major Templer, Major Elsdale, and Lieut. Mackenzie, and the country, I think, has reason to thank these officers for the really good work they have done with the means at their disposal. At the Inventions Exhibition there was an exhibit of balloons in the War Department. Perhaps the more important feature of that exhibit was a balloon made of gold-beater-skin, such as was used in the war in Egypt. Gold-beater-skin is an admirable substance for forming balloons, on account of its lightness and capacity of holding gas.

The free balloon has its use in war as well as the captive one.

[1] A Lecture delivered by Mr. Eric S. Bruce, M.A. Oxon., at the London Institution, on December 28, 1886.

At the siege of Paris this use of balloons was demonstrated most efficiently. At the time when the Parisians found themselves cut off from all means of communication there were but a few balloons in Paris, but the successful escape of some aëronauts in these few was considered encouraging enough to establish an aërial highway involving a more wholesale manufacture of balloons than has ever been undertaken, the disused railway-stations being converted into balloon manufactories and training-schools for aëronauts. During four months 66 balloons left Paris—54 being specially made for the administration of Posts and Telegraphs—160 persons were carried over the Prussian lines, 3,000,000 letters reached their destination, 360 pigeons were taken up, of which, however, only 57 came back, but these latter brought 100,000 messages. These facts show that free balloons are useful in war. The utility of a free balloon would be largely increased if it could be steered against a considerable wind. Attempts have been made to navigate balloons on two principles: (1) by using the various currents of the air; (2) by some kind of mechanical propulsion. I will say just a word or two on each of these heads.

(1) As regards mechanical propulsion. There are some persons who, when they hear any suggestion regarding a steerable balloon, denounce the idea as impossible ever to be accomplished. I think it a wiser course to reserve a definite opinion as to whether such a thing is possible in the future, as the experiments worth anything which have been made in this direction have been few and far between, and it is unwise to draw conclusions on a basis of inadequate facts. I will, however, say this much, that those who have the task in hand have a difficult problem before them, and that the engineer who first steers a balloon against a strong wind by mechanical propulsion will deserve a high place amongst the heroes of science. I will enumerate some of the difficulties in the way of steering a balloon against the wind by mechanical propulsion, and then proceed to give you a short description of some of the latest experiments that have been made.

There is an essential difference of condition between navigating the water and navigating the air. In the former we have a body moving within the limits of two media, air and water. These two media have different densities and elasticities, consequently resistances. In air-navigation the body moves in one medium only, which renders the motion of a paddle-wheel entirely useless in that one medium—a paddle-wheel moving in the air would effect nothing—therefore, the only available means of propulsion in air-navigation is the screw: this cuts into the medium. Now it stands to reason that this medium must be in a state of comparative rest, or else the work of the screw will be overpowered. A moderate wind is sufficient to overpower a strong screw, hence the obstacle to air-navigation by mechanical propulsion. Capt. Renard has recently sent in to the French Academy an account of his experiments with his so-called navigable balloon *La France*, at Meudon. His experiments were decidedly interesting—in fact, they were in advance of anything yet accomplished in balloon guidance, but there has, I think, been a tendency to exaggerate the results obtained. I think anyone who reads carefully the accounts of those experiments which appeared in *La Nature* will see that the old difficulty with the screw still remains. The experiments to which I refer took place in comparatively calm weather. It is said that out of seven performances the balloon returned five times to the place whence it started. This is certainly more than most balloons do. To accomplish this, much care and ingenuity must have been exercised; but on reading the accounts, we find that great care was taken for the selection of that kind of weather that would not make the work of the screw *nil*. A whole month, in fact, had to elapse between the first ascent mentioned and the second, owing to unfitness of weather. On the day of the second experiment the wind blew from the north-north-west from Paris at a velocity of from 3 to 3·50 metres per second, starting from Meudon. The balloon was directed towards Paris at 4.25 p.m. It crossed the railway-line at 4.55, reached the Seine at 5 o'clock; at 5.12 the balloon entered the *enceinte* by Bastion 65. Then the aëronauts decided to go home. The balloon was easily turned, and, aided now by the aërial current, reached the exact spot whence it had started. The journey going had taken 47 minutes, the journey back took 11 minutes. Such experiments as these, to my mind, deserve praise, because they were conducted in a scientific manner, and because some results were attained; although the result of navigating a balloon against a wind of *considerable* power certainly did not come to pass. One must, it seems, still be content with mere bread-crumbs of aërial navigation.

(2) As regards the second means of navigating the air, by a fit selection of those varying currents that are frequently overlying one another blowing in different directions over the same spot. I think a closer and more methodical study of those currents might lead to satisfactory results. Up to the present time but little has been ascertained concerning them. Unfortunately for aëronautical science its Glaishers have been few, its mountebanks numerous. It is true there has always been a difficulty in the way of studying the aërial currents from a balloon, namely, the difficulty of keeping the balloon at a certain elevation. After expending ballast to make the balloon rise to a certain elevation for the sake of reaching a particular current, some change of temperature produced by the sun or clouds will often affect the delicately-balanced machine, and alter its altitude. If it has risen higher, gas must be sacrificed to reach the lower level; if it has descended, more ballast must be expended. In this way gas and ballast, which a celebrated aëronaut has called the "life-blood of the balloon," is quickly exhausted. It is these facts that make the successful experiment carried out by M. Lhoste last August so worthy of note. In his voyage across the Channel he made use of an apparatus which he called a "*flotteur frein*." This acted as a kind of floating anchor or brake. It was a cylindrical iron vessel with a conical air-chamber at the top, 1 metre 60 centimetres in length, 22 centimetres in width, weighing 10 kilogrammes when empty, and 60 kilogrammes when filled with salt water. The *flotteur* was attached to a bar underneath the balloon, on which a small sail was hoisted. The important function of this *flotteur* is, that by its means the same altitude of the balloon can be maintained when the favourable current is once found. By means of this *flotteur* the water itself can be drawn up into a reservoir in the balloon and utilised as ballast, after sunrise, when the expansion of the gas by the heat of the sun's rays would otherwise cause the balloon to shoot upwards. By this method of adjusting the altitude of the balloon, several important observations of the various currents of air about which we know so little might be taken, and it would, I think, be well if Governments organised experiments with these various currents, as well as with elaborate screws worked with power inadequate for the purpose of propelling a balloon against a powerful wind. Perhaps the aërial machine of the future may be directed by utilising in a thoroughly scientific manner these varying currents. In such a system of aërial locomotion perhaps the screw may be used as a kind of makeshift in a dead calm, when a change of level is not desirable, like the oars when there is no wind to fill the sails.

One of the most practical uses of balloons in war is for signalling. The utility of balloon-signalling consists in the elevation obtainable. Any accepted method of signalling may be used in the car of an ordinary captive balloon, *e.g.* flag-signalling or lantern-signalling. But signalling from the car of a balloon necessitates the use of a balloon of considerable size to secure the required lifting-power. This limits the practicability of such a method. About a year and a half ago it occurred to me to so apply electricity to a captive balloon that a method of flashing signals from a balloon is practicable while the operator remains on the ground. Thus the weight of the operator is obviated, and consequently the balloon can be of such a size as to be extremely portable. It is my wish to thoroughly explain to you this method. In the interior of a balloon which is made of a material that is perfectly translucent and filled with hydrogen or coal-gas are placed several incandescent electric lamps. The lamps are in metallic circuit with a source of electricity on the ground. In the circuit on the ground is an apparatus for making and breaking contact rapidly. By varying the duration of the flashes of light in the balloon, it is possible to signal according to the Morse or any other code. To thus place a source of light in the midst of the gas inside a balloon would not have been possible until the development of the electric light. Many persons even now seem to think the proceeding of showing a light inside a balloon a dangerous one. Therefore, before I describe my invention in detail, I will show you a few experiments, after which I think you will realise that the placing of the incandescent lamp inside a balloon is not attended with danger. [Experiment shown.] If I take a jar of hydrogen in my hands, and insert a taper at the mouth, the gas catches fire, but the taper goes out when I thrust it upwards in the jar. You see, hydrogen gas takes fire under certain conditions, but is incapable of itself of supporting combustion. The flame you have seen burning at the mouth of the jar is the effect of the great affinity which exists between the atoms of hydrogen and the atoms of oxygen which, in the atmosphere of the room, borders upon the hydrogen of the jar. Further up in the jar the hydrogen atoms have no oxygen atoms wherewith to combine. Now, it may seem a surprising assertion to make, but it is nevertheless true that one could place a red-hot poker in the body of gas in a balloon without setting fire to it. If I were to ask anyone here so to do, I am sure he would decline, and say the gas would catch fire as he placed the poker in the mouth. That is quite true; and, to perform the experiment successfully, he would have to avoid the borderland altogether. Here is a puzzle to put to your friends:—How to put a red-hot poker into the body of a gas-balloon without setting fire to the gas. Now, I will show you how to do this. [Experiment shown.] Here is a glass globe, through which a continuous stream of coal-gas is passing. You see this must be so, for I have ignited the gas jet at the top of the globe. Now I have stretched a little piece of platinum wire across the terminals of an electric battery, and placed these terminals inside the globe. Now I will cause the electric current to pass through the piece of wire, and it becomes white-hot, and we have this condition of things: a piece of white-hot metal unprotected inside a globe filled with gas. Now, if we were to substitute a balloon for the globe, and have a battery of exceeding power, and if we were to place a poker between the terminals of the battery, the red-hot poker in a balloon would be a *fait accompli*. The incandescent lamps which we place inside the balloon consist of a thin filament of carbon inclosed in a glass globe exhausted to a high degree of air. This filament of carbon is raised to a white heat by the electric current. [Experiment shown.] I have thrown the image of a filament of carbon upon the screen, rendered thus incandescent. On my table I have another globe filled with gas inside, which is our incandescent lamp. This is the condition of things we have in the balloon. [Experiment shown.] Now, some person may say: "Suppose by accident you get an explosive mixture of oxygen and hydrogen inside the balloon, and that this fragile little bulb breaks." Well, if it does break, one lamp will be lost; that will be all the damage done, for the oxygen present will at once destroy the carbon filament. [Experiment shown.] I will show you this experiment by breaking an incandescent lamp in the midst of this inflammable piece of tow; you see, as I break the lamp, the light instantaneously goes out, as the action of the oxygen is to destroy that delicate carbon bridge which you have seen depicted on the screen. Now, one more of this series of experiments. [Experiment shown.] Here is another globe filled with gas; in this I discharge a naked electric spark between two platinum points. I perform this experiment to show you that, even if there were a bad connection in the electric arrangements inside the balloon, there would be no danger of firing the gas. However, in the special form I provide, I obviate all chance of any sparking, so that, in case of the contingency of there being an explosive mixture of oxygen and hydrogen inside the balloon, there would be nothing to determine it. That an electric spark can fire a mixture of hydrogen and oxygen in certain proportions I can show you by producing this respectable electric spark by means of this induction-machine, and then bringing near it a jet of coal-gas. [Experiment shown.]

A convenient size for one of these signalling-balloons is a gas capacity of some 4000 cubic feet, or, if required, they can be made smaller than this. Varnished cambric is a suitable material. I have two separate arrangements for suspending the lamps inside the balloon; the first consists of a holder made like a ladder, the lamps being placed one above the other in multiple arc. Here is this arrangement before you, with the lamps lit up. This arrangement is convenient because of the small breadth of the ladder, which is easily admitted into the neck of the balloon. The ladder arrangement casts a small shadow on the balloon. In my opinion this shadow is of no consequence whatever; but I have an alternative method which obviates the appearance of any shadow altogether. It consists of a ball, from which project lamps at various angles; the arrangement is protected from risk of breakage by a wire framework. [Experiment shown.]

The form of contact-breaker which produces the intermittent flashes of light is in form somewhat like a Morse key. In reality it is essentially different. An ordinary Morse key, such as is used in telegraphy, would not withstand the large currents used to light the lamps. In my latest form of contact-breaker I use carbon-contacts. These can be easily renewed at trifling cost when worn away. [Experiment shown.] I have also on my lecture-table another form of contact-breaker [experiment shown], in which there is a rubbing contact faced with platinum. The leads which convey the electric current to light the lamps must be as light as possible, consistent with the current they have to carry, and [experiment shown] here is a special type of cable I have had manufactured for the purpose. By means of the model balloon before you, I will now show you the action of the key. We will flash the words "A Merry Christmas and Happy New Year to you all." [Experiment shown.] On the switch-board which contains the key I have an arrangement to switch on the lights in the balloon continuously, in this manner, because these portable balloons thus illuminated would be useful for other purposes than for flashing signals, viz. for a preconcerted signal, or as a "point-light" to guide advances or retreat.

The source of electrical power for working the lamps inside the balloon may be varied according to circumstances. It may be: (1) a small dynamo; (2) a storage battery; (3) a primary battery. Each of these three forms of power can be supplied in portable and convenient form. In some cases, where there is a stationary dynamo-machine in close proximity, storage-cells may be conveniently used, as they can be charged from this stationary dynamo, and brought into the field as required. I used storage-cells just now to light up that ladder of lamps and for working the lights in my model balloon. These storage-cells are, you see, arranged at the foot of my lecture-table. A portable way of obtaining power would be, I think, to use a little gas-engine with dynamo combined, such as, by the courtesy of Messrs. Crossley Brothers, I am enabled to show you this afternoon at work. [Experiment shown.] This might be fixed on the waggon, with all the other apparatus connected with the balloon. The engine would be worked by the gas, which is always a necessary adjunct to the balloon. The gas-supply might be a portable apparatus for generating the gas, or else the method of storing gas in steel bottles could be adopted. This has been done successfully by our own Government. At the Inventions Exhibition a bottle of compressed gas was exhibited in the War Department. I now wish to show you how easily gas may be compressed, stored up, and used when wanted. Here is a small bottle of compressed hydrogen, and I will soon transfer the gas from that to this goldbeater-skin balloon, which now rises to the ceiling. [Experiment shown.] There is another method of lighting these balloons—by using a primary battery. There is a very excellent primary battery now in the market, invented by M. Schanschieff. A good primary battery has long been a great desideratum. For some time I have searched to find one that was anything near the mark for electric lighting purposes. This battery which is before you is the best I have had in my hands, and I am applying it to several of my patent arrangements. I am glad to be able to show you one of these batteries in working order. [Experiment shown.] In this comparatively small compass we have 32 cells. The size of each cell is 3½ inches by 2 inches. In the cells we have a single fluid solution—sulphate of mercury acidulated. There is a sample of the sulphur in this bottle. Now, with most single-fluid batteries we have what is technically called polarisation, which means diminution of electric power. Mr. Schanschieff has overcome this polarisation, and in overcoming it he has done a great deal towards the development of electrical appliances. There is one piece of apparatus connected with the balloon worth mentioning. This is the reel for winding the cable. [Experiment shown.] The electric connection is made, you see, as the cable unwinds.

The advantages which I claim for this method of signalling are, briefly: It facilitates night-signalling; it facilitates signalling to long distances; and in places where the ordinary methods would fail to be of any use, such places as hilly and wooded districts, the apparatus is portable and simple; the balloon shows a large body of light. In order that you may realise the use of a balloon in time of war in a place where ordinary signalling would be of no use whatever, I have prepared the illustrations which my assistants will now throw upon the screen. Here we have a mountainous region. There are supposed to be two friendly armies separated by chains of mountains, and wishing to communicate. Now these two armies might be possessed of every other modern appliance for signalling from the ground without being able to make a signal seen by either side. Therefore, in the scene before you, the signallers of one army are depicted as filling the portable signalling-balloon with gas preparatory to the ascent for purposes of signalling. The army on the other side of the mountains has already sent up a similar balloon. The next scene shows a nearer balloon ascended to a certain height. Now the two balloons are about to communicate. You see the flashes of light from the balloon.

Although this invention is not two years old, it has already a short history. It was exhibited in model in the War Department of the Inventions Exhibition, and while on exhibition there the method was referred for Government trial under a Committee of the Royal Engineers at Chatham. During the time the model was being exhibited at South Kensington, some experiments were tried with a balloon of 4000 cubic feet capacity at the Albert Palace. In this balloon were placed six lamps worked to 16 or 20 candle-power. The six lamps took a current of some 9 amperes, and the electromotive force was 24 volts. The source of electric power then used was 25 cells of the Electrical Power Storage Company. During this Exhibition the value of the method for long-distance signalling was well tested, the flashes of light from the balloon being observed as far as Uxbridge, a distance of sixteen miles. This was effected by less than 100 candle-power. I used the same apparatus for the Government trial at Chatham, after which trial I received an order from the War Office to supply some of my apparatus to the Royal Engineers. The system was again tried at Aldershot under the Signalling Department. On the day fixed for the trial there was a snowstorm and a fog, two very unfavourable conditions in a system of signalling, but signals were read and answered from my balloon, in spite of snow and fog, by the signallers stationed some few miles off. As I mentioned the other day at a meeting of the Aëronautical Society, I wish, as the inventor of this system, to see it tried to its utmost capacity, and I purpose to put the system myself shortly to the most rigorous of tests. One of those tests will be, I hope, to signal over the Channel, *i.e.* to send up the balloon on some site on the English coast, probably Dover, and observe whether the balloon can be seen on the French coast. The Channel is by no means the most favourable expanse for signalling, for there are frequent fogs in it to obscure the view. The Channel, however, is a time-honoured and popular measure of distance, and I must repeat here the wish I expressed lately at the meeting of the Aëronautical Society, that, if the flashes of light can be observed over that expanse, I hope the public will look upon the accomplishment, not as a sensational feat, but as showing the practical value of balloon-signalling. Up till lately I have only considered my system as being useful to the army. I think, however, it would be also useful to the navy. I have schemed a method of employing these balloons on board ship. Their greatest use in the navy would be, I think, for coast-signalling—signalling round corners; I have been asked to submit this scheme to the Admiralty, and am preparing to do so. The picture now before you represents its use in the navy on board a ship stationed in a bay, which vessel wishes to communicate with another at the other side of the cliffs which form the bay. It is, as you see, night-time. The ship that is not visible to you sends up the balloon, and now the two balloons commence signalling to each other. [Experiment shown.]

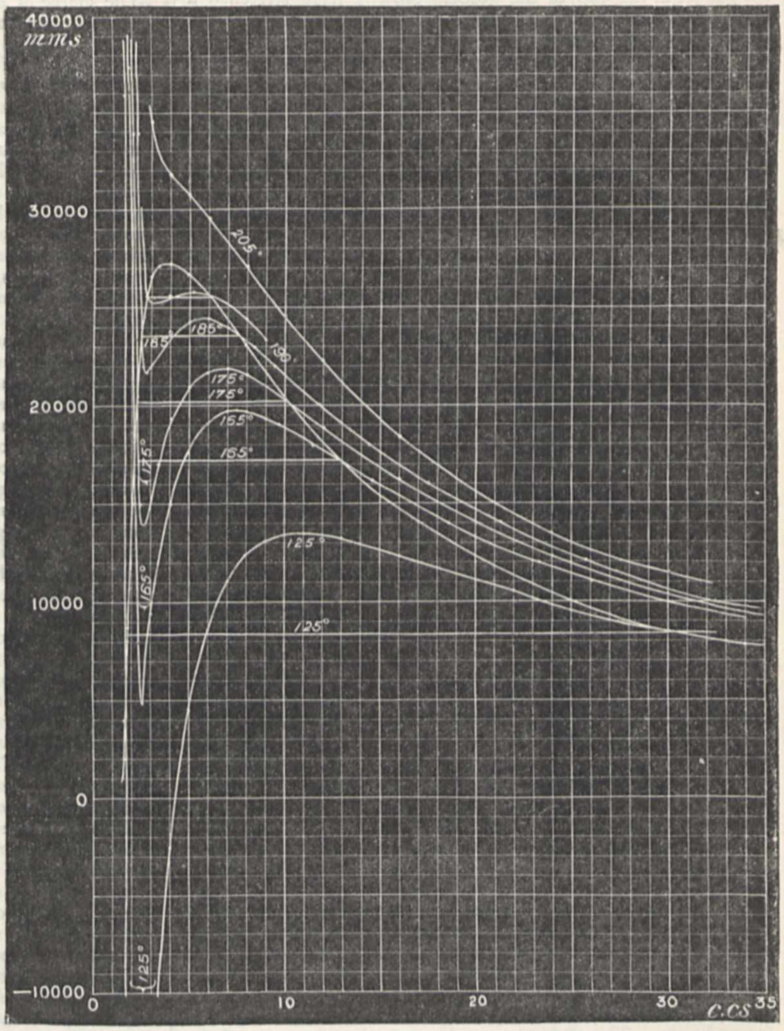
You may perhaps be inclined to think that I ought to mention some one particular occasion in history when this balloon would have been useful. I do not think we need look far back to find one example. But a short while ago there was a brave general shut up in a besieged city with a few followers. Near at hand there were friends ready to help, but ignorant of the immediate necessity of that help. Need I name that general and that city? Now, if from Khartoum there could have arisen such an electric signalling-balloon as I have described to-day, its flashes of light in the skies would have told the tale of the events below—a tale that would have been eagerly read—and perhaps that brave general would then have left Khartoum, a conqueror, and with his life spared for the future service of his country.

SOCIETIES AND ACADEMIES

London

Royal Society, January 6.—"Preliminary Note on the Continuity of the Liquid and Gaseous States of Matter." By William Ramsay, Ph.D., and Sydney Young, D.Sc.

For several years past we have been engaged in an examination of the behaviour of liquids and gases through wide ranges of temperature and pressure. The results of our experiments with ethyl alcohol have recently been published in the *Philosophical Transactions*; those with acetic acid in the *Transactions* of the Chemical Society; and the Royal Society have in their hands a similar investigation on ether. We have also finished a study of the thermal properties of methyl alcohol.



In consequence of a recent publication by Wroblewski, of which we have seen only the abstract (*Berichte*, 1886, p. 728, abstracts), we deem it advisable to communicate a short notice of an examination in which we are at present engaged.

We find that with the above-mentioned substances, acetic acid excepted, whether they are in the liquid or gaseous state, provided volume be kept constant, a simple relation holds between pressure and temperature. It is $p = bT - a$. This is evidently a simple modification of Boyle's and Gay-Lussac's laws; for at low pressures, where volume is large, the term a approaches and finally equals zero, while b diminishes and finally becomes equal to the value of c, calculated from the ordinary equation,

$$p = \frac{cT}{v}.$$

We have as yet only had time to apply this formula with ethyl ether to the liquid state; and as we are not yet quite certain whether the relation holds for volumes between 4 and 20 c.c. of 1 gramme of ether, we are at present engaged in measurements of volumes and pressures at temperatures between 220° and 280°. Assuming the above relation to be true (and it is at all events a close approximation to truth), it is possible to calculate those portions of isothermals included within the liquid-gas area, and represented in Andrew's diagram by horizontal straight lines. We have calculated a few of these isothermals for ether, and find that the areas above and below the horizontal lines (see woodcut) are equal, when measured by a planimeter.

Reserving a full discussion of the subject until the completion of our experiments, we would here point out the similarity between the equation $p = bt - a$ and those proposed by Clausius and by van der Waals to represent these relations. Clausius's formula is

$$p = \frac{RT}{v - \alpha} - \frac{c}{T(v + \beta)^2},$$

and van der Waals'

$$p = \frac{RT}{v - b} - \frac{a}{v^2}.$$

In these formulæ Clausius's α and c are equivalent to van der Waals' b and a respectively, but R has a different signification.

We find that a somewhat similar formula agrees better with experiment than either of the above; it is

$$p = \frac{RT}{v - b} - \frac{a}{Tv^n},$$

where R, b, and a have the same meaning as in van der Waals' formula. This formula expresses the results of experiments with great accuracy, where the volume of 1 gramme of ether occupies not less than 25 c.c.; but at smaller volumes it ceases to represent the facts.

It is to be noticed that both Clausius's equation and ours introduce T into the denominator of the second term; they evidently differ from our first equation $p = bt - a$, in which a is independent of temperature.

We shall soon be in a position to communicate the results of this investigation, giving full data.

PARIS

Academy of Sciences, January 3.—M. Gosselin, in the chair.—A new method of determining the constant of aberration, by M. Loewy. M. Nyren having shown that none of the methods hitherto adopted are free from systematic error, the author here proposes a process by which all instrumental errors may be avoided. It also eliminates the effects of precession and nutation, and enables the observer to take accurate account of the proper movements of the stars without depending on their approximate values drawn from the catalogues. Lastly, it neutralises the parallactic effect of the stars, dispensing with the numerous experiments needed to determine the instrumental constants. In a word, it calculates directly the phenomenon of aberration itself, without employing any physical constant.—On the relations of the lactiferous vessels with the fibro-vascular system, and on M. J. Vesque's aquiferous apparatus of Calophyllum, by M. A. Trécul. Further researches are described confirming the conclusion already announced by the author regarding the numerous points of contact between the milk-yielding vessels and the various elements of the fibro-vascular system in a large number of plants. It is further shown that the anatomical results described by him in the year 1865 are amply confirmed by M. Vesque's recent note on the aquiferous apparatus of *Calophyllum Calaba*.—Actinometric observations made during the year 1886 at the Montpellier Observatory, by M. A. Crova. The comparative study of these observations (made by M. Houdaille with the author's actinometer) with those of the three previous years confirms the conclusions already arrived at regarding the annual variations of calorific intensity in the solar rays.—Note on the diurnal nutation of the terrestrial globe, by M. Folie. The important consequences of the existence of this phenomenon for geology, astronomy, and geodetics are pointed out, and it is shown that it places beyond doubt the fluid state of the interior of the globe surrounded by a relatively thin outer crust.—Note on the Maclaurin series in the case of a real variable, by M. O. Callandreau.—On a class of differential equations, by M. Emile Picard.—Observations relative to M. P. Serret's recent note on a geometrical theorem, by M. L. Lindelöff. A slight error is pointed out in M. Serret's calculation establishing the correspondence between the lines of curvature in two surfaces with reciprocal vector rays.—Note on the problem of electric distribution, by M. H. Poincaré. The author points out the defective character of the method proposed by MM. Neumann, Schwarz, and Harnack for solving this difficult problem.—Remarks respecting M. Hirn's observations on the flow of gases, by M. Hugoniot. The author returns with regret to this subject, and makes some final remarks on M. Hirn's paradoxical inferences, calling upon him to present a complete statement of his experiments, and of the causes of the errors he professes to have detected in the calculations of the upholders of the kinetic theory.—Note on the specific heats of a perfect gas, by M. Félix Lucas. On theoretic grounds it is argued that the two specific heats of a perfect gas become increasing functions of the temperature.—On the nature of the electric actions in an insulating medium (second communication) by M. A. Vaschy. These problems of electro-statics are brought into general relation with those dealing with the equilibrium of the ether regarded as an elastic body. It is hence inferred that the electric perturbations must be propagated with a uniform velocity, just as a mechanical concussion is propagated in an isotropic body, and this velocity must be that of light.—On electric pressure and on electro-capillary phenomena, by M. P. Duhem.—On a phosphate of hydrated silica, by MM. P. Hautefeuille and J. Margottet. From three analyses made with specimens obtained from different preparations it is shown that the formula of this substance is $SiO_2,2PhO_5,4HO$.—Action of sulphur on ammonia and on some metallic bases in the presence of water, by M. J. B. Senderens. These researches have been carried out in continuation of MM. Senderens and Filhol's studies in connection with the action of sulphur on the saline solutions and on those of soda and potassa.—Note on the maxima vapour tensions of acetate of soda, by M. H. Lescœur. M. Berthelot's conclusion that there is no isomery either between the solid salts or between the diluted solutions of the various acetates of soda, are fully confirmed by the results here obtained by a different process.—On the preparation of the isobutylamines, by M. H. Malbot. It is shown that the three isobutylamines are formed in proportions differing little from each other, the operation constituting an effective method of preparing all these amines simultaneously.—Isomery of the camphols and camphors, by M. Alb. Haller. Here the author deals with the camphols of madder, of Borneo (*Dryobalanops camphora*), and of yellow amber.—Heat of formation of some alcoholates of potassa, by M. de Forcrand. Determinations are given for the heat of formation of the propylate and isobutylate of potassa.—On some points relating to the action of saliva on the grain of starch, by M. Em. Bourquelot.—Experimental researches on mercurial intoxication, by M. Maurice Letulle. The paper deals especially with the paralytic accidents and lesions of the surface nerves caused by this intoxication (chronic hydrargyrism).—Studies of the relations existing between the cranial nerves and the cephalic sympathetic nerve in birds, by M. L. Magnein.—Note on the red and white muscles in the rodents, by M. L. Ranvier.—Observations relative to M. Maupas' recent note on the multiplication of *Leucophrys patula*, by M. Balbiani. It is shown that the peculiar process of fissiparity in these organisms is not such a rare phenomenon as is supposed by M. Maupas.—On the line of development followed by the embryo of bony fishes, by M. L. F. Henneguy. The author's researches confirm the conclusions already arrived at by Kupffer and Œllacher.—On the amphipod crustaceans of the west coast of Brittany, by M. Edouard Chevreux.—Observations relative to M. Viguier's note on the so-called ophite rocks of the Corbières, and to M. Depéret's communication on the Devonian system of the Eastern Pyrenees, by M. A. F. Noguès.—Microscopic examination of the ashes ejected by the Krakatão volcano, by M. Stanislas Meunier.—A critical examination of certain rare minerals, by M. A. Lacroix. Descriptions are given of pterolite, villarsite, grängesite, and gamsigradite.—The death was announced of M. Francisque Fontannes, a distinguished geologist, who was awarded the Academy's Grand Prize for the Physical Sciences in 1883.

Berlin

Physical Society, November 19, 1886.—Prof. du Bois-Reymond in the chair.—Prof. Liebreich reported on phenomena he had observed in the course of experiments respecting slowly-proceeding chemical reactions. If hydrate of chloral were mixed with an alkaline solution, then was chloroform formed in the shape of a white precipitate. This reaction occurred with all alkaline solutions, only the time varied according to the alkali. While, however, chemical reactions usually ensued in the whole mass of the reacting substances, it was here observed that, when the process of mixture was effected in a test-glass, the uppermost layer remained clear, no turbidity and precipitate formation occurring in it. This layer, which the speaker named the "dead space" ("todter Raum"), was bounded on the upper side by the meniscus of the fluid, and on the lower side by a sharp boundary, having, apparently, a curve opposed to the meniscus. In the capillary space between two glass plates, the dead space displayed itself in very beautiful formation. In horizontal capillary tubes the dead space came into shape at both ends, and in very short capillaries the reaction failed entirely. If from the dead space a little clear fluid were withdrawn and warmed, then did the reaction set in. This showed that in the dead space both fluids were contained, and that it was only their chemical action that was prevented. The dead space showed itself in drops at the edge of the curve. In the capillary space between two menisci was found an external ring, and the middle clear, while reaction occurred only in a small ring. If tubes were closed by a membrane above and below, and filled with the mixture of hydrate of chloral and alkali, then did the dead space appear both at the top and the bottom. The same phenomenon presented itself likewise in animal membranes—for example, in a rabbit's bladder or in an intestine. On the other hand, the dead space was observed neither in a gutta-percha alembic nor in a similar shaped glass retort. The speaker also discussed many other sorts of phenomena in respect of the dead space, both with the fluids already named and with other fluids, demonstrating a large part of them by experiments. In conclusion, he set up the hypothesis that, in the experiments referred to, the chemical reaction was hindered by phenomena of surface-tension, a matter which should be further investigated by additional experiments. A lengthy discussion followed this paper.—Dr. Weinstein then reported on a publication of the Normal Standard of Weights and Measures Commission, "Construction and Repeated Trial of the Principal Standards and the Control Standards" ("Die Herstellung und Wiederkehrende Prüfung der Hauptnormalen und der Controllnormalen"). He brought out that in this publication the idea of weight was officially defined by a mass, the unit of which, the kilogramme, was equal to a cubic decimetre of distilled water at 4° C. The trial of the normal metre of platinum resulted in the establishment of its invariability. The kilogramme of platinum was likewise unchanged, while, on the other hand, the control standard-kilogramme showed a slight increase of weight through oxidation. The examination of the dry measures resulted in showing a considerable diminution of volume, a fact which would have to be ascribed to elastic and thermal after-effects in the material that had been employed for the standard dry measures.

Physiological Society, November 26, 1886.—Prof. du Bois-Reymond in the chair.—After the re-election of the President and Council, in accordance with the statutes of the Society, and the disposal of several business motions, Prof. Falk communicated a case taken from his forensic practice, which was not without physiological interest. A boy was run over by a heavy van and in a few minutes died. A *post-mortem* showed a gaping rupture of the thyroid and of the cricoid cartilage, the entrance of blood into the air-passages—causing death by suffocation—and into the digestive organs. It was, now, a remarkable and physiologically interesting fact that the blood had penetrated not only into the stomach, but into the small intestine, and that, as far as the neighbourhood of the cœcum. Seeing that the abdominal organs were perfectly intact, and the intestines even to a high degree anæmic, the blood must have proceeded from the stomach, and that during the brief time of the agony; for peristaltic movements appeared indeed after death, but in no case in the stomach, and the passage of the contents of the stomach into the intestine was never observed after death had set in. The speaker had, on the other hand, observed very violent swallowing movements as well as increased peristaltic movement in the intestine and stomach in men, and especially in his experiments with animals during the agony of suffocation. In the discussion following, Prof. Zuntz corroborated the fact of the appearance of increased peristaltic movements, and of the abnormally far advance into the intestine of the contents of the stomach during death by suffocation, citing, as he did, some earlier experiments he had not yet published. By way of testing the assertion proceeding from the laboratory of Prof. Ludwig, that acid chyme was normally found in the small intestine of animals, he had instituted experiments in which very soon after death he opened the abdomen of animals, and by a ligature isolated the small intestine from the stomach; he then in every case found the contents of the intestine neutral or alkaline. If on the other hand he poisoned the animals, as in the case of Ludwig's experiments, with curare, then were the contents of the intestine acid. The cause of that, however, was that the animals had died from suffocation, and that the asphyctic blood had induced a lively peristaltic movement of the smooth intestinal muscles not paralysed by curare, and so, therefore, an abnormally rapid propulsion of the contents of the stomach into the small intestine.

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