THURSDAY, AUGUST 29, 1889.

THE SCIENTIFIC WORKS OF SIR WILLIAM SIEMENS.

The Scientific Works of Sir William Siemens, LL.D., D.C.L., F.R.S. 3 Vols. (London: John Murray, 1889.)

THE "Life of Sir William Siemens," which was noticed in the pages of NATURE some months ago, has been followed by three most interesting volumes containing a reprint of his scientific papers. The task of editing the collection was committed by the executors to Mr. E. F. Bamber, for many years private secretary to Sir William Siemens, and it has been admirably discharged. The labour has been no light one; for the volumes contain, besides the greater and more highly finished contributions to the learned Societies, a very large number of extracts from the published proceedings of the various Societies and from the scientific journals—reports of the speeches delivered by Sir William Siemens during the discussions at scientific meetings.

Many of these papers are of high scientific importance, particularly to various classes of engineers, electricians, and chemists; and the whole collection forms a monument of unusual interest, exhibiting the many-sided nature of Siemens' labours and inventions. Both the papers and the unwritten speeches are very remarkable for clearness of thought and of style. Siemens was pre-eminently a man who made up his mind with complete decision, after careful thought, on whatever came before him. This decisiveness gave him the power of taking hold of a matter by the right end in the exposition of it: and the consequence is a clearness of thought and of diction which are alike unusual and satisfactory. The reader seldom requires, even in the case of descriptions of complicated apparatus, to reperuse a sentence; nor is it ever difficult to follow the reasoning on which an opinion is based.

Of the three volumes before us, the first contains the contributions of Siemens to the subjects of heat and metallurgy. The second is mainly taken up with electricity and miscellaneous subjects; while the many lectures and addresses, which from time to time he was called upon to deliver, are collected in the third volume.

It is impossible, in a brief article like the present, to review in detail these substantial volumes, or offer any lengthened criticism of their contents. We must content ourselves with such brief notice of them as will indicate to our readers some of the chief features in the life-work of this remarkable man.

In the second volume, under the heading "Miscellaneous Subjects," will be found two papers of no great length, but of special interest. These papers contain an account of Siemens' improved water-meter. Of what vast importance this invention proved to the inventor is probably not generally known. To use a common expression in the widest sense, "it made his fortune." It was his first thoroughly successful invention; and it gave to the young engineer the pecuniary assistance (greatly needed at the time) which enabled him to push forward into higher and yet higher regions of invention and success. The meter was invented in 1850-51, and patented in 1852. It satisfied the tests of a committee of inquiry of the Manchester Corporation Waterworks; and very soon a large number of the meters were at work, and were giving complete satisfaction. The general principle is that of using "various arrangements of screws or helices, which are caused to revolve by the passage of water or other fluid through them, and of fixed guides and channels in connection with such screws or helices to regulate and direct the current of the fluid, together with various contrivances for registering the number of revolutions of the screws." For the larger meters a many-bladed screw is used, the blades and guides being properly shaped that the blades may "partake fully of the onward motion of the water without sensibly impeding or agitating the same." For the smaller meters a kind of Barker's mill is used, with conditions as to the inlet and outlet arranged to fulfi the object in view.

"From a practical point of view," says Mr. Pole, in his "Life of Siemens," "the Siemens water-meter has been one of the most useful and valuable machines ever brought into hydraulic engineering. . . . . Down to the end of 1885 nearly 130,000 meters had been sold by Messrs. Guest and Chrimes (the first makers) alone, and in many cases it has been established as the standard apparatus for the sale of water." The two papers contained in the present volume were contributed in 1854 and 1856 to the Institution of Mechanical Engineers, and they contain a full discussion of the conditions necessary to be fulfilled by a water-meter, and descriptions, with illustrative drawings, of the inventions in this direction of the author.

In the first volume are contained the papers of Siemens on heat and metallurgy. These are well known to all workers in these departments of science and industry, and a brief notice must suffice here, in spite of their vast intrinsic importance. Very early in his life we find Siemens devoting his attention to the "regenerative principle" in heat. The words "regenerator" and "regenerative" are most unfortunate—utterly misleading to those who attempt to imagine the nature of the "principle" from the name by which it is called. The names, however, were not due to Siemens, but to Dr. Stirling, inventor of the hot-air engine; and it is worthy of being mentioned here that Siemens objected to the name, and wrote to Mr. Manby, a friend of Dr. Stirling, that "perceiving him (Stirling) to repudiate the name of 'respirator,' I really think he would confer a benefit on posterity if he would give his child a proper name, that of 'regenerator' being certainly incorrect, and likely to produce misconception."

The name "respirator" readily suggests the nature of the principle here spoken of. The metallic plate of a respirator, used by delicate people to protect the lungs or throat, takes up the heat of the outgoing breath and parts with it again to the air which is inspired; and this is precisely the principle of the heat-saving arrangements with which the name of Siemens is so closely connected. It may be, however, that a better name than either of these could easily be found.

In this first volume of the papers we find the titles of many communications describing arrangements for heat-saving and for obtaining increased temperatures by causing what would otherwise be waste heat to warm the air or gaseous fuel used in the process of combustion. Thus we have a "regenerative condenser for high-pressure and low-pressure steam-engines"; a "regenerative steam-engine"; the regenerative furnace applied to glass houses and to various metallurgical processes—to the manufacture of steel, the puddling of iron, &c.

Towards the close of his life, Siemens took up warmly the question of abatement of smoke in large towns, and economy in domestic heating and lighting. Accordingly we find interesting and important papers on the use of coal-gas as a fuel, and on gas supply both for heating and illuminating purposes. These papers contain a description of a regenerative domestic fire and a regenerative gas-lamp. It is very surprising that the views of Siemens on these important subjects have been so little appreciated by the gas companies on the one hand, and by the general public on the other. The smoke nuisance becomes year by year more and more terrible in our large towns; while the gas companies are undoubtedly neglecting to take advantage of sources of enormously increased profits to themselves.

Space fails us to enter into any detailed account of the important papers on metallurgy contained in the second part of the volume just now before us. In these are elaborated the descriptions of his improvements in iron processes. The two main features of the inventions are, first, the production of "mild steel," as it is called, of a quality surpassing that obtained by older processes; and, second, the production of first-class steel by the "direct process"—that is, directly from the ore instead of from the pig-iron of the blast-furnace, or from puddled iron. It is probable that even now, when there are over a million tons of steel being produced annually in Great Britain alone by the processes of Siemens, we are far from seeing in full the results of these improvements. It must be remarked, however, with regard to the direct process that the very existence of the enormous establishment of blast-furnaces in this and other countries constitutes a formidable adversary to its introduction.

The volume containing the papers of Siemens on electrical subjects is naturally divided into two parts: one containing papers on cable-laying, &c., and the other on the production of electricity by the dynamo-electric machine, and its application when so produced. The life of Siemens was intimately associated with the electrical developments which have made the last forty years startling in the rapidity of growth and improvement. By the electric telegraph, the commercial and social relations not only of individuals, but of the nations, have been revolutionized; while with regard to the dynamo-electric machine, much as its invention has accomplished, there can be no doubt but that its past and present are but infinitesimal compared with its future importance. The papers of Siemens must always have exceptional interest in connection with the early history of these two industries.

We cannot do more here than mention a few of them. First we have three papers largely taken up with land-line telegraphs, and giving an account of the progress which Dr. Werner Siemens was making in Germany, both in the construction of telegraph lines and in the improvement of telegraph instruments. Next we meet with a paper describing a machine for covering telegraph wires with india-rubber. Then we have contributions to the tests of deep-sea cables; and again, a paper on the outer covering of deep-sea cables. A most interesting paper gives an account of the steamship *Faraday* and her appliances for cable-laying. The *Faraday* was built with the object of laying the Direct United States cable, and was fitted with every appliance which the experience of former great submarine cables had suggested as important. A number of minor papers give descriptions of accessory instruments and appliances connected with the work of laying down deep-sea cables. Thus we have a deep-sea thermometer, the bathometer, &c., described in short interesting memoirs.

The papers connected with the production of electricity by the dynamo-electric machine, and of the uses of the great currents so produced, deal with a department of science and industry in which Sir William Siemens and his brothers were pioneers. The Siemens family, and the manufacturing firms of Siemens in this country and in Germany, designed and produced machines which undoubtedly were the best of those early days, and which served Siemens in setting on foot the first electric railways, the first electric furnaces, and first and only experiments on horticulture by electric light.

Only a few lines remain to us in which to refer to the third of these volumes. A man of Siemens's power and standing, and one who was able to speak with authority on so many subjects of high scientific and commercial interest, was naturally called on to give many more or less popular expositions of these subjects. Many lectures and addresses were therefore obtained on various occasions from this gifted and public-spirited man. These are collected in the third volume of the papers. Here we find addresses on deep-sea telegraphs, testing electric cables; on fuel, a popular lecture to the working classes under the auspices of the British Association at Bradford; on air-engines and steam-engines, in which the regenerative principle is explained; on utilization of heat, a lecture under the Glasgow Science Lectures Association; on waste, delivered to the Coventry Science Classes; several addresses and speeches on subjects connected with the production and uses of steel. We have also addresses which he delivered as President of various learned Societies—as President of the Mechanical Section of the British Association; two addresses to the Society of Telegraph Engineers, two to the Iron and Steel Institute, his address as President of the British Association in 1882, and many other minor addresses and speeches.

Among other subjects on which Siemens had thought deeply, is the highly important one of technical education, which is exercising the minds of so many at the present time. He had more than common opportunities for forming a correct judgment on the requirements of those who are to advance the various arts and industries of the world; and his knowledge of Germany and England, and of German workmen and English workmen in very varied departments, gave him special title to speak with authority on this subject. The consequence is that in many of his shorter addresses and speeches very valuable remarks and criticisms are to be found on this question so vital to our national prosperity.

In taking leave of these important volumes, we cannot but feel that scant justice has been done to them in this brief article. It is only a very small proportion of the subjects on which Siemens thought and wrote to which we have been able even to allude. Very many subjects occupied his active mind, and it is most remarkable how thoroughly and completely each one of them was worked out and brought down to a definite conclusion. Much he attempted; and pre-eminently he acted on the principle that "whatever is worth doing is worth doing well."

THE ADVANCEMENT OF MEDICINE.

Reports from the Laboratory of the Royal College of Physicians, Edinburgh. Edited by J. Batty Tuke, M.D., and G. Sims Woodhead, M.D. Vol. I. (Edinburgh and London: Young J. Pentland, 1889.)

IT is a healthy and most welcome sign of the increased interest taken in pathological research that, at the conclusion of what is but the first year of its existence, the laboratory instituted by the Royal College of Physicians of Edinburgh has been able to issue a volume of Reports of such importance as the one lying before us. When, further, it is noted that this is, if we mistake not, the first volume of its kind published in the United Kingdom—the first collection of papers emanating from a single laboratory, and treating of pathology alone—then the energy that is being displayed north of the Tweed in the advancement of medicine by research should gain the cordial appreciation it well deserves.

Willing as our own Royal Colleges of Medicine have of late shown themselves to encourage investigation, they have, from a variety of causes, been unable to bring forward their schemes to a practical issue with the rapidity and thoroughness displayed by their Edinburgh *confrère*, and although the idea of instituting a research laboratory has for long engaged the attention of the authorities in Lincoln's Inn Fields, we are still very far from seeing that laboratory in complete working order.

It must be admitted that, to devise the details of a new departure such as this is far from being an easy task. Many and opposing interests have to be taken into account, and, as may be gathered from Dr. Sims Woodhead's introductory article, at Edinburgh, despite the ardour of Dr. Batty Tuke and his Committee, nearly two years elapsed before plans could be developed to the stage at which they were at the same time feasible and acceptable to the College of Physicians. But, this stage once passed, no time was lost. A commodious house was taken and adapted to the required purposes, a scientific superintendent appointed in the person of Dr. Woodhead, and in the course of a very few weeks the laboratory was ready.

The regulations laid down by the College are conceived upon a broad and generous basis. The laboratory is open without fee to Fellows and Members of the College, and, with the sanction of the Committee and Curator (Dr. Batty Tuke), to any Licentiate, and "to any medical man or investigator who shall obtain the sanction of the Council of the College, as well as of the Curator and Committee, to use the laboratory for the purposes of scientific research." The scientific superintendent, while himself undertaking the prosecution of original research, shall be prepared to assist, if required so to do, in the work of the investigators, and it would appear that leave having once been given to work in the laboratory, little or no restriction is placed upon the investigators with regard to the nature of their work beyond the broad control exercised by the superintendent. All these points are worthy of attention at the present time when a similar institution is in the process of development in London. This volume, coupled with the fact that during the first year two-and-twenty investigators in one or other department of medicine have made use of the laboratory, yields full evidence of the success of the scheme.

We note with some curiosity what is apparently an effort to reconcile opposing views as to the functions of the new laboratory, in the regulation requiring the superintendent to furnish the Fellows of the College "with reports. . . upon the histology of morbid specimens and of the chemical and microscopic characters of urines." Certainly, by undertaking work of this kind the laboratory becomes of very definite service to the Fellows, and could our English Colleges, for example, see their way to the institution of departments to which members might send any morbid material as to whose nature they desired advice, they would, by adding largely to the possibilities of a correct diagnosis, confer no little benefit upon the public, apart from the benefit they would bestow upon their members. It is, however, questionable whether this form of work falls within the province of medical corporations; it is still more questionable whether such work can wisely be required of one whose time and energies, as director of a research laboratory, are liable to be wholly utilized in a very different direction.

Coming now to the consideration of the papers which form the volume before us, we may say that they well exemplify the tendencies and traditions of the Edinburgh medical school. Bacteriology is represented by the details of an investigation into the air of coal-mines; by Dr. Woodhead's very able "Notes upon the Use of Mercuric Salts in Solution as Antiseptic Lotions"; by the report of an inquiry undertaken in Japan as to the causation of cholera, the work of Dr. N. Macleod and Mr. W. J. Miller (tending to confirm Koch's views); and also by the condensed report of Dr. Woodhead's lectures before the Grocers' Company upon tabes mesenterica and pulmonary tuberculosis. This last, and Dr. Bruce's article upon a case of absence of the corpus callosum in the human brain, are both of very general scientific interest, and represent the accurate and thoughtful work done at Edinburgh in the domain of pathological histology; while the large proportion of four papers out of the eleven of which the volume is composed, reflects the prominent position long held by Edinburgh in the department of gynæcology.

With scarce an exception, the reports bear upon practical matters, and have more than an academic value. But at the same time they exhibit the one especial weakness of the school. Pathology, embracing as it does the whole of medicine save the treatment of disease, is capable of being advanced by two equally valuable methods, the synthetic and the analytic, as they may be termed: on the one hand by studying the part played by individual factors in producing diseased conditions, and, on the other, by determination of those factors through examination of diseased organs; that is to say, by the methods of experimental pathology and pathological anatomy respectively. The first of these is almost unrepresented in the volume, save by the record of work done away from Edinburgh. We venture to express a hope that, the laboratory offering as it does every facility, this neglect of constructive pathology is apparent and not real, and that it is due not to the absence of experimental inquiry, but to the fact that investigations along these lines have not become completed in the course of a short twelve months.

The facts and suggestions contained in the article upon tuberculosis, by Dr. Woodhead, above referred to, are deserving of a far wider circulation throughout the country than is rendered possible by the conditions under which they now appear. On the Continent, and, especially at this moment, in France, the infectiousness of tuberculosis, and the appalling extent of its distribution, is at length exciting that serious and general attention which precedes active measures. No disease contributes so largely to the lists of mortality. As Dr. Woodhead points out, the maximum affection by mesenteric tubercle—by tuberculosis of the lymphatic glands of the intestines—is attained between the ages of one and five years, and a large mass of evidence would seem certainly to indicate that the cause is to be sought for in the milk derived from tubercular cows.

"Many Commissions on the subject have sat, and have delivered themselves of what must, to all who know anything about the matter, seem most sound judgments, but nothing is done. Where is our inspection of milk—not a mere chemical analysis—but a thorough chemical and biological examination? Where are our clauses for the compulsory notification of disease, either in the farm or the farm-house? Where are our regulations for the examination at regular intervals, and by competent veterinary authorities, of the cattle from which the milk is derived? . . . We must strike at the root of the whole matter as regards the connection between bovine and human tuberculosis. We then not only remove one set of centres of infection, but in so doing we, in turn, diminish the number of human centres from which the disease may spread."

Finally, a word is deserving to be said concerning the appearance of the volume. No expense has been spared in making the reports worthy of their origin. The type is large and clear, the individual contributions are well and profusely illustrated; the appearance of the volume, as a whole, is excellently calculated to make critics fulfil the motto of the College displayed ingenuously upon the back—"*Non sinit esse feros.*" J. G. A.

TREATISE ON HYDRODYNAMICS.

Treatise on Hydrodynamics. Vol. II. By A. B. Basset, M.A. (London: George Bell and Sons, 1888.)

THIS second volume of Mr. Basset's "Treatise on Hydrodynamics," the publication of which followed at no long interval that of his first volume, is in all respects a fitting complement to that work, and fulfils the expectations of value and completeness aroused by its appearance.

The prevailing impression on studying this volume and contrasting it with the first is, that many more avenues for research and discovery lie open in the subjects here treated, than can possibly be found in the more fully explored parts of hydrodynamics that constitute the subject-matter of the first volume.

This impression is borne out by the fact that many results here collected together are the results of recent years, placed in this volume in a more accessible form than when engulfed in the original papers. When we find that this book enters fully into such diverse branches of the subject as vortex motion, tides, and viscous fluids—not that these exhaust its contents—we can realize the width and variety of reading necessary to make the matter of the book as valuable and accurate as it unquestionably is, and also the probability that the author must expect to see these chapters rendered incomplete by the advance of knowledge in these directions.

The chapters on vortex motion owe their results and form largely to the writings of Prof. J. J. Thomson; in the discussion of the stability of the vortex it seems impossible to evade long and arduous algebraical processes, even though the kinematical surface condition used may be of the simplest. The author himself has given in addition an investigation of the fluted vibrations of a circular vortex ring, making use of toroidal functions, and obtaining the same equation for the periods as in the case of similar vibrations of a columnar vortex.

We have read with considerable interest a method given in the first chapter on vortex motion, in which the principle of inversion is applied for the first time to a hydrodynamical problem. It is true that its success is restricted to cases of motion in two dimensions; but a new field might be opened up if, by use of co-ordinates in an inverse system, the ordinary equations of motion would admit of yielding at once two solutions to each problem, in a way similar to the electrical method of inversion. Apparently, the co-ordinates cannot so be changed, nor is any simplification obtainable in the case of viscous fluids, where certain product terms are always disregarded.

Another most interesting chapter is that on the motion of a liquid ellipsoid under its own attraction; here the various shapes possible to rotating fluid are passed in review, and, placed as they are in order, beginning with the familiar instance of Maclaurin's spheroid, the necessary criteria that separate one possible surface from another are easily distinguished.

The question of the stability of some of these shapes is considered, and reference made to the papers of Poincaré in the *Acta Mathematica*, though certain *ex cathedrâ* statements in Thomson and Tait's "Natural Philosophy" have to go unexplained.

To enter on the discussion of waves and tides seems, by contrast with vortices, to begin a fresh subject, so totally distinct are the equations and methods; yet these two chapters are not the least valuable in the book. The chapter on waves contains all the known solutions of waves in canals or on the sea, and also includes Sir G. Stokes' masterly investigation of the form of the wave-front in the deep sea. In the chapter on tides, after a brief account of the equilibrium theory, Prof. Darwin's version of Laplace's dynamical solution is laid under contribution.

The last four chapters of the book are devoted to viscous fluids, and include, besides the theorems usually given, the oscillatory motion of a sphere and cylinder, published first by Stokes in 1850, and also a solution, due to the author, of the motion of a sphere under any forces. In this latter, certain integrals suggested by the theory of conduction of heat are used to obtain the equation of motion of the sphere, the solution of which can be obtained by approximation.

Certain miscellaneous theorems find a place in the last chapter, including an article on the effects of viscosity on a vortex sheet, which plainly has an important bearing on the practical determination of the stability of such a sheet.

The very full array of references to original papers adds considerably to the usefulness of this work, which is in all respects one of the most valuable on mathematical subjects that has appeared for some time. The results are accurate, the discussion of each branch is thorough and complete, and the analytical methods are powerful and in touch with the most recent developments.

THE LAND OF MANFRED.

The Land of Manfred, Prince of Tarentum, and King of Sicily: Rambles in Remote Parts of Southern Italy, with Special Reference to their Historical Associations. By Janet Ross. Illustrated by Carlo Orsi. (London: John Murray, 1889.)

THAT part of Italy lying to the south-east, forming the "heel," was once a land full of stirring events, but it has long lapsed into a state of semi-oblivion; to tell of its past glories and its present prospects is the object of this charming little volume by Mrs. Ross.

Italy seems possessed of powers of rejuvenescence, and the time appears approaching for the revival of some of the past glories of this "Land of Manfred." The traveller from Naples can now journey by rail from Naples to Taranto and Brindisi, and thence by the East Coast line north to Bari and Manfredonia; but, to get some idea of the beauty of this fair portion of Italy, one must leave the iron road and wander over flowery meads, climb up the gently sloping hills crowned with many an ancient castle and overlooking the grey olive gardens and out to the blue encircling sea; then in some measure can the land's loveliness be comprehended. This district of Apulia is not only out of the range of the ordinary tourist, but is even to this moment so little known to the inhabitants of Northern Italy that it is regarded by them as not safe to travel in; the newly-made lines of railway, the building of a great harbour for the Italian fleet at Taranto, will no doubt speedily dissipate such notions. These pages of Mrs. Ross's will undoubtedly tempt many of her compatriots to visit this fair unknown land, to its and the travellers' benefit; and they will also show that the perils of Apulia consist solely in bad inns—a peril getting less and less each season.

Many of the towns along the coast were visited by Mrs. Ross, and the leading events connected with their history are very graphically described; such as Manfredonia, Trani, Barletta, Bari, Brindisi, Otranto, and Taranto. Of the more remarkable inland places visited may be mentioned Castel del Monte, Foggia, Lucera, and Benevento.

As the chief events associated with each city or town are recorded, it is difficult to make a selection. At Bari the immense fortress-like priory attracted deserved attention; the crypt is described as formed of pillars, apparently innumerable, with their capitals richly carved in every conceivable design. Under the silver altar were the bones of St. Nicholas. The Cathedral of St. Sabinus was even more ancient than the Priory of St. Nicholas, its crypt being said to have existed in 733.

To tell of all the churches and cathedrals mentioned, and castles and fortresses described, would be but to reprint the volume, so we must content ourselves with transcribing the charming description given of Sir James Lacaita's residence at Leucaspide. The *loggia*, or arcade, running all along the south-west front of Leucaspide, overhangs a garden full of orange trees, wallflowers, stocks, Parma violets, carnations, and roses; beyond, an expanse of brilliant green corn grown under the colossal olive trees, said to be 2000 years old; then a belt of cultivated land, across which now and then the white smoke of a rushing train reminds us that we really are in the nineteenth century; and last a long line of dark pines, which fringe the Gulf of Taranto. On the opposite side of the Bay rise the Basilicata Mountains, tipped with snow, and further to the left, dimly perceptible on a clear day, are the wild and rugged hills of Calabria. The whole country is redolent of rosemary, and in the Gravina or deep ravine of Leucaspide, the myrtle, white and pink gum-cistus, the lentick and wild pears, were in a blaze of bloom. Troops of small black sheep, with eyes like topazes, graze upon thyme and other fragrant herbs among the rocks, while their shepherd dressed in a waistcoat and trousers of goat-skin, all made in one, leans against a tree or a wall, and plays wild and melancholy music on a little pipe made out of a cane.

The clever sketches by Carlo Orsi assist in illustrating a country about which Mrs. Ross tells us much, but about which it seems evident there is much more to be told, and about which we may hope to have from the same pen some still further details.

OUR BOOK SHELF.

The Zoology of the Afghan Delimitation Commission. (Trans. Linn. Soc., Zoology, Vol. V., Part III.) By J. E. T. Aitchison, M.D., C.I.E., F.R.S., &c.

ALTHOUGH this is very far from being a complete account of the fauna of North-Western Afghanistan, there is good reason to congratulate the author on his success in collecting a fairly representative series of the animals inhabiting the frontiers between Afghan and Russian territory. As Dr. Aitchison explains, his special calling is that of a botanist, and he undertook the office of collecting the fauna under considerable difficulties. The specimens obtained, representing 16 mammals, 123 birds, 35 reptiles, 2 batrachians, 7 fishes, about 100 insects, and a few *Arachnida*, *Myriopoda*, and *Crustacea*, were determined, and the new forms described, by the officers of the British

Museum, notes on distribution, &c., being added by Dr. Aitchison.

The publication by the Linnean Society of the whole series of descriptions in one fasciculus is a manifest advantage. If it has no other effect, it may perhaps convert from error some of those who, like the contributor of the part "Aves" to the last four numbers of the *Zoological Record*, still retain the mistaken idea that the Afghan fauna belongs to the Oriental or Indian region Not only does the prevalence of genera like *Arvicola*, *Ellobius*, *Cricetus*, and *Alactaga*, among mammals; *Pica*, *Accentor*, and *Phasianus*, amongst birds; *Teratoscincus*, *Phrynocephalus*, *Scapteira*, *Taphrometopon*, and *Vipera*, amongst reptiles; and *Schizothorax*, amongst fishes, show plainly the Palæarctic character of the fauna, but there is a remarkable absence of Indian types, with the exception of wide-ranging forms like the tiger, which is found here and there in suitable localities throughout Central Asia, from the Caucasus to the banks of the Amoor (and which, as its absence from Ceylon shows, is doubtless a comparatively recent immigrant into the Indian peninsula). A few species, like the wild ass and *Ovis cycloceros*, extend into the extreme north-west of India, but cannot possibly be said to form a part of the typical Indian fauna. Even amongst non-migratory birds, only two or three kinds, like *Pratincola caprata* and *Lanius vittatus*, are characteristic Indian species, and the forms named have a considerable range beyond the limits of the Oriental region.

It is interesting to find that some of the naturalists who have described the *Invertebrata* notice affinities between the forms collected and those inhabiting the Mediterranean basin. The *Vertebrata*, on the other hand, are characteristically Central Asiatic, as is shown by the genera already noticed.

The illustrations are excellent, and the representation by figures of all species of insects and *Arachnida* described as new is much to be commended. W. T. B.

A Text-book of Paper-making. By C. F. Cross and E. J. Bevan. (London: E. and F. Spon, 1889.)

An increase in the number of technical schools and institutes will no doubt call for a number of trustworthy text-books on various chemico-mechanical industries, arranged not only for the student proper but for the manufacturer as well; indeed, it is perhaps the latter who needs and can use a good text-book to greatest advantage.

It would be well for us if we had other text-books as commendable in their particular connection, and as clear, concise, and thorough, as this on paper-making chemistry, for that is what it amounts to.

The authors state in their preface their belief in the importance of a scientific training for paper-makers. This of course would apply to many trades besides paper-making with equal force. As the earlier and most important operations in paper-making are of a purely chemical nature, or at any rate more chemical than mechanical, the authors have very rightly treated this portion more fully than the mechanical operations proper, which would involve descriptions of complex machines and details not exactly fitted for a text-book of an instructive nature as this.

The introductory note and chapter i. treat of the chemical properties and composition of cellulose and its varieties as far as is known at present. It is a somewhat concentrated chapter on the natural history of this class of substance, and to appreciate it fully the reader should already have a fair acquaintance with the more common chemical processes and elementary principles. It is a useful and valuable chapter, and nobody is better able to discuss it than the authors. The same applies to chapter v., in which processes for isolating cellulose from plant substances are considered.

The chapter on the special treatment of fibres is a very exhaustive one. The remainder of the book—with the exception of short sections on "chemical analysis" for paper-makers, and "paper-testing," and the "Willesden paper"—is taken up with the more mechanical part of paper-making. They are very fully illustrated with large diagrams.

Many besides paper-makers will find interesting matter and much information in this book. W. R. H.

Boilers: their Construction and Strength. By Thomas W. Traill, F.E.R.N., M.Inst.C.E., Engineer-Surveyor-in-chief to the Board of Trade. (London: Charles Griffin and Co., 1888.)

As a hand-book of rules, formulæ, tables, &c., relative to material, scantlings, and pressures for boilers, this volume will prove most useful. The name of the author is a sufficient guarantee for its accuracy. It will save engineers, inspectors, and draughtsmen a vast amount of calculation, and the fact that the information is calculated from formulæ embodying the Board of Trade practice will add greatly to the confidence of those using it in any particular design. The tables contain over 60,000 results, and include in their scope most of the information required in any ordinary case. Engineer inspectors will also find valuable information pertaining to the qualities of iron and steel generally in use, and many good hints as to what ought to be allowed or prohibited in the ordinary working of the material. Among the many duties of the Board of Trade inspectors is that of determining a safe working steam-pressure for old boilers. In the tables relating to this subject thin plate scantlings are given. The decision as to a suitable pressure must, of course, to a large extent depend on the actual condition of the old boilers under inspection, whether the plates are corroded or pitted, and on the condition of the stays and rivet heads. One hears an occasional "growl" about the severity of the Board of Trade inspection, but there is no branch of engineering more carefully and conscientially done than that under Mr. Traill's control, and the present volume should be of great service to his inspectors. The work is the result of much thought and labour, and the author deserves the cordial thanks of all who have to design and superintend the construction of boilers. N. J. L.

Lord Howe Island: its Zoology, Geology, and Physical Characters. Printed by order of the Trustees of the Australian Museum, Sydney. (Sydney: Charles Potter, 1889.)

In 1887, by the order of the trustees of the Australian Museum, Sydney, a collecting party was despatched from Sydney to Lord Howe Island. Most of the results of the expedition are described in the present volume. An excellent epitome of the general zoology of the island, by Mr. R. Etheridge, Jun., is first given. Then come detailed descriptions of the specimens obtained by the members of the party. Mr. A. J. North deals with oology, Mr. J. Douglas Ogilby with reptiles and fishes, Mr. A. Sidney Olliff with insects, Mr. R. Etheridge, Jun., with geology and physical structure, and Mr. T. W. Edgeworth David with rock specimens. The memoir also includes descriptions of various collections made in Lord Howe Island, by Mr. Alexander Morton, in 1882; of collections, chiefly entomological, made by Mr. George Masters, in 1869; and of some gatherings made by Mr. E. H. Saunders after the return of the Museum party. The contributors to the volume have evidently striven to write accurately, concisely, and clearly, and everyone who may have occasion to consult their work will admit that it is well done. The various papers are carefully illustrated. We may note that the descriptive account of the Mollusca is not yet ready, but that the plates are here issued in advance.

LETTERS TO THE EDITOR.

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

Sunset Glows at Honolulu.

THERE has just been at Honolulu a reappearance of the phenomenon of sunset glows like those so familiar in 1883-84. It was first noticed after sundown of July 13. It seemed somewhat brighter on the 14th and 15th. After this it declined in intensity, but could be distinguished until the 20th.

A space of 15° radius around the sun was occupied by a whitish glow like that in "Bishop's ring." The outer coloured ring seemed to be entirely wanting.

We have no cable, and no foreign mail has arrived since the 6th. By a mail due to-morrow, we hope to hear of a probable cause to which this remarkable appearance may be due.

I note the following differences between these sunset glows and those of 1883-84. These are very much less bright than those; possibly equal to what those became after one year's continuance. Perhaps the most notable difference is the appearance of a tertiary glow after the primary and secondary. This consisted of a delicate rosy flush occupying a large tract of sky above the western horizon, from the altitude of 10° to that of 45°, and about 60° horizontally. This shaded off into purple at the edges against our clear blue Hawaiian sky. I think this the most exquisite and lovely tint I have ever seen in the sky, comparable only to that of some perfect jewel.

The larger stars were visible at the time of this tertiary glow. It continued for only a very few minutes each evening. A faint purple tint extended along the horizon quite to the south. This third glow failed to gather down upon the horizon like those preceding it.

Another marked peculiarity is the much earlier time at which the primary and secondary take place. The primary glow gathers soon after the sun is down, and makes its display while the sky is still bright. So it fails to be very effective as a show, although casting upon the western sky broad streaming radiations of glowing surface.

The secondary glow promptly follows and makes the chief display. It differs from the secondary Krakatão glow in the earlier time when it takes place, being nearly finished before any stars are visible. The Krakatão secondary lingered until after full darkness, settling down into a low blood-red stratum simulating the reflection of a remote conflagration. That peculiar simulation was entirely absent from the late appearances. Both at its close and throughout its course this secondary glow substantially resembles the primary glows as seen in 1884. It especially resembles the latter in presenting a well-defined and serrated upper edge bordered by dark sky. That, however, had small and numerous serrations, apparently due to cumuli upon a very remote horizon. The serrations of this, on the contrary, are large and broad, the interspaces being apparently the inverted shadows of cloud-masses upon a somewhat near horizon.

It seems evident that the reflecting stratum of haze in the late appearances was very low down as compared with the Krakatão haze. Hence the rapid succession of the glows. The reflected rays of the sun, traversing a much smaller extent of the lower atmosphere, show less red, having less of the other colours intercepted. For the same reason, they retain force enough for a third reflection, in which a very pure though faint red appears.

Honolulu, July 25. SERENA E. BISHOP.

Globular Lightning.

THE following account of a display of globular lightning will, I think, be of interest to your readers, as it was well observed by several independent observers, and differs in some respects from those previously recorded. It is greatly to be wished that this phenomenon could have its place assigned to it in electrical theory.

On Monday, the 5th instant, at midday, this district was visited by a violent storm of rain, which lasted half an hour, and was accompanied by thunder and lightning. When the storm had passed over and the sky was getting bright, a rod-like object was seen to descend from the sky. It is described as being of a pale yellow colour, like hot iron, and apparently about 15 inches long by 5 inches across. These dimensions are given by an observer who estimated its distance (about correctly, as it subsequently appeared) at 100 yards, and are not therefore affected by the uncertainty attaching to estimates of the sizes of objects whose distance is quite unknown. This object descended "moderately slowly," "not too fast to be followed by the eye" and quite vertically.

On reaching a point about 40 feet from the ground, and in close proximity with a chimney-stack belonging to a house in Twickenham Park, the object seemed to "flash out horizontally as if it burst," showing an intensely white light in the centre and a rosy red towards the outer parts. At the same instant a violent explosion was heard, and soon afterwards a strong smell was perceived, which is described by the observers as "resembling that of burning sulphur," for which the smell of ozone and nitric oxide might easily be mistaken.

Ordinary lightning is frequently most capricious in its action. In this respect this globular flash was in nowise behind.

I examined the outside of the chimney stack carefully, but no external effect whatever was visible. Inside, however, remarkable effects were produced, and I quote the following:—

"The back rooms consist of (1) basement kitchen; (2) ground floor dining-room; (3) first and second floor bed-rooms, and at the top a half attic. A stack of chimneys runs up the whole, and projects about 6 feet above the roof. There are no chimney-pots. No one was in any of the rooms except the kitchen, in which the servants were, and in which a fire was burning.

"The explosion filled the kitchen with smoke and soot. The dining-room also was filled with smoke and soot, though no fire was burning in it.

"The master of the house was just coming into the dining-room from the conservatory when he heard the detonation and simultaneously saw a bright flash of light. He staggered back a moment, and then ran through the smoke and soot to the hall, and called out to know if anyone was hurt. Finding all safe he returned into the dining-room. A Japanese umbrella set open as an ornament in the empty grate, but not fixed in any way, was undisturbed, though the hub of it was hot to the touch. Piles of soot spread out in a semicircle to the centres of the side walls of the room, and an arm-chair, which had been standing close to the fire-place, was 6 feet from its previous position, and had evidently been turned round and thrust against the wall. In the bed-room, on the first floor, soot was on the floor and in the fire-place. The slab of marble forming the architrave under the mantel-shelf, and extending the whole width of the fire-place, had been thrust out from its setting, and was, with a number of bricks, lying 6 feet away on the floor. The mantel-shelf and pier-glass were undisturbed. In the second-floor bed-room, soot and mortar were in the fire-place and on the floor; one end of the grate was broken and a piece of the detached cast iron (some 3 inches square) was lying against the wall 6 feet to the right. In the attic bed-room, mortar reduced to the condition of fine silver sand was lying in the fire-place and on the floor; the wash-stand, which stood against the fire-place, was pushed some 2 or 3 feet towards the centre of the room, but not overturned; and the carpet was rumpled up. There is in this room a bell on the wall opposite the fire-place, and a helical check-spring passes from this bell to an attachment in the wall. At this point of attachment a piece of plaster of the size of one's hand had been detached from the wall, and was found near the fire-place, 18 feet off at the other end of the room."

At this time, when electrical theory is receiving so much attention, the views of a theorist such as Dr. Lodge would, I think, be of great interest on the subject of these rare discharges. To all appearance a detached portion of something—is it atmospheric, or ethereal?—is carried along bodily through the air, bearing with it a very considerable potential energy, and at the same time radiating light. At an instant determined, perhaps, by its proximity to the chimney-stack, its constraint is suddenly relieved, and a discharge like ordinary lightning seems to occur between it and the earth, *viâ* (as it seems) the heated air of the chimney. Has anyone an explanation for this?

A. T. HARE.

Neston Lodge, East Twickenham, August 24.

On some Effects of Lightning.

I CAN fully corroborate Mr. A. F. Griffith's account of the remarkable way in which two trees in a wood near St. Albans have been broken in two, and rent to splinters, by lightning. The first tree which he mentions, however, suggests very forcibly that the "explosion" must have occurred at the core of the tree, for long wedge-like splinters of the wood have been forced outwards, and are now projecting from the stem. The fact, also, that the whole of the bark was in each case torn off, and projected in every direction round about the trees, can be accounted for only by an impulse proceeding from the middle of the stem southwards. One feature of the case which Mr. Griffith did not mention is the twisting which seems to have occurred with the second tree: the portion which is nearly broken off appeared to have been twisted through about 90°, and the portion of the stem which is left standing is also considerably twisted in the same direction; as to the stem, however, it is difficult to estimate how much of the twisting may be due to the growth of the tree.

That any part of the effects are due to wind, is, I think, quite out of the question. It is indeed a curious sight to see two sound oak-trees, some 6 or 8 feet in circumference at their base, broken off, twisted, and torn to splinters, as if they had been so much matchwood; but one of the most remarkable features of the case appears to me to be, that there are *two* trees which have been treated in almost exactly the same manner. If it were the effect of one shock, that shock must have divided itself into nearly equal portions, and must have struck two trees which are some 30 yards apart, which do not stand in any isolated position, and which are separated from each other by several other trees, all of which remained untouched. On the other hand, it is quite inconceivable that two shocks of such an exceptional character should have occurred within a few yards of the same spot, and should have produced identical effects of such an extraordinary character.

The case is one which certainly deserves investigation.

Harpenden, August 18. SPENCER PICKERING.

Some Lake Ontario Temperatures.

THERE are, among the great lakes of the St. Lawrence, exceptional opportunities for observing the effect of heat and cold upon large bodies of fresh water. The vast area and depth of the lakes, the different latitudes in which they lie, and the extremes of heat and cold of the Canadian seasons, all combine to render observations of interest.

It thus far appears that, in their main expanse, Lake Superior and the Georgian Bay (the eastern basin of Lake Huron) constitute, in midsummer, great bodies of colder water—the former registering at the surface as low as 39½° F. (Hind), and the latter at 10 fathoms indicating 45° F., and, at the bottom, even lower than 39½° F. (Boulton). On the other hand, the lower lakes, including Ontario, are shallower than Superior, lie in warmer latitudes, have some affluent streams from even farther south, and may be said to have perceptible, though light, currents through them. The temperatures of their waters are thus very different from those of Lake Superior and the Georgian Bay. Thus, on May 6 of this year, at 4.15 p.m., Commander Boulton, R.N., found the surface of the water off Griffiths Island, in the Georgian Bay, 35° F., and the bottom, at 60 fathoms, 35½° F.; whilst on May 23, at 11 a.m., near the outlet of Lake Ontario—my first soundings there—I found the air (the day being calm and cloudy) 55° F., the surface-water 52¼° F., and the bottom at 13 fathoms 50¼° F., and this was after a cool and exceptionally windy spring.

Some general results, which seem warranted by very numerous thermometer-readings near Kingston, may be of interest. The north-east end of Lake Ontario here does not usually exceed 20 fathoms in depth, but through it flow into the St. Lawrence all the waters of the great lakes.

Areas of Water of Different Temperatures.—At the surface the water is not uniform in temperature, even at points relatively near each other, and which appear to have the same conditions—the variations being generally from 1° to 3°. At different depths down to the bottom there are equally marked variations. In the tributary streams similar results appear. In a shallow creek fully exposed for an eighth of a mile to the sun's rays, and slowly flowing over a succession of limestone ledges, the mercury, in 1½ inch of water on a warm June afternoon, could be seen rising and falling between 81° and 83° F. Here there were exceptional causes, but in the line of outflow from the lake to the St. Lawrence the fluctuations are to be ascribed rather to the great evaporation at the surface, and the cooler waters beneath ascending to supply the place of the evaporated water. As the evaporation would be irregular, varying with the passing clouds, and the gusts of wind, the ascending currents would also be irregular. These ascending waters would give rise to an inflow at the bottom from the deeper and cooler parts of the lake to take their place, and both these currents would be affected by the general light onward flow of the lake waters towards the entrance of the St. Lawrence.

Gradual Absorption of Heat.—The general rise in the temperature of the Lake Ontario waters as the summer advances is at first slow compared with the general rise in the temperature of the air, but as midsummer is reached, the rise is more rapid both at the surface and at the bottom. A comparison with temperatures from Lake Erie will, eventually, better explain this. The circumstance, however, has its bearing on the well-known modifying effect of great bodies of water on the climate of the immediately surrounding land. In illustration of it, on June 14, at noon, when the air indicated 79¾° F., the surface water in the main channel—2 miles from Kingston—was still as low as 57½° F., or only 5° higher than on May 23. On July 5, the readings in the same place had increased to 69½° F., with the air at 79° F., and on July 10 to 74¾° F., with the air at 92¾° F., the thermometer always being in the sun. The most marked change was between June 25 and July 5, when the advance registered was 9°. The bottom temperatures indicate somewhat similar results. On May 23 at 13 fathoms the deep sea thermometer registered 50¼° F.; on June 14 at 12 fathoms, 52° F.; on July 10 at 17 fathoms, 53° F.; and on July 25 at 12 fathoms, 67° F.

The absorption and retention of the sun's heat is, however, most noticeable in the small streams and quiet pools. There we find well illustrated the general proposition that in high temperatures the surface of comparatively still water, where unaffected by deep under currents, absorbs and retains the heat of the sun to a much greater degree than the immediately overlying air. A marked example of this was observed in the shallow lightly flowing stream already referred to, where on June 14 at 3.15 p.m. the air at 3 feet above the water indicated a slight breeze 73° F., and at the surface 76°, whilst the water at 1½ inch registered 83° F., at 4 inches varied between 79½° and 82½°, and at 7 inches on the bottom fell to 72½° F. The records of other creeks did not indicate such extremes, but showed that each stream in its current, bottom, and surroundings, may have circumstances which vary the temperature. In very shallow, still pools, exposed freely to the sun and breeze, the difference between the air and water surface temperatures is even more marked, the water on sunny afternoons in June and July showing about 11° higher range. In such shallow, still pools, however, the water, though indicating some variation, is tolerably uniform in temperature, even to the bottom.

Effect of Channel Currents.—Near Rockport, among the Thousand Islands, there is a broad and deep channel where the current down the river runs at about 2 miles an hour. Here at 37 fathoms, in different localities, the deep sea thermometer gave the same readings as the surface thermometer, showing that the water was completely churned up.

Another illustration was in the Gananoqui River immediately below the falls. The temperature at the bottom here on June 10 was 62¾° F.; a quarter of a mile down stream at the outlet to the St. Lawrence, it was 61½° F.; in the St. Lawrence, 150 yards off the outlet, 57° F.: and 200 yards further up the St. Lawrence, 54¼° F.; the surface water at each of these points varying only between 62¼° and 63° F. These records show how the deeper and colder waters of the St. Lawrence gradually asserted themselves on coming into contact with the Gananoqui River waters. A. T. DRUMMOND.

The Yahgan.

THE tribe in Tierra del Fuego described by the Rev. C. Aspinall are called the Yahgan (Jahgan being a German form and not the English). The missionaries have translated the Gospels into Yahgan with some interpolations of special English terms. There are two or three other distinct languages for the scanty population. It can be seen that the Yahgan is a language of Old World roots, and words can be recognized that philologists determine to be typical Aryan roots. The variety of languages is a fact noticeable among small exogamous communities, and it is a matter of interest to find such variety at the extremity of the New World. H. C.

Electrolysis of Potassium Iodide.

THE following form of this experiment differs from that producing blue iodide of starch usually given in text books, and as I am not aware of it being known it may be of interest to those engaged in teaching the subject to which it belongs.

Into a U-tube pour a solution of the salt coloured with red (slightly acid) litmus solution, then, on introducing the electrodes (carbon for the anode) and passing a current, the solution in the anode limb is turned brown, due to the solution of I in KI, while at the kathode the liquid turns blue from the liberation of potassium.

This form of the experiment is very pretty, and is suitable for large classes.

For small classes the poles of a battery may be drawn over red litmus paper moistened with KI solution.

It is well to exhibit the action of iodine and potassium (potash) upon separate portions of the red solution before conducting the experiment. E. F. MONDY.

Dacca College, Bengal, July 24.

Spherical Eggs.

WILL you allow me to thank Profs. Greenhill and Liveing for their notes in reply to mine on the question of the packing of spherical eggs. The chief drawback of life in New Zealand is the inaccessibility of works of reference, such as those mentioned by Prof. Greenhill. W. STEADMAN ALDIS.

Auckland, New Zealand, July 11.

ANOTHER PHOTOGRAPHIC SURVEY OF THE HEAVENS.

WE gather from two circulars received from Prof. Pickering that another photographic map of the heavens is to be made, in addition to that arranged for at the Paris Conferences. The first circular runs as follows:—

It is proposed to establish an Astronomical Observatory on one of the mountains of Southern California, under climatic conditions probably superior to those at any similar institution now existing, with possibly one or two exceptions. It is therefore extremely important to increase these natural advantages by a plan of work and form of instrument which shall give results such as cannot be obtained elsewhere. Moreover, in California the interest in astronomy is wide-spread. There are many persons of large means who might be willing to make an important contribution to science if they could be sure that the promised results would be attained. The plan detailed below provides for a telescope with which stars could be studied that would be beyond the reach of any other instrument. The amount of material accumulated would be far greater than that obtained by telescopes of the usual form. A satisfactory test of the work could be made before a large part of the money had been expended. No great delay would probably arise, so that the donor could soon see the results arising from his gift. When money is given to erect a building without sufficiently endowing it, the value of the gift is greatly diminished if the name of the donor is attached to the building. This objection does not hold in the present case, since a large part of the expenditure is for current work. On the other hand, the donor's name would always be honourably associated, not only with the instrument, but with the work done with it. As in the case of the Henry Draper Memorial, it is believed that by such a living reminder a patron of science will be more widely known and appreciated than by a much larger expenditure for a building or fund.

Photography is rapidly changing the older methods of astronomical study. It gives an accurate representation of many objects at the same time; and, since copies may easily be made, it permits the results to be studied at leisure at any place and time. In a recent paper before the National Academy of Sciences, the writer recommended the construction of a large photographic telescope of the form described below. The lens should be like that used by photographers rather than like that of an astronomical telescope, and should consist of two achromatic lenses. Its aperture should be 24 inches, and its focal length 11 feet, thus giving images of objects on a scale of 1 millimetre to a minute of arc. Its great advantages would be the large region covered by a single photograph, since 5° square could be represented by it upon a plate 12 inches square. This is six or eight times the area covered by a telescopic objective. The time required to photograph a given portion of the sky would be reduced in this proportion. Such a lens, if mounted in a favourable location and kept constantly at work, would add more to our knowledge of the stars than could be obtained by a large number of telescopes of the usual kind. A telescope of this form, but of one-third its size, is now in use at Cambridge, and illustrates the advantages and amount of work which can be obtained by such an instrument. 3186 photographs have been taken with it, and from them a catalogue of 28,000 spectra of 11,000 stars has been prepared; also a catalogue of 1200 stars near the equator as standards of brightness, and a catalogue of 1000 stars within 1° of the Pole, where the most extensive existing catalogues only contain about forty stars. A search for new nebulæ was made on a small number of these plates covering about 1/250 of the entire sky. Eighteen nebulæ were already known to exist in this region. Twelve new ones were found upon the plates. These results are derived from a small portion of the entire series of plates, and much additional material will be extracted from them. The large telescope should first be used in making a map of the entire sky. All the stars north of − 30° can be advantageously photographed in the latitude of Southern California. This region, covering three-quarters of the sky, has an area of 30,000 square degrees. If each plate covered 25 square degrees, 1200 plates would be required. There are about 3600 hours of darkness in a year. Allowing one-half for clouds and moonlight, and one-third of the remainder for imperfect plates, the whole work could be done in one year, allowing an exposure of an hour to each plate. Perhaps longer exposures would be found advisable, and two years should be assigned to this work. An equal time should be spent in repeating the work, since it is essential that every part of the sky should appear on at least two plates, to verify all supposed discoveries. By using a prism to cover the lens the spectra of all the stars may be taken in the same way and in the same time. When this work is completed, it should be repeated, since we ought to have a complete map of the sky at intervals of about five or ten years in order to detect changes. Moreover, the improvement in photographic processes would perhaps be so great that a second series of plates would be desirable. The recent applications of erythrosin and other coal-tar products to photographic plates render them much more sensitive to red and yellow light. The difficulty of photographing satellites, asteroids, comets, nebulæ, and red variable stars may therefore be diminished.

The telescope should be mounted in a place having the best possible climatic conditions, preferably on a mountain where the air is as clear and steady as possible. No work need be done there except taking the photographs and developing them. Accordingly, the work might be done by a single observer; but, to avoid interruptions due to illness or accident, at least two would be required. Since their duties would be a routine requiring only ordinary skill, such services would not be expensive.

The results would take the form of a series of glass photographs about a foot square, each of which would depict all the stars visible in a part of the sky 5° square. Glass positives could be made from these by direct printing, and copies could be furnished for about a dollar apiece to any astronomer desiring to discuss them. Or an edition of paper photo-engravings could be issued. A complete set of about 1200 plates could probably be furnished for about $200. This would be a very small sum compared with the cost of a telescope which would show far less. The cost of the lens should not exceed $20,000; of the prism, $5000; of the mounting, $5000; of the building, $5000; total, $35,000. A large additional sum might be spent upon a building, but the experience of modern astronomers has shown that the best results are obtained by mounting each instrument in a small detached building which will readily assume the temperature of the air. It is more difficult to estimate the current expenses. The photographic plates alone would cost $1500 annually. The total annual expenses would not be less than $5000, not including superintendence, reductions and discussion of the observations, and publications. An outlay of $50,000 would probably complete the instrument, and secure photographs of the entire northern sky. If the anticipated results are attained, this should be followed by an endowment of $100,000, which would keep the instrument permanently at work.

The faintest stars photographed with the 8-inch telescope in Cambridge are invisible with the 15-inch telescope. The inner satellites of Uranus have been photographed at Cambridge with a 13-inch lens, although they are among the most difficult test objects known. We may therefore expect that stars too faint to be detected with any other instrument might be photographed with a 24-inch lens. We thus see that any person could obtain at a comparatively small cost a map of a portion of the sky showing stars too faint for him to observe in any other way. Many investigations might be carried on by means of these plates; for instance, a search for double stars, for nebulæ, for asteroids, for variable stars by comparison of plates of the same region taken on different nights, for stars having large proper motion when we have plates repeated after a considerable interval of time. In all these cases the plate furnishes an accurate measure of the object discovered, which is often wanting in the first observation of an object by the eye. Studies of the distribution of the stars can now scarcely be undertaken in any way except by photography. The stellar spectra might lead to the discovery of planetary nebulæ, variable stars, bright-line spectra, and other interesting objects. The number of stars shown on the charts would be so vast that it would probably be impossible to catalogue them all. In some cases it is estimated that twenty or thirty thousand stars have been photographed upon a single plate. A systematic examination of all the plates for the detection of objects of interest would itself be a laborious undertaking. Such work could, however, be done at any place and time, and therefore under the most favourable conditions as regards expense. One great advantage of the work would be, not only that we could discover certain objects of a given kind, as a particular class of double stars, but that we could make our catalogue complete, and be sure that no other objects of this kind existed, which in visual work is an extremely difficult matter.

There is always danger of failure in the construction of a new instrument. This danger is diminished in the present case, since an instrument of one-third the size is already in successful operation. Moreover, the front portion of the proposed double lens should form a good photographic objective, and might be made of the reversible form, which may be used either for visual or photographic purposes. The 13-inch lens referred to above is of this form, and proves that such an instrument is entirely practicable. We should thus be able to use the telescope in three ways: for visual purposes, as a telescope having an aperture of 24 inches, and a focal length of 17 feet; as a single photographic lens of the same dimensions; and as a photographic doublet covering a large field, and having a focal length of 11 feet. The prism could be used with each of these, making really six instruments in one. The short focal length would greatly diminish the cost of the mounting, and of the dome required to contain the instrument. The difficulties from exposure to violent winds and storms would also be much less than in an instrument of the usual form.

Should the proposed plan be carried out successfully, a contribution to astronomy would be made of continually increasing value, since each year would increase the facility with which slow changes in the stars might be detected by the comparison of later photographs with those first made.

In connection with the second circular we may remind our readers that we lately referred to the fact that the Astronomical Observatory of Harvard College has received from Miss C. W. Bruce, of New York, a gift of fifty thousand dollars to be applied "to the construction of a photographic telescope having an objective of about 24 inches aperture, with a focal length of about 11 feet, and of the character described by the Director of the Observatory in his circular of November last; also to secure its use under favourable climatic conditions in such a way as in his judgment will best advance astronomical science." This, then, is a very concrete reply to the first circular.

The second circular contains full details of the instrument, which will differ from other large telescopes in the construction of its object-glass, which will be a compound lens of the form used by photographers, and known as the portrait lens. The focal length of such a lens is very small compared with its diameter, and much fainter stars can be photographed in consequence. The advantage is even greater in photographing nebulæ or other faint surfaces. Moreover, this form of lens will enable each photographic plate to cover an area several times as great as that which is covered by an instrument of the usual form. The time required to photograph the entire sky is reduced in the same proportion. A telescope of the proposed form, having an aperture of 8 inches, has been in constant use in Cambridge for the last four years, and is now in Peru, photographing the southern stars. It has proved useful for a great variety of researches. Stars have been photographed with it, too faint to be visible in the 15-inch refractor of the Observatory. Its short focal length enables it to photograph as faint stars as any which can be taken with an excellent photographic telescope having an aperture of 13 inches. The 8-inch telescope will photograph stars about two magnitudes fainter than can be taken with a similar instrument having an aperture of 4 inches. A corresponding advantage is anticipated from the increase of the aperture to 24 inches. Each photograph will be 13 inches on a side, and will cover a portion of the sky 5° square, on a scale of 1′ to a millimetre. The dimensions will be the same as those of the standard charts of Chacornac and Peters. The entire sky would be depicted upon about two thousand such charts.

In an article in the *Observatory* for August the action taken by Prof. Pickering in making the appeal for a money grant to carry out the new map is distinctly challenged on the grounds—(1) that in the appeal there was no statement made that very nearly similar work was about to be commenced by all the civilized nations of the world after most careful consideration of the whole question by the strongest gathering of astronomers that has ever been seen; (2) that Prof. Pickering suggested to the Conference the use of a telescope similar to the one he has induced Miss Bruce to supply; and (3) that there are conditions of construction and execution of such difficulty that Prof. Pickering's plan may fail altogether.

THL JOURNAL OF MORPHOLOGY—A RECORD OF PROGRESS.

WE have before us the third and concluding part of the second volume of this excellent publication. It contains five papers (260 pages) with seventeen plates (with one exception folding ones) and fifty-four woodcuts. The illustrations are most admirable, and the plates, which bear the magic names of Werner and Winter, possess an exceptional charm. While all familiar with this Journal must admit that it has, from the first, taken high rank among its contemporaries, few will have been prepared for the magnificent display of the part now under review. With respect to its get up, the editors may well-nigh defy competition, so liberally have the publishers responded to their demands. Much that is proffered is truly American, in its revolutionary and highly sensational character; but, contrary to that which so often prevails, the startling deduction is based upon a solid foundation of fact, whereby the thing becomes tolerable, and the reader's attention is arrested. A refreshing thoroughness permeates the whole, and the work teems with originality.

The senior editor and Dr. W. Patten each contribute a short paper embodying "facts and conclusions . . . . stated in advance," of papers to be published in full in forthcoming numbers of the Journal. It is in connection with these that the revolutionary element to which we have alluded is most marked; and the reader is worked into a tremor of enthusiasm by the following among other declarations:—

"The eyes (of certain leeches) are segmental in origin, and strictly homologous with the segmental sense-organs. . . . The only evidence of an eye is a single large visual cell, on either side of the head, without a trace of pigment investment. In view of these facts . . . . we can no longer regard pigment as an essential element of the leech eye. It will not do to fall back on the hypothesis of degeneration; . . . . the visual cells are here as perfectly developed as in the pigmented eyes, and the same is true of the optic nerves."

Again—

"The segmental sense-organs of the leech are identical with the lateral line organs of vertebrates," and "when we find strong grounds for thinking that the lateral line organs have served as the point of departure for the formation of gustatory, olfactory, and auditory organs, our suspicion in regard to the eyes no longer appears incredible.[1]

The paper in which the above cited statements occur is entitled "Some New Facts about the Hirudinea," and the author defines these animals as "a group, characterized by the possession of *segmental* sense-organs on the first ring of every somite." Writing of the leeches in especial relation to the progressive development of sense-organs, he tells us that "nowhere is the transition from lower to higher sense-organs so perfectly illustrated as in the leech," and he then gives us the following remarkable passage:—

"*Branchelliopsis, Clepsine*, and *Hirudo* reveal all the intermediate steps beginning with the purely tactile organ; then advancing to the compound organ, in which a few of the cells have been modified to serve the purpose of vision, while the rest have retained their primitive character; and finally, culminating after a long series of progressive encroachments—the visual elements increasing gradually at the expense of the tactile—in an organ in which the original function has been entirely suppressed and a new one substituted for it."

Again, we read—

"As the metameric arrangement of these sense-organs characterizes marine as well as fresh-water and land leeches, and as they everywhere agree in certain remarkable details of number, topography, and structure, I am led to believe that the diffuse or non-metameric arrangement, exemplified in *Nephelis* and some other forms, has been secondarily acquired."

[1] Somewhat similar views have already been postulated, for the eye by Hill (*Brain*, 1888, p. 422), and for the taste organs by Beard (*Anat. Anz.* 1888, p. 879.)

Dr. Patten's "*vorläufige*" is entitled "Segmental Sense-organs of Arthropods." His concluding remarks read as follows:—

"The ventral cord and brain of Arthropods is at first composed entirely of minute sense-organs, which in Scorpions have the same structure as the segmental ones at the base of the legs. On the lateral edge of each ganglion of the ventral cord of scorpions are two of these sense-organs, conspicuous on account of their size and dark colour. In each segment of the brain are similar but still larger ones. All these sense-organs are converted into the ganglion-cells of the brain and ventral cord."

The deductions above cited involve absorbing topics of contemporary research. We eagerly await the full papers and the discussions which they will raise, in the earnest hope (on a knowledge of that which has gone before) of an amicable settlement.

Prof. A. E. Dolbear contributes a paper on "The Organization of Atoms and Molecules," in reply to the senior editor's remarks upon "The Seat of Formative and Regenerative Energy," previously noticed in these pages. The author deals only incidentally with the biological aspects of the question; he claims that

"in late years chemists have adopted the term *Chemism* in place of chemical affinity, and have given to it a greater range of proclivities, finding no difference but one of degree between it and cohesion;"

that

"chemists have not attempted to give a physical explanation of the cohesion of atoms into molecules, but have stopped with chemism, as if it were an ultimate fact or property;"

while he attempts, as his chief object, to give

"a physical explanation of chemism or atomic cohesion, and to extend it to the building up of geometrical crystalline forms."

To this paper the editor adds some trite remarks, for which, in his modesty, he asks the reader's forbearance. The editor claims that the article in question "cannot be said to come strictly within the scope" of his journal. With that we cannot agree. The physicist's view of the nature of organic phenomena is very welcome, and we are of opinion that much good would result could we replace many a purely discursive biological article with one such as this, if only with a view to a more definite agreement with the physicist than at present exists, upon a sound basis for future work.

The papers which will attract most attention are those of Minot and Allis, upon the mammalian placenta, and the lateral line system in Amia, respectively. Each is a masterly monograph: the chief interest of the first-named centres in its revolutionary character; that of the last-named in its solidity and thoroughness. Prof. Minot deals in full only with man and the rabbit, and he proceeds at the outset to supplement previous work in matters of detail. He seeks to show that "the changes in the uterus during gestation" are "a prolonged and modified menstrual cycle," and that "the ovum has no power of initiating the development of a *decidua*, but only of modifying the menstrual process; hence pregnancy *can* begin only at a menstrual period." In discussing the views of others he is dogmatical but never disrespectful, and the following may well be cited in example:—

"We know positively scarcely more than that the maternal and fœtal circulations are brought very close together in the placenta. We infer that there must be a transfer of nutritive material from one blood to the other. As to *what* material is transferred and *how*, we have only theories, but of them an abundance. Under these circumstances, the best beginning is undoubtedly a frank acknowledgment of our ignorance."

The author contends that "we are brought squarely to the conclusion that the fœtal placenta is chorionic," and that "from this premise phylogenetic speculation must start." He tells us that, "so far as our present knowledge enables us to judge, the discoidal is probably the primitive placental type." With this we heartily agree, and it has always appeared to the writer of the present article that the same conclusion is, on the Balfourian hypothesis (from which Prof. Minot dissents) that both the yolk-sac and allantois were primitively concerned in rendering the chorion vascular, by far the most natural one warranted by the facts. The belief in the primitive nature of the diffuse placenta is, beyond doubt, largely attributable to its non-deciduous character. With Dr. Minot, we are opposed to Ryder's theory of the "origin of the discoidal placenta by constriction of the villous area of the zonary placenta." We would rather reverse the order, and regard the zonary type as transitional between the more primitive discoidal one and the more recent and modified diffuse cotyledonary and metadiscoidal varieties, regarding the replacement of the discoidal in the zonary type as primarily due to extension consequent upon the complete withdrawal of the yolk-sac from the chorion. Under this hypothesis the simple nature of the villi of the diffuse placenta might well be considered secondary.

Dr. Minot's paper furnishes a moral which cannot be too often borne in mind, viz. that it is not necessary to look beyond the most familiar organisms for material for legitimate work: neither a "new body" nor "a hitherto undescribed organism" are indispensable to the building up of a reputation.

Mr. Allis's paper is one for which we have eagerly watched, it being (as our readers will be aware) the first of a promised series. The author maps and classifies the sense-organs of the head with minute accuracy, at the leading stages of growth. When he tells us that "as many as thirty-seven hundred" pores "were counted on the head of a single large specimen," some idea of the laboriousness of his task may be formed; and on finding that he has worked out the detailed relationships of the parts to the individual bones, that he has, in addition to working out their development, determined the limits of individual variation and taken count of abnormalities, it is clear that his labour is a labour of love. The thoroughness of his work and the beauty of his illustrations must be seen to be appreciated; and should he complete his task, maintaining the standard of excellence with which he has started, he will have merited the regard of biologists for all time. He has brought to light the surprising fact that many of the first formed openings of the cutaneous canal system fuse to form pores, and that the dendritic systems and groups of pores which, in the adult, replace these, arise to a large extent from their repeated dichotomous division.

The author deals neither with polemics nor generalities,[1] nor does he even allude to striking facts which his figures show, foreign to his immediate inquiry. Consideration of these is doubtless deferred. He deals incidentally with the neuro-epithelium of the spiracular cleft discovered by Wright; this he regards as a sense-organ, which was "regularly developed in the epidermal covering of the head along with the other organs of the infra-orbital line, but, lying near the edge of the spiracular cleft, it wandered into this cleft as it was closed." Indeed, it is upon this observation that the author's co-editor confessedly bases his belief in the migratory origin of the gustatory organs; and Mr. Allis's allied discovery that "the nasal pits are inclosed in the same way that the lateral canals are" will be welcomed with especial interest by embryologists of the hour.

We have often wondered that our American brethren should have been so tardy in working out the structure and development of their native *rarissima*. Their Opossum and their Urodeles are now receiving attention, a beginning has been made with Lepidosteus, the Gymnophiona remain. Zoologists of the Old World could desire nothing better at the hands of their New World *confrères* than a series of exhaustive monographs upon the structure and development of the animals named, uniformly with the one now under review. A better model of conscientious work it would be difficult to produce. G. B. H.

[1] He appears to have overlooked an important paper by Fritsch, in *Stzb. Berlin Akad.*, 1888, viii., p. 273.

THE AUGUST PERSEIDS OF 1889.

THE moon being full on the morning of August 11, it was hardly to be expected that the Perseid meteors would exhibit a notable display this year. Apart, however, from the ill effect the moonlight must certainly have exercised upon the visible character of the shower, there is no doubt that the phenomenon has proved one of minor importance. I have never observed, during the previous twenty-two years, so scanty a fall of the August meteors.

I made observations on July 26, 27, 29, 30, 31, and August 3, for the express purpose of determining the radiants of early Perseids, but failed to secure an adequate number of paths to carry out that intention. In watches extending over eleven hours I counted 89 meteors, but not more than 6 of these could have been Perseids. It was evident that this system was very feebly represented. Yet in 1887 it formed a very distinct and fairly active display as early as July 19 and 22, and I have sometimes remarked decided traces of it in the second week of July. In 1878 and several other years I observed that the Perseids made a prominent shower towards the close of that month, and it was easy to find the position of its radiant on every clear night. But this has been quite impracticable in 1889, owing to the exceptional scarcity of mteors.

On August 7, 1889, I looked towards the eastern region of the firmament during the $2\frac{1}{2}$ hours from $11\frac{1}{2}$h. to 14h., and recorded 28 meteors only. Amongst these were 10 Perseids with a radiant point very sharply defined at $41° + 58°$. They were rather small and traversed short paths; nearly all of them appeared near the centre from which they radiated. The shower was, however, of greatly inferior character to what was expected on a date so near the maximum. The ensuing nights were pretty clear, but in the brilliant moonlight meteoric apparitions were very infrequent. On August 10 only 8 Perseids were noticed in one hour before midnight.

My recent observations would seem to indicate that we have passed through a minimum of the August meteors.

The Aquarids which are generally very abundant at the end of July were also weakly displayed this year. I registered 6 of them between July 27 and August 3, from a radiant at $336° - 13°$. Of the other streams which distinguish this epoch I saw several, the principal of them being a shower of Cepheids from $329° + 62°$ and of Cassiopeids from $8° + 52°$. W. F. DENNING.

NOTES.

WE print to-day the Report of the Committee appointed by the Treasury on the Scientific Collections at South Kensington under the control of the Science and Art Department. It is some seventeen years since the Duke of Devonshire's Commission recommended their formation, and it would seem now that something may really be done after so long a delay. The Committee, it will be seen, discuss both the question of a new building and that of the proper organization of such collections. The eminence of the members of the Committee adds great weight to their recommendations, and the Report has been very favourably received by the Press.

THE meeting of the Iron and Steel Institute in Paris on the 24th and following days of September promises to be of great interest. A large attendance of members is expected. They will be received and entertained by an influential committee under the presidency of M. Eiffel; and the French Society of Civil Engineers will entertain them at breakfast on the Eiffel Tower. Among the papers will be one by Sir Lowthian Bell on the subject of water gas, and Prof. Jordan will deal with the mining and metallurgical exhibits at Paris. Excursions will be made to the iron-works of the Loire and St. Etienne, and of the Nord, and to other centres of the iron and steel industry. Luxembourg and the works of M. Schneider at Creusot will also be visited.

PROF. LÖWIG has resigned his appointment as Director of the Chemical Laboratory at the University of Breslau. He has seen nearly sixty years of academical service.

A SEVERE shock of earthquake was felt in Greece on August 26. According to a Reuter's telegram from Athens, the direction of the earthquake was from north-west to south-east. Its effects were most severe in the district of Acarnania. Most of the houses in the towns of Amerinion and Aetolikon have become uninhabitable, and chasms were formed emitting sand and water. The centre of the shock is believed to have been in the Gulf of Corinth, where the telegraph cable was broken.

THE National Home-Reading Union has now opened its office at Surrey House, Victoria Embankment, W.C. Miss Mondy has been appointed Secretary to the young people's section, and Mr. George Howell, M.P., Secretary to the artisans' section. All communications concerning either of these sections should be addressed to them respectively. Miss Mondy has also been appointed Office Secretary, and communications concerning the general work of the Union, as well as concerning the general readers' section, should be addressed to the Hon. Secretary. Letters of inquiry should be accompanied by a stamped and addressed envelope.

THE *Victorian Naturalist* for May and June contains a most interesting paper, by Prof. Baldwin Spencer and Mr. C. French, describing a trip through the district of Croajingolong. Speaking generally, they describe West Croajingolong as composed of Lower and Upper Silurian strata—slates, shales, sandstones, more rarely conglomerates, and at times metamorphosed by contact with irruptive rocks. The latter are in the form of (1) continuous bands of granite, or (2) a series of knobs of granite, both running along lines lying roughly north and south. In the former case they are traversed along their length by river-valleys. In districts where there are isolated knobs of granite, the rock masses stand out, forming prominent peaks and ridges. The weathering of the granite on Mount Ellery is described as most striking. On the surface it has been formed into huge boulders from 20 feet to 75 feet in height, which lie piled up on one another in indescribable confusion. One huge mass, the egg shape of which gave to the mountain the native name of "Goonegerah," stands out high above the dense forest, which, save in this instance alone, clothes to their summits the long ridges and many peaks of this wild district. So far as the insect life of the district is concerned, the most striking phenomenon seems to be the vast number of ant-hills in every part. Over large areas the mounds of "jumper" ants were so thick as to remind the travellers of "mole-hills" at home. In their study of the flora of Croajingolong they were most impressed by the numerous specimens of the cabbage-tree palm (*Livistona australis*) and the waratah (*Telopea oreades*). The existence of the latter species, peculiar to Victoria, was first discovered by Baron von Mueller during his journeying through the Genoa district in East Croajingolong. This tree, which sometimes reaches the height of 50 feet, grows with equal profusion and strength in the deepest valleys and on the tops of the loftiest hills.

THE Board of Regents of the Smithsonian Institution have issued Part I of the Annual Report, showing the operations, experiments, and condition of the Institution, for the year ending June 30, 1886. A general appendix contains papers relating to anthropology, by various writers; a paper on certain parasites, commensals, and domiciliares in the pearl oysters, by R. E. C. Stearns; a paper on time-reckoning for the twentieth century, by S. Fleming; a report on astronomical observatories, by G. H. Boehmer; and a catalogue of publications of the Smithsonian Institution, by W. J. Rhees.

MR. J. H. HART, Superintendent of the Botanic Gardens, Trinidad, refers, in his Report for 1888, to the comparatively large number of American and European tourists by whom these gardens are now visited. Mr. Hart has been more impressed by the energy and enthusiasm displayed by visitors from the north than by "anything seen from the European side of the world." "In fact," he says, "Europeans must look to their laurels in these matters. Speaking as one myself, it cannot be said that any prejudice dictates this expression of opinion, but I record it as a fact worthy of the attention of my countrymen." Tourists of all classes at Trinidad, it seems, agree in one respect—in their love of photographing forms of plant life which are new or strange to them. Mr. Hart is so unkind as to describe this as a "prevailing epidemic." The expenditure of dry plates in the Trinidad Gardens is "so large as to afford a rich harvest to the manufacturers."

THE Committee of the Chester Society of Natural Science and Literature has issued its Report, with statement of accounts, for 1888–89. This Society was founded by Charles Kingsley in 1871, and has made steady progress in every department of its work. It has now 617 members. Originally, it included only three sections; now there are seven, "with the prospect of an eighth in the coming year." During the past year the debt on the present building was entirely wiped out through the liberality of some of the members, and the Society looks forward with satisfaction to an increase of accommodation.

A PAPER on the soft palate in the domestic cat, by Dr. T. B. Stowell, has been reprinted from the tenth volume of the Proceedings of the American Society of Microscopists. It is offered as a preliminary contribution to a more general inquiry "as to the phylogenesis and the function of the uvula of the palate, or the conditions which favoured or led to the uvula of the palate, or the conditions which favoured or led to the development of the uvula of the soft palate." On March 2, 1888, the same writer read before the American Philosophical Society, a paper on the glosso-pharyngeal, the accessory, and the hypoglossal nerves in the domestic cat. This paper has also been issued separately.

La Nature of August 17 contains an interesting account, by M. Angot, of the laboratories and instrumental arrangements of the Central Meteorological Office in Paris, which now occupies a large building and grounds formerly connected with the Emperor's stables, with an entrance in the Rue de l'Université. The building is lighted, when required, by electricity, and contains, in addition to the usual offices, several rooms for the verification of instruments, of which a great number are tested annually, darkened chambers for the photographic registration of earth currents and magnetic elements by instruments designed by M. Mascart. These instruments are influenced by surrounding buildings, and are principally intended for the instruction of visitors; the more accurate records are made at the Observatory of the Parc St. Maur. Another large room is devoted to the apparatus invented by M. Weyher for reproducing atmospheric whirls artificially. In the grounds are evaporation tanks, and a platform for anemometers of various descriptions; the records of one of Richard's sensitive instruments are compared with a similar instrument on the Eiffel Tower, and it is said that the comparison has already led to some interesting results; the platform also contains an actinometer on M. Violle's principle, with two spheres, one blackened and the other gilded. It is intended to erect in the garden a whirling machine for anemometer experiments, having a circumference of 40 metres, with a maximum motion, by electricity, of one revolution per second, which is equivalent to about 90 miles per hour.

Das Wetter for August contains the first part of a lecture by Dr. W. Köppen, entitled "Biological Considerations upon Cyclones and Anticyclones." He points out that the word cyclone was first proposed by Piddington, in his "Sailor's Horn-Book," in 1848, to describe the violent hurricanes of the tropics, in which the wind rotates, in the northern hemisphere, in a direction opposite to the hands of the watch. The term anticyclone was first used by Mr. F. Galton, in his "Meteorographica," in 1863, to represent the opposite class of atmospheric disturbance, in which the wind circulates in the same direction as the hands of a watch. The use of synoptic charts, with isobaric lines, drawn for large areas, shows that the same cyclonic motion occurs in our latitudes, in all degrees of force, down to a gentle breeze. This constitutes one of the most important discoveries of modern meteorology, which dates from about the year 1860. The author points out that the circuitous motions of the atmosphere, whether cyclonic or anticyclonic, consist of three component parts, which can be proved by the laws of mechanics, viz. one rotating motion, one in the direction of the radius, and one perpendicularly to both of these, parallel to the axis of the whirl. The behaviour of the atmospheric motions in the higher regions is more difficult to describe, but so much seems certain from observations of clouds, &c., that the rotation is similar to that below, but the component falling in the direction of the radius is the opposite to that below, viz. an indraught below corresponds to an outflow above. He explains the more frequent gyration of the wind-vane to the right than to the left by the fact that stations in our parts are generally to the right of the storm-areas. He also shows how the ascending current of cyclones produces cloud and rain, by cooling and condensation of vapour, and how the descending current in anticyclones produces dry and bright weather. The remaining article is a discussion by Dr. Kremser, of the extraordinarily high temperatures in North Germany during May and June last. He has compared the daily temperatures of the last forty-two years with those for 1889, and shows the result in a diagram; from which it is seen that for the whole period (April 19–June 20) the temperature was on an average 9° above the normal value. The author states that the Berlin observations, which date back to 1719, show that no May has been so warm, and that the temperature of June has only once been slightly higher, viz. in the year 1756.

Mr. Edward Stanford has published a little volume containing useful "Algerian Hints for Tourists," by Mr. Charles E. Flower. The writer intends that it shall be used as an appendix to the guide-books. He tells his readers what there is in Algeria to see, and "how to get to see it." For further information they are directed to the guide-books properly so called.

We have received Parts 11 and 12 of the Transactions of the Leicester Literary and Philosophical Society. Part 12 includes the Report of the Council, and the Annual Reports of the Sections, presented to the general meeting on June 24.

Messrs. George Philip and Son have issued, in two sheets, an excellent topographical map of the Riviera. It has been published by A. Donath, in Genoa.

The Calendar of University College, Dundee, for the seventh session, 1889–90, has been issued. University College, Bristol, has also published its Calendar for the session 1889–90. In a prefatory note attention is called to the fact that the Bristol College particularly affords appropriate instruction in those branches of applied science which are more nearly connected with the arts and manufactures.

"Flowerland," an introduction to botany, by Robert Fisher, is about to be issued by Messrs. Bemrose and Sons. The work includes 150 illustrations.

At a recent meeting of the Vaudois Society of Natural Sciences, Prof. Blanc gave some interesting information about lake trout reared at the agricultural station of Champ de l'Air. The peculiarity of the experiment was keeping the ova in complete darkness throughout the time of incubation. The water used had a temperature of 4°·8 C. Prof. Blanc compares the experiment with one at Moudon. There, with a temperature of 2°·3, the hatching occurred after 145 days. At Champ de l'Air (temperature 4°·8), it occurred after 160 days, a difference of 15 days, due to the darkness. There are sundry advantages in prolonging the incubation: (1) the young fry put into the streams in April or May more readily find food than in February or March; (2) they are found to be more vigorous; (3) there are few or no monstrosities.

Some curious facts bearing on the *morale* of the lower animals are given by a correspondent of the *Revue Scientifique*. One source of animal sociability is a permanent sexual friendliness, making individuals mutually agreeable. Thus in stables without stalls, it is desirable to put animals of opposite sex next each other, to avoid injuries. A mare may be safely put into a field containing a horse unknown to it, but if two unacquainted horses be thus put together they will fight. A stallion, indeed, will sometimes get injury from an unknown mare put into a field with it. Again, the authority of the oldest and strongest in a group of males often favours sociability. In the Spanish *ganaderias*, a horseman will lead about a numerous troop of bulls, by means of five or six bulls who obey him and maintain order. In the Madrid circus the writer saw three of these animals bring to its stall a vicious bull which had ripped up five or six horses and mortally wounded its *Espada*. They made a slight movement of the horns, and the creature, after a little hesitation, turned and followed them. Once more, when flocks of wild ducks and geese have to go long distances, they form a triangle to cleave the air more easily, and the most courageous bird takes position at the forward angle. As this is a very fatiguing post, another bird, ere long, takes the place of the exhausted leader. Thus they place their available strength at the service of the society.

The attention of the French Government has recently been drawn to the destruction of small fish, especially flat-fish, round the coasts, by shrimp trawls, and the question was referred to the French Fisheries Committee to be inquired into. The Committee have now published their report, in the *Journal Officiel*, in which they recommend the entire prohibition of fishing for shrimps with trawls, and advocate in its place the adoption of two other methods which were brought to their notice at Croisic and at Saint Gilles, where they are already in practical use. At Croisic the engine consists of a trap, somewhat on the principle of an ordinary lobster-pot; it is a wooden frame, in shape like a barrel, and about 2 feet 6 inches long, covered with a small meshed net drawn in at the ends, thus forming two funnels. Each funnel terminates in a small opening through which the shrimps are attracted by bait suspended inside the trap. The machine, which is weighted with stones made fast to the frame, is further provided with a mooring line, and cork float. These traps, of which each fisherman may own from twenty-five to thirty, are kept permanently on the fishing-grounds during the shrimping season, and are visited daily, when the catches are taken out through a hinged opening at the side, and fresh bait put in. The second method recommended consists of a conical pocket of small meshed net about 18 inches deep, fixed to an iron ring with a diameter of 2 feet 6 inches to 3 feet. Four short lines are attached to the ring, and are made fast to a rope and cork float. The bait, which consists of bits of fish, is either placed at the bottom of the pocket or on two lines stretched across the iron ring. These nets require to be raised every 15 or 30 minutes; they should be sunk so that the ring just rests on the bottom, the supporting lines being kept clear of the bait by means of a float fastened at the junction of the lines with the mooring rope. This method is said to be most successful when carried on at low water in the early morning.

A RECENT number of the *China Review* (vol. xvii. No. 3) contains a paper by Dr. Macgowan on the alleged avenging habits of the cobra in Indian and Chinese folk-lore. The belief in India is that a wounded cobra which escapes will sooner or later revenge itself on the man who has caused the injury, wherever he may go or whatever he may do. Dr. Macgowan says that this belief is prevalent in Indo-China and China as well as in India. But in China there is also a strong prejudice against killing the cobra, lest its spirit should haunt the slayer ever after. Cobras, therefore, are shunned rather than pursued and attacked. Popular stories of the dire consequences of slaying them keep up the superstition: a high official who had killed one died soon afterwards of some mysterious disease, and the death is attributed to the slain snake; again, the spirit of the snake enters into possession of its slayer, and employs the vocal organs of the latter in uttering imprecations on himself until death mercifully removes him. Dr. Macgowan gives a large number of stories of this character. A number of others refer to the retribution on snake-killers after their own deaths. Gratitude, as well as vindictiveness, is ascribed to snakes, of which some characteristic stories are given. In conclusion, Dr. Macgowan observes that the recently established vernacular press in China furnishes inexhaustible stores of folk-lore. "Paragraphs describing popular superstitions, impossible occurrences, monstrosities, and so forth, constitute a great portion of their matter." In regard to snakes, the marvel is that any are killed at all in China, so many dreadful punishments are supposed to overtake their destroyers; and, indeed, it is considered a work meriting favour here and hereafter to purchase captured snakes and liberate them. Nevertheless, poisonous snakes are not numerous in China, probably because their presence is inconvenient to Chinese farmers, and they are therefore destroyed, folk-lore notwithstanding.

IN connection with the recent discussion, in Parliament and elsewhere, respecting emigration to South America, it may be interesting to reproduce certain observations of Dr. Alfredo da Luy, at a late meeting of the Academy of Medicine at Rio, on the effect of climate on race. They are quoted in a report from the British Legation in Brazil, which has recently been published. "I have long noticed," he says, "that Brazilians in general are more pallid, and are less vigorous and energetic, than persons coming from temperate and cold climates. Here in Rio de Janeiro the degeneration of the Portuguese race may also be noted. In fact such inhabitants of Rio de Janeiro as are not coloured persons are generally pallid, weak, of short stature, and of but little muscular strength. I have found that an anæmic condition is very common among us, and, in most cases in our country, malarious infection is the cause of the impoverishment of blood, whenever this impoverishment exceeds physiological limits. I believe, however, that such malarious impoverishment of blood seldom kills by itself, but this it is which makes children in Rio de Janeiro show so little resistance to other maladies, and it is one of the causes which concur to produce the great infant mortality in the city of Rio de Janeiro. The average annual mortality of children in Rio de Janeiro, up to seven years of age, was 2900 in the five years from 1882 to 1886, excluding those born dead. It is chiefly among the children of Europeans resident in Brazil that I have met with the most accentuated impoverishment of blood and debility, and I believe the explanation to be marshy malaria (*impaludismo*). I have noticed in my practice that the children of Portuguese and Italians do not fare so very badly in the Brazilian climate, but that the children of foreigners coming from the north of Europe show a noted physical degeneracy, and a frail vital resistance, so that the greater part of them succumb at a tender age, and even if they reach adult life they never show any grade of robustness and energy comparable to that of their progenitors. Although I am fully persuaded of the good moral qualities of the European colonist, I think it my duty to state that Germans, French, Belgians, and other persons from climates very different from ours, will never be able to give a prosperous colonization to our warmer provinces, except in the case of crossing with races better adapted to hot climates."

IN Consul-General Playfair's Report to the Foreign Office on the agriculture of Algeria, it is said that viticulture in that country is beset with many dangers. In spring, hailstorms frequently destroy the young shoots; the flowers are often ruined by fogs; and the ripe fruit by the sirocco. The most serious enemy is, of course, the *Phylloxera*, but the officials have been fairly successful in dealing with this pest. Another is the *altise*, a small beetle that causes great destruction, particularly when in its larval condition. The mode of killing the *altise* commonly adopted is to place bundles of grass and vine-cuttings around the vineyard when winter is approaching; in these the insects conceal themselves in large compact masses, and the whole is then set on fire. Other diseases are the *oïdium*, *anthrachnosis*, *peronospera*, and *chlorosis*. It is calculated that the want of intelligent treatment of these diseases causes the owners of the vineyards to lose annually nearly a third of the crop. The olive seems to grow everywhere in Algeria except in marshy ground, and attains dimensions quite unknown on the northern coast of the Mediterranean. At present, however, from careless cultivation, the plant has not proved as remunerative, nor have its products been as good, as in Europe.

THE British Consul at Bogota, in his last Report to the Foreign Office on the agricultural condition of Colombia says that for tobacco cultivation in that country no manure is used, and the same land is used over and over again for an indefinite number of years. In some districts, where disease has completely exterminated the tobacco plantations, it has been found that when plants are brought from other districts they are not attacked for a few years, but ultimately they are also destroyed. This, perhaps, might be avoided by constantly importing fresh seed; but the experiment was tried on some of the best tobacco land in Colombia, with the result that as the seed brought from inferior districts began gradually to improve by transportation to the better soils, it became more liable to disease, while the plants grown from seeds brought from the better districts were attacked at once. Another instance of the ignorance of scientific agriculture in Colombia appears in the case of cocoa. It is most carelessly cultivated, though it is a crop which requires constant care and labour to weed and clean the ground, and free the trees of the numerous insects, especially the caterpillars, which infest them. A most destructive disease has lately attacked the trees in the south of the Tolima, which is one of the very richest districts in Colombia. This disease does not seem to have been investigated, and no remedy has been suggested, but the extent of its ravages will be understood from the fact that one of the plantations attacked produced only 175 pounds instead of 18,000 pounds of cocoa.

THE additions to the Zoological Society's Gardens during the past week include a Formosan Deer (*Cervus taëvanus* ♂), a Japanese Deer (*Cervus sika* ♀) from Japan, two Three-striped Paradoxures (*Paradoxurus trivigatus*), a Great Eagle Owl (*Bubo maximus*) from China, presented by Capt. C. Taylor s.s. *Aberdeen*; a Common Fox (*Canis vulpes* ♀), British, presented by Mr. Edward Hall; a Bewick's Swan (*Cygnus bewicki*) from China, presented by Mr. Jansen; a Peregrine Falcon (*Falco peregrinus*) from Cyprus, presented by Dr. W. Hoad; a Mantchurian Crane (*Grus viridirostris*) from North China, eighteen Spanish Blue Magpies (*Cyanopolius cooki*) from Spain, an Indian Python (*Python molurus*) from India, two Water Rattlesnakes (*Crotalus adamanteus*) a Mocassin Snake (*Tropidonotus fasciatus*) from North America, deposited; five African Lepidosirens (*Protopterus annectans*) from the River Gambia, West Africa, purchased; a Royal Python (*Python regius*) from West Africa, received in exchange; an Indian Muntjac (*Cervulus muntjac* ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET 1889 *d* (BROOKS, JULY 6.)—The following elements and ephemeris for this object are by Herr Otto Knopf (*Astr. Nach.*, No. 2916):—

T = 1889 July 12·2616 Berlin M.T.

$$\left.\begin{aligned} \pi &= 330^\circ\ 7'\ 5'' \\ \Omega &= 29\ \ 4\ 56 \\ \iota &= 5\ 44\ \ 7 \end{aligned}\right\}\text{ Mean Eq. 1889·0.}$$

$\log q = 0·35280$

Error of middle place (O – C).

$d\lambda \cos \beta = +20''$; $d\beta = -2''$.

The observations on which these elements are based were obtained at Lick, July 8; Vienna, July 21; and Dresden, July 30.

Ephemeris for Berlin Midnight.

1889.	R.A. h. m. s.	Decl. ° ′	Log *r*.	Log Δ.	Brightness.
Aug. 31	0 7 30	5 53·2 S.	0·3665	0·1326	1·37
Sept. 4	0 6 29	5 48·4	0·3686	0·1324	1·36
8	0 5 14	5 43·8 S.	0·3709	0·1333	1 34

The brightness on July 8 is taken as unity.

On August 1, Mr. Barnard observing at the Lick Observatory, found the comet to be composed of three distinct adjacent comets, perhaps more; and Prof. Weiss, under date August 6, reported it as fourfold.

COMET 1889 *e* (DAVIDSON).—Dr. Becker gives the following elements and ephemeris for this comet, derived from observations made at Rome on July 26, Vienna on August 4, and Dun Echt on August 15.

T = 1889 July 19·29538 G.M.T.

$$\left.\begin{aligned} \pi - \Omega &= 345^\circ\ 53'\ 6''·9 \\ \Omega &= 286\ \ 8\ 16·2 \\ \iota &= 65\ 59\ 59·7 \end{aligned}\right\}\text{ Mean Eq 1889·0.}$$

$\log q = 0·016949$

$\Delta\lambda \cos \beta = +6''·6$; $\Delta\beta = -0''·3$; (O – C).

Ephemeris for Greenwich Midnight.

1889.	R.A. h. m. s.	Decl. ° ′	Log Δ.	Log *r*.	Brightness.
Aug. 28	16 9 43	24 8·2 N.	9·9432	0·0919	0·12
Sept. 1	16 18 58	25 47·5	9·9794	0·1043	0 10
5	16 27 38	27 9·7	0·0125	0·1170	0·08
9	16 35 53	28 18·8	0·0429	0·1299	0·06
13	16 43 49	29 17·6	0·0708	0·1428	0·05
17	16 51 34	30 8·2	0·0966	0·1557	0·04
21	16 59 12	30 52·3 N.	0·1205	0·1686	0·04

The brightness on July 22 has been taken as unity.

NEW MINOR PLANETS.—Two new minor planets were discovered on August 3; the one, No. 285, by Herr Palisa at Vienna, the other, No. 286, by M. Charlois at Nice.

NEW DOUBLE STARS.—Mr. Burnham reports that η Ophiuchi is a close double, the two components being of nearly equal magnitude. The present position of the fainter is angle = 274°·7, and distance = 0″·35. It will probably be found to be a binary of somewhat short period.

θ Cygni has a small companion at position-angle 43°·9, and distance 3″·62, recently discovered by Mr. Burnham. The companion is about the fourteenth magnitude.

STARS WITH REMARKABLE SPECTRA.—The examination of the photographs of stellar spectra taken at Harvard College in connection with the Henry Draper Memorial has shown DM + 43° No. 3571 to have a spectrum crossed by bright lines, and similar to those of the three stars discovered by Wolf and Rayet in 1867. Two other stars, DM + 66° No. 878, and DM + 84° No. 516, especially the latter, have the most strongly marked spectra of Secchi's third type which have yet been recognized, except in the case of some variables of long period.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 SEPTEMBER 1–7.

(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 September 1

Sun rises, 5h. 15m.; souths, 11h. 59m. 46·7s.; daily decrease of southing, 18·9s.; sets, 18h. 45m.: right asc. on meridian, 10h. 43·1m.; decl. 8° 8′ N. Sidereal Time at Sunset, 17h. 30m.

Moon (at First Quarter September 2, 20h.) rises, 11h. 59m.; souths, 16h. 50m.; sets, 21h. 31m.: right asc. on meridian, 15h. 33·9m.; decl. 15° 29′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m.	° ′
Mercury..	7 10	13 14	19 18	11 58·0	0 5 N.
Venus.....	1 33	9 23	17 13	8 6·4	19 33 N.
Mars......	2 59	10 33	18 7	9 16·1	17 5 N.
Jupiter....	15 16	19 9	23 2	17 53·6	23 26 S.
Saturn....	3 54	11 11	18 28	9 54·1	14 1 N.
Uranus...	9 3	14 30	19 57	13 13·9	7 12 S.
Neptune..	21 39*	5 29	13 19	4 11·7	19 26 N.

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

Sept.	h.	
4	2	Jupiter in conjunction with and 1° 2′ south of the Moon.
7	8	Neptune stationary.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
S Arietis	1 58·7	12 0 N.	Sept. 1,		*M*
R Arietis	2 9·8	24 32 N.	,, 7,		*M*
R Ursæ Majoris	12 31·3	60 6 N.	,, 5,		*M*
R Boötis	14 32·3	27 13 N.	,, 2,		*M*
δ Libræ	14 55·1	8 5 S.	,, 5,	0 22	*m*
U Coronæ	15 13·7	32 3 N.	,, 3,	2 1	*m*
U Ophiuchi	17 10·9	1 20 N.	,, 3,	0 46	*m*
			,, 3,	20 54	*m*
X Sagittarii	17 40·6	27 47 S.	,, 2,	1 0	*M*
W Sagittarii	17 57·9	29 35 S.	,, 2,	22 0	*M*
Y Sagittarii	18 14·9	18 55 S.	,, 1,	1 0	*m*
β Lyræ	18 46·0	33 14 N.	,, 4,	23 0	m_2
R Lyræ	18 52·0	43 48 N.	,, 5,		*M*
U Aquilæ	19 23·4	7 16 S.	,, 5,	2 0	*m*
T Vulpeculæ	20 46·8	27 50 N.	,, 1,	0 0	*M*
δ Cephei	22 25·1	57 51 N.	,, 3,	23 0	*m*

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

Meteor-Showers.

	R.A. °	Decl. °	
Near ρ Persei	43	39 N.	Swift; streaks.
,, 33 Cygni	305	55 N.	Swift; bright.
,, γ Piscium	347	0	Slow; bright.

THE SCIENCE COLLECTIONS AT SOUTH KENSINGTON.

THE following is the Report of the Committee appointed by the Treasury to inquire into the Science Collections at South Kensington :—

1. Our original instructions are contained in the Treasury Minute of the 19th February 1889, which will be found in the Appendix (No. 1). Upon consideration, we found that some amplification of these instructions were necessary, and we accordingly communicated to Government the resolution which is printed in the Appendix (No. 2). In reply to this resolution we received a letter from the Treasury under date of the 23rd March, Appendix (No. 3).

2. After some preliminary deliberation, and an inspection of the collections which form the subject matter of our inquiries, we proceeded to take evidence from representatives of the Science and Art Department and others who had been practically concerned in the formation and arrangement of these collections ; and, during our inquiries, we have again inspected the several branches of the Museum in company with professors of the Normal School of Science and others specially conversant with the contents of each ; we have also been furnished with detailed catalogues of the collections. By these means we trust that we have secured an acquaintance with the contents of the science collections sufficiently exact for the purpose of our present inquiry.

3. It may be convenient that we should recapitulate the different collections with which we have had to deal, noticing at the same time the manner in which they are at present housed. In these respects, the changes since Sir Frederick Bramwell's Committee reported have been not inconsiderable.

The collections have been classified by the Department (January 1888) under two main divisions :—

I. Instruction and Research.

II. Industrial Applications.

Division I.—The collection of Scientific Instruments and Appliances for science teaching occupies 6325 square feet on the ground floor and 15,840 square feet on the upper floor (in all 22,165 square feet) of the Western Galleries.[1]

It is grouped by the Department under the following heads, corresponding in the main with the arrangement of the Science Directory.

A.—Mechanics and Mathematics.

B.—Physics.

C.—Chemistry, Metallurgy, and Principles of Agriculture.

D.—Biology.

E.—Geology, Mineralogy, and Mining.

F.—Navigation, Nautical Astronomy, and Physiography.

The collections illustrative of Mining are, however, housed in the Geological Museum in Jermyn Street, in connection with the Royal School of Mines. These we have not examined or considered.

Division II.—Industrial Applications.

(*a*) The collection of Machinery and Inventions (including the selected specimens from the old Patent Museum, and also some few illustrations of metallurgical operations) occupies 18,476 square feet on the ground floor of the "Southern Galleries."[2]

(*b*) The collection illustrative of Naval Architecture and Machinery occupies 15,374 square feet in all on the upper and ground floors of the "Southern Galleries," the machinery being on the ground floor.

(*c*) The Fish Culture collections and some miscellaneous objects occupy 5630 square feet in a wing at the west end of the "Southern Galleries."

4. In addition to these branches of our subject we should, in order to complete the list of scientific collections, mention the two following, which lie beyond the terms of our reference :—

(i.) The Educational Library of Science. This is now placed in the Museum, to the east of Exhibition Road, in connection with the Art and General Library.

(ii.) The collections of Food and Animal Products, formerly at South Kensington. These are now housed in the Bethnal Green Branch Museum.

It may be convenient to add that about 16,000 square feet on the two floors of the eastern end of the Southern Galleries (formerly the National Portrait Gallery) are now occupied by a collection of modern industrial products, furniture, and ornaments, removed thither from Bethnal Green, which belongs to the Art division of the Museum, and has no connection with the Science collections upon which it is our duty to report. Further, about 9200 square feet on the ground floor of the Western Galleries are used only for examination rooms.

5. It will be observed that in our enumeration of the branches of the Science Collections as at present existing, we have made no reference to two branches mentioned in the Report of Sir F. Bramwell's Committee :—

(*a*) The Educational Collection.

(*b*) The Structural Collection.

For these sections spaces of 7000 square feet and of 15,000 rising to 25,000 square feet respectively, were demanded by the Committees whose recommendations were adopted in that Report.

These sections have been suppressed for reasons given by General Donnelly, the articles of which they were composed having been returned to the lenders or otherwise disposed of. It was probably the aspect of these collections which, upon a superficial view of them, led to the severe strictures sometimes passed on the contents of the Southern Galleries.

As regards these two sections, we may here say that in our opinion the necessity for the exhibition of school furniture and fittings, such as are required for schools receiving grants under the Elementary Education Acts, no longer exists ; but (under proper limitation) a series of diagrams and models of the best forms of construction and a collection of specimens of material, specially designed for scientific and technical education, might with advantage be exhibited in connection with the subject of mechanics as taught in the Norman School, and with that subject and with building construction as taught in science classes, and with the general collection of applied science. Such a collection should be strictly technical in character ; otherwise there would be a risk of indefinite extension in this department.

6. The order in which we have described the collections in our third paragraph follows the arrangement adopted by the Science and Art Department in January 1888, and agrees with that suggested in paragraph 26 of Sir F. Bramwell's Report, where the "instruction given in the Normal School of Science" coupled with "the teaching of science generally throughout the United Kingdom," precedes "the acquisition of other objects in the interest of science or of the arts."

It is indeed evident that the collections in the Western Galleries, containing instruments and appliances indispensable for the teaching of science, are more closely connected with the work of the Normal School and the science classes in connection with the Department than the machinery, to which, however, some of the professors refer by way of illustration in their lectures ; and the machinery is more closely connected with the Normal School and science classes than are the ship models, which at present are not used at all for the school ; whilst the fish collection serves no direct educational purpose at all. We learn from the Treasury Letter of March 23 that the view as to the object of these collections expressed in paragraph 26 of Sir F. Bramwell's Report has in substance been adopted by Government, with the qualification that "the teaching of science generally" must be subject to "reasonable regulations."

Prof. Huxley, who, in one capacity or another, has had a very large share in the formation of these collections, maintains that the connection of the collections with the Normal School of Science is "accessory and accidental," the essential object of them being, firstly, "to facilitate practical instruction in science, particularly in the teaching in the science classes connected with the Department, by enabling teachers to acquaint themselves with the various apparatus, models, and specimens which are indispensable to proper scientific instruction, or which have been found especially useful in such instruction, and in original investigation," and, secondly, "the preservation of apparatus and models which possess historical interest as marking stages either in the progress of discovery or in that of the application of scientific principles to art and industry."

Without attempting to determine the relative value of such collections as regarded from different points of view, we would state that in our opinion their direct educational bearing does not afford an adequate test of their value and importance.

7. We proceed to consider *seriatim* the several sections of the collection, beginning with the "Appliances for Instruction and

[1] The Western Galleries are those adjoining Queen's Gate and north of the new Imperial Institute Road.

[2] The Southern Galleries are those extending from Exhibition Road to Queen's Gate to the south of the new Imperial Institute Road.

Research" now in the Western Galleries. For this section, which now occupies a little over 22,000 square feet, the committee of professors, whose report was adopted by Sir F. Bramwell and his colleagues, estimated that 37,000 square feet were required, with an addition of 3,000 square feet in the next ten years, *i.e.* nearly double the area at present available. The space now provided is well filled but hardly overcrowded; the objects exhibited are, speaking generally, either of historical interest as illustrative of the development of scientific discovery, or representing the latest and most improved forms of scientific instruments and appliances. The collection is clearly of great use to the students in the Normal School, the professors of which draw upon it largely for illustrations of their lectures, or bring their classes into the galleries when that course is more convenient; and these remarks apply to the historical side of the collection almost as much as to its more immediately practical portions. It is of no less use to such of the teachers and students in science schools throughout the country (which receive grants from the Science and Art Department) as have opportunities of visiting it, whether singly or in organized classes. A special feature in the collection is the series of appliances for the teaching of science which it contains, sometimes systematically arranged ready for class use, sometimes shown as a group of similar objects made by different makers, with prices attached. We think that these samples (as they may be called) require very careful administrative watching in order to keep the selection exhibited up to the latest date and the best quality. For such specimens the Department has, especially in the early stages of the collections, been largely indebted to the assistance of private firms; for whom proper consideration must therefore be shown. These samples are doubtless of service to teachers, especially in the present comparatively undeveloped condition of elementary scientific teaching in this country; and the space occupied by them (mostly in wall cases) need not be large.

The collections now under consideration appear to have been on the whole carefully watched by a committee of professors in the Normal School, who, under the exigencies of a limited space, have eliminated from them almost all objects of an obsolete character. Little further weeding is possible in them as they now stand, except perhaps in the case of some of the samples described above. Turning to the other side of the question, the complaints of want of space do not appear to be very serious; and the future development of such collections can, we think, be met in part, but not altogether, by the elimination of objects which, appropriate and necessary to-day, will become obsolete in the inevitable progress of scientific knowledge and procedure. We say, "not altogether," because there ought to be retained a limited number of objects illustrating the historical development of the more important implements of scientific research; moreover, some natural increase must be contemplated arising from the introduction of new methods of scientific investigation. Wall space is all that is required for the exhibition of *diagrams*, which can often be usefully employed in lieu or in aid of actual objects or instruments.

The need for the exhibition of the appliances for elementary science classes may be expected to diminish as the organization of scientific education improves, in the same way as the universal extension of primary schools has removed the necessity for such an exhibition of school desks and fittings as formerly existed in this Museum.

Included in the 40,000 square feet provided for by Sir F. Bramwell's committee are 4000 square feet for "agriculture." At present only a very small collection exists in connection with this subject. Lectures are from time to time delivered at the Normal School, on the *principles* of agriculture, and the Department holds examinations in the same subject. But it is obvious that for the portions of this subject in which instruction can usefully be given in lecture-rooms, the illustrative collections required need occupy only a very moderate amount of space. Any complete collection of objects illustrative of the study of all branches of agriculture would require a space at South Kensington far larger than could be allotted to a mere branch of a Science Museum. The principal agricultural implements should be represented by models in the department of Machinery and Inventions; and provision seems to have been made for this purpose in the scheme for that department, to which we will subsequently refer.

The Western Galleries at present in use are fairly satisfactory as regards construction and lighting, and allow their nominal area and wall space to be utilized to the full extent of their capacity. They are, however, inconveniently situated as regards both the Normal School and the rest of the Museum, and we have little doubt that a building giving an equal accommodation could be provided at a cost less than the capitalized value of the rent (£2000 per annum) at present paid for them.

On the whole, we are of opinion that, having regard to the financial exigencies which must always be present to those intrusted with the expenditure of public funds, a moderate increase on the present space should, subject to one important proviso, suffice, for some time to come, for the needs of the Normal School and other requirements of this section.

The proviso to which we refer is, that there should be a well-organized system of management of the collection. We will revert hereafter to this point, which, in our judgment, affords the key to the whole question now before us.

8. Passing to the section devoted to Machinery and Inventions, we have to observe that this is of the nature of a technological museum rather than of a collection for the special benefit of the Normal School, or of the Science Classes connected with the Department. It is, however, to be observed that the Professor of Mechanics attaches great value to this collection for the purposes of his teaching; and that the objects used as illustrations by the Professor of Metallurgy (so far as he does not use diagrams) are practically included in this division of the Museum. Regarded from a broad point of view, the value and importance of this section must be admitted; and we approve of the policy which has been adopted by the Department in recent years, of developing it at the expense of less important collections. In pursuance of this policy the area of this section has increased from 11,000 to over 18,000 square feet, now occupied to nearly its full capacity. This is still very far short of the space of 45,000 increasing to 60,000 square feet adopted by Sir F. Bramwell's committee, and even of the more moderate demand of 40,000 square feet put forward by Mr. E. A. Cowper in his evidence before us, and based on carefully-detailed calculations. That gentleman has devoted a great amount of time and trouble to this collection, which bears the mark of his patriotic labours in the evident endeavour to utilize the available space to the best advantage. There are a few objects, but only a few, in this collection which could properly be eliminated; but we consider that care should be taken not to acquire or receive full-sized machines where models can be made to serve the same purposes, and also to avoid unnecessary multiplication of parts in either model or machine. For example, two or three rows of bobbins, &c., on a spinning frame show as completely the principles on which a machine is constructed as would a complete series, such as is to be found in actual use. Inferior or obsolete examples must be eliminated as better or more recent specimens are obtained, subject only to the retention of a few typical illustrations of historical development. Moreover, the development of the collection must inevitably be gradual, if properly carried out, as the right objects cannot be obtained off-hand, and the temptation to obtain or accept inferior examples should be avoided in every possible way. Even with these restrictions, we agree with Mr. Cowper that ultimate, if not immediate, provision of a maximum space of 40,000 square feet should be made for this branch of the Museum; and we believe that, under well-organized and efficient management such as we have already pronounced essential, this space, if provided by means of suitable buildings, ought to suffice to contain a technological collection worthy of a great manufacturing country. As a temporary measure, space might be found for the expansion of this section by the removal of the decorative objects which occupy the eastern end of the ground floor of the Southern Galleries.

9. *Naval Collections.*—Under this head are included complete models of vessels of various kinds, actual or proposed, forming an historical series, and mostly on loan; models illustrative of naval construction; and models of marine machinery, many of historic interest. In regard to this section of the Museum, we have had to consider the very debatable question of the suitability of South Kensington as a site for a marine collection. Though classes are examined by the Department in naval construction, no provision is at present made for teaching the subject in this locality. It is right, however, to say that "summer classes" in this subject are contemplated; and a class is intended to be held next autumn. It will be remembered that the School of Naval Architecture (in connection with which this collection was originally formed) has been removed to Greenwich, and has assumed a more prominently military character. It is not easy at first sight to regard the west end of London as

the most convenient centre for those interested in ship construction, especially considering the small amount of ship-building operations now conducted on the Thames. But it has been shown that there is a very strong sentiment among those interested in shipping in favour of the retention of the ship models in their present home, and the following are some of the practical reasons given in support of this view, by the Institute of Naval Architects and others:—

(1) The shipping companies and other owners of the large ornamental models have, it is said, declined to lend their property for permanent exhibition elsewhere than at South Kensington.

(2) The naval collections are closely connected with the Machinery and Inventions Section of the Museum.

(3) Being at South Kensington, the departmental system of circulation can, it is said, be applied to them.

This latter remark only applies in practice to a small portion of the collection, viz. the models, &c., illustrative of the details of ship construction. The large models of ships do not belong to the Department, and in any case are too large and too valuable to be sent round, under the plea of some slight educational utility, to local schools of elementary science; though, under special circumstances, some of them have been lent by their owners to Exhibitions in the provinces, or even at Paris.

On the whole, we have arrived at the conclusion that it would be practically impossible to reconcile public opinion to the removal of this collection elsewhere, and that space must therefore be provided for it at South Kensington.

For this collection 10,500 square feet were demanded at once by the committee referred to in Sir F. Bramwell's Report, with an increase of 10,000 square feet. The space at present occupied is 15,374 square feet, or three-fourths of the maximum desired by the special committee. We consider that the present space should suffice, under proper administration, for an adequate exposition of the methods and results of the very important national industry of shipbuilding. In connection with this conclusion we would observe that, in our opinion—

(1) A certain number of the objects now exhibited could be eliminated "without injury to the value or representative character of the collections"; and the fact that so much of the space is occupied by large ornamental models of ships, many of them on loan, would facilitate such elimination, when required for the introduction of new examples.

(2) Having regard to the fine historical and practical collection of war-ships which exists at Greenwich, and is readily accessible to the general public, the portion of the South Kensington collection which relates to ships of war should be reduced to a minimum. It now occupies twenty pages of the catalogue, in which fifty-three numbers are described.

(3) The additions to the collection, other than in substitution for objects eliminated, should mainly consist of diagrams or small models of *parts* of ships or machinery, suited for practical instruction in the art of ship-building. Such objects would be of use for circulation, and would not occupy any considerable amount of space.

10. *Fish Culture Collection.*—No mention of this collection is made in the departmental scheme of classification dated January 1888; and indeed it seems to bear little relation to the instruction given in the Normal School, to the teaching in science classes connected with the Department, or to the other sections of the Science Museum. Nor is South Kensington a situation naturally well adapted for fish-breeding operations. We beg to refer to the weighty opinion of Prof. Huxley as to the want of connection between this collection and its present surroundings, and the small educational or scientific value which it possesses in its present condition.

The greater part of this collection was bequeathed to the Department in 1880 by the late Mr. Frank Buckland, and a series of British fishes has, since that date, been presented to it by Dr. Day. This state of things would, however, in our opinion, hardly prevent the Department from transferring the collection to some other public institution. The Buckland Professorship, if the funds for its support are still available, might well be attached to the Marine Biological Laboratory at Plymouth, under regulations agreed to by the Science and Art Department. With the consent of the donors (when obtainable), some objects now forming part of this collection might find a place in the Natural History Museum; and the remainder might be transferred to the Marine Biological Association, and the Scotch Fishery Board, provided that those bodies are able and willing to receive them. In any circumstances we are of opinion that there is no necessity for the collection being retained at South Kensington, and certainly no provision should be made for it in any building scheme there.

The large State barge and Venetian gondola now housed in the same galleries as the fish collection should also be removed.

11. *Circulation.*—With regard to that portion of the reference to us which relates to the system of circulation of objects in the provinces, we should explain that two different systems are comprised under that name. Under one of these, objects forming an integral part of the collections are lent by the Department, for a limited period, to local museums. This in the case of the science collections is only done on a small scale; the space so vacated is insignificant and cannot be utilized for other purposes, and it has therefore no practical bearing on the housing of the collections. The other kind of circulation is confined to science schools in connection with the Department. It consists in the loan of a typical set of objects and apparatus suitable for the teaching of one branch or another of science, such as chemistry, geology, &c., with a view to improve the practical portion of local teaching. These circulating sets are never regularly exhibited at South Kensington, and therefore can only require a small amount of warehouse space for storage and arrangement. If the system of circulation grows, some additional warehouse space may be required, but no increase in the exhibition space would be involved.

12. The frequent mention in this Report of areas of exhibition space suffices to indicate how inevitably the question of housing the collections has been forced on our attention, notwithstanding that it does not explicitly form part of the terms of reference to us. In suggesting certain areas as, in our opinion, sufficient to meet the requirements of the case, we have assumed that the exhibition buildings should be well arranged, well lighted, and of a durable character. These requisites, however, are not fulfilled in the case of the Southern Galleries, the upper floor of which is, we are informed and believe, incapable of supporting considerable weights, so that collections of machinery cannot be placed in that portion of the building. It may also be observed that these galleries appear not to be well secured against fire. The rent of £1500 per annum is paid for the central block of this building, for the capitalized value of which sum a larger and more convenient building could apparently be erected. The present state of dispersion of the Museum involves extra expense in connection with the entrances, attendants, and police, and also increases the difficulty of an efficient superintendence by the superior officers in charge of the collections. We feel bound to call attention to these facts, which have been forcibly impressed on us by our observations on the spot as well as by the evidence we have received.

13. We have already adverted to another matter which, though outside the literal terms of reference to us, is in our judgment of the very greatest importance in regard to the substance of the questions under consideration. We allude to the organization for the custody and management of the collections. At present this duty rests, under the Secretary, with the staff of the Director of the Museum, whose functions cover both the Art and the Science divisions, which differ widely from one another. Attached, however, to each section of the Museum is a separate consultative committee; which, for the collections of scientific instruments and appliances, consists of the professors of the Normal School; while in the case of the other sections, the committees consist of gentlemen external to the Department. These committees can only recommend, not decide; and even when their recommendations are adopted, it does not follow that they can see that they are carried out. To committees of this kind the task of refusing unsuitable loans is also peculiarly difficult and irksome; and there is also some danger of different committees causing overlapping between different portions of the collections, although we have no reason to think that this has as yet happened. On the other hand, there seems to be no system of regular meetings of the committees at prescribed intervals (oftener than once a year), and regard being had to the composition of the committees, it is not to be expected that many members of them should be able to devote much time to this work, certainly not to the detailed and continuous supervision which collections require. It must not be supposed that nothing has been gained from the existence of these committees; on the contrary, Mr. Cowper's work on the machine collections is an instance of the excellent service which individual members have rendered. But we consider the system defective in principle,

apart from the personal qualities of those working under it; and having formed a very decided opinion to this effect, we feel it our duty to call attention to the subject, in the interests of economy as well as of efficiency. The responsibility for the formation and supervision of these collections should certainly be of a more definite kind.

14. Suggestions have been made that these collections might encroach on the field occupied by other scientific museums. With regard to this point we would call attention to the evidence of Prof. Judd as showing that a practical distinction can readily be drawn even at a point where two Museums closely approach one another in character.

15. In conclusion, we may summarize the results of our inquiries by expressing the opinion that little, if any, space can be gained by weeding the existing collections, and that, subject to the reservations we have made as to effective organization and administration, and as to the character of the buildings to be assigned to the collections, an exhibition space of about 90,000 square feet should be provided without delay, and would suffice for the requirements of a creditable Science Museum, with adequate space for all the departments for which it appears at present necessary to provide. This space includes provision for a scientific structural collection on the lines indicated in paragraph 5 of this Report, but does not include any provision for offices, warehouses, workshops, or other accessories to such a Museum.

JOHN EVANS.
FRANCIS HERVEY.
RAYLEIGH.
B. SAMUELSON.
DOUGLAS GALTON.
HENRY E. ROSCOE.

STEPHEN E. SPRING RICE, Secretary.
July 23, 1889.

AN ITALIAN'S VIEW OF ENGLISH AGRICULTURAL EDUCATION.[1]

IN this *brochure*, M. Italo Giglioli, Professor of Agricultural Chemistry at Portici, has collected together a large amount of information upon agricultural education and agricultural research as carried out in the United Kingdom. A similar work upon the teaching of agriculture throughout Europe, by the same author, appeared last year. It is, however, noticeable that the volume on English agricultural education is three times the bulk of the earlier effort. M. Giglioli, as a foreigner, has considered our methods worthy of a much more detailed Report than those of the Continent. This can only be regarded as a tribute to the excellence of English agriculture. We have heard a great deal of late upon the small amount of interest taken in agricultural education in England compared with Continental countries. An Italian Professor finds material for a portly volume on our systems of agricultural education and research, while he is able to compress his information upon the German, French, and Hungarian systems into a pamphlet of comparative thinness.

As a matter of fact, the Continental nations have been, at least in the past, ahead of us in these matters. The value of what is done in England rests rather upon the quality of our agriculture than upon our efforts to systematically teach it. Continental Professors of Agriculture find it as essential to visit England and to study English agriculture, as would an American Professor of History to visit Europe, or a Biblical student to visit Egypt and Palestine. The most noted breeds of cattle, sheep, and pigs, the best types of implements and machinery, the best artificial manures, the best systems of farming, have originated in England and Scotland, and hence the attention which is paid to agricultural research as prosecuted in Britain. So far, however, as the study of Agriculture is concerned, or painstaking and wide-spread investigation goes, the Continental nations are before us. It is not by any means certain that with these advantages they will excel us in the actual practice of agriculture. As a nation we are more adapted for doing than for study, and our progress is generally the result of pressure under competition, and the spontaneous adoption of the best practices, as they are published in the press. Our improvements are less likely to emanate from technical schools than from the promulgation of new ideas, new processes, new material, new appliances, adopted by leading agriculturists, exhibited and reported upon.

M. Giglioli, like all Continental visitors to England, wonders with great admiration at the spontaneous character of our efforts. Here, we succeed without Government help. There, both teaching and research often languish, although supported by huge grants, and are always discontentedly asking for more. "Il carattere più saliente che le distingue da tutte le altre scuole agrarie di Europa, è quello della loro completa autonomia, anche finanziaria. Esse non ricevono sussidio alcuno nè dal Governo, nè da provincie, nè da associazioni agrarie: vivono completamente sopro quello che quadagnano. Il contrasto tra le scuole inglesi e le continentali appare nel seguente quadro." The author then recounts, in tabular form, the cost to the student, and the incomparably greater cost to the State, of agricultural education in Germany, France, and Italy; and, after showing that each student costs his State from 700 to 2500 lire, in addition to his own costs, he triumphantly writes "*niente*" in the column showing the cost to the State opposite the chief English agricultural schools.

The author's introductory remarks having been concluded, the principal Societies engaged in agricultural education in these countries are next passed in review, and their methods, examinations, prizes, diplomas, are described. Such matter will no doubt be more interesting to Italian agriculturists than to ourselves. The number of these means of instruction is probably greater than many Englishmen are aware of, and, as a point of considerable interest at the present time, we take the following list from M. Giglioli's book:—

The Royal Agricultural Society of England (an examining body).
The Rothamsted Experimental Station (for research only).
The Royal Agricultural College, Cirencester (instructional and examining body).
The College of Agriculture, Downton (instructional and examining body).
The Colonial College, Hollesley Bay (instructional and examining).
The Department of Science and Art, South Kensington (instructional and examining).
The Darlington Chamber of Agriculture (Lecturer employed).
The Normal School of Science, South Kensington (Agricultural Professorship).
The University of Oxford (Sibthorpian Professorship).
King's College, London (Agricultural Lectureship).
City of London College (Agricultural Lectureship).
The Worleston Dairy School, Cheshire.
The Sudbury Dairy School.
The Weald of Kent College of Agriculture.
The School of Agriculture, Aspatria, Cumberland.
The Agricultural School at Alvecote, Tamworth.
The agricultural instruction given at various County Schools.
The facilities for agricultural instruction in rural Elementary Schools.
The Forestry Department at Cooper's Hill.
The Surveyors' Institution, 12 Great George Street, Westminster (examining body).
The Royal Veterinary College, Camden Town.
The Brown Institute.
The Highland and Agricultural Society (examining body).
The Agricultural Department of the University of Edinburgh.
The Agricultural Department of the College of Science and Technology, Edinburgh.
Course of Agriculture at Glasgow Technical College.
The Agricultural Department in Aberdeen University.
The Royal Veterinary College, Edinburgh.
The New Veterinary College, Edinburgh.
The Veterinary College, Glasgow.
The Agricultural School at Templemoyle, Ireland.
The Royal Albert Institution, Glasnevin, Dublin.
The Dairy School for Females, Glasnevin.
The Munster Dairy School, near Cork.
Canon Bagot's Creameries, Ireland.
The Governmental agricultural instruction in Elementary Schools, Ireland.

The above Societies, Colleges, and Schools engaged in the work of agricultural education are all carefully described. The list might have been made longer, as M. Giglioli does not seem

[1] "Educazione agraria Britanica," relazione di Italo Giglioli. (*Annali di Agricoltura*, 1888.)

to be aware of various dairy and other agricultural schools which have been recently founded, or are now being promoted. Among these may be especially mentioned the Travelling Dairy School of the Bath and West of England Society.

JOHN WRIGHTSON.

"*INFERNITO.*"

SOME strange natural phenomena are described in a recent report from the United States Consul at Maracaibo in Venezuela. That part of the department of Colon situated between the Rivers Santa Ana and Zulia and the Sierra of the Colombian frontier is very rich in asphalt and petroleum. The information we have regarding this extensive and interesting region, which is an uninhabited forest, is derived chiefly from the reports of the searchers after balsam copaiba, which abounds; but the following data were taken from the personal observations of an American gentleman who made a special exploration. Near the Rio de Oro, at the foot of the Sierra, there is a very curious phenomenon consisting of a horizontal cave which constantly ejects thick bitumen in the form of large globules. These globules explode at the mouth of the cave with a noise loud enough to be heard at a considerable distance; and the bitumen, forming a slow current, falls finally into a large deposit of the same substance, near the river bank. The territory bounded by the Rivers Zulia and Catatumbo and the Cordillera is rich in deposits and flows of asphalt and petroleum, especially towards the south, where the latter is very abundant. At a distance of a little more than 7 kilometres from the confluence of the Tara and the Sardinete, there is a sand mound of from 25 to 30 feet in height, with an area of about 8000 square feet. On its surface are a multitude of cylindrical holes of different sizes, which eject with violence streams of petroleum and hot water, causing a noise equal to that produced by two or three steamers blowing off simultaneously. For a long distance from the site of this phenomenon the ground is covered or impregnated with petroleum. The few explorers for copaiba who have visited this place call it the "Infernito" (little hell). Among other things, it is stated that from one only of these streams of petroleum was filled in one minute a receptacle of the capacity of four gallons. This represents 240 gallons in an hour, or 5760 gallons in 24 hours; and even if this calculation be somewhat exaggerated, the fact remains that such a considerable number of petroleum jets in constant active operation must produce daily an enormous quantity. This petroleum is of excellent quality, with a density of 83°, which is a sufficient grade for foreign markets. Considering the immense amount of inflammable gases which must be given out by the flows and deposits of petroleum as described above, it may be easily believed that this has a direct bearing upon the phenomenon known since the conquest as the Faro of Maracaibo. This, consisting of constant lightning without explosion, may be observed towards the south from the bar at the entrance to the lake, and Coddazzi in his geography explains it as being caused by the vapours arising from the hot water swamp situated about one league to the east of the mouth of the Escalante, at the southern extremity of the lake. Near the mountains, and not far from the River Torondoy, there are various flows of a substance which seems to be distinct from either asphalt or petroleum. It is a liquid of a black colour, with little density, and strongly impregnated with carbonic acid, and is almost identical with a substance met with in the United States among the great anthracite fields.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 2.—"On the Spectrum, Visible and Photographic, of the Great Nebula in Orion." By William Huggins, D.C.L., LL.D., F.R.S., and Mrs. Huggins.[1]

It might be suggested that the want of coincidence observed between the nebular line and the magnesium band, amounting to λ 0001·9 nearly, might be due to a motion of translation of the nebula towards the earth. The motion required to produce this shift of position is about sixty-seven miles in a second. [The earth's motion at the time of comparison with magnesium band may be taken at nearly seventeen miles in a second of recession from the nebula. This motion would bring the nebular line nearer the red, and diminish the apparent interval between that line and the termination of the band. If the nebula has a motion of approach, the earth's motion would bring the line back again, to an extent corresponding to about seventeen miles in a second, towards its true plane.—*May* 18.]

[1] Continued from p. 407.

I showed in my paper on this subject in 1874 (Roy. Soc. Proc., vol. xxii. p. 253), that, in the case of the Orion nebula and six other gaseous nebulæ—namely, 4234, 4373, 4390, 4447, 4510, 4964, of Sir J. Herschel's "General Catalogue of Nebulæ"—"in no instance was any change of relative position of the nebular line and the lead line detected." We should have to resort, therefore, to the overwhelmingly improbable supposition that all seven nebulæ were approaching the earth with velocities such that, having respect to the earth's motion at the different times of observation, they all gave a sensible shift corresponding to 67 ± 15 miles in a second.[1] There is little doubt in my mind, therefore, from these comparisons, which, considering the strong evidence we possessed before of the relative positions of the nebular line and of the magnesium line, are, strictly speaking, supplementary and confirmatory evidence only, that this line of the gaseous nebulæ is not produced by "the remnant of the magnesium fluting."

In the diagram on p. 134 (Roy. Soc. Proc., vol. xliii.), Mr. Lockyer represents this nebular line followed by fine lines, which give it the appearance of a fluting similar to that of the magnesium band placed above. I am unable to find in the paper any authority for this representation of the line. In another place (Programme Royal Society *Soirée*, May 9, 1888, p. 12) Mr. Lockyer says: "On one occasion, at Greenwich, it was recorded as a fluting in the spectrum of the nebula in Orion." Mr. Maunder's words are ("Greenwich Spectroscopic Results," 1884, p. 5): "None of the lines (with two-prism train) are very sharp. λ 5005 showed a faint fringe mainly on the side nearer the blue."

Mr. Maunder has recently sent a note to the Royal Astronomical Society, in which he explains that the observation was made with a second half-prism added to the half-prism spectroscope. He says:—"The three principal lines of the nebular spectrum were seen as very narrow bright lines, but none of them were perfectly sharp, each showed a slight raggedness at both edges; but in the case of the line near λ 5005 it was clear that this fringe, or raggedness, was more developed towards the blue than towards the red. In the case of the other two lines, they were not bright enough for it to be possible to ascertain whether the fringes were symmetrical or not. But λ 5005 was clearly a single line. There was no trace of any bright line, or series of bright lines, close to it on either side; no trace of a fluting, properly so called. The entire line, fringes and all, was only a fraction of a tenth-metre in total breadth" (*Monthly Notices R.A.S.*, vol. xlix., 1889, p. 308). [It should be noticed that, with the instrumental conditions under which Mr. Maunder observed, the second and third lines were not sharp, but also showed fringes.—*May* 18.]

My own observations of this line, since my discovery of it in 1864, with different spectroscopes up to a dispersion equal to eight prisms of 60°, show the line to become narrow as the slit is made narrow, and to be sharply and perfectly defined at both edges.

[1] [The following observations of Orion for motion in the line of sight have been made at Greenwich:—

1884. February 15.—About thirty-one miles approach. Note, *measures purely tentative.*

February 18.—About fifty-one miles approach. Note, *the measures are not trustworthy.*

March 10.—*Direct comparison.* With neither one nor two prisms, after very careful direct comparison, could any displacement be detected; the coincidence of the two spectra was evidently very close.

March 12.—*Direct comparison.* . . . Direct comparison with one prism-train showed coincidence as complete as could be detected, considering the faintness of the two spectra. . . . No part of the nebula showed any marked displacement, but at a point a little preceding the Trapezium the pointer did not seem perfectly central on the line, but a little (perhaps one-tenth, certainly not more) towards the red.

1887. October 25.—Six measures, three of which show approach, and the other three recession. Note, lines in nebula faint, and bisections very rough.

In a letter dated May 17, Mr. Maunder permits me to state that the measures and estimations made in 1884 and 1887 are of no weight, but that he considers the *comparisons* in March 1884 to be as satisfactory as possible with so faint an object, and to show that the nebula has very little, if any, sensible motion in the line of sight.—*May* 18.]

As some importance attaches to the precise character of this line, I wrote to Prof. H. C. Vogel for permission to quote the result of his experience, which has been nearly as long as my own, of the character of this line. He says in his reply, dated March 20, 1889: "Beeile ich mich Ihnen mitzutheilen, dass meine langjährigen Beobachtungen über die Spectra der Gas-Nebel *vollkommen* mit den Ihrigen darin übereinstimmen, dass die Nebellinie λ 5004 schmal, scharf und nicht verwachsen ist. Auch D'Arrest hat in seiner Untersuchung über die Nebel-Spectra (Kopenhagen, 1872) nicht erwähnt dass die hellste Nebellinie unscharf sei."

Dr. Copeland permits me to quote the following sentences of a letter dated March 19, 1889:—"Respecting the appearance of the line λ 5004 in the spectrum of the Orion nebula, I may say that I have always drawn and seen it quite sharp and well defined on both edges. About nine years ago I made a special effort to divide it, if possible, with a large spectroscope in which the viewing telescope was 3 inches in aperture. The lines were then seen as sketched." (The diagram shows the nebular lines with sharply ruled lines for edges.) "They were drawn by holding the note-book 10 inches from the left eye, in such a position that the image seen in the instrument with the right eye was apparently projected on the paper. If I had noticed any peculiarity about λ 5004, it would certainly have been noted."[1]

In an early observation of the dumb-bell nebula Prof. Vogel, indeed ("Beobachtungen zu Bothkamp," p. 59, 1872), describes this line as less defined towards the violet side. In a letter (April 3, 1889) Prof. Vogel says this appearance of the line was probably due to a slit not sufficiently narrow. He says that he re-examined this line in his observations with the great Vienna refractor, and that it did not then appear otherwise than defined and narrow.

The other line in the spectrum of the nebulæ upon which Mr. Lockyer mainly relies for the presence of magnesium is the line shown in my photographic spectrum of 1882 (Roy. Soc. Proc., vol. xxxiii. p. 425), and to which I assigned the wave-length of about 3730. Mr. Lockyer says of this line (Roy. Soc. Proc., vol. xliii. 1887, p. 122): "In the bunsen as ordinarily employed the fluting at 500 far eclipses the other parts of the spectrum in brilliancy, and at this temperature, as already observed by Messrs. Liveing and Dewar, the ultra-violet line visible is that at 373." Passing by a minor point, which Liveing and Dewar have already pointed out (Roy. Soc. Proc., vol. xliv., 1888, p. 244), namely, that their observation was made at the higher temperature of burning magnesium, this statement is insufficiently complete, for what occurs at this part of the spectrum, and is characteristic of the magnesium-flame spectrum, is a triplet, of which the line given by Liveing and Dewar at about 3730 is the least refrangible member only.

I have given a representation of this triplet at the wave-lengths given by Liveing and Dewar, namely λ 3730, 3724, and 3720. In the photograph of 1888, in which the strong line can be seen distinct from the lines near it, the line is found to be very near the middle line of the triplet. I have therefore assigned to this line the position of about λ 3724. This line appears pretty strong, and therefore if it were really one of the lines of the triplet, the other two members of the triplet should have appeared on the plate. On one side of the star-spectra this line is a little broader than on the other side, but as a similar appearance is presented by G, and the stronger of the lines of the group, it may arise from some optical or photographic cause. The line at 3724 impresses me strongly as a single line, and there is certainly no trace of the first line of the triplet at 3730. The line appears to me stronger where it is upon the star-spectra.

As therefore there is little doubt that the "remnant of the fluting at 500, which far eclipses the other parts of the spectrum in brilliancy," is not coincident with the brightest nebular line, and the next most characteristic group of this spectrum, the triplet at 3722, 3724, and 3730, according to Liveing and Dewar, does not appear to be present in the photographs, we may conclude that the remarkable spectrum of the gaseous nebulæ has not been produced by burning magnesium.[1]

I should mention that Mr. Lockyer attributes one other line occasionally seen in the gaseous nebulæ to the flame spectrum of magnesium—namely, a very faint line at about λ 4700. Now, according to my experience, it is only in the spark and arc that a line of magnesium appears at this place, a condition of the spectrum when the lines at *b* are very conspicuous, and the band at λ 5006·5 is usually absent. When, however, the spark is taken in magnesium chloride, the band is present under some conditions, but the triplet at *b* is always bright. I therefore consulted Prof. Liveing, who says:—"I have never seen the line at λ 4703 in the spectrum of the magnesium flame. As it is a conspicuous line in the arc and spark, we looked for it in the flame, but did not find it."

With reference to the second nebular line at λ 4957, Mr. Lockyer says (Roy. Soc. Proc., vol. xliii. p. 133): "The lines at 500 and 495 have been seen in the glow of the Dhurmsala meteorite when heated, but the origin of 495 has not yet been determined." And further (at p. 135): "I should add that the line at 495 makes its appearance much more rarely than the one at 500 in meteorite glows." In the diagram on the same page this line is represented as coincident with the nebular line.

The circumstance of a line appearing at 495 can scarcely be regarded, considering the very great number of spectral lines, as amounting to a presumption that the material to which it is due in the meteorite is the same as that present in the nebulæ which gives the line at 4957. If it should be shown that the unknown substance in the meteorite gives rise to a line at the position of the nebular line—namely, λ 4957—in that case the observation would have sufficient importance to make it desirable to compare the spectrum of the meteorite directly with that of the nebula.

Lines Observed and Photographed in the Spectrum of the Nebula.

Line measured by Dr. Copeland, probably D_3		λ 5874·0
Brightest line...		5004·6 to 5004·8
Second line		4957·0
Third line, Hβ		4860·7
Fourth line, Hγ		4340·1
Line measured by Dr. Copeland		4476·0
Strong line in photographs 1882 and 1888, about		3724·0
Line in photographs 1888, about		3709·0
,, ,, ,, ...		3699·0
Photograph 1889. 1st pair	about... ...	3752·0
	,, ...	3741·0
,, 2nd pair	,, ...	3285·0
	,, ...	3275·0
Line at	,, ...	3060·0
,, 3rd pair	,, ...	3053·0
	,, ...	3047·0
Photograph 1888 ... ... Line across star spectra, 1st group	,, ...	4116·0
	,, ...	4123·0
	,, ...	4130·0
	,, ...	4142·0
	,, ...	4154·0
	,, ...	4167·0
2nd group	approximate	3998·0
	,,	3988·0
	,,	3975·0
	,,	3959·0
3rd group	,,	3896·0
	,,	3887·0
	,,	3878·0
	,,	3870·0
	,,	3859·0
	,,	3854·0
	,,	3848·0
	,,	3842·0
	,,	3832·0
	,,	3825·0

[1] Mr. Taylor, late of the South Kensington Laboratories, observing at Sir Henry Thompson's observatory in November 1888, says:—"The 5001 line is by far the brightest in the spectrum. It is never seen sharp, but with the narrowest slit always has a fluffy appearance, this being much more marked on the blue than on the red edge. This line was most carefully examined for evidence of structure, but was always found to be single, and no decided evidence of fluting structure could be made out. It may be that greater dispersion may show structure, but with the dispersion used here no structure could be seen."—*Monthly Notices R.A.S.*, vol. xlix. p. 125.

[1] On the narrower basis of the magnesium spectrum only, Profs. Liveing and Dewar point out that "the appearance of a line in the position of the first band without any trace of the second band, which is nearly as bright as the first, and without any trace of the *b* group, is quite sufficient to create a suspicion of mistaken identity when Mr. Lockyer ascribes the sharp green line in the spectrum of nebulæ to this band of magnesia. This suspicion will be strengthened when it is noticed that the line in question is usually in nebulæ associated with the F line of hydrogen, if it be borne in mind

Chemical Significance of the Lines.

Until I can obtain more photographs taken on different parts of the nebula, I wish to be understood to speak on this point with much hesitation, and provisionally only. We know certainly that two of the lines are produced by hydrogen. The fineness of these lines points to a high temperature and condition of great tenuity of the hydrogen from which the light was emitted. This condition of the hydrogen may give us a clue as to the probable interpretation of the other lines. These may come from substances of very low vapour-density, and under molecular conditions which are consistent with a high temperature. It is in accordance with this view that the recent measures of Dr. Copeland, since confirmed by Mr. Taylor (*loc. cit.*), show with great probability that the line known as D_3, which has been supposed to indicate some substance of low vapour-density, which shows itself only at the hottest region of the sun, is present in the nebular spectrum. The great simplicity of the three pairs of lines seen in the photograph of 1889 suggests a substance of a similar chemical nature.

If hydrogen can exist at half its usual vapour-density, with a molecule of one atom only, we might possibly expect to find it in some of these bodies, but at present we do not know what its spectrum would be in such a condition. It may be possibly that it is in molecular states of our elements other than those we are acquainted with that we may have to look for an interpretation of some of the lines of these bodies.

[With respect to the groups of lines which cross the star spectra, any statements must also be provisional only.

These lines are distinct and fairly strong in the star spectra, and do extend, some farther than others, into the adjoining nebular matter. Whether they are peculiar to these particular stars and the matter close about them, or whether they will be found everywhere in the nebula, or in certain parts of greater condensation only, can be known only from future photographs.

The first group shows some general agreements with a strong iron group, but there are also formidable discrepancies.

The position of the third group suggested the well-known cyanogen group, especially as this group, beginning at λ 3883, is the first to appear under the chemical conditions which might have been conceived to exist under circumstances of condensation (see Liveing and Dewar, Roy. Soc. Proc., vol. xxxiv., 1883, p. 128). Under these conditions this group appears alone in a photograph, without the less refrangible group, as was probably the case in the photograph I took of Comet II., 1881. I therefore took a photograph of an oxy-coal-gas flame, the coal-gas having passed through ammonia, and a magnesium-flame spectrum on the same plate for comparison.

On comparing this photograph with that of the nebula it was seen by eye, and afterwards confirmed by measurement, that the nebula group begins sooner by one strong line than the cyanogen group, and presents besides in the relative strength and grouping of the lines a distinctly different character. The evidence appears to me to be against attributing these lines to cyanogen.

I took great pains to ascertain if the group of lines which accompanies the triplet of the magnesium-flame spectrum could be made to agree with the much longer group of lines in the nebula at this part of the spectrum. Again, as in the case of the cyanogen group, the whole aspect of the grouping of lines is quite different. The groups begin and end differently, and the relative strength of different parts of the group is not the same. The great increase of strength which is seen in the middle of the magnesium group is not present at the corresponding part of the nebula group. I do not think therefore there should be much weight given to the near positions of several individual lines of the two groups, which in the case of so close a grouping might well be accidental, especially as the wave-lengths can be but approximate only. (The strongest lines of the magnesium-flame group are those forming the triplet which appears also in the spark and the arc. A nebular line is near the middle line of the triplet, but there are no lines corresponding to the other lines of the triplet. The other lines of the flame group are too faint to be expected to appear, unless the triplet at 3720—3730 were strong upon the plate.—*May* 18.)

The three pairs of lines in the photograph of 1889, which are doubtless rhythmically connected, appear to me to possess great interest, especially if it should come to be found from future photographs that these groups are characteristic of the most tenuous part of the nebula. At present, I am not able to make any suggestion as to their chemical origin, but the suggestion presents itself that we may have to do with some molecule of very low vapour density.

The pair of lines on the more refrangible side of the line at λ 3724, may possibly be connected with the state of the nebula as it exists in the neighbourhood of the stars.—*April* 26.]

General Conclusions.

It seems to me premature until we can learn more of the significance of the new groups of lines, and especially of their connection with the nebular matter generally, or with certain condensed parts only, to express more than provisional suggestions as to the nature of these nebulæ. It may be that they represent an early stage in the evolutionary changes of the heavenly bodies.

As some physical importance, in the relation of these nebulæ to each other, has been given to my inability, in consequence of insufficient optical means in my original observations in 1864, to see all three of the bright lines in some faint nebulæ, I may mention that in the case of one object, the Ring Nebula in Lyra, in which at that time the light appeared monochromatic, as only the brightest line could be certainly seen, as soon as larger means were placed at my disposal by the loan of the Royal Society telescope in 1870, I had no difficulty in seeing all three lines on any night of sufficient clearness. There is little doubt that the same cause prevented me from seeing more than the brightest line in Nebula 4572 of Herschel's "General Catalogue." Vogel saw two lines ("Beobachtungen zu Bothkamp," 1872, p. 59).

These bodies may stand at or near the beginning of the evolutionary cycle, so far as we can know it. They consist probably of gas at a high temperature and very tenuous, where chemical dissociation exists, and the constituents of the mass, doubtless, are arranged in the order of vapour-density. As to the conditions which may have been anterior to this state of things, the spectroscope is silent. We are free, so far as the spectroscope can inform us, to adopt the hypothesis which other considerations may make most probable. On Dr. Croll's form of the impact theory of stellar evolution, which begins by assuming the existence of stellar masses in motion, and considers all subsequent evolutional stages to be due to the energy of this motion converted into heat by the collision of two such bodies, these nebulæ would represent the second stage in which these existing solid bodies had been converted into a gas of a very high temperature. They would take the same place, if we assume with Sir William Thomson (Roy. Instit. Proc., vol. xii. p. 15) the coming together of two or more cool solid masses by the velocity due to their mutual gravitation alone.

I pointed out in 1864 (Phil. Trans., 1864) that the gaseous nature of these bodies would afford an explanation of the appearance of flat disks without condensation which many of them present. The light emitted by the portions of the gas further from us would be in part or wholly absorbed by the gas through which it would have to pass, in this way giving to us the appearance of a luminous surface only.

In some of these bodies there is also a very faint continuous spectrum, which if we had more light might be found to consist, in great part at least, of closely adjacent bright lines. Such is probably the nature, in part, of the apparently continuous spectrum of the nebula with which this paper deals chiefly, the Great Nebula in Orion.

In other gaseous nebulæ strong condensations are seen, and a stronger "continuous" spectrum. When we come to nebulæ of which the nebula in Andromeda may be taken as representative, the strong bright-line spectrum is absent, and we have what for convenience I called, in my original observations of these bodies, a "continuous" spectrum, though I was careful to point out that it was probably "crossed by bright or dark lines."

Out of about sixty nebulæ and close clusters observed by me up to 1866, I found a proportion of about one-third—namely, nineteen—to present the spectrum of bright lines (Phil. Trans., 1866, p. 383).

The stage of evolution which the nebula in Andromeda represents is no longer a matter of hypothesis. The splendid photograph recently taken by Mr. Roberts of this nebula shows a planetary system at a somewhat advanced stage of evolution; already several planets have been thrown off, and the central

that the spark of magnesium in hydrogen does not give the bands, and that the oxyhydrogen flame hardly produces them from magnesia when the hydrogen is in excess" (Roy. Soc. Proc., vol. xliv. p. 245). Mr. Taylor records a brightening of the continuous spectrum of the nebula at λ 5200, which he suggests may be magnesium. But this position is twenty-five units from that of the middle of the magnesium triplet at *b* (*Monthly Notices R.A.S.*, vol. xlix p 125).

gaseous mass has condensed to a moderate size as compared with the dimensions it must have possessed before any planets had been formed.

SYDNEY.

Royal Society of New South Wales, July 3.—Prof. Liversidge, F.R.S., President in the chair.—The Chairman announced that Mr. C. S. Wilkinson, the Government Geologist, had kindly consented to deliver (gratuitously) a course of (three) lectures in connection with the Clarke Memorial, commencing in October or November next.—The following papers were read:—Notes on the high tide of June 15-17, 1889, by John Tebbutt; and on the marine and fresh-water Invertebrates of Port Jackson and the neighbourhood, by Thomas Whitelegge. At the conclusion of the latter paper the President presented the Society's bronze medal, which, together with a money prize of £25, had been awarded to Mr. Whitelegge for his paper.—Prof. Anderson Stuart showed a modification of the "kymoscope" which he exhibited at the Society's last monthly meeting. This form demonstrated the phenomena of interference in wave motion—one series of tubes had one wave, a parallel series had the other, and both opened into a common series in which the interference was made visible. The two waves came from pumps which could be so arranged as to vary the amplitude of the waves and to change the position of the straight lines produced when the waves met or "interfered."

PARIS.

Academy of Sciences, August 19.—M. des Cloizeaux, President, in the chair.—Remarks on the conditions under which the fixation of nitrogen is effected in argillaceous soils, by M. Berthelot. Here is described a fresh series of experiments on the fixation of nitrogen in the ground with the co-operation of living organisms, microbes, and more highly organized plants. Replying to a recent communication of M. Schlœsing on the negative results of his studies, M. Berthelot accepts these conclusions, and even claims priority for them, adding, however, that they were given by him as defining the negative conditions of the phenomenon—that is, the conditions under which the fixation of nitrogen does not take place. In a second paper M. Berthelot describes some further researches on the fixation of nitrogen by vegetable humus under the influence of electricity.—Note on the glacial epoch, by M. H. Faye. It is argued that glaciation does not depend on any direct cause, such as a passing obscuration of the sun at the beginning of the Quaternary epoch, but is due to a far more remote cause—that is to say, the appearance of the seasons and of the poles of low temperature at a time when the sun had acquired its definite form and dimensions. A repetition of the great changes that took place during Tertiary times has been prevented by the continually increasing thickness of the terrestrial crust and by the slower rate of progress of the cooling process.—Observations on the sardine frequenting the Mediterranean waters, by M. A. F. Marion. The results are here communicated of the researches made by the author during the fishing season 1888-1889, for the purpose of verifying and completing his previous observations on the migrations and life-history of the sardine periodically visiting the shores of the Mediterranean.—On the total eclipse of August 19, 1887, by M. N. Egoroff. This is a summary of the Russian report on the observations of the eclipse of 1887 made at the seven stations of the Russian Physico-Chemical Society in accordance with the programme prepared by the Special Commission.—Electric figures produced by lightning, by M. Ch. V. Zenger. The curious effects are described of an electric discharge which struck a silvered mirror during a terrific thunderstorm near Prague, on June 9, 1889. The mirror shows over ten points at which the electric fluid penetrated through its gilded frame, volatilizing and transferring the gold to the anterior face of the glass, while on the opposite side the volatilization of the silver coating produced the most beautiful electric figures. These figures show that there occurred repeated and successive discharges, as also indicated by recent photographs of flashes taken with the oscillating camera obscura.—Observation of the occultation of Jupiter and its satellites by the moon, taken at the Observatory of Nice, by M. Perrotin. The hours of the various phases of the occultation that took place on August 7, 1889, are tabulated at mean time at Nice. The satellites are shown to have disappeared, not instantaneously, but gradually during several tenths of a second.—Observations of the new planet discovered at the Observatory of Nice on August 3, 1889, by M. Charlois. The observations are for the period August 3-6, when the planet had the brightness of a star of magnitude 13·5 to 14.—On a new mode of teaching music, based on the periodicity of the octave, by M. Ricard. The author aims at a radical reform in the teaching of music, and expounds his system in a series of fundamental propositions, such as: musical effect is quite different from acoustic effect; there can be no physical gamut, a major and a minor, but one only, that of the white notes of the piano, called the major, and so on.—On contraction in solutions, by M. Charpy. The object of these researches is to determine how the contraction produced in the process of solution varies with its concentration.—On the phosphotungstic acids, by M. E. Péchard. The methods hitherto employed for the preparation of these acids have all been indirect. But the study of metatungstic acid has suggested to M. Péchard the possibility of realizing the direct union of this acid with phosphoric acid. The general method of preparation consists in evaporating, under suitable conditions, a mixture of both acids in determined proportions.—On the passivity of cobalt, by M. Ernest Saint-Edme. It is shown that certain treatises on chemistry are wrong in stating that cobalt in the presence of concentrated nitric acid becomes *passive* like iron and nickel.—On the heat of combustion of some organic compounds (continued), by M. S. Ossipoff. The author's series of determinations is here concluded with teraconic acid, malic anhydride, methyl fumarate, and maleate of methyl.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Leçons Synthétiques de Mécanique Générale: M. J. Boussinesq (Paris, Gauthier-Villars).—Traité d'Optique, tome premier, M. E. Mascart (Paris, Gauthier-Villars).—Index Generum Avium; a List of the Genera and Subgenera of Birds: F. H. Waterhouse (Porter).—The Alternate Current Transformer in Theory and Practice; vol. i. The Induction of Electric Currents: J. A. Fleming (*Electrician* Office).—Album von Celébes-Typen: Dr. A. B. Meyer (Dresden).—Lung-Ch'Uan-Yao oder Altes Seladon-Porzellan: Dr. A. B. Meyer (Berlin, Friedländer).—Le Développement de l'Image Latente: A. de la Baume Pluvinel (Paris, Gauthier-Villars).—Traité Pratique du Développement: A. Londe (Paris, Gauthier-Villars).—Le Cylindrographe: P. Moëssard (Paris, Gauthier-Villars).—History of Higher Education in South Carolina: C. Meriwether (Washington).—Education in Georgia: C. E. Jones (Washington).—History of Education in Florida: G. G. Bush (Washington).—Higher Education in Wisconsin: Allen and Spencer (Washington).

CONTENTS.

PAGE
The Scientific Works of Sir William Siemens . . 409
The Advancement of Medicine.—J. G. A. 411
Treatise on Hydrodynamics 412
The Land of Manfred 413
Our Book Shelf:—
Aitchison: "The Zoology of the Afghan Delimitation Commission."—**W. T. B.** 413
Cross and Bevan: "A Text-book of Paper-making." —**W. R. H.** 414
Traill: "Boilers; their Construction and Strength." —**N. J. L.** 414
"Lord Howe Island; its Zoology, Geology, and Physical Characters" 414
Letters to the Editor:—
Sunset Glows at Honolulu.—**Serena E. Bishop** . . 415
Globular Lightning.—**A. T. Hare** 415
On some Effects of Lightning.—**Spencer Pickering** . 415
Some Lake Ontario Temperatures.—**A. T. Drummond** 416
The Yahgan.—**H. C.** 416
Electrolysis of Potassium Iodide.—**E. F. Mondy** . . 417
Spherical Eggs.—**Prof. W. Steadman Aldis** . . . 417
Another Photographic Survey of the Heavens . . . 417
The Journal of Morphology—A Record of Progress. —G. B. H. 419
The August Perseids of 1889. By W. F. Denning . 420
Notes 420
Our Astronomical Column:—
Comet 1889 *d* (Brooks, July 6) 424
Comet 1889 *e* (Davidson) 424
New Minor Planets 424
New Double Stars 424
Stars with Remarkable Spectra 424
Astronomical Phenomena for the Week 1889 September 1-7 424
The Science Collections at South Kensington . . . 425
An Italian's View of English Agricultural Education. By Prof. John Wrightson 428
"Infernito" 429
Societies and Academies 429
Books, Pamphlets, and Serials Received 432