THURSDAY, APRIL 19, 1894.

THE THEORY OF HEAT.

The Theory of Heat. By Thomas Preston, M.A. Pp. xvi. and 719. (London: Macmillan and Co., 1894.)

FROM the point of view of scope and comprehensiveness this work forms the most important treatise on heat that has yet been published in this country. It does not teem with new ideas or new modes of presentation, like the book bearing the same title that Maxwell contributed to a series of text-books announced as primarily intended for the instruction of artisans; nor does it appeal to the general reader in the same way as the remarkable book in which Tyndall undertook to present to him the "rudiments of a new philosophy" a generation ago. Each in its own way, both the books we have referred to far surpass the one now before us in originality and individuality. These qualities, indeed, are not specially characteristic of the present work. A systematic and comparatively complete presentation of the present state of the science of heat, both in respect of experimental methods and theoretical developments, has been what the author has striven to furnish, and in this he has attained a degree of success which makes his book one of great value, and amounts to a kind of originality. In French and German we find works dealing with the whole round of Physics (*e.g.*, Jamin and Bouty, Wüllner), in which the section devoted to Heat is planned on as comprehensive a scale and carried out in as much detail as the work before us, but hitherto no similar treatises have existed in English. Mr. Preston's book thus supplies, for the branch of which he treats, a distinct want in our scientific literature, and it may be confidently expected to contribute a good deal towards raising the culture and widening the scientific horizon of English students.

Mr. Preston deals with his subject in eight chapters, each of which is divided into sections, and these again into articles. The articles are numbered consecutively throughout for facility of reference.

Chapter i. is entitled "Preliminary Sketch," and is partly historical and partly expository. It contains some valuable and suggestive matter, specially perhaps in the section relating to energy; but on the whole it does not strike us as equally successful with the parts in which the author gets to closer quarters with his subject. He sets out with a luxuriance of language which happily makes room after a page or two to something more common-place and business-like:—

"With its return in springtime the bud breaks into blossom, and new life animates [*sic*] the vegetable kingdom. By its agency the incubation of the egg progresses, a living thing is brought into the world, and heat is still necessary to its support. Finally, to the power which man has acquired over it is due that supernatural strength which has made him superior to all other animals, and master of land and sea."

But this is only while we are getting under way: once fairly started, there is practically nothing more to fear.

Opinions may fairly differ as to the value of an historical sketch so very much in outline as that contained in the author's first dozen pages. Our own opinion is that the value is little or nothing. It is impossible in a two-line phrase to indicate the points of view and general intellectual surroundings that gave birth to the scientific doctrines of former times. This part of the book accordingly seems defective in historical perspective and "relativity" of view. One statement, not referring to the far past, seems to call for modification or explanation:—

"The systematic study of heat, as a distinct branch of experimental science, commenced little more than half a century ago."

Such a period can hardly be made to include Black, Lavoisier, Laplace, Rumford, Leslie, Gay-Lussac, Dulong and many others whom the rest of the book shows that our author cannot have intended to overlook or undervalue.

Chapter ii. deals with "Thermometry," and contains a good and full description of many of the methods that have been devised for the measurement of temperatures. The general nature of the problem of thermometry is dealt with to some extent in chapter i., but with some want of distinctness, and we do not find anywhere a clear statement that what is commonly called measuring a temperature is in reality the comparison of an *interval* of temperature with a conventionally adopted standard interval. The only problem is to find a satisfactory experimental method of making the comparison. As to this, there is again a want of definiteness. At page 17 we are told about the mercury thermometer that "we have now a perfectly definite standard of reference for all other temperatures"; but on page 115 we are told that, in consequence of differences in the glass, two mercury thermometers "generally differ, sometimes considerably, in their indications," and should therefore be "corrected by direct comparison with the standard air thermometer." Apparently, if it were practicable to construct mercurial thermometers to read accurately alike, no appeal to the air thermometer would be wanted. It is not till page 120 that we learn that—

"The ultimate standard for thermometry is, for reasons which will appear later, afforded by the use of a permanent gas, such as hydrogen or nitrogen."

Of course the reference here is to Lord Kelvin's thermodynamic correction of the gas thermometer, but the secret is not fully revealed till we get to the last section of the last chapter of the book. We may admit that, with the arrangement of matter which the author has adopted, the full discussion of this point could not well come earlier than he has placed it; but surely it would be possible, without going beyond quite elementary considerations, to show why a gas thermometer affords a more trustworthy comparison of intervals of temperature than a mercurial thermometer.

The care bestowed on the more purely descriptive parts of this chapter induce us to mention that the author does not seem to have come across M. Guillaume's recent work in the same field, or to be acquainted with the high-range mercurial thermometers now made in Germany, or the instruments made in this country by Messrs. Baly and Chorley with sodium-potassium alloy. Kopp's correction for the exposed part of the stem is also omitted:

it may not be quite accurate, but it gives in most cases a very fair approximation. The method (page 104) of cleaning the bulb and stem of mercurial thermometers, with boiling nitric acid before filling, has not yet, so far as we know, been generally adopted.

Chapter iv. deals with Calorimetry. The general notion of a quantity of heat introduced in the first chapter is here used without further discussion of what is essentially implied in it. This leaves it on a not altogether satisfactory basis. The notion as first brought in is somewhat metaphysical :

"In order to account for the sensation experienced in presence of a hot body, an active agent is postulated and the name given to this agent is heat." (p. 21.)

This is hardly the ground, or the kind of ground, on which the idea of heat as a measurable quantity rests. We need to recognise that objects which can give rise to the sensation of heat can also produce various measurable effects—can melt ice, for instance ; that the power to produce these effects is communicable from one body to another ; that, unless there is expenditure of some form of energy, such power when possessed by one body is exhausted in proportion as it is transferred to others ; and so on.

It is much to be desired that writers on physics would make a point of following, whenever possible, the precise and carefully considered terminology adopted by Prof. Everett in "The C.G.S. System of Units." They would not then speak of *thermal capacity* and *specific heat* as though they meant the same thing.

A useful part of this chapter is a good description, with figures, of Joly's condensation-method of calorimetry.

Chapter v., extending to more than 170 pages, is devoted to "Change of State." It contains valuable discussions of the properties of bodies at and near the 'critical point" and the equations by which Van der Waals and Clausius have attempted to express generally he properties of fluids in relation to pressure, volume, and temperature.

This chapter contains much valuable matter that has not previously been made so fully accessible to English students. We are, however, rather surprised not to find any reference to the experiments of Rudorff, Guthrie, Raoult and others on the effect of substances in solution on the freezing points and vapour-pressures of liquids, nor to Van t'Hoff's theoretical discussion of such results. Another even more important omission is any mention of the liquefaction by Cailletet and Pictet of what everybody used to call, and Mr. Preston still calls, the permanent gases. As a natural consequence there is no reference to the determination of the boiling points and critical points of several of these gases by Wroblewski and Olzewski.

Chapter vi. is on "Radiation." The most novel matters included in it are descriptions and figures of Prof. Langley's bolometer and Prof. Boys's radiomicrometer.

In chapter vii., on "Conduction," we must point out a very good description and discussion of Angström's method (alternate heating and cooling) of determining the conductivity of metals.

Chapter viii., on "Thermodynamics," we are inclined to think the most valuable in the book, in the sense that it contains a specially large amount of important matter that has never before been readily accessible to English students. The section on the dynamical equivalent of heat includes the recent results of Miculescu and of Mr. E. H. Griffiths, as well as a full description of Rowland's experiments, which ought years ago to have attracted more attention in this country than they seem to have done. In the theoretical part of this chapter the author has, in the main, followed Clausius's method of presentation, but he has included admirable expositions of Massieu's Characteristic Function, of Duhem's Thermodynamic Potential, of the allied work of Gibbs, and of the last author's geometrical treatment of thermodynamic questions.

Notwithstanding omissions, some of which we have mentioned, every chapter affords evidence of care in looking up authorities and collecting material. But the value of the book as a work of reference might be a good deal increased by more numerous and more extended tables of numerical results. For some reason French books are quoted very largely, and not only for the work of Frenchmen ; even Tredgold is referred to in a French translation.

If, in the course of the above notice, criticism seems to be more prominent than commendation, we should do injustice to ourselves, as well as to the author, if we did not say distinctly that, in our opinion, he has produced a very valuable and useful book which we earnestly recommend to all serious students of the subject. When an author obviously aims at a high standard, he invites a critic to adopt a similar standard. And in a short notice such as this, fault-finding necessarily occupies a disproportionate space as compared with praise : if we find fault, it is only fair to particularise, whereas praise applicable to hundreds of pages can be put into a very few words.

We ought to add that printing, paper, and wood-cuts are all excellent, and for a book of so many pages there are very few misprints. The index has one rather irritating characteristic, which, however, is by no means peculiar to this work. If we wish to know what has been done on a given subject by a particular author, we very likely find his name followed by references to ten or a dozen different pages, but without anything to show on which, if on any of them, we shall find the matter we want.

It may perhaps save some reader trouble if we point out that, on p. 202 (in "Cor. 2"), λ, μ, ν are printed instead of α, β, γ, and on p. 588, the column headed "C.G.S. System" should be headed Kilogrammemetres.

G. Carey Foster.

AN EDUCATIONAL ATLAS.

Philip's Systematic Atlas, Physical and Political, specially designed for the use of Higher Schools and Private Students. By E. G. Ravenstein. (London: George Philip and Co., 1894.)

THE chief claim of this atlas to consideration, as indicated in the title, is the careful design and plan of construction ; the order and selection of the maps, their scale and mode of colouring being, it is stated, based on a definite system. The work is one of Philip's Geographical Series, which is edited jointly by Mr. Ravenstein, Mr. J. Scott Keltie, and Mr. Mackinder.

An admirable discussion of projections, scales, and measurement on maps with diagrams, is the most interesting part of the introductory text, and these difficult questions are handled with rare conciseness and clearness. The name of the projection and the natural scale are given for every map—a most useful innovation. An original diagram, showing the relative heights, depths, and curvature of the surface of the globe along the equator, and the parallels 30°, 45°, and 60° N. and S. gives a very striking view of the vertical relief of the earth. Ten plates are devoted to general physical geography, and although the scale is small, and the features consequently much generalised, they are clear and satisfactory. The rainfall maps on plate 5 are particularly interesting, including two which are entirely new, representing the average number of rainy days in different parts of the world, and the relative humidity of the atmosphere. Equal praise cannot be given to the maps dealing with the distribution of plant and animal life, the names on which are frequently puzzling, and the species selected for treatment curiously unequal.

The maps of continents and countries, which make up the bulk of the atlas, show configuration by a combination of contour lines and tints with hill-shading. Here we regret that Mr. Ravenstein had not courage to disregard the conventional strong green tint for the lowlands, and to adopt an unbroken system of deepening shades of brown. It is noticeable, also, that the application of the green tint is unsystematic, extending to 300 feet in some maps, to 600 in others, and in one at least to 3000 feet above sea-level. A similar break in the system of indicating density of population is sure to give rise to confusion; the same shade being used to represent regions of over 512 inhabitants to the square mile in Europe, those over 256 in Asia, over 64 in Africa, and over 32 in America. There are several minor defects visible in the maps, such as the omission of links in the through railway system, and difference in the representation of county-boundaries in the maps of England and Scotland, but these are not more frequent than in atlases of much greater pretensions, and will of course disappear in a new edition. The colour-printing of many of the maps may also be improved.

A great feature of the work is the number of inset maps, garnishing the margins of larger plates with enlargements of regions of special interest, or small-scale general maps showing geology, climate, vegetation, race, language, or density of population. In this way the fact that there are as many maps as there are sciences involving distributions is kept to the front, and the teacher or scholar using this atlas is led to see that geography is no haphazard agglomeration of disconnected details, but a shapely system incorporating and elucidating the results of all departments of nature-study. We know of no atlas in any language in which the systematic plan has been more successfully elaborated, the exceptions we have noted above being thrown into undue prominence by the general excellence of the whole.

OUR BOOK SHELF.

Life and Rock: a Collection of Zoological and Geological Essays. By R. Lydekker, B.A., F.G.S., &c. *Knowledge* Series. (London: Universal Press, 1894.)

MR. LYDEKKER'S name is well known as that of a popular exponent of the results of zoological and palæontological research. The essays which he collects under the title of "Life and Rock," and which deal with a wide range of zoological subjects, from elephants to what he terms "forams," will serve to sustain his reputation in this respect. Mr. Lydekker's chief aim is to convey information which shall not be couched in terms so technical as to discourage those who have neither the inclination nor the desire to become serious students. In this he is eminently successful. His language is simple, clear and direct, without any attempt at a distinctive style; and he shows good judgment in drawing the line beyond which his readers would not be able to follow him, nor care to make any effort to do so. Above all he is accurate, and his information may be relied on as up to date. We question, however, his wisdom of speaking in a book of this popular kind of "those writers who explain evolution by some mode of what *they are pleased to call* natural selection"; and of "those who put their faith in a mode of evolution dependent only upon *so-called* natural causes." Let us by all means have the best and most forcible available criticism on natural selection as a valid explanation of the observed facts of organic nature and on the evolution of living and extinct beings by processes which are termed natural. Such criticism is the very life of science. But the words we have italicised are mere side-thrusts, which do the reader no good, and the writer no credit.

Disease and Race. By Jadroo. (London: Swan Sonnenschein and Co., 1894.)

"TO show some continuity in disease, to evolve a little order out of the existing chaos," these were the objects which led the author to write this book. He collects inoculable diseases, and arranges them in a genealogical table, which is suggestive, to say the least of it. Tuberculosis is shown to be descended directly from scrofula, and scrofula from syphilis, which in turn is regarded as having descended from leprosy. Other diseases are supposed to be connected in a similar manner, though the grounds upon which the supposition is based are not very firm in many cases. The chief point to which the arguments lead is that "every contagious or infectious disease, by either the formation of a hybrid, or by hereditary transmission of the individual modification, tends to eradicate itself." The author is strongly in favour of the establishment of institutes for the purpose of research into the bacteriology, etiology, epidemicity, and sequence of diseases. As there is a dearth of human subjects upon which to experiment, he suggests that convicted murderers should be given the option of death or the probability of leading a comparatively comfortable existence in a bacteriological institute. It has been said that "the worst use you can put a man to is to hang him"; and certainly, if a murderer were used as a medium for the cultivation of bacteria, he would expiate his offence in a very suitable manner.

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 anuscripts intended for this or any other part of* NATURE. *o notice is taken of anonymous communications.*]

The Mass of the Earth.

THIS month's *Philosophical Magazine* contains an interesting, instructive, and suggestive, criticism of Prof. Poynting's

Adams prize essay on "The Mean Density of the Earth," in which I have to-day read the following paragraph :—

"The author is to be congratulated on the strictly scientific title under which he describes his work—'The Determination of the Mean Density of the Earth,' or 'The Determination of the Constant of Gravitation,' instead of the utterly unmeaning 'Determination of the *Weight* of the Earth,' which is found even in such a work as Arago's *Popular Astronomy*, and which is a characteristic of too much of our modern popular science *à la mode*. Have we not seen in some old and popular treatise a picture of 'the room in which Mr. Baily *weighed* the earth'? It is to be hoped that some day our leading authorities will be induced to abandon that fatal dogma which is still, unfortunately, 'of great emolument'—that science, to be popular must, above all things, be inaccurate."

As comment, I remark that the earth's weight, or mass, is $6 \cdot 14 \times 10^{21}$ tons. What is unmeaning or unscientific in this clear, intelligible, and accurate statement?

Prof. Poynting's work was in fact, directly and simply, a weighing of the earth against a lead weight on the same principles, and by the same instrument, as a grocer weighs a quantity of tea against brass or iron weights, with inference calculated by aid of the additional knowledge of the earth's radius. "The determination of the constant of gravitation" is a deduction requiring, not a knowledge of the earth's radius, but the knowledge (derived from pendulum experiments) of the gain of velocity, per unit of time, which a free falling body would experience at the place of the gravitational weighings. The critic is of course quite right in applauding Prof. Poynting's double title, but he is not right in decrying the simple, clear, and scientific expressions, "weighing the earth" and "the weight of the earth."

In Cavendish's original experiment, and in Baily's repetition of it, and in Cornu's corresponding experiment with mercury instead of lead, the more immediate result is "the constant of gravitation": the weight of the earth and the earth's mean density are deductions.

The "constant of gravitation" is not a very good or logical expression, though it is not quite so bad as "coefficient of friction," or "coefficient of thermal conduction," or "coefficient of self-induction."

"Constant of gravitation" does not explain itself, either to the learned scientific mind, or to the intelligent, non-scientific, reader.

K.

April 10.

The Royal Society.

It may interest your readers to see the kind of foundation on which rumours with regard to the Royal Society are based. The following paragraph is from the *Daily Chronicle* of April 16, and the fact is that neither the Council nor the officers have as yet met to consider the claims of the numerous candidates.

John Evans.

The Royal Society, Burlington House.

"It is reported that the list of successful candidates for admission into the Royal Society, which will be issued in a few days, is not calculated to allay the acrid criticism to which the council has of late been subjected. Far apart from its containing some very obscure names, and rejecting some much more notable ones, the official selection, if all tales are true, will exhibit more than ever the influence of that "professorial" element into whose hands the Society has been getting more and more every year. The election of Sir Henry Howorth, which few approved of, was really due to his rejection being advocated by that unpopular clique, the members at large protesting in their rather futile fashion against the nepotism of University and South Kensington officials. This year, however, the college tutor and the tripos hero is said to be more and more in favour. By the way, it is curious to find that Mr. Selous, who has contributed so many papers to the Royal Geographical Society and was one of its gold medallists, has only now cared to be elected a Fellow. But neither Nansen nor Hector, who shared in the same distinction, are enrolled in the Society's membership. One would imagine that a medallist ought to be an honorary Fellow, more especially as some very peculiar people appear *dans cette galère*."

Lepidosiren paradoxa.

The villi of the pelvic fins of this fish, referred to by Prof. Lankester in the last issue of Nature, have been already briefly described by Prof. Ehlers (*Nachr. Kais. Gesellsch. der Wiss. Göttingen*, 1894, No. 2), as was shown by Dr. Günther in commenting upon them before the Zoological Society on the 3rd inst. Dr. Günther advanced good reason for regarding the villi as sexual and confined to the male, as is implied in Prof. Lankester's letter. A specimen of a fine male has recently come into my hands, in which, in contradistinction to all others yet described in print, the "anus" (cloacal aperture) is located to the right of the median ventral fin; and it is thus proved that *Lepidosiren*, like *Protopterus*, is individually variable in the inter-relationship of these two parts of its body. Being aware that Brock had recently described the histological structure of dendritic processes occurring in the neighbourhood of the genital orifice, in the male of *Plotosus* (*Copidoglanis*) *anguillaris* and in the two sexes of *Gasterotokeus biaculeatus*, I requested my pupil Mr. J. Sumner to make sections of those of *Lepidosiren*, hoping that erectile tissue and tactile organs, such as Brock describes, might have been present. We can find neither. The villi are highly vascular and non-muscular. Dr. Bohls, who captured the specimens that have lately reached Europe, has signified his intention of working out these structures in full; and it is fair to him to assume that he is in possession of material specially prepared for the purpose.

My specimen is further remarkable for an inequality in growth of the pelvic fins—that of the (right) side on which the cloacal aperture occurs exceeding its fellow in length by a quarter of an inch; and, in view of Prof. Lankester's assertion that the forward position of the pelvic fin is one "which the animal can give it in life," the fact that the right pectoral is in my specimen forwardly thrust into the branchial chamber may not be without interest.

No one can doubt the generic distinction of *Lepidosiren* and *Protopterus*; indeed, the late Dr. Anton Schneider fully established this, in reply to Ayers' proposal to regard them as mere varieties of a common species. And it may be incidentally remarked that prior to the acquisition of Dr. Bohl's specimens, authoritative records of six museum preserved examples were established (*cf.* Nature, vol. xxxviii. p. 126).

G. B. Howes.

Royal College of Science, April 16.

The Aurora of March 30.

On the night of March 30 there occurred here an exceptionally brilliant auroral display, remarkable, in this latitude, in several respects. When I saw it I was a few miles north of the city proper, and the southern horizon was lit up by the lights in town, so that any faint display near the horizon to the south would have been obscured. I first noticed the aurora about 8.30 p.m. (75th meridian east of Greenwich time), and it continued till midnight, but was much fainter and confined to a simple glow in the north-west to north-east after about ten o'clock. When first noticed, the sky from east to west round by north was either quite deep red or reddish white. No clouds were then visible, and there were no streamers, though the glow extended about to the zenith. Then, as the red grew fainter, a few small clouds formed in the north, and the *still* glow was confined to the sky from east to west along the horizon, and about 50° above it in the north, but less in the east and west. From this arch of light, streamers shot up, not only from the north but from east and west (or east by south and west by south), and met in a place about 10° *south* of the zenith. These streamers pulsated rapidly, the light at times starting at the arch of (apparently) still glow and travelling without break to the point of meeting. At other times the glow would appear in places along the course of the former streamers—first near the arch, then further on, disappearing again, to again appear nearer the zenith. When these rays met in the place south of the zenith, their paths sometimes crossed, but more generally the rays seemed to mingle and either form a roundish glowing spot about 5° to 10° across, or a roundish, confused mass of glow that looked like glowing smoke. Occasionally an appearance like a hollow-centred whirlpool appeared. When the rays met without mingling, one ray seemed to cut another off abruptly, only one ray ever appearing to pass the point of meeting. About nine o'clock, rays could be faintly seen in the south extending up to the point of meeting. Then these rays grew brighter, extending from about 30° above the *southern* horizon, and *throbbing* up from there to the place near the zenith where the northern, eastern, and western rays met. The southern rays were fainter than the others. They may have extended further towards the horizon than 30° above it, but, if they did, the lower part of them was too faint to be seen, on account of the city lights. I have never before seen or heard of an aurora in this latitude, with rays coming upwards from the south. The whole display seems to have been much farther south than usual. It was also much brighter than is usually seen here, even on exceptional occasions.

Finally, a mass of cloud about 12° long and 5° to 7° wide, formed in the north and drifted very slowly away to the eastward. During the aurora the *relative* humidity seemed to increase, and it grew quite misty. This I have noticed during every exceptionally brilliant auroral display that I have seen. The mass of cloud mentioned above was about 40° above the horizon. No other cloud formed as high as this, though a few very small ones appeared in the north-west to north-east, from 20° to 30° above the horizon. F. R. WELSH.

Philadelphia, U.S.A., April 2.

Fireball.

ON Wednesday, April 11, a somewhat sudden and heavy thunderstorm passed over the Dunstable and Luton district. The lightning, which was close overhead, killed several cows, and did other damage. The storm was ushered in by banks of lurid coppery and dark grey clouds from the south-west. When the storm was at its heaviest, bright blue sky could be seen towards the north-east.

Whilst watching the incessant forked lightning in the east at 2.30 p.m., I suddenly saw a broad spout of fire drop almost vertically from the clouds to the earth. The band of fire was not at all like lightning, as it was ten or twenty times as broad, and formed a continuous, slightly curved line, without the slightest trace of zig-zag. It was like a large ball of ribbon being quickly unrolled, one end being retained in the clouds. The fall was less rapid than lightning, and was accompanied by a dazzling light. It was immediately preceded and followed by the crash of thunder, but the thunder was at the time continuous.

The fall appeared to be close by, and I soon after learned that a "fireball" had descended on the Dunstable side of Luton, near Dallow Farm, about four miles from here. On visiting the spot, and questioning two or three eye-witnesses of the fall, I was told that the "thunderbolt" was seen as a large "ball of fire," that the fall was accompanied by a loud rushing sound and a dazzling intense light.

The fire descended close to a well, and on to the roof of a small wooden barn or shed packed with firewood, garden tools, and potatoes. The roof was of red pantiles, and the contact of the fire instantly smashed every tile to atoms, and broke up and suddenly lighted the barn, so that every part, with the contents, was totally destroyed. The men on the spot said the sound of the impact on the tiles was so loud that they thought all the cottages near by had had their roofs smashed in. Other barns and sheds near by were visibly shaken.

Immediately before the descent a workman was inside the barn taking shelter from the storm, but being frightened at the unusual violence of the tempest, he put a sack over his shoulders and walked into the open; as soon as he had done so, the ball of fire fell on to the shed or barn, with the result described.

Dunstable, April 15. WORTHINGTON G. SMITH.

Micro-Organisms and Fermentation.

IN your issue dated April 5, in a review of Jörgensen's "Micro-Organisms and Fermentation," occurs the following:—"In England, however, we are slow in applying scientific research to industrial pursuits, and though a number of brewers already use Hansen's system, it can hardly be said that it has received the attention it deserves, and chance, tradition, and blind empiricism still govern too much the manufacture of beer in England."

Strange to say, on the same evening a large number of brewers and scientific workers were gathered together at the Hôtel Métropole to do honour to an English brewer, who has also made his name known widely in the scientific world—Mr. Horace T. Brown, F.R.S., &c., and the following quotations from a report of the meeting, which I herewith enclose, appear somewhat opposed to the statement above quoted:—

"It is the boast of Englishmen that although behind some other nations in the application of science to many branches of manufacture, in regard to that of malt and beer they rank second to none." Again, to quote Mr. Brown:—"The two really great foundation stones of modern scientific brewing undoubtedly are the vitalistic views of fermentation initiated by Pasteur and the important discoveries of our distinguished countryman, Cornelius O'Sullivan—discoveries which first enabled us to explain the complex chemical changes of the mashing process."

If such firms as Messrs. Bass and Co., Allsopp and Sons, and Wm. Younger and Co., with their regular staff of scientifically trained brewers and skilled analysts, can be accused of "blind empiricism," even though they do not use Hansen's system, the term must have a new meaning.

Speaking from a knowledge of breweries in various parts of the kingdom, one can affirm that there is almost a general desire to hear the latest scientific suggestions for practical brewing, and a marked willingness to adopt methods that can be shown to be practically advantageous; and Mr Kanthack must, I think, be labouring under a total misapprehension of the English brewers' attitude with regard to the science of brewing.

On the other hand, the natural caution of English and Scotch manufacturers, which has largely assisted in making our country the commercial head of the world, prevents them adopting the innumerable scientific suggestions which have not as yet been demonstrated to be practical improvements as regards the English process of brewing. FRANK E. LOTT.

Burton-upon-Trent.

The North-East Wind.—Devonian Schists.

ABSENCES from London and pressure of work in the intervals have thrown me back in reading NATURE; hence my delay in replying to Mr. Burbury's criticism.

I have not made a special study of meteorology, and have had to follow authorities, such as Scott, Abercrombie, and Hann, but I believe my statements about the coldness of our spring east winds accord generally with what they say. There is a tendency, according to the first, for the air to flow from land to sea in winter time, and from sea to land in summer; and an anticyclone, according to the last, usually extends in the winter over north-eastern Europe and the adjacent region of Asia, and a cyclonic area over the northern Atlantic. The latter appears, to move somewhat northward about or after the vernal equinox, and to cause a more steady draught westward from the other area. It must be remembered that the maximum of cold lags after midwinter, and that the exceptional conditions of our island—such as the frequent winter "bombardment" by smaller and deeper cyclones, interferes with the regular development of a winter east wind, such as my friend suggests. Still, I speak with all submission, remembering the saying *ne sutor ultra*.

It may save time to add that I have observed how a remark of mine has again stirred up Mr. A. R. Hunt in defence of Devonian schists. In regard to his letter, I content myself with repeating what I have already said: viz., that either I have wasted a good many years in study bearing on this question, both in the field and with the microscope, or his "evidence" is of little value, and his knives of the wrong temper for the dissection which he has essayed. He will not succeed in drawing me into a controversy with him on this question. Life is short.

T. G. BONNEY.

Are Birds on the Wing Killed by Lightning?

A LADY was looking out of the window when a flash of lightning occurred, accompanied simultaneously by a clap of thunder without reverberation. Immediately afterwards she observed a dead gull, lying in a grass field in front of the window, which, she is convinced, was not there before.

Those who picked the bird up report it as still warm, and it is said that it smelt villanously of "brimstone." I should like to know whether a bird *not perched* can be killed by lightning, and, if so, whether instances are common. SKELFO.

The Early Return of Birds.

THE remarkably early appearance of some of our migratory birds this season is worthy of note. On Wednesday, April 4, while crossing some fields south of Ashtead Station, a solitary chimney swallow (*Hirundo rustica*) passed close to me, flying near to the ground.

On the following Saturday (7th inst.), when strolling through the woods on the Common, I heard two cuckoos, getting quite near them to prevent mistake. They have been heard in the neighbourhood each day since. ROBERT M. PRIDEAUX.

Ashtead, Surrey.

The Foundations of Dynamics.

IF no one else cares to raise the question, may I ask Mr. Bassett how he fixes the foundations of his dynamics, viz., the axes of reference to which the positions and velocities of his particles are referred? There are other questions, of more or less metaphysical interest (such as the nature of "Force"), which his paper does not touch; but this one is of importance to the most practical view of the subject; and only an elementary text-book for schoolboys can afford to beg it, while treating of the Foundations of Dynamics. EDWARD T. DIXON.

Cambridge, April 13.

THE ELEVENTH INTERNATIONAL MEDICAL CONGRESS.

LAST autumn, when the public health of Europe was in an unsatisfactory condition, it was thought that it would be wise to postpone the Medical Congress until this spring, though it was feared by everyone that such a determination would be fatal to the efforts of the Congress. The votes of the majority and of the most influential members of the Executive Committee, however, impressed upon Prof. Baccelli the necessity of postponement. It was also thought that the visitors would prefer to enjoy the attractions of the city in the spring rather than in the autumn. No one in Rome expected such a numerous concourse of savants, doctors, and others, as assembled on this occasion. At such an extraordinary meeting we must not only consider the characteristic note of the congress and the certainty of its success, but also ascertain the causes of various inconveniences which members of the congress have had to submit to, and of which complaint has been made.

The object of a congress is to afford an opportunity to its members to make new personal acquaintances and to renew old ones with the view of exchanging ideas between men who live at great distances from each other, and to ventilate their arguments.

A congress provides also a means of estimating the scientific condition of a country, which it is impossible to do through correspondence or through the public press.

The ordinary channel of particularity was abandoned at the Congress, and it will have been seen from the speeches that more general and comprehensive ideas were evolved than is possible through ordinary scientific literature.

Considered in this sense, the Congress at Rome has been a great success, and it has been easy to see that visitors have a growing sense of admiration for medical science in Italy, and especially for the younger branches of the profession. Italy, however, has been regarded from other points of view. Its reputation led many persons to expect a spectacle of misery, but they, on the contrary, have been agreeably surprised at the enlightened aspect, comforts, and welfare of the land. This has shown visitors that they had formed a wrong impression, and the critical condition has proved only a temporary difficulty; for the original foundation still exists unchanged.

The best proofs of scientific progress were seen while travelling through the Mont Cenis Tunnel and visiting Turin. Passengers found there many large edifices destined shortly to be utilised as scientific institutions.

Only one of the four blockss is entirely finished and one almost furnished. On one side is the Department of General Pathology (Prof. Bizzozero), and that of Experimental Pharmacy in Medicine (Prof. Giacosa). On the other side, Physiology (Prof. Mosso).

Prof. Mosso has distributed to his colleagues of the section of physiology a pamphlet containing the description and drawings of his institute. Everyone has admired the beauty of the new laboratory. The University of Turin is the second in rank in Italy for the number of students it will accommodate.

The Congress was divided into several sections. The conferences were held in the central part of Rome, in a building very badly selected, but which had the advantage of being near the building where the International Exhibition was held. The meetings of the sections were held in the Policlinic buildings, outside of the Porta Pia, at a convenient distance from the centre of the town, but in a quarter very difficult of access.

The Policlinic is a very large institute, built by Prof. Baccelli. It is not yet finished, a small portion only being complete. The essential and historical elements of the eternal city are equally represented in this institute, which has evidently been built regardless of cost in its external appearance and its maintenance hereafter. The Policlinic was built for the accommodation of the clinics. It is arranged not only for the welfare of the sick, but also in the interests of students.

It is interesting to note that the man who has built two edifices for the clinics in the Policlinic has totally overlooked the tuition. The complete buildings are five in number, connected by a passage which in the future will be turned into a portico.

The central building, which is also the largest, has a large marble staircase, which called forth the admiration of more than one of the congressists; it contained the offices of the presidency, secretary, and accommodation for the press, post, and strangers' committee.

The meetings were held from the 30th March to the 5th of April, from 9 a.m. until 3 p.m. At 4 in the afternoon addresses were given, which constituted a most interesting part of the programme. Among these addresses we must mention those of Prof. Virchow, of Bizzozero, growth and regeneration in the organism; Cajal, morphology of nervous cells; Danilewsky, protoplasm and its modifications by life; Foster, the organisation of science. Other addresses were given by Profs. Brouardel, Babes, Nothnagel, Laache, Kocher, Jacoby, and Stockvis.

In some sections the debates were carried on with difficulty. The most rational method has not been always observed, many meetings therefore have left a certain impression of confusion. Certainly for a future congress it will be necessary to make some definite rule on the matter; that is to say, to indicate the special theme and argument, which will conduct the discussion in a more useful manner between competent men, who are always to be found in such a congress. It is a cause of complaint that in such an assembly those who wished to speak on the arguments and questions interesting to science have been obliged to keep silence, and interesting debates, which would have lost nothing by insertion in the public press, did not take place.

A very good example was given by the Section of General Pathology, one day being dedicated to the discussion of cancer. On this day, many ideas were exchanged between the partisans and adversaries of the parasitical theory of this disease. Prof. Foá (Turin) gave his experiences, which led him to admit the existence of the parasite in cancer, and to his observations M. Cornil and many others replied. Nothing leads more to new researches and helps towards the discovery of the truth than such discussions.

In the Pharmacy Section, Stokvis (whose address we print elsewhere), Lauder Brunton, Fraser, and in the Italian ranks, Colasanti, Fubini, Gaglio, Giacosa, Mosso, and others have made some very interesting suggestions. In the same section, on the proposition of Prof. Giacosa, an order of the day was voted, asserting that the study of the alterations produced in the living body through the absorption of chemical substances constitutes a branch of biological science, having a definite aim, and that it is necessary to give to pharmacological laboratories grants equal to those of physiology and pathology. Many Italian universities have pharmacological laboratories insufficiently equipped, and in many countries pharmacology is taught only as a subsidiary question to therapeutics, which is not a science, but a rational application, and very often empirical.

Physiologists occupied themselves, naturally, with the questions interesting the cerebral function. Prof. Mosso, who brought with him many instruments and animals to serve at his demonstration, showed some of them for the purpose of taking the measurement of the pressure of the blood on the pulse of the patient. The questions of the temperature of the organs were also discussed.

In Surgery many very animated and useful discussions took place.

The principal question which has been discussed was the cure of hernia, ascertaining the large tendency to adopt in every case the most painful process of operation. Jean and Lucas took up the question in opposition to Paci. The surgery of the nervous system was discussed by MacEwan; while D'Antona, of Naples, spoke on the cause of the functional disturbances which follow bone diseases. On this subject a very interesting suggestion was made by Ollier, who is an authority upon it.

Tuberculosis and pneumonia and their therapeutics, and subjects relative to anæmia, with the transfusion of the ferruginous preparations or with organic substances, and malaria, were also the subject of some discussion.

The sudden death of Brown-Séquard was the subject of solemn commemoration in the Medical Section (Prof. Cardarelli) and in the Physiological Section (Prof. Richet).

Altogether the debates raised 2700 questions, and if some were not settled, many others were adjourned which were not included in the orders of the day.

The Medical Exhibition, arranged by Prof. Pagliani, was one of the most complete ever witnessed, and without doubt the most interesting and original part was that relating to the history of medicine by the exhibition of fragments of anatomic models of the Roman epoch; of Egyptian, Greek, Roman surgical instruments of the earliest date; by the illuminated manuscript and by the Greek, Roman, and Arabic classical authors relative to the first works on surgery; by the diplomas and the cards of the old universities; by the manuscripts, pocket-books, drawings of the celebrated anatomists and physiologists of the sixteenth, seventeenth, and eighteenth centuries. All these documents, extracted from the archives of libraries and museums, were shown to a public competent to appreciate them.

It would be unfortunate if all those riches were dispersed again, and with the view of keeping them together, the Pathological section of the Congress has invited the Minister of Public Instruction to compile a catalogue.

It would be difficult to assert that every one was pleased with the fêtes; but even if the organisation of all the services was not the acme of perfection, there was the beautiful and grand city, its animated streets, its incomparable monuments, its enchanting landscape, and specially its sun. It rained one day, but with the return of the sun the visitors found themselves in the royal garden of the Quirinal, dominant over the town, and with the eternal lines of the landscape coloured by the setting sun. We must mention also the lunch at the Thermal Baths of Caracalla. It is very difficult to say whether the food and drink were distributed equally among the guests, and if some people went away hungry while others went away with their handkerchief full; but I am sure no one will ever forget those grandeurs and immense drawing-rooms, those splendid tables around which thousands of people were delighted, those quiet corners under the shadow of the trees, the bands, and especially the heavens, so beautiful that it caused one cold Teutonic to dance on the old mosaic floor of the Imperial Bath.

PIERO GIACOSA.

THE ROYAL METEOROLOGICAL SOCIETY'S EXHIBITION.

THE Royal Meteorological Society's fourteenth exhibition of instruments was opened on Tuesday, the 10th instant, in the rooms of the Institution of Civil Engineers, Great George Street, Westminster. Each annual exhibition has been devoted to the illustration of some branch of meteorology, the object being to show the progress that has been made in each particular department. The subject chosen for the present exhibition is "Clouds: their Representation and Measurement." From this title it will be readily understood that this is largely a pictorial exhibition, although it includes a considerable number of instruments.

Luke Howard, F.R.S., was practically the first person to carefully study the clouds and to classify them; and in 1803 he published a memoir "On the Modifications of Clouds, &c.," setting forth his classification, which is that in general use at the present time. A fine crayon portrait of Howard occupies a prominent place in the exhibition, as well as two original sketches by him showing clouds gathering for a thunderstorm, and also the commencement of a stratus. The first and third editions of Howard's memoir are shown, while alongside of them is a reprint of the first edition, with facsimiles of the plates, which has just been published under the direction of Dr. Hellmann, of Berlin.

Since Howard's time many attempts have been made to amend or improve his classification of clouds; most of the various nomenclatures which have been proposed are illustrated in the exhibition, such as those recommended by Admiral FitzRoy, M. A. Poey, Rev. W. Clement Ley, Dr. H. H. Hildebrandsson, and the Hon. Ralph Abercromby.

A most interesting and valuable collection of photographs, showing the various forms and modifications of clouds, is arranged around the walls of the rooms. Among the photographs of cirrus and cirro-cumulus, the highest forms of clouds, are specimens taken by M. P. Garnier, at Boulogne-sur-Seine; by M. A. Angot, at Paris; by Prof. A. Riggenbach, at the Säntis Observatory, Switzerland; and by Signor Mannucci, at the

Vatican Observatory, Rome. Mr. A. W. Clayden exhibits a number of enlargements of cloud photographs taken by reflection from a black glass mirror, and he also shows the camera by which they were obtained. The mirror is placed in front of the lens so that the plane of the mirror makes an angle of about 33° with the axis of the lens. The mirror extinguishes the polarised light, and so causes the image of the cloud to stand out brightly on a dark background. Mr. Birt Acres contributes some fine specimens of cloud photography, as also do Dr. F. G. Smart, Dr. A. Sprung, Colonel H. M. Saunders, and Captain D. Wilson-Barker.

Some interesting photographs of several remarkable clouds are exhibited. Two of these show the "festooned cumulus" (or pocky cloud) that formed part of a storm-cloud which passed over Sydney, New South Wales, on January 18, 1893. Mr. H. C. Russell, F.R.S., exhibits two photographs illustrating the "southerly burster" (which is a violent inrush of Polar wind) at Sydney on November 13, 1893. The first was taken at 6 p.m., and shows the clouds preceding the "burster." In the second, which was taken an hour later, the "roll cloud" had come near enough for its peculiar character to be distinctly seen, and the evident rolling up of the cloud is very well shown, as well as the light rain squall which sometimes accompanies these winds. Three photographs of tornado clouds are exhibited, in two of which the cloud funnel was twelve miles distant, and in the third the spiral-shaped funnel is seen trailing at a considerable altitude in the air.

A collection of pictorial illustrations of clouds, from various meteorological works, is also set out in the exhibition. The earliest of these is a plate showing the method of measuring the height of clouds, by means of two theodolites, from J. F. Glöckner's *De Pondere Nubium*, 1722.

The instruments used for observing the direction of motion of the clouds are called "nephoscopes"; and of these there are several specimens in the exhibition, amongst them being those devised by Mr. Goddard, Herr Fineman, General R. Strachey, F.R.S., and Mr. F. Galton, F.R.S. These consist of circular mirrors with radial or parallel lines marked on them, the points of the compass being engraved on the outside of the frames. The direction of motion of a cloud is ascertained by turning the mirror on its axis until the image of the cloud passes along one of the lines. Photo-nephographs, designed by Captain Abney, F.R.S., and by MM. Teisserenc de Bort and G. Raymond, are also exhibited; as well as a model showing the manner in which the pair of photo-nephographs are mounted for use at the Kew Observatory, and the apparatus designed by the late Mr. G. M. Whipple for ascertaining the height, direction, and rate of motion of clouds from the photographs. In this case simultaneous photographs of a cloud are taken by two cameras half a mile apart, and fixed in such a way that their optical axes point to the zenith. The dark slides of the cameras carry a pair of fiducial lines at right angles to each other, and adjusted so that one of the lines shall be parallel to the measured base, and these lines are reproduced upon the cloud photographs. The two negatives are super-imposed in the sliding frames of the apparatus, which are then moved till the images of the cloud exactly coincide, when the parallax is given by a line joining the intersections of the fiducial lines. The parallax having been measured by a pair of compasses, the height of the cloud is at once determined by means of a prepared curve. A similar operation is then performed with one of the same negatives, and a second taken in the same camera after the lapse of one or more minutes. The pictures having been made to coincide as before, the distance between the intersections of the fiducial lines indicates the drift of the cloud. The direction of the drift is indicated by the position of the line joining the two intersections relatively to the fiducial line parallel to the base. The velocity of the drift, or the rate of motion of the cloud, is found graphically by means of a prepared diagram. Mr. R. Inwards exhibits a simple appliance for estimating the height of clouds of the roll-cumulus type by means of their perspective effect.

The exhibition includes a number of instruments invented or first constructed since the previous exhibition. Mr. R. W. Munro shows a very fine specimen of Dines' recording pressure-tube anemometer, as well as two other patterns of Dines' pressure and velocity gauge for use with the tube anemometer. Mr. J. J. Hicks exhibits Bartrum's open scale barometer, Callendar's compensating open scale barometer, Keating's hydrometer, and some useful and pretty circular levels with the fluid hermetically sealed. Mr. L. P. Casella shows Goad's geodetic altazimuth, a universal sun-dial, some artificial horizons, an alarm thermometer by MM. Richard Frères, and a hypsometer or boiling-point thermometer. Mr. H. Hainsby, a shoemaker at Shanklin, exhibits three ingenious instruments which he has himself devised and constructed. These are an inverted tube-hygrometer, a vapour condenser, and a compensating siphon evaporator for large water surfaces. Mr. H. N. Dickson shows a model of his bottle for collecting samples of sea water from moderate depths, and Dr. W. G. Black shows his louvered glass evaporator.

A number of sketches and photographs of meteorological phenomena are also exhibited, as well as photographs and diagrams of instruments.

A special feature of the exhibition is the large and interesting collection of lantern slides, nearly 300 in number, and mostly of cloud subjects.

Wm. Marriott.

NOTES.

The next meeting of the American Association for the Advancement of Science will be held in August, at Brooklyn. The mayor of that city has just appointed a large and influential local committee to make arrangements for the meeting.

The fine weather of the past few weeks has enabled General Pitt-Rivers, F.R.S., to resume his excavations at Wor-Barrow, a large twin-barrow near Woodyates, on the borders of Dorset and Wilts. An extensive section has been cut through the tumulus, and quite recently the work of the investigator was rewarded by the discovery on the *old surface line* of two human skeletons. Anthropologists will await with interest the results which may be deduced from the examination and measurement of these remains, and their relation to those already made by General Pitt-Rivers in the round barrows, and in the Romano-British settlements explored in the immediate neighbourhood.

The Royal Commissioners appointed "to inquire and report what light-houses and light-vessels it is desirable to connect with the telegraphic system of the United Kingdom by electrical communication, for the purpose of giving information of vessels in distress or casualties at sea to places from which assistance could be sent, and of transmitting storm warnings," have presented their second report. Although the general question of signalling was not referred to the Commissioners, it is so intimately connected with the subject of electrical communication that they have considered it, and in the first report they stated that in cases "where the distance from the shore is not great, an improved system of distress-signals (distinct from the usual fog-signals) might, both at rock-stations and on light-vessels, prove an effective temporary substitute for the more costly expedient of electrical communication." This view has been confirmed by the experience gained during the last tour of inspection. The Commission therefore recommends that the general light house authorities be invited to consider the subject with the view of instituting a universal system of visual and sound signals at all the various light stations on the coasts of Great Britain and Ireland. Appended to these recommendations is a report by Sir Edward Birkbeck on the system of coast communication in Canada and the United States, from which it appears that while both these countries possess an efficient system of electrical communication round their coasts, none of the light-vessels are electrically connected with the main-land.

THE Franklin Institute, through its Committee on Science and the Arts, has recommended the award of John Scott medals and premiums to Mr. F. Pontrichet, of New York, for his improved "black-print" process; Herr S. Riefler, of Munich, for the invention of a pendulum escapement for clocks of precision; and Mr. E. G. Acheson, of Monongahela City, for his invention of carborundum.

THE Technical Instruction Committee of the Cheshire County Council have set aside £5000 towards an agricultural college in Cheshire, and £1,000 for the furnishing of it. The Royal Agricultural Society of England have promised the sum of £1000 towards the fund, and an offer of £500 has been received from a private donor. It is thought that £11,000 would be required for the college, and £1000 for its equipment.

DR. A. H. HASSALL died at San Remo, on April 9, at the age of seventy-six. He was the author of a work on British freshwater algæ, published in 1845, and of one on the microscopic anatomy of the human body, published in 1852. In 1850 he took up the question of food adulteration, and made a series of analytical reports, which led to a parliamentary inquiry into the pernicious and systematic adulteration that had been going on. He also assisted in the microscopical investigation of the water supply of London, especially during the cholera outbreak of 1854. In 1877 Dr. Hassall removed to San Remo, and there passed the remainder of a busy and useful life.

THE Council of the Royal Society of Edinburgh have recently made the following awards:—The Gunning Victoria Jubilee Prize for 1891–94 to Dr. Alexander Buchan, for his varied, extensive, and extremely important contributions to meteorology, many of which have appeared in the Society's publications. The Keith Prize for 1891–93 to Prof. T. R. Fraser, F.R.S., for his papers on *Strophanthus hispidus*, Strophanthin, and Strophanthidin, read to the Society in February and June 1889 and in December 1891, and printed in vols. xxxv. xxxvi. and xxxvii. of the Society's Transactions. The Makdougall-Brisbane Prize for 1890–92 to Dr. H. R. Mill, for his papers on the Physical Conditions of the Clyde Sea Area, the first part of which was published in vol. xxxvi. of the Society's Transactions. The Neill Prize for the period 1889–92 to Mr. John Horne, for his investigations into the Geological Structure and Petrology of the North-West Highlands.

A VERY interesting series of experiments were lately made by Mr. Charles A. Stevenson, with a view to proving that it is possible to communicate between lighthouses and lightships without a submarine cable requiring to be laid. After a number of laboratory experiments, made with a view to ascertaining the size of the coils and the number of turns necessary to give workable results with the ordinary commercial telephones, some experiments on a large scale were tried near Edinburgh. Two coils, 200 yards in diameter, and each containing nine turns of ordinary telegraph wire, were erected on poles, a distance of 800 yards intervening between the two. So well did the system act that it was possible to read, by induction, the messages passing in the ordinary telegraph wires which were situated at a distance of 200 yards. After the sending of messages along this telegraph wire was stopped, it was found possible to send messages from one coil to the other with great ease.

THE official report of the cases treated for hydrophobia at the Institut Pasteur during the past year has been drawn up by M. Henri Poltevin, and appears in the current number of the *Annales de l'Institut Pasteur*. The mortality table issued by the institute only includes those deaths from hydrophobia which occurred *after* the lapse of fifteen days from the date of the last inoculation, such deaths being regarded as taking place in spite of the treatment. Any deaths which happen within this prescribed period are excluded. Last year two such deaths occurred, and as three other cases ended fatally during the treatment, and one other in consequence of the patient refusing to permit the completion of the inoculations, these also are excluded. Out of the 1648 persons treated at the institute during the past year, observing the above reservations, only four died. Of these cases, 135 were admitted suffering from bites on the head, 857 from bites on the hands, and 656 from bites on the limbs. Since the commencement of the inoculations, in 1886, 14,430 persons have been treated at the institute, and out of this number only seventy-two deaths are recorded. The following table shows the nationality of the 188 foreigners who presented themselves for treatment at the institute. It is significant that England again has been by no means loth to avail herself of the benefits of the anti-rabic treatment in Paris, although the opposition to the establishment of a similar institute in this country remains unabated.

Nationality of the Foreigners treated at the Pasteur Institute in 1893.

Germany	2	Greece	35
England	23	Holland	9
Austria	1	India	14
Belgium	22	Morocco	1
Brazil	1	Portugal	6
Egypt	18	Russia	1
Spain	43	Switzerland ...	9
United States ...	1	Turkey	2

THE last number of Dr. Danckelman's *Mitteilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten* bears evidence to the energy with which the officials of the German protectorates in Africa set themselves to the scientific study of the lands which they administer. Sets of meteorological observations for 1891 and 1892 at Bismarckburg in the Togo district, and at two stations in the Camaroons, are published with a partial discussion. The magnetic constants of the Togo district are also given, together with long lists of astronomically-determined positions in both West and East Africa. Dr. C. Lent gives a report on the scientific station on Kilimanjaro, which stands at 1560 metres above sea-level on the southern slope of the mountain. The work in progress at this station is the exact mapping of the immediate neighbourhood, which is being done by triangulation. A geological survey is being carried on simultaneously, with special reference to the character of the superficial soil, but including the determination of the volcanic and sedimentary rocks as well. Complete meteorological observations have been set on foot, and before long the scientific geography of this island of temperate climate, rising above the hot plains of East Africa, will be sufficiently known to allow the question of its suitability for permanent colonisation by Europeans to be put to a practical test in the conditions best likely to ensure success.

DR. OSCAR BAUMANN, whose successful journeys in Eastern Equatorial Africa we have frequently referred to, has written a short but valuable article on topographical surveying for travellers in the last number of the *Mitteilungen* for German protectorates, edited by Dr. Danckelman. Dividing the requisites for a complete topography into route surveying, compass bearings, measurement of altitude, and astronomical determination of latitude and longitude, he insists on the importance of all travellers being adequately instructed before setting out, so that they may use their instruments to the best advantage when in the field.

THE difficult question of the delimitation of the Congo State in the south-east, where the district of Lunda was in dispute with the Portuguese, has been settled by a commission consisting of the Rev. George Grenfell and Captain Gorin for the Congo State, and Lieutenant Sarmento for the Portuguese Government. The work of surveying and settling the frontier was completed in May last year, and the treaty was ratified at Brussels in March 1894. A map and brief report on the conditions of the border country are published in the *Mouvement Géographique*. The country is richly wooded, and *Elais Guineensis* is abundant at levels below 2000 feet. The commission did not meet with many animals, except on the rivers, and few birds were to be seen.

THE Lubudi, one of the upper tributaries of the Congo which joins the Lualaba about 9° south, was reported by Cameron on the strength of native rumour, and was not properly laid down on the map until the Katanga Expedition of Francqui and Cornet in 1892. An account of the river, with a map, is given in the last number of the *Mouvement Géographique*. The Lubudi rises on the high land known as Mount Kamea, the southern slopes of which drain to the Zambesi, and before it reaches the Lualaba follows a longer course than the main river itself. The confluence is somewhat remarkable, the two large rivers flowing parallel to each other for about a mile and a half, separated by a narrow strip of low alluvial land. The lower part of the Lubudi only has been explored as yet, although it has been crossed higher up by Mr. Arnott and others.

AN improved form of Blackburn's pendulum for the slow production of Lissajous's figures has been exhibited before the Istituto di Bologna by Prof. Augusto Righi. The ordinary simple form, in which a cup filled with sand is suspended by two strings joined in the shape of a Y, and the sand traces the compound oscillations about the two centres of suspension on a plate underneath, is unable to exhibit the figures obtained when the two periods are equal. In Righi's modification both the cup and the plate are suspended separately, and oscillate in planes at right angles to each other. By means of a clamp sliding vertically along the support, the cup can be given a great variety of periods, and a graduated scale enables the experimenter to adjust the two periods to any desired ratio. The strewing of the sand is controlled by a small valve at the bottom of the cup worked by an electromagnet, the current being transmitted along the suspending wires. This renders possible a very beautiful modification of the experiment. By making the current intermittent with regular intervals, the lines of sand are broken up into short pieces, whose length represents the velocity of the moving cup with respect to the plate. Another electromagnetic contrivance enables the observer to fix the exact phase of the vibrating plate at which the cup shall start on its own vibrations. The apparatus may easily be adapted to the composition of two oblique oscillations, and the curves, which are neat and sharply defined, may be fixed by means of steamed gum or sensitive paper.

IN dealing with refractive index as an aid in the elucidation of chemical constitution, one of the most important questions which has to be answered is how to eliminate or allow for the effect of wave-length. The relationships obtained vary with the colour of the light used. According to Maxwell's theory, for infinitely long waves the square root of K, the dielectric constant, is equal to the refractive index; $\sqrt{K}$ may therefore be taken as a measure of the "dispersion-free" refractive index. In the *Zeits. für phys. Chem.* xiii. 385, Jahn and Möller give a series of relative values of K for a number of liquids consisting of alkyl and aromatic halogen compounds and fatty acids. The communication forms an addition to that published by Landolt and Jahn (*loc. cit.* 10, 289) in 1892, and which dealt with liquid hydrocarbons. The first term, A, in Cauchy's dispersion formula has been generally used as giving the refractive index for infinite wave-length. The present work shows, however, that of all the above liquids the paraffins alone give values of $\sqrt{K}$ which approximate to those of A. The paraffins alone exhibit normal dispersion. Moreover, the values of the molecular refraction as calculated by means of $\sqrt{K}$ differ considerably from those obtained by using A or refractive indices for light of a particular wave-length such as the red hydrogen line. Indeed, isomers which have the same molecular refractions for the red hydrogen line may give values which differ considerably when K is used, and in general the values of K are largely influenced by chemical constitution. The communications are important contributions to the connections which exist between optical properties and chemical nature.

A CATALOGUE has been issued of works on Italian Literature, Art, Archæology, and History offered for sale by Mr. Bernard Quaritch.

M. A. KLOSSOVSKY has prepared a memoir (in Russian) on the climate of Odessa, from observations made at the Meteorological Observatory of the Imperial University.

THE *Zoologischer Anzeiger*'s index to the zoological literature of the second semester of last year has just been published. The titles are classified under forty-one heads; hence there is little difficulty in finding the various papers.

MM. J. B. BAILLIÈRE ET FILS, of Paris, have issued a catalogue of old botanical works (prior to the nineteenth century) and works on the history of botany, comprising more than 1000 volumes and pamphlets.

PROF. W. TRELEASE reprints, from the fifth annual report of the Missouri Botanic Garden, a monograph of the American species of two little-known genera of Onagraceæ, *Gayophytum* and *Boisduvalia*.

FURTHER papers have been issued by Mr. C. A. Barber on the "Diseases of the Sugar-cane in the West Indies," and suggestions made for their remedy, which consist chiefly in the selection of those strains which appear to be least susceptible to the disease.

IN *Bulletin* No. 9 of the *Minnesota Botanical Studies* is an interesting article by Miss Josephine E. Tilden, on the elaters of the Hepaticæ, especially of *Conocephalus*, in which their tendency to branching is described. In a young state the elaters always contain starch.

MESSRS. BAILLIÈRE, TINDALL, AND COX have re-issued the second edition of Mr. Henry Penning's "Text-Book of Field Geology," published in 1879. The book contains a section on Palæontology, by Mr. A. J. Jukes-Browne.

MESSRS. BAILLIÈRE have also published a fourth edition of Mr. C. T. Kingzett's "Nature's Hygiene," the first edition of which appeared fourteen years ago. The book has been carefully revised, and a chapter has been added on the subject of phagocytosis and immunity, as well as one on alimentation and foods.

A VOLUME containing the results of magnetic and meteorological observations made at the Government Observatory, Bombay, during 1891 and 1892, under the direction of Mr. Charles Chambers, F.R.S., has recently been issued. The publication also includes a paper on the secular variation of magnetic dip at Bombay.

MM. TH. AND E. DURAND, of Brussels, are preparing for publication, with the assistance of other orchidologists, a *Census Orchidearum*. In this work will be enumerated about 8000 species of orchids, with their synonyms, spontaneous or cultivated varieties, and natural or artificial hybrids. For each species will be given the place and date of first publication, a reference to the figures, and the geographical distribution. The work will probably extend over more than 1000 pages, and is intended to be published in five fascicules, at six francs the fascicule to subscribers.

AN interesting account, by Sir Archibald Geikie, of the nature and extent of the work carried on by the Geological Survey, is contained in the *Journal* of the Royal Agricultural Society of England (vol. v. part i. March). The *Journal* also contains, among other papers, one by Mr. C. F. Archibald, on useful and injurious wild birds, the birds described being warblers, tits, pipits, buntings, and finches. Mr. Archibald's contribution should be read by all agriculturists who wish to be able to distinguish their friends from their enemies.

PROF. S. H. GAGE'S excellent work on "The Microscope and Microscopical Methods" (Comstock Publishing Co., Ithaca, N.Y.), reviewed by us in September 1892, has reached a fifth edition. We have received part i., dealing with the microscope and histology; part ii. is in preparation, and will deal with the application of the microscope to study and investigation in vertebrate histology. The edition has been considerably enlarged, the additions including a chapter on photo-micrography. The expansions and emendations have been judiciously carried out, thus adding to the value of one of the best elementary works on the technique of the microscope.

A BIOGRAPHICAL sketch of Dr. Marcellus Malpighi, the distinguished physiologist and investigator, whose researches have figured in medical treatises since the middle of the seventeenth century, appears in *The Asclepiad* (vol. x. No. 40), accompanied by his portrait. Though he seemed to have worked with a simple microscope not better than a half-crown lens of the present time, he made some very important discoveries. He was elected a Fellow of the Royal Society in 1668, and between 1671 and 1684 contributed eight papers to it. His complete works, very copiously illustrated, were published by the Royal Society in 1686, in two volumes. Sir B. W. Richardson, the author of the biography, summarises most of Malpighi's work, comparing it with other physiological and anatomical researches of the seventeenth century, and with the knowledge that has since been gained.

A USEFUL journal for bacteriologists is *Modern Medicine and Bacteriological Review*, the "Bulletin of the Sanitarium Hospital and Laboratory of Hygiene, Sanitarium, Battle Creek, Michigan." It is edited by Dr. J. H. Kellogg, Superintendent of the Sanitarium and Hospital at Battle Creek, and the number before us not only contains three original papers by him, but a translation, also, of a paper by Prof. A. Charrin, M.D. A special section is devoted to "Bacteriological Notes," whilst abstracts and notes of medical and other papers are freely scattered throughout the journal. Articles on special subjects also form an important feature in this magazine. Amongst the twenty-two collaborators whose names figure on the cover we note that of Prof. Metchnikoff, of Paris. Following the usual complement of advertisements, we find a picture of the Sanitarium Hospital, and three pages setting forth its special objects, as well as its constitution and management.

AN illustrated official handbook to the aquarium, picture galleries, and museum collections under the control of the Exhibition Trustees, Melbourne, has been compiled by Mr. James E. Sherrard. The Melbourne Exhibition Aquarium was opened in 1885, and was the first established in Australia. Some useful experiments have been carried out by workers in it, pointing the way to further developments of the fishing industries of the colony. Mr. Sherrard's little handbook contains a large amount of information about the fish of Victoria, and the aquarium equipment. He has made a number of experiments with a view to keeping fish alive in artificial sea-water, but only with partial success. In sea-water, prepared according to chemical analysis, the fish became blind and only lived a few days. In water brought up to a standard strength with refined salt made from sea-water, the more hardy kinds of fish did very well, and in water made with Southall's sea-salt the fish seemed quite as much at home as in their natural element.

THE volume of *Transactions of the Sanitary Institute* for 1893 has been received. It includes papers read at the sessional meetings of the Institute, reports of a series of lectures on the sanitation of industries, and two lectures delivered to sanitary officers. We have also received the first number of the *Journal of the Sanitary Institute*, which it is intended to issue quarterly, in place of the annual volume of *Transactions*. The journal contains a paper on the etiology, spread and prevention of diphtheria, by Dr. R. Thorne Thorne, C.B., F.R.S.; one on the sanitation of places where food is prepared, by Dr. F. J. Waldo; and a report of a lecture on sanitary building construction, by Mr. Keith D. Young. Mr. G. J. Symons, F.R.S., contributes a list of works and papers on sanitation, and Prof. A. Wynter Blyth is the author of notes on legislation and some recent law cases. As the journal is a new development, a short epitome of the history of the growth of the Institute forms an appropriate introduction to its contents. The next Congress of the Institute will be held at Liverpool from September 24 to 29. The Health Exhibition in connection with the Congress will remain open until October 20.

A REPORT, by Mr. F. V. Coville, on the botany of the expedition sent out in 1891 to make a biological survey of the region of Death Valley, California, has been received from the U.S. Department of Agriculture. The botanical work undertaken by Mr. Coville was to collect and identify the plants of the region traversed by the expedition, to collate those data which had references to the range of species, and to arrange the material accumulated in such form that it would be useful in studying the facts and problems of geographical distribution. The report contains an itinerary, a section on the principles of plant distribution, and one on the distribution of plants in South-eastern California. In the section devoted to the characteristics and adaptations of the desert flora, a statement is given of the environmental conditions of the Death Valley desert region, and the resultant adaptive modifications of the flora are discussed. The report also contains a systematically arranged catalogue of the plants collected, a list of specimens, and a bibliography. We note that the metric system of linear measurements is used throughout the report, the itinerary excepted. The mass of matter brought together by Mr. Coville, and the fine plates which illustrate his descriptions, call for the highest commendation. By making grants for the expedition, the United States Congress has shown that it understands the importance of accumulating scientific observations, while the organisation of the work reflects great credit upon the Department of Agriculture.

Mr. Victor Collins has compiled a catalogue of the library of the late Prince Louis-Lucien Bonaparte, and it has just been published by Messrs. H. Sotheran and Co. Prince Bonaparte's collection of linguistic works is regarded by many authorities as the finest in the world. From his youth upwards, he devoted his best energies and talents to the formation of his library. His high social position and rare literary attainments allowed him to give full scope to his philological enthusiasm, and assisted largely in the attainment of his ambition. According to Mr. Collins, the primary object of the Prince was the acquisition of works on every language and dialect represented in Europe; but in the course of years his ambition went further, and he collected specimens of every known language which possessed even the most rudimentary literature. Though it must always be a matter of regret that Prince Bonaparte did not carry out his intention of compiling a catalogue of his library on a scientific basis, Mr. Collins' compilation will be of considerable assistance not only to the bibliophile, but also to the philologist. The books are classified into three divisions, dealing respectively with monosyllabic, agglutinative, and inflectual languages; and the list of them covers more than seven hundred pages. We have previously noted that these linguistic treasures are for sale *en bloc*. It is to be hoped that they will be acquired by some learned institution, where they may be studied at leisure by experts, for they afford a unique means of research on the relations of languages and dialectal connections.

During the year 1892, Mr. W.B. Evermann spent six months on board the U.S. Fish Commission steamer *Albatross*, and made some interesting observations on the Ptarmigan of the Aleutian Islands (*Proceedings* Indiana Acad. Sci. 1892, p. 78). Among the birds collected were Willow Ptarmigan (*Lagopus lagopus*) and Rock Ptarmigan (*L. rupestris*) from Kadiak Island. The former ranges near the bases of the mountains and among the sparse willow growth of the lower portions of the island. At the time of Mr. Evermann's visit, the snow had melted from considerable areas frequented by this species, while higher up the mountains, where the Rock Ptarmigan was found, and where there was little or no woody vegetation, the snow covered everything completely. The principle of adaptation to environment was clearly illustrated by these two species. The one which ranged in the region still covered entirely with snow had not begun to change from winter to summer plumage; not one of the sixty odd specimens collected showing a single brown feather; the plumage of every one was a solid white. This was not so, however, with the Willow Ptarmigans. Their plumage had began to change with the slowly melting snow, and in most cases the head and neck had almost completely changed to the summer brown, while brown feathers were scattered here and there through the rest of the plumage. It is easy to see, Mr. Evermann points out, that it is greatly to the advantage of each of these species to change from winter to summer plumage synchronously with the melting snows; too rapid or premature change, as well as change too long delayed, would defeat the object of protective colouration.

During the last few days Mr. Rowland Ward has had on view, in his Piccadilly establishment, a remarkably fine specimen of the so-called white rhinoceros (*Rhinoceros simus*). The late Mr. Burchell described this rhinoceros many years ago, and reported it as very numerous at that time at Latakoo. It is the largest of the genus, and has now become nearly if not quite extinct. Some ten years since Mr. F. C. Selous shot a specimen in Mashonaland, which he gave to the Cape Town Museum, and beyond one other which was shot by the late Mr. J. S. Jameson whilst hunting with Mr. Selous, no authentic records of any specimen of this rare animal have been published. Mr. R. T. Coryndon shot two specimens early in July 1893, both of which have been modelled by Mr. Ward. On account of the weight of the specimens the skins were cut up into several pieces, which has made the work of modelling them one of the greatest difficulty. The largest rhinoceros is to form part of the Hon. Walter Rothschild's collection at the Tring Museum; the remaining one, which is not yet completed, has been acquired by the trustees of the Natural History Museum. The specimens are adult males, and the two skeletons are being macerated. Mr. Coryndon is leaving England again in a few days, his object being to travel to the northern end of Lake Tanganyika, in Central Africa, and to station himself there, build a permanent station, and collect insects, moths, butterflies, birds and small mammals for several English collections and museums. He hopes to gain some definite information in regard to the supposed new species of rhinoceros, and to determine the exact geographical district of the square-mouthed rhinoceros, the animal exhibited by Mr. Rowland Ward.

Dr. K. von Chrustschoff, of St. Petersburg, has recently succeeded in preparing artificially the cubic modification of silica, which was discovered some years ago by Von Rath, and called christobalite. The manner in which the substance has been formed is as follows: Dry crystals of boric acid are saturated with dry silicon-tetrafluoride gas, when it is found that the boric acid crystals swell up and give rise to a very voluminous white mass, which is a combination of boric acid and silicon-tetrafluoride. This substance being thrown into an excess of dilute ammonia, gives rise to borate of ammonia, which is easily dissolved, and a white residue, and must be repeatedly washed with ammonia, water and alcohol, till every trace of the ammonia and boric acid is removed. The snow-white granular mass, which is not in the least gelatinous, is soluble to such an extent in pure water that aqueous solutions containing from 5 to 7 per cent. of silica can be obtained. Once dried, however, the solubility of the silica is completely destroyed. The silica thus prepared, with water containing a slight trace of hydrofluoric and boric acids, is introduced into the platinum apparatus used by the author in his previous experiments in mineral synthesis, and is heated to 200° C. for two hours, under a pressure of from fifteen to twenty atmospheres; when clear and colourless crystals from 0·1 to 0·3 mm. in diameter make their appearance. These crystals were isolated by treating the mass with alkalies and dilute hydrochloric acid. The crystals are found to be various combinations of the octahedron, cube and rhombic dodecahedron; they are completely isotropic, and show no trace of the anomalous double refraction described by Mallard and others in the natural crystals. On analysis they yielded 99·78 per cent. of silica.

A new mode of demonstrating the electrolysis of hydrochloric acid upon the lecture table is described by Prof. Lothar Meyer in the latest issue of the *Berichte*. As the late Prof. von Hofmann himself pointed out, in describing the well-known apparatus for this purpose which bears his name, the electrolysis of hydrochloric acid is not a very satisfactory experiment, as it invariably happens, even when the acid has been previously saturated with chlorine gas, that the volumes of hydrogen and chlorine obtained are unequal, the hydrogen being considerably in excess. A somewhat nearer approximation to equality is obtained by employing, as recommended by von Hofmann, a concentrated solution of common salt mixed with ten per cent. of the strongest hydrochloric acid, but even in this case the volume of the chlorine is always less by some few cubic centimetres than that of the hydrogen. This discrepancy is due to the fact that after closing the taps of the collecting tubes, the liberated gases accumulate under continually increasing pressure, the liquid being forced up the reservoir tube, and under this higher pressure the liquid is able to take up more chlorine, and hence a portion of the rising gas is absorbed. This difficulty is overcome by adopting the following arrangement:—The two collecting tubes, joined as usual by a connecting cross tube near their lower ends, are made shorter than usual and without taps. The upper end of each is connected by a ground joint or a piece of thick caoutchouc tubing with a delivery tube bent outwards horizontally at a little distance above the joint; each delivery tube is sealed, a few inches along the horizontal limb, into a three-way tap which forms the summit of a measuring cylinder standing in a glass trough, and upon the other side of the tap the delivery tube is continued for a short distance as an exit tube. The carbon electrodes are not cemented in glass enclosing tubes, but merely closely fitted with loose enveloping tubes, in order to prevent admixture of the gases in the connecting cross tube. In order to carry out the experiment the electrolysis vessel is three-fourths filled with ordinary strong acid, the delivery tubes attached, the glass trough on the cathode side nearly filled with water, and that on the anode side with chlorine water. By attaching an aspirator, conveniently in the form of a caoutchouc ball, to the short exit tube attached to each three-way tap, the liquids in the troughs may be drawn up to the tops of the measuring cylinders; when this is achieved the aspirator is removed, and the taps so arranged that the measuring vessels are shut off and the electrolysis apparatus is open to the air. The electrical circuit is then completed, and the gases allowed to escape for a few minutes, during which they may be shown to be chlorine and hydrogen, the former by its action upon starch and potassium iodide paper, or indigo solution contained in a test tube held under the mouth of the exit tube, and the latter by collecting a quantity in another test-tube held above the open end of the other exit tube, and igniting the gas. Both taps may then be simultaneously turned so as to shut off the electrolysis apparatus from the air, and connect it with the measuring cylinders, when the gases will rapidly fill the latter to precisely the same extent. When sufficient has accumulated the current may be switched off, or the measuring vessels closed by suitable movement of the tap, and the volumes of the two gases shown to be exactly equal.

FURTHER details of the preparation of the salts of di-amidogen, hydrazine, $\begin{matrix} NH_2 \\ | \\ NH_2 \end{matrix}$, from the interesting diazo-derivative of acetic acid, $\begin{matrix} N \\ \| \\ N \end{matrix}\!\!>CH.COOH$, are given in the current number of the *Berichte* by Prof. Curtius and Dr. Jay. Diazo-acetic ether is first prepared, essentially as follows. Equal weights of chloracetic acid and ammonium chloride are dissolved in water, and twice as much powdered lime added by degrees, so as to avoid undue heating. After standing the liquid is saturated with hydrochloric acid and converted by evaporation over the water bath to a yellow solid. This product is subsequently dissolved in alcohol and again saturated with hydrochloric acid gas, after which the alcohol is removed and the residue dissolved in water. In order to diazotise it sodium acetate is first added, so as to modify the action of sodium nitrite, then ice and sodium nitrite, when diazoacetic ether is formed and may be extracted by means of ether. In order to obtain the hydrazine salt from diazoacetic ether, the latter may be reduced either with ferrous sulphate and soda or zinc dust and soda, the former reducing agent being preferable, and affording 92 per cent. of the theoretical yield. Upon acidification with the acid whose hydrazine salt is required, the salt in question is produced. The theory of the reaction is that hydrazoacetic acid, $\begin{matrix} HN \\ | \\ HN \end{matrix}\!\!>CH.COOH$, is formed upon reduction of diazoacetic ether in alkaline solution, and that this substance is decomposed by acids with formation of a salt of hydrazine and glyoxylic acid. Thus, with sulphuric acid hydrazine sulphate is produced as follows:—

$$\begin{matrix} HN \\ | \\ HN \end{matrix}\!\!>CH.COOH + H_2SO_4 + H_2O = N_2H_4.H_2SO_4 + \begin{matrix} CHO \\ | \\ COOH \end{matrix}.$$

The silver salt of the unstable hydrazoacetic acid has actually been isolated from the liquid by action of silver nitrate. It is an insoluble substance which yields crystals of hydrazine sulphate upon addition of dilute sulphuric acid and evaporation. The glyoxylic acid by-product has also been isolated in the form of its hydrazone by addition of phenyl hydrazine. Hence the above reaction, memorable as the one by which Prof. Curtius first isolated di-amidogen, is now fully cleared up.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♂) from India, presented by Mr. Robert O'Callaghan; a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mr. J. Pearson Callum; a Meller's Duck (*Anas melleri*) from Madagascar, presented by Mr. H. H. Sharland; a Rose Hill Parrakeet (*Platycercus eximius*) from Tasmania, presented by Mrs. Carter; a Smooth Snake (*Coronella lævis*) European, presented by Mr. Ignatius Bulfin; a Cape Zorilla (*Ictonyx zorilla*) from South Africa, a Hairy Armadillo (*Dasypus villosus*) from La Plata, two Rabbit-eared Perameles (*Perameles lagotis*) from Western Australia, an Adorned Ceratophrys (*Ceratophrys ornata*) from South America, three White's Tree Frogs (*Hyla Cærula*). four Golden Tree Frogs (*Hyla aurea*) from New South Wales, deposited; a Tayra (*Galictis barbara*), a —— Coot (*Fulica*, sp. inc.), an Orange-chested Hobby (*Falco fusco-cærulescens*) from South America, purchased; a Bennett's Wallaby (*Halmaturus bennetti*, ♀) from Tasmania, received in exchange; three Raccoons (*Procyon lotor*), a Crested Porcupine (*Hystrix cristata*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE PRESENCE OF OXYGEN IN THE SUN.—At the meeting of the Paris Academy of Sciences on April 9, Dr. Janssen described a convenient method of raising gases to a high temperature, used by him in connection with investigations on the spectrum of oxygen. The question of the presence of oxygen in the gaseous envelopes of the sun comes under two distinct cases. In the first place, oxygen may exist in the exterior parts of the corona, that is to say, in a medium where the temperature approaches that of the terrestrial atmosphere. In this case the spectrum of the gas would be similar to that which is produced by our atmosphere, and, in order to prove its absence in such parts of the coronal envelope, it is sufficient to show that the lines and bands due to oxygen in the solar spectrum are entirely produced, both as regards number and intensity, by the earth's atmosphere. Dr. Janssen's observations from the summit of Mont Blanc, and his experiments at Meudon, have been made with a view of settling this point. But the case of observations on oxygen at ordinary temperatures only represents a part of the question. Any oxygen existing in the lower portions of the corona, in the chromosphere, and in the photosphere, must be at a high temperature, and in order to decide, by means of spectrum analysis, as to whether it is present or not in these solar layers, it is necessary to know the modifications which the spectrum of oxygen undergoes when the temperature of the gas is elevated. This research, however, is attended with special difficulties. The absorption lines and bands of oxygen are only produced by great thicknesses of the gas. The B group, for example, only appears in the spectrum when a luminous beam has traversed a thickness of 60 metres of the gas under the pressure of two atmospheres. The dark band situated near D requires for its production a thickness of 60 metres at a pressure of six atmospheres. It is extremely difficult to raise such long columns of gas to high temperatures, and the better plan is to reduce the length and increase the pressure. By means of an electrical method, Dr. Janssen has been able to heat a column of oxygen to incandescence without sensibly heating the tube containing the gas. He has used a steel tube 2·2 metres long and about 6 centimetres in external diameter, with an internal diameter of 3 centimetres. This tube is able to resist pressures of over 1000 atmospheres. The temperature of the gas is raised by means of a platinum spiral traversing the length of the tube, and insulated from it by means of a layer of asbestos. Dr. Janssen will shortly give an account of the results obtained when oxygen was introduced into the tube, heated, and spectroscopically observed.

Melting of the Polar Caps of Mars.—In the April number of *Astronomy and Astro-Physics*, Prof. W. H. Pickering calls the attention of astronomers to the fact that on May 30 Mars will reach the same part of its orbit with regard to the sun that it did on July 12, 1892, when a series of conspicuous changes were observed upon the planet's surface (see Nature, vol. xlvi. p. 179). It is therefore presumable that a similar series of changes will occur about the end of next month, and though the planet will not be so favourably situated for observation, the phenomena will probably be observable with any telescope of moderate size. Mars is a morning star at the present time, rising an hour or two before the sun. At the end of May it will be in Aquarius, and will then rise shortly after midnight, and be on the meridian at about 6.30 a.m. Prof. Pickering points out that the centre of the Northern Sea, around which a series of striking changes of shape and colour occurred, is central on May 30, at 17h. 5m. Eastern Standard Time. There is no reason, however, for expecting the meteorological phenomena to occur on precisely the same date in two different years, and observers would do well to take every opportunity of watching the planet, as it is possible that the southern ice-cap may begin to melt earlier than usual.

Ephemeris for Denning's Comet (*a* 1894).—The following ephemeris is given for Denning's comet in *Astronomische Nachrichten*, No. 3223.

Ephemeris for Berlin Midnight.

1894.		R.A. h. m. s.		Decl. ° ′
April 19	...	11 4 0	...	+19 59·6
21	...	8 19	...	19 7·0
23	...	12 29	...	18 15·9
25	...	16 30	...	17 26·1
27	...	20 25	...	16 37·6
29	...	24 14	...	15 50·3
May 1	...	27 55	...	15 4·4
3	...	31 32	...	14 19·7
5	...	35 4	...	13 36·1
7	...	38 32	...	12 53·6
9	...	41 55	...	12 12·2
11	...	45 14	...	11 31·8
13	...	48 30	...	10 52·4
15	...	51 43	...	10 14·0

The comet's brightness on April 22 is 0·31, that at the time of discovery (March 26) being taken as unity. It is fading, and on the last date given in the above ephemeris it will only be about one-tenth of the original brightness, and therefore extremely difficult to see.

The Spectrum of Nova Normæ.—Prof. W. W. Campbell made some visual observations of the spectrum of Nova Normæ during February (*Astr. Nach.* 3223). On February 13 the star exhibited an exceedingly faint continuous spectrum in the yellow and green, and four bright lines apparently identical in position and relative intensity with the bright lines at wave-lengths 575, 501, 496, and 486 in the spectrum of Nova Aurigæ in August 1892. Rough measures of the two brightest lines gave the positions 5013 and 4953. Prof. Campbell says that there can be no doubt that the star has a nebular spectrum.

A New Southern Comet.—Mr. Gale, of Sydney, discovered a comet in R.A. 37° 42′, Decl. 55° 35′ S., on April 3. This was the second comet of this year, and will therefore be known as comet *b*.

IRRITABILITY OF PLANTS.

At the last meeting of the Versammlung, or meeting of German naturalists and physicians, Prof. Pfeffer gave an address on the above subject—one which his own work has done so much to elucidate. Irritability, he points out, is not an exceptional characteristic found in special plants; it is a fundamental quality existing in all plants, from the highest to the lowest, although its manifestations in great measure escape superficial observation. The sensitiveness of a Mimosa, the curling up of tendrils when touched, or the curvatures of growing internodes in response to light and gravitation, are well known and easily observed instances of irritability. But the less obvious reactions are of equal interest. Pfeffer instances the remarkable researches of Hegler on the effect of mechanical traction on growth stems, which when stretched by a weight, gain mechanical strength through the development of the mechanical tissues, which follows as a response to the pull to which they are subjected. Pfeffer has recently shown that resistance put in the way of growing roots increases enormously the energy with which they grow. Other instances of adaptive stimulation escape ordinary observation because of the microscopic character of the reaction. For instance, the extraordinary directive influence of malic acid on the movement of the antherozoids of ferns, or of potash salts on the movement of bacteria. In the same way the irritability of the higher plants is commonly exhibited by movements so slow as to be imperceptible to the naked eye. It is no wonder indeed that the layman does not realise that plants have the same power of reaction to stimulation as animals. Pfeffer remarks, in a striking passage, that—"Man would not have inherited such a belief, if the world of plants had been visible to him from childhood as it appears under the higher powers of the microscope. Then he would have had constantly before his eyes the innumerable host of free swimming plants and other low organisms; and the hurrying bacterium turning and rushing towards its food, would have been as familiar as the beast of prey springing on its victim. To such eyes the growing stems and roots of the higher plants would have appeared circling with a search-like movement, and many other rapid reactions to stimulus would have been apparent. Under the influence of a multitude of such images, irritability would, without a doubt, have seemed to be a self-evident and universal property of plants."

He goes on to point out how necessary it is to clear our judgments in regard to reactions in which movement is the observed factor. A bacterium rushing across the field of the microscope moves nothing like so fast as a snail, yet it moves rapidly in reference to its own minute dimensions, since it will traverse three to five times its own length in a second, while man at a walk only gets over half his height per second.

The one thing common to all the varied stimulus-reactions is that in each of them we recognise a phenomenon of release (Auslösung-), or, to put it in familiar language, a trigger-action. Stimulation is therefore release-action in living matter.

In classing irritability among trigger-effects, we express the fact that the stimulus is only the releasing agent: the nature of the effect depending on the specific qualities of the organism. Just as the touch of a finger may, in the case of human machines, either blow up a powder magazine, start a steam-engine, or set a musical-box a-playing, so in the case of plants, the same stimulus produces different or even opposite effects on different species.

In machines, as in the living organism, every degree of disproportion between the releasing agent and the amount of energy released occurs. The latent period again is not peculiar to the manner of reaction of organisms, but finds a place in machines of human manufacture. In a clock set in action, a period elapses before the striking of the hour (part of released action) comes into play.

It is again no peculiarity of the organism that reaction to stimulus is usually adaptive, since machines are adaptive and self-regulating. The adaptive character of most reactions is as comprehensible as the failure of an organism to adapt itself to conditions not met with in nature. A bacterium being lured to certain death in a mixture of corrosive sublimate and extract of meat, is an example of what is meant.

Doubts may arise whether or no certain processes are to be called release-actions. Take the case of enzymes, from the point of view of the plant they serve to bring about a wide change at the cost of a relatively small amount of energy. Or take a simpler instance, the tensions which allow the capsule of Impatiens to burst or the stamens of Parietaria to explode, are the product of vital activity, and have, moreover, an adaptive quality. But the release is purely mechanical; there is nothing like *perception* in the ordinary sense of the word, so that these phenomena differ from the reaction of Mimosa. Pfeffer, therefore, prefers not to consider the explosions of Mimulus, Parietaria, &c. as cases of irritability, while he acknowledges that there is no real objection to the word irritability having a wide enough meaning to embrace such cases. All that matters is that we should have a clear conception of the existence and importance of release action in the vegetable organism. Pfeffer points out that in his "Physiology" (1881) he laid down the same general principles that are developed in the present address, together with examples in various regions of change, and that even earlier, in his "Osmotische Untersuchungen" (1877), he expressed, without reserve, the same views as applicable to the phenomena of life generally. He claims for these views a practical priority in botanical literature, although he fully recognises that Dutrochet, in 1832, set forth perfectly clear and sound views on the subject.

In 1881, too, he used the word *Reiz, i.e.* stimulus-effect, as equivalent to physiological release-action; and he used the expression *Release* intentionally, because of the mystic conception attaching to the terms stimulus and irritability. In fact, he would at the present moment throw over altogether the word *Reiz* if it were not that the time has gone by for those mystic conceptions of life which are inconsistent with the law of the conservation of energy.

Pfeffer goes on to point out that when, in 1882, Sachs set forth his belief in the general existence of irritability, and in its necessity for the machinery of the organism, he spoke of it not as a phenomenon in the wider category of release-actions in general, but as a specific peculiarity of living organisms. Sachs, according to Pfeffer, holds the specific character of irritable organs to be not so much their unstable equilibrium as the fact, that after stimulation they return automatically to the labile condition. Pfeffer claims that this definition does not apply to many undoubted cases of stimulation. When callus is produced by injury, or when adventitious roots are developed in response to certain stimuli, there is no such automatic return, but a permanent alteration.

To produce a stimulus-reaction, a change in external or in inner conditions is necessary. The sensitive-plant does not react to steady pressure, but to variation in pressure. An analogous state of things is found when a plant in a condition of cold-rigor is made to grow by heat. For the change in temperature is merely a stimulus, since it only releases activities which are carried on by the energy at the plant's disposition, not by the heat. At a constant temperature the plant is in a statical condition of irritability, which is a necessary condition for the realisation of vital activity. If the results of temperature-changes are not generally recognised by botanists as phenomena of stimulation, this is only a proof of the need of accurate conceptions in this branch of physiology. The association of the word with strikingly visible phenomena is partly to blame for this. Everyone recognises that, for instance, in the opening of the crocus or tulip flower, the change of temperaature is a stimulus. In these instances the action of heat may be compared to the regulation of certain machines of human construction by the heat-expansion of a metallic rod.

Even when the increased temperature, by increasing molecular action, brings about a union with oxygen, still the temperature-change is only the indirect cause of the combustion; and this reasoning applies to respiration.

In a similar sense the addition of a salt of potassium to a culture-fluid produces a release action in a plant in which growth was checked by the absence of this element.

Pfeffer has some interesting remarks on the condition of irritability of organs in a condition of equilibrium: for instance, on the continued action of the gravitation stimulus on a geotropic organ growing vertically. Bacteria are less sensitive to the attraction of meat-extract when themselves immersed in dilute extract; that is to say, the homogeneous medium, which has no directive action, shows its effect in diminished irritability. The same is true of heat, which stimulates when it varies, and which, when constant, is a necessary condition for certain states of irritability. The idea is not a new one, for no less a man than Johannes Müller (Pfeffer points out) defined the formal conditions of animal and plant life as *Lebensreize* or *integrirende Reize*.

The stimulus need not come from the outside, for just as a clock by internal machinery strikes at intervals, so in the organism combinations occur which function as stimuli for certain effects. These are naturally obscure, and for this reason we do well to fix our attention principally on external stimulation; but it can hardly be too much impressed on us that the development and ordered activity of the living body is inconceivable without the co-operation of stimulus from the inside.

With regard to stimulus and reaction, we are in the position of a man, ignorant of mechanics, who sets a machine in motion by a touch of his finger, and who has no idea whether the effect is due to a falling weight, to water-power, or to steam. Considerations of this sort make us realise our ignorance, so that when a new result is observed (in a case of stimulation) we do not even know whether the cause is to be sought in the perception of the stimulus or in the machinery of reply. While denying himself the discussion of cognate points, Pfeffer finds room to call attention to one or two interesting points of resemblance in the irritability of plants and animals. Thus, for instance, in plants as in man, an increase in the stimulus produces a dulling of sensitiveness. Just as a beggar is stimulated by the gift of a shilling, which on a rich man has no such effect, so a starving bacterium is stimulated to movement by excessively minute quantities of meat extract, while the same organism living in the midst of plenty can only be stimulated to similar movement by an absolutely greater quantity of extract. In the irritability of plants we find, in fact, the relations which are expressed in Weber's law—a proof that the relation in question has nothing to do with the higher psychic functions.

A plant or a plant-organ is never sensitive to a single stimulus only; thus during a geotropic curvature mechanical traction may bring about a strengthening of cell walls, and an injury may produce protoplasmic movement. Here lies a proof that different stimuli do not produce one and the same effect in a given cell, that, in fact, the cell does not react like our eyes, in which the most varied stimuli produce the effect of light. In the case of plants there can be no question of such a limited capacity—of specific energies in the sense of Johannes Müller.

The development of distinct organs of sense whose function is the perception of a single agent, is well known to be as little characteristic of plants as of the lower forms of animal life. But distinct organs of sense are no more a condition of irritability than they are of life. Indeed, plants exhibit a variety of sensibilities equal to that of animals, while in delicacy of perception the vegetable kingdom has the advantages. Bacteria are attracted by a billionth or trillionth of a milligram of meat-extract or of oxygen, infinitesimal quantities which we cannot weigh, and of which indeed we cannot form any adequate conception. It is just because the whole secret of life is contained in protoplasm, that the simplest organism, such as a bacterium, can be the theatre of as rich and varied a play of stimulus and reaction as the most complicated plant.

CHEMISTRY IN RELATION TO PHARMACO-THERAPEUTICS AND MATERIA MEDICA.

[BY the courtesy of the editor of the *Lancet* we are able to give the following translation of an address delivered at the Eleventh International Medical Congress, by Prof. B. J. Stokvis of Amsterdam University.]

THE TERM AND SCOPE OF PHARMACO-THERAPEUTICS.

"Therapy" or "therapeutics," by which terms we understand the art of serving the cause of humanity by assuaging human suffering and healing human ill, avails itself of every means in its power to arrive at these ends; *elle prend son bien où elle le trouve.* And the art of therapeutics, like all of us here assembled at this Eleventh International Medical Congress, has discovered that all ways lead to Rome. To Rome therapeutics has come—now in the guise of electricity, now as a water cure, now as psychical influence; so that we here are able to review, as they defile like armies before us, electro-therapy, pneumo-therapy, hydro-therapy, hypnopsis, and psychic suggestion, and compare their merits as healing agents when placing themselves at our orders to combat disease and put death to flight. But most ancient of all the branches of medical art is that which makes use of drugs; and in the hands of the inexperienced drugs can cause death (φαρμακεία—the use of medicines or poisons), so that the science and art of the introduction of medicaments into the human body with the view of healing it carry with due right the appropriate title of "Pharmaco-therapeutics." And at one time, pharmaco-therapeutics was the most important branch of the healing art, though in our days it has declined and occupies but a second, or perhaps, I should say, third place; operative surgery, proud of its victories, and as admired as admirable, full of vigour and sap, has distanced the ancient branch. And, again, we see hygiene, young, fresh, lovely, and assured beforehand of all suffrages, taking its place in the front of all medical science, confident in the future success of its attempts to render the arts of healing superfluous by preventing the malady. Why, then, it may be asked, do I essay to interest you in an art which seems to be growing old under our eyes; whose past, it is true, is very honourable, but whose future hardly seems to promise the triumphs that have fallen to the lot of surgery and of hygiene. My reply is simple—because we shall not be able to dispense with this essential branch of our art; because, as much in external as internal medicamentation, we must for the present make use of pharmaco-therapeutics.

The Prime Importance of Chemistry.

The substances that we employ in medicine are composed of chemical bodies, or are, perchance, pure chemical bodies; and to understand their physiological action we must have recourse to biology and chemistry; while to appreciate their application in disease it is necessary to study pathology and therapeutics. Chemistry, in its wide sense, enables us to understand the composition, the structure, and what I would term the affinities of a substance, as it is chemistry that enables us to analyse by tests, and to construct and reconstruct by synthesis. The relations between chemistry, on the one hand, and pharmaco-therapeutics and materia medica, on the other, are so intimate, so indissoluble, and so obvious that it almost seems to me superfluous to trouble you with their consideration. However, you will not mind, I hope, if I take the liberty of submitting to you a few points which may not be new, but which at any rate have the merit of being *apropos*, and may by thought upon them make us better appreciate chemistry. To pile stones on the top of each other is not to construct an edifice. Without a definite plan, without a general view—that is, a comprehensive conception of the whole constructive scheme—there can be no scientific edifice durably reared. Therefore, it would not be sufficient to constitute pharmaco-therapeutics a science to say that if it has arisen without preconceived ideas it is founded upon observations extending from the most ancient date with regard to the effects produced by the administration of certain substances to the sick; nor is it sufficient to claim that pharmaco-therapeutics has availed itself of experiments on healthy man and on animals, and has taken into consideration physiological results and the fruits of clinical study. A sound basis of operation from which to inquire into the use of medical substances is required. We must know, if we would satisfy the claims of science, the mode of action of these substances, and understand how it comes about that they possess the power to produce or remove functional troubles. And it is here that chemistry comes to our aid—chemistry in general, chemistry in its largest sense. I in no way lose sight of the incomparable services of biological chemistry and physiological experiment. Who of us would overlook the assiduous and successful work of Coppola, Gracosa, Pellacano, Albertoni, and of all that young Italian school that is now marching victoriously along the route traced out for them by Fraser and Brown? The method of action of medical substances has been and will be rendered more clear and comprehensible by their researches; but this is not enough. The conscientious striver after truth will always find himself face to face with one problem, a problem in the solution of which lie concealed—an inextricable secret so far—the true phenomena of life. We recognise this, for everywhere; where we are powerless to comprehend the action of medical substances upon the living organism as being due to their own inherent properties, we do not hesitate to call to our assistance the unknown properties of living protoplasm, and attribute the phenomena to them; but it is chemistry that should tell us that we must not be discouraged by the enigma of life. Enigma there is doubtless, but let us recall that Lavoisier first named life "a chemical function," and that—once given that the creature lives—from that it obeys neither more nor less than dead or material nature the general laws of chemistry.

Vital Phenomena and their Meaning.

The familiar phrases "living force" or "vital phenomena" serve us to design the outward expressions of condensed energy in dead material, being borrowed from the manifestations of life. In dead material, we are all aware, force can appear as thermal energy, as electricity, as light, or as mechanical expression, and we can go back along this line of transformations and see all the changes unmake themselves. In living protoplasm—considered as the unit of the psychic and reproductive functions—the essential phenomena are the same. There is the same change of *rôles*, the same production of warmth, electricity, mechanical energy, and chemical energy. We know that the living cell "reacts," as we please to term it, to variations of temperature, electricity, light, and energy, chemical and mechanical; but this irritability in the cell, this aptitude of the cell to change one form of energy for another, resembles the transformations that take place in dead material, as the stimulants of the living cell, without which the vital phenomena do not appear, are just the different forms of energy which arrive to it from its environment, and which it changes into chemical energy.[1] For life the cell must have warmth and moisture. Take away the moisture or lower the temperature to the necessary point, and life becomes latent or disappears. In dead nature the same takes place. We are all familiar with the admirable experiments of Prof. Pictet, bearing upon this point. He proved by them beyond dispute that chemical energy disappeared and reappeared in accordance with the temperature to which certain substances were submitted, and that water is every whit as indispensable as a proper temperature for the maintenance of the phenomena of life. Certain it is that life is a chemical function, but the point is—Is not the chemical function a sort of life? Did not the father of medicine show a wonderful insight in counting water and fire among the four elements of which the universe is composed?

Now if we examine closer the special problems which fall within the scope of pharmaco-therapeutics, if we examine the results which follow the introduction of drugs—healing or poisonous—into the organism of man and animals, it must appear that we can never learn how to solve the problems without looking for their explanation in these "vital elements," as I may term them. The manifestations of their agency in the behaviour of living organism have so characteristic an imprint that even Claude Bernard himself did not hesitate to place chemical and purely physical action in the comparative background. I will give examples of my meaning. How are we to understand the fact that the ingestion of infinitesimal quantities of certain substances which pass through the organism without causing in it the least change can provoke such disordered chemical actions as to occasion death? How are we to understand the fact that different parts of the organism seem to be able to distinguish these substances the one from the other? We must admit special elective functions proper to the life of the cells. How are we to understand the facts that nothing but a change in the quantity of their dosage, the duration of their administration, and the method of their application suffices to make of certain toxic substances stimulants or paralysants? How are we to understand the fact that insoluble substances like arsenic, cannabis indica, and lead can defy that well-known axiom, *Corpora non agunt nisi soluta*, and manifest therapeutic and toxic action. We must admit the presence and agency of some unknown power within the living cell. How, again, are we to understand the therapeutic power exhibited by solutions of iodine and bromine which have apparently been diluted to the deprivation of all chemical action, unless we attribute to the living cell the power of liberating the iodine and the bromine from such dilute solutions? Thanks to my compatriot and dear colleague at the University of Amsterdam, Prof. van t'Hoff, thanks to the admirable work of Arrhenius and of Ostwald, thanks to congresses of physicians and chemists, light seems to me to be abou to be shed upon all these dark places in pharmaco-therapeutics. And it has not been Mahomet who has gone to the moun-

[1] It must be remembered that all of this is qualified by Prof. Stokvis's original reservation, "Once given that the creature lives."

but the mountains which have come to him. In other words the study of the chemical affinities of dead matter has revealed to us the secrets of the living cell.

The Appearance of "Vital Phenomena" in Certain Chemical Solutions.

We have been accustomed to regard the neutral solution of sugar or of some neutral alkaline salt in water as an inert liquid deprived of all molecular power. We know to-day that such a solution must be held to possess the same kinetic power as if the substance dissolved were present in the gaseous state. Placed in contact with other solutions it will exercise pressure according to the laws that Avagrado and Dalton have discovered for gas. It will exercise an osmotic pressure in direct proportion to its molecular weights. But this is not all. We have to remember the electrolytic phenomena of such solutions by which their kinetic power may be rendered enormous. This conception of the molecular properties of solutions is of the highest importance both in biology and pharmaco-therapeutics. It is not by accident that life is so closely leagued, as it were, to water. It is not by accident that living organisms contain without exception more water than solid properties, that they contain much more of it in proportion than any other terrestrial object of palpable and visible formation. It is not by accident that the youngest and most energetic organisms, those in which life is the most intense, are distinguished by containing the most water, while the tissues in which life is ready to expire have the least. Life has been compared to a torch. From a chemical point of view life is not only a torch—it may also be compared to a river. It is an ocean in which the molecules of the chemical substances there constantly dissolve, constantly develop chemical, electrical, thermal, and mechanical energy, an energy whose seat is the living cell.

From all of this it follows as an absolute necessity that the chemical actions which constitute vital phenomena become stimulated, troubled, or altogether upset from the moment that we introduce into the system some new complicated substances in solution, whose molecular forces are now added to those of the cellular system. We are only embarrassed what example to choose when we seek in organic and inorganic chemistries proof of this point. I only wish to name one to you which seems to me conclusive. By warming pure chlorate of potassium we obtain pure oxygen, but the presence of the smallest quantity of chloride of potassium is sufficient to change part of oxygen into ozone. In giving rise to this development of ozone the chloride of potassium remains itself completely unaltered; but, what is more remarkable yet, this chloride of potassium itself has, like peroxide of manganese—which acts in an identical manner—the property of destroying ozone.

We find, then, here, as M. Brunck, to whom belongs the honour of having discovered the reactions, has said, a most remarkable phenomenon. We see a chemical substance, without itself appearing to undergo the least appreciable molecular change, favours the formation of a new chemical body, which, on the other hand, it has the power to destroy the moment that it is formed. There is, in fact, in the domain of organic chemistry, with no question of fermentation, a catalytic force, in considering which we have to make for dead nature a complete pendant of that which should we scarcely consider characteristic for therapeutic actions—the phenomena of excitement and paralysis, manifested by the slightest possible quantities of one and the same substance which itself remains unaltered! And speaking always with these phenomena before our eyes and looking on the cell as a colloid or membranous mass containing several substances organic and inorganic at the same time dissolved in water, there is no longer any reason to be astonished that slight changes in the quantity of one substance or the other, or that the presence in one of a body that is absent in the other, suffice perfectly to change the chemical affinity of the cells, as well as to differentiate them in such a manner that each of them seems to be endowed with an elective affinity peculiar to itself. As for the manifestation of therapeutic and toxic action by bodies considered to be insoluble,, of which Nageli in a posthumous work has made so profound a study, they are also capable of the simplest interpretation. The insolubility of these bodies is not absolute, but only relative. If we throw, for example, metallic copper into water, and wait for some days, we shall find that a certain proportion of the copper has dissolved, *i.e.* one part to seventy-seven million parts of water. The copper dissolves in this manner without the least intervention of any living organism. In the same way it is not the vital function of the human organism which makes arsenic, cannabis indica, and lead, display active properties when introduced in a metallic state under the skin. It is the mass of water which is the agent (for the human body may be regarded as a jug of water containing forty-five litres) and the temperature.

The view that regards the solutions of salts as mediums in which the chemical molecules are perpetually striving to assert their individuality has contributed, on the other hand, in the most efficacious manner to elucidate the action of some of the drugs that are most in use. I have particularly in my eye now the purgative and diuretic salts, the chlorates, iodides, and bromides, whose therapeutic effects are obtained upon doses that may be called massive when comparing them with the infinitesimal doses of which we have just spoken. Since my dear and honoured colleague of the University of Amsterdam, Prof. Hugo de Vries, discovered the law of iso-tonic solutions, and since the admirable work of Prof. Hofmeister of Prague and his pupils, the effects of purgative and diuretic salts have been recognised to depend uniquely upon their pure chemico-physical properties. On the other hand, we owe to the zeal and perseverance of Prof. Hofmeister of Prague again a series of very beautiful researches on the imbibition of salt solutions by tablets of pure agar-agar gelatine, which demonstrate to proof that all that we have hitherto considered the elective affinity of the living cell can be explained in the most natural manner in the world by its colloid condition and chemical constitution. Add to this that the quickness of chemical action, according to the interesting chemical researches of Vladinarsky, is in no way impaired by the colloid state of the medium in which the substances are placed, and you will easily arrive at a conception of the immense progress that pharmaco-therapeutics has made by the agency of physical chemistry. Among the salts that I have named, the iodides and bromides are also to be found. Their therapeutic effects are, I need not say, altogether specific. What is more natural than the belief that we ought to attribute the results to the iodine and bromine themselves; and we all know that some long time ago, my colleague at the University of Bonn, Prof. Binz, has been able to demonstrate that it is the living cell which frees the iodine and bromine from solution. The fact is not, however, proved to universal satisfaction.

I should never finish my task if I tried to place before you all the points of the new view on the action of drugs, poisonous and otherwise, whose pharmaco-therapeutics are traceable to the theories of modern chemistry. Let us glance only at the catalytic fermentative action which takes place everywhere in live protoplasm, and which without doubt plan a preponderating *rôle* in the therapeutic effects of drugs. These can no longer be considered the appanage of the living cell. They also take place in dead matter.

Chemistry in Relation to Materia Medica.

If I now stop theorising it is not from fear lest anyone in this Areopagus of science should say: To what practical good does all this tend? Evidently it is not to-day or to-morrow that the art of medicine will profit by chemistry. But all these new ideas have rendered necessary new methods of experimentation, and new methods of investigation; and a new track is now being traced by human genius, along which there is much to discover; and from the moment that the new physical methods shall have been applied to the study of drugs (all honour to M. Dreser, who has here taken the initiative in his investigation into diuresis) medical art will profit and will find in chemistry a sure and trusty guide in its efforts to serve humanity.

In speaking of chemistry in its relation to materia medica I do not employ the words materia medica in the sense in which Discorides used them. I employ them in their strictest and primitive sense to mean the collection of drugs and medicaments in use in our days—our *thesaurus medicaminum.* Materia medica recruits from botany, zoology, and above all from chemistry; but its immense progress of late is due to chemistry. The active principle of almost all our drugs are now known to us. They have been isolated, prepared, and elaborated; the chemical constitution of their active principles is no longer a secret. We know that sugar and glucosides, and aromatic oils belong to chemical groups, and are as well defined as the alkaloids derived from pyridine or chinoline. Every day the number of contumelious substances—substances which do not wish to reveal to us their secrets—grows less. Chemistry has revealed to us the presence of more than twenty alkaloids in opium, and of more than six in quinine; and it will soon be extremely difficult to name the drug, of animal or vegetable origin, in which there have not been found one or several active principles. And, going from victory to victory, chemistry has also succeeded in producing a great number of alkaloids by the synthetic manner. These have not been the exceptional lucky strokes (*coups de maître exceptionels*). No constitution and composition of other bodies that chemistry has not yet reproduced for us is already familiar to the chemist who can transform morphia into codeia and *vice versa*, and worthless cupreine into effective quinine. We may predict with every confidence that the manufacture by synthesis of all the known alkaloids is only a question of time for chemistry. But the triumphal march of chemistry does not stop here; it has constructed for us new alkaloids endowed with therapeutic effects of great value. It has furnished us, *inter alia*, with apomorphine and apocolaine.

It would be unequalled ingratitude to fail to recognise the imperishable services that chemistry has rendered to materia medica in endowing it with the alkaloids and the pure active principles because there are a few black clouds on the horizon. That there are such I do not deny, but they are not wholly the fault of chemistry. Is the gunsmith responsible for the accidents that a new firearm may cause in the hands of a client who does not know how to use the weapon properly? Surely not. Why did not the purchaser take the trouble to understand the structure of the gun? Why was he not more careful? Why did he pay no attention to warnings? Why did he behave like a happy child, with nothing more important to do than to display his new acquisition to all the world and to put it to the test with the innocence of youth? On the other hand, should not the gunsmith help to avoid such disasters by explaining matters to the purchaser? And if he is not himself sufficiently informed and does not thoroughly understand the mechanism of the weapon, should he have offered it for sale? Either party may be to blame. What I want to convey by my parable is this: by a very pardonable illusion, to which the many physicians and some chemists have given way, it has become generally believed that the active principles of drugs, when chemistry can furnish them for us in a crystallised state, are purely chemical bodies, and that identity of name guarantees identity of chemical composition. This illusion is rapidly being dispelled, but, alas! not without having done harm to physicians and their patients. As far as the chemical purity of crystalline products is concerned, it is to-day a secret of Polichinello that crystallised quinine contains cinchonidine, that atropine contains hyoscyanine, and atropamine, and that pilocarpine contains jaborandi. As much in organic as in inorganic chemistry we come across this phenomenon of mixed crystallisation. The crystallisation of substances is no guarantee of their chemical purity. These facts are sufficient to condemn entirely the new therapeutic system that M. Burggraeve has wished to inaugurate under the name of "dosimetric medicine." Dosimetric medicine is doubly on the wrong track—first, in assuming the chemical purity of active crystallised principle of which it exclusively makes use, and secondly, in enunciating the therapeutic heresy that the administration of a single active principle is worth much more than the administration of the drug from which the active principle has been derived. I do not hesitate to describe this dosimetric profession of faith as a heresy. The drugs that are most used are admirably made compositions in which different principles, working for or against each other, are found together. Their therapeutic effect on the system is altogether different from the effect that would be obtained by adding and substracting the therapeutic effects of each ingredient. Recent pharmaceutic researches have conclusively demonstrated this fact. I do not wish to say too much against domestic medicine. I think it has been, on the whole, inoffensive. Alas! I cannot say as much of the unreasonable faith which leads persons to believe that similarity of name and of active principle in crystalline form will produce chemical and pharmaceutical identity. *Ingentem, regina, jubes renovare dolorem!* We all know the grievous results that may be caused by giving aconitine or digitalin derived from different sources. Here again the progress of chemistry promises improvement. The animal organism is most sensitive to stimulus, and modern chemistry has so many methods of stimulus at its disposal that the task will not be too arduous. It is a question which interests all civilised countries, which is brought forward at all medical and pharmaceutical international congresses, and which is in most urgent need of a satisfactory solution.

THE VAGARIES OF MODERN PHARMACY.

The services rendered by chemistry to therapeutics is not an exhausted subject. Certainly our predecessors already possessed a goodly medicinal treasury, but it seems very insignificant when compared with what we now utilise. Chemistry has loaded Materia Medica and Pharmacology with wealth; it is the mother of new remedies, and we are proud of its aid; it has given us our anæsthetics, antiseptics, hypnotics, and antipyretics. These groups of remedies enable us to give relief in many cases where our forefathers were quite helpless. To them chloroform, ether, carbolic acid, iodoform, creosote, chloral, the salicylates, antipyrin, were all alike unknown. But here, again, and more so than with respect to the alkaloids, there are shades in the picture. Chemists and chemical manufacturers add more and more to our store of remedies day by day without stint or truce, without heeding the great despairing physician already overstocked with drugs. We are tempted to cry out for mercy. This is no exaggeration, for these new chemical products are all forced upon the same therapeutic market under the most attractive names, and all proclaimed aloud with the noise of the most perfect advertising machinery. This is now done to an extent that, in my opinion, is detrimental to the interests of therapeutics. I am not speaking of quack remedies, the ovietara of our day, of these secret specifics which the medical man views with wholesome horror, to which, and to whose use, the old adage, *Trompeurs, trompés, trompettes* can be so well applied. I am speaking of genuine well-known products; for, unfortunately, modern and industrial chemistry, in manufacturing and in placing at the disposal of doctors these drugs, does not at all object to their being purchased by the general public. If this is not so, why do their proprietors select for their names the fascinating names that act as veritable flags to attract the public—for instance, anti-nervine, anti-phthisine, anti-rheumatic, anti dysenterine, and, most expressive of all, migrainine. I fully appreciate the difficulty of finding new names for these new products, and can understand that the manufacturer should shrink from giving them the names derived from their chemical composition, for these, generally speaking, could only be pronounced with linguistic gymnastics and intolerable strain upon our memory. I must, with great regret, note that we have departed from the ancient method, which taught us to denominate new products according to their origin, and we have followed freely a course that I cannot blame too severely—that of seeking for euphonious, sonorous names, pompously proclaiming the therapeutic use and effect of the drugs designated by them. It is not sufficient nowadays to have a good remedy—say agathine;—we must be assured of its superlative excellence, hence aristol. Do you want to prescribe for a patient who is "out of sorts," you have euphorine; for a lack of appetite, you have orexine. You desire to procure sleep for him: you have hypnal, hypnon, somnal, or somniferine. You wish to lower a febrile temperature: do not let the emergency trouble you, for you have antipyrine, antifebrine, antithermine, thermomine, thermofugine, pyrodine, and thermodine. You want to assuage pain? *Eh bien*, you have awaiting your orders analgesine, analgeine, exalgine, exodyne, and neurodyne. Or you desire to stimulate urinary secretions, you have diuretine, pheduretine, and uropheime. To check the formation of pus there is a remedy termed pyoktonine; and to combat spasms antispasmine. I do not wish to exhaust your patience, and I will spare you the enumeration of the antiseptics, the disinfectants, the microbidines *e tutti quanto*. Ten years exactly have elapsed since my honoured colleague, Prof. Rossbach of Jena, published an article full of wit and sound sense in ridicule and blame of these tendencies of modern therapeutics, and in those days we had not the long lists of antiseptic and antipyretic remedies. Nor was it then imagined that the essential extracts of the organs of animals, of which the late Prof.

Brown-Séquard and M. C. Paul were the earliest to explain the therapeutic value, would find a place in materia medica, nor cultures of microbes. It was not foreseen that we should have to chronicle in 1894 the sale not only of sequardine, but also of veritable bacterial products such as tuberculine, tuberculocidine, antituberculine, antitoxine, κ.τ.λ. How shall we check the fury of this flood? There seems no reason why it should ever come to an end.

TRANSPARENT CONDUCTING SCREENS FOR ELECTRIC AND OTHER APPARATUS.[1]

IT is well known that electrostatic instruments require to be screened from outside electric disturbance, in order that their indications may be correct; but it is not so generally recognised that instruments intended to measure small forces, such as certain types of *electro-magnetic* voltmeters, delicate vacuum gauges, &c. are liable to give wrong readings from an electric attraction being exerted on the pointer, such as is produced by the glass cover when it is touched or cleaned.

There is on the table here a well-known type of gravity *electro-magnetic* voltmeter, which may be found on the switch-boards of many English and continental electric light stations. At the present moment its terminals are not connected with the electric light mains of the building, so that it should indicate zero pressure. Let me, however, but stroke the right-hand side of the glass cover with my finger, and the pointer, as you see, at once turns to eighty volts or more. Conversely, let the terminals of the voltmeter be connected with the electric light mains; the pointer should point to about 100 volts, for that, as you know, is the pressure supplied by the Westminster Company. The voltmeter appears to be indicating correctly, but, on stroking the left-hand side of the glass cover, the pressure, as read by the instrument, appears to suddenly fall to some forty volts. And a similiar effect is produced if a piece of wash-leather or dry waste be used in place of the finger.

If, then, it is possible to cause this instrument to indicate at will sixty or eighty volts too high or too low, how impossible must it be to feel sure that the glass cover—which is, of course, maintained in a dry condition in a hot engine room—has not been electrified by some accidental touch of the coat sleeve sufficiently to cause an error of three or four per cent. in the reading of this voltmeter!

We find that it is not merely with this particular type of voltmeter that an error can be produced by stroking or rubbing the glass cover, for other electro-magnetic instruments that we have tried can also have their pointers deflected in the same way, but not to the same extent.

Nor, of course, is this source of error in any way connected with a voltmeter being an instrument constructed to measure an electrical magnitude, for it would equally exist if the glass were clean and dry and the controlling force remained of the same magnitude, no matter what was the quantity the instrument was constructed to measure. For example, on the table there is a vacuum gauge the wheel-sector-pinion of which has been replaced with an Ayrton-Perry magnifying spring. This gauge is, no doubt, very sensitive, for you observe that the pointer moves even when I produce an extremely slight diminution of pressure by rotating the short length of india-rubber tube as slowly as I can; the change of pressure on pinching the tube, or even on dropping it, is indicated by the pointer. On the other hand, the pointer is of glass, and therefore is not suitable for being acted on by an electrostatic force; still, a stroke on the glass cover, as you see, causes the pointer to deflect through several degrees.

It has been known for a long time that it is possible to screen an instrument from such outside electrostatic disturbances by surrounding it with a metallic cage composed of wire or of strips of tinfoil. Such a method of screening, however, has the great disadvantage that it renders it difficult to observe the exact position of the pointer from a distance, for the wires or strips of tinfoil cover up the pointer more or less. We therefore thought of placing the pointer underneath the metallic dial of our electrostatic voltmeters, and of only allowing the tip to project through a slot in the dial plate. But this method we abandoned on trying it eighteen months ago, for to make the

[1] A paper by W. E. Ayrton, F.R.S., and T. Mather, read at the Institution of Electrical Engineers on April 12.

screening good the visible part of the pointer must be reduced to a spot, and the exact position of this spot we found less easy to read at a distance of several feet than that of a long black line, which is the appearance of a pointer when it is visible along its whole length. This method of screening has, however, we understand, been recently adopted by a firm of instrument makers.

We next considered whether it was not possible to make a perfectly transparent conducting screen, so that, while the electrostatic screening of the pointer should be practically perfect, the pointer and dial should be as easily seen as if the screen were not present. Our first idea was to make the glass cover double, and to insert between the two sheets of glass a layer of clear conducting liquid. Fearing, however, trouble from leakage of the liquid, or from the liquid becoming gradually turbid and giving the dial a dirty appearance, we turned our attention to depositing films of solid matter on the inside of the glass cover, or shade, of sufficient thinness to be practically transparent, but with the solid particles near enough together to be conducting. We tried smoke, silver deposited in layers of various thicknesses, mercury vaporised and deposited, sal-ammoniac vaporised and deposited, &c., but we were quite unable to obtain in this way both transparency and electric conduction.

After a conversation with Prof. Boys, when discussing the problem that we were then engaged in solving, we commenced experimenting on varnishes, with the view of arriving at a varnish which should be as hard and as transparent as *clear* shellac, but which, instead of being an insulator like shellac, should be a sufficiently good conductor to allow of the instantaneous production of an induced electric charge to balance the electrostatic action of any outside body. Glass plates were coated with gum, with coaguline, with the gelatinous electrolyte used in accumulators (composed of sodium silicate and dilute sulphuric acid), with isinglass dissolved in acetic acid, with gelatine dissolved in acetic acid, with isinglass dissolved in a mixture of acetic and sulphuric acids, and with gelatine dissolved in the same mixture. After much experimenting, we arrived at the following two methods of coating a glass cover, or shade, which gives perfectly satisfactory results:—

No. 1.—Dissolve ¼ ounce of transparent gelatine in 1 ounce of glacial acetic acid by heating them together in a water bath at 100° C. To this solution add half the volume of dilute sulphuric acid which has been prepared by mixing 1 part of strong acid with 8 of distilled water by volume, and apply the mixture while still warm to the glass shade, which should be previously polished and be warm. When this film has become very nearly hard, apply over it a coating of Griffith's anti-sulphuric enamel.

Method No. 2.—Thin the gelatine solution, prepared in the manner previously described, by the addition of acetic acid (say 2 volumes of acid to 1 of the solution), and, after polishing the glass, float this thinned solution over the glass cold. Drive off the excess of acetic acid by warming, allow the glass to cool, and repeat the floating process, say, twice. Thin the anti-sulphuric enamel by the addition of ether, and float it over the gelatine layer applied as just described. Expel the ether by heating, and apply a second layer of this thinned anti-sulphuric enamel.

With experience, such as Messrs. Elliott and Messrs. Paul have at length acquired after much practice, a layer can be applied, either according to method No. 1 or No. 2, so that, when finished, it is quite hard to the touch, and so transparent that it is only by looking at the glass plate obliquely that the presence of the varnish can be detected. It is also so conducting that when a P.D. of several thousand volts, alternating with a frequency of 200, is set up between the needle and inductors of one of our electrostatic voltmeters, the pointer, which is metallically part of the needle, is not visibly attracted by a metallic rod held just outside the glass close to the pointer, this metallic rod being electrically connected with the stationary inductors.

Without experience, however, it is somewhat difficult to apply the coating so that it is not either cloudy, or a comparatively poor electrostatic screen, or both.

This second electro-magnetic voltmeter—which, like the former, has been kindly lent us by Mr. Barley, of the Knightsbridge electric light central station—looks exactly like the other one, and, indeed, behaved exactly like the other one when we received it. It has, however, had a layer of our transparent varnish applied on the inner side of the glass subsequently, and you will find that you may rub the glass as much as you like, or even hold a rubbed stick of ebonite near it, without producing any effect on the pointer.

Again, these two clear glass shades, belonging to gold-leaf electroscopes, are one of them coated with our varnish, and the other not. Which is the uncoated one is at once apparent from the alteration produced in the deflection of the gold leaves when I approach a stick of rubbed ebonite near the lower part of the glass shade of the uncoated one, for no such change in the deflection is produced, as you see, when the ebonite rod is brought near the glass shade, which is protected by a layer of this varnish applied on the inside.

THE CURRENTS IN THE GREAT LAKES OF NORTH AMERICA.

A PAPER, entitled "The Currents of the Great Lakes," prepared by Prof. Mark W. Harrington, from data collected by means of bottle-papers during the navigation seasons of 1892 and 1893, has just been published by the U.S. Department of Agriculture as a Weather Bureau *Bulletin*. We reprint some of the more interesting parts of the paper, and reproduce a map showing the results of the inquiry.

Early in 1892 the Weather Bureau published a wreck chart of the Great Lakes, prepared in the winter of 1891–92. The wrecks noted on this chart were only those due to meteorological agents, and a striking feature of the chart was the clustering of wrecks in certain parts of the surface of the lakes. This suggested that unknown currents might play a considerable part in wreckage, and steps were at once taken to get some idea of what these currents are.

The method pursued was that of bottle-papers, which have frequently been used to study ocean currents, but had not been employed in the lakes, and is as follows:—A bottle, containing a paper on which is written the time and place of floating, is thrown overboard at some definite point, left to float freely, and when picked up the enclosed paper is marked with the time and place of finding. In this way two points in the line of current are obtained, and by considering a very large number of these, satisfactory conclusions can be drawn as to the currents which convey the bottles.

A large number of bottles were specially made for this purpose, with the name of the Bureau blown into the glass. They were of an unusual colour, but the contents could be easily seen by anybody who picked them up. The weight of a bottle was about 420 grams; total external displacement, 460 cubic centimetres; volume displaced when floating, 430 c.c.; volume exposed above water, 30 c.c.

From the position of flotation it appears that enough of the bottle was above the surface of the water to give the wind some power in drifting it. This would probably make little difference with the direction of the drift, for the wind that drifted the bottles would drift the surface water in the same direction. It may have made some difference in the speed with which the bottles travelled, making them move, perhaps, faster than the water, but this effect would be slight. Within each bottle a franked envelope was placed, addressed to the chief of the Weather Bureau, at Washington. Before a bottle was thrown overboard a blank form in the envelope had to be filled up, giving the name of the vessel and its captain, the date of floating, and the place where floated. Another space was left for the finder to insert similar data.

The bottles actually picked up were, for the most part, on shore, very few of them having been found in the water. It is impossible to say what proportion of the bottles was recovered, but it was not great. Though probably more than five per cent., it did not exceed ten per cent. The figures cannot be given exactly, because it is not known how many of the bottles are still in the hands of masters of vessels. A considerable portion of the papers recovered was found on the Canadian shore, and, curiously, a large number of them came from shores which are for the most part uninhabited.

The investigation covers the years 1892 and 1893, but it must be remembered that the observations could be taken only during the season of navigation. This practically limits the conclusions to the summer months, as when the bottles are floated in the spring they will probably be found in the autumn, and those that are floated in the autumn will be lodged in ice, and their routes be variously changed, so that trustworthy conclusions cannot be drawn from them. In general, the finds of the latter sort—that is to say, the finds of bottles floated in the autumn and picked up in the spring—have been left out of consideration. The currents shown in the accompanying map are herefore those of the season of navigation, and practically the currents of summer.

Classification of the Currents.

The currents in the Great Lakes can be grouped under the four following heads:—

(1) *The Body Currents.*—These lakes all have an outflow, and there must be a general motion of the water towards the outlet. This is visible upon the map of each lake, and the currents which result from it must be continuous throughout the year, and must affect most of the water.

(2) *A Surface Current due to the Prevailing Winds.*—That the winds have great effect on the currents in large bodies of water is widely recognised, and the more constant they are the more marked is the effect. The westerly winds, in case of lakes lying nearly east and west, cause a surface current from the west which is in the same direction as the body current. In the case of the lakes which lie across the direction of the wind, the surface drift is from the west across the lake. The details of the direction, however, depends on where the outlet is, on the form of the lake, and on the position of the inlet.

(3) *The Return Currents.*—It will be seen from the illustration that, in the case of three of the lakes, the main currents hug one shore. In the case of Lake Superior, it is on the southern shore; in the case of Lake Michigan, it is on the eastern shore; and in that of Lake Huron, it is on the western shore. Lakes Erie and Ontario do not show this phenomenon so plainly. This feature can be explained by the two sorts of currents already mentioned, combined with the lay of the lakes as to the prevailing direction of the wind and the position of the outlet. In any case, however, the drive of the water from one end of the lake to the other necessitates more or less a return current, providing the outlet is not sufficiently large to allow this water to pass through. In the Great Lakes, the outlets are comparatively small, hence in all these cases there are return currents.

(4) *Surf Motion.*—Owing to this motion, the bottles have been found to show a decided tendency shoreward whenever they came within its vicinity, and especially so when the water was shallow.

Velocities of the Currents.

The directions of currents can be ascertained with much more precision by means of bottle-papers than can the velocities. It has therefore been very difficult to arrive at any satisfactory conclusions concerning the speed of the currents in the Great Lakes. In a general way, the speed appears to vary from four to twelve miles a day. In a few special cases, very much higher velocities have been found, but these are probably due to surf motion rather than the motion of the surface water as a whole. It is not at all improbable that the general surface motion of the lakes has a higher velocity than from four to twelve miles a day, but the only conclusion which it seems safe to draw from the data is that the velocities are at least as high as the figures mentioned.

Lake Superior.

In this lake thirty-five bottles were recovered in 1892, and the same number in 1893. From the courses of the bottles it appears that there is a general surface current along the south shore of the lake, from the Apostle Islands eastward, and that to the east of Keweenaw Point this eastern current has very great breadth. Still further eastward, toward the eastern end of the Lake, it spreads out in a fan-shaped way, and a branch of it seems to pass to the northward and westward, reaching the extreme northern coast of the lake. A branch of this current also turns southerly round Keweenaw Point, and at the bottom of the bay, on the south coast of the lake, an eastern current is taken up, which joins the main current to the eastward of Marquette, Michigan. The minimum velocity of the main eastward current of the lake appears to be from four to six miles a day.

Lake Michigan.

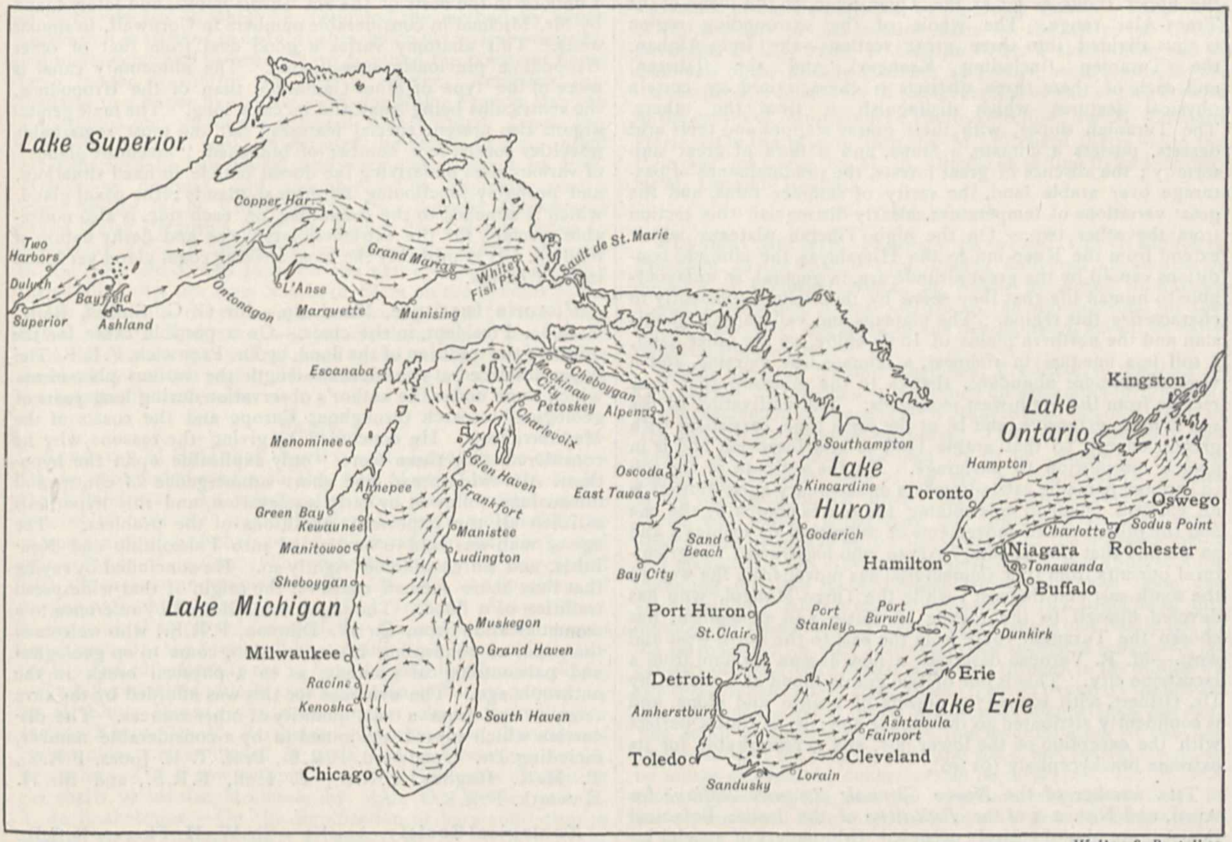
In this lake 163 bottles were recovered in 1892, and thirty-five in 1893. The currents indicated by the floating of the bottles are of unusual interest. There is first a strong and well-marked current up the eastern coast, passing between the Maniton Islands and the Michigan mainland, and ending in the reefs and rocks to the north of Little Traverse Bay. There is a current down the west coast, but at some distance off-shore. In the space between its margin and the shore there are varying currents, sometimes to the northward and sometimes to the southward—on the whole rather from the south than from the north. There is a great but gentler whirl about Beaver Island in a direction contrary to the hands of a watch. The velocities found in these currents are greater than those found in Lake Superior, and this is especially true of the northern end of the current, which passes up along the east coast. In the case of the bottles which crossed Lake Michigan, the velocities obtained in the best cases varied from four to four and a half miles a day. Taking only the bottles which passed between Maniton Islands and the mainland, the velocities obtained varied from six and a half to ten a day.

developed at no great distance from the south coast, and much farther from the north coast, which is cut by two long points extending out to about one-third of its width.

LAKE ONTARIO.

In Lake Ontario 56 bottles were recovered, of which 55 belonged to the season of 1892, and one to that of 1893. The directions taken by the bottles in the lake are somewhat similar to those in Lake Erie, but quite distinct from those of the upper lakes. There is a general current extending diagonally across the lake from opposite the mouth of Niagara River to the outlet near Kingston. The bottles exhibited a strong tendency to seek the east coast, passing down into the bay on which Sacketts Harbour, N.Y., is situated. There are evidences of a whirl in the western end of the lake, west of the meridian of Toronto.

The general conclusions of the paper relate only to the greater currents of the lakes. These currents must be substantially as indicated by the five or six hundred bottle-papers which have been recovered. There will, however, be some modifications due to season and direction of wind, but these modifications will be superficial, while the regular currents of the Great Lakes, which are described above, must be fairly persistent. Many of the modifications will be found in the bays and at the extreme angles of the lakes, and these remain for further investigation.



Walker & Boutall sc.

LAKE HURON.

In this lake 186 bottles were recovered, 142 for the season of 1892, and forty-four for 1893. From the courses of the bottles, it is concluded that the arrangements of currents is very much like that of Lake Michigan. In this case, however, it seems that the main current is along the west coast, while in Lake Michigan it is along the east coast. It is found that in Lake Huron there is a strong current passing down the west coast and some little distance out, the whole length of the lake, turning on itself near the point of the lake, and passing up the east coast, possibly turning again along the north shore and rejoining the other current in the vicinity of Bois Blanc Island. A branch of this return extends into Georgian Bay.

LAKE ERIE.

The number of bottles recovered in Lake Erie was 96, of which 66 belonged to the season of 1892, and 30 to 1893. The general course of these bottles was eastward along the axis of the lake, with a tendency from point to point toward the coast. The indications are that the main current along the axis is best

SCIENTIFIC SERIALS.

L'Anthropologie, tome v. No. 1, January–February.—M. Émile Cartailhac contributes certain new facts with regard to the prehistoric history of the Pyrenees; in the present number he describes some quartzites of the St. Acheul type that have been recently found in the cave of Herm (Ariège). The examination of the animal remains was confided to M. Marcellin Boule who communicates a short note on the remains of the Glutton (*Gulo luscus*) and the Cave Lion (*Felis spelæa*) which were found there in association with the worked flints. The mandible of *Felis spelæa* found in the cave of Herm presents characters intermediate between the lion and the tiger, and M. Boule would prefer to look upon this great cave cat as merely a polymorphous race of the modern lion; he suggests that it should be called *Felis leo*, race *spelæa.*—M. Salomon Reinach treats of sculpture in Europe prior to Greco-Roman influence; and M. G. Capus describes the ethnical migrations in Central Asia from a geographical point of view. From the Himalaya, southwards, to the Altai, northwards, the great mountain ranges of Central Asia form a series of practically parallel ridges running from east to west; but from the 35th to the 45th parallels of latitude there is also a mountainous barrier extending from north to south, and separating the western plains from the valleys and plateaus of the east. This barrier has played an important part in determining the course of the migration of nations and the distribution of the two great Asiatic races. It is formed more particularly by the Pamir plateau, extending from the valley of the upper Indus as far as the Thian-Shan, to the north of the Trans-Alai range. The whole of the surrounding region is thus divided into three great sections—the Indo-Afghan, the Turanian (including Kashgar), and the Tibetan, and each of these three districts is characterised by certain physical features which distinguish it from the others. The Turanian slopes, with their grassy steppes and their arid deserts, possess a climate, a fauna, and a flora of great uniformity; the absence of great forests, the predominance of pasturage over arable land, the rarity of summer rains, and the great variations of temperature, clearly distinguish this section from the other two. On the high Tibetan plateaus which extend from the Kuen-lun to the Himalayas, the climatic conditions caused by the great altitude are, in general, so unfavourable to human life that they serve by themselves sufficiently to characterise this region. The plateaus and valleys of Afghanistan and the northern plains of India enjoy, on the other hand, a soil less unequal in richness, a climate less extreme, and a vegetation more abundant, thanks to the moisture that they receive from the south-west monsoons. The cultivation of the soil is more extensive, and is, at the same time, carried on with greater energy, so that arable land is less localised, and is in greater proportion to pasturage. But the aptitude of the soil to support nomadic cattle-breeders or sedentary agriculturists is an efficient factor in determining the routes chosen by the one and the other in their movements of migration or exodus; and so we find that the sedentary Aryan who has trusted to agricultural pursuits from time immemorial has moved from the west to the south-east and the east; while the Turco-Mongol, who has devoted himself to the raising of cattle and nomadism, has chosen the Turanian route from the east to the north-west and west.—M. R. Verneau describes a new human cranium from a lacustrine city. This is one of two crania found at Concise, by Dr. Gilbert, with some 1700 objects of bronze and stone, and is confidently attributed to the bronze age; it is almost perfect with the exception of the lower jaw, and is remarkable for its extreme brachycephaly (91·46).

The number of the *Nuovo Giornale Botanico Italiano* for April, and Nos. 2-4 of the *Bullettino* of the Italian Botanical Society, are almost entirely occupied with papers of special interest to Italian botanists, with whom the study of the galls produced on plants by insects occupies a large share of attention.

SOCIETIES AND ACADEMIES.

London.

Royal Microscopical Society, March 21.—A. D. Michael, President, in the chair.—Mr. C. L. Curties exhibited and described a new form of photo-micrographic camera and drawing apparatus, designed by Prof. Edinger, and constructed by Herr E. Leitz.—Dr. W. H. Dallinger exhibited and described a new model microscope by Messrs. Swift.—Messrs. Watson and Sons exhibited a new super-stage plate fitted with two steel springs; they also showed a Ramsden screw micrometer and an Abbe camera lucida, both made in aluminium.—Mr. R. T. Lewis described a scale insect from Natal, which he believed to be *Trioza pellucida.*—Mr. J. G. Grenfell exhibited and described specimens of Dicyemida, parasites found on the renal organs of cephalopods.—The President read a paper entitled "Notes on the Uropodinæ," a sub-family of the Gamasidæ, one of the higher families of Acari. The classification was first considered, that by former authors was reviewed, and a new classification proposed suitable to the present state of knowledge on the subject. Two new genera were established: one, *Glyphopsis*, for species with the body of irregular form sculptured on the dorsal surface, and with excavations for the legs on the ventral surface, which the author claimed as forming a natural group; the other, *Trachetes*, to replace *Celæno*, which name has failed by the operation of the law of priorities and for other reasons. Three new species were described, two from Cornwall and one from the Tyrol. One of the former, *Glyphopsis Bostocki*, is the largest and handsomest of known Uropodinæ; the Tyrolese species, *Uropoda hamulifera*, is also a remarkable creature. A list of the British species, which has not been attempted before, was then given, and the synonomy, which has fallen into great confusion, elucidated. The author then treated of the anatomy of *Glyphopsis formicariæ*, a curious species found some years since by Sir John Lubbock in the nests of the ant *Sasius flavus*, and lately found by Mr. Michael in considerable numbers in Cornwall, in similar nests. This anatomy varies a good deal from that of other Uropodinæ previously investigated. The alimentary canal is more of the type of other Gamasidæ than of the Uropodinæ, the ventriculus being small and its cæca long. The male genital organs also present special features; but the most remarkable novelties consist in a number of branched "racemose glands" of various sizes underlying the dorsal cuticle in fixed situations, and probably functioning as dermal glands; the coxal gland, which is attached to the second leg on each side, is also noticeable specially for the extremely large size and fleshy nature of its duct. It is probably the most striking coxal gland yet found in the Acarina.

Victoria Institute, March 19.—Sir G. G. Stokes, Bart., F.R.S., President, in the chair.—On a possible cause for the origin of the tradition of the flood, by Dr. Prestwich, F.R.S. The paper described at considerable length the various phenomena which came under the author's observation during long years of geological research throughout Europe and the coasts of the Mediterranean. He concluded by giving the reasons why he considered that these were "only explicable upon the hypothesis of a widespread and short submergence of continental dimensions, followed by early re-elevation, and this hypothesis satisfied all the important conditions of the problem." The age of man was held to be divided into Palæolithic and Neolithic, and he considered rightly so. He concluded by saying that thus there seemed cause for the origin of that widespread tradition of a flood. The paper was followed by reference to a communication from Sir W. Dawson, F.R.S., who welcomed the paper as confirming his conclusion, come to on geological and palæontological grounds, as to a physical break in the anthropic age. The evidence for this was afforded by the cave remains and from a vast quantity of other sources. The discussion which ensued was joined in by a considerable number, including Dr. Woodward, F.R.S., Prof. T. R. Jones, F.R.S., T. McK. Hughes, F.R.S., E. Hull, F.R.S., and Sir H. Howorth, F.R.S.

Zoological Society, April 3.—Sir W. H. Flower, K.C.B., F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of March 1894.—Dr. Günther exhibited and made remarks on some specimens of the American Lepidosiren (*Lepidosiren paradoxa*) from the Upper Rio Paraguay, collected by Dr. Bohls.—Captain H. G. C. Swayne, R.E., gave a description of the physical features of Somaliland, and an account of the expeditions he had made into the interior of that country during the past nine years, pointing out the localities in which the larger mammals were usually met with. The paper was illustrated by the exhibition of a large series of well-mounted heads of the various species of antelopes and other animals of Somaliland.—Mr. O. Thomas read a paper on the dwarf antelopes of the genus *Madoqua*, in which three species from Somaliland were described as new, and named *M. swaynei*, *M. phillipsi*, and *M. guentheri*. A revised classification of the six known species of this genus of antelopes was added.—Mr. R. T. Coryndon gave an account of his pursuit of the white or Burchell's rhinoceros (*Rhinoceros simus*) in Mashonaland, and of the way he had obtained the specimens which would shortly be placed in the British Museum, the Tring Museum, and the Cambridge University Museum (see p. 584).—A communication was read from Miss E. M. Sharpe containing a list of the butterflies collected by Captain J. W. Pringle, R.E., while on the march through British East Africa from Teita to Uganda. A new *Papilio* was proposed to be called *P. pringlei*, and a new genus and species of Satyridæ was named *Raphiceropsis pringlei*. Altogether examples of 134 species were obtained.

Linnean Society, April 5.—Mr. F. Crisp, Vice-President, in the chair.—Sir Joseph Hooker, K.C.S.I., exhibited a portrait, in oils, of Sir Samuel Bentham, Kt., a colonel in the service of the Empress of Russia, painted at St. Petersburg in 1784. He was father of George Bentham, the distinguished botanist, and former president of this society, 1861–74 (*Proc. Linn. Soc.*, 1886, pp. 90–104).—Dr. B. Shillitoe, exhibited some specimens of a primrose having abnormal leaf-like bracts immediately below the true calyx, and found growing with ordinary flowers of the same species.—An exhibition of some Trap-door spiders and nests, by Mr. F. Enoch, was deferred to a subsequent meeting.—Mr. R. H. Burne read a paper on the aortic-arch system of *Saccobranchus*, in which he elucidated the method by which respiration is effected in certain fishes which in tropical countries, but more especially in India, have acquired the power of living for a longer or shorter time out of water. Referring particularly to a paper by the late Surgeon-Major Francis Day, on amphibious and migratory fishes of Asia (*Journ. Linn. Soc. Zool.* vol. xiii. p. 198), he detailed the results of some recent investigations he had made, and were characterised by Prof. Humes as original and valuable.—The Secretary read a paper by Mr. H. N. Ridley, on the *Orchideæ* and *Apostasiaceæ* of the Malay Peninsula from the Kedah State (long. 99·30 to 104·30 lat. 7 N.) to Singapore, including the islands adjacent to the west coast, and those on the east coast of Johore, with the addition of a few from Southern Siam on the borders of the Malay Peninsula, the entire area comprising about 50,000 square miles. Mr. C. B. Clarke, who criticised the paper, commented upon the important additions made to the existing knowledge of the *Orchideæ* of this region, of which so large a portion was even yet botanically unknown.

PARIS.

Academy of Sciences, April 9.—M. Lœwy in the chair.—On the unoccupied spaces in the zone of small planets, by M. O. Callandreau. An investigation into the character of the stability of motion of small planetary bodies as affected by the commensurability of their periods of revolution with the period of revolution of Jupiter. The regions of instability correspond with the regions unoccupied by asteroids.—On the spectrum of oxygen at high temperatures, by M. J. Jansen. A description of the method employed for studying the spectrum of oxygen under pressure, the source of heat being a platinum spiral electrically heated. Results are to be published in a further paper.—On differential equations containing an arbitrary parameter, by M. Émile Picard.—On some copper objects belonging to ancient Egypt, by M. Berthelot.—On the slow alteration of copper objects when buried in earth and in museums, by M. Berthelot.—On a new octopus of Lower California inhabiting the shells of bivalve Mollusca, by MM. Ed. Perrier and A. T. de Rochebrune.—On the signification of hermaphrodism in relation to the differentiation of plants, by M. Ad. Chatin.—Note by M. Edmond Perrier accompanying the presentation of a work on the "Histoire des Étoiles de mer."—Report of the section of geography and navigation on the disasters of the Iceland fishery, by M. Guyou.—New parabolic elements of the comet Denning, by M. L. Schulhof.—Observations of the comet Denning (March 26, 1894) made at Algiers Observatory, by MM. Trépied and Renaux.—Observations on the comet Denning (March 26, 1894) made at Toulouse Observatory, by MM. E. Cosserat and F. Rossard.—Observations of the planet AX and of the comet Denning (March 26, 1894) made at Lyons Observatory, by M. G. Le Cadet.—Occultation of Spica Virginis, observed at Lyons Observatory, by MM. G. Le Cadet and J. Guillaume.—On the *rapport conique et la relation conique*, by M. Mozat.—On reflection of electrical waves at the end of a conducting thread terminating in a plate, by MM. Ed. Sarasin and Kr. Birkeland.—Magnetic properties of iron at various temperatures, by M. P. Curie. The deduction is drawn, from data given, that at high temperatures iron commences to be magnetised with an enormous initial coefficient, but this almost immediately suddenly changes in the direction of the curve $I = f(H)$, the field and the intensity of magnetisation being yet very feeble; the curve afterwards presents itself as a right line much less inclined and appearing to pass through the origin.—On the fusibility of mixtures of salts, by M. H. Le Chatelier. The mixtures (*a*) potassium and lithium carbonates and (*b*) sodium borate and sodium pyrophosphate have been studied in all proportions. The fusibility curves indicate, for (*a*) a very definite combination in equivalent proportions; for (*b*) a combination not so distinctly marked.—On the combinations of molybdenum dioxide and disulphide with alkaline cyanides, by M. E. Péchard.—On the use of polishing in the study of the structure of metals, by M. Osmond.—Action of halogens on homopyrocatechol, by M. H. Cousin. Chlorine has given (1) trichloro-homopyrocatechol, (2) the ortho quinone of (1), (3) more highly chlorinated substances now being examined. Bromine has yielded similar derivatives. Iodine does not seem to yield iodo-derivatives.—On a new earthworm of the family of the Phreoryctidæ (*Phreoryctes endeka*, Gd.), by M. Alfred Giard.—On the nerves of the antennæ and the chordotonal organs among the ants, by M. Charles Janet.—On the reviviscence of the Tardigrades, by M. Denis Lance.—The course of resin canals in the cauline parts of the silver fir (*Abies pectinata*, D. C.), by M. J. Godfrin.—On a siderolithic bed of mammals of the Middle Eocene, at Lissieu, near Lyons, by M. Ch. Depéret.—Discovery of fossil remains of the striped hyæna in the grotto of Montsaunès (Haute-Garonne), by M. Édouard Harlé.—On the glyptic race, by M. Édouard Piette.—On the "*cassage*" of wines, by M. A. Bouffard.—Squalls and storms, by M. Durand-Gréville.

BERLIN.

Physical Society, February 16.—Prof. von Helmholtz, President, in the chair.—Prof. Planck delivered an address in memory of Heinrich Hertz, in which he drew, in warmly appreciative words, a clear picture of the development of the career, character, and work of the distinguished savant so early removed from science.

March 2.—Prof. du Bois-Reymond, President, in the chair.—Dr. Roepsel had previously described an apparatus for the relative measurement of the magnetic properties of different kinds of iron suitable for technical purposes. This was composed of two coils of wire in which the needles to be compared were so placed that the north pole of the one lay immediately opposite to the south pole of the other. In the magnetic field so produced was placed a flat wire coil connected with a torsion needle, and by means of this the strength of the magnetic fields was measured. Dr. Roepsel now described a new apparatus for obtaining absolute measurements which depended upon the yoke method. After a short discussion of the principle of this method, he described the experiments which had finally led to the introduction of that instrument for technical purposes. It consists of a half-yoke which is pierced through in the middle by two semicircular holes 1 mm. broad; the iron bar goes through the two limbs of the yoke, inside of which the magnetising coil lies. The small coil which measures the magnetisation of the bar passes through the small hole in the yoke, and carries a pointer by means of which its deflection can be measured. Dr. du Bois spoke concerning the need for very intense magnetic fields in the experimental examination of certain still unsolved problems of physics, and described minutely ring electromagnets, already mentioned and examined in detail by him, which were made in the works of Siemens and Hulske, and which, under the application of currents accessible in the laboratory, gave between conical poles of 60° a strength of field of 38,000 c.g.s.

March 16.—Prof. du Bois Reymond, President, in the chair.—Prof. Börnstein reported on electric measurements which he had made in the previous year during two balloon ascents on August 18 and September 23. At the first ascent he had, on the ground of previous statements, expected that the fall of potential would increase with the height. The measurements were made with two polished aluminium points—these were soon of no use—and also with a water-collector consisting of a funnel, which acted well. The result was that the fall of potential decreased with the height, and at 3000 m. no conduction to the electroscope occurred. The supposition that the measuring apparatus was in disorder was shown to be wrong, for in a lower air current, under 1900 m., electricity was again shown. At the second ascent observation was made with a collector in a metal funnel, and here also a diminution of the fall of potential was found at greater heights. Two subsequent balloon ascents, which were carried out in Paris, and a third carried out in Berlin in the previous month, have given similar results. The views hitherto held concerning atmospheric electricity, and which originate from Exner, therefore need modification ; at any rate, the view that the aqueous vapour produces negative electricity at the higher levels can no longer be held to be correct. What part it plays can only be determined by further electrical measurements from balloons.—Prof. von Bezold explained how the condition of the atmospheric electricity could be represented in the simplest and most diagrammatic manner by the aid of the graphic method. —Dr. Gross described new experiments on the electrolysis of sulphates in alkaline solutions, as, for instance, silver sulphate and silver oxide in ammonia solution, which led again to results from which he believed a dissociation of sulphur might be inferred.

Physiological Society, February 23.—Prof. du Bois Reymond, President, in the chair.—Prof. H. Munk spoke concerning Prof. Golz's lately published research on a dog which had survived for a long time extirpation of the cerebrum, and on whose behaviour evidence against the localisation of sense perceptions in defined regions of the cerebral cortex were founded. Prof. Munk, in the discussion which followed, explained that all the phenomena which can be referred to the presence of visual, auditory, olfactory, and gustatory perceptions in a dog which has been deprived of its cerebrum, were simple reflex phenomena which are awakened through general sensation without the participation of a sense perception. Dr. Ullmann described experiments which led him to the view that the red blood corpuscles are not biconcave discs, but are biconvex bodies.

Meteorological Society, March 6.—Prof. Hellmann, President, in the chair.—Dr. Schubert reported on the results of his further observations of the temperature and humidity in woods and in the open. The observations were taken last year at the same time, and were made at least twice daily, three hours after noon and at sunrise, by means of an aspiration hygrometer. On each occasion nine single measurements were taken in three groups, which were separated from one another by a quarter of an hour, while in the groups the single observations followed at intervals of one minute. The mean of twenty-six days' observations showed that in the morning the temperature in the woods was 0·08° higher than outside them, while after midday the temperature in the open air was 0·3° higher than in the woods. The humidity, both absolutely and relatively, was greater in the open than in the woods both in the morning and in the afternoon ; the difference was similar to the temperature difference, only smaller. Measurements in the tent gave similar but greater differences than those made with the aspiration hygometer. Prof. Sprung spoke concerning the diurnal range in velocity and direction of the wind on the Eiffel Tower. From the Espy-Köppen explanation of the daily variation of wind velocity at the plain and summit stations, Prof. Sprung has derived an explanation for the opposed direction of the wind at the lower and at the higher levels ; he has pointed out that from the presence of ascending currents about midday it follows that, at the lower level the wind must change direction with the hands of a watch, while at the higher station it must change against the hands. As, however, the wind observations at the summit stations are not free from the friction of the surface of the earth, Prof. Sprung has examined the reports of the wind observations on the Eiffel Tower, and has found here also a decrease of the wind velocity during the day, and an increase during the night, as was found on the summit station. The minimum wind velocity occurs, however, in summer as early as 9 a.m., while in winter it occurs first at 1, and in spring and autumn between 10 and 11. The wind direction, as on the summit stations, shows a maximum of turning with the watch before noon, and a maximum of turning against the watch after noon, the changes occurring also earliest in summer and latest in winter, but the changes of direction show themselves about three hours after the minimum velocity. The wind observations on the Eiffel Tower, therefore, confirm the Espy-Köppen explanation, and show that the influence of rising air-currents is already sensible at these moderate heights.

Göttingen.

Royal Society of Sciences.—The *Nachrichten* is now issued in distinct series, dealing respectively with literary, biological, and mathematico-physical memoirs. The first number of the *Mathematisch-physikalische Klasse* contains the following papers :—

January 13, 1894.—Ed. Riecke: A contribution to the theory of swelling by imbibition (*Quellung*).

February 3.—Prof. O. Henrici: On a new harmonic analyser.—W. Voigt: On an apparently necessary extension of the theory of elasticity (continued).—C. Brodmann: Some observations on the rigidity of glass rods.—O. Wallach: On the behaviour of the oximes of cyclic ketones (II.).

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Transactions of the Sanitary Institute, Vol. xiv. (Stanford).—Machines Frigorifiques a Gaz Liquéfiables: R. E. de Marchena (Paris, Gauthier-Villars).—A Treatise of Natal Astrology: G. Wilde and J. Dodson (Halifax, Occult Book Company).—Attempt at a Catalogue of the Library of the late Prince Louis-Lucien Bonaparte: V. Collins (Sotheran).—Tell el Amarna: W. M. F. Petrie (Methuen).—Man's Place in Nature, and other Anthropological Essays: T. H. Huxley (Macmillan).—Nature's Hygiene: C. T. Kingzett, 4th edition (Baillière).—Recherches sur l'Histoire de l'Astronomie Ancienne: P. Tannery (Paris, Gauthier-Villars).—Smithsonian Institution Report to July 1892 (Washington).

Pamphlets.—Recherches Geologiques sur les Environs de Vichy (Allier): G. F. Dollfus (Paris).—Report of the Board of Managers of the Department of Archæolology and Palæontology of the University of Pennsylvania, 1893 (Philadelphia).—Die Temperatur-Verhältnisse des Bodensees: Dr. F. A. Forel (Lindau i. B.).—Die Schwankungen des Bodensees: Dr. F. A. Forel (Lindau i. B.).—Transparenz und Farbe des Bodensees: Dr. F. A. Forel (Lindau i. B.).—La Lava Incandescente: A. Ricco (Roma).

Serials.—Journal of the Sanitary Institute, April (Stanford).—Journal of the Chemical Society, April (Gurney and Jackson).—Record of Technical and Secondary Education, April (Macmillan).—American Journal of Science, April (New Haven).—American Naturalist, April (Philadelphia).—Annalen der K.K. Universitäts-Sternwarte in Wien, viii. and ix. Band (Wien).—The Asclepiad, No. 40, Vol. x. (Longmans).—Mind, April (Williams and Norgate).—Transactions and Proceedings of the Botanical Society of Edinburgh, pp. 233-636 (Edinburgh).—Journal of the Franklin Institute, April (Philadelphia).—Zoologischer Anzeiger, xvi. Jahrg. 1893, Litt. 2 (Leipzig).—American Meteorological Journal, April (Ginn).—Astronomy and Astro-Physics, April (Wesley).—Contributions from the U.S. National Herbarium, Vol. iv. Botany of the Death Valley Expedition (Washington).—Proceedings of the Aristotelian Society, Vol. 2, No. 3, Part 1 (Williams and Norgate).

CONTENTS.