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MATHEMATICAL GEOLOGY.

Popular Lectures and Addresses by Sir William Thomson (Baron Kelvin), P.R.S., LL.D., D.C.L., &c. In three volumes. Vol. II. "Geology and General Physics." With illustrations. NATURE Series, pp. x. + 599, with index. (London and New York: Macmillan and Co., 1894.)

THIS handy republication of the lighter scientific utterances of Lord Kelvin was begun in 1889, with the volume reviewed in NATURE (vol. xl. p. 433), was continued in 1891, with a volume on "Navigational Affairs," and is now concluded for the present by a volume, nominally the second of the series, which deals mainly with Geological Dynamics, or the application of the physical sciences to the past history of our planet, and likewise includes such later addresses on general physical topics as were not included in the volumes already issued.

The preliminary remarks appropriate before reviewing utterances of leaders in science, were made in connection with the first of the series (vol. xl. p. 433), and need not now be repeated; we will enter straight upon a summary, and perhaps an occasional slight criticism, of the contents.

The first paper is a little article on dew, wherein it is pointed out that the protective action conspicuously exerted on vegetation by invisible aqueous vapour is due not to its "athermancy," as Tyndall imagined, and as text-books teach, but to its infinite heat-capacity. The temperature of bodies which cool only from the surface cannot fall below the point at which dew is being deposited upon them; and naturally the moister the air the higher is this said point.

Then comes a brief note, a kind of text or starting-point for many subsequent addresses, in which the extreme doctrine of geological uniformity is briefly refuted. The refutation consists in the simple arithmetical calculation, that if the observed gradient of temperature in the earth's crust had been uniform for, say, twenty thousand million years back, the amount of heat that must have flowed out from it into space in that time would be enough to heat the whole earth ten thousand centigrade degrees, unless it were made of material very different from surface rock, or unless fresh quantities of heat had been generated by chemical action. In any case, allowing for these possibilities to the uttermost, the past temperature would have been at some such date so excessively high that *ipso facto* no approach to uniformity of other conditions could possibly be maintained or contemplated.

In this simple argument the "mathematics" is but little more severe than that needed in what the author later on (p. 240) calls "a simple effort of geological calculus," whereby it is estimated that 1° per 30 metres is the same as 1000° per 30,000 metres; or (a fairer comparison) that quoted on p. 86, that a deposit at the rate of one inch per century demands ninety-six million years for the deposition of the stratified rocks; yet the simple argument may well be held as more conclusive and convincing than an appeal to Fourier and the laws of distribution of temperature in a cooling sphere. For this reason: an immediate application of Fourier to the gradient of temperature observed in the earth's outer skin is liable to all the uncertainties attaching to very violent extrapolation both in space and time; it has to assume that the sole operative cause is conduction of heat, and always has been conduction of heat, up to a certain past date deduced from the data as the era of reckoning.

Now, it is quite possible to hold that the main mass of the earth consists of metal, chiefly iron, and that the heat, observed in the damp skin or coat of rust on which we live and into which we bore, is being generated *de novo* by the rusting action still going on.

The heat generated by the oxidation of a pound of iron is (I estimate) sufficient to warm an equal mass of rocky material something like three thousand centigrade degrees; so that small confidence can be felt, by those who are impressed with the probability of a meteoric view of the earth's origin, in refined calculations as to successive distributions of temperature in a simply cooling globe started in a molten condition and left to radiate into space undisturbed.

But it is to be observed that the argument of Lord Kelvin contemplates the possibility of fresh generation of heat, but maintains that nevertheless at some by no means infinitely distant date the obvious physical conditions of the earth's surface must have been extremely different from what they are now.

The doctrine of extreme uniformity, which at one time was undoubtedly held by some leading geologists, is now however abandoned, a result due most likely in large measure to the author's calculations and reiterated arguments; and the only reasonable hesitation which can now be felt is as to how far the numerical data available, from observations hitherto made in the earth's outer skin, are sufficient for fixing an upper limit to the age of the earth: especially since these underground thermometer-readings are likely to be disturbed by local and by general chemical action at considerable depths.

The author suggests borings in the African deserts, where moisture is less prevalent than elsewhere, and it may be that observation of underground temperature there conducted will be productive of valuable information; but it is unlikely that these data have already been obtained.

Whatever hesitation may still rationally be felt as to the acceptance of the author's numerical estimate of the earth's age—and he is careful to allow ample margin when he extends the more strictly estimated ten million into a possible hundred million years—yet the reception of his calculations by contemporary palæontological and stratigraphical geologists, as summarised in a controversial address on Geological Dynamics in this volume, will probably be surprising to a more fully informed posterity. Instead of heartily welcoming fresh light on the subject of the earth's past history, from an unexpected quarter, they seem to resent interference from what they are pleased to consider "outside," and their most able advocate, Prof. Huxley, accepts a brief to repel the intruder.

The quotations made by Lord Kelvin from Playfair, from Lyell, from Darwin, and from writers of text-books, are evidences of the natural though exaggerated reaction into scientific uniformitarianism, from the ancient legendary prescientific cataclysmal period, when everything was done in a hurry, and a week was an epoch of serious moment in the earth's history. In the reactionary period, on the contrary, it was customary to airily postulate a few thousand million centuries for any particular achievement; geologists then drew upon "a practically unlimited bank of time, ready to discount any quantity of hypothetical paper." Lord Kelvin by physical reasoning recalled them from this unnecessary vagueness, and put into their hands new data, ascertained by observation of the earth's crust of just as close and valid a character as any inspection of strata or classification of fossil remains, but of a kind more immediately amenable to mathematical calculation; he called for more data from observers, and meanwhile treated in the light of present knowledge the data already available, just as the observing geologists had endeavoured to treat ordinary stratigraphical facts in the light of what they perceived to be at the present time occurring near river-mouths and coast-lines.

And in thus discussing and drawing deductions from terrestrial data, Sir Wm. Thomson was a true geologist. If researches and discoveries concerning the past history of the earth, in respect of age and temperature and physical condition and length of day and exposure to sunshine, are not geology, it is difficult to adduce anything that has a right to that title. Yet Prof. Huxley, in a peroration to an address to the Geological Society of London in 1869, on the subject of Sir Wm. Thomson's address to the Glasgow Society the year before, speaks of "the cry for reform which has been raised from without," says "the case against us has entirely broken down," and concludes with the comfortable assurance: "we have exercised a wise discrimination in declining to meddle with our foundations at the bidding of the first passer-by who fancies our house is not so well built as it might be."

And another more astounding but very characteristic sentence occurs in an earlier part of this forensic speech:—

"I do not suppose that at the present day any geologist would be found to maintain absolute uniformitarianism, to deny that the rapidity of the rotation of the earth *may* be diminishing, that the sun *may* be waxing dim, or that the earth itself *may* be cooling. Most of us, I suspect, are Gallios, 'who care for none of these things,' being of opinion that, true or fictitious, they have made no practical difference to the earth, during the period of which a record is preserved in stratified deposits."

This attitude of "not caring" for the results of scientific investigation in unpopular regions, even if those results be true, is very familiar to some of us who are engaged in a quest which *both* the great leaders in the above-remembered controversy agree to dislike and despise. It is an attitude appropriate to a company of shareholders, it is a common and almost universal sentiment of the noble army of self-styled "practical men," but it is an astonishing attitude for an acknowledged man of science, whose whole vocation is the discovery and reception of new truth.

Certain obscure facts have been knocking at the door of human intelligence for many centuries, and they are knocking now, in the most scientific era the world has yet seen. It may be that they will have to fall back disappointed for yet another few centuries, it may be that they will succeed this time in effecting a precarious and constricted right of entry; the issue appears to depend upon the attitude of scientific men of the present and near future, and no one outside can help them.

I admit that it savours of presumption even to quote in a critical spirit from the utterances of a man of Prof. Huxley's eminence, a man who fought with surpassing eloquence and vigour the battle of free and open inquiry into the facts of the universe before most of us had cut our wisdom teeth; but having been guilty of such an act of presumption, I propose to cap it with another: I shall take permission to say how cordially we recognise the immense service to truth and progress which has been effected by those gladiators who, in despite of fierce hostility, and in face of deadly odds, encountered and overcame the forces of superstition and won for us who follow so great a measure of freedom and friendly countenance as we now enjoy.

It requires an effort of imagination now, or a visit to some stagnant country town, to realise the strength of prejudice which the evolutionary spirit of science had at one time to encounter. It would ill beseem us who are enjoying the peaceful outcome of this struggle to regard with other than the deepest honour those veterans who bore the burden of the fray, even though they sometimes display their fighting front to a left wing of earnest investigators who come heavily marching over the bog and swamps not far removed from those into which the conquered hosts retreated. The morass is difficult and treacherous—it may once more be overwhelming—but if ever secure foothold is gained, and the mud on our clothing has time to dry, the veterans will recognise their own colours and not the colours of their former foes.

Returning to our immediate subject, I pick out from the address on Geological Time the following interesting points. The tides are a case of forced vibration in which the natural period of free swing is *longer* than that corresponding to the forced period; consequently, but for friction, the tidal humps are at right angles to the line of tide-generating force. Were the free period shorter than the forced, the tidal humps would be in the line of force, again excepting friction; and were the two periods the same, the tidal humps, but for friction, would be infinite. The fact that the natural or free period is longer, not shorter, than the lunar or solar day period, as well as the bare fact of appreciable friction itself, are proved by a delay in the occurrence of spring-tide, which again establishes the fact that the lunar tide is more accelerated by friction than is the solar tide; the solar being of slightly shorter period than the lunar, and therefore slightly more discordant with the natural swing.

The effect of friction is to accelerate the tidal phase, and by this acceleration its amount can, or could if the data were good enough, be estimated. It is equivalent to a friction brake applied to the equator, and tightened till it requires a total tangential force equal to the ordinary weight of four million tons to hold it still.

Or, if the earth be supported like a terrestrial globe by a polar axis 100 miles in diameter, that axle must be clamped and subjected to a tangential drag of 320 million tons in order to represent the energy dissipated by tidal friction.

Given this gigantic retarding "couple," it is surprising to remember how slow the consequent lengthening of the day actually is: that the earth, in fact, lags behind a perfect time-keeper only an accumulated few seconds—the estimate in this book is the rather high one of twenty-two seconds—in the course of a century, *i.e.* in the course of 36,500 rotations.

To test or detect this retardation by direct observation is, as is well known, very difficult, because the only other time-keeper available for purposes of comparison is the moon, and she is a very bad and complicated one. Only by efforts of great genius has the astronomical discovery of the diminishing speed of the earth's rotation been made; but if astronomical clocks were as perfect as Lord Kelvin thinks they ought to be, the observation would be comparatively easy. He looks forward to a time when clocks will not be set by the stars, as at present, but when the earth's motion will be rated by a standard clock of extraordinary perfection. At present, or at least in 1868, "astronomical clocks are just as great a disgrace to the mechanical genius of Europe and America as chronometer watches are a credit."

(Incidentally a curious statement is made as to the feasibility of working coal at enormous depths, in spite of the presumably high temperature there—"Suppose there was coal, or rather charcoal, where the strata were red hot, it might be gone into, and that with perfect ease. All that is necessary is plenty of ventilation": the ventilation being conducted on the freezing-machine principle of adiabatic expansion of previously compressed air.)

Other causes affecting the rate of the earth's rotation are likewise considered, such as the deposition of meteoric dust, the redistribution of polar ice and equatorial water, the shrinking of the earth by cooling. If meteoric dust, without initial moment of momentum, were deposited at the rate of one foot in 4000 years it would produce the observed retardation, and likewise the acceleration of the moon's mean motion, without aid from the tides. On the other hand, any redistribution or accumulation and dissipation of polar ice must be a periodic phenomenon, and therefore, though it may exert a distinct effect for some cycles of years, disturbing calculations of eclipses and such like, yet in the long run it must integrate out and be inoperative. As to the accelerative influence of thermal contraction, it is believed by the author to be extremely small, probably not the 1/6000th part of that due to tidal friction.

Concerning the probable antecedent condition of the matter which has fallen together to make the earth, it is interesting to note (p. 121) that "any great degree of *relative* motion of different portions of matter through space renders the chance of their hitting one another very small"; it is probable, therefore, that the heat developed by the falling together of the earth's materials arose simply from their gravitative potential energy, which is fairly calculable, and not from vague stores of unknown initial motions.

On p. 185 a statement is made with respect to Helmholtz' theory of solar heat, to the effect that "this condensation can only follow from cooling." It is rash to question a statement allowed to stand by this author after revision, but perhaps he would look at it again. Surely condensation can, under some conditions, not only generate heat but also elevate temperature?

Towards the end of a Presidential address delivered to the British Association at Edinburgh in 1871, the author, while quoting with "cordial sympathy" a couple of sentences from "The Origin of Species," on the subject of biological evolution, omits an intervening sentence "describing briefly the hypothesis of 'the origin of species by natural selection' because [he] had always felt that this hypothesis does not contain the true [*i.e.* doubtless the complete] theory of evolution . . . in biology. Sir John Herschel, in expressing a favourable judgment on the hypothesis of zoological evolution . . . objected to the doctrine of natural selection, that it was too like the Laputan method of making books [which it may be recollected was something like this: haphazardly composing all the type available, and hoping that of all the random statements thus made the fittest might survive] and that it did not sufficiently take into account a continually guiding and controlling intelligence. This seems to me a most valuable and instructive criticism."

Eliminating the slightly anthropomorphic mode of expression from one sentence of this quotation, it illustrates, what is certainly the truth, that to the interested onlookers from other sciences there already seemed cogent need of a supplement to the fraction of truth contained in Natural Selection, a supplement involving some such treatment of the Origin of Variations as is now attempted in Mr. Bateson's recent work.

In an address to Section A, at Glasgow, 1876, the author goes back to geology and considers the question of a possible shift of the earth's polar axis and of possible temporary alterations in the length of the day, while he entirely repudiates and demolishes the view that the earth's interior can be mainly or even largely liquid. His conclusion from the whole of tidal phenomena is that the earth is now extremely rigid and must be practically solid all through.

He nevertheless contemplates with equanimity Newcomb's bold hypothesis, based on the lunar theory and on apparent irregularities in the moon's motions, that the earth actually went slow and lost seven seconds between 1850 and 1862, and then went fast and gained eight seconds from 1862 to 1872. Lord Kelvin tentatively explains the conceivable possibility of this acceleration by possible changes in the earth's shape, as detectable by changes in sea-level.

"A settlement of 14 centimetres in the equatorial regions, with corresponding rise of 28 centimetres at the poles (which is so slight as to be absolutely undiscoverable in astronomical observatories, and which would involve no change of sea-level absolutely disproved by reduction of tidal observations hitherto made), would suffice. Such settlements must occur from time to time; and a settlement of the amount suggested might result from the diminution of centrifugal force due to 150 or 200 centuries' tidal retardation of the earth's rotational speed."

A paper on Geological Climate continues what we are treating as the geological portion of the volume under review. One of the chief subjects therein discussed is the probable cause of the warm Arctic climate once experienced, so that not only are remains of forest trees found within fifteen degrees of the North Pole, with every evidence of their having grown there, and that not so very long ago, but the return of the Arctic expedition in 1876 brought "evidences of a very warm climate, probably as warm as we have it now in the tropics, within nine degrees of the North Pole"!

For explanation, at any rate of the more moderate pine-forest temperature, we are told to look in the direction indicated by Lyell's twelfth chapter, viz. to a redistribution of land and water.

The Arctic Ocean is a land-locked sea, and the effect of the surrounding coasts is to hem the ice in and prevent free oceanic circulation, while the land itself serves to receive and accumulate snow wherewith to load the neighbouring sea with a thin layer of surface ice.

But now lower the land 2000 feet: the sea would be open, but for a few islands, and the water would be deep enough for plenty of warm currents to flow in, sufficient to clear the ice away and keep it clear. Even now the ice seems to be only 5 feet thick, evidently melting away underneath. It is asserted that the climate of a small island in an iceless circumpolar sea would be probably "temperate and free from frost except in hollows." Considering all the defences, the heat-capacity of moist air, the formation of dew, and so on, it appears that the same defences as protect a large continent in temperate zones from destructive cold during a summer night, would "prevent even so much as hoar-frost on a small island at the very pole during its whole winter six months' night, if it were surrounded by a deep ocean with no land to obstruct free circulation between it and tropical seas."

And in the other direction Lord Kelvin agrees that the simplest cause of the glaciation of India is some 15,000 feet extra elevation. But at the same time "the astronomical cause invoked by Herschel must have had, and must now have, its effect," the well-known fact, namely, of the varying distance of the sun, and the periodic coincidences of its least distance with the northern summer. The sometimes postulated shift of the earth's axis to account for changes in climate does not satisfy Lord Kelvin; he says that there is no evidence, either geological or astronomical, for any considerable shifting of the position of the poles. As to the warmer climate evidenced all over the earth at one time: underground heat is often appealed to, but it is hopelessly inadequate, it can never have sensibly influenced the climate during the period of the stratified rocks. "The earth might be a globe of white hot iron covered with a crust of rock 2000 feet, or there might be an ice-cold temperature within 50 feet of the surface, yet the climate could not on that account be sensibly different from what it is, or the soil be sensibly more or less genial than it is for the roots of trees or smaller plants."

The simple and in every way "almost infinitely probable" hypothesis to account for past high temperature is *a warmer sun*.

Persons who are inclined to imagine a future limit to the duration of life on the earth as in any way dependent on a failure in the supply of heat from below, will do well to note the above strong pronouncement.

The next essay, on "The Internal Condition of the Earth," asserts that on the meteoric theory the earth would once have been just about molten throughout, by reason of the heat of its own formation; but subsequent occurrences must depend on whether solid rock sinks or swims in molten rock. Definite experimental information on this fundamental point appears to be still wanting, but so many facts show that the earth is rigid, that practically the author seems to have little doubt but that it would *sink*. He is careful to point out, however, that the crude notion sometimes met with of a rise of temperature in arithmetic progression at different depths in the crust is certainly false. The law of increase is an asymptotic one, and the temperature at the centre *need* not be higher than two or three thousand degrees. He denies altogether the intensely high temperature often imagined, and thus has no difficulty in accepting the solidity and rigidity otherwise indicated.

Some ingenious arithmetical calculations attempted in Dr. Croll's book on Climate and Time, form the subject of the next paper, on "Polar ice-caps and their influence in changing sea-levels." It is interesting to know that if the ocean were of quicksilver instead of water, it would not spread over the earth as it does, but would accumulate itself entirely at one side. The stability of the ocean depends on the low specific gravity of sea-water as compared with earth. Now, any great piling of material over a large area, such for instance as over the gigantic Antarctic continent, would have the effect of drawing by gravitation some of the ocean toward itself, and thereby lowering the sea-level all over the rest of the earth. And if the material so piled up were itself ice, having been withdrawn by distillation from the ocean itself, the fall of level would be greater still. By the formation of an ice-cap on the Antarctic continent, twelve miles thick, an immense change of sea-level can be produced; the amount of lowering thereby caused in distant parts of the globe being differently estimated as 380 feet, 650 feet, 1140 feet, and 2000 feet.

But Lord Kelvin denies the possibility of a coat of ice twelve miles thick, such as Dr. Croll postulates; the pseudo-viscosity of ice forbids it; but suppose it only a quarter-mile, suppose the thickness varied by 1200 feet from some cause, the area of the Antarctic continent is something like $\frac{1}{40}$th of the whole earth, and so, if such a coat of ice melted off it, the sea-level all over the world would rise twenty-five feet,—sufficient to make many important changes.

The greatest permissible thickness of ice at the South Pole seems to be about 18,000 feet, such a height as that with a gradual slope could stand; and a comparatively small fluctuation in its thickness would have very important geological results. What the actual condition of affairs now is at the South Pole can only be settled by an Antarctic expedition, of which the feasibility and importance are now in some quarters being seriously considered. The thickness of the ice-cap would depend on the annual snowfall and on the rate of viscous sliding down. The internal heat of the earth has nothing to do with the problem—the underground heat could not melt a millimetre of ice thickness per annum. It is singular that an increase in the southern ice-cap tends to increase that of the northern also, by lowering the level of the ocean, and so retarding circulation. Any cause which lessened the Antarctic ice-cap would moderate the rigour of the extreme northern climate, and tend to warm the Arctic Ocean.

So much for the first half of the book under review. The remaining half will be treated in another article.

OLIVER J. LODGE.

ELEMENTARY METEOROLOGY.

Elementary Meteorology. By William Morris Davis, Professor of Physical Geography in Harvard College. (Boston, U.S.A.: Ginn and Co., 1894.)

THE necessity for the production of text-books would seem to diminish with lapse of time, but the examination of publishers' catalogues discloses no diminution in their numbers. If there be any excuse for the writing of new text-books in any branch of science, it might be found in those at present unformed departments, like meteorology, where well-directed and systematic inquiry is constantly enlarging the boundaries of knowledge by the addition of new facts, or the discovery of fresh grounds for the acceptance of facts not yet admitted as demonstrated truths. The science of meteorology is not like that of mathematics, which immediately displays its power, and has nothing to hope or fear from passing time; but appealing as it does to observation and experience, its progress must be gradual and comparative. And if any one be entitled to write text-books, it is those who having been engaged practically in teaching have felt a particular want to be ill-supplied, and who feel themselves qualified by their office and minute acquaintance with the subject to remedy the defect. For these reasons we may welcome the appearance of Prof. Davis' work on "Elementary Meteorology," which originally intended for those engaged in the earlier years of college study, and with whom the author has been brought much into contact, may well be read by others, who wish to keep themselves acquainted with the more recently-acquired facts concerning the behaviour and the processes of atmospheric circulation. In fact, Prof. Davis has had both classes of readers in his mind, as he has prepared this work; and further, recognising how many in his own country are more or less intimately connected with the national and state weather services, he has endeavoured to supply them with a well-digested treatise which may be a supplement to the meagre but precise instructions issued to observers under official authority.

It is not to a text-book of this character that one goes to learn the present position of the more speculative side of meteorology, and since the author excludes from his programme purely mathematical discussion, some of the more recondite inquiries cannot be treated. The qualities that we should look for in a book intended primarily for college students, are exactness of facts and expression, lucidity of description, and orderly consecutive arrangement, carrying the student gradually forward to complete knowledge of the subject, within the limits proposed by the author. And, supposing this to have been the aim of the writer, it seems to have been admirably fulfilled. A text-book embracing the views and the experience of others cannot hope to be original, but it should be thorough, and this on the whole is the opinion we have conceived of the book.

In a few short chapters, we have a description of the atmosphere as a whole, and of the forces that are continually operative, giving rise, by the succession of day and night and summer and winter, to vertical interchanging currents whose behaviour under varying conditions and circumstances embraces the whole province of meteorology. Having thus prepared the way by sufficient reference to the physical processes which influence the temperature of the earth as a whole, it might have been expected that the author would have proceeded naturally to the consideration of local temperatures, and a more minute division of his subject. But, unfortunately, he delays the progress by the introduction of a chapter on the colour of the sky. Doubtless the author can defend himself, but to us, it appears an interruption of the orderly development of the subject, and a defect in the arrangement of the work. It is, however, the only distinct blemish to which we shall have to refer in the plan and conception of the book. We should suspect that the subject of the colour of the sky has had great attraction for Prof. Davis, and that he has over-valued its importance in a book of this nature. But having surmounted that difficulty, there is nothing to stop the consideration of temperature, its measurement, its distribution, and the causes affecting its disturbance, either as a whole by the obliquity of the earth's axis, or locally as by ocean currents, &c. All this is very admirably arranged; and here we may say a word for the sufficiency and clearness of the diagrams. Prof. Davis has apparently had access to a very admirable and complete collection, and his selections are judicious and well illustrative of the points under discussion.

From isotherms the transition to isobars is easy and natural, and though we cannot expect anything original in the description of a barometer, the quality of thoroughness to which we have before alluded is again illustrated. The author does not recommend the correction of the individual readings of the barometer to the sea-level, a practice which is falling more and more into disuse. Unfortunately a definition of sea-level, as understood in America, is not given, at least where we expected to find it. We doubt whether many English readers could supply a correct definition, but the expression may be perfectly clear on the other side of the Atlantic.

Proceeding as far as possible with the discussion of barometric readings, revealing the varying distribution of pressures, the author finds it necessary to introduce the subject of the observation and distribution of the winds. This we consider absolutely in its right place, and assists the gradual progress materially. On the subject of the reduction of wind observations the information is certainly meagre. Wind observations offer one of the most complicated problems in meteorology, one certainly out of the range of the ordinary college student, and this may be a sufficient apology for the author. Here, too, we should have looked for some reference to the recent work of Prof. Langley, indicative of both the difficulty of making exact observations of velocity, and of the important results that may be expected from a complete discussion. But the author is more intent upon describing the general effects of wind circulation as affected by the rotation of the earth, before proceeding to partial and local disturbances. Of course, in this section, the author follows Ferrel, and without employing mathematical illustration, succeeds in fairly well placing before the student an outline of the essential features that mark the work of his distinguished countryman.

This gradual progress of the book seems to throw the question of rain and precipitation far into the work. No inconvenience arises from this, though in many minds, not necessarily scientific, the subject of rain is considered the most important fact in connection with meteorological science. Prof. Davis, however, is not to be hurried. He wishes to approach the subject of cyclones and local storms, and as these are more or less accompanied with rainfall, he finds it necessary, in pursuance of his scheme, to clear away the general features connected with the moisture of the atmosphere, including clouds, dew, frost, and the various forms in which we find water precipitated. In connection with cloud observation, a simple method is mentioned of determining the direction and velocity of cloud movement, which might be worthy of more systematic trial than, it is believed, has yet been accorded to it. The method consists in noting the path of the reflection of a cloud in a horizontal mirror, in which the observer looks through an eye-piece that remains fixed during the observation. If the eye-piece is placed so that the reflection of a certain part of the cloud falls at the centre of the mirror, and after a few seconds a radial arm is turned so as to bring its edge on the position then taken by the cloud, the edge of the arm will lie parallel to the cloud's motion, on the admissible assumption that the cloud is drifting in a horizontal plane. (pp. 181–2.) A slight addition to the apparatus permits the ready appreciation of the relative velocity of the cloud drift, far better than can be estimated by the eye alone.

Having dealt with the general subject of rain and clouds, the author is in a position to treat of cyclonic storms, thunderstorms and tornadoes, and the more violent interruptions of meteorological phenomena. The reason for this section, interesting as it is, being sandwiched in between the description of clouds, &c., and the causes and distribution of rainfall is, however, not so clear. The author probably did not wish to have a greater separation than possible between his chapter on winds and that on cyclones; but we think it would have been better to have finished the subject of rainfall before returning to the motion of the atmosphere. But the writer is clearing the way for the consideration of the "weather," "weather prediction," and climate, with which his book ends. On the subject of weather forecasts, Prof. Davis does not take a very hopeful view. We believe that our authorities at Victoria Street look with a certain degree of satisfaction on the results of their predictions. They are able to point to a percentage of some 90 per cent. of successes, and as far as is known, they, and the public too, consider their existence justified. But listen to Prof. Davis:—"The number of stations has grown, and their equipment has been materially improved; the accuracy of various processes preparatory to charting has been increased; a vast body of information has been accumulated for study relative to the kinds and changes of weather; various predicting officers have had extended practice in their art, and while the forecasts are truly made for longer periods than they were at first, and are certainly superior in definiteness and accuracy to those issued twenty years ago, their improvement is not so great as was hoped for. Mistakes in prediction are still made, and of much the same kind as at the beginning of the service." (p. 325.)

In laying aside this book, which we have read with pleasure, and heartily commend to the student, one word of caution may not be unnecessary to the English reader. The book is written for American students, and the use of "our" and "us" is apt to be a little confusing. For instance, "our" damp winter north-easters (p. 145) will scarcely apply to "our" climate, and the statement (p. 269) "that in the six years 1885–1890 there were 2233 buildings set on fire by lightning in this country," is one which must be considered in connection with the area of the country to which it applies. W. E. P.

THE WEALDEN FLORA.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum. Part I. *Thallophyta—Pteridophyta.* By A. C. Seward, M.A., F.G.S. (London: Printed by order of the Trustees, 1894.)

THIS hand-book serves to show how interesting a monograph of all that is known regarding this mysterious formation would prove. In the folds of the Wealden we imagine the secret of the evolution of angiosperms must be locked. It is as if we stood at the mouth of a great river flowing from an unexplored interior, whose flotsam we anxiously interrogate for clues as to the nature of the unknown hinterland; yet nothing reaches us from beyond the coast-belt, which we have already explored. The Wealden flora is in fact so meagre that it is hard to regard the formation as fluviatile, and one is tempted to believe that it was formed in some brackish lake into which the spoils of the land were rarely drifted.

The first pages afford a comparison of the plants of the English Wealden with those of other countries, but that any of the formations included, especially from beyond Western Europe, are really contemporaneous, must be open to doubt. None of them, however, with trifling exceptions, contain any indications of the presence of angiosperms. Another remarkable fact is the extraordinary geographical range of the English species, only ten out of thirty being peculiar to this country, and these are the most poorly represented. A perhaps unavoidable drawback, to this book and former ones of the series, is that they change established nomenclature so greatly as to render preceding lists of British fossils useless.

A new term, *Algites*, designates the markings which probably represent Algæ. A rather widely distributed *Chara* and a new species under *Marchantites* are important acquisitions; as are the three species of *Equisetum* with tuberous roots, of which one is new. These tubers show that some description of fruit could have been preserved if they had ever been present.

The bulk of the volume is taken up with the Ferns, which are fairly, perhaps over-cautiously, treated. The time-honoured *Sphenopteris Mantelli*, with an enormous range, becomes *Onychiopsis*, representing *Onychium*. A second British form is identified with one hailing from Japan and China; and a new and pretty *Acrostichum*, described as *Acrostichopteris*, completes the list assigned to the vast family of the *Polypodiaceæ*. Tree ferns are more abundant. A remarkable and oft-described species will probably find its final resting-place in *Matonidium*, where it was first placed by Schenk. Another, known from the trunk only, is described under the scarcely satisfactory name *Protopteris*, Presl., preferred by the author to *Caulopteris*. With its marked affinities, it would have been convenient if this, and perhaps two other species, had been given a generic name suggesting relationship with *Dicksonia*.

Sphenopteris is further dismembered by the reference, with a query, of *S. Gœpperti* to the *Schizaceæ*, a family so well represented in the newer Cretaceous and Eocene rocks. It seems again somewhat unfortunate that this species should have received a new generic name (under cover, perhaps, of the query) which in no way reveals its presumably strong affinities with *Anemia*. If nomenclature is to be an aid instead of a stumbling-block, meaningless names should be prohibited. In this particular case Mr. Rufford did not even discover the species, and *Ruffordia* as a generic name will probably disappear when the highly probable close relationship is incontestably established. Moreover, the author's desire to pay Mr. Rufford a well-earned compliment could have been easily gratified among the "genera which afford no trustworthy evidence as to their affinities with existing families," which follow on. Of species falling under this head six are placed in Brongniart's *Cladophlebis*, a provisional genus adopted by some of the best palæobotanists. Two species, one new and the other renamed, represent *Sphenopteris*. The old *Lonchopteris Mantelli* becomes *Weichselia*. It is an abundant but distinctly brittle fern, which may prove to be a *Gleichenia*, a species so abundant in the newer Cretaceous that it could hardly be unrepresented in the Wealden. The remaining forms comprise a number of interesting fragments, the Oleander-like *Tæniopteris*, *Sagenopteris*, two curious net-veined fragments, *Dictyophyllum* and *Microdictyon*, new to the Wealden of England, and which might have come from the Eocene, so closely do they agree. These suffice, at all events, to show that if we could only meet with some fairly representative leaf-beds, such as abound in newer formations, the Wealden would yield a flora, both varied, and of enormous interest. The descriptions conclude with a sufficiently exhaustive discussion of the affinities of that difficult fossil *Endogenites erosa*, which the majority appear agreed to place in *Tempskya*. This, by the by, as an arborescent fern, would have more properly followed the *Cyatheæ*.

The whole result shows that a few species which grew on or near where they are found are abundant in the Wealden, while the rest are rare and fragmentary. A large proportion possessed separate fertile pinnæ, a character maintained in ancient fern-life down to the Tertiaries, and judging from the preponderance of ferns, the Wealden must be still reckoned in the age of Cryptogams. The next part, dealing with Gymnosperms, will be awaited with interest.

OUR BOOK SHELF.

A Monograph of Lichens found in Britain; being a Descriptive Catalogue of the Species in the Herbarium of the British Museum. By the Rev. James M. Crombie, M.A., F.L.S., F.G.S., &c. Part I. (London: Printed by order of the Trustees, 1894.)

MR. CROMBIE'S monograph of the British lichens, of which the volume before us forms the first half, is a valuable addition to that splendid series which, issued by the order of the Trustees, form the "Catalogues" of the vast collections preserved in the British Museum.

Botanists will welcome Mr. Crombie's book, for notwithstanding the works of Leighton and others, the lichens have for the most part been treated with singular neglect. Nor need we seek very far, perhaps, for the reason of this; their isolation, and the tedious difficulties connected with the task of dealing minutely with the group, have all tended to restrain people from a pursuit which is further hedged about with a formidable and unwieldy terminology. Other problems more immediately awaiting, or at least inviting, solution, have attracted the majority of investigators, and this notwithstanding the splendid results yielded by the researches of Schwendener and others into the real nature of these plants. And yet the disregard into which the study of lichens has fallen is really not deserved. It is even possible that a clue to the physiological solution of some of the most interesting questions of morphology may ultimately be found amongst these very plants, which from their composite nature can be constructed or altered at the will of the investigator.

It must, however, be admitted that the taxonomy of lichens is not altogether an inviting study, and Mr. Crombie has rendered a great service in lessening the actual difficulties which necessarily have to be encountered. He begins by providing a glossary (which we think might with advantage have been more extensive), and then, after a synopsis and a conspectus of the groups and genera, occupying a dozen pages in all, he enters at once on the main body of the work.

The diagnoses are extremely good and, in so far as we have tested them, accurate and distinctive. We cannot, however, help wishing that some stand could have been made against the practice of using incorrect, though possibly convenient, "chemical" formulæ (*e.g.* CaCl for chloride of lime) to denote the reagents so often used in determining the different species.

Those who are familiar with the literature will recognise Nylander's influence through the book as a whole, and we do not hesitate to express our satisfaction at this; indeed, in a systematic treatise it is perhaps impossible for some of Nylander's own definitions to be improved on.

Perhaps the only parts of the book which are at all suggestive of weakness, are the illustrations. These are frequently rather diagrammatic, but at the same time we venture to think they are sometimes not as clear as they might have been, and the impressions are unfortunately not seldom lacking in sharpness and definition. Of course the actual preparations of lichens are often neither very clear nor particularly illuminating; but these are precisely the defects which admit of remedy in a diagram or a figure. Apart, however, from this point, the book deserves the very highest praise, and its great merits will assuredly cause it to occupy a distinguished and a permanent position in the literature of lichens.

Travels in a Tree-top. By Charles Conrad Abbott. Pp. 208. (London: Elkin Mathews and John Lane, 1894.)

THE naturalist with poetic fancy, who sees beauty in "all that run, that swim, that fly, that crawl," and publishes his feelings in writings more or less after the style of Richard Jefferies, is very much abroad just now. Sometimes he is more poet than naturalist, but he is always a lover of nature, and though his interpretations are often lacking in scientific accuracy, his observations are generally worth putting on record. Dr. Abbott belongs to this class of nature's disciples. Systematic science has no charms for him. He prefers rather to roam the fields and woods, and watch life in all its varying moods and motions. Ensconced in the branches of a high tree, he has seen sights never vouchsafed to mortals with more limited horizons. He has watched the building of nests, and his observations on the method of working are as valuable as they are interesting. The footprints of various birds, the sinuous traces made by mussels and water-snakes on the ripple-washed sand of a sea-shore, and an infinite variety of similar impressions, have furnished him with objects of study. These are the kind of topics treated in the book, the scene of which, judging from internal evidence, is in Maryland. For the most part, the reading is pleasant gossip, free from rhapsody and tiresome platitude. The title does not, however, clearly express the character of the contents, for it only refers to one of the seventeen papers which make up the volume.

The publishers are famed for their tasteful editions in *belles-lettres*, and they have done their best to give an æsthetic value to Dr. Abbott's musings on sundry phenomena.

LETTERS TO THE EDITOR.

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

The Electrification of Air.

As attention is called to this subject by the paper, by Lord Kelvin and Mr. Magnus Maclean, in NATURE for July 19 (p. 280), it may be worth while to point out that two distinct questions, which it is important should not be confused, arise as to the electrification of air. The first question is whether an electric charge can be given to a quantity of dust-free air? In other words, whether a gas can get into a condition in which it can carry a charge of electricity? The evidence derived from the electrification observed in vacuum tubes, &c., seems almost conclusive in favour of an affirmative answer to this question, which is the one considered by Lord Kelvin. The second and quite different question is whether this electrification of the gas is possible unless some of the gas is in a special state, such, for example, as would be produced if some of the molecules were split up into atoms? To adopt a definite theory, for the sake of putting the question clearly: Is the electricity in the charged gas carried by molecules or atoms?

It was the second of these questions, not the first, which I discussed in my "Recent Researches in Electricity and Magnetism," under the heading "Can a *molecule* of a gas be electrified?" The ultimate fate of a charged drop of water, alluded to by Lord Kelvin and Prof. Elihu Thomson, is, as far as I can see, not in any way inconsistent with the view which I advocated, that the *molecule* of a gas can not be electrified. For take the case of a drop of water impure enough to be regarded as an electrolyte, and suppose it negatively electrified. The negative charge will be carried by oxygen ions or atoms; thus, if it were possible to evaporate all the water away, the electricity would be left on these atoms, and there would be no charge on either the *molecules* of water or air. On the other hand, the fact that the water molecules escape from the electrified surface without any electrification, seems in favour of the view that the water molecules can not be electrified. Again, it is worth remembering that a square centimetre of surface, immersed in air at the standard temperature and pressure, is struck by about 10^{25} molecules per second; yet such a surface will retain for hours, without sensible loss, a charge of electricity, which, as we know from the electrolytic properties of liquids and gases, could be carried by a few thousand millions of particles if these were to receive such a charge as the *atoms* of the gas are able to carry. J. J. THOMSON.

Cambridge, July 20.

"Testacella Haliotoidea," Drap.

IN NATURE for the 5th inst. Mr. J. Lloyd-Bozward has a note headed "Testacella haliotoidea," of which slug he says that "specimens are not infrequently collected in asparagus-beds, as are also those of the much rarer *T. scutulum.*"

It will be allowed that the latter species is often found in such places, those recently recorded from Buckhurst Hill, for instance (*Essex Naturalist*, vol. vii. 1893, p. 46), but exception may be taken to the statement that *Testacella scutulum*, Sow., is much rarer than *Testacella haliotoidea*, Drap.—in fact, it would seem that the opposite is the case.

Until recently every British example of the genus not referable to *Testacella maugei*, Fér., was called *haliotoidea*: however, the late Mr. Charles Ashford in 1885 pointed out to Mr. J. W. Taylor that there were anatomical differences between the form that seventy years before had been called *scutulum* by Sowerby, and the typical *haliotoidea*. The figures in Mr. Taylor's paper (*Journal of Conchology*, 1888, p. 337), which was the outcome of this, were not altogether convincing, and the present writer, in some remarks to the Linnean Society (June 1893), on the method of feeding in Sowerby's species (see *Zoologist*, August 1893) thought it advisable to endorse Mr. Taylor's statements from his own observations. Again, in the following July, Mr. Walter E. Collinge (*Annals and Magazine of Natural History*) gave some very clear figures and descriptions of some anatomical details of the genus, ably supplementing Mr. Ashford's work.

Now that the specific distinctness of *Testacella scutulum* is beginning to be recognised, the records for this species are getting numerous, while those for *haliotoidea* are apparently dwindling, doubt being thrown on existing records, and, as can easily be foreseen, supposed localities having to be struck out in favour of the allied form. Almost all the shells of this genus preserved in the British Collection at South Kensington, on running through them with Mr. Edgar Smith, turned out to belong to *Testacella scutulum*.

Mr. Bozward's record of *Testacella haliotoidea* is interesting, as Tate's list of counties can hardly be reliable now, a catalogue of localities as exhaustive as that given for the other species by Mr. Taylor, in his paper, already referred to, would be most useful. The following are a few records which the writer has been able to lay his hands upon, at short notice, for the *true haliotoidea*.

Horsham.—The first specimen which Mr. Taylor sent to Mr. Ashford, which was really this species, was from here (letter to the writer).

Oxford.—Mr. Taylor mentions having a specimen from Prof. Poulton (in his paper on *T. scutulum*).

Chepstow.—Mr. Taylor mentions this locality (letter to the writer).

Yorkshire and Cornwall.—Mr. Collinge had his specimens chiefly from these counties (letter to the writer).

Ireland.—Dr. Scharff gives Youghal, co. Cork (in "Irish Land and Freshwater Mollusca," *Irish Naturalist*, 1892).

Kew.—The writer collected specimens in the Royal Gardens some years ago. WILFRED MARK WEBB.

Biological Laboratory, Chelmsford, July 19.

Two Arctic Expeditions in One Day.

THE 7th of July was memorable as the date of sailing of two Arctic expeditions, one from St. John's, Newfoundland, the other from New York. The steamer *Falcon*, having set out from New York in June, and touched at St. John's, made its final departure from that point for Bowdoin Bay, Inglefield Gulf, Greenland, having on board the Peary auxiliary expedition, the intention being to convey Lieut. Peary and his twelve companions back to the United States in September, after their twelve months' sojourn in the Arctic regions. The *Falcon* was saluted in passing by the British man-of-war *Cleopatra*.

The expedition will be gone about ten weeks. Cary Island, Cape York, and Clarence Head will be visited. Various scientific work will be pursued, including the study of glacier systems.

The iron steamer *Miranda*, chartered by Dr. Frederick A. Cook, of Brooklyn, sailed from New York the same afternoon with a party of fifty men of science and pleasure-seekers. Labrador and the west coast of Greenland will be visited. Several of the party will remain in Greenland to prosecute scientific researches. The steamer will then go to Melville Bay, and perhaps visit the quarters of Peary and other explorers, returning about the middle of September.

Among the passengers were ten Eskimo, who had been stationed in the Eskimo camp at the World's Fair in Chicago last year, and are returning home. WM. H. HALE.

Brooklyn.

Rearing of Plaice.

IN NATURE of July 12 (p. 251), there is an interesting note on the rearing of larval plaice at Plymouth, by Mr. J. T. Cunningham, in which it is mentioned that they have been reared to the age of thirty-seven days; but it is not stated how long the incubation went on. It may be interesting to say that at the Fishery Board's Marine Hatchery, at Dunbar, I succeeded in preserving many millions of larval plaice from twenty-four to thirty-three days, counting from the time of fertilisation; and some were reared in jars for longer. On one occasion I kept them in a thriving condition to the forty-seventh day after impregnation of the eggs, at which age they were carried away by an accidental overflow. The eggs were fertilised on April 3, hatched on April 19, and larvæ reared until May 20, when the accident occurred. A description in full will be given in the Fishery Board's report. HARALD DANNEVIG.

Fishery Board's Marine Hatchery, Dunbar, July 17.

Absence of Butterflies.

REFERRING to "Delta's" note, I may say that in the fine weather which we had here in April, the small tortoise-shell butterfly appeared more numerously than ever I had witnessed it at that season, or indeed at any time. I recollect counting a dozen at one time on a small bush of *Andromeda floribunda*, then in flower. Many of them were on wing in the latter days of March, alighting on the willow blossoms. With the fall of temperature in May they disappeared, and only in these recent warm days of July have I again seen them. The first white butterfly of the season was seen here April 21, the glowworm on June 23 (three weeks later than last year), and the horse-fly, *Hippobosca equina*, on June 28. J. SHAW.

Tynron, Dumfriesshire.

THE OXFORD MEETING OF THE BRITISH ASSOCIATION.

WE regret to announce that Mr. W. H. White, C.B., will be unable, through ill-health, to give the evening lecture on "Steam Navigation at High Speeds," announced for Thursday, August 9. The Council of the Association has secured the services of Dr. J. W. Gregory to fill his place, and we believe that the title of Dr. Gregory's lecture will be "Experiences and Prospects of African Exploration."

During the past week further information has come to hand as to the work in some of the Sections. In Section C (Geology) the President, Dr. L. Fletcher, will deal in his address with the progress of mineralogy since Dr. Whewell's report was presented in 1832. Prof. Green will read a paper on the geology of the country round Oxford, with special reference to the places to be visited during the excursions. Prof. Boyd Dawkins will contribute several papers, including one on the probable range of Coal Measures under the newer rocks of Oxfordshire. Amongst others are papers by Mr. H. A. Miers, on a new method of measuring crystals; by Mr. E. P. Culverwell, on an examination of Croll's and Ball's theory of Ice Ages and Glacial Epochs; Mr. W. W. Watts, on barytes in Keuper sandstone; Dr. H. Hicks, on some Lacustrine deposits of the Glacial Period in Middlesex; and Dr. J. Anderson, on some volcanic subsidences in the North of Iceland. There will be a joint meeting of Sections C and H, to discuss the implements of the plateau gravels and their bearing on the antiquity of man.

In Section G (Mechanical Science), the President, Prof. A. B. W. Kennedy, will deal in his address with modern mechanical training, constructive and critical. Sir Frederick Bramwell will read a paper on Thursday, August 9, on Steam Locomotion on Common Roads. On the Friday there is to be a joint discussion with Section A, on Integrators, Harmonic Analysers, and Integraphs, and their applications to physical and engineering problems. This discussion will be opened by Prof. O. Henrici, who is expected to exhibit some valuable models and instruments. On the same day, Lord Kelvin will read a paper on the resistance experienced by solids moving through fluids, which will be followed by a discussion on Flight. Other papers, by Prof. Fuller, Mr. FitzMaurice, and Mr. H. Davey, will follow. On the Saturday, Sir A. Noble, F.R.S., will open with a valuable paper on the measurement of pressures in gun bores; and other papers, by Mr. B. Donkin and Mr. J. Kenwood, will follow. The Monday will be devoted to electrical questions, and among others Mr. W. H. Preece will give two papers on Signalling without Wires, and on the Efficiency of Glow Lamps. On the Tuesday, several papers of mechanical engineering interest will be read by Prof. Unwin, Mr. J. Swinburne, Prof. Capper, and Prof. Hudson Beare.

The programme of Section H (Anthropology) is already a large one, including nearly fifty reports and papers of great interest. Amongst these are papers by Mr. Lionel Decle, on the native tribes of Africa between the Zambesi and Uganda; Dr. A. B. Meyer, on the distribution of the Negritos; M. Émile Cartailhac, on the art and industry of the Troglodytes of Bruniquel (France), and two other communications; Mr. J. Theodore Bent, on the natives of the Hydramoot; Count Goblet d'Alviella, on recent discoveries in prehistoric archæology in Belgium; Prof. Max Lohest, on observations relative to the antiquity of man in Belgium; Mr. Arthur Evans, on the discovery of a new hieroglyphic system and pre-Phœnician script in Crete; and Prof. J. Kollmann, on pygmies in Europe. It must be understood that where dates have been given above, they are only provisional, and that the order in which the papers are to be read is liable to alteration before and during the meeting, due notice of which will be given in the daily journal.

Section I (Physiology) will meet in the fine Physiological Laboratory of the University adjoining the Museum; and, judging from the number and interesting character of the communications which have been already promised, its launch into independent existence should prove most successful. A very large number of the physiologists of Great Britain have announced their intention of being present, and, in addition, the President of the Section, Prof. Schäfer, will have the support of several distinguished foreign physiologists, amongst whom are Prof. Chauveau (of Paris), Prof. Hermann (of Königsberg), Prof. Engelmann (of Utrecht), Prof. Heger (of Brussels), and Prof. Gaule (of Zurich).

The programme of local arrangements is drawn up, but owing to alterations being required, consequent on the withdrawal of Mr. W. H. White's lecture, and other causes, it will not be ready for distribution before the beginning of next week.

The Local Secretaries desire to give notice that all communications should be addressed to them at the British Association Office, the Examination Schools, Oxford, and *not* to the University Museum, as heretofore.

BIG GAME SHOOTING.[1]

WHILE partridges and pheasants, and even hares and rabbits (in spite of the Ground Game Bill) continue to increase and multiply, to the delight of the ordinary sportsman, there can be no doubt that the supply of what is termed "big game" is rapidly and seriously diminishing year by year. In North America the bison or "buffalo" is extinct as a wild animal, and the wapiti is hardly to be met with anywhere within reach. In Europe the steinbock has entirely disappeared, and the chamois is found only in certain districts where it has been carefully preserved. Cashmere, formerly the happy hunting-ground of the Indian officer, is now nearly cleared out, and it is very hard work, we are told, to get one decent "head" of barasingha or ibex in a whole season. As for Africa, the whole of the easily accessible country has been swept clean by the host of "big game" shooters, and it is only by penetrating into such distant places as the swamps of the Luapula, or the torrid deserts of Lake Rudolph, that the larger mammals, which formerly populated its whole surface, can be "got at" in any numbers. Such being the case, it was quite time that an account of what has been for many years one of the great national sports of the British race should be taken in hand. It will help the adventurous spirits of the present generation to share more easily in a pastime that cannot last much longer, and, at the same time, hand down to future ages a record of what were the delights and dangers of slaughtering the extinct mammals of the preceding era.

Of the high qualifications of the editor and those who have assisted him in the present work, there can be no doubt whatever. Mr. Phillipps-Wolley is a recognised authority upon the game of the Caucasus and Western America. The names of Baker, Oswell, Jackson, Pike, and Selous are well known to sportsmen all over the world as those of ardent and intrepid hunters of the past and present generation. In the present work they have all made excellent contributions to the common stock of knowledge on the subject; but, as is usually the case where five or six people join together in writing one book, there is perhaps a little want of a uniform system in the combined product. We may even venture to hint that a little judicious compression and excision might have combined the two volumes into one. On the whole, however, this perhaps would not have been altogether desirable; it might have caused the omission of some of the excellent illustrations which pervade the two volumes, and possibly have interfered with the very plain and legible print now before our eyes.

The first volume of "Big Game Shooting" opens with an essay by Mr. Phillipps-Wolley on the general principles of the subject. No apology, we agree with him, is required for "Big Game Shooting." Man from his earliest origin has been a hunting animal. Even in the most highly civilised races the love of wild sport affects some of the most highly gifted and intelligent of the race, and gives exercise to those masculine virtues which in these days it is so necessary to encourage. The best hunters, moreover, have done much for geography and much for science, although it may be the mere love of hunting that has originally prompted them in their expeditions. In Africa, as Mr. Phillipps-Wolley well puts it, hunting and exploration have certainly gone hand in hand; in America, it was the hunter who first explored and settled the great West; while in India, not the least amongst those latent powers which enable us to govern our Asiatic fellow-subjects, is the "respect won by generations of English hunters from the native shikaris and hillsmen."

Agreeing fully with the author in his vindication of the

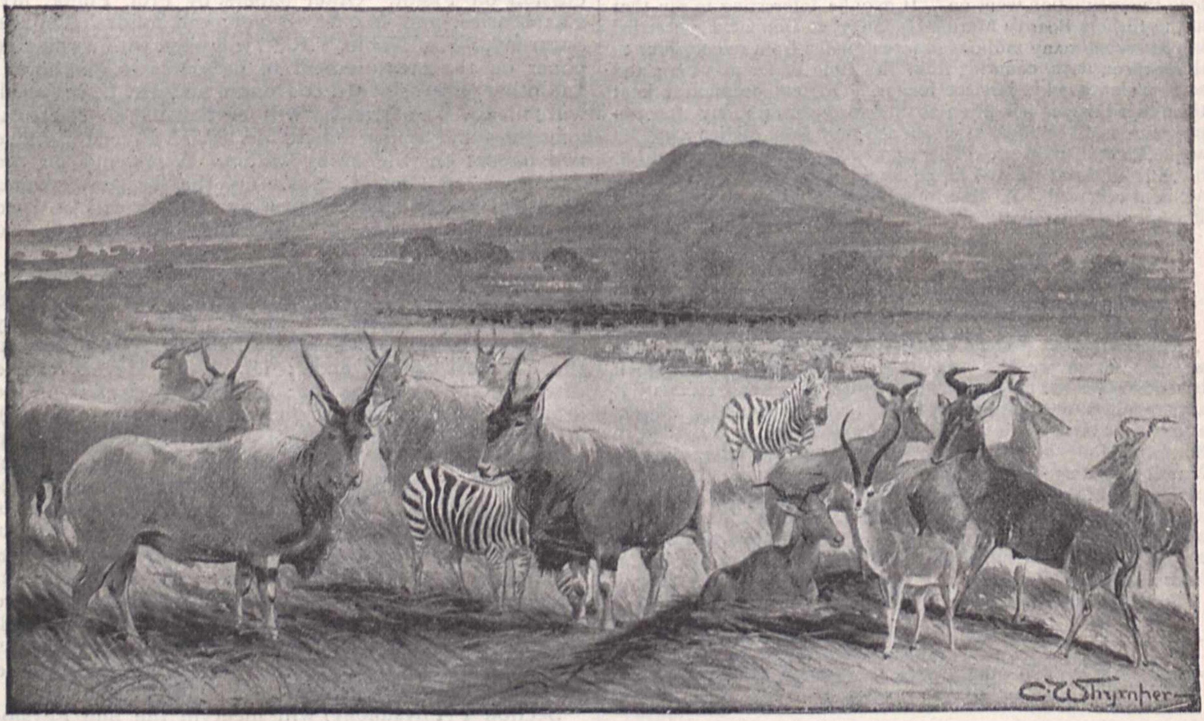


FIG. 1.—Game animals in British East Africa.

[1] "Big Game Shooting." By Clive Phillipps-Wolley. With contributions by Sir Samuel W. Baker, W. C. Oswell, F. J. Jackson, Warburton Pike, and F. C. Selous. The Badminton Library. Two vols. (London: Longmans, Green, and Co., 1894.)

merits of big game shooting, we will not follow him into the arcana relating thereto, which will be mainly profitable to those who wish to indulge in the pursuit.

The four chapters which follow Mr. Phillipps-Wolley's introduction are devoted to a biography of Oswell, and to a history of his various expeditions in South Africa. These are all of great interest, and will be read by his brother shooters with an affection and reverence correctly due to so renowned a pioneer of their favourite pursuit. But the days of Oswell, alas, are past and gone, and we doubt whether the modern shooter of big game will profit much by the narrative of his hazardous exploits, although they will form excellent chapters for reading round the camp fire—if big game shooters ever have time for such a diversion. Very different is the case with Mr. F. J. Jackson, of Uganda fame, whose eleven chapters occupy the next place. East Africa is now almost the only country in the world where there is still unoccupied space left for the shooters of big game, and where the elephant, the buffalo, the lion, the rhinoceros, the hippopotamus, the giraffe, and a host of antelopes are still to be met with in luxuriant abundance. Mr. Jackson commences with good advice on the proper mode of fitting out an expedition, and on the routes and districts to be traversed with greatest profit.

He then devotes separate chapters to the various animals above mentioned, and gives us altogether what will prove to be a most useful guide-book to the hunter in Eastern Africa. The chapter on antelopes is of very great interest even to the scientific naturalist. The various species are separately enumerated, and discussed under their correct scientific names. Their number, not only as regards individuals, but species, is simply astonishing. Dividing them according to the sportsman's point of view into two categories, Mr. Jackson places eighteen antelopes under the head of those which frequent the open plains, while those which are usually found in the bush make fifteen more, so that not less than thirty-three species of these elegant bovine animals are registered as occurring in East Africa. Had Somaliland been included within East African limits, several more species might have been added. We look upon Mr. Jackson's contribution as the most original and valuable part of the first volume, although Mr. Selous' chapter on the lion and his ways, and Mr. Pike's account of the slaughter of the musk-ox in the barren lands of Arctic America, are likewise of considerable value.

To the second volume of "Big Game Shooting" the contributors are hardly less inferior in fame than those who have written the former portion. Mr. Arnold Pike discourses on Arctic hunting, in which the walrus and the polar bear form the chief subjects of attraction. Mr. Phillipps-Wolley tells us of his adventures in the Caucasus, where the chief mountain game consists of the chamois and two species of ibex, while the slopes on the northern side of the chain are the favourite haunts of the few bison that are left, and of a large stag, termed by Mr. Phillipps-Wolley the red deer. But this stag is more probably the maral (*Cervus maral*) which many years ago was introduced into the Zoological Society's gardens from Circassia, and flourished abundantly for more than ten years.[1] Of the bison, or as it is called in this work, the "Caucasian aurochs," the redoubtable traveller and hunter, Mr. St. George Littledale, the only Englishman who has slain this mighty beast in the Caucasus, gives us full particulars. As is now well known, a small district on the northern slope of the Caucasus and one far-distant forest in Lithuania are the only remaining spots on the face of the earth where this splendid animal is still to be met with. Not many centuries ago, no doubt, the European bison pervaded the whole intervening district, and in past ages spread all over Europe, and was abundant even in England. But to call it the "aurochs" is a misnomer, for the true aurochs is the extinct Urus (*Bos primigenius*) which was found in the forests of Germany during the time of Julius Cæsar. Mr. Littledale also gives us a good

FIG. 2.—Spanish Ibex.

account of the huge *Ovis argali* of Mongolia, and the corresponding *Ovis polii* of the Pamir, two gigantic sheep, which he was amongst the first of British sportsmen to encounter.

Another well-known hunter, Mr. Baillie-Grohman, writes chapters on the more familiar chamois and stag of the Alps, while Messrs. Chapman and Buck contribute an excellent account of the large game of Spain and Portugal, a subject on which they are well qualified to speak from long personal experience. The picture of the Spanish ibex, taken from Mr. Chapman's sketches, with the lammergeiers floating in the distance, gives us a good idea of the attractions still to be met with in "Wild Spain," which he and Mr. Buck have done so much to

[1] See Mr. Sclater's article on "The Deer, now or lately living in the Society's Menagerie." (*Trans. Zool. Soc.* vii. p. 336.

make known to us. Indian shooting is well treated by Colonel Percy, who goes very fully into the subject. It is, indeed, an ample one, and Colonel Percy enumerates no less than fifty-three animals to be included in the category of big game by the fortunate sportsmen of India. The second volume concludes with good advice about camps, transport, rifles, and ammunition, and with a few hints on taxidermy, showing the way in which the larger animals should be skinned and their heads set up as sportsmen's trophies.

In concluding our notice of this attractive work, we may be permitted again to call notice to the illustrations, which, with few exceptions, are of a high degree of excellence. Two of these, by the kind permission of the publishers, we reproduce on the present occasion. The first of them represents a scene in British East Africa, between Teita and Taveta, in the Kilima-njaro district, where (in September 1886) the country was "literally crawling" with zebra, hartebeest, impala, oryx, and Grant's antelope, besides eland and giraffe, and an occasional steinbok and wart-hog." In those days Taveta was correctly designated the "Hunters' Paradise." The second illustration shows us the haunt of the Spanish ibex, of which we have already spoken.

Before concluding our notice of what will no doubt quickly and deservedly become the big-game-shooters' favourite handbook, we venture to call attention to what is probably a slight slip on the part of Mr. Phillipps-Wolley. General Richard Dashwood, than whom there can be no better authority on the subject, has commented, in an article in *Land and Water* (March 24, 1894), rather severely on some of Mr. Phillipps-Wolley's statements regarding the caribon and moose of North America. It is no doubt incorrect to say that caribon and moose feed upon the same food. As explained by General Dashwood, their tastes are very different. It is also an error to describe the "call-cry" of the female moose as a roar. General Dashwood's experienced ear teaches him to describe it as a "beautiful clear note, rising and falling with a sort of entreaty in the tone and a soft grunt at the end."

POPULARISING SCIENCE.

"POPULAR science," it is to be feared, is a phrase that conveys a certain flavour of contempt to many a scientific worker. It may be that this contempt is not altogether undeserved, and that a considerable proportion of the science of our magazines, school text-books, and books for the general reader, is the mere obvious tinctured by inaccurate compilation. But this in itself scarcely justifies a sweeping condemnation, though the editorial incapacity thus evinced must be a source of grave regret to all specialists with literary leanings and with the welfare of science at heart. The fact remains that in an age when the endowment of research is rapidly passing out of the hands of private or quasi-private organisations into those of the State, the maintenance of an intelligent exterior interest in current investigation becomes of almost vital importance to continual progress. Let that adjective "intelligent" be insisted upon. Time was when inquiry could go on unaffected even by the scornful misrepresentations of such a powerful enemy as Swift, because it was mainly the occupation of men of considerable means. But now that our growing edifice of knowledge spreads more and more over a substructure of grants and votes, and the appliances needed for instruction and further research increase steadily in cost, even the affectation of a contempt for popular opinion becomes unwise. There is not only the danger of supplies being cut off, but of their being misapplied by a public whose scientific education is neglected, of their being deflected from investigations of certain, to those of doubtful value. For instance, the public endowment of the Zetetic Society, the discovery of Dr. Platt's polar and central suns, or the rotation of Dr. Owen's Bacon-cryptogram wheel, at the expense of saner inquiries might conceivably and very appropriately result from the specialisation of science to the supercilious pitch.

It should also go far to reconcile even the youngest and most promising of specialists to the serious consideration of popular science, to reflect that the acknowledged leaders of the great generation that is now passing away, Darwin notably, addressed themselves in many cases to the general reader, rather than to their colleagues. But instead of the current of popular and yet philosophical books increasing, its volume appears if anything to dwindle, and many works ostensibly addressed to the public by distinguished investigators, succeed in no notable degree, or fail to meet with appreciation altogether. There is still a considerable demand for popular works, but it is met in many cases by a new class of publication from which philosophical quality is largely eliminated. At the risk of appearing impertinent, I may perhaps, as a mere general reader, say a little concerning the defects of very much of what is proffered to the public as scientific literature. As a reviewer for one or two publications, I have necessarily given some special attention to the matter.

As a general principle, one may say that a book should be written in the language of its readers, but a very considerable number of scientific writers fail to realise this. A few write boldly in the dialect of their science, and there is certainly a considerable pleasure in a skilful and compact handling of technicalities; but such writers do not appreciate the fact that this is an acquired taste, and that the public has not acquired it. Worse sometimes results from the persistent avoidance of technicality. Except in the cases of the meteorologist, archæologist, and astronomer, who are relatively free from a special terminology, a scientific man finds himself at a great disadvantage in writing literary English when compared with a man who is not a specialist. To express his thought precisely he gravitates towards the all too convenient technicality, and forbidden that, too often rests contented with vague, ambiguous, or misleading phrases. It does not follow that, because, what from a literary standpoint must be called "slang," is not to be used, that the writer is justified in "writing down" as if to his intellectual inferiors. The evil often goes further than a lack of precision. Out of a quite unwarrantable feeling of pity and condescension for the weak minds that have to wrestle with the elements of his thought, the scientific writer will go out of his way to jest jests of a carefully selected and most obvious description, forgetting that whatever status his special knowledge may give him in his subject, the subtlety of his humour is probably not greatly superior, and may even be inferior to that of the average man, and that what he assumes as inferiority in his hearers or readers is simply the absence of what is, after all, his own intellectual parochialism. The villager thought the tourist a fool because he did not know "Owd Smith." Occasionally scientific people are guilty of much the same fallacy.

In this matter of writing or lecturing "down," one may even go so far as to object altogether to the facetious adornment of popular scientific statements. Writing as one of the reading public, I may testify that to the common man who opens a book or attends a lecture, this clowning is either very irritating or very depressing. We respect science and scientific men hugely, and we had far rather they took themselves seriously. The taste for formal jesting is sufficiently provided for in periodicals of a special class. Yet on three occasions recently very considerable distress has been occasioned the writer by such mistaken efforts after puerility of style. One was in a popular work on geology, where the beautiful problems of the past of our island and the evolution of life were defaced by the disorderly offspring of a quite megatherial wit—if one may coin such an antithesis to "etherial." One jest I am afraid I shall never forget. It was a Laocoon struggle with the thought that the huge subsidiary brains in the lumbar region of *Stegosaurus* suggested the animation of Dr. Busby's arm by the suspicion of a similarly situated brain in the common boy. The second disappointment was a popular lecture professing to deal with the Lick Observatory, and I was naturally anxious to learn a little of the unique appliances and special discoveries of this place. But we scarcely got to the Observatory at all. We were shown—I presume as being more adapted to our intelligence—numerous lantern-slides of the road to the Lick Observatory, most of them with the "great white dome" in the distance, other views (for comparison probably) with the "great white dome" hidden, portraits of the "gentlemen of the party on horseback," walks round the Observatory, the head of an interesting old man who lived in a cottage near, the dome by moonlight, the dome in winter, and at last the telescope was "too technical" for explanation, and we were told in a superior tone of foolish things our fellow common people had said about it. For my own part, I really saw nothing very foolish in a lady expecting to see houses on the moon. My third experience was ostensibly a lecture on astronomy, but it was really an entertainment—and a very fair one—after the lines of Mr. Grossmith's. "Corney Grain in Infinite Space" might have served as a title. It was very amusing, it was full of humour, but as for science, the facts were mere magazine *clichés* that we have grown sick of long ago. And as a pretty example of its scientific value I find a newspaper reporter, whose account is chiefly "(laughter)" with jokes in between, carried away the impression that Herschel discovered Saturn in the reign of George the Third.

Now this kind of thing is not popularising science at all. It is merely making fun of it. It dishonours the goddess we serve. It is a far more difficult thing than is usually imagined, but it is an imperative one, that scientific exponents who wish to be taken seriously should not only be precise and explicit, but also absolutely serious in their style. If it were not a point of discretion it would still be a point of honour.

In another direction those to whom the exposition of science falls might reasonably consider their going more carefully, and that is in the way of construction. Very few books and scientific papers appear to be constructed at all. The author simply wanders about his subject. He selects, let us say, "Badgers and Bats" as the title. It is alliterative, and an unhappy public is supposed to be singularly amenable to alliteration. He writes first of all about Badger A. "We now come," he says, "to Badger B"; then "another interesting species is Badger C"; paragraphs on Badger D follow, and so the pavement is completed. "Let us now turn to the Bats," he says. It would not matter a bit if you cut any section of his book or paper out, or shuffled the sections, or destroyed most or all of them. This is not simply bad art; it is the trick of boredom. A scientific paper for popular reading may and should have an orderly progression and development. Intelligent common people come to scientific books neither for humour, subtlety of style, nor for vulgar wonders of the "millions and millions and millions" type, but for problems to exercise their minds upon. The taste for good inductive reading is very widely diffused; there is a keen pleasure in seeing a previously unexpected generalisation skilfully developed. The interest should begin at its opening words, and should rise steadily to its conclusion. The fundamental principles of construction that underlie such stories as Poe's "Murders in the Rue Morgue," or Conan Doyle's "Sherlock Holmes" series, are precisely those that should guide a scientific writer. These stories show that the public delights in the ingenious unravelling of evidence, and Conan Doyle need never stoop to jesting. First the problem, then the gradual piecing together of the solution. They cannot get enough of such matter.

The nature of the problems, too, is worthy of a little attention. Very few scientific specialists differentiate clearly between philosophical and technical interest. To those engaged in research the means become at last almost as important, and even more important than the end, but apart from industrial applications, the final end of all science is to formulate the relationship of phenomena to the thinking man. The systematic reference of *Calceola*, for instance, *Theca*, the Lichens, the Polyzoa, or the Termites, is an extremely fascinating question to the student who has just passed the elementary stage, and so too is the discussion of the manufacture and powers of telescopes and microscopes; morphological questions again become at last as delightful as good chess, and so do mathematical problems. But it must be remembered that morphology, mathematics, and classification are from the wider point of view mere intellectual appliances, and that to the general reader they are only interesting in connection with their end. To the specialist even they would not be interesting if he had not first had their end in view. The fundamental interest of all biological science is the balance and interplay of life, yet for one paper of this type that comes to hand there are a dozen amplified catalogues of the "Cats and Crocodiles" description. I find again, presented as a popular article, a long list of double stars with their chief measurements. Now, to a common man one double star is as good as a feast. Again, the botanist, asked to write about leaves, will get himself voluminously entangled in the discussion whether an anther is a lamina, or in an exhaustive and even exuberant classification of simple and compound, pinnate and palmate, and the like, making great points of the orange leaf and the barberry. But the kind of thing we want to have pointed out to us is *why* leaves are of such different shapes and so variously arranged. It is a thing all people who are not botanists puzzle over, and a very pretty illustrated paper might be written, and remains still to be written, linking rainfall and other meteorological phenomena, the influence of soil upon root distribution and animal enemies, with this infinite variety of beautiful forms.

Enough has been said to show along what lines the genuine populariser of science goes. There are models still in plenty; but if there are models there are awful examples—if anything they seem to be increasing—who appear bent upon killing the interest that the generation of writers who are now passing the zenith of their fame created, wounding it with clumsy jests, paining it with patronage, and suffocating it under their voluminous and amorphous emissions. There is, I believe, no critical literature dealing generally with the literary merits of popular scientific books, and there are no canons for such criticism. It is, I am convinced, a matter that is worthy of more attention from scientific men, if only on the grounds mentioned in my opening paragraphs.

H. G. WELLS.

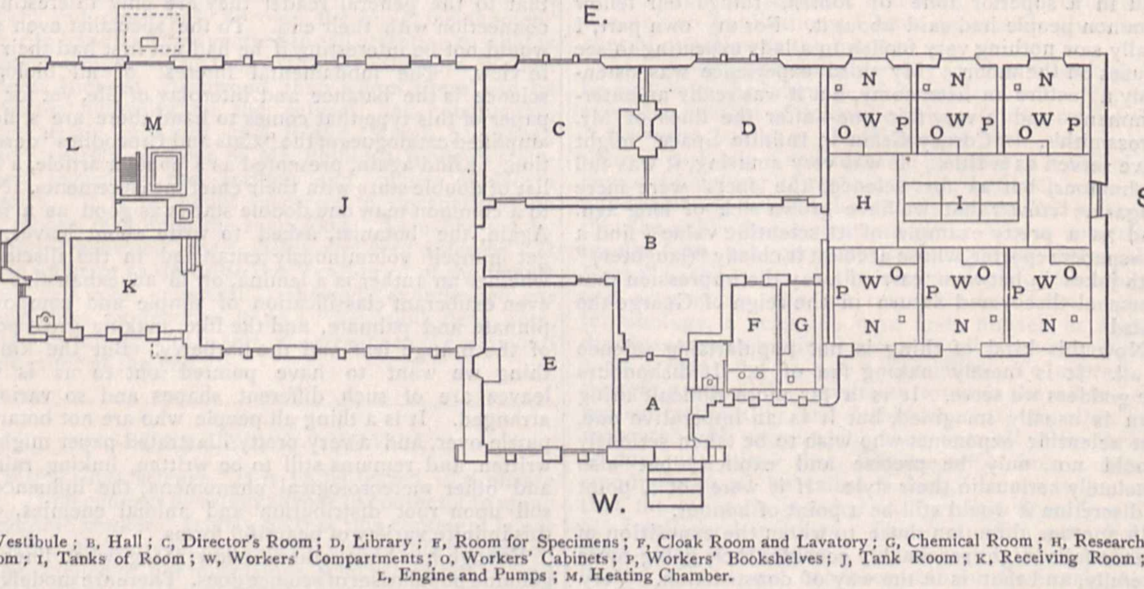
ON THE NEW BUILDINGS FOR THE ST. ANDREWS (GATTY) MARINE LABORATORY.

THAT St. Andrews had not one of the oldest marine laboratories was the result of an accident. Nevertheless it has the oldest marine laboratory in Britain, since it was opened early in 1884, though since 1882 the practical laboratory in the College had been used for this purpose; and it could not well be otherwise, since it was within a stone's cast of the bay—so rich in a varied fauna and flora. For ten years the work of the laboratory has been carried on under considerable difficulties in a wooden building originally erected as a temporary fever-hospital, and the walls and roof of which were neither wind- nor water-tight. This structure was situated on a spit of sand near the harbour, and most conveniently placed for easy access to the fishing-boats and the beach; but it was on a public common, and though for nearly two years every effort has been made to get the new laboratory erected on the same site, it was found to be impracticable, and a new site was therefore chosen on University ground, about 300 yards further south, and close to the beach. This site affords ample space, and, besides, a small fresh-water stream flows through it.

The new laboratory is the munificent gift of Dr. Charles Henry Gatty, of Felbridge Place, East Grinstead, who has placed £2500 at the disposal of the University of St. Andrews for its erection. The building will face the west, with the back towards the east and the sea, and will be for the most part of one storey. From its eastern or sea face the windows command an extensive view of the picturesque bay, with the Forfarshire coast terminating

mirror, and other fittings, on the right wall a series of shelves (P) for books and other things, while behind is a cabinet of drawers (O) for storage of delicate apparatus and specimens. From the position of the building three of these windows look to the sea, and three to the west; while a seventh admits light from the southern end of the building. In the centre of the room is a series of tanks of sea-water, six in number (one for each worker), besides various shelves for smaller glass aquaria, and the necessary pipes and nozzles for distributing sea-water as required. A fireproof compartment for long-continued use (all night) of the hot bath occurs at one end, while each worker has a separate small paraffin apparatus in his compartment.

The lobby on the left leads to the tank-room (J) or aquarium, 30 ft. 6 in. × 30 ft., and with three windows on each side (east and west) for illuminating the tanks—of slate and glass—ranged round the room, as well as placed in the centre. While that part of the building already described has wooden floors, the aquarium is paved with concrete. A door at the northern end leads by a few steps to the receiving-room (K), with its long table and sink, where the specimens procured by the



A, Vestibule; B, Hall; C, Director's Room; D, Library; E, Room for Specimens; F, Cloak Room and Lavatory; G, Chemical Room; H, Research Room; I, Tanks of Room; W, Workers' Compartments; O, Workers' Cabinets; P, Workers' Bookshelves; J, Tank Room; K, Receiving Room; L, Engine and Pumps; M, Heating Chamber.

in the steep rocks of the "Red Head" on the left, and on the right the well-known cliffs from which the "Rock and Spindle" and "Maiden Rock" stand out boldly, while here and there a more gentle slope gives a patch of bright green sward. The western face or front has a view embracing the fine old ruins of the cathedral, the southern suburbs of the city, and a wide stretch of Fife, including such eminences as Drumcarro Craig and Clatto Hill. It has a frontage of 125 feet, and the building is in the Scottish style of architecture—unpretending externally, but comfortable and convenient internally.

The entrance is in the projecting block on the west, leading into a vestibule (A), and a spacious hall (B), with lobbies leading right and left. In this block are situated three official rooms, viz. the Director's room (C), the library (D), and the room for specimens (E), the two former looking into the bay, the latter to the west. Besides these are a cloak-room with lavatory (F) and a chemical room (G). The lobby on the right leads to the research room (H), which is 30½ ft. × 30 ft., and contains compartments (W) 10 ft. square, with partial partitions about 8 ft. in height, for six workers. Each of these has at the window a large and convenient table (N) with sink,

boats are arranged by the attendant before being introduced into the tank-room or distributed to the workers. The outer door to this room is on the western face of the building (front), and above it is a large storage-tank for sea-water. In this block are the apartments for the engine and pumps (L), a store and the heating-chamber with accessories (M), all these being entirely separated from the tank-room by a thick wall of stone.

The main apartments are heated by hot-water pipes, with the exception of the three in the centre (viz. Directors' room, library, and museum), which have fireplaces for gas.

The laboratory is capable of easy extension should that ever be necessary, and it is readily reached from the class-rooms of the University. Moreover, being in direct connection with the latter, the workers have the advantage of free access to the University library and museum, besides that communication with those of similar tastes, which is so congenial as well as profitable to the naturalist, and which cannot be compensated by mere richness of fauna and flora, if these are in an isolated locality or difficult of access.

Further, in addition to its connection with the University, the laboratory from the first has been under the control of the Fishery Board for Scotland, who administered the Parliamentary grant given in 1884 for its equipment, and who maintain the attendant and defray certain other expenses.

Ample space exists for the formation of large external ponds and tanks, and certain portions of the tidal rocks in the neighbourhood are fitted for enclosure, so that young fishes and crustaceans may be reared from the post-larval stages onward, under conditions as closely approaching nature as possible. In the same way the culture of useful mollusks can be experimented with.

The beach at St. Andrews is remarkably adapted for marine researches, since it combines extensive reaches of sand with their special forms, and on which a vast variety of materials in a fresh state are stranded by storms, with great stretches of tidal rocks and rock-pools so rich in littoral animals and plants. The valuable mussel-bed in the estuary of the Eden, the proximity of the Forth and the Tay, the constant stream of specimens brought by the fishing-boats, and the plenitude of life in the bay itself—all combine to render it classic ground to the naturalist. For example, amongst the rarer forms at St. Andrews are *Corymorpha*, *Cerianthus*, *Pennatula*, *Asterias Mülleri*, *Echiurus*, *Magelona*, *Tornaria Mitraria*, swarms of Appendicularians (*Oikopleura*), *Pelonaia*, *Actinotrocha*, the Pteropods *Clione* and *Spirialis*, the Nudibranch *Idalia*, and the Tectibranch *Aplysia*.

The greatly improved facilities for research which the munificence of Dr. Gatty has granted to St. Andrews cannot but increase the results in regard to marine biological science and the fisheries, and render the old University city even better known in this connection in the future than in the past. Yet there are those still living who remember the glee of Edward Forbes as he picked up the living spoon-worms (*Echiuri*) on the west sands, and who listened to a short course of lectures he gave in the University on star-fishes, before the publication of his work on this group, and who were familar with the figure of John Reid as he descended the steps at the Baths to hunt for *Hydra tuba*, and watch the scyphistoma-stage of *Aurelia*, which he independently worked out there. It is unnecessary on the present occasion to allude to the names of more recent workers, but they are many, and include continental and American, as well as those of our own country. W. C. M.

NOTES.

ALL who take an interest in science will be glad to hear that the health of Prof. von Helmholtz has been improving of late, and that he has regained partial use of his paralysed side.

THE resignation of Prof. Dana, from the position he has so long occupied at Yale University, is announced. Dr. Dana was appointed, in 1850, Silliman Professor of Natural History and Geology at Yale, and now at the age of eighty-one years he is compelled to abandon further active work by reason of feeble health. We hope that many years of well-earned rest remain to him.

PROF. H. S. WILLIAMS, formerly of Cornell University, has been appointed Prof. Dana's successor at Yale University.

THE sixty-second annual meeting of the British Medical Association will take place at Bristol, from July 31 to August 3, under the presidency of Dr. E. Long Fox. The report which the council has to present is, we understand, a very favourable one, and shows that the membership of the Association has increased from 14,703 to 15,090, and the total investments to £41,789. Dr. Long Fox is to deliver his address on Tuesday, July 31, and during the meeting the following addresses will be delivered:—On Medicine, by Prof. Sir T. Grainger Stewart; on Surgery, by Prof. Greig Smith; and on Public Medicine, by Sir Charles Cameron.

THE Société Industrielle de Mulhouse has issued a programme of the prizes to be awarded next year. The prizes are open to all, whether natives of France or not, and works competing for them must reach the President of the Society before February 15, 1895. Most of the awards consist of medals only, but some carry with them prizes varying from one hundred to five thousand francs. A complete programme can be obtained by applying to the Secretary of the Society, Mulhouse.

THE twenty-third meeting of the French Association for the Advancement of Science will be opened at Caen on August 9, under the presidency of Prof. Mascart. The work of the Association will be divided into four groups, each containing from three to five sections. The first group (Sciences Mathématiques) will be devoted to mathematics, astronomy, and geodesy, mechanics, navigation, civil and military engineering. To Group II. (Sciences Physiques et Chimiques) belong physics, chemistry, meteorology, and terrestrial physics. In the third group (Sciences Naturelles et Médicales) will be found geology and mineralogy, botany, zoology, anatomy, physiology, anthropology, and medical sciences. The fourth group (Sciences Économiques) is concerned with agriculture, geography, political economy and statistics, pedagogy, hygiene, and public health.

THE next annual meeting of the Italian Botanical Society will take place at Palermo, in 1895. For the present year a botanical excursion is arranged, on September 25 and the three following days, to the Island of Giglio, the largest of the Tuscan Archipelago, except Elba, the flora of which has been but imperfectly explored. Botanists desirous of taking part in the expedition should communicate, not later than September 15, with the President, Prof. Arcangeli, 19 Via Romana, Florence.

INFORMATION has come to hand respecting an International Exhibition of Arts, Industries, &c., which is to be held at Bordeaux in 1895. The exhibition, which is the thirteenth held at Bordeaux, will be opened on May 1, and will be divided into some ten Sections, as follows:—Section I. Education. II. Arts (Liberal, Industrial, and Decorative; Medicine, Hygiene, &c.). III. Social Sciences. IV. Agriculture, Horticulture. V. Wines and Spirits. VI. Industries (Mineralogical, Mechanical, Chemical, &c.). VII. Habitation (Furniture, Dress, &c.). VIII. Transport, Civil Engineering, and Military Art. IX. Electricity. X. Commerce and Colonies. England, Belgium, Italy, Portugal, Spain, and Switzerland are invited to contribute.

THE seventeenth annual meeting of the Midland Union of Natural History and Scientific Societies will take place on August 3 and 4, at Ellesmere, under the auspices of the Ellesmere Natural History Society and Field Club. A strong programme has been arranged, and after the business meetings of August 3 a conversazione will be held at St. Oswald's College. The following day will be taken up by three excursions: one to Chirk, Llangollen, and Valle Crucis for the archæologists, led by Mr. A. T. Jebb; a second, round the Meres and Peat Mosses of the neighbourhood for the biologists, under the leadership of Messrs. Peake, Jennings, and Thompson. The third, for the geologists, will be under the guidance of Dr. Callaway, who will conduct his party to Hawkstone and Grinshill. We understand that the Ellesmere Society hope that many of the visitors will be able to stay in the neighbourhood over the Bank-holiday, when further excursions may be arranged, and they are perfecting the arrangements in a most generous and hospitable spirit.

WE hear, with much regret, of the death, at the age of seventy-nine years, of Dr. Daniel Cornelius Danielssen, who has been since 1864 president of the Directors of the Bergen Museum, and of Prof. Michele Lessona, President of the Royal Academy of Science at Turin.

The death is announced of Mr. Alfred Williams, who for many years has been closely identified with the branch of his profession relating to gas engineering. Mr. Williams was one of the founders of the Society of Engineers, and has acted as its honorary secretary and treasurer since its inauguration in 1854.

The Accademià dei Lincei at Rome held its annual meeting on June 3, the President, Senator Brioschi, being in the chair. The King of Italy always attends these meetings, and this year the Queen accompanied him. The magnificent Palazzo Corsini, which compares with the rooms of the Royal Society very much as the consideration shown to men of science in Italy does with the neglect of science by the powers that be in England, was *en fête*, and the sitting, already recorded at length in the *Atti*, was a most interesting one. The President referred to the work done by the Society, and the constant sympathy of the King with its affairs; and Prof. Ferraris, of the Turin Industrial Museum, gave a discourse on the electric transmission of energy.

We have often in these columns had to complain of the backwardness of the Government of this country to recognise the value of men of science and the work in which they are engaged, and a fresh instance of this slowness of vision is furnished in a recent number of the *Electrical Review*. It seems that of the deputations sent last year to the International Congress at Chicago, the delegates who represented France and Germany had the whole of their expenses paid, and were rewarded according to their several merits with decorations, honours, and with courteous thanks. The representatives of Great Britain alone have been ignored entirely: and, so far from their services receiving remuneration or thanks, it is doubtful whether her Majesty's Government even know the names of those who looked after British interests and maintained the credit of Britain on this most important occasion. Yet they were all men of the highest eminence, who sacrificed much time and trouble to this thankless business. According to our contemporary, among them was one whose labours have been rewarded abroad with every kind of honour and acclaim, whose work has wrought incalculable benefit, whose inventions are in constant universal use, who gave his greatest discovery freely to the world—and who has never in his own country received the smallest official recognition or distinction. Truly, a prophet is not without honour save in his own country and among his own people.

Some sensational paragraphs have appeared in evening papers as to all hope of the Wellman arctic expedition being abandoned; but this is not the case. There is serious cause for anxiety, but the probability that Mr. Wellman had left the *Ragnvald Jarl* before she was lost, is at least as great as that he was on board at the time. During the next month there will be frequent communication with Spitzbergen, and the position of Mr. Oyen on Danes Island will not be one of utter desolation. Colonel Feilden writes to the *Times* from Lerwick on July 21, correcting some of the extravagant rumours which had been published. He states that none of Mr. Wellman's party had any previous experience of Arctic work, and that the conduct of the expedition, so far as known, showed ignorance of the risks they would have to run.

The American Museum of Natural History have commissioned Prof. Rudolph Weber to organise an expedition to Sumatra, for the purpose of scientific exploration and the collection of specimens. Mr. Weber will leave New York on the 28th inst., and will study for a short time in Germany, thence proceeding to Sumatra, where he will collect and equip a force of natives for the expedition.

With reference to the note in our last number, respecting the Rev. S. A. Thompson Yates's gift to the University College, Liverpool, a correspondent writes:—"The Thompson Yates Laboratories are to be exclusively devoted to physiology and pathology; and since of no two subjects can it be said with more truth that "aliud ex alio clarescet," it is to be hoped that both will largely benefit by the fact of their being housed in the same building. Many of the requirements are identical, so that the proposed new laboratories, whilst providing the separate accommodation for such teaching and research as the study of the subjects requires, will be as far as practicable dovetailed, so as to avoid the reduplication of costly special rooms. It is hoped that such combined laboratories may prove of value by bringing into intimate association pathological and physiological scientific workers, and it is certain that a building complete in itself, which provides for both departments, must lend itself most advantageously to economical maintenance. The building will be situated in the ample grounds of the College, and will form a block to which, at some subsequent date, the Medical faculty hopes to add further new buildings for other departments of its Medical School."

By permission of the postal authorities, the wires between St. Margaret's and the General Post Office, London, were, on Sunday afternoon and evening last, used for the purpose of some experiments with the teleautograph, the invention of Prof. Gray, of New York; the time for the experiments being selected owing to the wires being comparatively idle on Sundays. The experiments took place between the General Post Office, London, and Cable Hut, St. Margaret's Bay, through which the London and Paris telephone passes. Special instruments were fixed up at both ends, and as this was the first time that long distance experiments in teleautography have taken place in this country, they were watched with unusual interest. The results were excellent, the messages transmitted being in every respect most successful, and the instruments working without the slightest hitch over a distance of 83 miles. Messages were both sent from and received at St. Margaret's Bay. The principle of the instrument is that it automatically records an exact *facsimile* of the writing contained in messages. In the experiments on Sunday the receiving pencil recorded with ease and clearness different handwritings, giving thick and thin strokes, dotting i's, and crossing t's very correctly.

The current number of the *British Medical Journal*, in a leader on "Cholera Prospects," laments the fact that "there are half-a-hundred places in England where, if cholera were to be introduced to-morrow, it would, unless at once detected, spread, and not only so, but spread to the danger of communities around, and which, by reason of gathering grounds of their water supply, or the like, are at the mercy of some rural body whose sole aim as a body seems to be to cut down the rates at the expense of the public health." The outlook, as far as this country is concerned, is not of the brightest, and health bodies would certainly do well to take to heart the advice of our contemporary, and bestir themselves betimes to the proper fulfilment of the duties devolving upon them.

Confirmation of the wisdom of the old adage, "There is nothing new under the sun," is to be found in the *Lancet* for July 21, which details from the "Newes" of 1665 a series of precautions employed in combating the plague of London in that year. "These include the appointment of parochial examiners to investigate cases of sickness and to take measures for their isolation if needful and the employment of watchmen to ensure this result and of chirurgeons to certify the presence of plague. Notification of this disease was the duty of householders; every infected house was marked in the manner with which we are all familiar and underwent a quarantine of longer or shorter duration, and disinfection was carried out by airing with fire and by medicated fumigation. Nurses on the termination of a case were subject to twenty-eight days' seclusion, and visitors were forbidden the house of sickness." We of to-day could do worse than act upon much of the advice here given.

IN the report of the Puffin Island Biological Station, just received, we find a history of the station since its vacation by the Liverpool Biological Society for their new home at Port Erin. The laboratory was taken over in 1892 by a number of members of the staff of University College, Bangor, and other residents in the neighbourhood; and a committee of management was formed, with Mr. P. J. White, who also edits the report, as director of the station. The contributors to the present report of thirty-two pages deal briefly with special points of interest in the terrestrial fauna and flora and the archæology of the island, and the director offers some suggestions in regard to the improvement of the sea-fisheries (shell-fish) of the district.

THE *Compte Rendu* of the fifth session of the International Geological Congress, held at Washington in 1891, has just appeared. The general arrangement of the book closely follows that of the report of the London Congress (1888), but it is printed on larger paper. The formal reports of discussions, &c., are printed in French, but these occupy only a small portion of the book; the greater part consists of descriptive papers and of fuller reports of some discussions, mainly in English. The description, by C. R. van Hise, of the pre-Cambrian rocks of the Lake Superior region, and the geological guide-book to the Rocky Mountain Excursion, edited by S. F. Emmons, are interesting portions of the report. Some notes and sketches by "visiting geologists"—Prof. T. McK. Hughes and Dr. Fr. Frech—are appended. We may also here note that Dr. F. Wahnschaffe has published detailed descriptions of the Western districts in *Naturwissenschaftliche Wochenschrift*. The Rocky Mountain Guide-book is by numerous contributors, and we have received a separate copy of that part relating to the Yellowstone Park, by A. Hague.

WE have received part i. of the twelfth annual report of the Fishery Board for Scotland, being for the year 1893. Following the practice of previous years, the report will be issued in three parts. The third part deals with the scientific investigations conducted under the direction of the Board, and in it the hatchery established at Dunbar for the propagation of marine food-fishes will be described. We learn from the present part that the establishment consists of a small tidal pond, in which a limited number of spawning fishes may be collected and preserved; a large concrete spawning tank, in which the fishes at maturity are placed; a chamber for the automatic collection of the fish eggs, and for the filtration of the water; a hatching room, in which the special hatching apparatus is fitted up; together with the necessary pumping apparatus. The whole of the expenditure, amounting to about £1600, has been met from the ordinary vote for scientific investigations. So far, the operations have been limited by the want of a sufficiently capacious sea-water enclosure. Nevertheless, over 25,000,000 eggs of the plaice have been hatched in the establishment, and arrangements are in progress with the view of obtaining a supply of adult turbot and soles, so as to admit of these fishes being propagated on a large scale, and the fry placed on the fishing grounds. The opinion is expressed that when large sea-water ponds or enclosures are added, it will be possible to retain the young flat fish until they have assumed the habits of the adults, and thus greatly increase the usefulness of the establishment to the fishing industry.

A REPORT on the cultivable land on Kilimanjaro, with special regard to its climate and healthfulness, is published by Dr. Brehme in the last number of the *Mittheilungen aus Deutschen Schutzgebieten*. The fertile land may be taken as the zone between 3700 and 7000 feet of elevation; this zone, strictly speaking, measures only 500 square miles, but several thousand square miles of the neighbouring country may be included as fit for settlement. The soil is the result of the weathering of volcanic rocks mixed with the humus formed by decaying vegetation; it is from 1 to 3 metres thick on the lower slopes, and of great natural fertility. The water supply is good, from melting snow, as well as from the discharge of the clouds which usually hang over the upper part of the mountain. Rains or wet mists occur frequently at all times of the year. The healthfulness of the slopes watered by rapid streams is in contrast with the fever-haunted marshes of the plain at the base of the mountain, where the slope of the land is insufficient for natural drainage. One very important circumstance is that the water of the mountain streams may be drunk unboiled without any risk. At the station of Marangu (1430 metres), meteorological observations, taken from October 1892 to December 1893, the highest monthly mean temperature at 7 a.m. was 17°·9 C. in December 1892, and the lowest 13° C. in August 1893. The mountain is exposed to the trade winds, the south-east trade blowing from April to October, and the north-east from the end of October to March; but the local winds are modified by a general up-hill wind during the day-time, and a down-hill wind at night. The illnesses most common on the cultivable zone of the mountain are much more frequently due to cold than to malaria. In addition to the banana, sorghum, and maize, all European cereals and vegetables grow readily. There seems to be no reason why the experiment of settling European farmers on the temperate uplands of the mountain should be unsuccessful if fairly tried.

IN the last number of the *Scottish Geographical Magazine*, Prof. Otto Pettersson continues his memoir on recent Swedish hydrographic research in the Baltic and North Seas. In this instalment, which is profusely illustrated with coloured charts and sections, he shows how the observations have thrown new light on the Baltic Current in the Skagerack and North Sea. The outflowing and inflowing currents which traverse the Skagerack can readily be distinguished by the different salinity of the water, the inflowing current containing more than 3·2 per cent. and the outflowing less than 3·0 per cent. of salt. In winter, when the outflowing current, or Baltic Stream, is reduced to its minimum by the freezing of the rivers, it shrinks to the dimensions of a narrow current along the coast, the Skagerack resembling a whirlpool with still water in the middle, and the moving water flowing along the coasts. The water is everywhere warmer than the air, but most so in the centre. Thus, while the air at or below 0° C. is in contact with water of nearly the same temperature off the Swedish coast, in the centre of the Skagerack it rests on water the surface temperature of which may be as much as 5°; thus a central mass of relatively warm air is produced, surrounded by concentric layers which are colder and colder. This not only affects the climate of the Swedish coast, but is favourable to the formation or attraction of cyclones. In spring the cold Baltic Stream overspreads the warm central waters of the Skagerack with a fresher and colder layer, destroying the conditions favouring the formation or passage of cyclones, and thus produces the typical dry and cold spring weather which prevails in Sweden.

IN a letter to the *Electrician*, Prof. Elihu Thomson mentions a curious and rather amusing illustration of the principle upon which the instrument for detecting the presence of electric oscillations, devised by Prof. Oliver Lodge, and called by him the "coherer," is based, which came under his notice lately. It will be remembered that the "coherer" depends on its action on the alteration in the resistance of a "bad contact" between an aluminium plate and an iron wire when electric oscillations are set up in the circuit containing the coherer. It was reported to Prof. Thomson that a certain electro-plater at Philadelphia had found that he could not pursue his silver-plating operations during a thunderstorm, and that if he left his plating over-night, and a thunderstorm came on, the work was invariably ruined. Prof. Thomson says:—"I was disposed to be thoroughly sceptical, and expressed my disbelief in any such effect. Being urged, however, I went to the silver-plater's shop, which was a small one, and questioned the silver-plater himself concerning the circumstances which had been reported. While it was evident that he was not a man who had informed himself electrically, I could not doubt that he had indeed stated what was perfectly true, namely, that when his plating operations were going on and a thunderstorm arose, his batteries, which were Smee cells, acted as though they were short-circuited, and the deposit of metal was made at too rapid a rate. The secret came out on an inspection of his connections. The connections of his batteries to his baths were made through a number of bad contacts, which would not fail to be of high resistance under ordinary conditions. I could readily see that virtually he was working through a considerable resistance, and that he had an excess of battery power for the work. Under these circumstances a flash of lightning would cause coherence of his badly-contacting surfaces, and would improve the conductivity so as to cause an excessive flow of current, and give a too rapid deposit. The incident suggests the employment of Dr. Lodge's ingenious instrument in the study of the waves which are propagated during thunderstorms, of which waves we have practically little or no information."

PROF. R. LEPSIUS, of Darmstadt, is preparing a new geological map of Germany, which will give a valuable summary of our knowledge of that area. It is founded upon the various national surveys and upon other good authorities. The scale is 1 : 500,000. The map will be complete in twenty-seven sheets, each measuring $15\frac{3}{4}$ inches by 13 inches. Four sheets in the south-western areas are published (by J. Perthes, Gotha); these are:—Sheets 17, Köln; 22, Strassburg; 23, Stuttgart; 25, Mülhausen. The sheets are completed beyond the German boundary. The meridian of the map is Paris, but the longitude east of Greenwich is also indicated on the upper margin of each sheet. A new point in this map is that a complete index is printed with each sheet, but only those rock-divisions indicated on the sheet are coloured. The subdivisions shown may be grouped as follows:—Post-Tertiary, 4; Tertiary, 4; Secondary, 11; Palæozoic, 10; Metamorphic, 2; Volcanic and Plutonic, 7. The "Silur System" includes Cambrian, Lower Silurian, and Upper Silurian. The map is unusually bright and clear; this is partly due to the black printing (topography, &c.) having been done last, over the colours. Like many other geological maps recently published, the price is small: two marks for one sheet, or three marks for each Lieferung containing two sheets.

THE generous manner in which reports on scientific matters are prepared and published in the United States has frequently been commented upon in these columns. In 1891 the sum of two thousand dollars was voted by Congress for investigations respecting the advisability of establishing a fish-hatching station in the Rocky Mountain region in the States of Montana and Wyoming, and also a station in the Gulf States. The results of these investigations are contained in a *Bulletin* (vol. xi. 1891) recently received from the U.S. Fish Commission. Prof. B. W. Evermann carried out the chief of the investigations. In looking for a suitable site for a fish-cultural station, the following requirements for the successful operation of such a station were kept in mind:—(1) There should be a constant supply of not less than one thousand gallons a minute, at a temperature never exceeding 50° or 55°, and free from any possibility of contamination. (2) There should be twenty to thirty acres of ground conveniently near the source of water supply. There should also be sufficient fall between the source of water supply and the hatchery building to permit a gravity supply. (3) The location should be central with reference to the region to be stocked, and should also afford good railroad facilities. Prof. Evermann and his party visited fourteen of the most promising localities, and the explorations were very satisfactory, both from the economic and scientific points of view. It was eventually decided that the region most nearly filling all the natural requirements was Horsethief Springs. These springs, situated in Montana, near the north-west corner of the Yellowstone National Park, are among the largest and most remarkable to be found anywhere in the United States.

WE are glad to see, from the "Abstract of Proceedings of the South London Entomological and Natural History Society" for the years 1892 and 1893, which has just reached us, that the condition of the Society is still a very satisfactory one, although the membership is slightly lower now than a year ago. The Society now numbers 192 members. The volume contains, in addition to reports of the various meetings held, the addresses of the respective presidents for 1892 and 1893.

THE London Matriculation Directory for June has just been issued by the University Correspondence College, and contains the papers set for the Matriculation Examination, June 1894, and solutions to the same.

A SECOND edition has been issued of the catalogue of the "Bibliothèque du Jardin Botanique de Buitenzorg," Java. The edition has been prepared by Dr. Brutel de la Rivière, and it is much more complete and better arranged than the first. We are requested to state that naturalists desiring to obtain a copy of the catalogue, should communicate with M. Treub, the Director of the State Botanic Garden, and the volume will be sent without delay.

THE July part of the *American Naturalist* contains, besides general notes, articles on "Animal Mechanics," by Dr. Manly Miles; "The Meaning of Tree-Life," by H. L. Clarke; "Lepidosirenids and Bdellostomids," by Theodore Gill; and "The Origin of Pelagic Life," by Prof. W. K. Brooks.

THE Quarterly Statement of the Palestine Exploration Fund for July contains many items of interest, among which we notice a translation of a paper by M. Th. Barrois, "On the Depth and Temperature of the Lake of Tiberias."

MESSRS. MACMILLAN AND CO. have just published a new edition, revised and enlarged, of "Arithmetic for Schools," by Rev. J. B. Lock.

THE Seventeenth Annual Report of the Connecticut Agricultural Experiment Station has just been issued at New Haven, and tells of a vast amount of work done during 1893.

AN interesting mode of converting oxide of iron into small but perfect crystals of hæmatite, exhibiting the characteristic forms of the naturally occurring mineral, is described by Prof. Arctowski, of Lüttich, in the current number of the *Zeitschrift für Anorganische Chemie*. The experiment simply consists in passing partially or totally dissociated ammonium chloride vapour over the oxide heated to a particular temperature. The oxide is placed in a combustion tube closed at one end, and at the closed end a quantity of ammonium chloride. The portion of the tube containing the latter is placed in a combustion furnace, and that containing the ferric oxide in an air bath, so constructed that the reaction within the tube can be observed, in order to be able to attain any desired temperature. When the ferric oxide is heated to about 600° in the stream of ammonium chloride vapour small glittering crystals commence to form after the expiration of a few minutes, the remainder of the oxide increases considerably in volume, and ammonium chloride is rapidly absorbed. No fusion occurs, so that the absorption is a mechanical one; the ammonium chloride condenses upon the exterior of the particles, eventually converting the powder into a white mass. Upon subsequent microscopic examination of this white product large numbers of the small brilliant crystals of hæmatite are observed interspersed among the whitened particles. When the experiment is performed at 700°, the whole of the ferric oxide is converted into miniature crystals of hæmatite; it is probable that the ammonium chloride is totally dissociated at this temperature. The crystals exhibit all the peculiar crystallographic properties of hæmatite. The fundamental rhombohedron possesses the characteristic angle of 86°, and the subsidiary forms developed, including those of the scalenohedron, are precisely those exhibited by the natural mineral and are developed to about the same extent. This mode of synthesising hæmatite is very probably intimately connected with that described by M. Sainte Claire Deville in 1861. The latter method consisted in heating ferric oxide to redness in an indifferent atmosphere into which traces of hydrochloric acid gas were admitted. As the ammonium chloride in the experiment at 700° was most probably completely dissociated into hydrochloric acid and ammonia, it is extremely likely that the crystallising action was due to the free hydrochloric acid. The synthesis of hæmatite by means of partially or totally dissociated ammonium chloride vapour is interesting, however, as throwing light upon the mode of formation in nature, for the vapours evolved by the fumaroles in volcanic districts always contain a certain proportion of sal-ammoniac, and it is usually observed that the fissures through which these vapours pass are more or less covered with crystals of specular iron and hæmatite. There is every probability, therefore, that the formation of the crystals is due to the partially dissociated sal-ammoniac, just as in the artificial experiments above described.

THE additions to the Zoological Society's Gardens during the past week include a Moustache Monkey (*Cercopithecus cephus*) from West Africa, presented by Mr. Clayton Pickersgill; a Leopard (*Felis pardus*) from East Africa, presented by Mrs. J. R. W. Pigott; a Lioness (*Felis leo*) from East Africa, presented by Major Owen; two Tiger Cubs (*Felis tigris*) from Pehang, Malay Peninsula, presented by Lieut.-Colonel Sir Charles B. H. Mitchell, K.C.M.G.; a Common Jackal (*Canis aureus*) from India, presented by Mr. Gerard Gurney; a Monk Seal (*Monachus albiventer*) from Madeira, presented by Mr. C. F. R. Blandy; a Cockateel (*Calopsitta novæ-hollandiæ*) from Australia, presented by Miss Sloane Stanley; six South African Francolins (*Francolinus afer*), a Puff Adder (*Vipera arietans*) from South Africa, presented by Mr. J. E. Matcham; a Smooth Snake (*Coronella lævis*) from Hampshire, presented by Mr. Willingham F. Rawnsley; a Long-eared Fox (*Otocyon megatotis*) from Somaliland, a Geoffroy's Terrapin (*Platemys geoffroyana*) from the Argentine Republic, a Ceylonese Terrapin (*Clemmys trijuga*) from Ceylon, an Ocellated Monitor (*Varanus ocellatus*) from Lake Tanganyika, two Black and White Snakes (*Pituophis melanoleucus*) from New Jersey, U.S.A., a Black-winged Peafowl (*Pavo nigripennis*) from Cochin China, deposited; a Muscat Gazelle (*Gazella muscatensis*) from Muscat, received in exchange; two Collared Fruit Bats (*Cynonycteris collaris*), four Mandarin Ducks (*Æx galericulata*), six Australian Wild Ducks (*Anas superciliosa*), two Slender Ducks (*Anas gibberifrons*), a Magellanic Goose (*Bernicla magellanica*), a Black-headed Gull (*Larus ridibundus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE RESULTS OF IMPRUDENT SOLAR OBSERVATIONS.—Dr. George Mackay, of the Royal Infirmary, Edinburgh, has sent us a pamphlet "On Blinding of the Retina by Direct Sunlight" (J. and A. Churchill), being a study in prognosis, based chiefly upon accidents incurred during the observation of partial solar eclipses. Tyros in observations of the sun, and also many incautious astronomers, have sustained more or less permanent injury to the sight by looking at it or its image without the interposition of a dark glass, or similar absorber, of sufficient thickness. During the progress of partial solar eclipses, the laity often make incautious observations, and the results of gratifying such curiosity have furnished Dr. Mackay with the chief part of the clinical material for his study. The paper, which originally appeared in the *Ophthalmic Review*, opens with a historical survey of the few cases of ocular injury from exposure to sunlight, recorded in historical literature. There is a tradition that Galileo seriously impaired the sight of his right eye by his solar observations, but Dr. Mackay has not been able to trace the story to its origin. It is well known that, in his later years, Galileo became quite blind, but the loss of sight was apparently caused by an affection of the cornea, and not by injury to the retina. The earliest precise description of the subjective sensations consequent upon focussing solar rays upon the retina is due to Reid, a Professor of Moral Philosophy in the University of Glasgow. He observed the transit of Venus in May 1761, without taking any precautions to modify the intensity of sunlight, and the result was that he was afflicted with metamorphosia; that is, objects appeared to him in distorted forms. Very few other cases of similar ocular injury have been described. Fortunately for Dr. Mackay, the partial eclipse of the sun in June 1890, and that of June 1891, both visible at Edinburgh, furnished him with seven new cases of "Eclipse Blinding," all of which he examined with great care, both with the ophthalmoscope and with type and colour-tests. The patients suffered from an impairment of visual acuteness, and, to most of them, dark spots appeared in their fields of vision. Sometimes these spots were fixed, and in other cases they oscillated rapidly. Dr. Mackay says that complete recovery from the injury, even in cases of only slight failure for test-type, is exceptional if investigated by sufficiently refined methods. It is pointed out that the treatment ought to be preventive: smoked and coloured glasses of the feeble shades ordinarily used by the public to view solar phenomena are quite insufficient. Experience shows that, to view the sun with impunity, even in January, it is necessary to use a glass so dark that no object illuminated by diffuse daylight is visible through it.

A NOVEL METHOD OF SOLAR OBSERVATION.—Dr. Deslandres made an important communication to the Paris Academy of Sciences on July 9. In December 1893, he suggested that separate photographs of the sun should be taken by means of the light of individual dark and bright lines in the solar spectrum. The success with which Prof. Hale has done this with the light of the K line shows that striking results may be expected from the development of the method. An ordinary photograph of the sun is mainly produced by the action, upon the sensitive plate, of the bright intervals between dark lines. Dr. Janssen's marvellous pictures of the sun are produced by using only light of high actinic power, and covering but a small region of the spectrum, to act upon his photographic plate. By carrying this principle still further, there can be no doubt that solar physics will be considerably advanced. The dark lines in the solar spectrum are only dark by contrast. Both Prof. Hale and Dr. Deslandres have shown that sun pictures can be produced by the light from them alone. Hence, by isolating a line due to any element, and using it to act upon a sensitive plate, a photograph is obtained of the layer of the sun in which that particular element predominates. Dr. Deslandres exhibited to the Paris Academy some of the photographs obtained in this way. His first results were produced by means of the light from the bright interval between two dark lines. The pictures thus obtained showed the photosphere with spots and faculæ much the same as

Janssen's photographs. One point confirmed by the pictures is that the difference between the brightness of the solar disc and that of the spots and faculæ is more marked the greater the refrangibility of the light employed. The bright lines due to the vapour of calcium, gave a different set of results. Such reversed lines do not represent incandescent solid or liquid, as in the preceding case, but are emitted by gaseous calcium at a higher level. Their light therefore imprints the image of the chromosphere upon the photographic plate. Dr. Deslandres' photographs of this kind agree with those previously mentioned as regards disposition and general forms of faculæ, but they differ in the fact that they show faculæ near the centre of the disc as clearly as faculæ near the edge, and also by greatly extending the areas of these bright patches. Using the light from a portion of the dark and wide calcium line, and exposing the photographic plate a little longer than when the bright reversal in the middle of the line was employed, a curious and altogether different result was obtained. The same faculæ appear upon the photograph, but they are not so clearly marked, and are of less extent. On the other hand, spots are shown very distinctly, with their penumbræ sharply defined. Dr. Deslandres has obtained similar photographs by using absorption lines of iron, aluminium, and carbon, which are wide enough to permit them to be isolated by means of his spectrograph. The results of further work in this direction will be awaited with interest.

THE ROYAL BOTANIC GARDEN, CALCUTTA.[1]

THE ponderous and important *Annals of the Royal Botanic Garden, Calcutta*, are known to all students of Indian flora. We have from time to time referred in terms of praise to these solid monuments of Dr. King's industry, and to the skill of the native lithographers and printers. The fourth volume of the *Annals* is before us, and is of equal excellence to the preceding ones. It is concerned with "The Anonaceæ of British India," a family of about six hundred species of woody plants. Although Dr. King, in an admirable introduction, gives an outline of the arrangement of the whole family, the present monograph only contains "a detailed account of those species which are indigneous to British India proper, to that part of the Malayan Peninsula which is under British protection, to the Islands of Singapore, Pangkore and Penang, and to the Nicobar and Andaman groups. This is the geographic area covered in the latter volumes of Sir Joseph Hooker's *Flora of British India*; and it may in the broad sense be considered for botanical (though not for political) purposes as *British* India, as distinguished from *Dutch* or *Netherlands* India, which consists of the Malayan Archipelago. The majority of the species indigenous to the British Indian area have already been dealt with by Sir Joseph Hooker and the late Dr. T. Thomson in that splendid fragment their *Flora Indica* (published in 1855). and still more recently by Sir Joseph Hooker in the first volume of his *Flora of British India*. It is with no idea of improving upon the work of these distinguished authors that I have redescribed the same species in the following pages, but chiefly in order that the species which have been discovered since the order was dealt with by them may be described, and that the relations of the new to the older species may be understood." Dr. King points out that the Malayan Peninsula remains even now but partially explored, and that its complete examination must bring to many new *Anonaceæ*. But as there was an opportunity of printing a fully illustrated account of the family at the present time, and as there is no knowing when the mountain range which forms the backbone of the Peninsula may be explored, it was decided to publ.sh the monograph, and risk the charge of having done so prematurely.

The great importance of such a work as that under notice can only be adequately judged by botanical experts. Altogether there are 220 lithographic plates, a figure of each species being given. These are accompanied by 169 pages of text, in addition to an index and the useful introduction, to which reference has been made. For the immense labour involved in the publication of such a volume, Dr. King deserves the thanks of all systematic botanists, and the Government of Bengal has done a great service to science by enabling the work to be published.

The hundredth anniversary of the death of Colonel Kyd, the founder and first superintendent of the Royal Botanic Garden at Calcutta, occurred last year, and Dr. King has taken advantage of the occasion by putting on record as much as can be traced of the early history of the Garden, and the career of its founder. The volume is dedicated to Colonel Kyd (of whom a portrait is also given), and prefaced with an interesting account, from which we have taken the following extracts :—

"Robert Kyd belonged to an old Forfarshire family, several members of which had preceded him in the service of the Honourable East India Company. He was born in 1746. At the age of eighteen he became a cadet of the Bengal Engineers, and on October 27, 1764, he received his commission as Ensign in that corps. His promotion to the rank of Lieutenant followed in the year after. Two and a half years later he became Captain, getting his majority on May 29, 1780, and his Lieutenant-Colonelcy on December 7, 1782. He died at Calcutta on May 26, 1793. From the fragmentary evidence which is still extant it appears that Colonel Kyd was a man of wide and varied sympathies and experience, and that, during the later years of his service he attained a position of so much influence that his suggestions on various weighty matters were not only listened to but promptly acted upon. Himself a keen gardener, he had brought together, round his country house at Shalimar, a collection of various plants of economic and horticultural interest which had been sent to him, partly by correspondents in the interior of the country, but which had chiefly been brought to him by Captains of the Company's ships returning from their voyages to the Straits and to the Malayan Archipelago. Colonel Kyd conceived the idea of supplying the Company's Navy with teak timber grown near the ports where it could be used in ship-building, and of increasing their commercial resources by introducing into India the cultivation of the spices which, in those days, formed so important an item in their trade, but for supplies of which they had to depend on their factories in Sumatra and Penang. He communicated this idea to the Governor-General of the day; and, in a letter written on June 1, 1786, he officially submitted a scheme for the establishment of a Botanical Garden, or Garden of Acclimatisation, near Calcutta. This scheme also included proposals for introducing, into territories subject to the Company, the cultivation of cotton, tobacco, coffee, tea, and various other commercial products. To have suggested to the local representatives of what was then practically a trading Company, the provision (at a considerable annual cost) of facilities for the pursuit of pure, as distinguished from economic, botany would probably not have increased the chances of the acceptance of the Garden scheme. The scientific aspect of the matter was therefore, with commendable sagacity, excluded from mention in the original proposal. So much, in fact, were the local Government impressed with the advantages of Colonel Kyd's proposed scheme that, without waiting for a reply to this letter from the Board, they secured land for the Garden 'in anticipation of sanction'; and, in a letter dated July 27, 1787, they reported this action to the Directors. This second letter, however, must have crossed a dispatch, dated London, July 31, 1787, in which the Board not only conveyed their sanction to the formation of the Garden suggested by Colonel Kyd, but warmly approved his action in bringing the proposal to their notice.

"Colonel Kyd's country house and garden stood near the village of Sibpur, on a promontory round which the Hooghly bends in passing the site of the present Fort William (at that time only recently completed), and which was known then (as it is now) as Shalimar. And it was land in the vicinity of Shalimar, and separated from his own private garden only by a ditch, which Colonel Kyd selected for the proposed Botanic Garden. The piece of land thus selected measures more than three hundred acres in extent, and is of rather irregular shape. It consists of a rather narrow strip running along the right bank of the Hooghly for about a mile and a half, but expanding towards its lower extremity into a large square block.

"Colonel Kyd, whose office at this time was that of Military Secretary to Government, was appointed Honorary Superintendent of the Garden, a post which he retained until his death. He never lived within the Garden. In fact, there was no dwelling-house within its limits until his successor, Dr. Roxburgh, built the present Superintendent's house in 1795.

[1] *Annals of the Royal Botanic Garden, Calcutta*, vol. iv. The Anonaceæ of British India. By Dr. George King, F.R.S., &c., Superintendent of the Garden, Calcutta. (Printed at the Bengal Secretariat Press, 1893.)

Colonel Kyd probably, as was the fashion of the day, had a town house in Calcutta. But he appears to have passed a good deal of his time at Shalimar; and in his will he directed that he should be buried in his garden there. The part of the Botanic Garden nearest to Colonel Kyd's house was devoted to the planting of teak trees, in accordance with the Company's earnest desire to supply themselves with timber for ship-building. The experience of thirty-four years having shown that good teak timber cannot be successfully raised on the muddy soil of the Gangetic delta, this part of the garden (extending to about forty acres) was in the year 1820 given up by Government to the Lord Bishop of Calcutta (Dr. Middleton) as the site for a Christian college. The Garden was thus reduced to its present area of 270 acres."

SCIENTIFIC SERIALS.

Bulletin of the New York Mathematical Society, vol. iii. No. 9, June 1894. (New York: Macmillan.)—Prof. E. W. Brown, under the heading "The Lunar Theory" (pp. 207-215), gives an admirable abstract of vol. iii. of Tisserand's "Théorie de Mécanique Céleste, Perturbations des Planètes d'après la Méthode de Hansen; Théorie de la Lune." Herein he opens with the remark: "It is somewhat strange that a subject like the lunar theory, which has received so much attention since its first principles were given by Newton, should be allowed to pass its second centenary before the appearance of a treatise like the present one." His opinion is that, notwithstanding a few defects, the book will take a high rank amongst the many classic treatises on celestial mechanics.—Students of the Theory of Numbers have recently been gratified by the publication (1892) of Bachmann's "Die Elemente der Zahlentheorie." An analysis of its contents, with a brief consideration of the parts which call for special remark, is given by Dr. J. W. A. Young (pp. 215-222).—Prof. Conant (pp. 223-224) calls attention to a work which occupies a unique place among translations, viz. "Memoirs on Infinite Series." These are classic memoirs by Lejeune-Dirichlet (2), Abel, Gauss, and Kummer. The book is brought out, under the auspices of the Tokio Mathematical and Physical Society, by Japanese professors.

IN the numbers of the *Journal of Botany* for June and July, Mr. A. B. Rendle describes new species of Asclepiadeæ and Convolvulaceæ from Tropical Africa, including a new genus of the former order *Odontostelma*, which is also figured.—A new British *Rubus*, *R. Rogersii*, n. sp., is described by Mr. E. F. Linton.—Mr. F. J. Hanbury contributes "A Tentative List of British *Hieracia*," numbering upwards of 100 species.

IN Nos. 5-7 of the *Bullettino della Societa Botanica Italiana* are two papers on fungus diseases of cultivated trees, by Sig. P. Baccarini. The "petecchia" or "vaiolo" (pock) of the orange has been ascribed to various causes. It is always accompanied by a number of fungi, but these are apparently saprophytic, and not pathogenic. The true cause appears to be a bacillus. The "mal nero" of the vine is also attributed to a microbe, *Bacillus vitivorus*, n. sp.—Sig. S. Sommier has two papers on the little-known flora of the Island of Giglio, near to Elba.—Sig. A. Jatta completes his paper on the lichens of Italy, of which he enumerates 1407 species.

THE number of the *Nuovo Giornale Botanico Italiano* for July is occupied by three papers:—"On the Roman Flora," by Sig. A. Terracciano; "On the Flora of Sicily," by Sig. L. Nicotra; and "On the Disease of the Strawberry caused by *Sphærella Fragariæ*," by Sigg. E. Baroni and G. Del Guergio.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 24.—"On the Influence of certain Natural Agents on the Virulence of the Tubercle-Bacillus." By Dr. Arthur Ransome, F.R.S., and Sheridan Delépine.

June 7.—"The Influence of Intra-Venous Injection of Sugar on the Gases of the Blood." By Dr. Vaughan Harley.

In a previous paper (*Roy. Soc. Proc.* 1893), he showed that the intra-venous injection of grape sugar caused an increase in the lactic acid in the circulation. It appeared probable that the lactic acid had combined with the bases of the carbonates in the blood, having driven out the carbonic acid.

Experiments were made on dogs to see what changes were produced in the gases of the blood after intra-venous injections of sugar.

It was found the quantity of carbonic acid was diminished, it being most markedly so during the first hour after the sugar injection, and still somewhat so three to five hours later. These results support the view that the lactic acid drives the carbonic acid from the sodium salts and replaces it.

In the next place, the changes met with in the quantity of oxygen in the blood were investigated. It was found the oxygen was markedly diminished during the first hour after the sugar injection. During the third and fifth hours the quantity in arterial was that usually found in venous blood. The explanation of this cannot up to the present be explained.

June 21.—"Researches on Explosives. Preliminary Note." By Captain Sir A. Noble, K.C.B., F.R.S.

The researches on which I, in conjunction with Sir F. Abel, have been engaged for very many years, have had their scope so altered and extended by the rapid advances which have been made in the science of explosives, that we have been unable to lay before the Society the results of the many hundreds of experiments under varied conditions which I have carried out. We are desirous also of clearing up some difficulties which have presented themselves with certain modern explosives when dealing with high densities and pressures, but the necessary investigations have occupied so much time that I am induced to lay a few of our results before the Society, trusting, however, that before long we may be able to submit a more complete memoir.

A portion of our researches includes investigations into the transformation and ballistic properties of powders varying greatly in composition, but of which potassium nitrate is the chief constituent. In this preliminary note I propose to refer to powders of this description chiefly for purposes of comparison, and shall devote my attention principally to gun-cotton and to those modern explosives of which gun-cotton forms a principal ingredient.

In determining the transformation experienced during explosion, the same arrangements for firing the explosive and collecting the gases was followed as are described in our earlier researches,[1] and the gases themselves were, after being sealed, analysed either under the personal superintendence of Sir. F. Abel, or of Prof. Dewar, and to Prof. Dewar's advice and assistance I am indebted, I can hardly say to what extent.

The heat developed by explosion, and the quantity of permanent gases generated were also determined as described in our researches, but the amount of water formed plays so important a part in the transformation that special means were adopted in order to obtain this product with exactness.

Numerous experiments were made to ascertain the relation of the tension of the various explosives employed, to the gravimetric density of the charge when fired in a close vessel, but I do not propose here to pursue this part of our inquiry, both because the subject is too large to be treated of in a preliminary note and because approximate values have already been published[2] for several of the explosives with which we have experimented.

With certain explosives, the possibility or probability of detonation was very carefully investigated. In some cases the explosive was merely placed in the explosion vessel in close proximity to a charge of mercuric fulminate by which it was fired, but I found that the most satisfactory method of experiment was to place the charge to be experimented with in a small shell packed as tightly as possible, the shell then being placed in a large explosion vessel and fired by means of mercuric fulminate. The tension in the small shell at the moment of fracture and the tension in the large explosion vessel were in each experiment carefully measured.

It may be desirable here to explain that I do not consider the presence of a high pressure with any explosive as necessarily denoting detonation. With both cordite and gun-cotton I have developed enormous pressures, close upon 100 tons per square inch (about 15,000 atmospheres), but the former explosive I have not succeeded in detonating, while gun-cotton can be detonated with the utmost ease. It is obvious that if we suppose a small charge fired in a vessel impervious to heat, the rapidity

1 *Phil. Trans.* vol. clxv. p. 61.
2 Noble, "Internal Ballistics," 1892, p. 33; *Roy. Soc. Proc.* vol. lii. p. 128.

or slowness of combustion will make no difference in the developed pressure, and that pressure will be the highest of which the explosive is capable, regard being of course had to the density of the charge. I say a small charge, because, if a large charge were in question and explosion took place with extreme rapidity, the nascent gases may give rise to such whirlwinds of pressure, if I may use the term, that any means we may have of registering the tension will show pressures very much higher than would be registered were the gases, at the same temperature, in a state of quiescence. I have had innumerable proofs of this action, but it is evident that in a very small charge the nascent gases will have much less energy than in the case of a large charge occupying a considerable space.

The great increase in the magnitude of the charges fired from modern guns has rendered the question of erosion one of great importance. Few, who have not had actual experience, have any idea how rapidly with very large charges the surface of the bore is removed. Great attention has therefore been paid to this point, both in regard to the erosive power of different explosives and in regard to the capacity of different materials (chiefly different natures of steel) to resist the erosive action.

The method I adopted for this purpose consisted in allowing large charges to escape through a small vent. The amount of the metal removed by the passage of the products of explosion, which amount was determined by calibration, was taken as a measure of the erosive power of the explosive.

Experiments have also been made to determine the rate at which the products of explosion part with their heat to the surrounding envelope, the products of explosion being altogether confined. I shall only briefly allude to these experiments, as, although highly interesting, they have not been carried far enough to entitle me to speak with confidence as to final conclusions.

Turning now to ballistic results. The energies which the new explosives are capable of developing, and the high pressures at which the resulting gases are discharged from the muzzle of the gun, render length of bore of increased importance. With the object of ascertaining with more precision the advantages to be gained by length, the firm to which I belong has experimented with a 6-inch gun of 100 calibres in length. In the particular experiments to which I refer, the velocity and energy generated has not only been measured at the muzzle, but the velocity, and the pressure producing this velocity, have been obtained for every point of the bore, consequently the loss of velocity and energy due to any particular shortening of the bore can be at once deduced.

These results have been obtained by measuring the velocities every round at sixteen points in the bore and at the muzzle. These data enable a velocity curve to be laid down, while from this curve the corresponding pressure curve can be calculated. The maximum chamber pressure obtained by these means is corroborated by simultaneous observations taken with crusher gauges, and the internal ballistics of various explosives have thus been completely determined.

Commencing with gun-cotton, with which a very large number of analyses were made, with the view of determining whether there was any material difference in the decomposition dependent upon the pressure under which it was exploded, two descriptions were employed: one in the form of hank or strand, and the other in the form of compressed pellets. Both natures were approximately of the same composition, of Waltham Abbey manufacture, containing in a dried sample about 4·4 per cent. of soluble cotton and 95·6 per cent. of insoluble. As used, it contained about 2·25 per cent. of moisture.

[Tables were given showing the results of the analyses of the permanent gases.]

From my very numerous experiments on erosion I have arrived at the conclusion that the principal factors determining its amount are: (1) the actual temperature of the products of combustion; (2) the motion of these products. But little erosive effect is produced, even by the most erosive powders, in close vessels, or in those portions of the chambers of guns where the motion of the gas is feeble or *nil*; but the case is widely different where there is rapid motion of the gases at high densities. It is not difficult absolutely to retain without leakage the products of explosions at very high pressures, but if there be any appreciable escape before the gases are cooled they instantly cut a way for themselves with astonishing rapidity, totally destroying the surfaces over or through which they pass. Among all the explosives with which I have experimented I have found that where the heat developed is low the erosive effect is also low.

With ordinary powders, the most erosive with which I am acquainted is that which, on account of other properties, is used for the battering charges of heavy guns: I refer to brown prismatic powder. The erosive effect of cordite, if considered in relation to the energy generated by the two explosives, is very slightly greater than that of brown prismatic, but very much higher effects can, if it be so desired, be obtained with cordite, and, if the highest energy be demanded, the erosion will be proportionally greater. There is, however, one curious and satisfactory peculiarity connected with erosion by cordite. Erosion produced by ordinary gunpowder has the most singular effect on the metal of the gun, eating out large holes and forming long rough grooves, resembling a ploughed field in miniature, and these grooves have, moreover, the unpleasant habit of being very apt to develop into cracks; but with cordite, so far as my experience goes, the erosion is of a very different character. The eddy holes and long grooves are absent, and the erosion appears to consist in a simple washing away of the surface of the steel barrel.

Cordite does not detonate; at least, although I have made far more experiments on detonation with this explosive than with any other, I have never succeeded in detonating it. With an explosive like cordite, capable of developing enormous pressures, it is, of course, easy, if the cordite be finely comminuted, to develop very high tensions, but, as I have already explained, a high pressure does not necessarily imply detonation.

[The velocities and energies developed by the new explosive were shown by the aid of diagrams.]

"The Rotation of the Electric Arc." By Alexander Pelham Trotter.

In the course of experiments made with the view of realising as a practical standard of light, the method of using one square millimetre or other definite area of the crater of the positive carbon of an electric arc,[1] the author has found that the effective luminosity is not as theory would predict,[2] either constant or uniform. By the use of a double Rumford photometer, giving alternating fields, as in a Vernon Harcourt photometer, his attention was called to a bright spot at or near the middle of the crater. The use of rotating sectors accidentally revealed that a periodic phenomenon accompanied the appearance of this bright spot, and although it is more marked with a short humming arc, the author believes that it is always present.

An image of the crater was thrown on a screen by a photographic lens; and a disc having 60 arms and 60 openings of 3°, and rotating at from 100 to 400 revolutions per minute, was placed near the screen. Curious stroboscopic images were observed, indicating a continually varying periodicity seldom higher than 450 per second, most frequently about 100, difficult to distinguish below 50 per second, and becoming with a long arc a mere flicker. The period seemed to correspond with the musical hum of the arc, which generally breaks into a hiss at a note a little beyond 450 per second. The hum is audible in a telephone in the circuit, or in shunt to it. The current was taken from the mains of the Kensington and Knightsbridge Electric Light Company, often late at night, after all the dynamos had been shut down. The carbons were, of course, not cored; six kinds were used.

A rotating disc was arranged near the lens, to allow the beam to pass for about 1/1000th of a second, and to be cut off for about 1/100th of a second. It was then found that a bright patch, occupying about one quarter of the crater, appeared to be rapidly revolving. Examination of the shape of this patch showed that it consisted of the bright spot already mentioned, and of a curved appendage which swept round, sometimes changing the direction of its rotation. This appendage seemed to be approximately equivalent to a quadrant sheared concentrically through 90°. Distinct variations in the luminosity of the crater are probably due to the fact that this is only an approximation.

The *à priori* theory of the constant temperature of the crater is so attractive, that the author is inclined to attribute this phenomenon, not to any actual change of the luminosity of the

[1] J. Swinburne and S. P. Thompson, discussion on paper by the author, "Inst. Electrical Eng.," vol. 21, pp. 384 and 403.

[2] Abney and Festing, *Phil. Trans.* 1881, p. 890; S. P. Thompson, *Soc. Arts. Journ.* vol. 37, p. 332.

crater, or to any wandering of the luminous area, as is seen with a long, unsteady arc, but to the refraction of the light by heated vapour. All experiments, such as enclosing the arc in a small chamber of transparent mica, or the use of magnets, or an air blast, have failed to produce any effect. A distortion of the image of the crater while the patch revolves, has been looked for, but nothing distinguishable from changes of luminosity has been seen.

An unexpected difficulty is thus introduced in the use of the arc as a standard of light, and one which may interfere with its use under some circumstances as a steady and continuous source of light. The author is further examining this phenomenon, with the view of ascertaining its nature, and of finding practical conditions under which it is absent or negligable.

"On the Viscosity of Water as determined by Mr. J. B. Hannay, by means of his Microrheometer." By Robert E. Barnett.

In a paper entitled "On the Microrheometer," published in the *Phil. Trans.* for 1879, Mr. Hannay described an apparatus which he devised for measuring the rate of flow of liquids through a capillary tube, and gave the times of flow of water at various temperatures, and of certain aqueous salt-solutions which he had observed by its means. The capillary was 21 mm. long, and 0·0938 mm. in diameter; the bulb had a capacity of 4·053 c.c., and the pressure employed was that of 1 metre of water at 20°. In order to compare the results with those of other observers, the author has converted the measurements of time of flow recorded by Mr. Hannay for water into viscosity-coefficients by means of the formula :—

$$\eta = \frac{\pi r^4 pt}{8Vl} - \frac{V\rho}{8\pi lt}.$$

The figures thus obtained are given in tabular form, and on comparison with the results given by Poiseuille, Slotte, Sprung, and Thorpe and Rodger, are seen to yield discordant values for the viscosity of water. Not only is the value at 0° far below that of any known liquid, but it diminishes so rapidly that at 6° and above it is a *minus* quantity. This paradoxical result is due to the fact that Mr. Hannay's experimental figures are inconsistent. It is physically impossible to pass such a volume of water under the stated pressure through a capillary tube of the dimensions given, in the times recorded. At 20°, for instance, the time of flow required under these conditions would be about 4600 seconds, instead of 131·3 seconds, as stated. The author has attempted in several ways to account for the discrepancy, but without success.

"On the Singular Solutions of Simultaneous Ordinary Differential Equations and the Theory of Congruencies." By Prof. A. C. Dixon.

PARIS.

Academy of Sciences, July 16.—M. Lœwy in the chair.—New researches on chromium, by M. Henri Moissan. Chromium has been prepared in large quantity by means of the electric furnace. Pure chromium has the density 6·92 at 20° C. It is more infusible than platinum, and has, apparently, no action on a magnetic needle. It is practically unacted on in moist air, but burns at 2000° C. in oxygen. It readily combines with silicon and carbon, to form very hard compounds; the silicide scratches the ruby. The pure metal is not nearly so hard, and readily takes a fine polish. It is hardly attacked by acids, resisting aqua regia, and is not acted on by fused potash, though oxidised by fused potassium nitrate or chlorate.—On the two ourang-outangs which have recently died at Paris, by M. A. Milne-Edwards.—On the mechanism of the murmurings caused by the passage of air in tubes; determination of the moment when a soundless flow, transformed instantaneously into a murmuring flow, becomes sonorous in the different points of the tube, by M. A. Chauveau.—On the necessity for ostriches, and most birds, to swallow hard bodies which remain in the pyloric region of the stomach, and which play the part, as regards foods, of masticatory organs, by M. C. Sappey.—On dimethylamidobenzoylbenzoic acid, diethylamidobenzoylbenzoic acid, and dimethylanilinephthalein, by MM. A. Haller and A. Guyot.—Note on some biological variations of *Pneumobacillus liquefaciens bovis*, the microbe of contagious peripneumonia of cattle, by M. S. Arloing. The author describes a non-liquefying variety of this microbe, and shows that it is not an independent species.—Studies on central actions: general laws relative to the effect of media, by M. F. P. Le Roux.—On interferences due to mean difference of path, by M. Georges Meslin.—Direct autographic record of the form of periodic currents by means of the electrochemical method, by M. P. Janet. A battery of fifteen steel styles, connected with fifteen points of the circuit taken, so that the difference of potential between consecutive points was about four volts, gave traces on prepared paper which indicated the characteristics of the discharge through the circuit.—Coefficient of self-induction of *n* equal and equidistant parallel threads of which the sections are distributed on a circumference, by M. Ch. Eug. Guye. The coefficients calculated for two selected definite systems by means of a formula quoted agree with the experimental values within about one per cent.—On the equation of discharges, by M. R. Swyngedauw.—Separation and estimation of tin and antimony in an alloy, by M. Mengin. The oxides are obtained as usual by means of nitric acid acting on the alloy of tin and antimony, and the metal antimony is reduced therefrom by means of a plate of pure tin and hydrochloric acid, and weighed separately.—On rotatory powers variable with the temperature; a reply to M. Colson, by M. A. Le Bel.—Synthesis of mesoxalic acid and bismuth mesoxalate, by M. H. Causse. The acid has been obtained by oxidation of glycerine by means of nitric acid in presence of bismuth nitrate. Insoluble bismuth mesoxalate is formed and, by virtue of its insolubility, the mesoxalic acid is removed from the field of action and escapes further oxidation.—Contribution to the study of some amido-acids obtained by the condensation of vegetable proteid substances, by M. E. Fleurent. On some derivatives of the propylamines, by M. F. Chancel. The preparation and properties are described of the compounds (1) propylpropylideneamine, (2) monopropylacetamide, (3) dipropylacetamide, and (4) tetrapropylurea.—On some points in the anatomy of the ourang-outang, by MM. J. Deniker and R. Boulart.—On the male genital apparatus of the ourang-outang (*Simia satyrus*, L.), by M. E. de Pousargues.—On the osteology of the ourang-outang, by M. P. Delisle.—Researches on the excitability of rigid muscles and on the causes of the disappearance of cadaveric rigidity, by M. J. Tissot. The author shows that the relaxation of the cadaveric rigidity of muscles is not due to putrefaction, which only sets in after the rigidity disappears.—Physiological mechanism of egg-laying among Orthopterous insects of the family of the Acridii. The *rôle* of the air as a mechanical agent, and multiple functions of the genital apparatus, by M. J. Kunckel d'Herculais.—Conditions of the development of *Rougeot* (*Exobasidium vitis*) on the leaves of the vine, by M. Albert Renault.—On a parasite of the vine, *Aureobasidium vitis*, by MM. P. Viala and G. Boyer.—On the carved ivories from the Quaternary station of Brassempouy (Landes), by MM. Ed. Piette and J. de Laporterie. An account of five statuettes or parts of statuettes of human figures, found among cinders and numerous bones of the rhinoceros, mammoth, aurochs, horse, and hyæna.—On the Constantinople earthquake. An extract from a letter from M. Moureaux to M. Mascart.

AMSTERDAM.

Royal Academy of Sciences, June 30.—Prof. van der Waals in the chair.—Prof. Behrens, Delft, gave some particulars concerning the detection of alkaloids by microchemical methods. A good method must give slides, showing the alkaloids pure or well crystallised combinations, from which the pure alkaloid can be set free by simple and trustworthy reactions. Such slides can be kept any time as documents for comparing with standard slides and further experiments, while the colour-tests in current use generally destroy the alkaloid. Volatile alkaloids are the most easy to isolate. Thus, from 0·3 mgr. of tea, and from 1 mgr. of coffee, by extraction with lime water and with alcohol, and subsequent sublimation, characteristic needles of theine were obtained without any difficulty. Cocoa must be extracted with weak acetic acid. After purifying with acetate of lead and concentrating, the liquid is dried with an excess of sodium carbonate, and sublimed at 300° C. Powdery theobromine is obtained, giving characteristic prisms with silver nitrate, and, later on, needles, resembling theine, more volatile than theobromine and more soluble in water. Their angle of extinction is 0°, and their chloromercurate is easily soluble. For theine, angle of extinction 45°, chloromercurate thrown down as long needles.

Two mgr. of cocoa are sufficient for showing both alkaloids. Among alkaloids that are not volatile, quinine may be cited, treated with success by the author six months ago. As another example, strychnine and brucine may be taken. For tracing strychnine the limit was found by de Vry and van der Burg at 0·001 mgr. With the aid of microchemical methods, well-defined crystals of strychnine can be obtained down to 0·0002 mgr. in the presence of as much brucine; afterwards the latter is made to crystallise as chloroplatinate. The actual limit is found at a fourth of this quantity. A detailed paper will be published next year.—Mr. Bakhuis Roozeboom discussed the graphical representation of heterogeneous equilibrium in systems of one to four substances. For systems of one substance we have only p, t lines which encounter each other in triple points. Systems of two substances may be represented in space between two parallel plans, by points which indicate p, t and the composition. For systems of three components the composition may be expressed in an equilateral triangle, and in a direction perpendicular to this plan, either p, or t. For systems of four substances the composition only can be expressed for one single temperature and pressure by points in a tetrahedron. The author discussed the conditions for a right selection of the components, and demonstrated that, in systems which admit single or double substitution, the number of components is one inferior to that of the apparent components.—Prof. J. A. C. Oudemans presented a note on the geographical position of the Astronomical Observatory at Utrecht, revised by him on a request from the editor of the British Nautical Almanac. The latitude $= 52° 5' 9''.5$. Using Leiden-Greenwich, as newly found by telegraph, and Utrecht-Leiden, geodetically determined, he deduced 20m. 31s.·00, practically the same result as given by the old observations of Hennert, van Utenhove, Wagner, van Beeck, Calkoen, and Keyzer, from 1778 to 1820.—Prof. C. A. J. A. Oudemans exhibited two new fungi, viz. *Septoria dictyotæ*, found on *Dictyota obtusangula*, a submerged *Rhodophyceæ*, detected by Miss Weber in the neighbourhood of Malacca, and *Ustilago Vuyckii*, discovered by Mr. Vuyck, in Leiden, in the ovary of *Luzula campestris*.—Prof. Kamerlingh Onnes commented on (1) the coefficients of viscosity of fluids in corresponding states, calculated by Mr. de Haas. They generally agree with the formula deduced from his theorem that the moving molecular systems in corresponding states are mechanically similar. Great deviations are shown by the fatty acids, and especially the alcohols. (2) The further experiments made by Dr. Kuenen, in the Leiden Laboratory, on the abnormal phenomena observed by Galitzine near the critical point. Dr. Kuenen proved that they are to be ascribed to impurities, and in particular to air. Gas can be originated at one side of the tube by heating a part of it, just as during the process of sealing. The gas being transferred to the opposite side of the tube, the density at this side changes in accordance. By admitting air at one side, anomalies such as were observed by Galitzine are obtained.—Mr. Jan de Vries presented an article on triple equations. He showed that the roots of such equations of degrees 7 and 9 cannot satisfy a symmetrical trilinear relation. This property is also verified for two distinct sorts of triple equations of degree 13; it has not yet been decided whether these are the only possible systems of this degree.

NETHERLANDS.

Entomological Society, June 9.—Mr. A. van den Brandt in the chair.—Mr. Everts exhibited a fine collection of specimens illustrating the biology of the honey-bee; Mr. Leesberg, specimens of the rare *Dorcatoma chrysomelina*, new for the Dutch fauna; Mr. Snellen, both sexes of *Euplœa martinii* de Nicéville, and a bread specimen of *Meliana flammea*, Curt.; Mr. J. C. H. de Meyere, several rare and interesting indigenous Diptera; Mr. F. J. M. Heylaerts, specimens of *Coleophora* and *Psychidæ*; Mr. H. A. de Vos tot Nederveen Cappel, *Agrotis dahlii*, *Boarmia abietaria*, and a very curious variety of *Tænio-campa incerta*; Mr. A. J. F. Fokker, specimens of two rare indigenous Hemiptera, *Eurygaster maura* and *hottentotta*. The latter stated that the name of *Podops horvathi*, a species which was not long ago described by him in the Dutch *Tijdschrift*, had been previously given by Distant to a Japanese species, and was therefore changed by Dr. Bergroth into *P. subalpina*.—Mr. H. J. Veth described the liquids emitted by the coxæ of several Coleoptera (Coccinellidæ and others), and which, according to Leydig, was a secretion of blood. A renewed chemical inquiry into its nature, however, seems to be desirable.—Mr. A. J. van Rossum gave a further account of his breedings of *Cimbex fagi* and *saliceti*.—Mr. J. Th. Oudemans exhibited an apparatus for setting Lepidoptera, and adapted to be used during long journeys.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Observations and Researches made at the Hongkong Observatory in 1893: W. Doberck (Hongkong).—Twelfth Annual Report of the Fishery Board for Scotland; Part 1, General Report (Edinburgh).—Total Eclipses of the Sun: M. L. Todd (Low).—The First Technical College: Prof. A. H. Sexton (Chapman).—Agricultural Zoology: Dr. J. R. Bos, translated by Prof. J. R. A. Davis (Chapman).—Royal Natural History, Part 9 (Warne).—Primary Geography: A. E. Frye (Boston, Ginn).—Arithmetic for Schools: Rev. J. B. Lock, new edition (Macmillan).—A Laboratory Manual of Physics and Applied Electricity, 2 Vols.; Vol. 1, Junior Course in General Physics: E. Merritt and F. J. Rogers (Macmillan).—Organic Chemistry, Part 1: Prof. Perken and Dr. Kipping (Chambers).—Histoire du Monde son Évolution et sa Civilisation: É. Guyard (Paris, L'Auteur).—Knowledge through the Eye: A. P. Wire and G. Day (Philip).

PAMPHLETS.—Researches in the Nervous System of Myxine Glutinosa: R. Sanders (Williams and Norgate).—Ueber die Geometrischen Eigenschaften homogener starrer Structuren und ihre Anwendung auf Krystalle: W. Barlow (Leipzig, Engelmann).—The Growth of St. Louis Children: W. T. Porter (St. Louis).

SERIALS.—Engineering Magazine, July (New York)—Journal of the Institution of Electrical Engineers, No. 113, Vol. xxiii. (Spon).—Annals of Scottish Natural History, July (Porter).—Actes de la Société Helvétique des Sciences Naturelles, 76e Session (Lausanne, Corbaz).—Compte Rendu des Travaux de la Société Helvétique des Sciences Naturelles, Soixante-seizième Session (Lausanne, Corbaz).—Mittheilungen der Naturforschenden Gesellschaft in Bern aus dem Jahre 1893, No. 1305-1334 (Bern).—Morphologisches Jahrbuch, 21 Band, 3 Heft (Leipzig, Engelmann).—Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Achtzehnter Band, 4 Heft (Leipzig, Engelmann).—Quarterly Review, July (Murray).—Palestine Exploration Fund Quarterly Statement, July (Watt)—Séances de la Société Française de Physique, 1894, 1er Fasc. (Paris).—Journal of the Franklin Institute, July (Philadelphia).—Records of the Geological Survey of India, Vol. xxvii. Part 2 (Calcutta).—Jahrbuch der K.K. Geologischen Reichsanstalt, Jahrg. 1891, xli. Band, 4 Heft; Jahrg. 1894, xliv. Band, 1 Heft (Wien, Hölder).—Abstract of Proceedings of the South London Entomological and Natural History Society, 1892-93 (London).—American Naturalist, July (Philadelphia).—17th Annual Report of the Connecticut Agricultural Experiment Station, 1893 (New Haven).—Proceedings of the Royal Society of Edinburgh, Vol. xx. pp. 161-240 (Edinburgh).

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