THURSDAY, MARCH 3, 1881

NATURAL CONDITIONS AND ANIMAL LIFE

The Natural Conditions of Existence as they Affect Animal Life. By Karl Semper, Professor in the University of Würzburg. International Scientific Series. (London: Kegan Paul and Co., 1881.)

THIS is in many respects one of the most interesting contributions to zoological literature which has appeared for some time. The author is well known as an accomplished anatomist and microscopist who, after spending some years in exploring the fauna of the Philippine and neighbouring islands, returned to Europe, and having been appointed to the Chair of Zoology in Würzburg, set himself to work at the morphological problems which so largely occupy at present the attention of anatomists. His most remarkable productions in this department have been his speculations and observations on the segmentation of animals and on the origin of the vertebrate kidney. But Prof. Semper has the advantage of being something more than an anatomist; as a traveller and one who has seen and studied life under most varied conditions, he has thought much and collected many facts bearing upon the problem of the influence of changed conditions of life in modifying the structure of animals submitted to those conditions.

With the leading theoretical consideration advanced by Prof. Semper no naturalist who knows the history of evolutional theory will agree, but the large collection of well-described and well-illustrated facts for which he claims attention in consequence of his theoretical preconceptions, are none the less interesting. The book has the great merit of being one which will be found equally readable by the professed zoologist and by the general reader.

Prof. Semper, whilst accepting the doctrine of the origin of new forms of life by the natural selection of fittest varieties of pre-existing forms, is unable to conceive of the "fittest varieties" in question, being such slightly divergent forms as are normally to be found in the offspring of all parents. Though he does not explicitly deny the physiological importance of even such minute variations as are not readily perceived by the human eye, and consequently does not openly controvert Mr. Darwin's theory to the effect that such of these minute variations as are fitted to given conditions of existence, are perpetuated and intensified by the survival of those animals in which they occur, and the failure and death of those in which they do not occur, yet Prof. Semper is among those who look for a more rapid and conspicuous method of the production of new species than that taught by pure Darwinism. He thinks that Mr. Darwin has overlooked or underrated the importance of "*directly-transforming* agents." He is no doubt aware that it is equally possible to over-estimate the importance of such action, and that this was done by Mr. Darwin's predecessors. Accordingly he examines in the volume before us such cases as may tend to give evidence on the subject.

Such cases are to be found when an animal living upon special food, or in given temperature, or light, or in water (still or running, fresh or saline), or air (dry or moist, still or breezy), or in isolation, or as parasite, is subjected to a change in those conditions either by natural processes or by experiment. A large series of natural instances are afforded by pairs of representative species of one genus, the one living under one set of conditions, the other under conditions in which the factor, the influence of which is sought, is removed or altered. Very few experiments, as Prof. Semper remarks, have been made upon this subject, but some of remarkable interest are cited.

The result of the examination of the instances which have been gathered together in this volume is *not* such as to lead to the conclusion that directly transforming agents play an important part in the production of new species. "Changed conditions," Mr. Darwin has said, "induce an almost indefinite amount of fluctuating variability, by which the whole organism is rendered in some degree plastic," and it is to the non-significant variations so produced which are selected by survival and fixed by heredity that new forms are due, and not to those *direct* adaptations effected in the individual by changed conditions, which are remarkably rare, and moreover, as Prof. Semper recognises (p. 38), are not transmitted, as a rule, to offspring. In order to establish his point Prof. Semper should have been able to give us, firstly, numerous instances of change of structure in the individual brought about in adaptation to a change in that individual's conditions of life. He produces very few, whilst the most striking and numerous facts which he records are instances of physiological adaptation to or toleration of new conditions *without any corresponding change of structure*. Secondly, he should have been able to give instances of the transmission to offspring of peculiarities acquired by the parent by undoubted action of the environment on the individual parent. Such instances are excessively rare, though a few are on record; but none are cited by Prof. Semper, and indeed the evidence as at present before us is such as to warrant the conclusion that such transmission cannot be in any way an important factor in the production of new races.

In his concluding paragraph (p. 405) Prof. Semper states that "there is a universal difficulty of deciding whether a modification which has taken place is to be ascribed to some direct determining and modifying cause, or to the enhancing of a previously modified character which is frequently connected with selection," and then deprecates the habit of theoretical explanations from general propositions. He holds apparently that we are not to seek an explanation of such modifications in those truths of heredity and adaptation, of variation and selection, which have been actually demonstrated and established by Mr. Darwin, but must, if we would behave as right-minded philosophers, keep before us the possibility of these modifications being due to—what? Not to a cause which has been shown to be necessarily or even usually at work, as have those to which Mr. Darwin points, but to a cause which has always proved illusory, namely, the "directly-transforming" action of the environment. It was because they appealed to this cause and could not show that it had a real existence that the "transformists" of the beginning of this century failed, where Mr. Darwin, appealing to another cause which he showed was an existing cause, has succeeded. Prof.

Semper's contribution to the subject does not tend to alter the low estimate which has been formed of the efficiency of directly-transforming agents, nor to justify the "final warning" which closes his book. It is then as a repertory of physiological facts of a kind usually neglected both by the professed physiologist and by the professed zoologist that this book will be found of value, not as the expository of new or of old theory.

After an introduction in which, amongst others, some interesting observations on the casting of the skin of reptiles and of crayfish are given with illustrative cuts, we find a chapter on "Food and its Influence." The variety of mineral and organic substances which constitute the food of animals is noted, and monophagous and polyphagous animals distinguished; curious adaptations to a special food such as that of egg-eating snakes, with their gastric teeth formed by processes of the vertebræ, are cited, and some remarkable examples of change of diet naturally occurring in a species *without any modification of structure*, *e.g.* the New Zealand parrot, which used to feed on the juices of plants and flowers, but now sucks the blood of sheep. Again, horses eating pigeons, vegetivorous snails (Lymnæus) eating young newts, crocodiles, some eating men, and others of the same species not prone to the habit. The only well-established instances of modification of structure caused by change of food are due to John Hunter, who fed a gull for a year on grain, and so hardened the inner coat of the bird's stomach as to make it resemble the gizzard of a pigeon; whilst Dr. Holmgren is cited as having obtained the converse result by feeding a pigeon on meat. The change brought about here is, however, not strictly speaking a change of structure, but rather a modification of the chemical activity of the gastric epithelium.

Many instances of wide difference of diet in closely allied species of animals not accompanied by any corresponding difference of structure are given in the text and in the valuable notes at the end of the book.

The influence of light is next discussed, and we have some statements as to the difference in their relation to light, of plants and animals. Prof. Semper does not admit the presence of chlorophyll in any animal, and goes so far as to say that the similarity of the spectrum of the solution of the green pigment of an animal with that of chlorophyll would not prove the pigment to be chlorophyll. If by "similarity" exact correspondence is meant, we should differ from him; but it is no doubt true that further exact observation is needed of those cases among invertebrate animals in which chlorophyll has been supposed to be present.

Semper holds that there is a high degree of probability in the view that the green-coloured bodies present in some lower animals in such abundance are really parasitic Algæ like the gonidia of lichens. As an argument in favour of this view he adduces Max Schultze's observation that the "chlorophyll-bodies" of the worm *Vortex viridis* divide and multiply spontaneously, which he states (in opposition to the generally received observations of Nägeli and the statements of his colleague Sachs) the chlorophyll bodies of plants do not. It would be interesting if this should prove to be the case, and if Prof. Semper should be destined to reform our notions of Vegetable histology among other things.

In a note Semper attacks Paul Bert for saying that "Infusoria containing green matter decompose carbonic acid in the same way as vegetable cells." The French physiologist is well within the facts, for Priestley's green matter was the Flagellate *Euglena viridis*.

It is necessary to point out that it is by no means proved by Cienkowski's observations that the yellow cells of Radiolaria are parasitic one-celled Algæ, as Semper assumes, though it is possible that such is their nature.

Light affects animals mostly through the eye only, and its intensity undoubtedly has a modifying influence upon that organ; but whether the degeneration of the eye in cave animals and deep-sea Fishes and Crustacea is due *directly* to disuse in any instance or to altered selection and heredity, is not clear. Many important facts and some good drawings bearing on this matter are given. Dr. Hagen informed the author that in all the species of cave-beetles of the genus Machærites the females *only* are blind, while the males have well-developed eyes, although both live together in total darkness, whilst it is well known that many blind animals, *e.g.* certain Mollusks, Crustacea, and Worms, live in bright daylight.

Facts are cited showing that the colours of animals are not developed by or dependent on light, whilst the change of colour effected by cuttle-fish, fishes, and Amphibia when light acts on the eye are discussed at length, and the researches of Lister and of Pouchet cited. Prof. Semper, in common with other naturalists, explains the difficulty presented by the colouration of some animals, such as those which live in the dark (many marine polyps and worms), by the assumption that the pigment is the inevitable secondary product of some indispensable physiological process. The same explanation is applied to the phosphorescent material of many marine organisms, which is apparently useless or even injurious to the animals which produce it.

Temperature affords subject-matter for a chapter, abounding in important records of fact, which are, it must be admitted, quite antagonistic to the notion that variations in the environment in this respect can directly produce *adaptative* change of structure. The most remarkable instance of temperature effecting a change of structure is that quoted from Weissman, who, by artificially lowering the temperature, succeeded in rearing *Vanessa levana* from the eggs of *Vanessa prorsa-levana*, the two supposed "species," being only winter and summer varieties of one. But here, though the colouring is different in the two varieties, there is no adaptational character about it, nor a transmission of the changed colouring to offspring.

A number of facts are cited as to the supposed change of colour of Arctic animals in winter, but the conclusion seems to be that no such change occurs. Facts establishing the possibility of freezing whole fish and other animals are given, and other facts showing that 5° below 0° C. kills the tissues of such animals as frogs, and may thus cause death to the whole animal. Important researches of Horvath are cited, showing that the Ground-squirrel (Spermophilus), the temperature of whose body is in summer like that of man, about 38° C., can, during its winter sleep, sink to as low a temperature as 2° C. without injury; its body in fact has, at this period, the same temperature as that of the surrounding air. The

rabbit, on the other hand, is infallibly killed when the temperature of its body is reduced to 15° C. The glacier flea (*Desoria glacialis*, one of the Thysanura) is cited as an example of an animal taking up by preference, as it were, a permanently cold life-arena; whilst as examples of endurance of high temperatures we have Crustaceans found in hot springs of 60° C., and fish (Sparus) in hot springs of 75° C. The acclimatisation of Mr. Buxton's parrots in Norfolk is described at length, and amongst many other details of the kind concerning the influence of temperature on the spawning and hatching of eggs of various animals, the fact is recorded that at 10°·5 C. the common frog requires 235 days to pass from the egg through complete metamorphosis, whilst at 15°·5 C. only 73 days are required. "Nothing in the Philippine Islands struck me so much," Prof. Semper writes, "as to observe that there all true periodicity had disappeared even from insects, land mollusks, and other land animals; I could at all times find eggs, larvæ, and propagating individuals, in winter as well as in summer." An important reflection in this connection is the following:—"It is generally assumed that we are justified in attributing to extinct animals a mode of life analogous to that of the nearest related surviving forms; . . . as soon as we reach the deeper strata, and the identity of the species with those now living ceases, our right to construct a theory of the climate of past epochs by a comparison of fossil and living species, absolutely disappears." How far, it may well be asked, is this true when plants are substituted for animals?

In a chapter on "The Influence of Stagnant Water" we have a large series of interesting facts and records of experiment under the headings "Freshwater Animals that Live in the Sea" and "Marine Animals in Fresh Water." In both these categories we find a number of animals, whilst as a matter of experiment it is found that, though very few animals will endure *sudden* transference from fresh to saline water, or *vice versâ*, yet a large number will tolerate the change if it be accomplished by slow degrees, whilst others will not endure it, however brought about. The same effect of gradation is noted with regard to change of temperature. But in neither the one case nor the other is Prof. Semper able to cite an instance which tends to favour the view that direct modification of structure is produced by such changes of life conditions.

The instances cited, though not so distinguished by Prof. Semper, may be divided into those afforded by certain species living in one kind of water (fresh or salt), whilst the other species of the genus live in the other kind of water; and secondly, those afforded by exceptional individuals naturally found in one kind of water, whilst normally the individuals of the *same* species occur in the other kind of water. Results derived from the experiment of gradual transference from one kind of water to the other would form a subdivision under this second head. The rare instances of animals living in brine may also be classified in the same manner. Many species allied to river-worms and earth-worms (Oligochæta) are now known to occur in the sea; also Crustacea allied to fresh-water forms. Sea-insects and sea-spiders (like the common fresh-water diving spider) are cited in the valuable list of references given at the end of Prof. Semper's book, and such characteristically fresh-water mollusks as Cyclas, Unio, and Anodonta (found living in the Livonian Gulf with Telluria and Venus). Paludina and Neritina are found living in the Caspian with Mytilus and Cardium: *Planorbis glaber*, in 1415 fathoms in the Mediterranean. Many freshwater species of fishes are recorded from marine waters, and the whole group of sea-snakes form an example in point.

Of marine animals living in fresh-water we have, besides the polyp, *Cordylophora lacustris* (of which some interesting facts, showing its historical advance into fresh-waters, are given by Prof. Semper), and the new jelly-fish Limnocodium, and other jelly-fish and polyps living in estuarine conditions (see *Quart. Journ. of Microsc. Science*, October 1880, for observations by Agassiz and Moseley), some Bryozoa of marine affinities, *e.g.* Membranipora, some Nemertines, and one cephalobranchiate Annelid, numerous Crustacea, such as Balanus, Mysis, Palæmon. Among Mollusks Pholades and Teredines are recorded from fresh-water, their congeners being marine, whilst actual marine species of fish (the grey-mullet and the basse) have been bred successfully for the market in the fresh-water Lake of Acqua, near Padua. The common stickleback, as is well known, can be kept in a marine aquarium. Migratory fish such as the salmon are further examples.

The experiments of Beudant and Plateau on the influence on animals of the change of saline to fresh-water or *vice versâ* are given in detail, and both are of great interest. Beudant's experiments were made with two series of molluscs—a fresh-water series transferred to salt-water, and a salt-water series transferred to fresh-water. The Pulmonata and species of Paludina were found to be very tolerant of sea-water, whilst Unio, Anodonta, and Cyclas were all eventually killed by it. *Patella vulgata*, *Purpura lapillus*, *Arca barbata*, *Venus maculata*, and *Ostrea edulis* survived in large proportion the gradual transference to absolutely fresh-water, whilst of *Mytilus edulis* not a single specimen died in the course of the experiments; species of Fissurella, Haliotis, Buccinum, Tellina, Pecten, and Chama were, on the other hand, killed by the same process.

For full reference to sources of information on this and all the many interesting observations recorded we must refer the reader to Prof. Semper's book.

In successive chapters we have similar details as to the influence of dry air, of currents of water, and of change of life from aquatic to terrestrial conditions; the land leeches, land planarians, land crabs, and land fishes being described and sometimes figured.

Some very remarkable observations on pulmonate snails living in the Lake of Geneva made by M. Forel and by Dr. Pauly are given at length on pp. 197, 198. Certain Lymnæi live at great depths in the lake with their lung-sac filled with water; they never come to the surface, and actually breathe water all their lives; but if brought to the surface they take air into the lung-sac and will not again return to the submerged existence. If forced to do so they retain air in their lung-sac and breathe water by the general surface of the body. "In no single case," Prof. Semper frankly observes, "have we as yet succeeded in proving that such a change of function as is involved in the transformation of a gill-

cavity into a lung must necessarily be accompanied by definite changes in the structure of that organ."

After chapters expounding Prof. Semper's original observations and special theory as to the formation of coral islands, in which he characteristically seeks to improve upon Mr. Darwin, and a chapter upon the influence of parasitism, we come to a final chapter entitled "The selective influence of living organisms upon animals." Here new facts bearing upon the competition for similar conditions, the relations of the pursuer and the pursued, and mimicry, are set forth in abundance. The curious dorsal eyes of the marine slug Onchidium are described and figured, and an ingenious attempt is made to account for their evolution in relation to the pursuit of the Onchidium by the leaping-fish Periophthalmus. Prof. Semper is not blundering when he states that these eyes are constructed on what he calls "a type identical with those of the vertebrata." At the same time such a statement is very misleading, for these eyes differ essentially in their origin and structure from those of vertebrates, although having one superficial resemblance to the vertebrate eye in the fact that the retinal nerve is distributed to the anterior instead of to the deep surface of the retinal cells. This arrangement exists also in Pecten, contrary to Prof. Semper's statement that Onchidium is a solitary example of its occurrence in invertebrata.

As to mimicry Prof. Semper brings forward a new instance among land-snails where a Philippine Helicarion which sheds its tail (metapodium) and so escapes when seized by a bird or lizard, is imitated closely in appearance by a Xesta which has not the power of shedding its tail, but benefits by the reputation for elusiveness of the Helicarion. On the general subject of mimicry Semper does not consider the doctrine of selection adequate, but thinks it necessary to improve the current theory relating to it by some original touches. He has made the not very new discovery that "under some circumstances the most perfect and complete resemblance between two creatures not living associated may originate without its being referable to the selective power of mimicry, *i.e.* a protective resemblance." The resemblance referred to is of course a superficial one of colour or appearance of one part of the body, and not really "perfect" or "complete." From this he goes on to suggest that subsequently to this stage a necessity for protection may arise, and the previously-established resemblance *may* become protective to one or other of the reciprocally counterfeit organisms. On the strength of this suggestion he proceeds further to question whether natural selection has ever produced mimicry, and declares that some causes "*must* have availed to produce by their direct action an advantageous and protective change of colouring" in the first instance. Similar to this, he states, is the conclusion which is arrived at in each chapter of his book in reference to other adaptations besides those coming under the head of mimicry, viz. that natural selection cannot operate until directly transforming agencies have produced advantageous characters of a definite and obvious kind upon which it may operate.

With the whole of this reasoning, and especially with the statement that any such conclusion can be derived from the facts stated in earlier chapters, we disagree. On the contrary, we maintain that natural selection operates upon advantageous variations which are exceedingly small, and do not, by an immense interval, amount to such coarse advantages as those assumed by Prof. Semper. Such small variations are incessantly caused by the action of external forces on the complex physiological units of the parents and by the action of those of one parent upon those of another. These causes of variation are not transforming causes, but produce irrelative and multifarious variations of small amount. It is upon these that natural selection acts. The existence of such variations, the power of selection to intensify them, and so to transform species and further the natural existence of a necessary selection, have been established by Mr. Darwin by an enormous mass of evidence. Prof. Semper, so far from having brought his reader in each chapter to a conclusion favourable to his views, has not adduced any evidence to show that natural selection cannot or does not act as taught by Mr. Darwin, and has moreover completely failed to adduce any evidence making it even probable that large changes of structure are ever effected by "directly transforming agents," of the very existence of which he can offer no evidence. Still less has he succeeded in showing that natural selection does or even that it could make use of such large changes—concerning which it is difficult to reason, since nothing is known about them excepting that Prof. Semper believes in them.[1]

The supposed cases of minute resemblance without mimicry which are given by Semper are either to be explained as due to a protective resemblance to a third object, or as due to like advantages secured independently in each case by natural selection in a way which may become apparent when we have more ample knowledge of the particular cases, or lastly, as due to an accidental superficial identity in two things having absolutely no relations in common. To argue that the last account of the matter is the true one, and that the elaborate mimicry of insects is to be explained with the assumption of the frequent occurrence of such coincidences rather than by the doctrine of natural selection, is, it may be conceded,

[1] It is necessary to plainly and emphatically state that Prof. Semper and a few other writers of similar views (*e.g.*, the Rev. George Henslow in *Modern Thought*, vol. ii. No. 5, 1881), are not adding to or building on Mr. Darwin's theory, but are actually opposing all that is essential and distinctive in that theory by the revival of the exploded notions of "directly transforming agents" advocated by Lamarck and others. They do not seem to be aware of this, for they make no attempt to seriously examine Mr. Darwin's accumulated facts and arguments. The doctrine of organic evolution has become an accepted truth entirely in consequence of Mr. Darwin having demonstrated the mechanism by which the evolution is possible; it was almost unanimously rejected, whilst such undemonstrable agencies as those arbitrarily asserted to exist by Prof. Semper and Mr. George Henslow were the only causes suggested by its advocates. Mr. Darwin's argument rests on the *proved* existence of minute many-sided, irrelative variations *not* produced by directly transforming agents, but showing themselves at each new act of reproduction as part of the phenomenon of heredity. Such minute "sports" or "variations" are due to constitutional disturbance, and appear not in individuals subjected to new conditions, but in the offspring of all, though more freely in the offspring of those subjected to special causes of constitutional disturbance. Mr. Darwin has further *proved* that these slight variations can be transmitted and intensified by selective breeding. They have in reference to breeding a remarkably tenacious or persistent character, as might be expected from their origin in connection with the reproductive process. On the other hand mutilations and other effects of directly transforming agents are rarely, if ever, transmitted.

It is little short of an absurdity for persons to come forward at this epoch, when evolution is at length accepted solely because of Mr. Darwin's doctrine, and coolly to propose to replace that doctrine by the old notion so often tried and rejected.

That such an attempt should be made is an illustration of a curious weakness of humanity. Not unfrequently, after a long-contested cause has triumphed and all have yielded allegiance thereto, you will find when few generations have passed that men have clean forgotten what or who it was that made that cause triumphant, and ignorantly will set up for honour the name of a traitor or of an impostor, or attribute to a great man as a merit, deeds and thoughts which he spent a long life in opposing.

original and startling; but it involves a deliberate renunciation of the exercise of reason.

The translation of Prof. Semper's highly entertaining and really valuable and suggestive book has been remarkably well executed. Throughout great care has been taken to give the correct English equivalents for the German names of many obscure animals, and to preserve the sense of the original. At the same time there is not from beginning to end any trace of that awkward diction which sometimes infects a translation from the German. It is not too much to say that it is the best executed translation of a foreign work on science which has appeared for twenty years. E. RAY LANKESTER

LETTERS TO THE EDITOR

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

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

Movements of Plants

FRITZ MÜLLER, in a letter from St. Catharina, Brazil, dated January 9, has given me some remarkable facts about the movements of plants. He has observed striking instances of allied plants, which place their leaves vertically at night, by widely different movements; and this is of interest as supporting the conclusion at which my son Francis and I arrived, namely, that leaves go to sleep in order to escape the full effect of radiation. In the great family of the Gramineæ the species in one genus alone, namely Strephium, are known to sleep, and this they do by the leaves moving vertically upwards; but Fritz Müller finds in a species of Olyra, a genus which in Enlicher's "Genera Plantarum" immediately precedes Strephium, that the leaves bend vertically down at night.

Two species of Phyllanthus (Euphorbiaceæ) grow as weeds near Fritz Müller's house; in one of them with erect branches the leaves bend so as to stand vertically up at night. In the other species with horizontal branches, the leaves move vertically down at night, rotating on their axes, in the same manner as do those of the Leguminous genus Cassia. Owing to this rotation, combined with the sinking movement, the upper surfaces of the opposite leaflets are brought into contact in a dependent position beneath the main petiole; and they are thus excellently protected from radiation, in the manner described by us. On the following morning the leaflets rotate in an opposite direction, whilst rising so as to resume the diurnal horizontal position with their upper surface exposed to the light. Now in some rare cases Fritz Müller has observed the extraordinary fact that three or four, or even almost all the leaflets on one side of a leaf of this Phyllanthus rise in the morning from their nocturnal vertically dependent position into a horizontal one, without rotating, and on the wrong side of the main petiole. These leaflets thus project horizontally with their upper surfaces directed towards the sky, but partly shaded by the leaflets proper to this side. I have never before heard of a plant appearing to make a mistake in its movements; and the mistake in this instance is a great one, for the leaflets move 90° in a direction opposite to the proper one. Fritz Müller adds that the tips of the horizontal branches of this Phyllanthus curl downwards at night, and thus the youngest leaves are still better protected from radiation.

The leaves of some plants, when brightly illuminated, direct their edges towards the light; and this remarkable movement I have called paraheliotropism. Fritz Müller informs me that the leaflets of the Phyllanthus just referred to, as well as those of some Brazilian Cassiæ, "take an almost perfectly vertical position, when at noon, on a summer day, the sun is nearly in the zenith. To-day the leaflets, though continuing to be fully exposed to the sun, now at 3 p.m. have already returned to a nearly horizontal position." F. Müller doubts whether so strongly marked a case of paraheliotropism would ever be observed under the duller skies of England; and this doubt is probably correct, for the leaflets of *Cassia neglecta*, on plants raised from seed formerly sent me by him, moved in this manner, but so slightly that I thought it prudent not to give the case. With several species of Hedychium, a widely-different paraheliotropic movement occurs, which may be compared with that of the leaflets of Oxalis and Averrhoa; for "the lateral halves of the leaves, when exposed to bright sunshine, bend downwards, so that they meet beneath the leaf." CHARLES DARWIN

Down, Beckenham, February 22

Barometric and Solar Cycles

REGARDING one of the conclusions drawn by Mr. F. Chambers in his paper on "Abnormal Variations of the Barometer in the Tropics," and Dr. Balfour Stewart's remarks concerning the same in the first article of NATURE (vol. xxiii. p. 237), I and other meteorologists would like very much to know which side of the earth is to be considered the east, and which the west.

In other words, if waves of high barometer travel slowly from west to east, on what meridian do they commence, and is there any reason why they should commence on one meridian more than on another? The only reason that I can think of is that some meridians embrace more land than others; but in this respect the meridians passing through the centres of America, Europe-Africa, and East Asia-Australia are very much alike. Again, if barometric changes originate, say at St. Helena, and travel slowly eastwards, as Mr. Chambers supposes, they ought after several months to reappear on the meridian from which they started, but Mr. Chambers's paper gives no evidence of this whatever.

Dr. Balfour Stewart says it is unmistakably indicated by all the elements that the connection between the state of the sun's surface and terrestrial meteorology is of such a nature as to imply that the sun is most powerful when there are most spots on his surface. The barometric evidence, however, is all the other way.

Mr. Blanford, following up a suggestion originally made by the present writer, has shown clearly enough that the decennial variation of the height of the barometer has nearly opposite phases in the Indo-Malayan region and in Western Siberia, especially if the winter season, when the pressure is higher over Siberia than in South-Eastern Asia, be considered alone (NATURE, vol. xxi. p. 480). From Mr. Blanford's paper it is clear that the barometrical differences, on which the strength of the winds depends, are greater when the sun-spot area is small than when it is large.

The true relation between the variations of sun-spot area, solar radiation, and barometric pressure will, I feel confident, be soon discovered through the agency of the United States Weather Maps in the manner pointed out by you at page 567, vol. xxi., in discussing the United States Weather Map for July, 1878. It is there shown that in the middle of summer in the last year of minimum sun-spot, the pressure of the air was below the average over all the great continents, and above it over the neighbouring oceans. In India, it is true, the pressure was above the average; but then India is not Asia, but merely a narrow triangular peninsula surrounded on two sides by the ocean, and on the third by a broad zone of snow-covered mountains which may be likened to an oceanic area as far as constancy of temperature is concerned.

Meteorologists will all agree with Dr. Balfour Stewart that "unexceptionable observations of the sun's intrinsic heat-giving power, if these could be obtained, would furnish a more trustworthy instrument of prevision than the sun-spot record." We may soon hope for a nearly continuous series of such observations, for, according to the last published Administration Report of the Indian Meteorological Department, a trustworthy form of actinometer is being sent to Leh, 11,500 feet above the sea, in the dry region of Tibet, where observations will be taken with it under the superintendence of Mr. Ney Elias.

Meantime we may perhaps adopt what is considered by Mr. Blanford the best criterion of the sun's heating power which can be obtained from ordinary meteorological observations, viz. the highest excess of the vacuum black-bulb thermometer above the maximum in shade for each month. At ten stations in India where comparable thermometers have been used since 1875, the mean maximum solar excess has been:—

1875		1876		1877		1878
67°·0	...	67°·2	...	68°·8	...	68°·1

The means of thirty-eight stations since 1876 give similar results, viz. :—

1876		1877		1878
68°·2	...	68°·8	...	68°·3

For 1879 and 1880 the figures have not yet been all worked up, but as far as they have been reduced they indicate that the intensity of solar radiation was a good deal less than in 1878.

Allahabad, February 3 S. A. HILL

The Continents always Continents

MR. WALLACE, in his recent excellent work on "Island Life," places me in a wrong relation to the question as to the continents having always been continents. After sustaining the view at length in Chapter VI. of his work, without any reference to my arguments on the subject, he later, in Chapter IX., says that "it appears to be the general opinion of geologists [*sic*] that the great continents have undergone a process of development from earlier to later times," and then quotes a paragraph of mine by way of proof.

My first discussion of the subject was published in the *American Journal of Science* for 1846 (vol. ii. of second ser. p. 352), where the "opinion" is partly speculative, the origin of the continents being made one of the initial results of the earth's refrigeration; but it is not left without the mention of facts sustaining it derived from the actual geological progress of the American continent. In the following volume, in an article entitled "On the Origin of Continents," the view is presented at more length, with some additional confirmatory facts connected with the structure of the continent; and facts from the earth at large bearing the same way are brought out in a second paper, "On the Origin of the Grand Outline Features of the Earth." In my "Geological Report" (published in 1849) of the Wilkes Exploring Expedition around the World, in which the same views are briefly presented (p. 431), I argue against "the existence of a continent in the Pacific Ocean within any of the more recent geological epochs" [referring here to those of the Tertiary and Quaternary], on the ground of "the absence of all native quadrupeds from its islands, and even from New Zealand."

A few years later (in 1856) I published, in vol. xxii. of the *American Journal*, two papers under the titles "On American Geological History" and "On the Plan of Development in the Geological History of North America," and in them I gave what I have regarded as a geological demonstration of the view by stating with some detail the facts with respect to the successively-developed features and geological formations of the American continent. Again, in my "Manual of Geology," the first edition (that of 1863), the progress of the rocks and mountains of the continent is traced out, from the V-shaped Archæan (Azoic) nucleus, in British America, onward; and in the account of the Archæan the statement is made (p. 136) that the structure lines apparent over the continent at the close of Archæan time were "features that were never afterwards effaced; instead of this, they were manifested in every new step in the progress of the continent"; and in the edition of the Manual of 1874, after a fuller account of the positions of Archæan mountains, it is then added (p. 160): "Hence, in the very inception of the continent, not only was its general topography foreshadowed, but its main mountain chains appear to have been begun, and its great intermediate basins to have been defined—the basin of New England and New Brunswick on the east; that between the Appalachians and the Rocky Mountains over the great continental interior; that of Hudson's Bay, between the arms of the northern V. The evolution of the grand structure-lines of the continent was hence early commenced, and the system thus initiated was the system to the end. Here is one strong reason for concluding that the continents have always been continents; that, while portions may have at times been submerged some thousands of feet, the continents have never changed places with the oceans. Tracing out the development of the American continent from these Archæan beginnings is one of the main purposes of geological history." In the course of the following pages (nearly 400) on Historical Geology in both editions, the evidence on this point is variously set forth—evidence afforded by the limits of the successive geological formations, by the occurrence of beds of shallow-water deposition at many levels in the long series, and by the progressive origin of the mountain-ranges. Then, in the edition of 1874 (and also that of 1880) I bring in (p. 525) the paragraph which Mr. Wallace cites in his Chapter IX. (p. 196)—not as the expression of an "opinion," but as the summing up after a demonstration.

The view that the continents have always been continents, which I have held for forty years, is written so plainly in the geology of North America that I am sure it would never have been set down among speculations, even by the most exacting of British geologists, had attention been fairly given to American facts. If the truth is not taught by British rocks, it is because these represent only a narrow margin of a continent, and hence could not be expected to illustrate general continental development, hardly more than an animal's leg, however profoundly studied, the embryological laws of the species.

JAMES D. DANA

New Haven, Connecticut, February 8

The Aurora of January 31; Position of Auroral Rays

THE bright loop shown in G. F. Seabroke's drawings of the aurora on January 31 at 6.30 and 6.35 p.m., as seen at Rugby, remind me of a striking feature seen here. If it was the same, a comparison of the observations will give some idea of the height of the phenomenon. As seen here at about 6.24½ this feature was the most conspicuous part of the aurora; it was a somewhat pear-shaped bright patch, with a region along the middle of it not quite so bright. Its edge was 10° above the moon, at Venus, Jupiter, β and η Pegasi; its pointed end being low down, and a good deal further to the right. At 6.26½ Venus was in the midst of its left end, and Jupiter quite outside. The moon was 5° below the lower edge. The dusky region gradually darkened, and finally opened through the right end of the patch, which became united by a rather serpentine bright band to a somewhat similar, but partly red, bright patch rising up in the east-north-east. This bright band formed the southern border of the aurora. At 6.31½ the position of the central line of this band, including the western bright patch which now formed a loop in it open to the north, was about as follows:—At or near the moon, one-third of the way from ι Ceti to Venus, ζ Cygni (the junction of the patch with the new band), α Pegasi I think, β Trianguli, α Tauri, and below Procyon.

The motion of these features, as well as of all the large masses of the aurora throughout the evening, was approximately from east to west (magnetic), so far as I could observe. The four or more arches seen at Rugby by G. M. Seabroke at 6.35 were not seen by me.

The spectrum of this aurora was very similar to those of February 4, 1874, and October 4, 1874, as given in Capron's "Auroræ," Plate V.; the band marked 4 of the former being sometimes present and sometimes absent. I also saw traces of the red line at times.

I am surprised that Prof. S. P. Thompson (NATURE, vol. xxiii. p. 289) is not aware that it is a thoroughly ascertained fact that the rays of auroras lie in the direction of the magnetic dip. I may add that the flashes or pulsations also generally appear to move away from the earth in the direction of the magnetic dip.

Sunderland, February 24 T. W. BACKHOUSE

Auroric Light

As Mr. W. H. Preece records the magnetic storms, if not too much trouble would he record what took place on the night of January 16?—as at midnight there was all the appearance of a grand display; but as the windows were all frost-masked, and my only place of observation was exposed to a cutting wind that would have "shaved a cast-iron policeman," to quote *Punch*, I could not observe what took place. I should also like to know why the grand displays this winter are of white lights. Those I saw in previous years—the best being while stationed in West Galway between 1867 to 1872—were principally red lights, some of them being most brilliant between midnight and morning, while all of them this year have been best early in the night, all lights usually disappearing before or a little after eleven. I am used to white lights in the summer months, but I never before saw them so prominent in the winter months—main lights, cross lights, and glows being white; while usually, each respectively have different colours. I have not seen an aurora that changes so much in character as the last, except that of September, 1867 or 1868 (I think, but I have not my notes to give the exact year). That of 1867 or 1868 was a grand display, rising in a red mass to the zenith, and then shooting out pencils of red, green, white, purple, and orange lights.

G. H. KINAHAN

Ovoca, February 20

The Recent Severe Weather

GRANTING (1) that solar periodicity produces a corresponding periodicity in any of the elements which make the climate of the earth as a whole what it is, and (2) that the expression for that periodical change contains only the two first terms of the general expression, *i.e.* that there are no secondary . . . periods, both large admissions in the present state of our knowledge, it does not appear how a simple fluctuation of solar temperature, recurring, we will say, every eleven years, could produce several periodic fluctuations of terrestrial temperature, identical in duration but not simultaneous, some one or more being therefore partially or completely opposed in phase to some one or more of the remainder, and to the causal fluctuation.

Further, we know that solar conditions are not as simple as those above assumed, and that the sun-spot period is subject to large and seemingly capricious variation amounting to something like ± 3 years at least. If then, as some able physicists believe, solar atmospheric changes are reflected in marked variations in terrestrial climate, we shall find these latter to be common to the whole earth, and to be represented by a function of the same form. The mere citation of local (for in this view even the climate of Europe is merely local) phenomena which have occurred at intervals approximately equal *individually* to the *average* length of a sun-spot period, proves nothing in favour of the view supported by your correspondent "H. W. C.," in NATURE, vol. xxiii. pp. 329, 363; and an analysis of the dates given in his first communication, which would make the occurrence of great frosts simultaneous, sometimes with sun-spot maxima, at other times with sun-spot minima, seems calculated to weaken his case in a material degree, on the supposition of an *uniform* eleven-year cycle.

Arranging the dates given by him in parallel column with the eleventh years of the present century, we get

Dates of severe frost.		1800 +
1.	1801—2	0
2.	1810—11	11
3.	1813—14	—
4.	1819—20	22
5.	1837—38	33
6.	1840—41	44
7.	1856—57	55
8.	1860—61	66
9.	1870—71	77
10.	1880—81	88

2 and 7 are placed as above, as those positions seem to favour the cyclic theory more than their original ones did. A *complete* list of great frosts collated with *actual* sun-spot variations is however most desirable, and would be specially valuable if representative of terrestrial climate in the cosmical sense. I trust that H. W. C. will favour us with such a table.

London, February 19 M. R. I. A.

Migration of the Wagtail

I FEAR I may be attempting to trespass too frequently on the columns of NATURE recently, but the paper in vol. xxiii. p. 387 on the subject of wagtails taking a passage on the backs of cranes in a long flight, resembles so much a somewhat similar story told and believed in by the Indians in several parts of North America, that I venture to send you an account of it.

All the Indians (Maskegon Crees) round the south-western part of Hudson's Bay, assert that a small bird of the Fringillidæ tribe takes a passage northward in the spring on the back of the Canada goose (*A. Canadensis*), which reaches the shores of Hudson's Bay about the last week of April.

They say that they have often seen little birds fly away from geese when the latter have been shot or shot at.

An intelligent, truthful, and educated Indian named George Rivers, who was very frequently my shooting companion for some years, assured me that he had witnessed this, and I believe I once saw it occur.

It is only the Canada goose that these little migrants use as an aërial conveyance, and certainly they both arrive at the same date, which is a week or two earlier than the other kinds of geese (*A. hyperboreus* and *albifrons*) make their appearance.

I knew the little bird well and have preserved specimens of it, but it is so long ago that I have forgotten the name.

The Indians on the shores of Athabasca and Great Slave Lakes—both great resorts of wild geese—tell a similar story. If a fabrication, I do not see why it should be invented about the Canada goose only, and not about other species which are equally numerous.

It may perhaps be necessary to explain that all the Coast Indians of Hudson's Bay devote a month or more every spring to wild fowl (chiefly geese) shooting, the game killed forming their entire food for the time.

As soon as the geese begin to arrive, the Indian constructs a concealment of willows and grass, usually near a pool of open water, at the edge of which he sets up decoys. When geese are seen approaching (usually flying at a great height) the Indian imitates their call, and the geese on seeing the decoys circle round, gradually coming lower down until within shot, when they are fired at. It is from these high-flying geese that the small birds are seen to come.

If the geese are flying low it is a pretty sure indication that they have already rested on the ground somewhere near, after their long flight, when of course their tiny passengers would have alighted. JOHN RAE

Royal Institution, February 26

Phosphorescence of the Sea

YOU will perhaps permit me to record the occurrence of a phenomenon very rarely witnessed on this coast—I mean the general and quasi-spontaneous luminosity of the sea.

It is of course common enough to observe sparkles of light more or less abundant when sea-water is briskly disturbed by contact with an oar or the bow of an advancing vessel; but it has only once before been my fortune, and that was twenty years ago, to witness the crest of each wavelet illuminated by the pale silvery light proceeding from countless phosphorescent organisms present in the water.

The night, being cloudy, favoured observation, but there was considerable haze. The wind was south-east or thereabouts, the temperature of the air being 52° F., that of the sea close by the shore 47°·5 F.

The phenomenon was visible on the night of Thursday, February 17 only. The following night was equally favourable for observation, and the temperatures were the same within a degree, but the cause or causes no longer operated. On casting into the sea a shower of pebbles, which the night before produced brilliant flashes of light, or larger stones, which then developed concentric luminous wavelets, only a doubtful effect was observed. The organisms had, it seemed, already expended their force—probably had actually died—and I thought I perceived an unusual frothiness in the water.

Is it not uncommon for this to occur so early in the year? It is in summer, when the temperature of the sea is high, that we expect to see the water "fiery." Was the phenomenon observed on other parts of the coast? THOS. B. GROVES

Weymouth, February 21

Minerva Ornaments

I HAVE twice had an opportunity of being in London during the time Dr. Schliemann's Trojan antiquities were exhibited at South Kensington, and the examination of them gave me very much pleasure. My last visit took place at the time Mr. Claypole's first letter and Prof. Sayce's reply appeared in NATURE, and I gave the "Minerva ornaments" particular attention. My interest in the subject has been revived by seeing another letter from Mr. Claypole in a recent number, and having refreshed my memory from notes taken during my visits, perhaps you would kindly afford me space for a few remarks.

Some of the "Minerva ornaments" appeared to me somewhat similar to Irish objects in my possession, but mine are more symmetrical, less flattish, and on the whole more suitable, I should say, for net-sinkers than the others, yet I never thought of ticketing them as such. I think that both sets of objects have had too much labour expended on them to favour the idea that they were used for such a common object as net-sinking. The Irish objects, which I should say are of stone, are identical in form with a class of glass ornaments known as double glass beads, found in most collections of Irish antiquities, which are certainly not net-sinkers. "Net-sinker" is a very common name in Ireland for almost any stone with a hole in it, and, without intending the slightest disrespect to Mr. Claypole, I believe the term is one of a set, of which "sling-stone" is another, applied in doubtful cases to cover our ignorance. As regards the use of the objects discovered by Dr. Schliemann, there may

be good grounds for believing that they were idols; but had I been left without help to interpret for myself I should not have guessed them to be net-sinkers, but rather children's playthings—the ancient representatives of modern dolls. To show how little pains are sometimes taken in the preparation of net-sinkers, I may mention that a few months ago, while walking along the banks of the River Bann, I saw a fisherman cutting the tough sward into pieces about two inches by three or four, which, in answer to my inquiry, he informed me were intended for net-sinkers. I asked him why he did not use stone or lead, and he replied that turf sinkers were much superior, as in using them the nets never became entangled in the bottom of the river. I wonder if this custom is a recent invention or a survival from earlier times.

I was struck by the close resemblance which several other objects in the Schliemann collection bore to Irish antiquities. I have noted several tool-stones with the usual hollowed marks on the sides, especially those bearing the double numbers 26 and 1578, 26 and 1478, 26 and 1522, 45 and 1499, and also a stone celt or hatchet with marks on the sides like those on the tool-stones, and hammered at the edge, numbered 13 and 1505, all of which I could match from my own collection. Several whorls are marked in my notes as being similar to others found in Ireland, and an object bearing the numbers 6 and 1636 as being almost identical with double stone beads in my collection. I have also a large series of rubbing or polishing stones similar to others in Dr. Schliemann's collection. Hammer-stones numbered 6 and 7268, 26 and 1529, 26 and 1566, 13 and 1570 are perfect duplicates of some of those found by myself, with flint and bone implements, &c., at Portstewart and Ballintoy. The ornamentation on a few of the stone and glass whorls and beads in my collection have a sort of resemblance to that on some of the terra-cotta whorls exhibited by Dr. Schliemann.

Cullybackey, Belfast, February 10 W. J. KNOWLES

Selenium

THE use of selenium for the automatic registry of star transits, proposed by me in a letter which you were good enough to publish in NATURE, vol. xxiii. p. 218, leads to the idea of applying it in a somewhat similar way for photometric purposes, in order to improve the existing scale of star magnitudes, and to watch any variations therein. W. M. C.

Bombay, February 5

A CHAPTER IN THE HISTORY OF THE CONIFERÆ

THE Sequoias form the third genus of the Taxodieæ in the "Genera Plantarum." The only existing species are the Wellingtonia and the Red-wood of California, both of which are confined to the south-west coast regions of the United States. Their nearest living allies are Taxodium and Glyptostrobus; but these were as completely differentiated in the Eocene as at present, and they all appear, like the Ginkgo, to be survivals from more ancient floras; Sequoia especially had formerly a far wider range than it has at the present day.

The Sequoias are monœcious, and have obtusely ovate ligneous solitary and terminal cones one to two inches in length, which are persistent and gaping after shedding the seed. The scales are spirally disposed, sixteen to twenty in number, wedge-shaped, with an orbicular or transversely oblong nail-like head, depressed, wrinkled, and mucronate in the centre, sharing thus to some extent the ornamentation which seems a characteristic of the Taxodieæ. The foliage is distichous and yew-like in *Sequoia sempervirens*, and spiral and imbricated in *S. gigantea*, but both occasionally foliate in the opposite way. The former, or red-wood, occupies the Coast Range, a sandy rock rising to 2000 feet, of supposed Cretaceous age, and forms dense forests twenty to thirty miles in width, from a little south of Santa Cruz to the southern borders of Oregon, following the coast line for some 350 to 500 miles, its distribution depending, according to Prof. Bolander, upon the sandstone and oceanic fogs. The *S. gigantea* extends at intervals along the western slope of the Sierra Nevada for nearly 200 miles, and at elevations of 5000 to 8000 feet. "Towards the north the trees occur as very small, isolated, remote groves of a few hundreds each, most of them old and interspersed amongst gigantic pines, spruces, and firs, which appear as if encroaching upon them; such are the groves visited by tourists (Calaveras, Mariposa, &c.). To the south, on the contrary, the Big-trees form a colossal forest forty miles long and three to ten broad, whose continuity is broken only by the deep sheer-walled cañons that intersect the mountains; here they displace all other trees, and are described as rearing to the sky their massive crowns; whilst seen from a distance the forest presents the appearance of green waves of vegetation, gracefully following the complicated topography of the ridges and river-basins which it clothes."[1] The leaves are scale-formed, rounded dorsally, concave on the inner face and closely inlaid, regularly imbricated on the branchlets, longer and looser on the branches. In young trees they are much larger and freer, with long and awl-shaped leaves at an acute angle to the stem. No trees under cultivation in this country seem yet to have completely assumed the small imbricated foliage characteristic of the giant trees of California.

Although the types of foliage in the two existing species appear to be perfectly distinct, they are not really entirely so; for *S. sempervirens* preserves the spiral scale-like leaves for a short distance at the base of each branchlet, and *S. gigantea* sometimes assumes the distichous arrangement. Besides, the foliage of the former is not in two rows as it is in Taxodium, being spirally arranged round the stem; but the leaflets, where they are flat and comparatively expanded, have a strong tendency to crowd into two marginal rows, so that every surface becomes exposed to light and moisture. The leaflets take a half twist near their base, and then diverge upward or downwards towards the sides of the branchlet, an additional row frequently lying centrally along the branch.

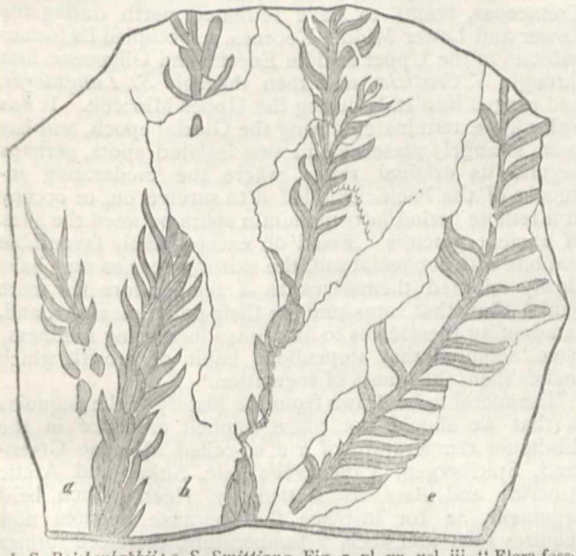
The earliest-known Sequoias are Cretaceous, and were described by Carruthers, one as *S. Woodwardii* from Blackdown, and others as *S. Gardneri* and *S. ovalis* from the Folkestone Gault. The foliage from the latter has falcate leaves like Araucaria, and it is only inferred that it and the cones belonged to the same trees. It is not impossible that the cones may have been brought down from some high ground, and the foliage been shed by trees nearer the sea-level. Although Sequoia itself cannot be traced farther back than the Cretaceous, Schimper speculates on its probable derivation from some much older Araucarian form, and believes its position to be between the Cupressineæ and the Abietineæ.

Saporta regards the Chalk period as the age of Sequoias, and our principal knowledge of them is derived from Heer's "Flora fossilis arctica," where a large number are figured. Saporta speaks of Pattorfik as a Sequoia wood carpeted with ferns, and Ekkorfat as a forest composed of cycads, sequoias, and firs. *S. Reichenbachii* is the chief form, and occurs in the Cretaceous of Kome, Spitzbergen, and doubtfully at Atane. The foliage resembles the larger foliage of *S. gigantea*, being spiral, awl-shaped, set at an acute angle to the stem, and with the points overlapping. It differs in being less regularly spiral, and often combines an approach to the more distichous *S. sempervirens* type, being called in such cases, *S. Smittiana*. In several of the figured specimens from the Komeschichten the branchlets of the two forms are almost united, and a very slight degree more care in collecting would, it seems, have placed the reality of the union beyond the possibility of doubt. One instance is reproduced from plate xx., and a fragment from the same plate determined as *S. Reichenbachii*, to show that even apart from the frequent association of the two species on the same slabs, their distinctness cannot be maintained if the

[1] Lecture before Royal Institution, April 12, 1878, by Sir J. Hooker.

plates are faithfully drawn. The separation of another species, *S. rigida* from *S. Smittiana*, seems even less warranted; but *S. ambigua* has somewhat smaller foliage and cones, and *S. gracilis* still smaller foliage, approaching *S. Couttsiæ*, yet compared, for no obvious reason, with *S. Gardneri*.

Spitzbergen has no Cretaceous species peculiar to it, but the Upper Cretaceous of Atanekerdluk possesses, besides two of the Komeschichten species, *S. fastigiata*, Sternb., and *S. subulata*, Heer. These two bear the

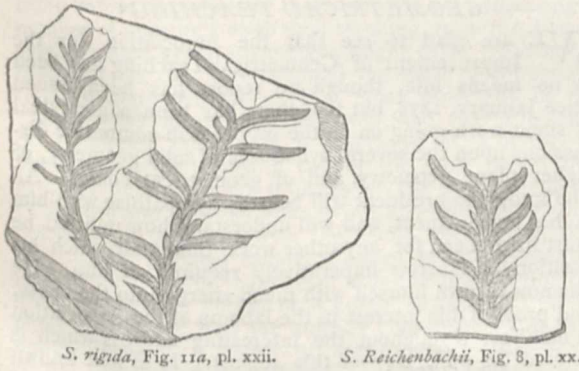


a, *b*, *S. Reichenbachii*; *c*, *S. Smittiana*, Fig. 7, pl. xx. vol. iii. "Flora foss. Arctica."

same relationship to each other that we have seen between *S. Reichenbachii* and *S. Smittiana*, only they are both considerably smaller, and were, as in the other case, doubtless the same tree.

S. Reichenbachii is said to be met with in other Cretaceous deposits in Bohemia, Saxony, Moravia, Belgium, &c., and *S. fastigiata* over the same, but a more restricted area; their wide distribution being held by Saporta to evidence a former universal equality in temperature.

It is of course useless, without further material, to seek



S. rigida, Fig. 11*a*, pl. xxii. *S. Reichenbachii*, Fig. 8, pl. xx.

to unite the whole of the above species, since they have been described as distinct by Heer; but it seems perfectly certain that had collecting been systematically carried on, a small proportion only of the specific distinctions could have been maintained. The excessive subdivision is to be regretted, since it has given undue prominence to the Arctic Sequoias of this age as a group, and will otherwise lead to inconvenience. Their chief and most interesting characteristics have been overlooked by Heer. These are first the union in one plant of the now almost completely differentiated *S. sempervirens* and *S. gigantea* types; and second, that the foliage, which then approached to the distichous *S. sempervirens* form, was produced, if the plates are correctly drawn, by the shortening almost to abortion of the upper and under leaves, and not to their being narrowed at the base and twisted, as at present, towards the sides of the branchlets.

The Arctic Tertiaries have yielded no foliage of the spiral, needle-leaved *S. gigantea* type, except that which has been referred to *S. Couttsiæ*. The large Araucaria-like foliage of *S. Sternbergi* does not seem at that time to have existed much farther north than Iceland, while the *S. sempervirens* type seems to have been abundant. *Sequoia Lagnsdorfii* is in fact the prevailing fossil in Greenland, scarcely any stone with leaf impressions being without some remains of it. The branchlets are generally simple and single, rarely forking, and seem thus to have had a short season of growth and been quickly shed, an adaptation probably to the long Arctic winter. Flowers, fruits, and seeds have been collected. It is hardly less abundant at Spitzbergen, Mackenzie River, and other localities near the Arctic circle and in Iceland. The cones are said to be somewhat larger, and with more scales, and the leaves less pointed than in the existing species. The more decidedly imbricated character of the fruit-bearing branchlets implies a closer affinity with the Cretaceous forms. Heer makes six duly-named varieties out of the Spitzbergen species, being probably unaware of the extent to which foliage on the same tree may vary at the present day. *S. brevifolia*, again, is at best a variety, and *S. disticha* has leaves in opposite pairs, and while unlike in this respect, has nothing besides to support its reference to Sequoia. *S. Langsdorfii* next appears in the Miocene Baltic and in the Aquitanian and Mayencian stages in Switzerland, Germany, Austria, and France, but does not seem to appear in any Upper Miocene beds except as far south as Italy, where it occurs in several localities. This distribution is important, as well as the fact that branchlets from beds of Central Europe are more compound than those from the far north. Another Spitzbergen species, extremely abundant where first found, is *S. Nordenskiöldi*, said to be distinguishable by smaller and softer foliage, narrower leaflets scarcely tapering at the base and at more acute angles to the stem, the last being the chief distinctive character. None seem to have been met with in the 1872 expedition, only *S. Langsdorfii* being illustrated in the fourth volume of the "Flora fossilis arctica."

Another species belonging to the same group, described by Saporta as *S. Tournalii*, is found in the Miocenes of Manosque, Armissan, and Kumi. It is principally characterised by the clustered, rarely solitary cones, and while the foliage resembles generally that of the existing species, the branchlets bearing fruit were much more imbricated, and in this respect resembled those of *S. Langsdorfii* of the Arctic floras.

Most of these types have also been met with in America —where Lesquereux, following Heer, has over-subdivided the fragments into species.

The *S. gigantea* type had by far the more restricted distribution of the two in the Tertiaries. Much of this form of foliage from the Lower and Middle Eocenes of England and France has been referred to Araucaria; but elsewhere, in the Oligocenes especially, almost the whole of it is referred to a single species of Sequoia, *S. Sternbergi*. It agrees with that of young plants of *S. gigantea*, the leaflets being less falcate, longer, and at a more acute angle to the stem than in the nearest existing Araucaria. On the other hand, however, no nearer approach to the ordinary adult foliage of *S. gigantea* is ever associated with them. The characteristic cones of Sequoia, which are small and numerous, and very persistent on the branches after the seed is shed, remain attached in several fossil species, as *S. Couttsiæ*, wherever

they are met with: but are rarely associated with the foliage figured as *S. Sternbergi*, none having been found at such important localities as Sotzka, Häring, Monte Promina, and Bilin, where foliage abounds. This absence of cones is very strong negative evidence against their foliage in the above localities at least being Sequoia, and in favour of their being Araucaria. The cones of Araucaria are few and large, shaken to pieces by the wind almost as as soon as ripe, and when carried by water the flotation of the winged seeds and of the foliage would differ enough to lead to their being separately imbedded. The foliage was described for years as *Araucarites*, and a well-defined immature cone of Araucaria was found in the deposit at Häring and figured by Sternberg [1] and by Goeppert [2] as *Araucarites Goepperti*, and afterwards considered by Unger and Ettingshausen [3] to belong to *A. Sternbergi*. Another small Araucaria-like cone is figured by Massalongo from Chiavon,[4] which was found associated with foliage identical with that from Bournemouth. Similar foliage, but still nearer to Araucaria, is found at many places in France, and in England at Sheppey, Bournemouth, Bracklesham, the Isle of Wight, &c., but also always without any Sequoia cones, although I have found an Araucaria cone at Sheppey.

Against all this evidence we have to set the fact that a branch with compressed cones attached has been found in the Upper Miocene near Turin, and that Sequoia cones are found in the same strata with somewhat similar foliage in Iceland. In both these instances however the foliage differs materially from the typical *S. Sternbergi* of Sotzka. If we consider that foliage of existing species of Araucaria, Sequoia, Cryptomeria, and Arthrotaxis can with difficulty be distinguished, and that species which have died out may have approached each other still more closely, the evidence upon which Heer has changed the determination of all the Austrian and German specimens must appear insufficient. The possibly accidental similarity, not identity, of foliage occurring in deposits far apart and of widely different age, does not, I hold, outweigh the other facts I have advanced.

This type of foliage, whether it belong to one or many genera, has not been found of Tertiary age north of Iceland, nor in the newer Miocenes of Central Europe, if we set aside two more than doubtful fragments from Oeningen. It abounds however in England, France, Germany, and Austria in Eocenes and Oligocenes, and recurs, as an Upper Miocene form, in Italy only.

The British Eocenes have been credited with several Sequoias, as *S. Sternbergi* and *S. Bowerbankii* from Sheppey, *S. Langsdorfii* from Alum Bay and Bournemouth, *S. du Noyeri* from Antrim, &c., &c. There is, I believe, no good evidence yet of the presence of any Sequoia except *S. Couttsiæ*, confined to Bovey, Hempstead, and perhaps Bournemouth, in any Tertiary rock of Great Britain. This question however cannot here be profitably discussed. *S. Couttsiæ* was originally described by Heer from Bovey Tracey, where it literally abounded. The foliage resembles that of *S. gigantea*, though smaller and more delicate, and must have been very graceful; but Heer's restoration of it, since copied into other works, is very stiff and unnatural. The foliage in the "Flora fossilis arctica" is much coarser, and should not have been referred to the same species. Saporta describes a beautiful variety "*Polymorpha*" from Armissan, in which the ultimate branchlets take on the *sempervirens* character. *S. Couttsiæ* seems to have been capable of supporting considerably greater heat than any of the other species, if we may judge from the associated plants.

The leading facts known to us respecting the past history of the Sequoias may be summed up thus. They are not known to be older than the Cretaceous, when they were principally a northern form. The differentiation of the existing types has progressed from that period to the present, being slight in the Cretaceous (*e.g. S. Reichenbachii*); more pronounced in the Eocene (*e.g. S. Couttsiæ v. polymorpha*); yet more so in the Oligocene and Miocene (*S. Langsdorfii*), and most so at the present day, though even now there is a tendency to approach each other. The number of fossil species should be considerably reduced, and much of the supposed Sequoia foliage transferred to other genera. The genus is known to have ranged as far south as Central Europe during the Cretaceous, seems to have retreated north during the Lower and Lower Middle Eocenes, re-occupied its former habitats in the Upper Middle Eocene and Oligocene, first through *S. Couttsiæ*, and then through *S. Langsdorfii*, and ranged into Italy during the Upper Miocene. It was well-nigh exterminated during the Glacial epoch, and has been strangely preserved in two isolated spots, perhaps beyond its original range, where the moderating influence of the Pacific enabled it to survive on, or occupy at a remote period lofty mountain spurs between the sites of ancient glaciers. Fixed on exceptionably favourable stations with congenial soil, the existing species may have slowly adapted themselves to a temperature far more genial than that supported by their polar ancestors, and, in adapting themselves to an always increasing mildness, have acquired that stupendous habit of growth which makes them the giants of vegetation.[1]

The moral to be drawn from the history of the Sequoias is that we should not place implicit credence in the minimum temperature of the so-called Miocene Greenland, Spitzbergen, Vancouver's Isle, Sitka, and Arctic America and Asia, as settled by Heer. Such bald argument, as for instance that because Sequoia now requires such and such a temperature, therefore former but different species must have required the same, is entitled to but little deference; yet Heer's facts and opinions are quoted as axioms by a wide range of workers. When examined they are seen to be disputable, whether taken as physiological, geological, palæontological, or any other data. Provisionally they were of use, but the questions depending on the accuracy of the data are so important and the evidence so intricate that they should not be deemed settled until some greater amount of care has been bestowed on them.

J. STARKIE GARDNER

[1] "Verst.," vol. ii. p. 204, Pl. 39, Fig. 4.
[2] "Monogr. foss. Conif.," 1850, Haarlem *Trans.*, p. 237, Pl. 44, Fig 2.
[3] "Flora von Häring," p. 36. [4] "Specim. Photogr.," pl. xxi.

GEOMETRICAL TEACHING[2]

WE are glad to see that the Association for the Improvement of Geometrical Teaching has been by no means idle, though no report has been issued since January, 1878, but that there has been a good deal of silent work going on in the way of sub-committee discussions upon the several syllabuses of solid geometry, of higher plane geometry, and of geometrical conics. All who know the president will heartily sympathise with him in his bereavement, and will understand how unfitted he must have been for any other work than that which his position at Harrow imperatively required of him. He has now thrown himself with much energy into the cause, and proof of his interest in the labours of the Association is manifest throughout the interesting address which is printed on pp. 12-17 of this Report. It is well known that he has long advocated an extension of the scope of the Association, and in this address he takes the opportunity of putting his views well forward.

"It was doubtless well at the outset of our work to concentrate our attention and confine our efforts to the definite field, in which perhaps the need for improvement

[1] If we can really trace back the history of *S. gigantea* to fossil forms, it becomes curious to notice that it is only now approaching *S. Couttsiæ*, the type which there is reason to believe formerly supported the highest temperature of any Tertiary Sequoia.
[2] Association for the Improvement of Geometrical Teaching. Seventh General Report, January, 1881.

was most pressing, that of the teaching of geometry. But it can hardly be denied, I think, that there are other branches of mathematics whose teaching might also be greatly improved by an association of teachers, conferring together as to the defects of existing books or methods, and intrusting to sub-committees the task of suggesting means of remedying such acknowledged defects. If this be granted it appears to me that it is our next duty to bring the strength of our existing organisation to bear on other branches of mathematics besides pure geometry. To do this would, I believe, assist rather than injure the work which we have still to do for geometry.

"I cannot doubt but that we have to some extent suffered from the restriction of the field within which we have hitherto worked. Elementary geometry is essentially a *school* subject, that is, one in which a student of mathematics ought to be fairly proficient before he enters on his university course, and which therefore is not a subject of *real teaching* in our universities or higher colleges at all. To this, and not to any ingrained spirit of opposition to improvement, which in the face of the changes going on in our universities it seems to me it would be absurd to charge upon any body of active workers therein, I am inclined to attribute the small amount of interest and attention which we have hitherto been able to obtain for our work, and our failure as yet to procure any recognition of our syllabus in any university of the United Kingdom. Where a subject is not taught, but is only a subject, and rather a subordinate subject, of examination, there can hardly be any very lively and active interest in the improvement of its teaching. It is reasonable to expect, therefore, that, by extending the scope of our work to other subjects, of which only the elements can in general be taught in schools, and which will afterwards be more fully studied at the universities, we shall enlist the sympathies of a wider circle of mathematical teachers, extend the list of our members, and connect ourselves more intimately with the living mathematical teaching of our universities, and then we shall, I believe, greatly promote the recognition of the work which we have already done. . . . . Algebra and trigonometry are perhaps less in need of our attention than other subjects, though even as regards these I believe valuable suggestions as to improved methods and range of teaching would arise in the discussion of a committee specially interested in them. But it is only necessary to mention the subjects of analytical geometry, higher geometry, higher algebra, elementary kinematics and dynamics (or mechanics), to bring before the minds of those whom I am addressing a number of questions as to their teaching, from the discussion of which great advantages might arise. Further, I think no one can have followed the more recent expositions of mathematical physics, more especially in the 'Matter and Motion' of Maxwell, and the 'Elements of Dynamic' (alas, only a fragment) of Clifford—to mention only the names of two of the most penetrative geniuses and profound thinkers of our age, whom we have loved and admired while living, and whose premature deaths we, in common with the whole world of mathematical and physical science, deplore as an irreparable loss—without feeling convinced that the time is not far distant when the notion of a *vector* or *step*, as Clifford happily names it, and the simpler consequences of that notion forming a *vector* or *step*-geometry (the basis of the calculus of quaternions), must be made a part of the elementary studies of every student of mathematics, more especially for the purposes of mathematical physics, but perhaps not less for its application to pure geometry. And if this be so I cannot help thinking that our Association, extended as I have suggested, might be the means of bringing together the right men to organise the method and bring it into a suitable stage for elementary instruction . . . I refer to the improvement of the teaching of arithmetic. I suppose there are none of us here who have had any experience in the teaching of arithmetic, who have not often wished that they could make a *tabula rasa* of their pupils' minds, as regards this subject, so fatally destructive of all appeals to reason have early unintelligent teaching and bad traditional methods shown themselves to be. In an effort to reform in many points the teaching of arithmetic, we might naturally expect to associate with us the best teachers in preparatory and even in primary schools; and perhaps also members of that very important body of men, the Government Inspectors of Schools; and thus our organisation might become the means of linking together all grades of mathematical teachers, from the humblest to the highest, in an association which could not fail, if heartily supported, to become a powerful influence for good on the whole education of the country."

As the President's proposal took many of the members present by surprise, it was ultimately resolved, as we read, that a special meeting of the Association should be held about Easter next, to consider the desirability or the contrary of thus extending the scope of the Association.

In connection with this matter we have also received a letter addressed to non-members to ascertain, if such an extension of the aims of the Association were adopted, whether they would allow themselves to be proposed as members of the new Association. A draft of rules accompanies the Report, from which we extract the following proposed rules:—"That the Association be called 'The Association for the Improvement of Mathematical Teaching'; that its object shall be to effect improvements in the teaching of the various branches of elementary mathematics and mathematical physics by such means as may appear most suitable in each particular case. This object to be carried out by the reading of papers or raising discussions at meetings of the Association, by the appointment of committees to report on existing defects in the usual methods, order, range, &c., in teaching special subjects, and the expediency of drawing up syllabuses or text-books of such subjects; by the employment of suitable means for bringing the work done by the Association before the universities and other educational or examining bodies, and using its influence to obtain recognition of such work from those bodies."

Another action on the part of the meeting was the passing a resolution "that a sub-committee be appointed to draw up proofs of the propositions of the syllabus of plane geometry." It was shown that many teachers had adopted the syllabus, and that it was meeting with a growing acceptance was evidenced by the steadily improving annual sale, 2033 copies having been already sold.

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

II.

NORTH-EASTERN ASIA has of late years disclosed to its explorers a number of very curious novelties in the class of Mammals. Amongst them are several species of great interest, examples of which have reached the Gardens of the Zoological Society alive.

4. The Tcheli Monkey (*Macacus Tcheliensis*) was so named by the distinguished zoologist, M. Alphonse Milne-Edwards of Paris, from the Chinese province of Tcheli (or Petcheli), in which it is found. The existence of a monkey in a latitude so far north—on nearly the same isothermal line as the city of Paris—is a very remarkable fact, and quite new to zoological distribution.

The occurrence of this monkey in the mountains of the north-eastern district of the province of Petcheli seems to have been first ascertained by M. Fontanier, who was for some years French Consul at Pekin, and who transmitted

[1] Continued from p. 38.

many valuable specimens to the Museum of the Jardin des Plantes at Paris. Amongst these was an example of the present animal—a female, not quite adult—which was described and figured by M. Alphonse Milne-Edwards in his "Études pour servir a l'Histoire Naturelle des Mammifères" (Paris, 1868-1874). The celebrated naturalist, Père David, also seems to have met with this monkey in the same district, as he includes it in several lists of the Mammals of Northern China which he has recently published.

For their pair of this scarce monkey now living in the Regent's Park, the Zoological Society are indebted to the kind exertions of one of their Corresponding Members, Dr. S. W. Bushell of H.B.M. Legation at Pekin. Dr. Bushell obtained these animals in 1880 from the Yung-ling, or Eastern Mausoleum, of the reigning Manchu dynasty, situated about 70 le from Pekin to the north of 40° N.L.

The Tcheli monkey belongs to the same section of the group as the well-known Rhesus monkey (*Macacus rhesus*), but has a shorter tail, and is generally of a more rufous colour. It is also readily distinguishable by its dense coat of short thick fur, adapting it to endure the bitter winter climate of its native hills, where the thermometer often descends 10° below zero. Like most of its congeners it is rock-loving in its habits.

5. The Water-deer (*Hydropotes inermis*) is another Chinese animal which has only lately become known in Europe.

Until of late years it was supposed that the annual production of deciduous bony processes (antlers) from the frontal bones was an invariable characteristic of the males of the deer-tribe (Cervidæ). In some cases these antlers might attain enormous dimensions, as in the Wapiti (*Cervus Canadensis*) and the Elk (*Alces machlis*); in others they might consist only of diminutive points, as in the Pudu-deer of Chili (*Pudua humilis*). But they were always present to a greater or less extent. The discovery of this little animal served to confirm, however,

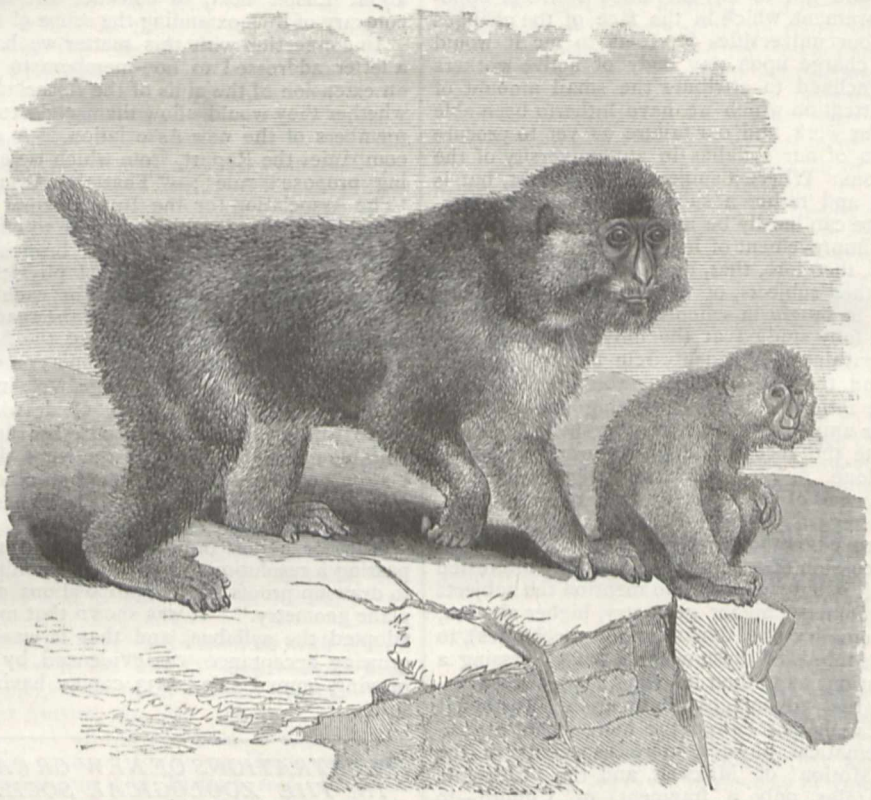


FIG. 4.—The Tcheli Monkey.

the truth of the axiom, that in Nature at least there is no law without an exception. Here we have a deer complete in everything except its antlers, usually the *most* characteristic feature in the males of these animals. In place of antlers the buck Water-deer is provided with other organs of defence in the shape of two long exserted canine teeth, which grow to a considerable size in the adult, and give him ample means of exercising his pugnacious powers.

For our first knowledge of the existence of this singular deer we are indebted to the exertions of the late Robert Swinhoe, who, during his residence in various parts of the Chinese Empire, added so largely to our knowledge of every part of its fauna. Mr. Swinhoe obtained his first specimens of the *Hydropotes* in the market of Shanghai in the winter of 1879, and described it at one of the meetings of the Zoological Society in the following year.

"In the large riverine islands of the Yangtsze above Chinkiang," Mr. Swinhoe tells us, "these animals occur in large numbers, living among the tall rushes that are there grown for thatching and other purposes. The rushes are cut down in the spring; and the deer then swim away to the main shore and retire to the cover of the hills.

"In autumn, after the floods, when the rushes are again grown, they return with their young and stay the winter through. They are said to feed on the rush-sprouts and coarse grasses, and they doubtless often finish off with a dessert from the sweet-potatoes, cabbages, &c., which the villagers cultivate on the islands during winter.

"They cannot however do much damage to the latter, or they would not be suffered to exist in such numbers as they do; for the islands have their villages and a pretty numerous agricultural population. Fortunately for the

deer, the Chinese have an extraordinary dislike for their flesh. They are therefore only killed for the European markets, and sold at a low price. The venison is coarse and without much taste, but is considered tolerable for want of better; it is the only venison procurable in Shanghai. The animal itself gives sport to the gunner; and numbers are slaughtered every winter by the European followers of Nimrod in the name of *sport*. Their numbers however do not appear to get much thinned."

Another most remarkable characteristic of these antlerless deer is their extraordinary fecundity. Mr. Swinhoe states that according to the testimony of the natives the mothers have four or five young at a birth, and that this is corroborated by Europeans who have killed gravid females and found the like number of embryos in the uterus. This account is to some extent confirmed by observations on the Water-deer in captivity in Europe. Although the Zoological Society have not succeeded in inducing this animal to breed in the Regent's Park, this feat has been accomplished by M. Josephe Cornély of the

FIG. 5.—The Water-deer.

Château Beaujardin, near Tours, in France—one of the most successful "acclimatisers" in Europe. In M. Cornély's beautiful park one of these deer produced three young ones in the spring of 1879, two of which, it is believed, lived to attain maturity. There can be no doubt therefore that the Water-deer is much more fruitful than the rest of its congeners, which certainly never produce more than two at a birth, and for this reason at least would be a valuable animal for domestication.

The adult water-deer standing reached at its shoulder a height of about twenty inches, and is generally of a pale fawn-colour, paler below.

According to Mr. Swinhoe the "Chinese at Shanghai call this animal the *Ke;* but at Chinkiang it is named *Chang*—the classical term for the Muntjac (*Cervulus Reevesi*). The Chinese dictionary, compiled under authority of the Emperor *Kanghe*, describes the *Ke* as 'stag-like, with feet resembling those of a dog, has a long tusk on each side of the mouth, and is fond of fighting.'"

NOTES ON THE GEOLOGY OF THE COREAN ARCHIPELAGO[1]

THIS archipelago, which consists of a number of smaller groups of islands separated by a depth of water varying from twenty to fifty fathoms, lies off the south-west coast of the peninsula of Corea. Whilst many of the larger islands vary from two to six miles in their extreme length, they are all of considerable height: their highest summits attain an elevation generally ranging between 600 and 1000 feet above the sea—Ross or Alceste Island, in the south-west corner of the archipelago, reaching to a height of as much as 1935 feet. The large and naked masses of rock which crown their summits give to these islands a somewhat rugged and uninviting aspect; and their quaint inhabitants view with ill-concealed dislike the presence of foreign ships within their waters.

I was enabled to land on two occasions on the Island of Mackau—the largest of a group of islands bearing that name. About six miles in length, it possesses some half-dozen lofty peaks, which range in height from 800 or 900 feet to 1400 feet above the sea. Naked masses of quartzite or quartz-rock crown the summits and often compose the upper third of the hills, whilst a thick and dense growth of creepers, shrubs, and mimosas clothes the hill-slopes for their lower two-thirds. The quartzite passes insensibly into a compact quartzitic sandstone underlying it; and lower down this rock assumes a coarse-grained texture, occasionally containing pebbles of quartz embedded in it. From the nature of the ground it was difficult to find

[1] Made during a brief visit of H.M.S. *Hornet* to these islands in October, 1878.

trustworthy signs of bedding in these rocks. Cropping out in the lower third of the hills—from the cliffs and the slopes immediately above them—are beds of a highly micaceous rock—greisen—and a gneissose rock sometimes approaching in its characters the typical gneiss; these beds are inclined at an angle of 15° to the east-north-east. Veins of quartz are observed to traverse both these rocks, whilst occasionally a layer of quartz—an inch in thickness—separates contiguous beds.

I had no opportunity of landing on any other islands of the archipelago, many of which in their general appearance resemble that of the Island of Mackau.

H. B. GUPPY

NOTES

THE International Medical Congress which it is proposed to hold in London in the beginning of August will be the seventh of its kind. The previous meetings have been held biennially in the principal university towns of the Continent. At the last meeting in Amsterdam in 1879, a general wish was expressed that the next should be in England, and the wish having been informally communicated to the Presidents of the College of Physicians and the College of Surgeons, they called a meeting of presidents or other delegates of all the Univerities, Medical Corporations, Public Medical Services, and the Medical Societies. The proposal to hold the Congress in London was heartily agreed to, and an Executive Committee was appointed under whose direction, and, especially, by the energy of the General Secretary, Mr. MacCormack, a very large scheme has been arranged for the discussion of the most interesting questions in all the divisions of the Medical Sciences. The Meetings will be held in fifteen sections, in rooms of most of which the use has been granted by the University of London, the Royal Academy, and all the learned Societies at Burlington House. Others have been engaged at Willis's Rooms. The officers and councils of the several sections include, with very few exceptions, all the chief and most active teachers and workers in the several subjects of medical science and practice, not in London alone, but in all the universities and great towns in the United Kingdom. In so far as general consent to the design of the Congress may be regarded as a promise of success, all looks well, and the agreement of our own countrymen is well matched by the assurances of co-operation already received from a large number of the most distinguished medical investigators and practitioners in both the Old World and the New. About 4000 invitations were issued, and it is expected that the roll of members will include at least 2000 names. Of course there are large arrangements for receptions and various hospitalities, and for making London as agreeable and instructive as may be in August; but if the design in the programme of the Congress be fairly fulfilled, a great quantity of hard and useful scientific work will be well done.

AT a meeting of the American Academy of Arts and Sciences held in Boston, Massachusetts, on January 12, the Rumford medal was conferred on Prof. Josiah Millard Gibbs, of Yale College, for his researches on Thermodynamics.

WE regret to hear of the death of Prof. James Tennant, F.G.S., the well-known mineralogist. Mr. Tennant was the assistant and afterwards the successor of Mr. Mawe, author of "Travels in Brazil," and of a "Treatise on Diamonds," and by adding to the series obtained by Mr. Mawe many fine specimens from every part of the globe, succeeded in thus forming a very large and valuable collection of minerals. Mr. Tennant was an excellent authority on gems, and his advice was taken by the Government with respect to the cutting of the Koh-i-Noor and other crown jewels. Besides holding the office of "Mineralogist to the Queen," Mr. Tennant was for many years Professor of Geology and Mineralogy in King's College, London, and after he resigned the professorship of the former science, still retained the post of Professor of Mineralogy, which he held at the time of his death. Mr. Tennant, in conjunction with the late Prof. Ansted and the Rev. W. O. Mitchell, wrote the treatise on Geology, Mineralogy, and Crystallography for Orr's "Circle of the Sciences," and he was also the author of some smaller educational works. Mr. Tennant did much useful work in preparing collections of minerals and fossils suitable for educational purposes; and by popular lectures and in other ways he aided in disseminating a knowledge of those sciences in which he was so greatly interested. Mr. Tennant had reached the age of seventy-three at the time of his death.

PROF. MARTIN DUNCAN, F.R.S., has been elected president of the Royal Microscopical Society.

THE *Daily News* Naples correspondent writes with reference to the Zoological Station at Naples that the average number of naturalists working in the laboratory was formerly about twenty-five, but this year it will be above thirty, adding to which the permanent staff of the station, there are altogether nearly forty naturalists bent upon promoting original research into marine zoology and botany, while enjoying the most unusual facilities and elaborate technical arrangements that have ever yet been contrived. The use of the diving apparatus has enabled the naturalists to find marine plants hidden in cracks and crevices and on the undersides of overhanging rocks, which otherwise would never have been brought to light, for the ground-net cannot reach them. By this means many interesting botanical problems have been brought nearer to a solution.

COLONEL PREJEWALSKI has just returned to St. Petersburg with a fine botanical collection he has made in Kansu. Dr. Maximowicz states that upon a cursory examination his previous impression is strengthened that we have to do here not with the flora of China, but with an altogether different one, belonging to the border of the great Central Asiatic plateau. There are no Chinese forms of trees or shrubs whatever, not even an Acer. The general character is entirely high alpine and cold. Dr. Maximowicz thinks that this Central Asiatic plateau has a flora with a distinct individuality of its own, and proposes to call it the Tangut flora, from the name applied by its first European explorer, Marco Polo, to the people inhabiting this inclement and inaccessible region.

THE arrangements for the international medical and sanitary exhibition of the Parkes Museum of Hygiene, which is to be held at South Kensington from July 16 to August 13, are now complete. The exhibition is to comprise everything that is of service for the prevention, detection, cure, and alleviation of disease.

THE Clarendon Press is about to issue a new edition of the late Admiral W. H. Smythe's "Cycle of Celestial Objects," a book which by universal consent has done more to promote popular astronomy in England than any other work of the kind. The new edition has been edited by Mr. G. F. Chambers, F.R.A.S., whose "Handbook of Astronomy," another Clarendon Press book, is well known. This volume, though professedly only a new edition, may be regarded as almost a new work. Whereas the original edition comprised only 850 objects, the new one comprises no fewer than 1604. But it is not merely in the number of the objects dealt with that the usefulness of the new edition will consist. It will be found that Mr. Chambers has cut down here, expanded there, and revised everywhere, Admiral Smythe's printed matter, so as to embody the progress of the science down to the year 1880. What this means in the case of hundreds of double-stars annually undergoing re-measurement, and many of them annually undergoing change, can only be

understood by those who have been called upon to perform similar literary work. But this is not all. Admiral Smythe's observations having been made in England, his labours only extended to those stars and nebulæ which were visible in England; but Mr. Chambers, by means of materials gathered from various sources, has extended the book to the whole of the southern hemisphere, and has thus made it an observer's handbook for the large English-speaking populations of India and the Australian and American continents. The New "Cycle" will be found to contain a great number of double-star measures by Burnham and others, many of them as recent as 1880. The places of the objects have been uniformly set out for the epoch of 1890, so that in this respect the book will be up to date for many years to come. A chromolithograph of twenty four typical star disks in different shades of colour intended for the methodical record of star colours forms an appropriate frontispiece.

We have received a very satisfactory report from the Sunday Lecture Society. It refers to an interesting experiment in Edinburgh of a Sunday Science School, in which ninety-two pupils were enrolled, with an average attendance from November to July of sixty. The pupils were mostly of the artisan class and youths who, owing to late business hours, could not avail themselves of evening classes.

Measurements of the "Midgets" who have lately been to Buckingham Palace and Marlborough House are being taken by Quarter-Master Sergeant Riordan, under the direction of the Anthropological Society. Successful casts of the mouths, showing an apparently abnormal dentition, have been obtained by Mr. F. S. Mosely, and were exhibited in the library of the Royal Institution last Friday evening.

At a meeting of the Electricity Exhibition Commission in Paris on Monday, M. Berger announced that arrangements had been made for the Palace of Industry being lighted up during the exhibition by all the French and foreign systems concurrently. This will involve 800 horse-power, and more than 50 kilometres length of wire. There will be six classes, viz. :—1. Production de l'électricité; 2. transmission de l'électricité; 3. électro-métrie; 4. applications de l'électricité; 5. mécanique générale dans ses applications aux industries électriques; 6. bibliographie et histoire. A proposal will be made to the Municipal Council of Paris to grant to Herr W. Siemens the concession of an electrical railway to the Hippodrome, in the Bois de Boulogne, in consideration of the expenses incurred by the construction of the railway from Place de la Concorde to the Exhibition Palace. The railway being constructed on a viaduct, the expense is estimated at 300,000 francs, and it is impossible to expect it will be recovered during the 107 days of the exhibition. The transmission of force at a distance by electricity will be tried in the Palais de l'Industrie during the Electrical Exhibition. Currents generated in the ground-floor will be utilised to work electro-magnetic machines, which will do various kinds of work. The Publishers' Union, under the direction of MM. Hachette, will establish an exhibition of electrical publications, and a reading-room, into which will be admitted all the scientific papers of the world, irrespective of their language.

The difficulties in the way of taking the census of our vast and heterogeneous Indian Empire have been sometimes very curious. In Burmah the census operations in the interior created no little consternation among the Karens, who were doing all they could to evade enumeration. The native officials employed to collect statistics seem to have shown their zeal in a curious way. The *Pioneer* declares that a census enumerator in the Central Provinces put down in his book a certain old tomb as a "house with one inhabitant." The phrase "to be numbered with the dead" will henceforward bear a new and vital meaning; and death will be robbed of his majority. Another anecdote states that when the census commissioner entered a certain compound with the forces of enumeration in his train, an ayah who had been taken account of by enumerator and supervisor both, ran excitedly to her mistress and warned her that there would be certainly some mistake in the hisab, for that the sirkar had counted her twice already and was going to count her again!

In a note on the Russian and Siberian varieties of the *Gaunnarus pulex* (*Memoirs* of the St. Petersburg Society of Naturalists, vol. xi. fasc. 1) M. Semenovsky shows that the representatives of this species in Lake Baikal and in Lake Gokcha of High Armenia, 6400 feet above the sea-level, are quite identical, and most akin to the Norwegian typical representative of this species, described by Prof. Sars. On the contrary, the *G. pulex*, which inhabits the lakes of the Taimyr *tundras* of Northern Siberia, that of the Baraba Steppe in Western Siberia and of the Ural region, belongs to another variety. A second variety, very different from the two preceding, was discovered in two salt lakes of the Government of Orenburg, notwithstanding the close proximity of one of these lakes to those of the Ural region. A third variety inhabits the northern lakes of European Russia and those of the Valdai Hills, whilst a fourth variety, being most like to that which is known from the lakes of Savoy, was discovered in the lakes near St. Petersburg.

It is known that the young horns of the *Cervus maral* (Severtzoff), when they are filled with blood and not yet ossified, are very much prized by the Chinese, who purchase them at the Siberian frontier, paying as much as six to twenty pounds the pair. A very active chase of the maral has therefore always been carried on in Siberia, and since it became rather rare, the Cossacks in the neighbourhood of Kiakhta have domesticated this stag. Now we learn from a communication by M. Polakoft that its domestication has greatly extended in Western Siberia, so that there are herds of seventy head; but the horns of the domesticated deer, as might be expected, have lost a good many of their original qualities.

In a recently-discovered stalactite cave at Kirchberg, near Kremsmünster (Austria), a jaw-bone of a man with well-preserved teeth was found among numerous remains of *Ursus spelæus*.

It is reported from Stuttgart (Wirtemberg) that bones of mammoth and rhinoceros have been brought to light by digging in a cellar on loamy ground. Dr. Fraas has recognised, besides tusks (60 cm. and 200 cm. long), two pieces of a jaw-bone belonging to a mammoth, and parts of mandibles, scapula, and maxilla of a rhinoceros.

The Mineralogical Museum at Breslau University has received a large number of bones belonging to the woolly-haired Rhinoceros (*Rhinoceros tichorhinus*). They were found near Skarsine in Silesia. The complete skeleton was found in a marl-pit at a depth of sixteen feet. Unfortunately the skull and several bones were broken through inattention on the part of the workmen. This is the fifth skeleton of the kind found in Silesia.

On February 20 a slight shock of earthquake occurred at Agram at 2h. 15m. a.m., and a more severe one at 6h. 15m. a.m., accompanied by a subterranean noise. During the last week wave-like motions were also felt.

The *Daily News* Lisbon correspondent, telegraphing on February 23, states that thirty-six successive shocks of earthquake have been experienced at St. Michael's in the Azores. "The church and 200 houses fell in. Several people were killed. A religious and penitential procession had taken place, the Civil Governor at the head. A volcanic island has been formed. At latest advices slight shocks continued. Many people were in tents outside the town."

THE Khedive of Egypt has nominated M. Gaston Maspero to the directorship of the museums in the place of the late archæologist, M. Mariette. To the latter a monument is to be erected at Cairo. A committee has already been formed, of which the Foreign Minister is president.

A NEW Italian serial will shortly be published at Naples. Its title will be *Rassegna critica di opere scientifiche e letterarie*, and its editor Prof. Andrea Angiulli. It will appear six times a year.

LAST Thursday the Hackney Microscopical and Natural History Society held their annual *soirée*, always a very successful event. Many other similar London societies were represented at the meeting.

AN elaborate report upon the opening up of two of the pyramids at the boundary of the Libyan Desert near Sakkara is now published by Prof. Brugsch. The learned professor estimates the matter to be of the most important and valuable kind. At the close of 1880 the entrances to the sepulchral chambers of the three pyramids were laid bare. The ceilings were taken off, and only the two sides, all covered with hieroglyphics, rose from the *débris*. The hieroglyphics point to the reign of Pharaoh Apappus.

THE additions to the Zoological Society's Gardens during the past week include a Bactrian Camel (*Camelus bactrianus*) from Afghanistan, presented by Col. O. B. C. St. John, R.E., F.Z.S.; a Punjaub Wild Sheep (*Ovis cycloceros*) from Afghanistan, presented by Capt. W. Cotton; a Mona Monkey (*Cercopithecus mona*) from West Africa, presented by Mr. W. Macmillan Scott; two Common Peafowls (*Pavo cristatus*) from India, presented by Mrs. Edward Brown; a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, presented by Miss Mary J. Richardson; a Stump-tailed Lizard (*Trachydosaurus rugosus*) from Australia, presented by Mr. F. O. Maitland; a Horsfield's Tortoise (*Testudo horsfieldi*) from Cabul, deposited; two Globose Curassows (*Crax globicera*) from Central America, a White-browed Amazon (*Chrysotis albifrons*) from Honduras, purchased.

GEOGRAPHICAL NOTES

WE take the following from the March number of the *Proc.* of the Royal Geographical Society:—The eminent Russian traveller and *savant*, Col. Prejevalsky, intends, we are informed, to devote himself for some time to the preparation in retirement of a great work on the results of his travels, including, besides his recent expedition to Tibet, his previous journey to Lob-nor, of which he was prevented, by want of time, from giving more than a bare outline. The work is to consist of eight volumes, and to be entitled "Travels in the Deserts of Central Asia." Volumes i. and ii. will contain the narrative and an account of the physical geography and ethnography of the countries he has visited, and will include also his surveys, the pictorial illustrations being from original sketches by his companion, Lieut. Robarofsky. Vol. iii. will be devoted to the mammalia of Central Asia; vol. iv. to the birds; vol. v. to the reptiles, amphibia, and fishes; vol. vi. to the flora of Mongolia; and vol. vii. to that of Tibet. Vol. viii. and last will contain the geology and mineralogy as far as materials will permit. The first two volumes, each containing 500 pages, and perhaps more, will be written by the traveller himself, and will appear towards the close of 1882. The ornithology will also proceed from his pen, as well as that portion of the zoology which treats of the antelope, buffalo, and a few other of the more important animals. The remainder will be written by the Academicians Strauch and Maximovitch, Professors Kepler, Inostrantsef, and Bogdanof, and will be issued in parts. The whole will not be completed for several years. The work will be brought out under the auspices of the Geographical Society, and a special grant for the purpose will be asked for from H.M. the Emperor.

AT the Geographical Society on Monday evening Sir Richard Temple delivered a lecture on the lake-region of Sikkim on the frontier of Tibet, which, in point of fact, was a description of the impressions acquired during a tour which he made as Lieut.-Governor of Bengal. Sir R. Temple told his audience that the fact of any part of Sikkim being British territory was due to the imprisonment of Sir Joseph Hooker and Dr. Campbell by the Rajäh; and he then gave a geographical sketch of the whole region. Possibly the most important matter dealt with was the construction of the politico-commercial road from Darjiling to the Jyalap Pass into the Chumbi Valley, which Sir R. Temple considers the frontier-line between British and Chinese territory. Sir R. Temple is apparently sanguine that the Tibetans will continue the road on to Lhasa, but he did not say when they were likely to do so. Mr. W. T. Blanford, who had also visited Sikkim, afterwards explained to the meeting that he believed these lakes to be due to glacial action, and that the Bidan Tso was a beautiful specimen of this kind of lake. Mr. Blanford also called attention to the opening afforded for exploration in Northern Sikkim, which has not as yet been visited by Europeans.

WE understand that Mr. Joseph Thomson has been elected a life-member of the Royal Geographical Society, in further recognition of his eminent services to geography during the recent East African expedition. The Council of the Society have presented to the British Museum the collection of shells which he made during his journey.

THE *Oesterreichische Monatschrift für den Orient* of this month contains a highly interesting paper by Prof. H. Vambéry, on the proposed Hyrkanian railway, a valuable description of the roads and land communications of Persia by Baron Gödel-Lannoy in Tcheran, a paper on the coffee districts of Yemen by Baron Schweiger-Lerchenfeld, besides two well-written historical papers.

AT the last meeting of the Berlin Geographical Society Prof. W. Förster, the director of the Berlin Observatory, made an interesting communication regarding one of the most important tasks of travellers in unknown regions, *i.e.* the exact determination of latitude, longitude, and elevation above sea-level. With several of the results of recent German expeditions serious errors in this regard were detected. Prof. Förster stated that the Berlin Observatory staff would shortly be in a position to undertake the practical and theoretical instruction of travellers and to superintend the selection, testing, and packing of the necessary scientific instruments for the various expeditions before starting.

THE last number of the *Tour du Monde* contains an instalment of Dr. Crevaux's account of his journey from Cayenne to the Andes, the present part dealing more particularly with the exploration of the River Parou. The illustrations are from original sketches, and are admirably drawn.

IN a recent issue *Les Missions Catholiques* publishes a letter from a missionary among the Kakhyens, which contains some interesting notes concerning that comparatively unknown people.

A SYDNEY telegram states that a bushman named Skulthorpe has telegraphed from Blackall asserting that he has found the explorer Leichhardt's grave, and has recovered the diary of the whole of his last expedition, together with other relics. Skulthorpe refuses to show any of the articles until his arrival in Sydney.

THE last number of *Le Globe* contains part of a paper entitled "Tartarie," by M. F. de Morsier, in which the writer proposes to deal with the Tartar, Turcoman, and Kirghiz steppes.

BY a telegram from Brisbane we learn that the Queensland Government expedition for the survey of the projected Transcontinental railway started on January 14, presumably from Blackall. A previous survey, it will be remembered, was made by a party under Mr. Favene, despatched by the proprietors of the *Queenslander*, but so far as we are aware no detailed account of his explorations has ever been made public, and possibly the new expedition has been sent to endeavour to find a better line of route.

THE Wellington correspondent of the *Colonies and India* states that the Southern Alps and other of the principal mountains of New Zealand are to be explored next year by members of the Alpine Club, who will find ample scope for their energies. The top of Mount Cook, the loftiest peak in New Zealand, between 13,000 and 14,000 feet in height, has not yet been reached.

THE International Alpine Congress will meet at Salzburg in 1882. The committee is now being formed.

ON THE VISCOSITY OF GASES AT HIGH EXHAUSTIONS[1]

BY the viscosity or internal friction of a gas is meant the resistance it offers to the gliding of one portion over another. In a paper read before the British Association in 1859 Maxwell[2] presented the remarkable result that on theoretical grounds the coefficient of friction, or the viscosity, should be independent of the density of the gas, although at the same time he stated that the only experiments he had met with on the subject did not seem to confirm his views.

An elaborate series of experiments were undertaken by Maxwell to test so remarkable a consequence of a mathematical theory; and in 1866, in the Bakerian lecture for that year,[3] he published the results under the title of "The Viscosity or Internal Friction of Air and other Gases." He found the coefficient of friction in air to be practically constant for pressures between 30 inches and 0·5 inch; in fact numbers calculated on the hypothesis that the viscosity was independent of the density agreed very well with the observed values.

The apparatus used by Maxwell was not of a character to admit of experiments with much lower pressures than 0·5 inch.

Maxwell's theory that the viscosity of a gas is independent of the density presupposes that the mean length of path of the molecules between their collisions is very small compared with the dimensions of the apparatus; but inasmuch as the mean length of path increases directly with the expansion, whilst the distance between the molecules only increases with the cube root of the expansion, it is not difficult with the Sprengel pump to produce an exhaustion in which the mean free path is measured by inches, and even feet,[4] and at exhaustions of this degree it is probable that Maxwell's law would not hold.

The experiments recorded in this paper were commenced early in 1876, and have been continued to the present time. In November, 1876, the author gave a note to the Royal Society on some preliminary results. Several different forms of apparatus have since been used one after the other, with improvements and complexities suggested by experience or rendered possible by the extra skill acquired in manipulation. The earlier observations are now of little value, but the time spent in their prosecution was not thrown away, as out of those experiments has grown the very complicated apparatus now finally adopted.

The Viscosity Torsion Apparatus, with which all the experiments here given have been performed, is a very complicated instrument. It consists essentially of a glass bulb, blown with a point at the lower end, and sealed on to a long narrow glass tube. In the bulb is suspended a plate of mica, by means of a fine fibre of glass 26 inches long, which is sealed to the top of the glass tube, and hangs vertically along its axis. The plate of mica is ignited and lamp-blacked over one-half. The tube is pointed at the upper end, the upper and lower points are 46 inches apart, and are accurately in the prolongation of the axis of the tube. Sockets are firmly fixed to a solid support, so that when the tube and bulb are clamped between them they are only able to move around the vertical axis. The glass fibre being only connected with the tube at the top, rotating the tube on its axis communicates torsion to the fibre, and sets the mica plate swinging on the same axis without giving it any pendulous movement. The diameter of the fibre is about 0·001 inch. The viscosity apparatus is connected to the pump by a flexible glass spiral, so as to allow the apparatus to rotate on the pivots and at the same time to be connected to the pump altogether with sealed glass joints. An arm working between metal stops limits the rotation to the small angle only which is necessary.

The torsional movement given to the mica plate by the light of the candle shining on it or by the rotation of the bulb and tube on its axis by the movement of the arm between the stops, is measured by a beam of light from a lamp, reflected from a mirror to a graduated scale.

The pump employed has already been described. The measuring apparatus is similar to that described by Prof. McLeod[1] before the Physical Society, June 13, 1874. As it contains several improvements shown by experience to be necessary when working at very high vacua, a detailed description is given in the paper.

When taking an observation the arm is moved over to the stop, and in a few seconds allowed to return to its original position by the action of a spring. This movement rotates the viscosity apparatus through a small angle, and sets the mica plate vibrating, the reflected line of light traversing from one side of the scale to the other in arcs of diminishing amplitude till it finally settles down once more at *zero*.

The observer watching the moving index of light records the scale number reached at the extremity of each arc. The numbers being alternately on one and the other side of zero are added two by two together, to get the value of each oscillation. The logarithms of these values are then found, and their differences taken; the mean of these differences is the logarithmic decrement per swing of the arc of oscillation. For the state of brevity this is called the log dec.

A very large number of experiments have been made on the viscosity of air and other gases. Observations have been taken at as high an exhaustion as 0·02 M, but at these high points they are not sufficiently concordant to be trustworthy. The pump will exhaust to this point without difficulty if a few precautions are taken, but at this low pressure the means of measuring fail in accuracy.

The precautions which experience shows to be necessary when exhausting to the highest points are fully described in the paper.

Viscosity of Air.—The mean of a very large number of closely concordant results gives as the log decrement for air for the special apparatus employed, at a pressure of 760 millims. of mercury and a temperature of 15° C., the number 0·1124. According to Maxwell the viscosity should remain constant until the rarefaction becomes so great that we are no longer at liberty to consider the mean free path of the molecules as practically insignificant in comparison with the dimensions of the vessels.

The author's observations show that this theoretical result of Maxwell's is at least approximately and may be accurately true in air up to comparatively high exhaustions; and that at higher exhaustions the viscosity falls off, as it might be expected to do according to theory.

The results are embodied in a table and diagrams.

The first half of the table gives the viscosity of air, in so far as it is represented by the log dec., at pressures intermediate between 760 millims. and 0·76 millim. (1000 millionths of an atmosphere). In order to avoid the inconvenience of frequent reference to small fractions of a millimetre, the millionth of an atmosphere[2] (= M) is now taken as the unit instead of the millimetre. The second half of the table is therefore given in millionths, going up to an exhaustion of 0·02 millionth of an atmosphere.[3]

Starting from the log dec. 0·1124 at 760 millims., the viscosity diminishes very regularly, but at a somewhat decreasing rate. Between 50 millims. and 3 millims. the direction is almost vertical, and a great change in the uniformity of the viscosity curve commences at a pressure of about 3 millims. At this point the previous approximation to, or coincidence with, Maxwell's law begins to fail, and further pumping considerably reduces the log decrement.

From 1000 M the diminution of viscosity is very slight until the exhaustion reaches about 250 M; after that it gets less with increasing rapidity, and falls away quickly after 35 M is reached.

The curves of increasing mean free path and diminishing viscosity closely agree. This agreement is more than a mere coincidence, and is likely to throw much light on the cause of viscosity of gases.

[1] Abstract of a paper read before the Royal Society, February 17, 1881, by William Crookes, F.R.S.

[2] *Phil. Mag.*, 4th ser. vol xix. p. 31.

[3] *Phil. Trans.* 1866, part 1, p. 249.

[4] Thus, supposing the mean free path of the molecules of air at the ordinary pressure is the 1-10,000th of a millimetre, at an exhaustion of the ten-thousandth of an atmosphere, the mean free path will be 1 millim. At one-millionth of an atmosphere the mean free path will be 10 centimetres, and at an exhaustion of one hundred millionth—by no means a difficult point to attain with present appliances—the mean free path will be over 30 feet. This rarefaction corresponds to that of the atmosphere at a height above the earth of a little more than ninety miles, assuming that its density decreases in geometrical progression as its height increases in arithmetical progression, and neglecting the small corrections for diminished gravity and temperature. As the height above the earth increases, the length of the mean free path of the molecules of air rapidly approaches to planetary distances; at about 200 miles height the mean free path is 10 million miles, whilst between eighty and ninety miles higher the rarity is such that the mean free path would extend from here to Sirius.

[1] *Philosophical Magazine*, vol. xlviii. p. 110, August, 1874.

[2] M = 0·00076 millim.; 1315·789 M = 1 millim.

[3] To give some idea of the high exhaustions at which its measurements can be taken it may be mentioned that the highest exhaustion on the table—0·02 M—bears about the same proportion to the ordinary atmospheric pressure that 1 millimetre does to thirty miles, or, converting it into time, that one second bears to twenty months.

In the table is also given the measurements of the repulsion exerted on the blackened end of the mica plate by a candle-flame placed 500 millims. off. The repulsion due to radiation commences just at about the same degree of exhaustion where the viscosity begins to decline rapidly, and it principally comes in at the exhaustions above 1000 M.

The close agreement between the loss of viscosity and the increased action of radiation is very striking up to the 35 millionth, when the repulsion curve turns round and falls away as rapidly as the viscosity.

Experiments are next described on the resistance of air to the passage of an induction spark.

Since the publication of the author's researches on the phenomena presented by the passage of the induction discharge through high vacua, the present results—which, although never published, precede by a year or two those just mentioned—have lost much of their interest.

The phenomena at the very high exhaustion of 0·02 M may be of interest. With a coil giving a spark 85 millims. long, no discharge whatever passes. On increasing the battery power till the striking distance in air was 100 millims. the spark occasionally passed through as an intermittent flash, bringing out faint green phosphorescence on the glass round the end of the — pole.

On one occasion the author obtained a much higher exhaustion than 0·02 M. It could not be measured, but from the repulsion by radiation and the low log dec. it was probably about 0·01 M. The terminals of the vacuum tube and wires leading to them were well insulated, and the full power of a coil giving a 20-inch spark was put on to it. At first nothing was to be seen. Then a brilliant green light flashed through the tube, getting more and more frequent. Suddenly a spark passed from a wire to the glass tube, and pierced it, terminating the experiment.

Since these experiments vacua have frequently been got as high, and even higher, but the author has never seen one that would long resist a 20-inch spark from his large coil.

Viscosity of Oxygen.—The series of experiments with air show a complete history of its behaviour between very wide limits of pressure. It became interesting to see how the two components of air, oxygen and nitrogen, would behave under similar circumstances. Experiments were therefore instituted exactly as in the case of dry air, but with the apparatus filled with pure oxygen.

The results are given in the form of tables and plotted as curves on diagrams.

The figures show a great similarity to the air curve. Like it the log dec. sinks somewhat rapidly between pressures from 760 millims. to about 75 millims. It then remains almost steady, not varying much till a pressure of 16 millims. is reached. Here however it turns in the opposite direction, and increases up to 1·5 millim. It then diminishes again, and at higher exhaustions it rapidly sinks. This increase of viscosity at pressures of a few millimetres has been observed in other gases, but only to so small an extent as to be scarcely beyond the limits of experimental error. In the case of oxygen however the increase is too great to be entirely attributable to this cause.

Oxygen has more viscosity than any gas yet examined. The viscosity of air at 760 millims, being 0·1124, the proportion between that of air and oxygen, according to these results, is 1·1185.

This proportion of 1·1185 holds good (allowing for experimental errors) up to a pressure of about 20 millims. Between that point and 1 millim. variations occur, which have not been traced to any assignable cause: they seem large to be put down to "experimental errors." The discrepancies disappear again at an exhaustion of about 1 millim., and from that point to the highest hitherto reached the proportion of 1·1185 is fairly well maintained.

Viscosity of Nitrogen.—The proportion between the viscosities of nitrogen and air at a pressure of 760 millims is, according to these experiments, 0·9715.

A comparison of the air curves with those given by oxygen and nitrogen gives some interesting results. The composition of the atmosphere is, by bulk,

Oxygen	20·8
Nitrogen	79·2
	100·0

The viscosity of the two gases is almost exactly in the same proportion: thus at 760 millims—

$$\frac{20{\cdot}8\ vis.\ O + 79{\cdot}2\ vis.\ N}{100} = vis.\ air,$$

$$\frac{20{\cdot}8\ (0{\cdot}1257) + 79{\cdot}2\ (0{\cdot}1092)}{100} = \ ,,$$

$$\frac{2{\cdot}61456 + 8{\cdot}64072}{100} = 0{\cdot}11255,$$

a result closely coinciding with 0·1124, the experimental result for air. Up to an exhaustion of about 30 M the same proportion between the viscosities of air, oxygen, and nitrogen is preserved with but little variation. From that point divergence occurs between the individual curves of the three gases.

Observations on the Spectrum of Nitrogen.—Spectrum observations during exhaustion give the following results:—

At 55 millims. pressure the band spectrum of nitrogen commences to be visible. The red and yellow bands are easily seen, and the green and blue are exceedingly faint. As the pressure grows less the bands become more distinct, until at 1·14 millim. the band spectrum is at its brightest.

At a little higher exhaustion a change comes over the spectrum, and traces of the line spectrum are observed.

At 812 M both the band and the line spectrum can be seen very brilliantly.

At 450 M the line spectrum is seen in great purity. As the exhaustion becomes higher the lines commence to disappear at the two ends of the spectrum.

At 188 M the lines below λ 610 ms. of m.m. at the red end, and above λ 400, cease to be visible.

At 94 M a bright greenish yellow line is visible at about λ 567.

At 55 M this greenish yellow line is still very prominent. The red lines have disappeared altogether, and the highest blue line visible is one at λ 419. The line 567 varies much in visibility; sometimes it cannot be seen, whilst at others it is very visible. Thus—

At 40 M the line 567 has quite disappeared.

At 17 M line 567 is visible again, being the most prominent line left.

At 12 M line 567 is not seen, although several other green and blue lines are left.

At 3 M only three lines are visible in the green, and these are very faint.

At 2·8 M line 567 is detected again.

At 2 M only traces of one or two lines can be seen, the faint light of the lines being overpowered by the green phosphorescence of the glass.

Line 567 has been seen on several occasions at high exhaustions when the gas under examination has been mixed with a little air. It is probably a nitrogen line, for one of the most brilliant nitrogen lines has a wave-length of 567·8 (Thalén), 568·0 (Huggins), or 568·1 (Plücker), and the author's interpolation curve is not sufficiently accurate to enable him to say that the line entered in as being at 567 may not in reality be a trifle higher. The reason of its being only sometimes visible may be accounted for by a difference in the sensitiveness of the eye at different times, or by a difference in battery power. This however cannot be the whole explanation, for other lines are not found to vary in the same manner.

The curve of Repulsion exerted by Radiation is much lower than in oxygen or air, and sinks rapidly after the maximum is passed.

Viscosity of Carbonic Anhydride.—The curves of this gas are given in diagrams plotted from the observations. At first the curve seems to follow the same direction as the air curve. But at a pressure of about 620 millims. it slopes more rapidly till the pressure is reduced to about 50 millims., when the curve again takes the direction of the air curve. The total diminution between 760 millims. and 1 millim. is nearly double that of air.

Observations have also been taken with the spectroscope during the exhaustion of carbonic anhydride. The maximum brilliancy of the spectrum occurs at an exhaustion of about 300 M. After that it gets fainter; at about 75 M the blue band (λ 409 to 408 ms. of mm.) disappears; as the exhaustion gets higher the other bands vanish until, at a vacuum of about 40 M, nothing is visible but the two lines λ 519 and λ 560. At higher exhaustions these lines disappear, and the phenomena of "Radiant Matter" commence.

The proportion between the viscosity of carbonic anhydride and air at 760 millims. is 0·9208.

Viscosity of Carbonic Oxide.—The results with this gas are remarkable as showing an almost complete identity with those of nitrogen both in position and shape. The viscosity at 760 millims. is in each case 0·1092.

Like that of nitrogen the curve of carbonic oxide is seen to be vertical—*i.e.*, assuming the curve to represent the viscosity, the gas obeys Maxwell's law, at pressures between 90 millims. and 3 millims. The straight portion in nitrogen is at a little higher pressure—between 100 millims. and 6 millims.

The curve of repulsion resulting from radiation is lower in carbonic oxide than in any other gas examined, and, unlike the other gases, there is no sudden rise to a maximum at about 40 M. At lower exhaustions the curve is, however, higher than it is in nitrogen.

During exhaustion observations were continued on the variations in the spectrum. The ordinary band spectrum is first seen with a few sharp lines terminating the bands.

At 12 millims. pressure a sharp green line is first seen, λ 515 ms of mm. This line rapidly grows brighter as exhaustion continues, and then fades out; it is last seen at a pressure of about 0·9 millim. This line is probably the bright oxygen-line, the wave-length of which is given by Plücker at 514·4.

At a pressure of 2·8 millims. the spectrum agrees in appearance with the "Carbon No. 2" in Watts's "Index of Spectra."

At 553 M the bands between the sharp lines appear to be breaking up into masses of fine lines.

At 211 M these fine lines are distinctly visible. The brightness of this spectrum is now near its maximum.

At 100 M the general spectrum is growing faint, but a sharp green line at λ 534 makes its appearance by fits and starts. This is coincident with Plücker's bright oxygen line λ 534.

After this degree of exhaustion the spectrum rapidly gets fainter. The line λ 534 soon disappears, and the carbon lines also go one after the other, until at an exhaustion of 4 M only two lines are visible, λ 560 and λ 519.

Viscosity of Hydrogen.—It has been found that hydrogen has much less viscosity than any other gas; the fact of the log dec. not decreasing by additional attempts at purification is the test of its being free from admixture. This method of ascertaining the purity of the gas, by the uniformity of its viscosity coefficient at 760 millims., is more accurate than collecting samples and analysing them eudiometrically.

Several series of observations in hydrogen have been taken. For a long time it was considered that hydrogen, like other gases, showed the same slight departure from Maxwell's law of viscosity being independent of density that appeared to be indicated with other gases; for the log dec. persistently diminished as the exhaustion increased, even at such moderate pressures as could be measured by the barometer gauge. Had it not been that the rate of decrease was not uniform in the different series of observations, it might have been considered that this variation from Maxwell's law was due to some inherent property of all gases. After working at the subject for more than a year it was discovered that the discrepancy arose from a trace of water obstinately held by the hydrogen. Since discovering this property extra precautions (already described at the commencement of the paper) have been taken to dry all gases before entering the apparatus.

The remarkable character of hydrogen is the uniformity of resistance which it presents. It obeys Maxwell's law almost absolutely up to an exhaustion of about 700 m., and then it commences to break down. Up to this point the line of viscosity is almost perfectly vertical. It then commences to curve over, and when the mean free path assumes proportions comparable with the dimensions of the bulb and approaches infinity, the viscosity curve in like manner draws near the zero line.

The repulsive force of radiation is higher in hydrogen than in any other gas. It commences at as low an exhaustion as 14 millims., but does not increase to any great extent till an exhaustion of 200 M is attained; it then rises rapidly to a maximum at between 40 and 60 M, after which it falls away to zero. The maximum repulsion exerted by radiation in hydrogen is to that in air as 70 to 42·6. This fact is now utilised in the construction of radiometers and similar instruments when great sensitiveness is required.

Taking the viscosity of air at 760 millims. as 0·1124, and hydrogen as 0·0499, the proportion between them is 0·4439.

The Spectrum of Hydrogen.—The red line (λ = 656), the green line (λ = 486), and the blue line (λ = 434) are seen at their brightest at a pressure of about 3 millims., and after that exhaustion they begin to diminish in intensity. As exhaustion proceeds a variation in visibility of the three lines is observed. Thus at 36 millims. the red line is seen brightly, the green faintly, whilst the blue line cannot be detected. At 15 millims. the blue line is seen, and the three keep visible till an exhaustion of 418 M is reached, when the blue line becomes difficult to see. At 38 M only the red and green lines are visible, the red being very faint. It is seen with increasing difficulty up to an exhaustion of 2 M, when it can be seen no longer. The green line now remains visible up to an exhaustion of 0·37 M, beyond which it has not been seen.

It is worthy of remark that although when working with pure hydrogen the green line is always the last to go, it is not the first to appear when hydrogen is present as an impurity in other gases. Thus, when working with carbonic anhydride insufficiently purified, the red hydrogen line is often seen, but never the green or the blue line.

(*To be continued.*)

SEEING BY ELECTRICITY[1]

ON being called upon by the chairman to show his experiments, Prof. Ayrton stated that he and Mr. Perry thought that the occasion of the reading of Mr. Bidwell's paper was a suitable one for their showing to the Society that they were constructing the apparatus described by them in a letter in NATURE, vol. xxii. p. 31. The feasibility of their plan had been combated, and at the last meeting of the British Association at Swansea it was confidently asserted that the action of selenium was not quick enough to register rapid changes of light intensity—an idea, however, which they stated in the discussion at the time there was experimental evidence to disprove. After that came the publication and exhibition of the photophone, proving that selenium changed its electrical properties synchronously with rapid changes in light intensity. For a light telegraph however not only was this property necessary, but in addition that the electric changes in the selenium should be considerable for a comparatively small change in the light. They had, therefore, tried to make sensitive selenium cells of low resistance. The method they had employed consisted in winding two wires parallel on strips of box-wood, ivory, and other non-conductors in section, somewhat like that of a paper-knife in the manner subsequently described by Mr. Bidwell in NATURE, but they had not found it necessary to cut a screw on the wood or mica in a lathe. Of the twenty-five cells that they had constructed they had invariably found, like Mr. Bidwell, that only those were sensitive that had a high resistance. They were aware that Prof. Adams had made sensitive cells of low resistance, and had he been present they would have liked to ask whether it was not only for very small electromotive forces that the cells were sensitive. They had also found that when sensitive cells of 100,000 ohms resistance diminished in resistance to only a few hundred ohms by natural annealing extending over some months, the cells lost entirely their sensibility. Further that certain sensitive cells of high resistance were sensitive as long as an electromotive force of not more than about seven volts was employed to send a current through them, but for electromotive forces much above this the cells were comparatively unsensitive to light, but the sensibility was not destroyed for electromotive forces smaller than seven volts used subsequently. These phenomena, which they believed had not been previously noticed, pointed, they suggested, to the sensibility of selenium being due almost entirely to a polarisation and not merely to a change of resistance, as was commonly supposed and stated. Might it not be possible, they asked, that there was an electromotive force developed in selenium by light, which, for different cells, increased more rapidly than the resistance of the cell, and which was the greater, the greater the electromotive force of the auxiliary battery employed; that in fact selenium became rapidly polarised by the auxiliary current flowing through it, and that this polarisation, the amount of which depended on this current, was removed in proportion to the intensity of the light. That a small electromotive force was developed in selenium by light when no auxiliary current was sent through it, had been conclusively shown by Prof. Adams and Mr. Day in 1876, a result that they had also experienced; and they would mention that a careful examination which they had recently made of the paper published by Prof. Adams and

[1] Paper communicated to the Physical Society, February 26.

Mr. Day in the *Phil. Transactions* for 1876, showed that if we assumed *all* the instances therein mentioned of sensibility of selenium to light were due to an electromotive force set up, and not to change of resistance at all, then on the whole all the results would have been arrived at if this electromotive force set up in different cells, for the same intensity of light, increased more rapidly than the resistance of the cell, and was the greater, the greater the electromotive force of the auxiliary battery employed. They disagreed therefore from Mr. Bidwell in his idea that the name "cell" was at all inappropriate.

Professors Ayrton and Perry referred the Members to their original letter in NATURE for the account of their plan for seeing by electricity. Shortly, it consisted in projecting at the sending-station an image on a screen consisting of a number of selenium cells, the current flowing in each of which from an auxiliary battery was controlled by the intensity of the light falling on it. At the receiving-end of the line a light was thrown on a screen intercepted more or less by little shutters, the opening or closing of each of which was controlled by the current allowed to pass through the corresponding selenium cell at the sending end. Hence on the receiving screen a picture in mosaics was cast corresponding with the image projected on the screen at the sending-end, and varying with every change in the image cast on the sending-screen.

The experiment they desired to show the Society was the successful reproduction on the receiving-screen of every change of illumination of one square of the sending-screen. The shutter was an elliptical blackened aluminium disk suspended in a blackened tube of a kind of galvanometer, and making an angle of 45° with the tube when all the light tending to pass through the tube was cut off. When this disk was deflected through 45° all the light passed through the tube and an image of a square hole was formed by a small lens attached to the tube. For every intermediate position of the shutter an image of the square hole was formed on the screen, but varying in intensity of illumination. Attached to the shutter was a small magnet making an angle of 67½° with it, and the two were suspended by a silk fibre about one-twentieth of an inch in length. These particular angles were selected so that first all variation in intensity of the illumination could be produced with a small motion of the shutter, and secondly, so that the magnet should always be in its most sensitive position in the coil through which passed the electric current which traversed and was controlled by the corresponding selenium square at the receiving-end of the line. [The apparatus was then shown in action.]

They explained how their method of putting, say, thirty or forty selenium cells on a revolving arm would enable them, while dispensing with a large number of cells, to transmit electrically a complete picture of even moving objects, and would in addition obviate the difficulty arising from abnormal variations of selenium.

Instead of the apparatus exhibited to the meeting to show the perfect feasibility of the scheme, Professors Ayrton and Perry mentioned that they were also experimenting with a large thin mirror with many thick ribs at the back crossing one another. Electro-magnets firmly fixed behind the thin parts of the mirror produced by their expansion and contraction very small convexities and concavities on the mirror's face. From their experiments, published in the *Proc.* Roy. Soc., on the so-called Japanese magic mirrors, it was known that excessively small convexities and concavities of this kind might be made to show themselves in a very decided way on a screen by a divergent beam of reflected light. They proposed to have a circular mirror in rotation, but with only a certain sectional space at the back fitted with electro-magnets as described, and they anticipated that this in conjunction with the rotating section of selenium cells at the other end of the line would produce on a screen a picture over the whole area of the mirror corresponding with the distant image projected on the area traced out by the revolving sector of selenium cells.

EARTH CURRENTS—ELECTRIC TIDES

AT a meeting of the Society of Telegraph Engineers and of Electricians on Thursday evening, February 10, Prof. G. C. Foster in the chair, a communication was read by Mr. Alex. J. S. Adams upon "Earth Currents—Electric Tides," in which the author related that, from investigations he had carried on in connection with earth currents since the year 1866, he considered the globe we inhabit as an electrified sphere whose normal electrical condition was liable to disturbance both from within and from without. Starting upon this theory as a basis, and finding from the result of his observations no evidence that the sun exerted sufficient influence to materially disturb the earth's electricity, he undertook a series of systematic observations upon the daily earth-current variations in strength, to elucidate the question, and obtained consecutive observations every quarter of an hour during the interval from April 1 to 21, 1879, with a result that the curves of those observations coincided throughout with the curve of moon-phases for the same period, and clearly indicated that the chief disturbing power was the moon, and that the earth current variations were strictly *lunar-diurnal*.

"But," said he, "there is a yet deeper meaning to the lunar-diurnal current curve than at first sight appears, for an examination shows that the curve for each day represents *four electrical maxima, two of a kind*, and that each maximum is divided from the other by a zero or point of no current." He further explained that whilst two of these maxima always exist upon the opposite sides of the globe, which are in a line *perpendicular* to the moon, two other maxima were also found upon the sides of the globe lying at right angles to the former maxima, and that from a long and careful consideration of these features of the phenomenon he had arrived at the conclusion that whilst the earth's disturbed electricity was, as it were, heaped up by the moon upon the sides of the earth nearest to and farthest from her, much as are the waters of the globe in forming the oceanic tides, the two *lateral* maxima, upon the other hand, must be considered as parts of a belt or band of electrical maximum that encircles the earth in a position at right angles to a line drawn between the earth and moon. Thus it appeared that there were zones of maxima at the sides of the globe nearest to and farthest from the moon, and a *circle* of maximum at right angles between them, but divided from them by zones of no current. This arrangement of the earth's electricity by the moon the author termed the earth's *lunar electric distribution*; the electric maximum facing the moon he designated the *major electric pole*, that farthest from the moon the *minor electric pole*, and the belt of maximum that encircles the earth the *electric circle*. Likewise the zone of no current that divides the electric circle from the major pole he terms the *major zero circle*, and that zero which separates the electric circle from the minor pole, the *minor zero circle*.

The earth's electricity, as thus arranged by the moon, followed that orb in her course through the heavens, and this motion of the earth's disturbed electricity round the earth, yet irrespective of the globe itself, was termed the *lunar diurnal electric circulation*, and the axis upon which it turned the *lunar-diurnal axis*.

A due apprehension however that *the moon's influence is in proportion felt by the earth's electricity at every part of the earth's surface* he considered necessary for the proper appreciation of the reasonings which led to the foregoing deductions.

It was then pointed out that there existed a regular retardation or lagging of the earth-current variations behind the corresponding phases of the moon to the extent of nearly three hours, this curious phenomenon being in no way, so far as he could trace, attributable to solar influence.

The magnetic variations were then considered, and a striking coincidence between the electric and the magnetic lunar-diurnal variation-curves was shown to obtain. The author reasoned that the earth's electric forces as constituted in the *electric distribution* revolved also about an axis parallel to a line passing through the centres of the earth and moon, *i.e.* a line drawn between the major and minor electric poles—a motion of the electric forces that agreed with the *observed direction* of the earth current, and which appeared fully sufficient to account for the effect of lunar-diurnal magnetic variation.

In conclusion he said that a comprehensive consideration of earth-current phenomena opens out a much wider sphere of investigation than that simply embracing variations of strength: it has to recognise *directive influence* which, applied to electricity, means the production of magnetism, and that the electric circulating systems that appear to obtain by reason of these three motions, the *earth's diurnal rotation*, the *lunar current circulation*, and the *terrestrial current circulation*—causes which result in the apparently disconnected variations observable in the movements of the magnetic needle.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The examiners for the Natural Science Tripos during this year are Dr. W. H. Gaskell, Prof. Bonney, Mr. P. T. Main, Prof. Watson (Owens College), Prof. Lewis (recently

appointed Professor of Mineralogy), Messrs. W. Garnett, F. M. Balfour, and S. H. Vines.

The Rev. W. Cunningham, M.A., of Trinity College, has been appointed Deputy for the Knightbridge Professor, Prof. Birks, and has resigned the Assistant-Secretaryship of the Local Examinations and Lectures Syndicate.

Mr. W. Hillhouse, B.A., of Trinity College, Assistant-Curator of the Botanical Museum, has been approved as a teacher of botany, and Mr. J. J. Lister, B.A., of St. John's College, Demonstrator of Comparative Anatomy, as a teacher of that subject for the purposes of medical certificates.

It was resolved last Thursday to admit women students at Cambridge to the Previous Examination and to the various Tripos Examinations, to publish separate class-lists for women, and in cases where order of merit is indicated in the men's class-lists, to indicate the position which any female student would have taken in the corresponding list of men. The examiners may also state that any candidate who does not attain an honour standard is adjudged to have deserved an ordinary degree. It will be necessary to present a further report on minor details of fees and regulations, but it can hardly be doubted that students duly qualified may be admitted formally to the examinations coming on in June next.

The University accounts just published show that examiners cost the University last year 2200*l.*, professors, demonstrators, lecturers, &c., 8400*l.*, in addition to those specially endowed. The ordinary expenses of the museums and lecture-rooms have been 2500*l.*, while the grant from the University is 2000*l.* The botanic garden has cost nearly 1000*l.*, and 660*l.* has been so far spent on a curator's house. The Local Examinations and Lectures Board have received 8400*l.*, and have invested a further sum of 500*l.*, which at a future time may help to provide a building for this extensive work. The University Library has overdrawn its balance nearly 900*l.*, and the Museums and Lecture Rooms Building Fund is in debt 2725*l.* On the whole it appears that the University has been very careful not to sanction new expenditure in this time of transition, and has succeeded in laying by 3000*l.*, now possessing a capital of 27,000*l.* in stocks. 3000*l.* was the University's income last year from common rents and dividends, while 27,000*l.* was paid by members of the University in fees for examinations, degrees, &c.

In the Special Examinations for the ordinary B.A. degree last year thirty-six candidates entered in Chemistry, nine of whom failed; two in Geology, nine in Botany; only one failed, viz. in Botany. The examiners report that in Chemistry the requirement of practical work has exerted a useful influence. This requirement however entails much additional work on the examiners in Natural Science, and the appointment of a third examiner is recommended.

Next Monday at three o'clock, Dr. W. H. Gaskell will make a communication to the Philosophical Society on the action of the vagus nerve upon the frog's heart; and Mr. F. M. Balfour will discuss the ancestral form of the chordata.

THE Calendar of St. David's College, Lampeter, for 1881, is of interest in connection with the forthcoming report of the Commission on Higher Education in Wales. It contains a full account of the foundation and history of the University, the means at its disposal, and the nature of the education it offers to students. The examination for the B.A. degree of this college includes either physics or chemistry.

SCIENTIFIC SERIALS

Archives des Sciences Physiques et Naturelles, No. 1, January 15.—Contributions to knowledge of the family of the Pintinnodea, by H. Fol.—On the use of the microphone in the service of the astronomical hour, by M. W. Meyer.—Exercises of analytical geometry, by L. de la Rive.—On the use of some azoic colours in physiological chemistry, by A. Danilewsky.—*Comptes rendus* of the Geneva Chemical Society, by S. Walter.—On the botanical geography of Southern Tessin, by S. Calloni.—Annals of Berne Observatory, by A. Forster.

Rivista Scientifico Industriale, No. 24, December 31, 1880.—Description of three new species of the aphides of Sardinia, by L. Marchiati.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xiii. fasc. xx.—On the rotatory movement of the heart, by E. Oehl.—On a new nuclearia; description and considerations as to its position in the geological system and its importance in animal ontogeny, by L. Maggi.—Registering instruments in meteorology, by C. Chistoni.—Synthesis of two new acids isomeric with vanillic acid, by G. Körner and G. Bertoni.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 27.—"On the Iron Lines widened in Solar Spots." By J. Norman Lockyer, F.R.S.

The observations put forward with reserve in my last communication to the Society have now been confirmed.

In the fine spots visible on December 24, January 1 and 6, many lines in the spectrum of iron were seen contorted, while others were steady.

The facts are given in the following table:—

	The iron lines indicating motion.	Iron lines, visible in the same field of view, steady.
Dec. 24, 1880 ...	5403·2	
	5404·8	5410·0
	5409·0	5414·5
	5408·8	
	5396·0	
	5370·5	
	5369·0	5366·5
	4919·8	
	4918·0	4923·0
	5142·2	5269·8
	5138·5	5268·5
In another part of the same spot—		
	5269·8	5323·5
	5268·5	5327·0 (double).
Jan. 1, 1881 ...	5323·5	5269·8
	5327·0 (double)	5268·5
Jan. 6,[1] 1881 ...	4919·8	
	4918·0	4923·5
	All lines between λ 5323·5 and 5410·0 except ...	5382·1

It is to be noted that these observations furnish us with an instance of inversion similar to those frequently obtained in our observations of the most widened lines in spots.

The inferences to be drawn from these observations, and those on which we are now continuously engaged, must be matter for future communication. But I cannot resist calling attention to the crucial nature of the evidence, at least as regards iron, in favour of the view first put forward by Sir B. Brodie, whom we have so recently lost, that the constituents of our terrestrial elements exist in independent forms in the sun.[2]

I have thought it right to send in a record of this work at once, with a view to induce other observers to follow the continually varying phases of the spots during the approaching maximum.

The observations have been made by Mr. H. A. Lawrance, and confirmed by myself in the majority of cases.

Chemical Society, February 17.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the estimation of organic carbon and nitrogen in water analysis simultaneously with the estimation of nitric acid, by M. W. Williams. The author has modified the well-known process of Frankland and Armstrong. Instead of reducing the nitrates with sulphurous acid, he uses the copper-zinc couple of Gladstone and Tribe, which converts nitrates into ammonia. The ammonia produced is distilled off and the distillate nesslerised; the water left in the retort, after distilling off the ammonia, is evaporated to dryness and the residue burnt in the ordinary way. The errors which accompany the use of sulphurous acid are thus avoided, and the time required for the analysis is much shortened.—Capt. Abney and Col. Festing then gave an account of their recent researches on the influence of the molecular grouping in organic bodies on their absorption in the ultra-red region of the spectrum. The authors have photographed the absorption-spectra of numerous inorganic and organic liquids in the region beyond the red. In many cases the presence of an organic radical seems to

[1] In this spot the D lines indicated motion, and *did not retain their parallelism.*

[2] Lecture delivered before the Chemical Society, June 6, 1867.

be characterised throughout its compounds by particular bands. Further research will probably throw much light on the internal structure of chemical substances.—On absorption-bands in the visible spectrum produced by certain colourless liquids, by Dr. Russell and Mr. Lapraik. The authors have carefully drawn the absorption-spectra of various liquids—water, ammonia, &c.—as seen through an ordinary spectroscope.—On the action of hydrochloric acid on ethylene alcohol, by C. Schorlemmer. By heating glycol with an excess of fuming hydrochloric acid in a sealed tube to 100° the author has converted this substance into ethylene dichloride, and has thus disproved the conclusion that the two hydroxyl groups had different functions.—On an attempt to accelerate the process of determining the soluble salts in a soil, by E. W. Prevost. The author added calcium sulphate and barium carbonate to the soil, but in neither case were satisfactory results obtained.

Linnean Society, February 17.—Frank Crisp, LL.B., F.L.S., in the chair.—Mr. Wickham exhibited two collections of Arctic plants. Of fifty-seven species collected by Capt. Markham in Novaya Zemlya (1879) thirty-seven of the most interesting Phanerogams were shown. The absence of species of Gentian is noteworthy, for Arctic Russia, in proximity, possesses six species. Leguminosæ are unrepresented in Spitzbergen and Arctic Greenland, but three species of the order obtain in Novaya Zemlya. Other features of the latter island's flora are equally remarkable. The second collection of typically Polar plants exhibited were those obtained by Mr. Grant in Mr. Leigh Smith's successful voyage to Franz-Josef Land, 1880, and where sixty-one flowering plants were obtained; though the facies of the flora indicates the probability of more yet to be got in this high latitude.—Mr. A. Hammond drew attention to a microscopic specimen and drawing of portion of the wall of the so-called glandular sac of the larva of the Puss moth, from which that insect ejects an acid liquid when alarmed or irritated. Although doubtless the organ is the source of the excretion, it yet is questionable to regard it as a true glandular structure, inasmuch as its tissue is largely composed of chitinous matter.—Dr. Francis Day read a paper, observations on some British fishes. In this he pointed out:—that *Pimelepterus Cornubiensis* is identical with the American *Pammelas perciformis*, Mitchell; that great confusion exists in the works of Yarrel and Couch respecting the Tunnies and their allies, most, if not all, the examples of the short-finned Tunnies being in reality specimens of *Pelamyo sarda*; that the Comber Wrasse (*Labrus Donovani*, Cuv. and Val.), is a peculiarly-coloured variety of *L. maculatus*, Bloch; that *Crenilabrus Baillonii*, Couch, is the *C. melops*, Cuv. and Val. Adult examples of Brill and Sole, coloured on both sides, but in which the eyes were normal, were exhibited. Some Sprats obtained off St. Ives were adverted to, which had fully-developed ova in January this year. It was also proved that the specimen of *Ostracion quadricornis* figured by Couch as a British fish had been brought in salt from abroad by a sailor. Observations also were made by Dr. Day concerning the habits of the Thresher Shark towards the Whale.—Mr. C. B. Clarke gave a communication on right-hand and left-hand contortion of the corolla. In this he maintains that Linnæus's definition of right-hand contortion is correct, and that the criticisms published by M. Alph. de Candolle in "Phytographie" are founded on a misconception. Mr. Clarke holds:—that everybody understands the same direction (viz. the watch-hand direction) by the term right-hand contortion; that the apparent direction of the heavenly bodies is reversed if the spectator looks north instead of south; that the direction of rotation is the same whether the observer supposes himself within or without the helix, but that the apparent direction of a helix is altered if the spectator reverses the direction in which he looks along the axis.—Prof. P. M. Duncan read a paper on some sponges obtained among a mass of fistulose coral from deep water off the coast of Spain during the expedition of the *Porcupine*. One kind, apparently new, is described as a species of *Leiodermatium*, *L. affine*, Dunc., and another belongs to the genus *Aphrocallistes*.

Geological Society, February 18.—Annual General Meeting. Robert Etheridge, F.R.S., President, in the chair.—The Secretaries read the Reports of the Council and of the Library and Museum Committee for the year 1880, the Council announcing with much satisfaction that the financial depression under which the Society had been suffering during 1878 and 1879 had proved, as was anticipated, only temporary, and that the Society is now in a very prosperous condition. The Council's Report also announced the publication of the new Catalogue of the Library, which, although considerably larger than was at first expected, will be issued to the Fellows at the price originally fixed for it. The Report further announced the awards of the various medals and of the proceeds of the donation funds in the gift of the Society. In presenting the Wollaston Gold Medal to Prof. P. Martin Duncan, M.B., F.R.S., F.G.S., the President addressed him as follows:—Professor Duncan,—It is with no ordinary pleasure that the Council have awarded to you the Wollaston Medal, the highest honour that it is in their power to bestow, in recognition of the valuable services which you have rendered during so many years to the advancement of geology, and especially of palæontology; and I may add that it is equally productive of gratification to me that this honour is to be formally conferred upon you by my hands. Since the year 1863 palæontologists have been indebted to you for no fewer than twenty-six memoirs relating to the history, structure, and distribution of the fossil Actinozoa, a group which you have made peculiarly your own by long-continued and most careful researches. Further, you have enriched the publications of the Palæontographical Society with several most important treatises on the British fossil corals, supplementary, or rather perhaps complementary, to the classical monograph of MM. Milne-Edwards and Haime. These labours alone, and the value of their results, might have justified the Council in awarding you the Wollaston Medal; but besides your researches upon the Actinozoa, we have to point to several important papers upon the fossil Echinodermata, to others relating to subjects of physical geology (also freely touched upon in your more special memoirs), and particularly to your exceedingly important work in connection with the Geological Survey of India, in describing the fossil corals of that peninsula, and discussing the questions of both zoological and geological interest which naturally arise out of the study of those organisms. Patiently and unobtrusively for nearly twenty years you have followed out the line of research necessary for the fulfilment of your self-imposed task; you have sacrificed the advantages of professional life to devote your energies to the advancement of science. On all accounts it is with much pleasure that I hand to you the Wollaston Medal. The President then presented the Murchison Medal to Prof. Archibald Geikie, F.R.S., F.G.S., and addressed him as follows:—Prof. Geikie,—If any one Fellow of our Society more than another could be selected to receive the Murchison Medal for his valuable contributions to geology, it would be yourself; since no man living has contributed more to the advancement of that science which it is the special object of our Society to cultivate and diffuse. Your labours in the field connected with your duties as Director of the Geological Survey of Scotland, your learned and valuable contributions to the *Journal* of our Society, the *Transactions* of the Royal Society of Edinburgh and the Glasgow Geological Society, and other publications too numerous to mention, eminently qualify you to be the recipient of the medal founded by your late chief and friend Sir Roderick Murchison. To enumerate your contributions to the literature of the geology of Scotland, or your many important writings connected with our science, would lead me too far—some thirty papers, besides educational works, have resulted from your industry and knowledge. Your able paper alone, on the "Old Red Sandstone of Scotland," published in the *Transactions* of the Royal Society of Edinburgh, would entitle you to the highest consideration of the Society. Able indeed are other contributions, especially those "On the Chronology of the Trap Rocks of Scotland," "On the Date of the Last Elevation of Central Scotland" (in vol. xviii. of our *Journal*), "On the Phenomena of Succession amongst the Silurian Rocks of Scotland" (*Trans.* Glasgow Geol. Soc. vol. iii.), and "On Earth Sculpture." The President next handed the Lyell Medal to Mr. Warington W. Smyth, F.R.S., for transmission to Dr. J. W. Dawson, F.R.S., of Montreal, and addressed him as follows:—Mr. Warington Smyth, I need hardly say that the Council, in awarding the Lyell Medal to Principal Dawson, have done so with a sincere appreciation of the high value of his truly great labours in the cause of palæontology and geology. When I refer to his published papers I find that they number nearly 120, and that they give the results of most extensive and valuable researches in various departments of geology, but more especially upon the palæontology of the Devonian and Carboniferous formations of Northern America. Considering the nature of these numerous contributions, the Council would have been fully justified in awarding to Dr. Dawson one of its medals, upon the

sole ground of the value of their contents; but these are far from representing the whole of the results of his incessant activity in the pursuit of science. His "Acadian Geology," "Post-pliocene Geology of Canada," and "Fossil Plants of the Devonian and Upper Silurian of Canada," are most valuable contributions to our knowledge of North American geology; whilst in his "Archaia," "The Dawn of Life," and other more or less popular writings he has appealed, and worthily, to a wider public. We are indebted to his researches for nearly all our knowledge of the fossil flora of the Devonian and other Precarboniferous rocks of America, and of the structure and flora of the Nova-Scotian coal-field; and finally I must refer especially to his original investigation of the history, nature, and affinities of *Eozoon*. These researches are so well known that they have gained for Dr. Dawson a world-wide reputation. The President then handed the Bigsby Medal to Prof. Morris, F.G.S., for transmission to Dr. Charles Barrois, and addressed him as follows:—Professor Morris, Dr. Barrois's chief or most important work (written in the year 1876, and published at Lille) is "Recherches sur le terrain crétacé supérieur de l'Angleterre et de l'Irlande," a production almost exhaustive in its description of the cretaceous rocks of England and Ireland, and of the utmost value to English students of geology. Dr. Barrois in this work has been the first to attempt to arrange the English Cretaceous rocks in palæontological zones, and eminently has he succeeded in defining and correlating the horizons of France and Britain. In handing to Prof. J. W. Judd, F.R.S., Sec.G.S., the balance of the Wollaston Donation Fund for transmission to Dr. Ramsay H. Traquair, F.G.S., the President said:—Professor Judd, in handing to you, to be forwarded to Dr. Traquair, the balance of the proceeds of the Wollaston Donation Fund, I have to request that you will inform him of the feeling of the Council, that it is rarely that they can have the opportunity of awarding this fund to a more able and accomplished naturalist than himself. His long-continued researches upon the ganoid fishes of the Carboniferous formation have rendered his name eminent in this department of palæontology. The President next presented the balance of the proceeds of the Murchison Donation Fund to Mr. Frank Rutley, F.G.S.; one moiety of the balance of the proceeds of the Lyell Donation Fund to Mr. G. R. Vine; the second moiety of the Lyell Donation Fund to Prof. H. G. Seeley, F.R.S., F.G.S., for transmission to Dr. Anton Fritsch, of Prague. The ballot for the council and officers was taken, and the following were duly elected for the ensuing year: President, R. Etheridge, F.R.S.; Vice-Presidents: John Evans, F.R.S., J. W. Hulke, F.R.S., Prof. J. Morris, M.A., and H. C. Sorby, F.R.S.; Secretaries: Prof. T. G. Bonney, F.R.S., Prof. J. W. Judd, F.R.S. Foreign Secretary, Warington W. Smyth, F.R.S.; Treasurer, J. Gwyn Jeffreys, F.R.S. Council: H. Bauerman, Rev. J. F. Blake, M.A., Prof. T. G. Bonney, F.R.S., W. Carruthers, F.R.S., Prof. P. M. Duncan, F.R.S., Sir P. de M. Grey-Egerton, Bart., M.P., F.R.S., R. Etheridge, F.R.S., John Evans, F.R.S., Lieut.-Col. H. H. Godwin-Austen, F.R.S., J. Clarke Hawkshaw, M.A., Rev. Edwin Hill, M.A., W. H. Hudlestone, M.A., J. W. Hulke, F.R.S., J. Gwyn Jeffreys, F.R.S., Prof. J. W. Judd, F.R.S., Prof. N. S. Maskelyne, M.P., F.R.S., J. Morris, M.A., J. A. Phillips, F. W. Rudler, Prof. H. G. Seeley, F.R.S., Warington W. Smyth, F.R.S., H. C. Sorby, F.R.S., H. Woodward, F.R.S.

Zoological Society, February 15.—Prof. W. H. Flower, F.R.S., president, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of January, and called special attention to a White-nosed Saki (*Pithecia albinasa*), purchased January 11; an American Monkey of the genus *Callithrix*—probably referable to *C. brunnea*, purchased along with the preceding; and an example of an Insectivore of the genus *Tupaia* (probably *T. tana*), obtained by purchase on the same day.—Mr. Sclater exhibited and made remarks on some eggs of *Opisthocomus cristatus*, obtained at Obydos on the Amazons.—Mr. Howard Saunders exhibited on behalf of Capt. E. A. Butler, and made remarks on specimens of the eggs of *Dromas ardeola*.—The Rev. O. P. Cambridge, C.M.Z.S., exhibited and made remarks on a Hymenopterous parasite, hatched from larvæ found on two spiders—*Linyphia obscura*, Blackw. ♀ and *L. zebrina*, Menge ♂. The larvæ were stated to be apodous, and to adhere to the abdomen of the spider, which, when full-grown, they fully equalled in size.—Mr. E. W. H. Holdsworth exhibited a specimen of White's Thrush (*Turdus varius*), killed in South Devonshire in January last.—Mr. C. O. Waterhouse read a paper on the Coleopterous Insects belonging to the family *Hispidæ*, collected by Mr. Buckley in Ecuador. Seventeen species of *Hispidæ* had hitherto been recorded as inhabiting that country; of these Mr. Buckley had met with fifteen, which, together with nineteen new species, made a total of thirty-six species in the series now described.—Mr. W. L. Distant read a paper on some additions which had been lately made to the Rhynchotal Fauna of the Ethiopian Region, nine new species belonging to the families *Pentatomidæ*, *Coreidæ*, and *Pyrrhocoridæ* were pointed out, and in the *Coreidæ* two new genera, allied to *Petillia* and *Petascelis*, were described. The specimens had been obtained from Western, Southern, and Eastern Africa.—A communication was read from Mr. Edgar A. Smith on some shells from Lakes Tanganyika and Nyassa and from other localities in East Africa, lately received by the British Museum. Great interest attached to some of the shells from Lake Tanganyika, from the fact that they had all the appearance of being modified marine types.—Lord Walsingham read a paper on some new and little known species of North American Tineidæ, amongst which were three new generic forms.

Meteorological Society, February 16.—Mr. G. J. Symons, F.R.S., president, in the chair.—I. L. Bell, F.R.S., J. Bernays, A. W. Blyth, J. Church, F. W. Cory, S. Cutler, T. L. K. Edge, C. Horsley, W. D. Howard, C. Kelly, M.D., G. Lingwood, W. Macgeorge, Capt. J. P. Maclear, R.N., A. Rigg, and H. C. Stephens were elected Fellows of this Society.—The following papers were read:—Relative humidity, by Charles Greaves, M. Inst. C.E., F.G.S. The object of this paper was to show that the term "relative humidity" was frequently the cause of misunderstanding, and that it was desirable that some other tables with a more correct denomination should be used in order that reliable values of this factor in our climate should be recorded.—On the frost of January, 1881, over the British Isles, by William Marriott, F.M.S. The author pointed out that the severe frost of the 7th to the 26th was remarkable for its unexpected appearance, its long continuance, and its sudden breaking up. The weather during the first week of January was comparatively mild, but frost set in over the north of Scotland on the 5th. The author then gave the lowest thermometrical readings from about 300 stations in the United Kingdom for each day of the frost, which were plotted upon diagrams, clearly showing the relative severity of the weather experienced in each district. The lowest readings were − 15° at Garstang on the 16th, and − 22° at Blackadder, − 16° at Kelso, − 15° at Stobo, − 11° at Thirlestane Castle, and − 10° at Melrose, on the 17th. Reference was also made in detail to the rivers and lakes which had been frozen over, and to other incidents proving the remarkably low temperatures which had occurred. Some idea of the intensity of the frost may be gathered by the fact that in the south of Scotland the temperature fell below 10° on more than eleven occasions, below 20° on nineteen occasions, and was below 32° on twenty-five to twenty-nine occasions. In the London district readings below 10° occurred on two or three days, below 20° on ten days, and below 32° on twenty days. In Ireland temperatures below 10° were registered on six or seven occasions, below 20° on twelve or fourteen occasions, and below 32° on twenty-two to twenty-four occasions. No place in the British Isles was exempt from the frost, even at Scilly the temperature was below 32° on three days, the lowest being 29° on two occasions. The winter sea-side health resorts afforded no protection from the frost; at Penzance the temperature fell below 32° on ten occasions, at Torquay on eleven occasions, and was below 20° on six occasions. At Ventnor it was below 32° on nineteen occasions, and below 20° on three occasions, and at Bournemouth it was below 32° on twenty-three, and below 20° on ten occasions. The heavy falls of snow prevented the frost from penetrating far into the ground, but where the snow was cleared away the temperature of the soil fell considerably. A diagram was exhibited showing the mean temperature of January, in the neighbourhood of London, for each year, from 1774 to 1881, from which it appeared that the low mean temperature of 31°·6 for last month had only been surpassed on five occasions, and that the three years, 1879-81, have been very cold, the mean for this period being only 32°·2; there is no instance during the past 100 years of any three consecutive Januarys having so low a mean temperature.

Royal Microscopical Society, February 9 (Anniversary Meeting).—Dr. Beale, F.R.S., president, in the chair.—The Report of the Council showed an addition of forty-nine Fellows

during the year (making 611 in all), with a considerable increase in the revenue and capital accounts of the Society. The attendance at the meetings was also shown to have increased by nearly 50 per cent. The President read his annual address, in which he dealt with the theory of evolution. A vote of thanks was passed by the meeting on the occasion of his retirement from the presidency, as also to the retiring treasurer, Mr. J. W. Stephenson.—The following Council was elected for the ensuing year:—President, Prof. P. Martin Duncan, F.R.S.; Vice-presidents: Prof. F. M. Balfour, F.R.S., W. B. Carpenter, C.B., F.R.S., John Millar, L.R.C.P. Edin., John Ware Stephenson; Treasurer, Lionel S. Beale, F.R.S.; Secretaries: Charles Stewart, M.R.C.S., Frank Crisp, LL.B., B.A.; Members of Council: Robert Braithwaite, M.D., Charles James Fox, William H. Gilburt, James Glaisher, F.R.S., A. de Souza Guimaraens, William J. Gray, M.D., John E. Ingpen, John Matthews, M.D., John Mayall, jun., Albert D. Michael, Frederic H. Ward, M.R.C.S., C. Tharters White, M.R.C.S.

Photographic Society, February 8.—J. Glaisher, F.R.S., president, in the chair.—A paper on sensitometers, was read by Leon Warnerke. After alluding to those already existing, he exhibited and explained one of his own, the "standard sensitometer." This consisted of a frame constructed to hold a thin block made of phosphorescent calcium sulphide mixed with paraffin, and made luminous by burning one inch of magnesium ribbon in close proximity; next is a glass, having upon it a series of squares (with consecutive figures on them) increasing in opacity; then a photographic plate, or any other material sensitive to light, is placed in front, and the phosphorescent light is then permitted to pass through the glass containing the squares; and the highest number visible represents the sensitiveness of the matter experimented upon; the numbers enabling relative values to be determined.

Statistical Society, February 15.—Mr. Jas. Caird, C.B., F.R.S., president, in the chair.—A paper was read on the number of deaths from accident, negligence, violence, and misadventure in the United Kingdom and some other countries, by Mr. Cornelius Walford, Barrister-at-Law, wherein he reviewed the numbers and causes of deaths of this class from the earliest periods at which records existed in the United Kingdom, bringing them down also to the latest date, and noting the circumstances which had helped to increase them, as also those which had a retarding influence. He was of opinion, supported by the statistics adduced, that violent deaths of various kinds had advanced with the progress of civilisation. New forces, as also increasing mechanical productiveness, rendered the risk to life and limb continually greater.

PARIS

Academy of Sciences, February 14.—M. Wurtz in the chair.—The following papers were read:—Progress of the zoological station of Roscoff, by M. de Lacaze-Duthiers. Since 1872 there have been 114 workers of various nationalities at the station, the numbers rising from three in 1872 to twenty-seven last year. Last August seventeen were accommodated at once. A keeper now stays at the station constantly, and despatches live animals to various laboratories in France. Zoologists can be lodged in winter. The station has a good sea-going vessel, and is about to acquire a diving-dress. (Particulars of the aquarium, laboratory, &c., are given.) A new station is being formed at Port Vendres, on the Mediterranean.—Existence of large spiral cells distributed in the parenchyma of certain *Crinum*, by M. Trécul.—Theorems relative to the equation of Lamé, by M. Brioschi.—On periodic movements of the ground, by M. Plantamour. In the year ending September 30, 1880, a great lowering took place on the east side, from October 4 to January 28, viz. 95″·80 (as against 28″·08 the previous year). The mean temperature of December was unusually low, but the author thinks some other cause must have operated also. The level placed in the meridian showed nearly the same oscillation as the previous year (4″·56). In winter the south side rises with rise of temperature; in summer it falls.—On the earthquake in Switzerland on Jan. 27, 1881, by M. Colladon.—Lithological and geological examination of the meteorite that fell on Oct. 13, 1872, in the neighbourhood of Soko Banja, in Servia, by M. M. Sunier.—On Fuchsian functions, by M. Poincaré.—On the laws which rule periods and coefficients of intensity in one of the principal groups of elementary electromotive forces due to solar induction, and on the possibility of using the magnetic needle to measure the velocity of rotation of the sun about its axis, by M. Quet.—On the relations which exist between the temperature, pressure, and circulation of the air on the Iberian peninsula, by M. Teisserenc de Bort. In winter the peninsula is colder than the seas around; it shows a barometric maximum, the air flowing outwards to the coasts. In summer the isotherms group round a maximum in the middle of Spain, where, on the other hand, the pressure shows a minimum, and the winds tend inwards. In intermediate seasons the isotherms are nearly perpendicular to the meridians; the isobars are grouped uniformly round great centres of atmospheric action, the most important being the oceanic barometric maximum. Spain is somewhat like monsoon countries. (The author also studies the action of the peninsula as revealed in daily phenomena).—On m'boundou (test-poison of the Gaboonese), new physiological, chemical, histochemical, and toxicological researches, by MM. Heckel and Schlagdenhauffen. It contains only one alkaloid, strychnine. The division of *Strychnos* into *tetanising* and *paralysing* is unwarranted. The effect depends on the dose employed.—On the treatment of phylloxerised vines by insufflation of vapours of sulphide of carbon, by M. Bourdon. He sends the vapours through a permanent drainage-system.—The Secretary made reference to the death of M. Kuhlmann.—Researches on the specific magnetism of ozone, by M. Becquerel. Ozone is found to be more magnetic than oxygen, and the ratio of the one specific magnetism to the other is considerably greater than the supposed ratio of the densities. Thus the specific magnetism of ozone is greater than that corresponding to the quantity of oxygen contained in it.—On the electric phenomena of tourmaline and of hemihedral crystals with inclined faces, by MM. Jacques and Curie.—On the combination of hydrochloric acid with bichloride of mercury, by M. Ditte. These substances may unite in several proportions.—Violet illumination of the retina under the influence of luminous oscillations, by M. Charpentier. If the sky, uniformly illuminated by diffused white light, be looked at steadily, and two fingers (separate about 0·02 m.) passed to and fro rapidly before the eye for about half a minute, one perceives a mosaic system of hexagons of violet purple colour separated by white lines. The author supposes the hexagons to represent the cones in the fovea and yellow spot, and the white lines filaments from the choroidian cells.—Determination of fundamental colour-sensations by study of the distribution of complementary colours in the chromatic circle (continued), by M. Rosenstiehl.—On a glucoside extracted from common ivy, by M. Vernet.—On cultivation of the microbe of rot, by M. Toussaint. This succeeds best in rabbit and mutton bouillon. The microbe appears in two states, that of bacteria and that of spores.—Structure and texture of the ink-bag of Sepia, by M. Girod.—Artificial reproduction of basalts, by MM. Fouqué and Lévy. They followed the igneous method. The peridote was crystallised at a higher temperature than the other minerals. The black earth used consisted of six of olivine, two of augite, and six of labrador.—Map of the central part of the Spanish Pyrenees, by M. Schroder.

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