THURSDAY, AUGUST 2, 1883

ZOOLOGY AT THE FISHERIES EXHIBITION[1]

II.—*Notes on the Vertebrata*

AT the request of the editor of NATURE I have drawn up this very general report on the Vertebrate animals now exhibited in the natural history sections of the different Courts at the International Fisheries Exhibition. In its compilation I have principally used the notes taken during a month's pretty close attendance at the great piscatorial show in South Kensington, and whilst doing work on the two special juries who had to examine and report on such collections. The space and time conceded preclude entirely anything like a detailed account even of this small portion of the rich and varied exhibit, whilst on the other hand books of reference could not be consulted, and strict nomenclature and systematic arrangement must be partly sacrificed. I shall, however, be content if I succeed in giving a fair general account of this special part of the Fisheries Exhibition, which cannot but interest many of the readers of this periodical to whom the sight of the exhibits themselves, some of very great interest, is not possible. I may also add that to my knowledge one group, that of Birds, wlll be the subject of a special article, to be published shortly in a special journal by one of our leading ornithologists, whilst on the other hand the Cetacea and Pinnipeda will be reported on in the jurors' reports by such distinguished specialists as Prof. Flower and Mr. Clark. I do not know whether any special report on the all-important and largely represented group of Fishes be imminent; I fear not; but as several highly competent ichthyologists have carefully gone over such collections in the Exhibition, I trust that so important a subject will also be laid before the scientific world by a competent reporter.

Before commencing my special task, and before taking the reader through the Vertebrate collections in the International Fisheries Exhibition, for which purpose I consider preferable a zoological to a geographical arrangement, I shall say a few words on the relative importance of the exhibits in this section contributed by different countries. Besides Great Britain and her dependencies, colonies, and possessions, such as the Isle of Man, Heligoland, Canada and Nova Scotia, Newfoundland, British Columbia, the Bahamas, Jamaica, New South Wales, Tasmania, India, Ceylon, and the Straits Settlements, the following foreign countries have contributed to the Fisheries Exhibition: France (not officially), Belgium, the Netherlands, Germany (not officially), Denmark (not officially), Sweden and Norway, Russia, Austria and Hungary, Italy (not officially), Greece, Spain, Switzerland, the United States, Chili, Venezuela, Haiti, China, Japan, Morocco, and Hawaii. Of these, however, nearly a third, viz. France, Germany, Italy, Venezuela, Haiti, Morocco, Japan, and Hawaii have no exhibit to call for our attention, while another third show so little, and that of so small a value that they hardly deserve a passing notice. In the richness, value, and beauty of the Vertebrata exhibited, the foreign countries who compete for the palm are Sweden and the United States of America, far above all the rest in this respect. Great Britain is, on the other hand, singularly defective, none of her great public institutions having taken any part in the competition; this may be partly accounted for by the close proximity of the Buckland Collection of Economic Fishery, adjoining the Fisheries Exhibition, while not much further is the new Natural History Museum in the Cromwell Road, and in this case it is much to be regretted that, at a time when many interested in fish and ichthyology have been attracted from afar by the Fisheries Exhibition, the zoological collections, and more especially the ichthyological ones, are not in a condition to be open to public inspection. However, if Great Britain is, with a single exception, meagrely represented by a few private exhibits in the Vertebrate col.ections, it is not so with some of her colonies and possessions, and the Courts occupied by the exhibits of New South Wales, Tasmania, and India are rich in specimens of much interest and great scientific value, while the Dominion of Canada is (in respect of Vertebrates) not far behind them.

The mammals ought in this case to be divided into two groups, those which are fished and those which fish, but I prefer to classify them scientifically rather than popularly. Carnivora mostly belong, when aquatic, to the latter group; amongst the more abundant are of course the otters, and especially our European kind, of which many specimens are in the British Natural History Gallery; Canada, India, and Chili show specimens of those belonging to their waters, and I was pleased to see in the latter Court fine specimens of my old friend *Lutra felina*, whose marine habits and agility amongst the kelp-beds of Western Patagonia I witnessed many a time. A few Polar bears are also shown, a very large and fine specimen being in the Russian Court; while Musteline Carnivora of more or less fishing propensities are to be seen amongst the Canadian exhibits. Seals and *Otariæ* form of course a prominent feature in the Exhibition; foremost in beauty and rarity is no doubt *Histriophoca fasciata* of the Behring Sea; the *Vega* exhibit shows a skull and a rather inflated and dilapidated skin, whilst a magnificent specimen is exhibited by the National Museum, Washington; these are, I believe, the first specimens of that rare mammal ever seen in this country. Some good specimens of *Cystophora, Ph. barbata, Ph. grœnlandica, Ph. gryphus*, are to be seen in the Canadian and Newfoundland exhibits, the latter belonging mostly, I am told, to the Liverpool Museum. Tasmania shows a splendid specimen of *Stenorhynchus leptonyx*. A large but badly mounted walrus is in the British gallery; but the enormous tusks and cranium and the life-like head of the Pacific species (*T. obesus*), of whose specific distinctness I should however greatly doubt, call for special attention in the United States department; the very beautiful sketches from life of those unwieldy creatures and of the agile fur seals, drawn by Mr. Elliott in the Pribylov Islands, deserve much praise. The *Otariæ* are represented by a fine group of *O. ursina* ♂ and ♀, the principal source of the sealskin industry, in the United States exhibit, mounted very beautifully indeed; an interesting group of *Arctocephalus cinereus* is conspicuous in the New South Wales Court, in which is a young specimen of what appears to be a distinct species; Chili has

[1] Continued from p. 291.

several interesting specimens of an *Otaria* from Juan Fernandez, a true *Loboa dospelos*, which might be the rare *Otaria Philippii*.

The strange and uncouth Sirenia are represented by a grand specimen, one of the principal attractions to every naturalist in the entire Exhibition, the nearly complete skeleton of a *Rhytina Stelleri*, which, with other bones of that most interesting creature is exhibited by Baron Nordenskjöld, one of the many grand results of the *Vega* expedition; the National Museum of Washington shows a very fine skull of that peculiar, rare, and extinct Sirenoid. Very interesting, and more noticed by the general public, are the two fine mounted specimens, male and female, of the Dugong (*Halicore australis*), exhibited by the Australian Museum of Sydney.

The Cetacea contribute an important portion of the Vertebrate series, and now and then afford instruction of a novel and rather startling nature; thus the large skeleton of *Balænoptera musculus*, covered with luminous paint and set up in the Garden, shows some remarkable innovations in practical osteology, the natural asymmetry of the skeleton of these creatures is most vividly exaggerated, and we are shown various of the larger paired bones curiously displaced from right to left, and *vice versâ;* but this is not all, we are told that the whale before us, which by the way was noticed by no less a man than Prof. Flower, when cast upon these shores, is the Greenland Whale (*Balæna mysticetus*), and the large label thus headed further informs us that it grows to be 75 feet long, swims at the rate of four miles an hour, and possesses a tongue so thick and fleshy, that when the mouth is closed it envelops the upper jaw and all the horny laminæ (baleen plates) along it! Not far off a Berlin dealer in whalebone, Isaac Mann, shows a fine series of baleen plates belonging to several species, but he startles us with the announcement in large letters that "the whale can grow to the length of 200 feet, reach the age of 1000 years, the weight of 20 tons, and is therefore the largest of known fishes." But from the comical and amusing, let us return to more serious and interesting matter; amongst the mounted and entire specimens of Cetacea exhibited, I may mention the large and beautiful *Orca gladiator*, which forms a prominent feature in the Swedish Court, five young and fœtal porpoises preserved in alcohol, shown by the Gothenburg Museum, and by the Norwegians; the large *Beluga* in the Canadian exhibit, less life-like, however, than the beautiful cast of the same species shown by the National Museum of the United States; special notice ought to be taken of the rare *Orcælla brevirostris* from Singapore, in the Straits Settlements exhibit. Skeletons and crania of Cetaceans are more numerous, and for the high scientific value and beauty of specimens exhibited Sweden has in this respect by far the highest rank; the complete skeletons of *Orca Eschrichtii*, *Hyperoodon diodon*, and *Mesoplodon bidens*, will be examined by all zoologists with pleasure and profit, but of more special interest is that of *Ziphius Gervaisii*. This form, which differs principally from *Z. cavirostis* in the absence of the stony *mesorostral* bone, and in the size and shape of the two teeth at the apex of the mandible, is probably the female of the latter; whilst examining again that most valuable specimen yesterday, I was grieved to find that some unprincipled person had abstracted the two teeth, an act of ruthless vandalism or pseudo-scientific kleptomania much to be deplored and condemned.

Birds, of course, figure largely in the British and foreign exhibits; they are more or less aquatic, and may or may not fish or otherwise prove injurious to piscatorial interests. It is to be hoped that the public will not take for granted that every bird displayed in this Exhibition is the fisherman's natural enemy and therefore to be ruthlessly destroyed whenever the opportunity occurs. The dipper, for example, largely repays any occasional injury he may do to the fish spawn by destroying a vast number of insects which habitually feed on it.

Amongst the notable exhibits in this series in the British section is a fine collection of British waterfowl very nicely mounted, shown by T. E. Gunn of Norwich, in which a pair of hoodies attacking a wounded widgeon and a pike drawing under water a female mallard are very effective. Mr. Burton's collection of New Zealand waterfowl is also good; and especially worthy of praise is a set of beautiful photographs illustrating bird-life, and more especially the gannets on the Bass Rock and Fern Islands, exhibited by W. P. Carr of Berwick. India, Australia, and the United States show a fair exhibit of their waterfowl, especially Anatidæ, Ardeidæ, Laridæ, Procellaridæ, and Spheniscidæ; but by far the most important exhibits in this class are the rare Arctic birds from the Behring Sea and Alaska in the Swedish and United States Courts. Ornithologists will look with unmitigated delight on the splendid specimens of *Eurinorhynchus pygmæus*, *Colymbus Adamsii*, and *Rhodostethia Rossii* in the *Vega* exhibit; and on the magnificent *Bernicla canagica*, *Somateria Fisheri*, and *Somateria V-nigrum*, shown both in the *Vega* and in the National Museum of Washington exhibits; some of these species are seen, I believe, for the first time in this country. A large collection of water-birds of North America, some three hundred species, has besides been sent over in skins by the National Museum of Washington; these, however, have not been exhibited for want of space.

Reptiles contribute a small but not uninteresting series to the Fisheries Exhibition. Amongst the Chelonians the most noticeable are a fine *Sphargis coriacea* shown by the Australian Museum of Sydney; a large specimen of *Chelonia imbricata* in the Spanish exhibit from the Philippines; several large turtles, *Emys* and *Trionyx*, in the Indian show, where may also be seen several large crocodiles and a set of snakes, amidst which several species of that most difficult but interesting group the Hydrophidæ, from Karachi. The United States National Museum shows some fine casts of turtles, tortoises, snakes, and lizards, amongst the latter a very fine one of the recently described poisonous lizard of Arizona (*Heloderma*).

The Amphibia are represented by a complete set of the North American Urodela exhibited in the United States section, while a few Anura are shown by India, and in the Chilian Court may be seen a few more, amongst which is the curious *Calyptocephalus Gayi*.

Fish naturally contribute the larger portion of the Vertebrata exhibited; in the British gallery may be seen a very great number of the common freshwater game and food fishes exhibited principally by anglers and by angling clubs, mostly mounted dry, and of little or no scientific interest. A small set of freshwater and marine British fishes shown by T. E. Gunn and Mr. Carr are noticeable; but of very great interest is the large and nearly complete collection of British fishes exhibited by Dr. Francis Day, they are of special value as being a set of types used by Dr. Day for his work on the fishes of Great Britain and Ireland at present in course of publication. A few interesting Mediterranean species of fish may be seen in the magnificent series of Invertebrata shown by Prof. Anton Dohrn, founder and head of the Zoological Station at Naples; amongst them are two specimens of *Callionymus partenopæus*, Gigl., the young of *Scymnus lichia*, *Centrina Salviani*, *Scyllium stellare*, and *Myliobatis bovina;* a *Fierasfer imberbis* is shown in the act of getting into a large *Holothuria*, whilst a specimen of the rare *Fierasfer dentatus* is of special interest. Good skeletons in alcohol of *Ceratodus Forsteri* and *Cestracion Philippii* are exhibited by Mr. Gerard, jun., and some well mounted disarticulated crania of fish are shown by Mr. Moore.

Besides a large set of the admirable casts of the more conspicuous of their food-fishes, and a splendid series of large photographs of many typical forms of their rich ichthyo-fauna, the United States (National Museum and Fisheries Commission of Washington, both under the able and energetic direction of Prof. Baird) exhibit a most interesting and complete series of type representatives of the freshwater genera of North America; the series embraces 173 species, amongst which the Ganoids, so well represented in that region, as *Amia*, *Lepidosteus*, *Spatularia*, *Scaphirhynchus*, and *Acipenser* deserve special notice. A collection of thirty-eight nominal species of American Salmonoids are also exhibited, and an interesting set they are; these two sets are mostly represented by specimens preserved in alcohol. The National Museum of Washington has also sent over a fine and highly interesting collection of the fishes of Alaska and another of those of the Gulf of Mexico and East Florida, all alcoholic specimens, and not exhibited from want of space. Prof. Brown Goode kindly showed me some of them; the former contains about 100 species, the latter 159. The Alaskan collection is of special interest, and contains many species recently described by Goode, Bean, and other ichthyologists.

In the Canadian Court a numerous series of mounted and alcoholic fish is exhibited, mostly freshwater and well known food-fishes; large specimens of Salmonids, Clupeidæ, Esocidæ, Sturgeons, and Halibuts may be seen, and a curious *Læmargus borealis* and a very large *Orcynus thynnus* deserve notice. Some very large Cod may be mentioned in the Newfoundland Court, whilst on the other side of the equator in the new continent, Chili shows a collection of food-fishes, principally marine and from Juan Fernandez, the highly esteemed "Peje Rey" (*Atherinichthys*) and *Heliastes crusma*, a large representive of our interesting Mediterranean species, may be recorded.

Sweden shows a magnificent collection of her Salmonidæ, large and beautiful specimens wonderfully preserved in alcohol in the finest of glass jars; an interesting series of types and embryos and larval fish is besides shown by the Gothenburg Museum, but of special interest is the *Vega* collection from the Arctic seaboard. In the Russian Court a good collection of mounted fish is exhibited, amongst which are to be noticed a large *Silurus glanis*, a fine *Hippoglossus*, very fine and large specimens of *Lucioperca sandra*, an excellent food-fish, which with greater profit than the black bass of America might, I believe, be introduced into British waters; besides a fine set of the various species of sturgeon which abound in Russian waters, and lastly some good enlarged wax models illustrating the development of *Acipenser* and *Petromyzon*.

Norway again deserves notice as exhibiting some very fine specimens of rare fish preserved in alcohol or mounted; I may particularly mention *Argentina silus*, *Argyropelecus Olfersii*, *Sebastes norvegicus*, with embryos taken alive from the female, *Raja niderosiensis* (the type), *Scymnus microcephalus*, and a fine Opah (*Lampris guttatus*).

New South Wales (the Australian Museum of Sydney) has one of the very best ichthyological exhibits; besides very beautifully mounted specimens, and very well preserved alcoholic ones, a set of splendid coloured drawings from nature and of natural size, and a large series of photographs of fish are exhibited. Most of the remarkable forms and of the peculiar species of the fish-fauna of Australia are represented. I may specially mention those living fossils *Ceratodus* and *Cestracion*, both represented by two species, the former *C. Forsteri* and *C. miolepis*, the latter *C. Philippii* and *C. galeatus; Ceratodus miolepis*, exhibited in a dry skin, is the companion specimen to the type. Amongst others of the many interesting species exhibited may be mentioned *Galocerdo Rayneri*, *Carcharodon Rondeletii*, *Crossorhinus barbatus*, *Rhinobatis granulosus*, *Odontaspis taurus*, *Trygonorhina fasciata*, *Myliobatis australis*, *Rhina squatina*, *Temnodon saltator*, the singular *Glaucosoma*, with its mussel-like opercular appendage, &c. Some of the freshwater food-fish, as *Oligorus*, *Ctenolabris*, and *Therapon*, are noticeable. A remarkable sun-fish is also exhibited; it differs from our species in shape, in the size and form of the caudal rays, and lastly in being covered with small carinate horny scales, which appear to cover the osseous granulations of the dermis; I am inclined to think that it differs from our *O. mola*, belongs to the southern hemisphere, and if so, might go by the name of *Orthragoriscus Ramsayi*, as a just acknowledgment to Mr. E. P. Ramsay, Curator of the Australian Museum, who brought it over, and to whose intelligence and activity the splendid exhibit of the New South Wales Court is entirely due.

Tasmania shows a collection of stuffed and alcoholic fishes, some very interesting. A fine *Lophotes cepedianus* deserves special notice, as also specimens of *Galaxias*, *Retropinna Richardsoni*, *Histiopterus recurvirostris*, *Phyllopteryx foliatus*, and *Pristiophorus cirratus*.

India exhibits a very large collection of mounted and spirit specimens, from Madras and Bombay principally; worthy of special mention are fine specimens of *Histiophorus gladius*, *H. belone* (?), *Cybium guttatus*, *C. Kuhli*, *Caranx sansun*, *Megalops indicus*, *Drepane punctata*, *Corinemus lysan* (so like our *Lichia vadigo* in appearance), *Polyphemus plebejus*, *Thynnus thunnina*, the beautiful *Muræna tessellata*, *Barbustor*, *Catla Buchanani*, *Wallago attu*, *Macrones seenghala*, and other peculiar freshwater forms; some interesting Elasmobranchs, as *Rhynchobatis djeddensis*, *Stegostoma tigri*, *Trygon uarnak*, and a *Dicerobatis*, very like the Mediterranean species.

Scientifically, however, the most important ichthyological collection exhibited in the Indian department is beyond doubt that shown by Dr. Day—fine specimens in alcohol of several hundred species illustrated in his great work, "The Fishes of India." Dr. Day also exhibits a set of his coloured drawings of Indian fish.

The Straits Settlements exhibit a fair sample of the sea-fish of that region, unfortunately unnamed; there are also a few freshwater fishes from Singapore.

China has a rich and interesting collection of fish, and also some very good drawings of them. Unfortunately they also are unnamed. The fishes exhibited are principally in alcohol, and come mostly from Swatow; some are very rare, and others appear to be new to science; amongst those of some interest I may mention: *Elacate niger*, *Rhynchobatis ancylostomus*, *Zygæna malleus*, *Cestracion zebra*, and some fine species of *Pteroplatea*, *Trygon*, *Raja*. One fish of special importance is *Polyodon gladius*, from Tchang.

I have now finished, and hope I have been successful in giving a fair general sketch of the Vertebrata shown in the International Fisheries Exhibition; some of the contributions might, no doubt, have been better, but on the whole we may well be content with the opportunity thus given of seeing many good things.

London, July 17 HENRY H. GIGLIOLI

STELLAR NAVIGATION

Stellar Navigation, with New A, B, *and* C *Tables for Finding Latitude, Longitude, and Azimuth by Easy Methods.* By W. H. Rosser. (Published by Norie and Wilson, 1883.)

THERE can be no doubt that star observations, when the horizon is clear and well defined, are the best means by which the position of a ship at sea can be ascertained; as, by altitudes of two or more stars, in suitable positions with regard to the observer, the latitude and longitude can be obtained at the same moment, whereas single observations of heavenly bodies only give one element, and consequently it is not possible to obtain simultaneous observations for both elements during the day, unless either the moon, Venus, or Jupiter passes the meridian whilst the sun is above the horizon.

It is true that when the azimuth of the sun is changing rapidly the latitude as well as the longitude can be obtained from two sets of observations, taken at a given interval of time, provided the alteration in the position of the ship, during that interval, can be accurately determined; but this supposes a knowledge, not only of the course and distance traversed during the interval, but also of the tidal stream or current affecting the ship, which is usually uncertain.

Any writer or teacher, therefore, who impresses on navigators and students the importance of obtaining star observations is deserving of praise, for it is impossible to take too much precaution in ascertaining the position of a ship; cloudy or foggy weather may set in at any moment, and an opportunity lost can never be recovered.

Mr. Rosser has in the *Nautical Magazine* drawn attention to the value of Sumner's method of working out simultaneous observations of two or more stars, and there is little doubt that it is the best, as it is the only method by which results obtained from simultaneous observations of three or more heavenly bodies can be readily combined. It has been for years constantly used by the naval officers employed on surveying service, and in fact by most navigators, though, perhaps, they seldom take observations of more than two stars at the same time. We however prefer three for precisely the same reason we prefer three to two chronometers.

Sumner's method may be thus briefly described. As at a given moment of time each heavenly body is at the zenith at some point on the earth's surface, so at that moment circles may be described on which its altitude will be 80°, 70°, 60°, &c. If then the altitudes of two stars are obtained at the same instant, and the Greenwich time be known, the two circles of altitude may be drawn on the earth's surface with the points where the stars are in the zenith as centres, and the point where these circles cut will be the position of the observers. In actual practice it is not necessary to draw the circles, it is merely necessary to be able to draw the arc of a small portion of each circle; for the position of the observer being generally known to within twenty miles, the arc of the circle of altitude on which he is situated can be readily drawn.

The method of obtaining this arc of altitude formerly practised was to calculate the longitude with two latitudes, using the same two latitudes for each star, which gave four resulting longitudes; then, by plotting these four longitudes on the two parallels, and drawing lines joining the longitudes given by each star, two circles of altitude were obtained, which either cut in a given point, or would do so when produced, which point was the position of the observer.

This method of calculation was however quickly discarded for a more simple one, where one latitude only was used; for as the azimuth of a heavenly body can be readily calculated at the same time as its hour angle, and he azimuth being the bearing of the place where the star is at the zenith from the observer, it is evident that a line drawn at right angles to the azimuth will be the arc of the circle of altitude on which the observer is situated, as practically the arc is, for so short a distance as twenty or thirty miles, a straight line. The two longitudes on one parallel with the azimuth enable the two arcs of altitude to be plotted as before.

The importance of Sumner's method has not as yet been pointed out in any treatise on navigation, principally because since the time of Lieut. Raper, R.N., no treatise has been written by a practical navigator. It is true the method is mentioned in Riddle's "Navigation," and was taught by him many years since, though not in the form now adopted, and we think Mr. Rosser has done good service by urging its importance and the importance of stellar navigation generally. All navigators should in our opinion obtain star observations every night and morning, during twilight, as constant practice will alone render them expert in these observations, and familiar with the positions of the stars.

The extra work entailed by such observations will be amply repaid if, when standing in towards the land, after three or four days' thick weather, a partial break in the clouds enables the expert navigator to secure a couple of star observations which give him his position and enable him to direct his course with confidence towards his point of destination. Whilst, however, giving Mr. Rosser credit for his advocacy, we cannot but regret he has thought it necessary to pad his pamphlet with problems which are in every good treatise on navigation, and with tables which are either useless or are to be found in a more complete form elsewhere.

In "Stellar Navigation," Problems I. to X. are simply repetitions from works already published, and we notice that in the examples given of obtaining hour angle and azimuth (pp. 9, 10, and 11), Mr. Rosser seems to be unaware of the existence of Raper's tables of logarithms of the log. sine square. Problem XI. is an example of Sumner's method, and is well explained, excepting that we think it far better and quite as quick a process to calculate the azimuth with the hour angle rather than refer to another set of tables. Problem XII. is what is called the new navigation, and is merely another, and in our opinion less simple, way of arriving at the same result as Sumner. Problem XIII., or Pagel's method, is merely to obtain the position by calculation instead of by plotting on a chart the two circles of altitude, and as this can be done by two plane triangles we should hardly have thought it required explanation. Problem XIV., to compute the altitude of a heavenly body, will be found in all treatises on navigation.

The Tables A and B are useless, for they are merely a complicated method of finding the error of longitude due to an error of one mile of latitude, which can be readily ascertained by the ordinary traverse-table. Table C., on azimuths, may be, as before stated, as readily and more accurately calculated at the same time as the hour angle. Table D is a combination of two tables invariably given in all treatises on navigation.

Table I., or mean places of stars, is given in the *Nautical Almanac*, which every navigator possesses; Table II. is given more elaborately in Jean's handbook for the stars, which every navigator should possess; and Tables III. and IV. are given in the *Nautical Almanac.*

THE STUDENT'S MECHANICS

The Student's Mechanics. By W. R. Browne. (London: C. Griffin and Co., 1883.)

THIS work, we are told in the Preface, "differs from the many previous works on the subject mainly in the fulness and care with which the foundations" (of mechanics) "have been considered," and it aims at such a treatment of the subject that the student may apply its principles "confidently in attacking questions of practical importance."

The book is characterised by a considerable amount of original and independent thought, especially in the earlier portion treating of First Principles. This is largely due to the definition of matter which is given:—"Matter consists of a collection of centres of force distributed in space, &c." We are not aware of any writer who has employed this hypothesis to deduce and explain the fundamental laws of mechanics in an elementary treatise. Nor does it seem to us at all well adapted to elementary students. It is so very important that they should see that mechanics depends, at every stage, in the establishment of its fundamental laws, on experiment, and also that they should know what the experiments are and in what way they serve to establish the laws, that the deductive method adopted by Mr. Browne, which does not sufficiently exhibit this connection, would seem to be unsuitable for the purpose he has in view. For though he explicitly states, once or twice, that the science of mechanics rests on experimental evidence, he does not point out the way in which it so rests, nor where the necessity for experiments comes in. As a specimen of his purely deductive method and, at the same time, of poor logic, we have a proof given on p. 9 which reads thus:—"We have defined a force as a cause of motion. Hence we see that, if a force has produced motion, it will be represented to us by the motion it has produced. . . . But motion is measured in terms of velocity. Hence, other things being equal, forces are measured by the velocities which they cause or generate." By the expression "other things being equal" must be understood (Art. 30) that "the things they act upon must be equal" (in what respect—of weight, volume, or mass—is not stated, although, from an illustration previously given, we are, presumably, to infer that their weights must be equal). If we substitute for *force*, *amplitude of vibration*, and for *motion generated*, *intensity of illumination*, all through the above proof, the reasoning will be equally plausible, and the conclusion false. Of course all that can be inferred from the fact of force having caused motion, apart from experiment, would be that the velocity might be expressed as a function of the force.

A possible source of much confusion to the student exists in the old-fashioned division of forces adopted in this book into statical, moving, and accelerating forces. The confusion will be increased by the introduction, in addition, of the more modern word "acceleration." In Art. 348 we have f called the acceleration in the formula $P = Mf$, whilst g is called the accelerating force of gravity; whilst in Art. 422 the actual tractive force P exerted by an engine on the following train is called an accelerating force.

The proof in Art. 359 is incomplete, owing to its not recognising the fact that the sum of an infinite series of vanishing quantities may be a finite quantity.

A valuable feature of the book is the prominence that is given to, and the early introduction of, the theory of the conservation of energy. The friction of machines is deduced from this principle in a very simple manner. The theorems of statics are very clearly put before the reader, and much that is suggestive and valuable is contained in the articles on elasticity and on the action of railway-brakes.

The book is one which may be read with profit by a student who is already familiar with elementary mechanics and is not liable to be confused by the peculiarities alluded to above, but does not seem to be adapted to students who approach the subject for the first time.

OUR BOOK SHELF

Manual of Taxidermy. A Complete Guide in Collecting and Preserving Birds and Mammals. By C. J. Maynard. Illustrated. (Boston: S. E. Cassino and Company, 1883; London: Trübner and Co.)

THIS small volume of 100 pages of thick paper contains the ordinary instructions for skinning, preserving, and mounting birds and mammals, given very briefly, but probably with sufficient detail to serve as a guide to beginners. The author appears to be a dealer in natural history accessories, and the book has rather the aspect of a trade advertisement from its recommending the almost exclusive use of a "preservative" prepared and sold by the author, the composition of which he keeps secret. As a practical guide to English collectors in foreign countries it is very inferior to Mr. Ward's "Sportsman's Handbook," which was reviewed in NATURE last year (vol. xxvii. p. 146). A. R. W.

LETTERS TO THE EDITOR

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

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

The Meteorological Council and Falmouth Observatory

THE Meteorological Council contemplate closing on December 31 next the Primary Observatories at Glasgow, Armagh, Stonyhurst, and Falmouth, which have been in full operation since 1868, and continuing only those at Kew, Aberdeen, and Valentia.

The Falmouth Observatory has a geographical position which insures it the first record from the south, and the position of the instruments is considered satisfactory by scientific men. It is superintended and managed by the Royal Cornwall Polytechnic Society, who for the small sum of 250*l.* per annum provide suitable buildings, an observer, assistant observer, gas, and the other necessary outgoings, thus supplementing by local effort the Treasury grant.

The Meteorological Office have been satisfied with the manner in which the Observatory has been managed. The accompanying report, which Prof. J. Couch Adams of Cambridge sent to the Meteorological Council at their own request, deprecates, on scientific grounds, the retrograde step contemplated by the Council, and I am requested by my Committee to invite through you the assistance of scientific men generally to prevent the discontinuance of so important an observatory as the one at Falmouth. EDWARD KITTO,

Secretary to the Royal Cornwall Polytechnic Society

Falmouth, July 30

Copy of the Document submitted to the Meteorological Council by Prof. J. Couch Adams, F.R.S., on July 5, 1883.

To the Members of the Meteorological Council.

In compliance with the wish expressed by some members of the Council at the interview of June 27, I have great pleasure in explaining my view on the matter then discussed more fully and clearly than I was able to do *vivâ voce*.

1. First I will say a few words about the relative value from a scientific point of view of a continuous record of meteorological phenomena when compared with occasional observations of the same phenomena.

In my opinion the continuous record would be in this case incomparably the more valuable. When we know the laws of variation of an observed quantity, occasional observations at intervals which may be settled beforehand are sufficient to determine all the constant quantities which enter into the expression of the law. On the other hand, when the law of variation is in a great measure or altogether unknown, as is the case with most meteorological phenomena, a continuous record may throw more light on the law or laws of variation than would be afforded by any amount of occasional observations.

I have no hesitation in expressing my belief that if we ever attain to a knowledge of the principal laws which regulate the weather, it will be as a result from continuous records, and not from occasional observations.

2. In the second place, in order to study the laws of variation of any particular phenomena, it is important to have continuous observations at different places which are not so far distant from each other as to make the circumstances of the phenomena at the different stations differ too widely from one another.

In this way only will it be practicable to study and trace the progress of a wave of disturbance of any kind across a given country. From this point of view I do not think that seven stations judiciously distributed over the surface of the British Isles are at all too many. Hence I should regard the proposed abandonment of four out of these seven stations as a retrograde step which is greatly to be deprecated.

3. In the first place I come to the circumstances which relate to the Falmouth Observatory in particular The unique situation of Falmouth, nearly at the mouth of the English Channel, and considerably to the south-west of any of the other meteorological stations will render continuous observations made there peculiarly valuable. Most of our storms and other atmospheric disturbances come from the south-west, and therefore they would first affect and be recorded by the instruments at Falmouth. Valentia is the only other station which can compare with Falmouth in this respect, and I should consider the observations at Falmouth more valuable, as its more southerly situation enables us better to trace the progress of any disturbance across the southern and the central parts of England by comparison with other observations in those parts, while Valentia is too much to the north to answer this purpose.

4. Next I will consider the objection which has been brought against further continuing these observations, viz. that they have already been continued for twelve years, and nothing of importance has been deduced from them. Considering the complicated nature of the phenomena we are concerned with, it is not to be wondered at that little or no progress has been made in twelve years in unravelling their laws. Even in astronomy, if the fate of the Greenwich Observatory had depended on the results deduced during the first twelve years of its existence from the observations made there, the consequences to the progress of the science might have been disastrous. The fact that we already have twelve years' continuous observations at a given place makes any additional observations at the same place much more valuable. Thus twenty-four years' continuous observations at the same place would be much more valuable for any theoretical deductions than twelve years' observations at one place and other twelve years' observations at a different place.

5. There can be no doubt that one of the principal astronomical conditions by which meteorological phenomena are affected consists in the varying motion of the moon in declination, and this again depends on the position of the moon's node, which takes between eighteen and nineteen years to perform a complete revolution.

Hence it would be desirable that meteorological observations should be continued at the same place during one or more revolutions of the moon's node.

This is already well recognised to be necessary in the case of tidal observations. And here I may incidentally remark, though it does not directly affect the Meteorological Council, that Falmouth would be a very important station for making continuous observations of the tides.

6. If the present grant were withdrawn from the Falmouth Observatory, the Cornwall Polytechnic Society have not the means of keeping it up, and the abandonment of the Observatory would be a heavy blow to the cultivation of meteorological science in Cornwall and the West of England generally, where there are many local stations which regard Falmouth as their scientific centre. This is a matter which ought not to be indifferent to the Meteorological Council. No doubt it is no part of the duty of the Council to subsidise local efforts, unless indeed by means of such efforts the objects of the Council can be better and more economically carried out than would otherwise be done. I submit that this is the case in the present instance. The difference between the expenditure at Valentia, where the Meteorological Office has to defray the whole cost of the establishment, and the expenditure at Falmouth affords some indication of the advantages to be derived from local efforts.

7. Lastly, if it is absolutely necessary to reduce the expenditure on some branches of the work undertaken by the Meteorological Office, it may be inferred from what I have already said that in my opinion the continuous records are almost the last branch in which any reduction should take place.

(Signed) J. C. ADAMS

Determination of "*H*"

IT has occurred to me that the following notes of a rough determination of the value of the horizontal component of the earth's magnetism, according to the method described by Mr. Andrew Gray (NATURE, vol. xxvii. p. 32), might not be without interest to some readers, as showing the amount of accuracy which can be obtained. The experiments were made by one of my students at this College about four months ago.

The form of reflecting galvanometer which lends itself best to these experiments is one devised by Prof. Stuart, in which the needle is centrally situated between two rectangular pieces of wood carrying the coils. To the sides of these, two boards can be easily attached by brackets, so as to be in the same plane as the needle, and quite horizontal, and in this position do not interfere with the light falling upon or reflected from the mirror. The reflecting magnet is then north or south of the needle, and perpendicular to it.

The magnets were made from thin knitting needles (about No. 19, B.W.G.), cut to the proper length, and made glass hard. They were made in two lengths, 8·5 and 12·5 cm., but the longer ones were slightly warped in hardening, and did not give concordant results. The scale was at a uniform distance of 62·5 cm. from the mirror, and in reading the deflections four observations were made and again repeated after noting the times of oscillation, as described by Mr. Gray. Each of the deflections given below is therefore the mean of *eight* observations.

The following are the details of the experiments :—

Denomination of magnet.	A.	B.	C.
Length	8·5 cm.	... 8·5 cm.	... 8·5 cm.
Weight	0·6760 grm.	... 0·6924 grm.	... 0·6900 grm.
Time of oscillation..	4·88 sec.	... 4·71 sec.	... 4·76 sec.
Deflection at 15 cm.	7·1 cm.	... 7·7 cm.	... 7·6 cm.
" 13 "	10·6 cm.	... 11·5 cm.	... 11·2 cm.

From these results we obtain, by aid of the formula :—

$$H = \sqrt{\frac{4}{3} \frac{\pi^2 l^2 w}{(r^2 + l^2)^{\frac{3}{2}} T^2 \tan \theta}},$$

the following values for H:—

0·17705
0·17635
0·17828
0·17754
0·17725
0·17770

Mean = 0·17736 ± 0·00048,

showing an amount of accuracy which may, I think, be compared with that obtained with much more expensive and delicate apparatus. T. S. HUMPIDGE

University College of Wales, Aberystwyth, June 27

The Lachine Aërolite

THE most remarkable fall of an aërolite that has yet been recorded took place at Lachine, about eight miles from Montreal, on Saturday, July 7, 1883. I give the following account from the Montreal *Daily Star* of July 11 :—

"The fall of the aërolite transpired during a rain shower on the forenoon of Saturday, and there were no premonitory indications to show that the air was more than usually charged with electricity. The person who witnessed the fall of the aërolite more clearly than any one else was Mrs. Popham, wife of Mr. John Popham, insurance agent. Mrs. Popham was seated in her house up stairs sewing, when all of a sudden the apartment became illuminated with a blinding flash of light. The lady instantly glanced out of the window, when to her astonishment she beheld a huge mass of fire descending towards the earth in a diagonal direction. This brilliant body had a solid nucleus that appeared to the eye about four feet square, and a strange, indescribable noise was caused by its flight through the air. Simultaneously, as it seemed to Mrs. Popham, she received a paralysing shock that affected her from head to foot, as if the entire contents of a highly-charged battery had been discharged into her body at once. The astonishing brilliancy of the meteor caused a temporary loss of sight, and it was fully half an hour before the lady could distinguish surrounding objects. When Mrs. Popham first beheld the falling mass she fancied that it was about to strike the house, and is still of the opinion that it must have passed alarmingly close. The lady took several hours to recover from the shock, and when Mr. Popham returned home several hours after he found her partially prostrated from its effects.

"Mr. McNaughton, a brother of Mrs. Popham, was sitting down stairs reading when the flash came. He jumped up, and, looking out of the window under the trees towards the river, he plainly saw the fiery ball strike the water at a little distance from the shore, causing a mountainous upheaval and sending splashes in every direction.

"Mr. Horace Baby also saw the glare caused by the flight of the meteor, although he did not actually see the body itself. He said that he felt a tremendous shock, and that he could feel the electricity oozing out of his finger-ends for some time after.

"Mr. C. P. Davidson, Q.C., was sitting down to lunch at the time, and describes the crash as being tremendous. The Rawlings family also felt the shock severely, as indeed did half the village. Mr. Popham's cottage stands about seventy feet from the water's edge at Stony Point, and it is thought that the aërolite fell into the stream about twenty or thirty yards from the shore, in about twenty feet of water. Owing to the high winds since the occurrence the water has been so muddy that it has been impossible to locate the whereabouts of the meteor. An attempt, however, will shortly be made to bring it to the surface."

I will send further details when they come to hand.

E. W. CLAYPOLE

New Bloomfield, Perry Co., Pennsylvania, July 15

Cold and Sunspots

YOUR correspondent, Mr. C. J. B. Williams, is wrong in the statement he makes in NATURE, vol. xxviii. p. 103, concerning the cold in California in the month of March. The month was the warmest March we have had for some years, the mean temperature being 3°·5 above the average, and 2°·8 above the average for the whole of the Pacific coast. February, on the contrary, was a very cold month, the mean temperature being 3°·6 below the average. I believe it will be found that the mean temperature of a hemisphere is not affected by sunspots. That the seasons, however, are influenced by the state of the sun's surface I have no doubt, but this only in a secondary manner. In a paper read before the California Academy of Sciences in 1870 (see *Proceedings*, vol. iv. p. 128), I pointed out that our extreme seasonal climates were caused by the prevalence of broad belts of north and south winds which would extend continuously from east to west for 1500 or 2000 miles, and would blow over the same surface for months together, causing extreme seasons with temperatures above the average where the south current prevailed, and cold winters where there was a northerly current.

As a general rule when there is a cold winter on the Pacific coast the winter in the Eastern States is mild. The following figures taken from the U.S. Meteorological Reports will illustrate what I mean :—

Mean Temperature for February 1883

Below the Average	°	Above the Average	°
North Pacific States ...	−4·3	North Atlantic States	+2·2
Middle Pacific region	−4·3	Middle Atlantic States	+4·3
South Pacific region ...	−2·1	Florida	+6·3

Thus while on the whole of the Pacific coast the temperature of the whole was from 4°·3 to 2°·1 below the average, on the Atlantic coast the temperature was from 6°·3 to 2°·2 above the average.

Towards the end of February the north current that had been prevailing over the western regions of the continent during the whole of the winter shifted to the east, and this change of longitude was accompanied by some of the worst cyclones that have visited the central and middle States for years.

During the month of March, whilst we were under the *régime* of a south current, the temperature in the Eastern States was low, the temperature in Massachusetts for March being 7°·3 below the average.

My own belief is that the connection between the character of our seasons and sunspots will have to be worked out through the influence of the sun on the regional distribution of air currents.

San Francisco, Cal., July 3 JAMES BLAKE

Intelligence in Animals—Can a Viper Commit Suicide?

HAVING occasionally caught a viper, and kept it for a time in a glass case, one of the platelayers called me last Thursday and said "there was a fine 'Long Cripple' (a local name for a serpent of any kind) lying on the bank a few yards down the line." I went to the place indicated, and there was a very large viper basking in the sun, but when I got near, it began to move away, and to prevent its escape I gently pressed a stick across it while I sent the man to fetch a glass jar to secure it in; but when it found its progress arrested, it began in a very spiteful manner to dart its nose forward, striking at the stick and stones and anything that was within its reach, but I could not see that it opened its mouth to make a real bite; but when it found with all its wriggling and twisting it was unable to free itself, it turned its head round upon itself, and about four inches from the head it opened its jaws and gave itself a bite, and when the fangs were well into the skin, it gave an extra squeeze, as if it intended to make sure that the operation should be thoroughly and effectively performed. It then deliberately withdrew its fangs, and in so doing it turned its head first one way and then the other, so as to withdraw one fang at a time.

Its head then went forward, and its body and tail became straight, and there lay the viper apparently lifeless, but I noticed a slight tremor in the skin and scales, which gradually passed from the head to the end of the tail. I took it up with my hand and placed it in the glass jar, and stood the jar in the window where the rays of the sun were hot, and in twenty five minutes the viper began to show signs of life, and in an hour it was as lively as if nothing had happened.

I should be glad to know whether it has come to the knowledge of any of the readers of NATURE that any human being or any animal has died from the bite of a viper. In my boyhood I have known sheep being bitten in the under jaw near the lip, and the animal's head has swollen very large, but invariably the sheep were well again when seen early on the following morning.

Some twenty years ago I saw a man who had been bitten in the hand by a viper, and his arm swelled and turned purple in places, and he was sick and faint for some hours, but he told me he was as well twenty-four hours after the bite as he was before.

R. LANGDON

Silverton Station, Cullumpton, Devon, July 28

A Cat and a Chicken

THE account I extract below was given in a local paper dated May 30 last:—

"*Strange Attachment.*—A curious instance of the above was brought to our knowledge by Mr. Hibbs, of the 'White House,' Swanage. A hen sitting on thirteen eggs hatched out twelve chickens on the 15th inst., but during her sitting four stray eggs had been laid in her nest, and as the eggs had not been marked these could not be removed. The hen with her little brood were not taken from the nest till two days later, when one of the stray eggs was found to be just bursting its shell. Mrs. Hibbs, in trying to assist the little stranger by removing the shell, somewhat injured it, and thinking it would die, and not liking to kill it herself, she thought that her cat (which happened to have a kitten a few days' old) would make short work of it. Strange to say the cat commenced to remove all the shell from the hatching chick, and then to shelter it with her kitten; since which she has carefully looked after it, and it is certainly a pleasing and unusual sight to see the little chick nestling between the forepaws of its foster mother with the kitten in close proximity. Mr. Hibbs tried to put the chicken with the rest of the brood, but the cat was so uneasy until the chicken was restored to her, that Mr. Hibbs has decided to let her have her own way, and bring them up together."

I kept the paper by me, intending, if I could verify the incident, to send the report of it to you. But under pressure of other writing it was not till a week ago that I addressed a letter to Mr. Hibbs. Last night I received from Mr. James Andrews of Swanage the following reply:—

"*Faircross, Wyke Regis, Weymouth, July* 24, 1883

"DEAR SIR,—David Hibbs of Swanage has forwarded me your letter of the 19th inst., asking me to reply to it. This he has done, I presume, as I had put his paragraph to the paper a little into 'shipshape' for him

"I am a resident at Swanage, and the bank manager there, and can vouch for the details of the 'Strange Attachment' just as recorded. I went round at Hibbs's request when the chicken was four days old. The old cat was lying down—the kitten asleep—and the little chick nestling with the cat, who would lift up her foreleg whenever the chick came near, to allow the chick to nestle under its arm, when it would close its arm around it in a most amusing and affectionate way, and seemed to be much more anxious about it than her own kitten. They began feeding the little chick at the first by sprinkling sop on the hair of the cat, which the chick would pick off. I do not know whether Hibbs has replied to you as well, as he did not say, but I hope the above will be sufficient.—JAMES ANDREWS."

It is to be noted that these aberrations from inherited habit—to which we have given the convenient name of instinct—occur almost invariably under the strong solvent of the maternal στοργή; but that they should occur at all points strongly towards the essential oneness and common origin of all life—however widely it may have deviated later along its ancestral lines of descent.

HENRY CECIL

Bregner, Bournemouth, July 25

Primæval Man and Working-Men Students

I RECEIVED a letter with great pleasure a fortnight ago from four new correspondents, who said they were working-men of Plaistow who had read my notes on Primæval Man in NATURE, had studied the Pitt-Rivers collection, and wished to show me their finds in Essex and have the North-East London position personally explained to them. Sunday having been mentioned as a convenient day, and this being approved by me, my correspondents (Messrs. W. H. Smith, Amos Herring, W. Swain, and Philip Thornhill) came here on Sunday morning, July 29. The stones brought were of great interest, mostly belonging to the Essex positions published by me. One example was a superb, rather large, wedge-shaped, pointed, slightly abraded, and ochreous implement found at Leyton; two were from Plaistow, a locality almost unrepresented in collections; one from West Ham, and other pieces from Wanstead. A somewhat small ovate specimen of great interest was found by one of my correspondents in the gravel excavated for the New Albert Dock, the extension of the Victoria Dock. The object of the greatest interest was a rude scraper-like tool made from a somewhat large piece of tabular flint, and found in gravel excavated between Loughton Railway Station and the "Robin Hood" Tavern, undoubtedly artificial and palæolithic; this ancient gravel is I think usually placed in the Glacial series; the find must be accepted as genuine. I may say here that on the 23rd of this month I found another implement and six flakes in gravel brought from Ware.

After my friends had looked over the collection here, listened to a few hints, and received a gift each of an implement from my own store in pleasant remembrance of the visit, we went to see some of the small excavations still open near Stoke Newington Common, in one of which the line of the "Palæolithic Floor" was distinctly visible, covered with about two feet of "trail and warp" and surmounted by humus. We then went into the Lea Valley, the meaning of the wide and deep excavation since palæolithic times being well understood by my visitors.

38, Kyverdale Road, N. WORTHINGTON G. SMITH

A Remarkable Form of Cloud

THE peculiar cloud formation observed by Mr. Hopkins and communicated to NATURE, vol. xxviii. p. 299, was also seen by me on Sunday, July 22, at 10.35 p.m. What I saw accords almost perfectly with the description given by Mr. Hopkins; but there was one rather important exception. Starting from a little above the horizon in the north-north-west I observed the position of another arch of cloud, clearly defined, strictly parallel to the principal arch, and ending somewhat abruptly about 20° from the zenith. The main streak was separated from it by about three times its width, and the intermediate space was quite clear. Both clouds appeared comparatively dense, and were situated at a moderate elevation. I did not notice any change in their appearance, nor did I see them break up.

It seems not improbable that currents of air from the north-north-west, passing through an otherwise tranquil but vapour-laden atmosphere of a much lower temperature than the surrounding air, may have originated these streaky bands of cloud by condensing the aqueous vapour suspended along their course into definite form.

ARTHUR EBBELS

Clapham, July 31

WITH reference to Mr. Hopkins's letter in NATURE last week (p. 299), I may say that I observed the bow-like band of cloud, and noticed that it had what I may compare to a bow-string stretched from end to end. On Thursday, July 19, from 11 to 12 p.m., the whole sky was divided by such band; converging east and west. This was noticed by many persons in Essex, where I was staying. E. C. WALLIS

31, Meadow Road, S.W.

ON MOUNTING AND PHOTOGRAPHING MICROSCOPIC OBJECTS[1]

II.

THE prepared slide fixed in a clip should be placed on a hob or in a cool oven (not above 50° C.) for two days, by which time the excess of balsam round the edge of the cover will have become brittle, and can be removed with the point of a scalpel or penknife. Any balsam still remaining can be cleaned off with methylated spirit and a clean soft rag. The final cleaning of the slide may be done with soap and water. As the balsam itself serves to secure the cover to the slide, no cement or varnish is needed, and it remains only to label the object.

After successfully mounting this object, no difficulty will be experienced in applying the same methods to other small insects and parts of insects, such as antennæ, spiracles, feet, wings, ovipositors, corneas, tracheæ, &c. The two last cases, however, require careful dissection.

Animal hairs are best mounted in balsam, and the only special treatment they require is soaking for a short time in ether to remove grease.

The siliceous skeletons of diatoms and spiculæ of sponges and Holothuriæ require cleaning from extraneous matter by treatment with strong acids, but space will not allow a description of the details of their preparation.

The mounting of the organs and tissues of the higher animals and plants should not be attempted until tolerable facility has been acquired in the preparation of the simpler objects previously mentioned, as their structure is usually revealed only by the somewhat difficult process of cutting thin sections of them.

Most animal substances require hardening before they can be cut. Hardening may be thus effected. The perfectly fresh tissue is to be cut into pieces about the size of Spanish nuts, and soaked in ten times its bulk of a solution, consisting of one part of methylated spirit, and two parts of a ½ per cent. solution of chromic acid. At the end of twenty-four hours, and again after every third day, the solution is to be changed. After a week or fortnight the pieces should be well washed in methylated spirit, and will then be hard enough for cutting.

The next process is to embed the tissue in some substance firm enough to afford it support, yet soft enough to be readily cut with it. A good material for this purpose is a mixture of three or four parts of solid paraffin (paraffin candles), three of lard, and one of paraffin oil. It should be heated just sufficiently to keep it fluid, and the hardened tissue from which the excess of alcohol has been drained should be soaked in it for a quarter of an hour if of moderately close texture. If of very open texture—lung or testis, for instance—it must be soaked for about half an hour in rectified alcohol, and for a like period in absolute alcohol, to remove all traces of water. Then after displacing the alcohol by a quarter or half an hour's immersion in oil of turpentine, the tissue may be placed in the melted wax, which being readily miscible with the turpentine, will gain access to all the interstices of the substance.

A mould must then be prepared by gumming a piece of paper round a cork or cylinder of wood, the paper being allowed to project about three-quarters of an inch. Into this mould the substance is to be put, and the space filled up with some of the melted wax. When quite cold the paper may be stripped off, and the preparation will be ready for cutting with a razor, wetted with spirit to prevent adhesion of the sections.

The sections as they are cut are to be floated off the razor into methylated spirit, from which they may be transferred to a staining fluid.

The object of staining is in most cases not simply to impart a general colour to the object, but to take advantage of the fact that different parts are affected in different degrees by the same dye and are thereby clearly discriminated. Thus if an ammoniacal solution of carmine be employed, the structures which are first and most deeply stained are nuclei, axis cylinders of nerves, and ganglion corpuscles. To a less extent it stains the protoplasm of gland-cells and connective tissue corpuscles. But if the action be too long continued, the whole will be deeply and uniformly stained, and the selective power will be lost.

Carmine solution may be prepared by dissolving with the aid of gentle heat 2 grammes of carmine in 4 c.c. of ammonia and 48 c.c. of distilled water. Continue the heat or expose to the air until the smell of ammonia has almost disappeared, and then keep in a well-corked bottle. When required for use, a few drops of this solution should be added to a watch-glass full of water.

Logwood resembles carmine in its action and is by many preferred to it. It may be prepared as follows:—12 grammes of extract of logwood and 36 grammes of alum, both in fine powder, are to be mixed with 60 c.c. of distilled water, stirred well with a glass rod and filtered. Add to filtrate 5 c.c. rectified alcohol. Dilute with two or three times its volume of distilled water when used. When the tissue has been hardened with chromic acid, the sections should be soaked for a few minutes in a 1 per cent. solution of sodic bicarbonate to neutralise the acid before staining in logwood.

No general rule can be given for the length of time the section must remain in the staining fluid. It will vary from a few minutes to as many hours, and the section must be removed and examined with the microscope from time to time to see when the process has gone far enough.

When sufficiently stained, the excess of staining fluid is to be drained off and the section passed through rectified spirit 60 O.P., oil of cloves, and oil of turpentine, remaining about five minutes in each, and may then be mounted in balsam as already described.

For displaying tesselated epithelium in mesenteries, lungs, and blood-vessels, nothing can be more beautiful than staining by oxide of silver reduced from the nitrate. The perfectly fresh membrane or the section of hardened tissue as the case may be must be well washed with distilled water and then soaked for five minutes in a 5 per cent. solution of nitrate of silver. It is then again to be washed and exposed in distilled water to sunlight until it assumes a brown colour. The necessary exposure will vary from ten minutes to an hour or more. After a final wash in distilled water, it may be treated like objects stained by other methods. By this treatment the tissue assumes a general pale brown tint and the outline of every cell is sharply marked out by a deep brown deposit of argentic oxide in the intercellular substance.

Many vegetable tissues, such as cork, pith, succulent leaves, and some fruits, tubers, and roots, can be cut without previous preparation, and for such as are too soft to be cut in the fresh state the process of hardening is simpler than that employed for animal substances. Dehydration by simply soaking for a day or two in methylated spirit usually suffices.

Stems of plants usually require softening before cutting, and this softening can be effected if the wood is young by two or three days' immersion in methylated spirit to remove resinous matter, followed by maceration for from four days to a week in water. When the wood is old or unusually hard, the maceration must be prolonged or the

[1] Concluded from p. 303.

specimen may be boiled for a short time. Longitudinal sections may be cut by gluing the piece of stem to a cork to afford a hold upon it.

The preparation of sections of minerals and rocks is usually considered a very difficult matter, but much may be accomplished without the aid of the usual lapidaries' wheel for cutting and the revolving lap for grinding the sections, if the microscopist provides himself with a flat piece of lead six to ten inches square, and two pieces of boiler plate of the same size, planed on one side. A chip of the rock may be ground flat on the leaden lap, charged with coarse emery and water, and the process continued with emery of moderate grain on one of the iron plates, and the finest flour emery on the other. The flat side being then cemented with balsam (undiluted) to a piece of plate-glass about an inch square, the process of grinding may be repeated on the other side of the chip, until it becomes perfectly transparent. It may then be detached from the glass by soaking in benzole, and mounted in balsam in the usual way.

When the sections are to be mounted dry, which is very rarely the case, the fine scratches left by the flour emery must be removed by giving the section a final polish on a hard and flat oilstone reserved for the purpose and wetted with clean water only.

When it is desired to preserve the natural colour of objects, especially of such as contain chlorophyll, the necessary preliminary treatment with alcohol raises an objection to the balsam process, and another objection is that some tissues are rendered too transparent, and many of their finer features are obliterated by the highly refractive balsam.

In these cases the object must be mounted in some aqueous medium, the best and most convenient being a preparation of glycerine and gelatine, which forms a transparent jelly when cold, but is easily liquefied by heat. It is best to buy this "glycerine jelly," as it is troublesome to make on a small scale. When required for use it must be liquefied by standing it in a cup of hot water.

In general, objects to be mounted in glycerine jelly should not be embedded, but if any support is needed in cutting, this should take the form of two pieces of cork hollowed out to the shape of the object.

Water in the objects no longer presents any difficulty in this method of mounting, but air has still to be contended with, and the methods adopted for its elimination in the balsam process are no longer applicable. Some objects may be freed from air by boiling in water for a few minutes, but many would be spoilt by such treatment. Recourse must then be had to the air-pump, or, if this instrument is not accessible, to a very simple process depending on the great solubility of air in water.[1]

A wide-mouthed bottle of about four ounces capacity, with a closely fitting *solid* stopper, is completely filled with water, which at the time is, and for half an hour previously has been, boiling, in order to expel all traces of dissolved air. The stopper being then inserted without inclosing a single air-bubble, the bottle is set aside until cool enough to receive the sections, which are then to be put into it. A few drops of boiling water are then to be added to make good the inevitable loss in removing the stopper; the bottle is to be again closed, wiped dry, and securely sealed with melted paraffin. After twelve hours it may be opened, and the whole contents turned into a white porcelain shallow dish. The sections can then be easily seen, and picked out with a section-lifter, and should be soaked for half an hour in a 50 per cent. solution of glycerine before mounting.

The process of transferring the object to the slide, applying the liquefied jelly, and lowering the cover, are exactly the same as in the balsam method, and the slide should be set aside in a clip for a few hours for the jelly to solidify. In cold weather it is advisable to warm the brass table by means of a spirit lamp, or the jelly may viscify too quickly.

When quite cold and set, the excess of jelly may be cleaned from the edges of the cover glass, and the slide may then be ringed with asphalte while running in the turntable. Two or three subsequent coats of asphalte and the attachment of labels will complete the slide.

The objects for which glycerine jelly is most suitable are the lower forms of vegetable life—Algæ, Desmidiaceæ, Characeæ, Hepaticæ, Fungi, Lichens, Mosses, &c., and cuticles and sections of plants of all kinds. Many animal tissues are also better seen in it than in balsam.

It is but seldom that other preservative media are required, and it will be found that almost all objects may be suitably preserved by one of the three methods here described.

Closely related to the preparation of objects for microscopic examination is their delineation by photography, an art of the greatest value on account of its freedom from bias and personal equation, and as a means of lecture illustration with the aid of the lantern it must be appreciated by the numbers who have experienced the difficulty of demonstrating microscopic structure to many persons.

This application of photography, which is almost as old as the photographic art itself, extending back to the days of Daguerreotype, owes its recent development and simplification mainly to the introduction of gelatine plates, and the object of Mr. Malley's work[1] (which, however, should be called Photomicrography, for it does not treat of the production of microscopic photographs, as its name would imply) is to show how in an ordinary room, with an ordinary microscope, photographic camera, and paraffin lamp, photographs can be taken which will bear comparison with those obtained in the old days by the aid of sunlight reflected from expensive heliostats, electric arcs, magnesium and lime light, microscopes of special construction, and rooms specially set apart for the work. It therefore appeals to a large class of persons—those who would wish to practice the art, but lack either the sunlight hours or the expensive illuminators and apparatus formerly considered necessary.

The microscope, camera, and dark room, with their accessories, and the method of working with the Swan incandescent lamp and sunlight are described in detail, but the reader is perplexed by references to an illustration which cannot be found in the book. Four Woodburytype reproductions of photomicrographs of Aulacodiscus, Pleurosigma, and Surirella, scales of Lepisma, and Bacilli in human lung, accompany the work.

The instructions for taking negatives by the wet collodion and gelatino-bromide processes and the production of positives, enlargements, &c., are clear and concise, but we must enter an emphatic protest against the author's opinion that in object-glasses for photomicrography, depth of focus or penetration is to be sacrificed to angular aperture. Penetration and flatness of field are really of greater importance in lenses for photographic than for visual purposes, for in viewing an object under the microscope the observer has the power of focusing in rapid succession, and by imperceptible gradations, points at different depths and different distances from the centre of the field; but a photograph represents only such structures as were in focus at the time of exposure, and once taken, the focus is unalterable. It is therefore desirable to secure as great a depth of focus and as flat a field as possible—qualities which are incompatible with large apertures.

Mr. Malley very properly advises his readers not to walk about during the exposure of a plate, but the extension of the prohibition to speaking also is surely an unnecessary restraint.

[1] The writer cannot remember where he has seen this process described, but he can testify to its efficiency.

[1] "Micro-Photography," by A. Cowley Malley, B.A., M.B., &c. (Lewis. Gower Street.)

PROPOSED ZOOLOGICAL STATION AT GRANTON, NEAR EDINBURGH

AT the half-yearly meeting of the Scottish Meteorological Society held at Edinburgh on Thursday last week, Mr. John Murray, convener of the Society's Fisheries Committee, submitted the following Report :—

"The Fisheries Committee of the Council appointed in February last have had under their careful consideration the matters remitted to them by the Council, viz. the carrying out of investigations in accordance with the terms of the grant of 1500*l.* made to the Society by the Executive Committee of the International Fisheries Exhibition held in Edinburgh in 1882. The Committee recommends (1) to continue and extend the river observations and the observations made by the District Fishery officers through the Scottish Fishery Board, and to discuss all observations made to the end of the fishing season of 1883, which are yet undiscussed.

"2. To obtain the assistance of a few naturalists in making observations at several of the chief fishing centres and principal inland lakes. Prof. Herdman has consented to reside at Loch Fyne for a month, and to arrange for observations for a year. Mr. Hoyle is in like manner to go to Peterhead, and Mr. Beddard to Eyemouth. The Rev. Dr. Norman has during the present month been engaged in examining a large number of the Scottish lochs. Instructions have been drawn up for the guidance of these gentlemen, and a sum not exceeding 50*l.* has been placed at the disposal of each for the expenses immediately connected with the investigations. These observations are of a strictly tentative character, but will certainly lead to additions to knowledge, and are, moreover, necessary as a basis for further investigations.

"3. The Committee have had under consideration the recommendation of the Executive Committee of the Fisheries Exhibition as to the foundation of a zoological station. A number of the members of Committee have examined the capabilities of the old Granton Quarry, which has been for many years in direct communication with the sea, as a suitable position for a zoological station.

"The convener has drafted the following scheme, which in the opinion of the Committee would, if carried out, afford excellent facilities for biological researches and meteorological observations bearing upon these inquiries :—It is proposed to inclose the Granton quarry, which has an area at high water of about ten acres, and depths varying to sixty feet, so as to regulate the inflow and outflow of the tide in such a manner that while admitting abundance of sea water at each tide, fish and other animals will be prevented from escaping out of the inclosure. This will be done by means of stakes and wire with other kinds of netting. The quarry will then be stocked with all kinds of fish and marine invertebrates. When it is desired to separate fish or other animals for special study this will be done by floating or fixed wire and wood cages.

"A barge, about 64 feet by 27 feet, of great stability, will be moored in the inclosure ; upon this will be built a house with laboratories, workrooms, and a library ; it will also be furnished with a small windmill to pump up sea water into a tank on the roof. The water in this tank will be conveyed by pipes to the various tiled tables, glass jars, and aquaria of the establishment. A small cottage will be built on the shore for the accommodation of the keeper and engineer, with one or two spare rooms. A steam pinnace for dredging and making observations in the Firth of Forth and the North Sea will be attached to the station.

"A naturalist will be appointed whose duty will be to make continuous observations and experiments, assisted by the engineer and keeper. There will be ample accommodation for four other naturalists to work at the station and carry on investigations ; and, so far as the accommodation will permit, British and foreign naturalists will be invited to make use of the station free of charge.

"Towards the carrying out of this scheme the Duke of Buccleuch has liberally granted a lease of the quarry at a nominal rent, with permission to erect a cottage on the shore ; and Mr. Howkins, his Grace's local commissioner, has promised all the assistance in his power to further the undertaking. A gentleman who takes a warm interest in the progress of research in Scotland has offered 1000*l.* to construct the barge and fit it up with laboratories and workrooms. Mr. John Henderson (of Messrs. D. and W. Henderson, shipbuilders, Glasgow) has undertaken to provide the plans and specifications of the barge and laboratories gratuitously ; Mr. J. Y. Buchanan has promised to fit up one of the rooms on the barge as a chemical laboratory suited to the requirements of the station ; Mr. Thomas Stevenson, the Society's Honorary Secretary, has agreed to give his professional services in inclosing the quarry gratuitously ; and Mr. John Anderson, of Denham Green, has undertaken to provide the station with a salmon and trout hatchery. The convener will furnish the laboratories with apparatus, and place his large zoological library at the service of workers. A number of gentlemen have promised to support the undertaking when once commenced ; and the convener believes that within a few months he will be able to announce that the station has been presented with a steam pinnace and with funds for the erection of a cottage on the shore—the only desiderata to complete the scheme.

"In these circumstances the Committee, believing that this scheme deserves their hearty support, recommend, for the year ending November 1, 1884, a grant from the Fishery Fund not exceeding 300*l.*, and 250*l.* for each of the two subsequent years, towards the expenses of the station, on the conditions that the biological and meteorological observations and the investigations above referred to, relative to the Scottish fisheries, be carried on, and that a report on the work done be annually furnished to the Council of the Society."

The above grants were agreed to, and it was announced that the works at Granton would be commenced at once. It is expected that by the beginning of November the proper work of the station will be begun. Already, we understand, several distinguished naturalists have signified their intention to avail themselves of the altogether unique facilities which will be afforded by this zoological station for the successful prosecution of biological research. It is gratifying to observe the heartiness with which the funds required for carrying out this admirable scheme are being provided, and it cannot be doubted that the 800*l.* still required for the steam pinnace, the 500*l.* for the cottage, and the 200*l.* for inclosing the quarry will also be soon provided by some of our more generous patrons of science.

ELEVATION AND SUBSIDENCE; OR, THE PERMANENCE OF OCEANS AND CONTINENTS

IT has been observed, and with increasing frequency within the last few years, that wherever considerable weight is added on any part of the earth's surface, a corresponding subsidence of its crust almost invariably follows. It is generally admitted that nearly the whole of the sedimentary rocks, enormous as their known thickness is, were deposited in shallow water, and therefore in slowly subsiding areas. The Palæozoic rocks consist mainly of sandy and muddy sediment, with occasional intercalated zones of limestone. They everywhere bear witness to comparatively shallow water and the proximity of land. Their frequent alternations of sandstone, shale, conglomerate, and other detrital materials, their abundant rippled and sun-cracked surfaces, marked often with burrows and trails of worms, as well as the prevalent character of their organic remains, show that they must have been deposited in areas of slow subsidence, bordering continental or insular masses of land.[1] Vast thicknesses of strata have been continuously deposited at or near the sea-level. The coal-measures present a series of alternating layers of vegetable matter and brackish water sediments, reaching in the South Wales district a thickness of upwards of 10,000 feet, whose accumulation must have been accompanied almost foot by foot by a corresponding subsidence. The Cambrian sediments accumulated in the British area to a thickness of 23,000 feet apparently without any great change in the depth of the sea in which they were formed; and throughout the deposition of the whole of the Silurians, subsidence seems to have kept pace with sedimentation. The Permian again furnishes many instances of sedimentation at or near the sea level sustained throughout great thicknesses, and of frequent alternation of marine and freshwater deposits. Among Mesozoic rocks, the New Red Sandstone furnishes an example of isolated basins of deposit to which the sea found repeated access, though a thickness in places of 3000 feet had accumulated in them. The German Triassic basin is for the greater part of its thickness a succession of terrestrial deposits containing plant-remains. The Jurassic and Cretaceous systems were deposited during interrupted depression of the sea bottom, while the Tertiaries abound with local instances in which subsidence has kept pace with sedimentation.

The washing of sea-coasts and removal of material shown by the discoloration of the sea for miles round the shore in stormy weather, shows that the process of accumulation of sediment still progresses on a very large scale.[2] It has been ascertained that nearly the whole of this must be redeposited within a distance of thirty miles. If the waves have no disturbing power at a greater depth than 40 feet, and could therefore neither deepen the sea-bed nor prevent its silting up to within that depth, our shores should be surrounded by enormous tracts of shoal water, whose bottom might be grooved or deepened by local currents, but whose average depth would not exceed 40 feet, or even less, since many rocks are so protected by seaweed that their further degradation when once below the reach of surf must be inappreciable. There is no cause therefore capable of generally deepening the sea round coasts beyond some such limit as this, except subsidence, and this can only be ascribed with any semblance of probability to the accumulating weight of sediment. The prevailing tendency on sea-margins is and must be towards depression, and there are few residents on the sea-coast who would be unable to contribute valuable observations on this point. It must however be remembered that while raised beaches are conspicuous objects, depressed beaches could obviously hardly ever attract attention, even if the shingle had not been removed by the surf, and further, most, if not all, of the existing raised beaches may have been formed during the general elevation of the land that took place at the close of the glacial period.[3] Other observers have recorded numerous submerged forests on the coasts of Cornwall, Devon, Somersetshire, and Wales. An elevation of the coast may, on the other hand, be sometimes accounted for when due consideration is given to the surrounding conditions.[1] It may, for instance, conceivably be produced on any shores where considerable sediments are forming at some distance out to sea or where masses of cliff are being washed away.

The extreme sensitiveness of the earth's crust to any changes in the distribution of weight on its surface is, however, best exemplified by those local depositions and removals of matter which have attracted more general attention at the present day. The chief of these is the transfer of matter by river action from large tracts, and its accumulation in such limited areas as plains, estuaries, and deltas. Borings of 400 and 500 feet have shown that these often consist of long successions of silts, which alternating layers of shells and of vegetable matter prove to have been deposited at or near the sea-level, and the Wealden and Eocene formations in the British area show that such accumulations may exceed 1000 feet in thickness. In the case of deltas, subsidence must keep pace almost foot by foot with the accumulation, and be confined to the area over which the sediment is being deposited, for any more rapid subsidence would check its growth and convert it into an estuary. This sinking is apparently of universal occurrence.

A similar instance of the transfer of weight from larger areas and its precipitation on a very circumscribed area[2] is seen in coral atolls and reefs. The explanation of their formation given by Darwin requires a gradual subsidence keeping pace with their growth, which takes place within twenty fathoms of the surface only. This theory, simple and admirable as it is, accounting satisfactorily for all the observed phenomena of coral growth, has been contested by Mr. Murray, who has shown that atolls might be merely incrustations of volcanic peaks. But his theory seems improbable by contrast, for it demands 290 volcanic peaks at the sea-level in the Pacific coral area alone, every foot of which has been completely concealed by coral growth, though few volcanic craters are known so near the sea-level outside this area. We seem thus to have in coral growths another evidence of subsidence keeping pace with the increase of weight, sometimes, as soundings prove, to a depth of 1000 feet or more. The replacement of a column of sea water 100 fathoms in depth, by a column of limestone, would increase the pressure per square fathom from $619\frac{1}{2}$ tons to 1487 tons, so that it is easy to realise how vast must be the increased pressure on such an area as that occupied by the great reef of Australia, 1250 miles long and 10 to 90 miles broad.

The sands, gravels, and clays, with marine shells and erratic boulders, prove that a great submergence took place during the Glacial Period, while Europe was under an ice sheet 6000 feet thick in Norway, and diminishing to 1500 in Central Germany. The extent of the submergence has been perhaps understated at 600 feet in Scandinavia, and was at least 1350 feet in Wales. A corresponding re-elevation accompanied the disappearance of the ice. It has often been supposed that the sinking of the west coast of Greenland is similarly due to its ice-cap.

It is probable that great outflows of lava may in like manner occasion subsidence—though it is by no means

[1] "Text Book of Geology," Geikie, 1882, p. 647.

[2] M. Marchal has estimated that the sea deposits annually 600,000 cubic metres of sediments in the Bay of Mont St. Michel, and 10,000,000 on the coasts of Flanders, Zealand, and Norfolk.

[3] My own experience on the south coast is that the weight of evidence points to a general sinking, for vestiges of submerged land vegetation and traditions of submergence are very frequent. At Bournemouth I have seen heath plants and roots, fresh-looking except for the incipient formation of pyrites, cast up from a tract of moorland now below the sea-level. Poole Harbour would long since have been left by the sea if there were no subsidence, and a landing-stage with rings found below low-water mark furnish valuable data as to the amount that has taken place in historic times. The Solent must have been originally a harbour like that of Poole, continually silting, sinking, and enlarging, the depression travelling west and cutting one river after another from the sea until the western channel was at last opened. The immense accumulations of mud in its channel seem to have dragged the land into a sort of trough with raised sides, so that the Yar, Medina, and Brading Rivers flow inland instead of out to sea. On its margins we find there have been oscillations of level, caused perhaps by alterations in the position of the sediments through changing currents. The inroads of the sea at Pagham and Selsea show the downward movement to have extended along the whole of the Hampshire coast.

[1] An elevation, for instance, has taken place on the Kentish coast which has closed the Stour to navigation and caused the sea to retreat from Stourmouth, Richborough, and Sandwich, and which is also marked by the great exposures of Eocene along this part of the coast above low-water mark, and which could hardly exist where exposed to strong tidal and wave action, unless the abrading process were counteracted. The immense deposits, taking place at a distance from shore, brought down by the Thames, must lead to considerable subsidence in its estuary and consequently some corresponding elevation along its shores. The Thames sediment is of unknown depth, but on its margins at Sheerness the alluvial mud is 80 feet thick, and at Upchurch, opposite Queenborough, 75 feet.

[2] But $3\frac{1}{2}$ per cent. of solids preexisted in the water displaced by the rock.

so well ascertained a fact. I have, however, observed in Iceland that lava-streams very frequently terminate in or flow under lakes or gulfs of the sea, though water presents no obstacle to their continued progress. Lakes have been filled in solid by outpourings of lava, and had those I observed existed previous to the flows the lava must have entered them in a more abrupt manner, and it seems therefore likely that they are depressions caused by the weight of the lava. But there are also instances in which the actual depression produced by the weight of lava-streams can be seen. A great lava flow has at some period debouched from Skjaldbreith, and from two other nameless craters to the south-east, on to the historic plain of Thingvállir, forty square miles of which is water. At its northern end the lava is still in its original position upon the slopes, but the whole central mass in the plain has torn itself away from the sides and sunk a hundred feet, leaving vertical cliffs of solid lava of that height on its flanks.

Again, near Mývatn there is an immense tract of lava, the latest contribution to which, estimated by Mr. Lock at 31,000,000,000 cubic feet, welled out in 1875. This tract, known as the Örœfi, presents a somewhat analogous instance, for the centre of the flow has also broken away from its flanks and sunk. Mývatn, a lake of some thirty miles in extent appears to have been formed by the weight of lavas which have poured on to the plain from nearly every side. Another recent stream in the same neighbourhood, whose source and age are unknown, follows the course of the Skjálfandafljót to the sea and terminates in a deep gulf. It appears that, as long as lava-flows occur in mountainous regions or in narrow valleys, any subsidence occasioned by the additional weight is difficult to detect, but as soon as it enters on to plains the subsidence is marked. It may also be that valleys in undulated or folded strata, being inverted arches, would resist pressure, while even in valleys of erosion much of the pressure must be exerted obliquely against the mountain masses instead of wholly vertically as on a flat surface. It has been suggested that the discharge of masses of lava at the surface would leave cavities in the interior and thus occasion subsidence, and it has even been anticipated that Iceland would bodily disappear from this cause, like the island of Friesland, from the maps; but there is no evidence of any such cavities having existed in old basaltic formations or in volcanic districts, and it is far more probable that the escaped matter is pressed out by other lava which immediately replaces it.

Dr. Fisher believes that all plains in proximity to mountain chains, upon which the material provided by their denudation is spread out, sink under the weight of the material and cause a compensating elevation of the neighbouring mountains. The sub-Himalayan range consists of subaërial deposits from 12,000 to 15,000 feet thick brought down by torrents, and which must have been deposited on a level and continuously sinking plain. "The conclusion seems irresistible that corresponding to the long, though occasionally interrupted, depression of these plains, a correlative elevation of the great range which has supplied the deposits has been going on."[1] If, as in the Himalayas, the region be one of approximate equilibrium, and much sediment is brought off the mountains and spread over the plains, the mountains become after a while too light and the plains too heavy,[2] and accordingly the mountains rise and the plains sink to restore the contour. This appears to be what has happened.

These comprise nearly all observable instances in which weight has been transported from elsewhere to areas where it did not previously exist, and are sufficient to prove that in such cases a subsidence more or less equalling in amount the vertical thickness of such added matter—except in the case of ice, which is of a much lower specific gravity—nearly invariably follows. Can it be reasonably maintained that these subsidences and the reelevations, which seem invariably to accompany the removal of weight, whether by melting of ice, as in the glacial period, or by denudation, are not the result of the increase or diminution in pressure? If the accumulation of sediment were due to the subsidence, instead of the subsidence to the accumulated sediment, as recently suggested by Dr. Geikie, it would be most improbable that they would so frequently bear such near proportion the one to the other. In none of these instances has the subsidence exceeded the accumulation, as must sometimes have been the case if the sediment merely accumulated because a subsidence quite independent of it happened to be in progress.

Such subsidences would only be possible with a substratum somewhere of viscous matter. Professors Shaler and Le Conte and Mr. Fisher, and many other very able geologists, have advocated the existence of a fluid or viscous layer between a solid interior of great density and a consolidated crust. If, Mr. Fisher maintains, it requires great pressure to solidify the materials at the temperature of the solid interior, a melting temperature may exist at some depth before the pressure is sufficient to solidify. Although Prof. Geikie and many other geologists do not admit the continuous existence of such a layer, it is difficult to see how they escape the conclusion. In his textbook[1] Prof. Geikie states that "from the rate of increment of temperature downwards it is obvious that at no great depth the rocks must be at the temperature of boiling water, and that further down, but still at a distance which relatively to the earth's radius is small, they must reach and exceed the temperatures at which they would fuse at the surface." Further on he explains that the crystalline rocks of the Highlands of Scotland and of the Green Mountains of New England are mechanical sediments metamorphosed chiefly where they are most highly contorted, or have been subjected to the greatest pressure. Strata of sedimentary origin which have accumulated to thousands of feet in thickness may be depressed deep beneath the surface and brought within the influence of metamorphosis,[2] and be eventually reduced to a soft and pasty condition, and protruded into some of the overlying less metamorphosed masses in the form of granite veins, or be erupted to the surface in the form of lava. This is an absolute admission that at some depth, relatively not great, pressure converts solid into viscous or fluid strata. He further states that "There can be no doubt that the lines of equal internal temperature (isogeothermal lines) for a considerable depth downward, follow approximately the contours of the surface, curving up and down as the surface rises into mountains, or sinks into plains;"[3] so that it seems difficult to understand why the particular line of temperature or of pressure at which most rocks melt, should not be continuous.[4] Like conditions must produce like results, and if the mere pressure of overlying strata can anywhere or at any depth render rocks molten or fluid, they will become molten or fluid wherever the required pressure occurs. A nucleus kept solid at a temperature higher than its melting-point, through excess of pressure, cannot pass into a crust whose solidity is due to lowness of temperature, through absence of pressure, without the existence of that intermediate stage of pressure or temperature requisite to produce a melted zone or layer. Prof. Geikie in fact himself admits "that the nucleus though practically solid, is at such a temperature and pressure that any diminution of the pressure by corrugation of the crust or otherwise, will cause the subjacent portion of the nucleus to melt."[5] But as the pressure diminishes gradually throughout the crust from the enormous amount on the solid nucleus to the merely atmospheric pressure

[1] "Physics of the Earth's Crust," p. 81. [2] *Ib.*, p. 83.

[1] *L.c.*, p. 289.
[2] Geikie, "Text-Book of Geology," p. 587. [3] *L.c.*, p. 287.
[4] Fisher maintains that mountain chains have solid roots, far exceeding their bulk above ground, projecting into the liquid layer. [5] *L.c.*, p. 265.

at the surface, how can the conclusion be avoided that there is everywhere a point in the earth's crust at which it must be just sufficient to keep rocks at the melting point. It seems utterly impossible, if it is once conceded that pressure does render rocks fluid, to avoid the conclusion that there everywhere exists a viscous substratum following to some extent the contour of the earth's surface.

Such a condition is precisely that which will alone explain the undoubted fact that the addition or removal of even comparatively small weights produces corresponding changes in the previous level of the earth's surface. "The deposition of 1000 feet of rock will, of course, cause a corresponding rise in the isogeotherms,"[1] that is, of the liquid layer, and "denudation of the land must lead to a depression of the isogeotherms, and a consequent cooling of the upper layers of the crust." Dr. Fisher[2] proves mathematically, in fact, that a liquid layer and no other condition can explain the movements that have taken place in the earth's crust, and satisfactorily account for volcanic action.

It appears in the present state of knowledge almost impossible to estimate the depth at which a viscous layer could exist. The estimates that have been made vary from 1000 miles to only 50,000 feet. On the one hand, however, if it is a fact, as Dr. Geikie surmises, that sedimentary formations of Silurian age have been fused and rendered viscous mainly by the mere superincumbent pressure of more recent sedimentary formations, the depth at which a viscous layer can exist must be less than the lowest estimate yet formed. On the other, the observed increase of temperature, not exceeding at most 1° F. for every 50 feet of depth, the melting temperature of rock, 2000° to 3000° F., would not be reached at a less depth than 100,000 feet. This is obviously too great a depth to account for some of the observed facts of geology, and is without any allowance for the increasing density of rocks at great depths, or for the many unknown agencies which may contribute at such depths to lower their melting temperature. The inert weight of 25,000 feet of rock of the density of slate, the thickness which according to Dr. Geikie has reduced rock to a viscous state, is about 2000 tons to the foot. I am not aware that any estimate has been made of the actual amount of heat that would be produced under such conditions. If, as must be the case, any relatively small increase of pressure produces a displacement in the molten layer, a compensating elevation must take place elsewhere, and if its effects are so considerable when the weights are relatively small, the results of pressure applied to oceanic basins must be infinitely great. The theory that oceanic basins have been permanent has been embraced by many of the ablest geologists, and since sediment has been forming in them uninterruptedly, at however slow a rate, since Eozoic times, its aggregate vertical thickness by now must be colossal. The pressure of water alone upon the rocks forming the bed of the greatest depths of the ocean (say 4000 fathoms) would equal 6195½ tons upon a square yard, and this pressure exists on a bottom which is at or near the freezing-point. The effect would be as if on land the pressure of the first 7000 or 8000 feet of rock generated no heat whatever, or rather as if the heat were intercepted by an icy layer, which also might conduct it away, with the result that the molten layer would rest under a greater weight under the ocean, where the rocks have been observed to be denser, than it does under the land. This extra weight, even if small, would tend to render the greatest depths of the ocean permanent, but lines of current, where sedimentation was less rapid, would present lines of relatively less resistance, which, becoming more and more elevated, would in time form submarine ridges or banks or dry land, until the extreme tension might possibly become relieved by the eruption of volcanic matter. The lines of absolutely least resistance would, however, most frequently perhaps coincide with sea-margins, because these would often be the nearest lines free from the pressure of accumulating sediment. While, therefore, actual shore-lines may be depressed by local sedimentation, there may be inland a far more important tendency to elevation. The recent mountain chains, whether volcanic or otherwise, follow at a distance the contours of coasts, and it is likely that such apparent exceptions as the Alps, Urals, and Himalayas were in proximity to coast-lines at the time of their formation.

To this extent, I believe, the permanence of ocean basins can be maintained, but the past and present distribution of both plants and pulmonate mollusca, which alone in terrestrial life seem to have any antiquity as species, appear to be wholly against any further extension of it.

That such considerations, theoretical as they seem, may have a practical value to geologists, a recent journey to Iceland abundantly proved. There is not only there, but in the Faroes, evidence of a period of quiescence between two great basaltic formations, during which plants grew and lignite was formed. It even appears that this quiescent period extended synchronously from Ireland to Greenland. During this time the Lower Eocene flora, splendidly represented at Reading, seems to have migrated through increasing temperature as far north as Greenland, for the Reading plants are almost wholly those which were thought to be characteristic of northern Tertiary floras and distinctive of Miocene time. A connection between Europe and America in these high latitudes has also been inferred on many grounds to have existed at about the same period. Does it not seem as if the elevation of land (which permitted these floras thus to migrate, and which probably raised the Eocene temperature by excluding the Arctic Ocean from the Atlantic) caused these stupendous eruptions of basalt to cease—for elevation on such a scale must mean relief from tension—and that its submergence during the Miocene led to, or was caused by, the renewal of the basaltic flow? The horizon in Iceland is marked by only very scattered sedimentary tuffs and lignites, and is far less marked than in the Faroes, but in the region of Akreyri it can be traced even from a distance by the highly-laminated beds of light-coloured trachyte, which seem to have ushered in the new volcanic activity. It would be impossible on internal evidence to assign most of them to any definite age, and it is only perhaps on broad considerations such as these that their geological position may hereafter be fixed, though their immense antiquity may be inferred by the denudation which has furrowed, since their deposition, nearly the whole surface of the island into deep troughs and high ridges, out of what were formerly continuous tabular sheets of basalt.

It would be interesting to ascertain whether the great basaltic outpours of Oregon and the Deccan preceded or accompanied any marked changes of level in adjoining areas.

The question has been asked as an objection to this theory, What possible mechanical properties can we attribute to the upper strata of the earth which will permit them to sustain the whole of the Himalayan plateau and North and South America above the sea-level, and yet will cause a continuous subsidence in an estuary in which sediment is being deposited? Such subsidence, it is maintained, could only occur with a substratum somewhere of viscous matter, and if such viscous matter exists, why does it not flow under the stresses due to the weight of continents and mountains?

It is difficult to meet this objection except by appealing to the facts. It is apparent that continents, and especially mountain masses, have been upheaved from below

[1] Geikie, *l.c.*, p. 287, 1° F. for every 50 feet.
[2] "Physics of the Earth's Crust."

through a pressure which the earth's crust is not rigid enough to resist, and that so long as this pressure is sustained they must remain at least stationary. There is no proof anywhere that the pressure that caused the elevation is now removed, but there are frequently indications, such as earthquakes and landslips in mountain chains, that it exists and is even on the increase. On the other hand, there is no evidence of any kind to show that some, especially of the older mountain chains, are not sinking, though subsidence in such cases would be very difficult to detect. Besides this it is conceivable that when the force which has squeezed the crust into folds has ceased to be exerted it is not flexible enough to regain its original horizontal position, but will remain in folds, and as there is no increased thickness, and consequently no addition of weight, but on the contrary a continual loss from denudation, there is no reason why they should not retain their position upon the hypothesis of a continuous molten layer subjected to greatest pressure at its lowest levels. Dr. Fisher even assumes that the mere removal of weight from them by denudation, and its accumulation on their flanks, would suffice to cause a continuous upheaval. The deflection of the plumbline has shown that the density of the crust beneath mountains must be less than that below the plains, and the relatively slow rate at which heat increases in boring through them shows also that the pressure there cannot be so great. Though strata are compressed into a smaller area through the folding, it is doubtful whether the aggregrate pressure on the liquid layer in such regions is at all increased, while in elevated plains it obviously cannot be so, as there is in that case no direct increase of weight. It thus seems as if it were as necessary that the crust of the earth should yield to increasing pressure as that the sea should roughen under the wind, and the apparently arbitrary upheavals and depressions are brought under a definite law. The greatest depths of the ocean would ever deepen and its superficial area tend to diminish, while that of the dry land would increase, and its mountain chains reach higher elevations. The theory appears in harmony with the truths of geology and of astronomy, for the records of Palæozoic times show neither evidence of great depth of sea nor mountainous elevation on land, the organic remains pointing to a little varied surface. The highest mountains are geologically the most recent, and evidence of deep seas increase towards the Cretaceous period, while our satellite, whose evolution may have progressed more quickly than ours, has relatively far greater, more numerous, and more abrupt elevations than the earth.

Somewhat similar conclusions to these have been arrived at in the "Physics of the Earth's Crust," by Dr. Fisher. Without presuming to compare the present superficial treatment of the subject with that great and philosophical work, some important differences will be observed between the views there expressed and these, as well as some entirely new observations and extensions of the theory. The views advocated are still so far from being generally accepted by geologists that their publication in NATURE will doubtless put many in possession of facts and inferences which are in a general way only accessible to those who have leisure to gather them from less popular publications. J. STARKIE GARDNER

THE ISCHIA EARTHQUAKE

ONE of the most disastrous earthquakes on record occurred in the little Island of Ischia, in the Bay of Naples, on the evening of July 28. It was only in March 1881 that a similar catastrophe occurred at the same place. The island is a favourite summer resort of Romans and Neapolitans, and Casamicciola, where the destruction was greatest, was crowded with strangers. The full extent of the loss of life has not yet been ascertained; but up to the present it is estimated that at least 4000 have been killed, and very large numbers wounded. The earthquake occurred at half-past nine, when strangers and natives were enjoying themselves in various ways under a cloudless sky with not a breath of air stirring. Not the slightest warning seems to have preceded what occurred; in the space of fifteen seconds Casamicciola was a heap of ruins, while a similar fate overtook the smaller towns of Forio, Laco Armino, and Fontana Serrata. At present we can only record the facts of the case; when further details are to hand it may be possible to throw some light on the real cause of the catastrophe. Besides the first shock, which lasted fifteen seconds, other two were noticed immediately after. Prof. Palmieri is stated to have expressed the opinion that the catastrophe was caused by a sinking in of the level, and not by an earthquake. On the 31st there was another slight shock; while Vesuvius is in a state of active eruption. A Rhenish journal states that on Saturday night, about the time when the Ischia earthquake occurred, a tremendous motion of the earth was distinctly felt at Wiesbaden. On the morning of the 31st also, it may be noted here, a shock of earthquake was felt in Oporto, lasting two seconds, with direction east and west; it naturally caused great consternation. Two shocks are reported to have occurred on the same day at Gilroy, California. With regard to the volcanic Monte Epomeo in the Island of Ischia, we may say that its last recorded eruption took place in 1302.

We are glad to learn that Dr. Dohrn, director of the Naples Zoological Station, who was in Ischia at the time, escaped unhurt.

THE AGRAM EARTHQUAKE[1]

IN connection with the Ischia Earthquake, the official report of the Agram Earthquake of three years ago may not be without interest. The detailed report by Herr Hantken von Prudnik contains all the information which he had been able to collect regarding the severe earthquake with which the district surrounding the town of Agram in Croatia was visited on November 9, 1880. Herr von Prudnik gives not only an exhaustive narrative of his own observations of the effects of the earthquake, made a few days after its occurrence, but also some account of careful observations made by inhabitants of the district where the earthquake actually took place; and his memoir is full of most interesting matter to seismologists. The district is situated in an area within which earthquakes are of very frequent occurrence, for Herr von Prudnik gives a long list with descriptive notes and dates, beginning with March 26, 1502, and coming down to Nov. 9, 1880, but most of them within the present century, of earthquake-shocks, some of which seem to have been severe, which have been felt in the locality. A few self-registering seismographs erected in suitable places in the district would yield, we think, much valuable information and would detect many of the smaller motions, partaking rather of the nature of tremors, which are no doubt frequent, but which, although of great seismological importance, remain unnoticed where such appliances are not in use.

With regard to the earthquake of November 9 itself, the shock seems to have been very severe, causing as it did, besides loss of life, a vast amount of damage to public and private buildings, especially churches. The details of the damage done, given by Herr von Prudnik, are very interesting, and illustrate very clearly the conclusions which have already been arrived at by seismologists as to the effects of the conformation of the ground in the neighbourhood of a building, and of the structure of the building itself, in diminishing or in aggravating the

[1] "Das Erdbeben von Agram in Jahre 1880." Bericht an das k. ung. Ministerium für Ackerbau, Industrie, und Handel, eingereicht von Max Hantken von Prudnik, gewesenem Director der k. ung. geologischen Anstalt. (London: Trübner and Co., 1882.)

destructive action of an earthquake. For example, we find that in some cases well-built and substantial churches and houses suffered severely, while crazy erections, considered to be almost on the point of falling to pieces, received little or no disturbance. This apparent paradox is of course explained by the fact that the sudden backward and forward motions of the ground on which a building stands, although they may be, and in general are, of limited extent, bring very severe stresses to bear on high masses of masonry, which although it may be of the very best construction has little strength to resist the strains produced; while more loosely put together, and, in ordinary circumstances, insecure structures are capable of yielding to the necessary extent and escape unharmed. Again, when an earthquake consists of approximately periodic movements of the ground, buildings or parts of buildings, whose natural period of free oscillation coincides with, or is some multiple of the period of the disturbance, yielding to the repeated and conspiring impulses, oscillate with increasing range, until return to the equilibrium position is no longer possible and they collapse in ruins.

A phenomenon observed in connection with many other earthquakes, the rotation of upright pillars such as gravestones and monuments, on their bases, was very remarkable in this. Herr von Prudnik does not accept the explanation which has been offered by Mallet and others that the rotation is due to vorticose movements of the earth's surface; and he offers an explanation which, though not quite clearly put dynamically, seems to point to the true theory. The cause of the phenomenon no doubt is that the first sufficiently severe shock causes the body to tilt over in the direction from which the shock proceeded, and immediately after, the shock, although rectilinear in direction, makes the body turn round on the corner or portion of an edge on which it for the moment rests. This explanation has been tested with model gravestones and obelisks placed on a table, which could be shaken so as to imitate the motions of the ground during an earthquake, and found to answer perfectly.[1] The circumstance that in the earthquake at Agram, as elsewhere, the gravestones at one particular place were for the most part rotated in one direction accords well with this explanation, as no doubt the gravestones there were all set so as to face in one direction.

Herr von Prudnik is not of opinion that the earthquake was due to volcanic agency, but thinks that it was produced by the yielding to mutual stresses of the materials underlying the Slamen mountain, which lies along the middle of the area in which the destructive effects were most marked. This mountain occupies an area roughly elliptical in shape, about 4·5 kilometres (6 Meilen) long by 3 kilometres broad, and is composed for the most part of slate, limestone, and dolomite surrounded with strata consisting mainly of marl. To this mountain all the effects point as the locality in which the earthquake originated; but here again we think the use of self-registering seismographs would be of great service in giving definite information. This would also give most valuable information as to the velocities of propagation of earthquake motions in strata of different materials. In the present case the disturbance travelled from Agram to Vienna in twelve seconds, which gives a velocity of propagation of 2·2 kilometres per second. It is not stated, however, how the exact times were observed.

Among the details of the many interesting phenomena, we find a very careful account of an outbreak of "mud volcanoes" at Reznik, a place about 8 kilometres west-south-west of Agram; but for details as to this and many other important points, we can only refer our readers who are interested in seismology to the memoir, which will well repay perusal.

[1] *Vide* Milne and Gray on "Earthquake Observations and Experiments," *Phil. Mag.*, November 1881.

NOTES

WE are enabled to give the text of the telegram received in Stockholm this week from the Swedish circumpolar observation party, which has wintered at Spitzbergen. The news is the first received from the expedition since October last:—"Cape Thordsen, July 4th, 1883. This message will be forwarded to-morrow to Capt. Startschin with the boat fetching our first mail this year. The wintering of the expedition has in every respect been attended with success, particularly as the scientific researches have throughout been carried on exactly in accordance with the regulations formulated by the International Polar Commission. Hydrographical and magnetic studies have also been pursued on the ice in the Ice Fjord, as well as parallax measurements of clouds, and observations as to the temperature of the air, the snow, and the earth. The winter has on the whole been mild; the greatest cold occurring on January 2, when the thermometer registered 35·5° C. below freezing point. Storms have been few. Since September last the following buildings have been erected:—A hut on a mountain at an elevation of 270 metres, containing the anemometer and the wind-fan, which were read by a self-registering electrical apparatus; two astronomical observatories; another magnetic hut; a bath-house, a forge, and a wood storehouse. The dwelling house and working room have also been enlarged. The following game was shot during the winter: 61 ptarmigans, 9 reindeer, 18 wild geese, 20 foxes, and some wild fowl. With continuous labour, plenty of food and drink, and frequent baths, the members of the expedition have throughout enjoyed excellent health. Descriptions of the nature, our labour and life here during the wintering will follow."

AT the meeting of the Scottish Meteorological Society held on Thursday last week it was announced that upwards of 4500*l.* had been already subscribed to establish the Meteorological Observatory on the top of Ben Nevis. The subscriptions vary in amount from 200*l.* to one penny, and the subscribers include Her Majesty the Queen and all classes of her subjects, and town councils and other corporate bodies in all parts of the United Kingdom. The road to the top of Ben Nevis is nearly half finished. The building will be commenced early this month, and it is contemplated that the portion to be completed this season will be ready at the end of October for the three observers, who will begin their regular observations on November 1.

MR. MUNDELLA in presenting his educational budget the other night had nothing but essential progress to report. The cry of overworking the children was introduced by some of the speakers, but Sir John Lubbock pointed out that monotony and not overwork was the real weakness of the present system, and that the tendency was to cultivate the memory at the expense of the observing faculty. The real remedy, as he pointed out, is to introduce greater variety into the elementary course, and above all to make practical science teaching an essential part of the curriculum.

FROM a statement issued with reference to the Rolleston Memorial we learn that the total sum subscribed is 1183*l.* 5*s.* 0*d.*, to which is added 59*l.* 7*s.* 5*d.*, dividends paid on sums invested from time to time in Consols before the list was closed. From this total have been deducted secretaries' expenses, charges for printing, advertising, &c., 36*l.* 16*s.* 9*d.*, leaving a capital sum of 1205*l.* 15*s.* 8*d.* invested in 1200*l.* Three per Cent. Consols. This sum has now been transferred to the chancellor, masters, and scholars of the University of Oxford, and accepted by them as the Rolleston Memorial Fund. The fund, it has been decided, will be expended in the institution of a prize to be awarded every two years for original research in any subject comprised under the following heads:—Animal and Vegetable Morphology, Physiology and Pathology, and Anthropology, to be selected by the candidates themselves. The period during which this prize may be obtained by a candidate is limited to ten years after the date of matriculation; and with a view to render the prize as widely associated with Prof. Rolleston's name as possible, it is open to the members of the Universities of Oxford and Cambridge.

A CORRESPONDENT writes to us that he has received from a resident at Zagazig, in Egypt, a curious fact concerning cholera, which, if not noticed before, may be of interest. The resident stated that the town of Zagazig was perfectly healthy, and that the swallows and sparrows were flying about as usual, and so long as they remained he considered they were quite secure from any attack, but when they left he would not be long before he followed them. He remarked further that the birds had been observed by old hands to depart before the approach of cholera during the last four epidemics. Our correspondent asks what can be the cause of this, and we shall be glad if any of our readers can answer the question.

A CORRESPONDENT makes the following statement:—"Kentish men who drink chalk water are large boned, whilst those people who drink soft water are the reverse. At Glasgow, where the water is supposed to be very soft, there are said to be more bandy-legged children than at any other place." Is this so?

M. PASTEUR has written to the *Voltaire* a letter justifying the step taken by him in advising the Government to send a mission to Egypt in order to study the generation of cholera. He believes that this plague is produced by some description of microzyme; but he admits that this minute organism has not been discovered yet.

M. BARTHÉLEMY ST. HILAIRE has just finished the printing of his translation of the "Natural History of Animals," by Aristotle, which will be published in a very few days; it consists of four large octavo volumes.

THE managing committee of the Vienna International Electric Exhibition, which recently announced that, in consequence of the delay in the arrival of exhibits, the opening of the Exhibition, originally arranged for the 1st inst., would have to be postponed, has now fixed the ceremony for the 16th.

THE International Medical Congress of the present year will open at Amsterdam on September 4, and will be attended by a number of the most distinguished physicians and medical men of Great Britain, France, Belgium, and Germany. Amongst the British physicians papers or addresses have been promised by Sir Joseph Fayrer, M.D., and Dr. J. Ewart, on the treatment of imported and tropical diseases in countries belonging to the temperate zone; Dr. F. de Chaumont, of Netley Hospital, on the best measures of quarantine; Dr. E. Waring, of London, on the remedies used by the natives of tropical countries against the most dangerous epidemics; Dr. J. B. Scriven, on quinine injections and malaria fevers; Dr. Norman Chevers, late Professor at Calcutta, on tropical epidemics and the influence of tropical climates upon them; and Dr. Dyce Duckworth, of London, on the education of physicians for the Colonies.

THE fifty-first meeting of the British Medical Association began on Tuesday at Liverpool with the address of the President (Dr. A. T. H. Waters of Liverpool). On Wednesday the Council met to consider invitations for 1884 and to nominate a President Elect.

THE Gardens of the Zoological Society of Philadelphia in Fairmount Park are, we believe, the most nearly complete and best organised Zoological Gardens on the American Continent. Their eleventh annual report, now before us, shows a considerable amount of progress since their last anniversary. The number of visitors to the Gardens in the twelve months ending on the last day of February 1883 was 252,866, being nearly 10,000 more than in the preceding corresponding months. The income of the Society during the same period was rather over $50,000, while the expenditure seems to have been some $8000 less. During the same twelve months 423 living specimens were added to the collection, the total number of animals in the gardens at the date of the report being estimated at 687, of which 306 were Mammals, 338 Birds, and 43 Reptiles and Batrachians. These figures, no doubt, cannot rival those of the Zoological Society of London. But it must be recollected that our Society has been founded upwards of fifty years, is supported by some 3300 members, and has a population of 4,000,000 to draw upon for its visitors, not to count the strangers who are perpetually seeing the "sights of London." Among the special additions to the menagerie to which attention is invited in the report is an example of the Coast Fox (*Vulpes littoralis*) received from Yucatan, and stated to be probably the first to be exhibited in a living state. This rare fox has, we believe, never been obtained by the Zoological Society of London, and we rather doubt whether there is any example of it in the British Museum.

THE Committee of the Sunday Society have resolved to petition the Prince of Wales to use his influence as President to have the Fisheries Exhibition open to the public on a few Sundays before the final close of the collection.

AMONG a number of very munificent bequests that have been left to Paisley by the late Mr. Brough, we, says the *British Medical Journal*, observe that he has directed that 300*l*. is to be spent annually in establishing and maintaining a science lectureship in that town, with all the necessary adjuncts and accessories. The subjects to be taught are left to the trustees to fix, but the testator himself recommends that one of them should be physiology.

A VIOLENT shock of earthquake was felt at Catanzaro, in Calabria, on the morning of July 25.

WITH reference to the volcanic eruption on Krakatan Island off the coast of Java, brief reports of which were received by telegraph, and then noticed in NATURE, the following particulars have since been received. During Sunday, May 20, and Monday, May 21, the eruption was very heavily felt at Batavia, also more or less on Tuesday, May 22; but the earthquake shocks have since ceased, although the mountain is still apparently vomiting fire and smoke. The following report is from Anjer, dated May 23, 3.47 a.m.:—On Sunday morning last, from six to ten o'clock, there was a tremendous eruption, with continuous earthquakes and heavy rain of ashes. On Sunday evening and Monday morning it was continued. The eruption was distinctly seen here till nine o'clock this morning, and smoke was seen until twelve o'clock; afterwards it cleared up a little, and at this moment the air is clouded again. Capt. Ross reports from Anjer that on May 22 he was sailing near Java's first point and tried to get Prinsen Island in sight, but found that it was surrounded by clouds. Then he steered for Krakatan, but found it to be the same there. The captain observed that the lower island or mountain situated on the north side of Krakatan was totally surrounded by smoke, and from time to time flames arose with loud reports. Fire had broken out in several places, and it is very likely that the trees in the neighbourhood have caught fire. The mountain of Krakatan has been covered all over on the north side with ashes. The captain could not make out the condition of the mountain, as he kept away as far as possible, being afraid of the wind falling, and the vessel being drifted on to the island. The strongest fire was seen on the evening of May 22, with heavy explosions and detonations. The fire was also seen at that time at Anjer, but on account of the heavy smoke nothing could be perceived, as all the islands remained clouded. The captain did not experience any shower of ashes. The master of the steamer *Conrad*, which arrived at Batavia on May 24, reports having passed Krakatan on the north side the previous night, and met with heavy rains of ashes, covering the decks, &c., with about 1½ inch of ashes. He also had to cut his way through nearly 1½ metres of pumice-stone, which occasioned a delay of almost five hours.

We have already referred in NATURE to the excellent scientific work being done by the French in the Indo-Chinese peninsula, as evinced by the large number of scientific missions which have been despatched from France to those regions. As a farther example of the pains taken in France to obtain a thorough knowledge of the country in which she seems destined to play so large a part, we may refer to a periodical published by the Government of Saigon, entitled *Cochin-chine Française: Excursions et Reconnaissances*. The fifteenth part is now before us, and as each part contains about two hundred pages the amount of information accumulated in these volumes is considerable. Speaking broadly, and slightly altering a well-known Latin maxim, it may be said that nothing relating to the vast territory between the mouths of the Brahmaputra and the Canton river, between the Bay of Bengal and the China Sea, is outside the scope of this journal. As a rule the papers are of a highly scholarly and scientific kind. Thus the last number contains the second part of a long and richly illustrated paper on the coins and medals of Annam and French Cochin China, by M. Silvestre, inspector of native affairs in Saigon; a short history of the Portuguese in Cambodia; an account of the typhoon of last November at Hué, the capital of Annam, with barometrical tables, by the surgeon to the French Legation there; a long paper on the vegetation and forest administration of British Burmah; and finally one of a series of very interesting papers on the customs and popular superstitions of the Annamites. The present instalment deals with marriage customs. The efforts of the Colonial Government to sustain and encourage the study of Indo-China does not, however, close with the publication of this excellent journal, for we observe the advertisements of a large number of works relating to that country in the magazine under review. Among these are a weekly journal for the natives, an annual summary of facts relating to Cochin China, various maps, medical reports, &c. Whatever may be thought from other points of view of the action of France in Annam and Tonkin, there can be no doubt that the increase of French power there carries with it a large increase to knowledge, for the Colonial Government of France appears to know how to organise and stimulate research in the countries over which it exercises rule.

The telegraph has made another step in advance in China. It has had the honour of being mentioned in a memorial to the throne. Li Hung Chang recently mentioned in a report to the Emperor that he received certain information by telegraph. And, more wonderful still, that mysterious and awe-inspiring document, an Imperial decree, written with the vermilion pencil, has actually been despatched by telegraph, for the Viceroy of Canton reports recently in a memorial that a decree had been conveyed to him in this way.

The German system of *privat docenten*, or University teaching by outsiders, is to be tried in France. A decree provides that any doctor of letters or sciences, or correspondent or member of the Institute, may apply to the Minister of Education for permission to lecture on his respective subject, the license being renewable annually. The lectures may be public or private, at the professor's option, and the expense falls on him, while he can charge the students what he pleases. The same system is applied to the medical school.

We have received the *Transactions of the Norfolk and Norwich Naturalists' Society* for 1882-83. In the first paper, on the scenery of Norfolk, Mr. Horace Woodward gives a history of the geological strata of the county, shows how the scenery was influenced by the action of water and the introduction of various forms of life, and how affected by the artificial changes brought about by man. There is also an interesting paper by Mr. Stevenson on the dusky petrel, and a paper by Mr. Southwell on the bottle-nosed whale and the history of the seal fishery. Mr. Clement Reed's paper on the discovery of Lithoglyphus in the Weybourn Crag is very interesting, from the fact that this freshwater shell is found now in Europe only in the Danube. Mr. Young gives his observations on the habits of the bearded tit, which birds he had kept in confinement for twelve years. Mr. Bidwell's list of British birds in whose nest the egg of the cuckoo has been found is the most complete yet published. The President contributes part x. of the fauna and flora of Norfolk, a list of the marine algæ.

The exhibition of the Society of Agriculture and Insectology of Paris has just come to an end with a ministerial visit and distribution of prizes at the Palais de l'Industrie. Thousands of visitors have flocked to this hall in order to visit the interesting collection. A special building will be erected for the Society in the Park de Montsouris, and a sum of 32,000 francs has been already voted for this purpose by the city of Paris. A menagerie of living insects is to be established.

According to the Austrian *Monatschrift für den Orient* the production of tin in the protected state of Perak, in the Malay Peninsula, for the year 1882 was 7000 tons, about equivalent to that of Cornwall. Forty thousand Chinese are employed in the Malacca tin mines.

The additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. J. W. Lucking; a White-throated Capuchin (*Cebus hypoleucus* ♂) from Central America, presented by Mr. F. Hoëy; a Leopard (*Felis pardus*) from Somali Land, East Africa, presented by Mr. Frederick Holmwood; four Babiroussas (*Babirussa alfurus* ♂ ♂ ♀ ♀) from Celebes, presented by Dr. F. H. Bauer, C.M.Z.S.; a Two-spotted Paradoxure (*Nandinia binotata* ♂), a Royal Python (*Python regius*) from West Africa, presented by Dr. D. Hume Hart; two Short-headed Phalangers (*Belideus breviceps* ♂ ♀), two Crested Pigeons (*Ocyphaps lophotes* ♂ ♀), a Modest Grass Finch (*Amadina modesta*) from Australia, two Bicheno's Finches (*Estrelda bichenovii*) from Queensland, a Funereal Cockatoo (*Calyptorhynchus funereus*) from New South Wales, a Saisset's Parrakeet (*Cyanorhamphus saisseti*) from New Caledonia, a New Zealand Parrakeet (*Cyanorhamphus novæ-zealandiæ*) from New Zealand, presented by Mr. T. H. Bowyer Bower, F.Z.S.; an Australian Cassowary (*Casuarius australis*) from Australia, presented by Capt. Mann; four Black Guillemots (*Uria grylle*) from Ireland, presented by Mr. H. Becher; a South American Rat Snake (*Spilotes variabilis*) from Brazil, presented by Mr. C. A. Craven, C.M.Z.S.; two Peacock Pheasants (*Polyplectron chinquis* ♂ ♂) from British Burmah, deposited.

WEATHER PROGNOSTICS AND WEATHER TYPES[1]

The object of the first paper was to explain the best known popular prognostics by means of the most recent discoveries in meteorological science.

A great advance has been made in meteorology during the last twenty years owing to the introduction of daily synoptic charts of the distribution of atmospheric pressure, temperature,

[1] Abstract of two papers read before the Meteorological Society: "On Weather Prognostics," by Hon. Ralph Abercromby and W. Marriott; "On certain Types of British Weather," by Hon. R. Abercromby. (*Quarterly Journal of the Meteorological Society*, vol. ix. No. 45.)

wind, rain, &c. From these it is evident that there is a distinct relation existing between the distribution of pressure and the direction and force of the wind, and temperature and weather generally. A glance at a number of the charts shows that there is nearly always present either an area of low pressure called a cyclone, usually having a circular form, and as a rule moving in an easterly or north-easterly direction; or an area of high pressure, called an anticyclone, also nearly circular in form but almost stationary in position. The wind in all cases also blows nearly parallel with the isobars, having the region of lowest pressure on the left hand. This has given rise to the following simple law propounded by Dr. Buys Ballot for the northern hemisphere,

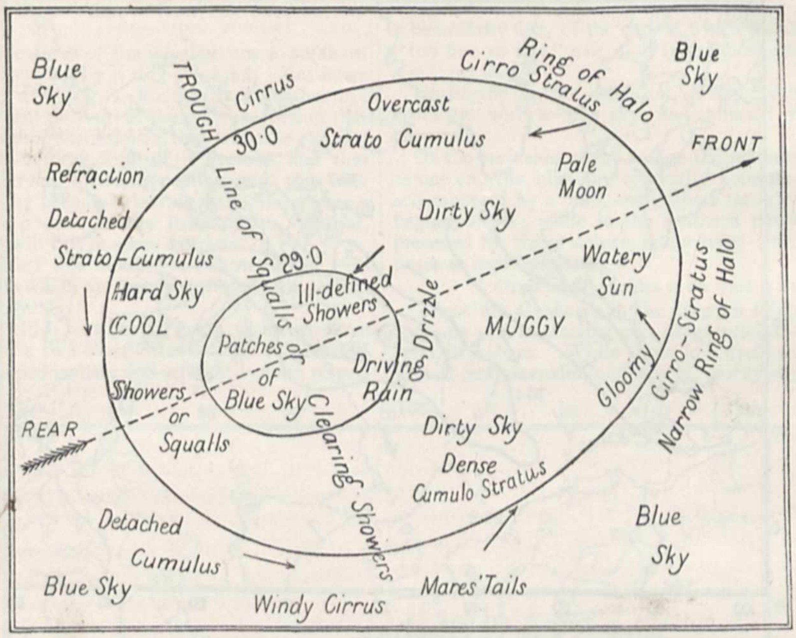

FIG. 1.—Cyclone Prognostics.

viz. "Stand with your back to the wind, and the barometer will be lower on your left hand than on your right." In cyclones the wind circulates round the isobars in the opposite way to which the hands of a watch move, but exhibits usually a little indraft; while in anticyclones the wind circulates round them in the same way as the hands of a watch, but exhibits usually a little outward motion. The velocity of the wind in all cases depends mainly upon the closeness of the isobars; for the closer the isobars the greater is the difference in pressure, and consequently the stronger the wind.

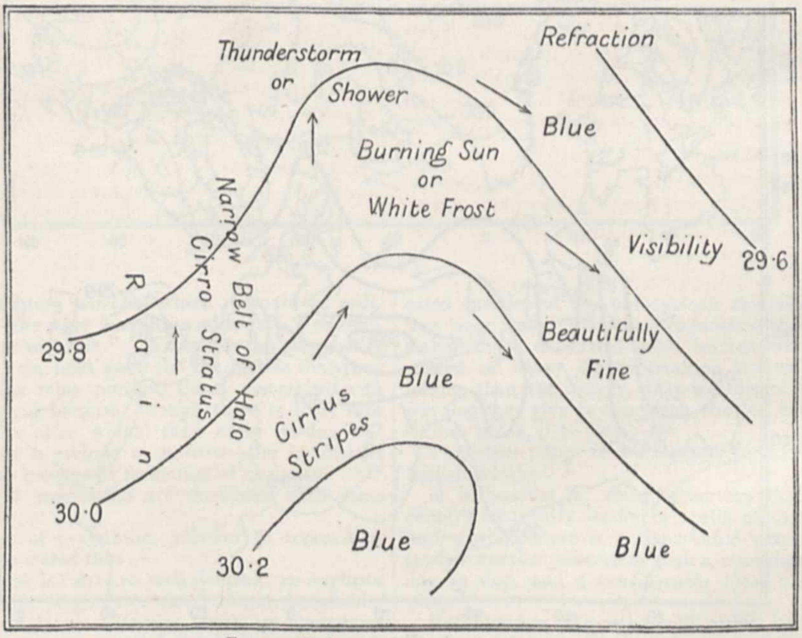

FIG. 2.—Wedge-Shaped Isobar Prognostics.

Since therefore nearly all our weather is of the cyclonic or anticyclonic type, and is entirely dependent upon the form and closeness of the isobars, it is by the aid of isobaric charts that the authors have attempted to explain a number of popular prognostics, and to associate them with certain kinds of weather. The method of research actually adopted has been for many years past to take notes of any good observation of any prognostic and put them by in a portfolio with the nearest synoptic chart available; or preferably with the nearest both before and after. When a sufficient number had been collected they were analysed, and the remarkable result has been arrived at that the greater number of prognostics are simply descriptive of the weather and appearance of the sky in the different portions of the various shapes of isobars seen on synoptic charts; and that they indicate foul or fair weather just as they precede the shifting areas of rain or blue sky which are mapped out by the isobaric lines.

These charts not only show the success of the prognostics, but also explain wherein they sometimes fail, by tracing the changes of each particular condition of weather. Hitherto the only prog-

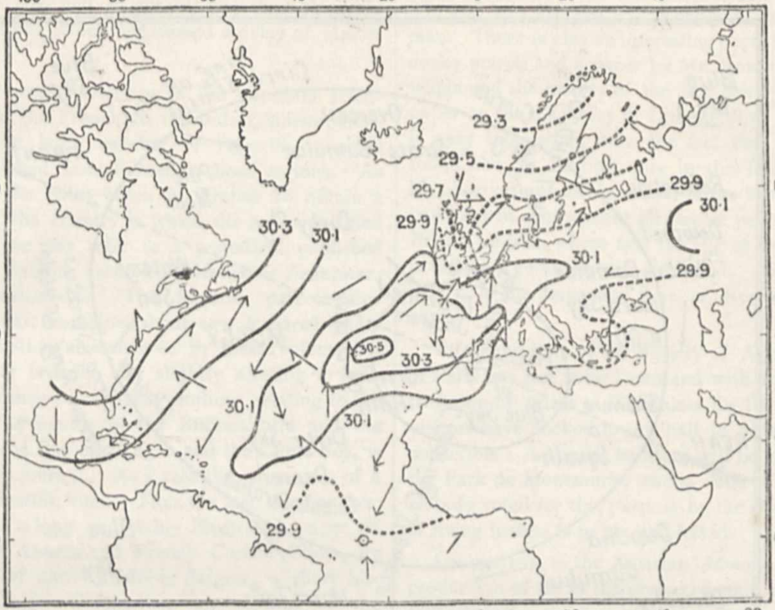

FIG. 3.

nostics which have been accounted for have been those due to excessive damp, but by means of isobaric charts many others can be readily explained. It must not be supposed that the modern methods diminish the value of prognostics, for even in forecasting weather from synoptic charts they are of great value, and will always be exceedingly useful to solitary observers who have only a single barometer to depend upon besides these prognostics, as for instance on board ship.

Though this way of treating prognostics is a great advance on the older methods, still there remains what may be called a

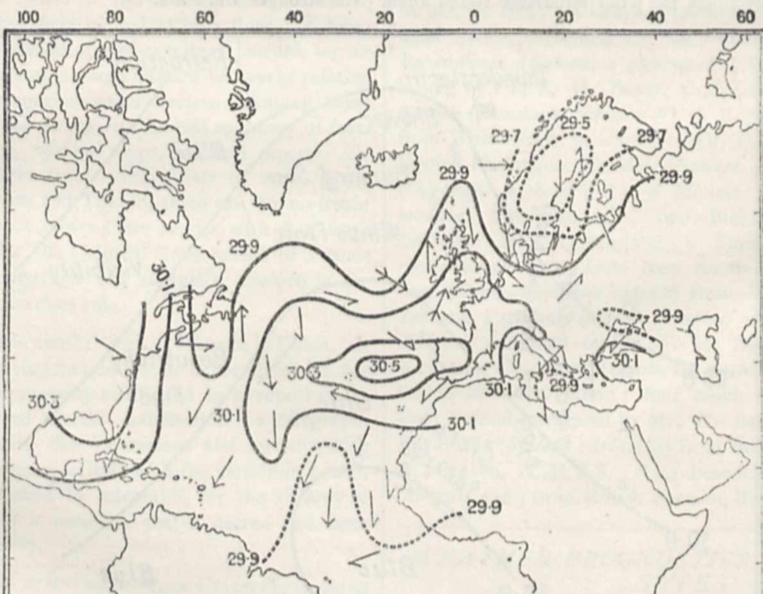

FIG. 4.

higher line of explanation. There is no doubt that the different shapes of isobars are the product of different phases of atmospheric circulation, just like the eddies and backwaters of a river, and that the appearance of the weather is the product of the complex vertical and lateral movements thus set up. For instance, there is no doubt that the principal cause of rain in a cyclone is the condensation of the ascentional current of air round its centre, while Ley and others have shown that many of the well-known forms of clouds are due to the action of upper currents moving in a different direction to those on the surface, and with a different velocity. Similarly the bright dry weather of an anticyclone is certainly due to the descending current found round its centre, and so on for every shape of isobars. Any reference to these movements was, however, intentionally omitted by the authors, as these movements are still to a certain extent only partially understood, and it was their desire to rest the explanations which they gave exclusively on observation without reference to any theoretical considerations.

In a cyclone the broad features of the weather are a patch of rain near the centre, surrounded by a ring of cloud. But if we write down on a diagram, as in Fig. 1, the details of weather and kind of cloud in the different portions of the cyclone, we find that many of the best-known prognostics owe their value to the fact that they are characteristic of the front of a cyclone, and that after they have been observed, the rainy portion must pass over the observer before the sky becomes clear again. Sometimes a cyclone, after crossing a portion of the British Isles, dies out, and then the prognostics will fail in some districts.

The prognostics of settled fine weather are shown to be characteristic of anticyclones, which are nearly stationary for several days, and even weeks, together.

Though the bulk of British weather is made up of cyclones and anticyclones, there are two other distributions of pressure, marked out by wedge-shaped isobars and straight isobars respectively, which are associated with many well-known sayings. The chief interest in these prognostics consists in the contrast which they present to cyclone prognostics, as in many cases they are associated with fine and dry weather as opposed to the damp of an approaching cyclone.

In the front of wedge-shaped isobars (which are frequently found between a retreating and advancing cyclone) the weather is beautifully fine, of the sort of which we should say that it was "too fine to last"; or, if it lasted a whole day, we should call it a "pet day."

During the day the sun is hot, at night white frost forms. Great visibility, with a blue sky, and unusual refraction, are often observed.

On the west side of the wedge-shaped area, as the new cyclone comes on, the blue sky gradually assumes a dirty appearance, accompanied by a halo, and gathers into cloud, and later on rain begins to fall; while in the southern portion the rain is often preceded by cirrus stripes, either lying with the wind, or sometimes at right angles to it.

"Cirrus at right angles to the wind is a sign of rain."

These are all shown in the diagram (Fig. 2).

Some very interesting rain prognostics are also associated with straight isobars. While those in a cyclone are preceded by an almost ominous calm, and a dirty, murky sky, these are associated

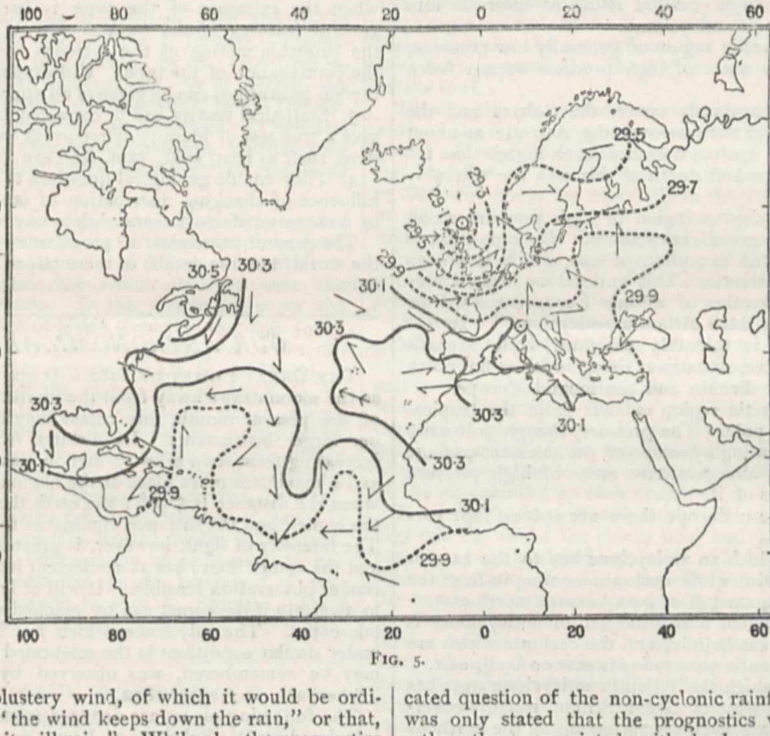

Fig. 5.

with a hard sky and blustery wind, of which it would be ordinarily remarked that "the wind keeps down the rain," or that, "when the wind falls, it will rain." While also the prognostics which precede cyclone rain hold good for the reason that they are seen in front of the rainy portion, those associated with straight isobars hold good because, though there is little rain actually with them, the area which they cover to-day will probably be covered by a cyclone to-morrow—the conditions being favourable for the passage or formation of cyclones.

Altogether, about 100 prognostics are associated with these four shapes of isobars.

The use and position of prognostics relative to forecasting from synoptic charts was stated thus:—

Theoretically, when the isobars are well-defined, we ought to be able to write down the prognostics which might be visible, but practically we cannot do so. Besides, there are sometimes cases of isobars which have no well-defined shape, but with which thunderstorms or heavy showers often occur. These, as is well known, hardly affect the barometer, but are abundantly forewarned by the commonest prognostics, and as the rainfall is usually heavy in them, the failure of the forecast which omits to notice them is very conspicuous.

The scope of the paper precluded entering into the complicated question of the non-cyclonic rainfalls in this country. It was only stated that the prognostics which precede them are rather those associated with broken weather, such as bright sunrise or heavy clouds banking up without the barometer falling, than the muggy, dirty weather of a cyclone front. The warning they give is also much shorter, rarely more than three or four hours, if so long.

The other paper is an attempt to classify certain types of British weather.

It is familiar to many observers that the weather in this country frequently occurs in spells of several weeks' duration, during which there is a remarkable persistence of the general type of weather overriding both a considerable fluctuation from day to day, and a considerable local variation from place to place.

For instance, the wind will often back to some point of south with a high temperature, a dull sky and rain, and then veer to some point of west with a cooler air and brighter sky; and after a day or so of fine weather it will back again to the south with bad weather, perhaps this time rising to the intensity of a gale, and subsequently veer towards the west with finer weather, and so on for weeks together.

The changes only vary in intensity and detail, not in general character, while the feel of the weather and the look of the sky remain through all of them what are customarily associated with westerly winds.

Similarly the wind will often blow persistently from some point of east, fluctuating between south-east for fouler weather and north-east for finer weather, and back again with many variations for several weeks, during which the predominant features of the weather are always characteristic of east winds. The frequent recurrence of particular types of weather at particular seasons of the year is also a matter of common observation; the north-east winds of March, the cold north winds of the middle of June, and the wet west winds of September are well-known instances.

If we examine a large number of synoptic charts we find that relatively to Europe the general position of the great areas of high pressure frequently remained constant for a lengthened period. Further examination shows that the constancy of these positions coincides with persistent types of weather similar to those above mentioned, the fluctuation of type being due to the passage of cyclones, while the local variation depends on the position of the cyclone centres and on the innumerable local conditions which modify any general type.

Over the North Atlantic and Europe the distribution of atmospheric pressure presents certain constant features, namely—

1. An equatorial belt of nearly uniform low pressure.

2. A tropical belt of high pressure rising at intervals into great irregular elevations or anticyclones.

3. A temperate and Arctic region of generally low pressure, but in which occasionally areas of high pressure appear for a considerable period.

The equatorial belt constantly covers the Sahara and the Amazon valley, and always narrows over the Atlantic at about 30° west longitude, where it often does not reach higher than 10° north latitude. The shape and depth of this area are tolerably constant.

The tropical belt comprises a region of high pressure rising at variable intervals into great anticyclones. Their position is generally variable, with the exception of one, which is always found over the central Atlantic. This anticyclone forms a very important factor of the weather of western Europe, and will be constantly referred to as "the Atlantic anticyclone." Its extension south and west is tolerably constant, while towards north and east it is variable, sometimes rising as far as 60° north and stretching over Great Britain and continental Europe.

The temperate and Arctic region extends from the tropical high pressure belt to the pole. The pressure, though ordinarily low, is perpetually fluctuating by reason of the incessant passage of cyclones; yet occasionally persistent areas of high pressure appear in certain portions of it.

With reference to western Europe there are at least four persistent types of weather—

1. The southerly, in which an anticyclone lies to the east or south-east of Great Britain, while cyclones coming in from the Atlantic either beat up against it or pass towards north-east.

2. The westerly, in which a tropical belt of anticyclones is found to the south of Great Britain, and the cyclones which are formed in the central Atlantic pass towards east or north-east.

3. The northerly, in which the Atlantic anticyclone stretches far to the west and north-west of Great Britain, roughly covering the ocean. In this case cyclones spring up on the north or east side, and either work round the anticyclone to the south-east, or leave it and travel rapidly towards the east.

4. The easterly, in which an apparently non-tropical anticyclone (or one disconnected with the tropical high-pressure belt) appears in the north-east of Europe, rarely extending beyond the coast-line, while the Atlantic anticyclone is occasionally totally absent from the Bay of Biscay. The cyclones, then, either come in from the Atlantic and pass south-east between the two anticyclones, or else, their progress being impeded, they are arrested or deflected by the north-east anticyclone. Sometimes they are formed to the south of the north-east anticyclone, and advance slowly towards the east, or in very rare instances towards the west.

The details of the southerly and westerly types are given in the paper. Here we can only reproduce the three diagrams of the westerly type, Figs. 3, 4, and 5, in which the general characteristics of the type, just mentioned, are readily seen.

The value of the recognition of type groups is shown in the following ways:—

1. They explain many phenomena of weather, and many popular prognostics.

For instance, besides showing the nature of spells of good, bad, dry weather, &c., they explain by reason of their persistence such prognostics as why "grouse coming down into farmyards are a sign of snow." Also why the prognostics, "When a river like the Tweed rises without any rain having fallen," or "Irregular tides are signs of rain," have a significance for the future; for though both are caused by past bad weather at a distance, yet the persistent type will almost certainly sooner or later bring more bad weather over the place of observation.

Then the recurrence of hot and cold periods, many of them well known, are shown to be due to the recurrence of a similar type of pressure distribution about the same season of the year. Particulars of seventeen such are given, and the manner in which the knowledge of them can be utilised in forecasting is stated thus: that though the forecaster is not justified in stating that any period will occur absolutely, still when about the time of its usual recurrence the synoptic charts show signs of the expected type, then the forecasts for a few days ahead can be issued with greater confidence. For instance, suppose that about November 6—a cold period—the charts begin to show traces of the northerly type, then, but not before, there would be good grounds for saying that a period of cold weather, which usually occurs at this season, has already set in, and may be expected to last for five or six days, the forecaster being thus enabled to issue a much longer forecast than can as a rule be safely attempted.

2. Type groups are of the utmost value in forecasting, for when the existence of the type is fairly recognised then the general features of the weather are at once given, as well as the probable motion of the cyclones which are formed during the continuance of the type. Unfortunately in many cases no certain indications can be given of an approaching change of type.

3. Statistical results can be corrected by their means, for they give a true test of identity of recurrent weather, which no single item, such as heat, cold, rain, &c., can do.

4. They enable geological questions to be treated, such as the influence of changing distribution of land and sea on climate, in a more satisfactory manner than any other method.

The general principles of prognostics and types hold all over the world, but the details in these papers apply to Great Britain only.

RALPH ABERCROMBY

OUR ASTRONOMICAL COLUMN

THE GREAT COMET OF 1882.—It appears quite possible that as the moon draws away from the morning sky towards the end of the present month, this comet may be again observed with our larger instruments. Its distance from the earth has been increasing from soon after perihelion passage in September last, and a maximum takes place at the beginning of September next, when the distance is 5·988; the earth then for a time overtakes the comet, and the distance diminishes to 5·709 on December 1. The intensity of light, however, is greatest at the end of August, and the comet then rises at a sufficient interval before the sun to render observation feasible. It will at least be of much interest to ascertain if the comet can be reached with our most powerful telescopes. The only comet which has been hitherto observed under similar conditions is the celebrated one of 1811, which, it may be remembered, was observed by Wisniewsky at Neu-Tscherkask, in August 1812.

The following places are deduced from the elliptical elements calculated by W. Fabritius of Kiev (*Astron. Nach.*, No. 2514), from a wider arc of observation than any other orbit yet published:—

At Greenwich Midnight

	R.A. h. m. s.	N.P.D. ° ′	Log. distance from Earth.	Sun.
Aug. 28	7 25 58	98 32·0	0·7773	0·7306
30	7 26 44	98 41·6		
Sept. 1	7 27 28	98 51·4	0·7773	0·7339
3	7 28 10	99 1·4		
5	7 28 49	99 11·5	0·7771	0·7372
7	7 29 26	99 21·7		
9	7 30 0	99 32·1	0·7768	0·7405

Dr. Julius Schmidt last saw the comet at Athens on April 28; in a letter addressed to NATURE, Mr. A. S. Atkinson of Nelson, N.Z., states that with a 4-inch refractor he saw it with certainty on May 6. Assuming the theoretical intensity of light on the latter date to be unity, the intensity on August 28 is 0·35.

THE ASTRONOMISCHE GESELLSCHAFT.—The next meeting of this society will be held at Vienna, in the apartments of the Academy of Sciences, from September 14–17, under the presidency of Prof. Auwers; the secretary is Prof. Schœnfeld, director of the Observatory at Bonn.

The last part of the *Vierteljahrsschrift* contains reports of the proceedings during the year 1882, from twenty-eight continental observatories, public and private. Also a portrait of the late Prof. Plantamour of Geneva.

EPHEMERIDES OF THE SATELLITES.—The last number of the *Monthly Notices of the Royal Astronomical Society* contains Mr. Marth's extensive ephemerides of the satellites of Saturn (excepting *Hyperion*), Uranus, and Neptune for their next oppositions, as well as data to facilitate the reduction of physical observations of Jupiter. *Hyperion* will have been omitted from want of reliable elements. Prof. Newcomb, however, is in possession of manuscript tables, which he has utilised in the *American Ephemeris* for 1883; we extract the early portion of his table: I represents inferior, and S superior, conjunction; E, east, and W, west elongation; the times are for the meridian of Washington (5h. 8m. west of Greenwich):—

	h.			h.			h.
Aug. 18,	2·9 E	...	Sept. 8,	10·6 E	...	Sept. 29,	17·0 E
23,	10·9 I	...	13,	18·4 I	...	Oct. 5,	0·6 I
28,	18·8 W	...	19,	1·9 W	...	10,	8·0 W
Sept. 3,	2·7 S	...	24,	9·5 S	...	15,	15·5 S

SCIENTIFIC SERIALS

Journal de Physique Théorique et Appliqué, July, 1883.—On the theory of electromagnetic machines, by J. Joubert.—Experiments on the aurora borealis in Lapland, by S. Lemström.—Note on a spectroscope with inclined slit, by M. Garbe.—A differential thermometer for class demonstration, by H. Dufour.—An addition to Atwood's machine, by A. Béquié.—The determination of the ohm by dynamometric methods, translated by M. Brillouin.—Electrochemical figure, with diagram, translated by Adrien Guébhard.

Rendiconti of the *Royal Lombard Institute of Sciences and Letters*, June 28, 1883.—On the theory of the potential, by Prof. E. Beltrami.—Note on the latitude of Milan, deduced from calculations of distances from the zenith observed near the meridian, by M. E. G. Celoria. In this concluding paper the author fixes the exact latitude of Milan (centre of the large tower of the observatory), at $45° 27' 59''·34 \pm 0''·09 \ldots A_1$.—On the kinematic significance of wave surface, by Dr. G. A. Maggi.—Observations on the figure of the planet Uranus, by E. G. V. Schiaparelli. Besides calculating its ellipticity, which agrees with the conclusions of Mädler and Shafarik, the author determines the presence of spots and changes of colour on the surface of Uranus.—Results of a microscopic analysis of the drinking water at Cadempino, Canton of Ticino, Switzerland, by Prof. L. Maggi.—A case of policheiria (abnormal number of claws) in a freshwater crab (*Astacus fluviatilis*, Rond.), by Dr. E. Cantoni. Appended to the paper is a bibliography of crustacean teratology.—Remarkable results obtained by the treatment of pulmonary tuberculosis with iodoform, by Prof. G. Sormani.—On a Russian scheme of international exchanges, by Prof. E. Vidardi.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 21.—"Supplement to former Paper entitled—'Experimental Inquiry into the Composition of some of the Animals Fed and Slaughtered as Human Food'—*Composition of the Ash of the Entire Animals and of certain Separated Parts.*" By Sir John Bennet Lawes, Bart., LL.D., F.R.S., F.C.S., and Joseph Henry Gilbert, Ph.D., LL.D., F.R.S., V.P.C.S.

In a former paper (*Phil. Trans.*, Part II. 1859) the authors had given the actual weights, and the percentage proportion in the entire body, of the individual organs, and of certain more arbitrarily separated parts, of 326 animals—oxen, sheep, and pigs—in different conditions as to age, maturity, fatness, &c. They called particular attention to the wide difference in the proportion by weight of the stomachs and intestines in the three descriptions of animal; the proportion of stomach and contents being very much the highest in oxen, considerably less in sheep, and little more than one-tenth as much in pigs as in oxen. On the other hand, the intestines and contents contributed a less proportion to the weight of the body in oxen than in either sheep or pigs; the percentage by weight in pigs being nearly twice as high as in sheep, and more than twice as high as in oxen. With these very characteristic differences in the proportion of the receptacles and first laboratories of the food the other internal organs collectively, as also the blood, contributed a pretty equal proportion by weight of the entire body, in the three descriptions of animal.

Ten animals had been selected for the determination of the chemical composition, namely—a fat calf, a half-fat ox, and a fat ox; a fat lamb, a store sheep, a half-fat sheep, a fat sheep, and a very fat sheep; a store pig, and a fat pig. In these, in the collective carcass parts, in the collective offal parts, and in the entire bodies, the total nitrogenous substance, the total fat, the total mineral matter, the total dry substance, and the water, were determined; and the results were recorded and discussed in detail.

It was shown that, as the animal fattened, the percentage of nitrogenous substance decreased considerably, whilst that of the fat and of the total dry matter increased in a much greater degree. It was estimated that the portions of well fattened animals which would be consumed as human food would contain three, four, and even more times as much fat as dry nitrogenous substance: and comparing such animal food with wheat-flour bread, it was concluded that, taking into consideration the much higher capacity for oxidation of a given weight of fat than of starch, such animal food contributed a much higher proportion of non-nitrogenous substance, reckoned as starch, to one of nitrogenous substance than bread. In fact the introduction of our staple animal foods to supplement our otherwise mainly farinaceous diet did not increase, but reduced the relation of the flesh-forming material to the respiratory and fat-forming capacity of the food.

Finally, the actual amount and the percentage of total ash in most of the internal organs and some other separated parts were given. It was shown that the percentage of total mineral matter, like that of the nitrogenous substance, decreased not only in the entire body, but especially in the collective carcass parts, as the animals matured. It was the object of the present communication to record the results of the complete analysis of the ashes of the collective carcass parts, of the collective offal parts, and of all parts of each of the ten animals. Forty complete ash analyses had been made.

As was to be expected, more than four-fifths of the ashes consisted of phosphoric acid, lime, and magnesia; these making up the largest amount in the ash of the oxen, less in that of sheep, and less still in that of pigs. Potash and soda were also prominent constituents. Assuming, for the purposes of illustration merely, that one of phosphoric acid was combined with three of fixed base, the ashes of the ruminants showed an excess of base; whereas, according to the same mode of calculation, the ashes of the pigs showed no such excess.

It was, unfortunately, only in the case of the offal parts of the pigs that the ash of the chiefly bony and that of the chiefly soft parts had been analysed separately. The results showed a considerable excess of acid, especially phosphoric, in the ash of the non-bony portions; presumably, in part at any rate, due to the oxidation of phosphorus in the incineration. In further reference to the point in question it may be stated that, although the oxen and sheep show a higher percentage of total nitrogenous substance than the pigs, yet, owing to the relatively small proportion of bone in the pigs, the amount of ash yielded from the non-bony parts is higher in proportion to that from the bones in their case than in that of the ruminants.

Comparing the percentage composition of the ashes of the entire bodies of the different animals, the chief points of distinction were that in the ash of the pigs there is a lower percentage of lime and a higher percentage of potash and soda than in the corresponding ash of the ruminants; there is a somewhat higher percentage of phosphoric acid in the ash of the pigs and of the oxen than in that of the sheep; and there is a higher percentage of sulphuric acid (and somewhat of chlorine also) in the ash of the pigs than in that of the other animals.

A table showing the quantities of total ash, and of each individual mineral constituent, in each of the ten animals analysed was given. Not much stress was laid on the amounts in the particular animals analysed, as the actual weights and condition of animals coming under similar designations may vary considerably.

It was of more interest to consider the amounts of the mineral constituents in carcass parts, in offal parts, and in all parts per 1000 lbs. fasted live-weight, of each description of animal.

It was shown that a given live-weight of oxen carried off much more mineral matter than the same weight of sheep, and a given weight of sheep much more than the same weight of pigs. With each description of animal the amounts of phosphoric acid, lime, and magnesia, are less in a given live-weight of the fatter than of the comparable leaner individuals. Of both potash and soda, again, the quantity is less in a given live-weight of the fatter animals. The same may be said of the sulphuric acid and the chlorine; in fact, in a greater or less degree, of every one of the mineral constituents.

It was estimated that the loss to the farm of mineral constituents by the production and sale of mere fattening increase was very small. It was greater of course in the case of growing than of only fattening animals. In illustration, the amounts of some of the most important mineral constituents removed annually from an acre of fair average pasture and arable land in various products were compared. Such estimates could obviously be only approximate, and the quantities will vary considerably. With this reservation it may be stated that, of phosphoric acid, an acre would lose more in milk, and four or five times as much in wheat or barley grain, or in hay, as in the fattening increase of oxen or sheep. Of lime, the land would lose about twice as much in the animal increase as in milk, or in wheat or barley grain; but perhaps not more than one-tenth as much as in hay. Of potash, again, an acre would yield only a fraction of a pound in animal increase, six or eight times as much in milk, twenty or thirty times as much in wheat or barley grain, and more than 100 times as much in hay.

From the point of view of the physiologist, it would doubtless have been desirable that the selection of parts for the preparation and analysis of the ash should have been different, and more detailed. The agricultural aspects of the subject had, however, necessarily influenced the course of the inquiry; and the extent of the essential work had enforced the limitation which had been adopted. The results must be accepted as a substantial contribution to the chemical statistics of the feeding of the animals of the farm for human food.

PARIS

Academy of Sciences, July 23.—M. Blanchard, president, in the chair.—Historic importance of Nicolas Leblanc's discovery of the method of extracting artificial soda from marine salt, by M. Dumas. To this great discovery, which the author compares with that of the steam-engine by Watt, is traced the vast development of the chemical industries during the last hundred years. The present annual consumption of the carbonate of soda resulting from Leblanc's process is estimated at from 700,000,000 to 800,000,000 kilograms in Europe and America. Yet the name of the discoverer had almost been forgotten till recently revived by the municipality of his birthplace, Issoudun, which now proposes to erect a monument to his memory.—Active or dynamic resistance of solids (continued). Graphic representation of the laws of longitudinal thrust applied to one end of a prismatic rod, the other end of which is fixed, by MM. de Saint-Venant and Flamant.—Method of distributing the heat developed in the process of forging, by M. Tresca.—Description of the new apparatus about to be fitted up in the Paris Observatory for the purpose of studying the movements of the sun, by M. C. Wolf. This mechanism, which is based on the same principle as that adopted by G. and H. Darwin in the Cavendish laboratory, Cambridge, is intended more especially for the observation of solar oscillations and deviations from the vertical.—On the present outbreak of cholera in Egypt, and on the probability of Europe escaping its ravages, by M. A. Fauvel. Every day tended to diminish the chance of an invasion, and should the epidemic be staved off for the next four or five weeks there would be little cause for further apprehension, as it was expected from past experiences that Egypt itself would be entirely free within six weeks at the outside. With regard to the prediction confidently made in many quarters, that the epidemic would reach the mainland through England, the author remarked that on the contrary it had on all previous occasions found its way to England from the Baltic ports on the mainland. He regarded Greece and Spain as in any case free from danger, and thought that in case it appeared on the French seaboard it might easily be prevented from spreading inland by carefully isolating the patients. He considered that the two cities most exposed to its attacks were Constantinople and Trieste, the former through Syria and Asia Minor, the latter through the arrival of immigrants escaping from Egypt. Notwithstanding the recent disclosures made on the spot, he still holds the view that the cholera was originally introduced into Egypt from Bombay in consequence of the suspension of the precautionary measures formerly adopted by the Egyptian Government against the epidemic.—On the origin of the nitrogen existing in combination on the surface of the earth, by MM. A. Müntz and E. Aubin. Nitrogenous combinations are due in the first instance to the electric phenomena of which the terrestrial atmosphere is the seat. These phenomena appear to have been much more intense in remote geological epochs than since the appearance of animal and vegetable life on the earth. Hence it would seem that we are now depending on a constantly diminishing stock of combined nitrogen, and the process of diminution must go on unless atmospheric electricity prove to be a source of sufficient reparation.—On the adaptation to viticulture of the sandy tracts of the Landes and Gironde in the south-west of France, by M. A. Robinson.—Experimental researches on the action of a liquid introduced by a special process into the tissues of the vine for the purpose of destroying phylloxera, by M. P. de Lafitte. Sulphate of copper diluted in water is recommended as best answering all the conditions, and consequently as the surest antidote to the evil.—On some linear differential equations of the fourth order, by M. Halphen.—On certain special solutions of the problem of the three bodies, by M. H. Poincaré.—On some recently observed solar perturbations, by Admiral Mouchez.—On a universal galvanometer without oscillatory action, adapted for the measurement of currents of great intensity or of high tension, with illustration, by M. Ducretet.—On the nitric derivatives of hydride of ethylene, by M. Berthelot.—On some derivatives of mannitic hexylene, by M. Wurtz.—On the products derived from the bacterian fermentation of albuminoids, by MM. Arm. Gautier and A. Etard.—On the supposed transformation of brucine into strychnine, by M. Hanriot.—On the heat-generating power of coal, by M. Scheurer-Kestner.—On the physiological properties of the bark of the dundaké (a West African shrub) and of dundakine, by MM. Bochefontaine, B. Feris, and Marcus.—On the nervous chords in the foot of the heliotides, by M. H. Wegmann.—On the temperatures of the sea observed at Concarneau and Douarnenez, by M. Goez.—A reply to M. Certes on the subject of the method proposed by him for examining corpuscles held in suspension in water, by M. Eug. Marchand.

CONTENTS