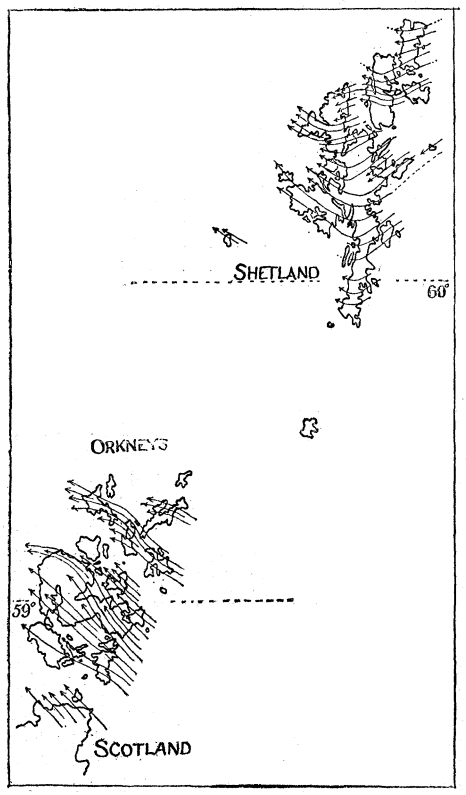

COURSE OF GLACIAL SCRATCHES.

but the motion changed to north-west about the middle line of the group. The great variety of rocks in north and south strips gives abundant opportunity for determining this motion by the direction of dispersion of the bowlders from their parent ledges. No Scottish bowlders are found here, nor do marine remains occur in the drift. Raised beaches do not appear on any of the islands. It is concluded that Scandinavian ice covered Shetland, while Scottish ice advanced over the Orkneys; the original motion of both glacial sheets being changed where they coalesced, in the shallow North Sea, and turned to the line of least resistance, — northwest to the open ocean. There they must have ended in a great ice-cliff like that discovered by Ross in the Antarctic Ocean. It may be well to refer here to Helland's study of the Faroes a few years ago, when he showed that they bear no marks of continental glaciation, the few scratches he found there depending on local form for their guidance.

Our space forbids mention of the many other interesting topics that Mr. Tudor's book discusses, although few volumes contain so many pages of entertainment to the general reader; but attention should be called to the well-considered character of the work, only seldom marred by a remnant of newspaper style. In its table of contents, illustrations, glossary, bibliography, and index, the volume is all that can be desired.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

Partial differential equations. — M. Darboux considers an arbitrary partial differential equation, defining a function, z, of any number of variables. Replacing z by $z + ez'$, developing according to powers of e, and equating to zero the coefficient of e, a new equation is formed, which the author calls the auxiliary equation. The auxiliary equation defines solutions differing infinitely little from a given solution; and so it has a signification which does not depend on the choice of variables, and which will remain unchanged by any arbitrary change of the variables. The equation, being linear, is easy to deal with, and conducts to many important results which are intimately connected with the given equation. The author considers especially two geometrical problems. First: having given a surface, Σ, attempt to find all the infinitely near surfaces which will form with Σ one family of a triply orthogonal system. This problem, which has already been studied by Prof. Cayley, is equivalent to either of the following problems: 1°, To find all surfaces admitting of the same spherical representation as Σ; or, 2°, To find all the systems of circles normal to the family of surfaces of which Σ is one. It follows at once, that, if the problem of the spherical representation of Σ is solved, the solution can be at once arrived at for the inverse surfaces to Σ, or the surfaces arrived at by the transformation by reciprocal radii.

The second problem considered by M. Darboux is one famed for its extreme difficulty; viz., to find the surfaces applicable to a given surface. Denote by δx, δy, δz, the increments taken by x, y, z, in passing from a point of the given surface, Σ, to the corresponding point on an infinitely near surface: then, expressing the necessary condition to the solution of the problem, — viz., that the small arc shall not change its length, — we have —

$$dx\, d\,.\,\delta x + dy\, d\,.\,\delta y + dz\, d\,.\,\delta z = 0.$$

Replacing δx, etc., by proportional quantities, — say, x_1, y_1, z_1, — this is $dx\,dx_1 + dy\,dy_1 + dz\,dz_1 = 0$; i.e., the corresponding elements on the surfaces Σ and Σ_1 are orthogonal. M. Darboux's problem is thus conducted back to a problem solved by M. Moutard. The

surfaces for which the problem can be solved are divided into certain *classes*. M. Darboux gives the expressions for the co-ordinates of a point in terms of two parameters for the surfaces of the first class. — (*Comptes rendus*, March 19.) T. C. [441

ENGINEERING.

Theory of the screw-propeller. — Mr. J. N. Warrington, of the Stevens institute of technology, discusses the theory of the screw-propeller, and the methods of designing it. He first discusses the action of the screw in the water, investigates the conditions of maximum efficiency, and obtains expressions for the efficiency in terms of the angle of the blades, and the ratios of resistance of friction to pressures exerted. He finds, as does Froude, that the angle of maximum efficiency is forty-five degrees. It is found that a small amount of slip does not necessarily give good performance, — a conclusion already proven by experience. It is found that the action of the screw, in its most efficient operation, does not involve the sternward projection of a solid stream; and hence it follows that all investigations based, as is common, on that assumption, are inaccurate. Yet it is only the water that is thrown aft that gives propelling-power, and the nearer the stream is solid, the better. He obtains the equation of the curve of the developed screw from Thurston, and expressions for the magnitudes of diameter and thrust from Seaton. The second part of the paper is devoted to the designing of the screw according to the principles deduced in the first part. The shape of a blade upon which the water shall glide without shock, and from which it shall be thrown aft with a given velocity, acquiring that velocity by a uniform acceleration, is given by its equation as deduced by Warrington. The relation between the pressure and the acceleration is ascertained; the slip is assumed, and the total resistance is given; and the required size of screw is calculated. The magnitude of the losses of energy, and the efficiency, are determined, and the process is applied to the guide-blade propeller as well as to the common screw. Two wheels are drawn, — the one a U. S. naval-department screw, the other a screw designed on Warrington's plan. — (*Journ. Frankl. inst.*, Aug.) R. H. T. [442

Light prime motors. — President D. Napoli, of La société de navigation aérienne, in a communication to the *Aéronaute*, compares the weight of steam-engines and electric motors for use in aeronautics. He finds that the weight of fuel and water demanded by a steam-engine of twenty-horse power for ten hours' work would be not far from 1,600 kilos (3,527 lbs.), while the weight of an electric motor and its supplies would be about 1,400 kilos (3,087 lbs.); giving a decided advantage to the latter aside from the weight of the engine, which may be anywhere from two hundred and fifty to four hundred per cent greater than the weight of its supplies, according to style, which M. Napoli does not prescribe. — (*Chron. ind.*, June.) R. H. T. [443

Resistance of railway-trains. — Professor Franck has written a memoir on the resistance of trains, studying the earlier experiments of Vuillemin, Guebhard and Dieudonne, and of Rockl. He obtains the formula for resistance,

$$w = m + \frac{l F v^2}{Q},$$

in which w is the resistance in kilos per ton, Q is the weight in tons, m, l, and F are the coefficients, as follows: —

For passenger-engines . .	$m = 0.0032$
" freight-engines . . .	$m = 0.0038$ to 0.0039
" the cars	$m = 0.0025$
" all cases	$l = 0.1225$
" passenger-engines . .	$F = 7$
" freight-engines . .	$F = 8$
" passenger & box cars,	$F = 0.5$
" unloaded flat cars . .	$F = 0.4$
" loaded flat cars . . .	$F = 1.0$

The author of the paper considers that this formula, used with this assortment of constants, will allow of very exact calculation of the resistance of trains. — (*Mém. soc. ing. civ.*, June.) R. H. T. [444

Dowson's gas for heating. — In 1882 the Messrs. Crossley put in a Dowson plant for making his gas. The trial of the system gave the following results: when the gas was made from Trimsaran anthracite, a gas-engine consumed 1.5 pounds (0.68 kilogram) per hour per horse-power; when using Garnant anthracite, the consumption was 1.4 pounds (0.64 kilogram). These results were so satisfactory that the Messrs. Crossley have adopted the gas-engine throughout their works, and are using some 200-horse power. The engine above referred to was of about 30-horse power. It is found that a larger engine, 40-horse power, uses but 1.2 pounds (0.54 kilogram). The process consists in passing a current of steam and air through a mass of red-hot carbonaceous materials. Coal-gas has nearly four times the heating-power of this gas, but the cost of the Dowson gas is so much less that it compensates this great difference. It is, however, intended to compete with the gas produced from coal-oils. The author of the paper calculates that the costs of operating a steam-engine, and of working a gas-engine driven by his gas, are as three to two, the engines being of 100-horse power each. — (*Proc. inst. civ. eng.*, 1883.) R. H. T. [445

AGRICULTURE.

Reversion of superphosphates in the soil. — Farsky shows, that, when a small quantity of water acts upon a superphosphate, the monocalcic phosphate which it contains is decomposed into dicalcic phosphate and free phosphoric acid. The same process seems to take place when a superphosphate is mixed with the soil. Subsequently the free acid appears to act upon the calcium, iron, and aluminum salts of the soil, forming dicalcic phosphate and soluble acid phosphates of iron and aluminum. The latter are not stable, and soon pass into insoluble combinations (compare SCIENCE, i. 825). — (*Biedermann's centr.-blatt.*, xii. 450.) H. P. A. [446

Fineness of superphosphates. — Farsky, both in pot-experiments with buckwheat, and in field-experiments with several other crops, found that coarse

superphosphate gave a greater increase than fine. Exactly the opposite result was given by Wagner's experiments, reported in SCIENCE, i. **310.** — (*Biedermann's centr.-blatt.*, xii. 453.) H. P. A. [**447**

Experiments on the continuous growth of wheat and barley. — These experiments by Voelcker, on the plan of the well-known Rothamsted experiments of Lawes and Gilbert, are in progress at Woburn, on a light soil, and are intended to supplement those at Rothamsted, which are on a heavy clay soil. The present report gives the results of the sixth year, viz., 1882. The most interesting of the results are those obtained on four plots, two of which had received mineral manures and nitrates or ammonia salts, and two stable-manure. Each plot was halved. One half received the same fertilizers as in preceding years; while the other remained unmanured (in case of the stable-manure plots), or received the mineral fertilizers of the preceding year, but no nitrogen. The mineral fertilizers alone gave no larger crop than was obtained from plots unmanured for six years, while the other half of the same plots, which received nitrogen, gave about thrice as large a crop. The evident conclusion was, that the plots were deficient in nitrogen, and that the large amounts of nitrates or ammonia salts, which they had received in previous years, had left no available residue of nitrogen in the soil. In the case of the plots which had received stable-manure, the unmanured halves showed that a portion of the manuring of previous years was still available, though the gain thus caused was small. In all the experiments of this year, sulphate of ammonia produced better results than an equivalent quantity of nitrate of soda. — (*Journ. roy. agric. soc.*, xix. 209.) H. P. A. [**448**

MINERALOGY.

Cuspidine. — This comparatively new mineral has been crystallographically examined by G. von Rath. It occurs at Vesuvius in very characteristic spear-head-shaped crystals, which are not to be confounded with any other mineral. The crystals were found to be monoclinic, the apparent rhombic form being the result of twinning. The axial relation is $a:b:c = 0.7243:1:1.9342$. $\beta = 89° 22'$. The measurements were made on a single small crystal, which showed no evidence of twinning; the symbols for seventeen different forms being obtained, cleavage parallel to the base, plane of twinning the orthopinnacoid. Sections from the mineral gave the optical properties of monoclinic crystals. Material pure enough for analysis could not be obtained, as the mineral is peculiarly liable to alteration. An analysis by E. Fischer, of impure material, showed that in addition to calcium fluoride the mineral contains the silicate Ca_2SiO_4.

A very few minute crystals of a mineral resembling cuspidine were found at Vesuvius, occurring in orthorhombic prisms, very much striated, parallel to the vertical axis, and terminated by an obtuse pyramid. An approximate axial relation, $a:b:c = 0.560:1:0.417$, was obtained; but the material did not admit of further investigation. — (*Zeitschr. kryst.*, viii. 38.) S. L. P. [**449**

Empholite. — This new mineral has been described by L. J. Igelström as occurring at Hörrsjöberg, Wermland, Sweden, in small, well-formed crystals and fibrous aggregates. The prisms, sometimes attaining a length of six millimetres, are brilliant, and resemble diaspore in form, the prismatic angle being about 123°–130°: with cleavage parallel to the brachypinnacoid; hardness, greater than six; color, white, changing to yellow on exposure, owing to the oxidation of the iron; before the blow-pipe infusible, giving a beautiful blue color with cobalt solution, and, in the closed tube, neutral water; scarcely attacked by acids. Two analyses, after correcting for sixteen per cent of gangue, yielded —

SiO_2	Al_2O_3	MgO. CaO. FeO.	H_2O	
52.3	30.5	3.4	13.8	= 100
48.8	33.3	3.3	14.6	= 100

The mineral is a hydrous silicate of alumina, and the formula $Al_2Si_2O_7 . 3H_2O$ is proposed; but the analyses are not correct enough to lead to any definite formula. — (*Bull. soc. min.*, vi. 40.) S. L. P. [**450**

METEOROLOGY.

Barometric maxima and minima. — The meteorological conditions which are characteristic of regions of high and low pressure have been studied by various investigators, notably by Mohn, Clement Ley, and Loomis. The latest contribution to this subject is made by Hildebrandsson, who bases his conclusions upon observations made at Upsala and other stations in northern Europe since 1873. He discusses the angle of the wind with the barometric gradient, the wind velocity, the direction of the upper and lower clouds, the air temperature, the amount of cloudiness and rainfall, the transparency of the air and fog, — all with regard to their relations to areas of maximum and minimum pressure. The conclusions are based wholly upon tabulations of the observations, and are primarily applicable to Upsala and vicinity, but are in general similar to those obtained for other countries. — (*La distr. élém. mét. autour min. et max. bar.*) W. U. [**451**

ZOÖLOGY.

Animal coloring-matters. — The application of the spectroscope to the determination and discrimination of coloring-matters from living organisms has opened an interesting field of research. Dr. C. A. MacMunn gives an extensive *résumé* of previous work, and the results of his own studies in this field. His article is a valuable presentation of our knowledge of the subject; but it necessarily contains many details, and is therefore unadapted to a brief abstract. The following points deserve special notice. Haematin may be prepared by a new method: "Fresh defibrinated blood is treated with a mixture of two parts of strong sulphuric acid to thirty-five of alcohol, and thrown on a filter, more alcohol being added to help the filtration; the filtrate is diluted with water, put into a separating funnel, and shaken up with chloroform. After standing some time, the chloroform is separated off, and filtered and evaporated. . . . The residue corresponds to haematin as it is usually described." By the action of strong mineral acids on

this haematin, Hoppe-Seyler's haemato-porphyrin was obtained; it is practically identical with Thudicum's cruentin. When neutral dried cruentin is boiled with equal parts of rectified spirit and acetic acid, a five-banded spectrum was obtained, similar to if not identical with that of Preyer's iron-free haematin. Bilirubin is identical with haematoidin. There are several lutein pigments; for example, that of the hen's egg is different from that of the corpus luteum of the cow. Tetronerythrin is very widely spread, occurring in 'the roses' around the eyes of certain birds, in the skin of the red mullet, and in many invertebrates; it is apparently capable of performing respiratory functions, somewhat like haemaglobin. Its presence in the crust of lobsters and crabs is noteworthy. The various classes of invertebrates are taken up in succession, the following being the principal pigments described: chlorophyll, pentacrinin, cruentin (in starfishes), echinochrome, cochineal, aphidein, bonellein, haemocyanin (in blood of Octopus), aplysiopurpurin, dermolutein, etc. Numerous spectra are reproduced in the charts. In an appended note, it is stated that chlorophyll is found in the liver of mollusks: *cf.* Royal society's proceedings, April 5, 1883. — (*Proc. Birmingham nat. hist. soc.*, iii. 351.) C. S. M. [452

Mollusks.

Abyssal mollusks. — Dr. Jeffreys continues his valuable papers on the deep-sea mollusks of the Lightning and Porcupine expeditions. The last instalment includes the Scissurellidae, Trochidae, Turbinidae, and Littorinidae, with two fine plates on which are figured twenty-one new forms. Several new genera are described. Tharsis Jeffreys has a closed umbilicus and appressed peristome, which separate it from Cyclostrema: the type is Oystele romettensis Seguenza. Ganesa is like a very minute, delicate Lunatia, with a perforate axis. Cantrainea is suggested for Turbo peloritanus Cantraine. Hela Jeffreys, beside being pre-occupied, proves to be identical with the Japanese Cithna A. Ad. Iphitus Jeffreys is a minute form, resembling Fossarus or a miniature Tectarius, with a peculiar apex and subspiral operculum. — (*Proc. zoöl. soc. Lond.*, March, 1883.) W. H. D. [453

Further researches on nudibranchs. — Bergh prints an important paper, illustrated by five beautiful anatomical plates, as a supplement to his monograph of the family of which Polycera Cuvier is the typical genus. After a number of general notes on species and genera, among which is the description of Ohola, a new genus collected by the Challenger at Arapura in the South Seas, the author considers the Doridi-dae in general, with their divisions and probable phylogeny. The genus Heterodoris of Verrill and Emerton is considered as probably belonging to a different family. The Doridae are separated into two very well marked groups by the possession of a single large retractile crown of gills or of numerous non-retractile branchia, cryptobranchiata, and phanerobranchiata respectively. The latter, connected with the typical Doridae through Staurodoris, diverge in two lines, of which the more ancient forms are Notodoris and Akiodoris. The former culminates in Plocamophorus, with Ohola as a lateral branchlet. The latter passes through Acanthodoris, Goniodoris, etc., toward Ancula and Drepania.

The phanerobranchiate, non-suctorial Doridae form the Polyceradae (better Polyceratidae) of Bergh, and the suctorial forms his Goniodoridae. Of these groups a full discussion is made, and a synopsis of their genera and species is given. They inhabit all seas, but are largest and most beautiful in the warmer regions. — (*Verh. zool. bot. ges. Wien*, März, 1883.) W. H. D. [454

Worms.

Development of Phoronis. — A. Foettinger has published an article on this subject in Van Beneden's *Archives de biologie* (iii. 679). He found in the morula stage, that the cavity contained a few spherical or oval corpuscles, sometimes surrounded by a fine granular substance filling the whole segmentation cavity. The important question he deems to be, whether these elements, which are clearly the first rudiments of the mesoderm, are derived from the endo- or the ecto-derm. Kowalevsky is in favor of the latter view, while Metschnikoff holds to their endodermal origin. If the larvae are treated with acetic acid, and immediately examined, evidence will be afforded as to the presence of the first mesodermic elements at a time when the ovum is still segmenting; and, indeed, indications of them were seen in two cases, where the developing ova consisted of only eight blastomeres, for there is in them a central corpuscle which appears to have a mesodermal significance. The author has no distinct opinion as to the origin of this cell, but inclines to doubt the explanation given by Metschnikoff. As to the still earlier stages, it is stated that the fecundated ova are developed outside the body of the parent, but that they remain attached to the branchiae for a certain time. After the appearance of four blastomeres, two divide, and so give rise to a six-celled stage, with two large and four smaller cells. (As to the origin of the mesoderm, compare Hatschek's researches on Sipunculus, to be given shortly in SCIENCE.) — (*Journ. micr. soc. Lond.*, iii. 509.) C. S. M. [455

Nervous system of Hirudinea. — Saint-Loup finds that the arrangements of the nervous system, which were thought to be peculiar to Clepsine, are very common among the Hirudinea. Commencing with Nephelis, he saw in the transparent tissues six capsules on the ventral surface of the ventral ganglia. Similar capsules were observed in Aulastomum and Hirudo. The author detected in all Hirudineae the intermediate or unpaired nerve first described by Brandt in the medicinal leech. Saint-Loup hopes to give a general account of the morphology of the nervous system of the group. — (*Comptes rendus*, xcvi. 1321; *Journ. micr. soc. Lond.*, iii. 509.) C. S. M. [456

Insects.

Classification of the larger groups. — From a study of the relationships of the lower insects, Packard has been led to a new arrangement of all

the larger groups, and proposes the following scheme, in which the names proposed for what he terms super-orders are all new:—

Super-orders.	Orders.	Sub-orders.
Euglossata	Hymenoptera. Lepidoptera. Diptera	Diptera (genuina). Aphaniptera. Pupipara.
Elytrophora	Coleoptera	Coleoptera (genuina). Strepsiptera.
Eurhynchota	Hemiptera	Homoptera. Heteroptera. Physapoda. Mallophaga.
Phyloptera	Neuroptera	Trichoptera. Planipennia.
	Pseudoneuroptera	Odonata. Ephemerina. Platyptera.
	Orthoptera. Dermatoptera.	
Synaptera	Thysanura	Cinura. Symphyla. Collembola.

A mere outline is presented in this paper, which is only an abstract of his researches, to be published in full in the forthcoming report of the U. S. entomological commission. — (*Amer. nat.*, Aug.) [457

VERTEBRATES.

The function of body-equilibrium. — The central gray substance of the third ventricle, according to Bechterew's experiments, given in this paper, forms an organ of equilibrium in the same sense as the semicircular canals and the olivary bodies. His investigations were made chiefly upon the dog; although confirmatory experiments upon other animals, birds, and frogs, are given. The method of operating was to trephine a hole through the sphenoid bone at the sella turcica; and then, thrusting a small knife through the hypophysis into the third ventricle, a section could be made of the gray matter in any desired direction. Injury of any portion of the gray substance of the third ventricle was always followed by disturbances of equilibrium, similar, in a general way, to those caused by section of the semicircular canals. The author points out that the disturbances of equilibrium which have been noticed by other observers, after sections made in this region, but which were attributed either to the corpora striata or corpora thalami, were most probably caused by injury to the walls of the third ventricle. To explain how it is that the gray matter of the ventricle is affected by changes in equilibrium, he supposes that the cerebro-spinal liquid, which in this portion of the ventricle lies almost in a closed sac, assumes a rôle similar to that played by the endolymph of the semicircular canals. Changes in position of the body cause changes in pressure of the liquid upon the walls of the ventricle, giving rise to stimuli which act reflexly on the co-ordinating centres in the cerebellum. The preservation of body-equilibrium is brought about, according to Bechterew, by the action of three peripheral equilibrium organs; viz., the semicircular canals, the gray matter of the third ventricle, and the olivary bodies of the medulla. Disturbances of equilibrium cannot act as a stimulus to the olivary bodies by reason of any change in pressure of the cerebro-spinal liquid. The normal stimuli for this centre are found in the skin sensations, and perhaps muscle sensations, which reach the medulla from the spinal cord. Each of these three equilibrium organs, it is interesting to notice, is not only connected with the cerebellum, through which it acts on the muscles, but each is closely related also to one of the higher sense-organs, — the olivary bodies, to the skin; the semicircular canals, to the ear; and the gray matter of the third ventricle, as is shown in detail in the paper, to the eye. The intimate connection existing between the organs of sight and equilibrium is known to all; and this connection depends not so much on the visual sensations as on the position of the eyeballs. Injury to the centre in the third ventricle was always followed by marked changes in the direction of the axes of the eyeballs; and the author advances an ingenious theory to show that any change in the position of the eyeballs will act as a mechanical stimulus to this centre. Taken in conjunction with previous work by the same author, this paper makes an important addition to our knowledge of the much discussed question of body-equilibrium. — (*Pflüger's archiv*, xxxi. 479.) W. H. H. [458

Birds.

Sternum of Notornis. — In this paper Prof. Owen replies to a stricture on his plate of this bone, and makes many valuable remarks on the sternum in general. He distinctly adopts the Lamarckian theory for the loss of the keel, and again calls attention to the heterogeneous nature of the Ratitae. — (*Proc. zoöl. soc.*, 1882, 689.) J. A. J. [459

Pacinian corpuscles of birds. — Mlle. Joséphine Cattani has studied the corpuscles of Herbst in the leg of the fowl. The axis of the corpuscle is constituted by an extension of the nerve-fibre; the extension comprising not only the axis-cylinder, but also the medullary and Schwann's sheaths. At the point of entry the fibre is slightly constricted, and there is a Ranvier's node where the fibre reaches the corpuscle. Within the corpuscle the axis-cylinder becomes ribbon-like; the medullary sheath becomes thinner, and has a nucleus. The mass investing this terminal organ is composed of a web of fibres, with scattered ramified cells having oval nuclei; there are also two rows of cells with round nuclei along the nerve-fibre. The external envelope is a layer of connective tissue with very elongated nuclei. The nerve-fibre ends with a little flask-shaped dilatation, which has a granular matrix in which each fibrilla of the axis-cylinder ends in a little button. The author has also investigated the degeneration of these organs, after cutting the sciatic nerve; but this portion of her work lies rather in the domain of pathology. — (*Arch. ital. biol.*, iii. 326.) C. S. M. [460

Mammals.

The lingual sense-organs of Ornithorhynchus. — E. B. Poulton has continued his researches on the tongue (SCIENCE, i. **523**) by studying that of Ornithorhynchus. The tongue is about two inches long, and has only a small part free. The posterior third forms a large rounded conical protuberance, pointing obliquely forwards, and bearing at its apex two corneous teeth. The anterior division is covered by horny papillae, and has numerous mucous glands. The posterior division is more complicated, bearing various organs on its dorsal surface: viz., numerous filamentous papillae; an arching fold, limiting the tongue behind; a median raphe, which does not reach the tip of the cone; and four gustatory pits, — one pair near together, in front; and one pair behind, widely separated.

The papillae upon the anterior division of the tongue are largest in front, and smaller (and more scale-like) towards the base of the tongue, and also extend over the inferior surface of the basal protuberance. Except a few in front, they are all cornified, pointed, and inclined backwards. In each of the interior of these papillae are lodged from one to four sub-epithelial sensory bulbs; a medullated fibre runs directly to each bulb, and there loses its sheath; while the axis-cylinder is continued into a spindle-shaped body within the bulb, which, for the rest, consists of a series of nucleated lamellar envelopes. Poulton compares these organs with the Pacinian corpuscles, and considers them tactile. The epithelium between the papillae is not cornified: in it are found the pore-like openings of the numerous mucous glands.

The epithelium of the overhanging ventral surface of the posterior protuberance is more specialized, in that four strata can be distinguished in it. Curiously, the outer stratum appears less corneous than that which it immediately overlies. The two teeth at the apex have a very thick corneous layer, which, however, does not cover their tips, but forms a ring around an apical spot of softer epithelium.

The dorsal surface of the protuberance is covered by a simple epithelium, with numerous hair-like papillae similar to those in Perameles (SCIENCE, i. **523**). In all four of the gustatory pits is a ridge projecting from the base, and bearing the taste-bulbs under its surface. In the specimen examined the left posterior pit was (abnormally?) rudimentary. Each bulb lies in a papilla, which penetrates far into the epithelium, which is also pierced by a pore over each bulb. The terminal organ is the axial body (cell?) of the bulb, appended to the end of the nerve-fibre. The surrounding cells are sub-epithelial, and form a sheath around the axial body. This observation confirms the author's theory that the taste-bulbs arose as papillary sub-epithelial structures. The value of this theory was asserted in the abstract of the author's previous paper. Numerous serous glands open around the base of the gustatory ridges. Such glands appear to be very generally associated with the organs of taste. Around the pits are smooth muscles, which (at least, around the mouths of the anterior pair) distinctly form sphincters.

The gustatory ridges of Ornithorhynchus, if they rose to the surface and were shortened, would become like circumvallate papillae; if they remained long and became furrowed, they would resemble the foliate areas of rodents: hence Poulton considers that the ridges represent a primitive form from which both the principal types of elevated gustatory areas in mammals may have been derived. — (*Quart. journ. micr. sc.*, xxiii. 453.) C. S. M. [**461**

Lymphatic and blood vessels. — Dogiel describes the lymph-vessels of the renal capsule and gall-bladder of the dog. In the renal capsule two layers can be distinguished, the outer of which alone is vascular. Prof. Arnstein, in an appended note, states that the rudimentary homologue of the fatty envelope of other species is included in this outer layer. The lymphatics form a coarse network of large vessels, which are accompanied by blood-vessels, and spun over by a loose network of very fine capillaries, while in the meshes of the lymphatic network is an abundant collection of anastomosing blood-capillaries. Each mesh thus forms a vascular island. By this distribution the lymph-vessels are brought as far as possible from the blood-vessels, — an arrangement which is attained in various ways in other parts, and which is important for the perfect drainage of the tissues.

In the gall-bladder there are three sets of lymphatics, — a net for the mucosa, one for the muscularis, and a third for the serosa externa. These are all described and figured. — (*Arch. mikr. anat.*, xxii. 608.) C. S. M. [**462**

(*Man.*)

Branchial arches and clefts. — Cadiat publishes an article destined to serve as "an introduction to the history of the formation of the face and its different cavities: of the neck, thorax, pharynx, and lung;" also the peritoneum, pleurae, pericardium, respiratory cavities: and gills of fishes (!) The reporter regrets to have found in the article nothing but redescriptions of the pharyngeal apparatus of the embryo chick. As the facts have been familiar to embryologists for very many years, the object of the publication is not obvious. — (*Robin's journ. anat. physiol.*, xix. 38.) C. S. M. [**463**

Laws of dentition. — Magitot publishes a somewhat lengthy essay on this subject; but the article hardly contains original matter, and is written from a point of view too exclusively that of the dentist. — (*Robin's journ. anat. physiol.*, xix. 59.) C. S. M. [**464**

ANTHROPOLOGY.

Ancient Orkney-Islanders. — Dr. J. G. Garson has made a very thorough study of the crania and other remains of the ancient inhabitants of the Orkney Islands. His paper takes up in detail their dwellings, stature, limb-bones, and skulls, the last named with great detail, and expresses his results in elaborate tables. The author comes to the following conclusions: —

It is evident that in this series of skulls we have not a single pure race to deal with, but two distinct races, which have existed at probably three different periods. The first and apparently the ruder race

seems to be the long-headed people, represented by the skulls from Skerrabrae and Saverough. We have next the round-headed race, which probably occupied the country for a considerable time. The time when these races inhabited the islands is quite uncertain. The abundance of deer-horn at Skerrabrae indicates the presence of these animals, which would probably be associated with forests. When the Romans visited the Orkneys, their historians tell us that there were no forests there. Also the absence of metals, and the rude implements, point to a people in the unpolished stone period. Some evidence is also found in the washing-away of the coast. The round-headed race seems to have lived just before or at the beginning of the bronze period. — (*Journ. anthrop. inst.*, xiii. 54.) J. W. P. [465

The Jutish type of face. — The peculiarity of the Jutish features consists in the form of the nose and mouth. There is no nasal point or tip, properly so called, as in the Danish, Cymric, and Iberian face, and their inter-crosses; nor is there any approach to the slight bulb which distinguishes the Saxon. The end of the nose is rounded off somewhat sharply, and the septum descends considerably below the line of the nostrils. The lips are less moulded or formed, and resemble the Iberian rather than the Saxon type. The lower lip, more particularly, is thick and deep. Mr. J. Park Harrison has been searching for specimens of the Jutish countenance in Kent, Isle of Wight, and in South Hants. — (*Journ. anthrop. inst.*, xiii. 86.) J. W. P. [466

Egyptian mechanical methods. — Petrie, who is the author of a treatise on ancient metrology, has lately turned his attention to ancient Egyptian processes. Though much labor has been bestowed on the literary remains of Egypt and the description of monuments, little attention has been given to finding out the tools and methods by which their results were reached. The first conclusion to which Mr. Petrie comes, is that the stone-cutting was performed by means of graving-points far harder than the material to be cut. These points were bedded in a basis of bronze; and in boring, the cutting action was not by grinding with a powder, as in a lapidary's wheel, but by graving with a fixed point, as in a planing-machine. From discovering spiral grooves in diorite and granite, at least $\frac{1}{100}$ of an inch in depth, the author supposes that an instrument was used of sufficient hardness to penetrate the material that far at a single turn. In this, however, he was corrected by Mr. Evans. The simplest tool used was a straight bronze saw set with jewels; but there is proof of one circular saw which must have been $6\frac{1}{2}$ inches in diameter. For hollowing the insides of stone objects, the inventive genius of the fourth dynasty exactly anticipated modern devices by adopting tubular drills varying from $\frac{24}{100}$ of an inch in diameter and $\frac{2}{100}$ of an inch in thickness, to 18 inches in diameter. Other drills, not tubular, were used for small holes, one measuring $1\frac{2}{10}$ inches long and $\frac{8}{100}$ of an inch in diameter. But this is surpassed by the Uaupes of South America, who drill holes in rock-crystal by the rotation of a pointed leaf-shoot of plantain, worked with sand and water. The writer of this note has seen, in Porto Rico, stone beads of the hardest material, 2 inches long, bored longitudinally with an orifice $\frac{1}{16}$ of an inch in diameter. The Egyptians understood rotating both the tool and the work. For the finishing of vases, a hook-tool must have been used; but the early Egyptians were familiar, not only with lathes and jewel-turning tools, but with mechanical tool-rests, and sweeping regular arcs in cutting. In addition to the tools mentioned, are to be noticed those for dressing out drilled cores, stone hammering and smoothing, saws with curved blades, mallets, chisels, adzes, and bow-drills. For marking and indicating the plane of the stone, red-ochre paint was used in a variety of ways, well studied out by Mr. Petrie. Rock-excavation, both for saving the stone and for the creation of vaults and chambers, was altogether an affair of drilling. Granite bowlders were utilized in the pyramids, but the best stones were taken from quarries. The method of handling these immense masses is not known. Mr. Petrie concludes with a sensible remark upon the oft-alleged inhumanity of the pyramid and temple builders. To require a man every six years to serve upon the public works, during the season when he could do nothing else, would certainly not be a great hardship. — (*Journ. anthrop. inst.*, xiii. 88.) O. T. M. [467

Navajo mythology. — The Navajos, says Dr. Washington Matthews, speak of five worlds, in four of which our fathers lived ere reaching this. In the first world were the first man, the first woman, and the coyote. In the second world were two other men, the sun and the moon people, and at the four corners were the people of the cardinal points. An amour of the sun with first woman led to the ascent of all to the third world, where they found another race of people living in the mountains. Here coyote stole the children of Tieholtsodi (he who seizes you in the sea), who caused a deluge to cover the earth. The emigrants ascended to the fourth world through the growth of a hollow reed. Here a disturbance arose concerning the relative value of men and women, which resulted in favor of the men. After the lapse of some years they were pursued hither by the giant looking for his cubs, which coyote still concealed. The floods rose, and they were let up into world five by the badger and the locust. The cubs were thrown down to the giant, and the waters subsided. Then came the fitting-up of the world for their abode. At this point of the myth are several very pretty origin-stories about the dry land, the mountains, the sun and moon, the making of climate, etc. Here is one. "On the fifth day the sun arose, climbed to the zenith, and stopped. Coyote said, 'The sun stops because he has not been paid: he demands a human life for every day that he labors.' At length a woman, the wife of a great chief, ceased to breathe, and grew cold. The sun travelled down the western sky, and passed behind the western mountain." There is a similar moon myth. Then follow the confusion of tongues, the making of the stars, the lengthening of the seasons, the forming of snow, the planting of corn. At this juncture, on account of the wickedness of mankind, first woman

made the five great destroyers, — Yeitso, Tsinahale, Delgeth, Tseta-holtsil-tahli, and Binaye. She also took to rear a foundling girl, Estsanatlehi. The latter, impregnated by the sun, brought forth twins, who, by the aid of their father, slay the five great destroyers of mankind. The stories of these Herculean labors is charmingly told, and is full of theories about the causes of familiar things, such as the birds, the shunning of a mother-in-law. The mother of the giants repeopled the world, built pueblos, established the gentes. The giants may still be seen in the waters of the San Juan, and the mother continues to send to the Navajos the snow, the spring thaw, the soft rain, the corn, and the green grass. — (*Amer. antiq.*, v. 207–224.) J. W. P. [468

EARLY INSTITUTIONS.

A history of guilds. — A Mr. Waterford, barrister-at-law, is writing a history of English guilds. He has already described the aims and purposes of the guilds. He has also described their history, and the history of public opinion and legislation regarding them. He is now taking up their geographical distribution in the different counties and towns. Extracts are given from the records. The work promises to be one of interest and value. The history of trade unions is a subject which deserves especial attention in these days. It is a very difficult subject, however, and by no means mastered as yet. Contributions towards its elucidation are therefore very welcome. — (*Antiq. mag.*) D. W. R. [469

The Merovingian grants of immunity. — These grants, a chief source of feudalism, are not considered by M. Fustel de Coulanges to have been confined to ecclesiastics, as is usually assumed. The grants to ecclesiastics were no doubt the most numerous, and the documents are at any rate better preserved; but lay proprietors received precisely the same powers. The essential feature of the grant he regards as the exclusion of the public officials from the territory of the immunity, whether for judicial, fiscal, or military purposes. Exemption from financial burdens was a natural but not necessary nor universal consequence. In this he agrees with Heusler, differing from him, however, in holding that the grantee was absolutely removed from all relation to the public official, the count, and stood only under the king; while Heusler considers that he only became an intermediary between his tenants and the count. The result of these grants was to completely break up the administrative system of the Frank empire by removing great stretches of territory from the authority of the public official, and practically to make the proprietor an irresponsible master over his free tenants as well as his serfs. The same effects followed the grants of *mundiburdium*, or protection, by which the proprietor entered into a purely personal relation to the king, ceasing to be under the authority of the count. This substitution of a personal relation for the political one of subject and ruler is also of the essence of feudalism. It is not possible to decide whether the grants of immunity or those of *mundiburdium* were the earlier. Immunity, however, applying primarily to the land, necessarily included the personal relation; while *mundiburdium*, by an equal necessity, led to immunity. The article is written in the interesting style and with the characteristic lucidity of the author, and forms a most important contribution to the study of the origin of feudalism. — (*Rev. hist.*, July–October.) W. F. A. [470

NOTES AND NEWS.

A CABLE despatch was received Nov. 30, at Harvard college observatory, announcing the discovery of a small planet by Palisa at Vienna. Its position Nov. 28, 13 h. 20 m., Greenwich time, was, right ascension, 3 h. 19 m. 14 s.; declination, north, 15° 52′ 17″; daily motion in right ascension, —48″; in declination, nothing. It is of the twelfth magnitude. The planet was readily identified at Harvard college observatory, and was observed by Mr. Wendell as follows: Nov. 30, 9 h. 30 m., Cambridge time; right ascension, 3 h. 17 m. 27 s.; declination, north, 15° 51.1′.

— While the revenue steamer Corwin was cruising on the coast of Alaska and in the north-west Arctic Ocean in 1881, Dr. Irving C. Rosse, her medical officer, found leisure to prepare a series of medical and anthropological notes, which have just been published by the Treasury department. The medical notes, although they exhibit the mind of a keen observer, are rather technical than racial: there is a short chapter on medical and surgical subjects, however, p. 25. The author holds that the marks of distinction between the Eskimo and the Chukchi are not very plain. At Kotzebue Sound many of the natives are tall and of a commanding appearance. Uniformity of features, so commonly attributed to the Eskimo, has frequent exceptions; many of the natives exhibiting countenances of Chinese, Jewish, Milesian, or even Mulatto cast. The experiments of strength and agility in rowing, racing, throwing stones, and lifting, given on p. 29, are valuable contributions to anthropometry. The popular notion regarding the great appetite of the Eskimo is one of the current fallacies, according to Dr. Rosse. As to the commercial connection between the two continents, natives cross and recross Bering Strait to-day on the ice and in primitive skin canoes, which have not been improved since the days of prehistoric man. With a view to finding out whether any linguistic affinity existed between the Japanese and the Eskimo, Dr. Rosse caused several Japanese boys employed on the Corwin to talk on numerous occasions to the natives, both on the American and Asiatic coast; but in every instance they were unable to understand the Eskimo, and assured him that they could not detect a single word that bore any resemblance to words in their own language. The language varies greatly from point to point. The interpreter taken at St. Michaels could with difficulty understand the natives of Point Barrow, while at St. Lawrence Island and on the Asiatic side he could understand nothing at all. The author happily likens spoken languages to those species of animals which are still in a plastic condition and are undergoing farther development. The Eskimo tongue