must be undertaken deliberately, planned by human intelligence, and achieved through human effort.

The author discusses, in a broad and philosophic manner, a great body of questions in which civilized man is deeply interested. He has therefore written for a wide reading; and happily his style, in its essential characteristics, will not repel those to whom it is presented.

GEOLOGY OF SOUTHERN PENNSYLVANIA.

Second geological survey of Pennsylvania. — Report of progress T². — The geology of Bedford and Fulton counties. By J. J. STEVENSON. Harrisburg, *Survey*, 1882. 15+382 p., 2 maps. 8°.

PROFESSOR STEVENSON has made a detailed survey of the district, which has led to but few material changes in the map of the first survey. The descriptions of the structural geology are careful, plain, and easily understood; and the second part of the report, consisting of a day-book of observations along the roads, with reference to outcrops, mines, and quarries, will doubtless prove very useful.

It is well that Professor Stevenson has not completely neglected paleontology in his descriptions of the various formations; but this feature of his report is capable of much improvement, only about sixty species being cited as occurring in a section that extends from the upper coal-measures to the calciferous. The value of his determinations, and the scientific interest of his work, would have been much increased, if care had been taken to collect and determine the fossils found in each group, and lists of them published, together with the localities in which they occurred. It is not meant to infer that Professor Stevenson's determinations are incorrect, but simply that he gives no evidence in support of them. For instance: he says, "Some of these layers contain fossils which are *distinctly Chemung*, none whatever of Portage type being present; but, owing to the weathering, the forms can be identified only generically." The writer does not think he is alone in doubting whether there are any fossils which are distinctively Chemung. At any rate, it would be interesting to know what these genera are. He mentions no fossils in his Hudson River group, and in the Trenton mentions only three forms, which are also very common at the top of the lower Silurian. The director of the survey, in his letter of transmittal, makes the following curious remark, which seems to indicate a peculiar conception of the objects of paleontology. He says, "Paleontologists will find it an easy task to copy out from the index, separately, the whole list of fossil names, and arrange them afterwards to suit their own purposes." Certainly, paleontologists do not want to arrange fossils to suit themselves, but to find out how nature has arranged them. The two maps accompanying the report are of very indifferent quality, as it is difficult, especially over the Broad Top area, to follow on the maps the descriptions in the text. Mr. Stevenson disclaims responsibility for several things in them, which may account for the discrepancies between the text and the maps. Professor Lesley seems to think that the maps may be easily followed by a person familiar with the country; but the maps should have been constructed so that others, also, may be able to understand them. He seems to apply preconceived notions of orography, whether it agrees with the geology as studied in the field or not; and, if the responsibility of preparing the maps rested with the same person who has done the field-work and prepared the text, the result would probably be more intelligible. Mr. Stevenson mentions a bed 195 feet above the Pittsburg coal. This would apparently belong to the upper series, considered Permian in other reports of the survey; but this does not appear to be represented anywhere on the map.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

ASTRONOMY.

Eclipses of Jupiter's satellites. — Cornu proposes to observe these eclipses photometrically, comparing the light of the satellite during the time while it is entering or emerging from the shadow with that of an artificial satellite visible in the same field, and made to vary in brightness at pleasure by an adjustable 'cat's eye,' so called. He shows that the moment when the light of the satellite is *half* that of its unobscured condition is the one which can be most accurately determined, and urges that the photometric observations should be so arranged as to give an automatic record. Admiral Mouchez has authorized the application of the necessary apparatus to one of the large equatorials of the Paris observatory.

M. Cornu does not seem to be aware that a very similar, but really more precise, method of observa-

tion has been in use at the Harvard college observatory for the past two years. Prof. Pickering, however, very wisely prefers to compare the eclipsing satellite with one of the other satellites, or with an image of the planet, rather than with an artificial star; and he uses polarization apparatus instead of a cat's eye to equalize the brightness of the objects compared. — (*Comptes rendus*, June 4.) C. A. Y. [40

MATHEMATICS.

Theory of functions. — In a series of three memoirs, M. Appell has reproduced in a more extended form a number of investigations which he has recently communicated to the French academy of sciences. The first of the three memoirs treats of uniform functions of an analytical point (x, y); the term 'analytical point' meaning simply the system of values of (x, y) formed by any arbitrary value of x and the, say, m corresponding values of y. The first section of the memoir contains three theorems concerning the development in rational fractions of such functions. In the second section a uniform function is defined, and also the poles and essential singular points (*points singuliers essentiels*, Weierstrass' *wesentliche singuläre stelle*). Functions with a finite number of singular points are then taken up, and a generalization of a known theorem concerning the coefficients in the development of a uniform function is given: viz., if $F(x, y)$ is a uniform function of the analytical point (x, y), having a finite number of singular points (a_i, b_i), and if R_i are the residues relatively to these points; if, further, in a certain region of the analytical point $\left(x = \infty, \lim \frac{y}{x} = C_k\right)$, we have $F(x, y) = \sum_{\nu=-\infty}^{\nu=\infty} A_\nu^{(k)} \frac{1}{x^\nu}$, — then we have the relation

$$A_1^{(1)} + A_1^{(2)} + \ldots + A_1^{(m)} = R_1 + R_2 + \ldots + R_n.$$

In this, i has all values from 1 up to n, and k has all values from 1 up to m; m denoting the number of values of y corresponding to a given value of x. After a brief review of some of the properties of the Abelian integrals, the author gives a generalization of a holomorphic function of x in the interior of a circle whose centre is a in terms of ascending powers of $(x - a)$. The subject of functions with an infinite number of singular points is then taken up, and a generalization is first given of Mittag-Zeffler's theorem concerning these functions; viz., if a series of distinct analytical points $(a_1, b_1) \ldots (a_\nu, b_\nu) \ldots$ are such that $\lim (a_\nu, b_\nu) = (a\ b)$ for $\nu = \infty$, and if $F_1(x, y), F_2(x, y) \ldots F_\nu(x, y)$ is a series of rational functions of x and y which become infinite only in the two points (a_ν, b_ν) and (a, b) respectively, then there exists a uniform function $\Phi(x, y)$ having only the point (a, b) as an essential singular point, and admitting as poles the points (a_ν, b_ν) in such a manner that the difference $\Phi(x, y) - F_\nu(x, y)$ is regular in the point (a_ν, b_ν).

The second memoir by M. Appell is a continuation of the first. In it he considers the decomposition into prime factors of a uniform function of an analytical point (x, y) having only one essential singular point, and also gives a theory of doubly periodic functions with essential singular points. The author examines, first, functions having in a parallelogram of periods a finite number of singular points, and gives an interesting theorem; viz., the sum of the residues of $F(u)$ relative to the singular points situated in a given parallelogram of periods is equal to zero. A general expression is then obtained for a doubly periodic uniform function $F(u)$ having in a given parallelogram of periods only one singular point.

In the third memoir, M. Appell considers the development of functions in series inside an area bounded by arcs of circles. These three memoirs by M. Appell, taken with a memoir by M. Poincaré, which precedes them, and which has already been referred to in these pages, constitute a very valuable series of papers on the modern theory of functions. — (*Acta math.*, i. no. 2.) T. C. [41

PHYSICS.

Acoustics.

Upper limit of audibility. — Pauchon and Bertrand have investigated the question of the effect of the intensity of the sound upon this limit. A siren blown by steam with pressures varying from 0.5 to 1.5 atmospheres gave from 24,000 to 30,000 double vibrations as a limit; but, with certain modifications and a higher pressure (2½ atmospheres), the most acute sound that could be produced by the instrument, due to 36,000 vibrations, was still heard. Metallic rods of different lengths, set into longitudinal vibration in the usual manner, gave the following results: 1. The length of the rod giving the highest perceptible sound is independent of its diameter; 2. For steel, copper, and silver, the lengths are proportional to the velocity of sound in those media. These results disagree with those reached with the siren. The authors find, however, that, if the ear is aided by a resonating trumpet, the limit is slightly raised; that the limit is raised with substances like rosin, producing the most energetic friction; and that the sound, even when too high to affect the ear, still acts on a sensitive flame.

These results of Pauchon with the siren agree with the fact observed several years since by Dr. H. P. Bowditch of Boston, that, with a König's bar of exceedingly large diameter, the limit of audibility is higher than with one of the ordinary size. — (*Comptes rendus*, April 9.) C. R. C. [42

Production of whispered vowels. — Lefort calls attention to the wide range of whispered vowels that can be artificially produced by blowing across resonant tubes or spheres: *ou*, *o* (closed), *o* (open), *u*, *eu*, *e*, *i*, *é* (closed), *é* (open), — all being produced as the capacity of the resonator is diminished. By diminishing the length of an open tube the vowels *â*, *à*, *e*, *eu*, *u*, *è*, *é*, *i*, are successively heard, while *ou*, *ô*, *o*, are obtained by closing the upper end of the tube more or less. — (*Comptes rendus*, April 23.) C. R. C. [43

Transmission of sounds by gases. — Neyreneuf has studied the relative transmission of sound

through air, carbonic oxide, carbonic acid, and illuminating-gas. The sound is transmitted through a tube two metres long, containing the gas experimented upon, and the intensity is studied by noticing the distance at which a sensitive flame ceases to be acted upon by it. He finds that air and carbonic oxide have the same transmissive power, air and illuminating-gas give very variable results, and carbonic acid has a much greater transmissive power than air. A table of results for air and carbonic acid is given. — (*Comptes rendus*, April 30.) C. R. C. [44

Experimental demonstration of velocity of sound. — Griveaux arranges a glass tube and a bar of pine wood of equal length, so that the passage of a pulse through either the column of air in the tube or the wooden rod shall move one of two light screws, and so break an electric contact. The current from a battery is divided, and passes into the two coils of a differential galvanometer; the light screw resting on the end of the rod being placed in one circuit, and a similar screw, resting on a membrane closing the end of the tube, in the other. The resistances are so arranged that the needle of the differential galvanometer remains normally undeflected. If a sound is produced by striking a drum, the needle of the galvanometer is deflected in such a direction as to show that the contact is broken by the movement of that screw resting on the end of the wooden rod, thus illustrating the greater velocity of the sound-wave in wood than in air. — (*Journ. phys.*, May.) C. R. C. [45

ENGINEERING.

Electric stop for steam-engines. — Mr. Tate, an English engineer, has combined the Leclanché battery, an electro-magnet, an auxiliary steam-cylinder, and a stop, to the closing of the stop-valve of the steam-engine, if its sudden stoppage should become necessary. It has been applied by Mr. Tate to the driving-engines of his large woollen-mills in Bradford. The mechanism consists of a weighted suspension rod attached to the stop-valve by a bracket, and actuated by a small steam-cylinder, the piston of which is supplied with steam through a valve which is opened by the action of the electro-magnet and the weighted rod. The movement of this auxiliary engine shuts the stop-valve of the engine in a small fraction of the time usually required to close it by hand. The wires of the battery are carried to various parts of the mill, so that the engine can be 'shut down' at any instant, and from any one of a number of promptly accessible points. This arrangement is proposed to be attached to the engines of steam-vessels, the wires being led to the bridge, and to other parts of the vessel where the officers can easily reach the button. — (*London times*, Oct. 21.) R. H. T. [46

Forms of steamers. — Two vessels recently built by the Messrs. J. & G. Thompson have been compared to determine their relative economy as a means of transportation as affected by a considerable difference in proportions. One was 390 feet long, 42 feet beam, and drew 18 feet of water : the second was 375 by 45 by 20 feet. The longer vessel had less fine ends than the broader ship. The former required 5,100-horse power to drive her 15 knots an hour, while the latter only demanded 3,900. At 13 knots, the power demanded was the same for both ; but at higher speeds the difference became greater and greater, and more and more in favor of the shorter, broader, but finer ended vessel. The gain to be expected from giving ships greater beam, and, at the same time, finer ends, is expected to be observed in larger and faster vessels. — (*Mechanics*, May 26.) R. H. T. [47

Efficiency of the steam-engine. — Professor R. R. Werner, of the Technical high school at Darmstadt, publishes a paper describing his trial of a compound engine driving a mill in Augsburg. The engine has an indicated power of 132 horses. The cylinders have a proportion of 2.75 to 1 ; they are steam-jacketed, as is the intermediate reservoir ; the ratio of expansion is 14. The boilers carry a pressure of about 7 atmospheres, and the steam supplied contains 3 per cent water. The steam-jackets condense about 11 per cent of the steam, and the cylinders demand about 7 kilograms (15.4 lbs.) of steam per horse-power and per hour, beside that condensed in the jackets. This is about the amount required as a minimum in the best-known English and American engines. In this country, a very similar figure has been reached by Corliss and by Leavitt. — (*Zeitschr. ver. deutsch. ing.*, May.) R. H. T. [48

'Compound' locomotives. — M. Mallet communicates to the French society of engineers a note from M. Borodine, giving the results of experiments to determine the relative economy of the simple and the compound system of engine for locomotives. The engines experimented with were those designed for the railway from Bayonne to Biarritz by M. Mallet. The trials extended over a considerable period of time, and the comparisons were made fairly complete. The result showed the compound system to have an economy of from ten to twenty per cent, according to the conditions under which they are carried out. The variation in the ratio of expansion is very greatly restricted in the compound engine. The use of the steam-jackets with which the engines were provided did not prove to be of advantage. The expenditure of steam was greater when they were in use than when they were shut off. — (*Mem. soc. ing. civ.*) R. H. T. [49

CHEMISTRY.

(*Organic.*)

Compounds of benzotrichloride with phenols and phenylamines. — When a mixture of one molecule of benzotrichloride and two molecules of phenol is heated gently, O. Döbner finds that the following reaction takes place: —

$$C_6H_5CCl_3 + 2\,C_6H_5OH = C_6H_5CCl\begin{matrix}C_6H_4OH\\C_6H_4OH\end{matrix} + 2\,HCl.$$

The remaining chlorine atom is replaced by a hydroxyl group when the product is heated with water, forming dioxytriphenylcarbinol, —

$$(OH)\diagdown\!\!\diagup C\diagup\!\!\diagdown\begin{matrix}C_6H_5OH\\C_6H_5OH\end{matrix}$$
$$C_6H_5$$

By reduction, dioxytriphenylmethan

$$\begin{pmatrix} H & C_6H_5OH \\ C & \\ C_6H_5 & C_6H_5OH \end{pmatrix}$$

is formed. An analogous reaction takes place if resorcine is used instead of phenol. The resulting resorcine benzein, by reduction, gives tetraoxytriphenylmethan, —

$$C_6H_5CH \quad CH\begin{matrix} C_6H_3(OH)_2 \\ C_6H_3(OH)_2 \end{matrix}.$$

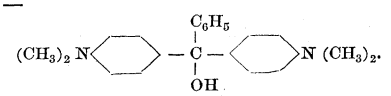
With primary aromatic amines, benzotrichloride united readily. When added to a mixture of dimethylaniline and zinc chloride, it formed malachite green, —

$$\begin{matrix} (OH) & C_6H_4N(CH_3)_2 \\ C & \\ C_6H_5 & C_6H_4N(CH_3)_2 \end{matrix}.$$

By reduction, this substance gave the corresponding leuko-base, —

$$\begin{matrix} H & C_6H_4N(CH_3)_2 \\ C & \\ C_6H_5 & C_6H_4N(CH_3)_2 \end{matrix}.$$

The base malachite green was easily decomposed, when heated with hydrochloric acid, into dimethylamine and benzoyldimethylaniline. This reaction points to the following structure for malachite green: —



The action of benzoyl trichloride upon hydroxyl or amido compounds seems, therefore, to be normal to the para position with respect to the amido or the hydroxyl group. — (*Ann. chem.*, ccxvii. 223.) C. F. M. [50

GEOLOGY.

Lithology.

The Potsdam and St. Peters sandstones. — The surface induration of the friable Potsdam and St. Peters sandstones, as determined by macroscopic observations in 1871-73, was brought to the notice of the readers of SCIENCE some time ago (i. 146), while a recent interesting paper by Prof. R. D. Irving gives the results of his microscopic investigations on the same subject. Irving finds, as Sorby had previously, that ordinary quartz grains, formerly rounded and worn, have been built out and supplied with crystal facets from silica deposited later on them. He finds that the induration of the above-mentioned sandstones arises from the deposition of intersticial quartz cementing the grains. The deposited quartz is found to be optically oriented, the same as the enclosed grain, which is distinguished by its cloudiness and worn surface, and frequently by a coating of oxide of iron upon it.

To the deposition of quartz upon worn quartz grains is ascribed the occurrence of quartz crystals in the Potsdam sandstone described in 1882 by Rev. A. A. Young. Credit should have been given by both Irving and Young to Rev. John Murrish for calling attention to the occurrence of quartz crystals in Potsdam sandstone in 1870–72 (*Bull. Wisc. acad.*, ii. 32), especially since Murrish's observations were discredited at the time.

All quartz crystals in sandstone have not this derivation, as the writer showed for the Lake Superior sandstone in 1880, the crystals of which come from old eruptive rocks owing to the decomposition of the matrix. It is pleasant to find my earlier observations on the surface induration of the Wisconsin sandstones, and the formation in them of quartz crystals, sustained by the much more complete and valuable work of Irving, made, as his was, without any knowledge of mine.

Irving holds that the quartz deposited may come from the action of water on the occasional felspar particles in the rock, although sometimes from an external source. He further regards the induration of quartzites and quartz schists as caused by the same deposition of intersticial quartz. — (*Amer. journ. sc.*, xxv. 401.) M. E. W. [51

Antase as an alteration product of titanite. — The titanite in a biotite amphibole granite from the Troad was found by Mr. J. S. Diller to be replaced by a light wine-yellow to honey-yellow mineral, showing, under the microscope, quadratic and rhombic sections. The former are isotropic, and have a well-marked cleavage parallel to their sides; the latter are strongly doubly refracting, extinguish parallel to the diagonal, and have one cleavage parallel to the short diagonal and another to the edges. In order to isolate the substance, the finely pulverized rock was separated into two portions, one of lighter and the other of heavier specific gravity than 2.72, by means of the potassium-iodine-mercury solution. The yellow mineral was found in the second portion, which contained also iron ore, zircon, and apatite. The ore was removed by the electro-magnet, and the apatite by nitric acid. By means of the cadmium-boron-tungstate solution it was shown that the yellow mineral had a specific gravity between 3.6 and 4.5. Some grains were picked out, and found to be insoluble in hot aqua regia.

The mixed zircon and yellow mineral powder gave a reaction for titanium, while the pure zircon would not: hence it was inferred that the mineral contained titanium. Its angles were found to be 98° 24′ and 136° 16′, while the corresponding ones of antase are 97° 51′ and 136° 36′. From its optical, chemical, and crystallographic characters, it was then inferred that the yellow mineral was antase. — (*Neues jahrb. miner.*, 1883.) M. E. W. [52

GEOGRAPHY.

(*South America.*)

The Puno railroad, Peru. — Dr. R. Copeland gives a readable account of a journey over this remarkable railroad from its beginning at Mollendo on the coast, through Arequipa, to Puno on Lake Titicaca, and of his farther travels by boat on the lake, and by stage, beyond to La Paz in Bolivia. The features that attracted his special attention were the deep, narrow valleys followed by the road in its sharp windings while ascending from one pampa level to the next; the broad, flat, barren pampas at great and greater altitudes; and the superb views of the volcanic peaks and ranges of the Cordillera, — Misti,

Chaycam, and Pichupichu, eighteen to nineteen thousand feet in height. On the pampa of La Joya (4,100 feet) he saw countless hillocks of pure, sharp sand (*médanos*), in half-moon form, with the curve to the west or windward (see SCIENCE, i. 488). A mirage gave these white hills the appearance of drift-ice in an arctic sea. — (*Deutsch. geogr. blätter*, vi. 1883, 105.) W. M. D. [53

Colombia. — R. B. White, for several years resident in Colombia, and a companion of Stübel and Reiss in some of their expeditions, furnishes a summary account of the more attractive parts of this republic, and of its productions, and chance of development. Several of the rivers that flow northward between parallel ranges of the Cordillera are navigable for small steamers for many miles into the interior, opening districts well adapted to agriculture, and well supplied with timber and mineral products. Above the low plains the climate is healthy. A good share of the world's platinum supply is obtained from the upper valley of the San Juan, and gold occurs in profitable quantity in many of the river-gravels. Brief mention is made of an ascent of the snowy volcano, Puracé; and the extensive view from the Cerro Munchique, nearly ten thousand feet high, west of Popayan, is highly praised. The geological observations on the origin of mountain and valley form do not carry conviction, and the frequent mention of volcanic upheaval and valleys of fracture remind one of the theories of fifty years ago. — (*Proc. roy. geogr. soc.*, v. 1883, 249.) W. M. D. [54

(*Africa.*)

The Kongo. — Dr. Pechuel-Loesche, a member of the German-African expedition to Loango in 1873-76, and later in charge at Stanley Pool while Stanley went to Europe, recently read an address on the Kongo and the neighboring mountains of western Africa before the German geographical congress at Frankfort. The river is remarkable for the rapids all along its course, and especially in its narrow passage through the mountains below Stanley Pool, where it falls nine hundred and twenty-eight feet in some three hundred and forty miles. Of the several falls in this part of its course, only one is vertical, that of Isangila, with a height of sixteen feet. There are two periods of high water, with a rise of twenty feet, when the falls disappear in a uniform rushing flow. The water rises from September to January, falls from January to March, attains its greatest height in the rainy months (April and May), and its lowest level in July and August. Many of the mountain brooks have cut deep channels, and join the main stream on a level; but some of the larger rivers of the interior, flowing over horizontal rocks, have not cut their way so deeply, and, on joining the Kongo, form cataracts. Thus the Luenga falls three hundred feet, and the Luvubi five hundred feet. (This, if correctly reported, is certainly a very abnormal arrangement.) The mountain belt is about two hundred miles wide, rising from a sloping plain at about one thousand feet to rounded and monotonous elevations with a maximum of three thousand feet. The higher land is grassy, with small trees and apparently leafless bushes: the more luxuriant growth of lofty trees and palms is hidden in the valleys. It is these deep and steep-sided valleys that make the rather open upland difficult to traverse. Near the river, the natives have destroyed all the forest-trees, either by burning or cutting. The villages are built on high and bare summits. Dr. Pechuel-Loesche regarded the Makoko (ruler of the stream), with whom de Brazza had made a treaty two years ago (SCIENCE, i. 79), as a local ruler of no general authority. The Makoko's son had reported that his father had ceded no land to de Brazza, and that he had no French flag in his possession. There are four Makokos in this region; and none of them has a right of precedence over the others, or any title to be sovereign of the Bateke population of this part of the Kongo. — (*Proc. roy. geogr. soc.*, v. 1883, 286.) W. M. D. [55

The muatiamvo of the southern Kongo basin. — Max Buchner, the fourth European who has been in this region in the last two centuries, spent half a year at the residence of the 'muatiamvo,' or king (SCIENCE, i. 19), and reports on the peculiar form of his government. The kingdom on the southern side of the Kongo basin, the special field of the German-African explorations, includes an area about as large as Germany. Its population can hardly exceed two millions, and its power cannot compare with that of Mtesa's country, farther east, where an army of a hundred thousand men can take the field. Here the army is not more than one thousand strong at the highest; and Buchner says he could go where he chose with fifty European soldiers, if they were not attacked by that more dreaded enemy, the African fever. And yet, through a large part of south-western Africa, the muatiamvo is the greatest native power. The most notable peculiarity of the government consists in the presence of a second high authority besides the muatiamvo, namely, the 'lukokessa,' or queen: she is not the wife of the king, who has some sixty wives of his own, but is free and independent of him, having her own chief consort, the 'shamoana,' and numerous frequently changing husbands of lower order. Buchner traces the origin of this form of government, and gives a list of thirteen muatiamvos, down to Shanana or Naoesh-a-kat, the present king, and describes the different parts of the kingdom and its neighboring states. — (*Deutsche geogr. blätter.*, vi. 1883, 56.) W. M. D. [56

BOTANY.

Pollination of Rutaceae. — Urban has studied the adaptations for fertilization in a considerable number of species of this heterogeneous order, using living material at the Berlin botanic garden. As few of the genera have been previously studied in this respect, a rather full translation of his tabulated summary is given.

I. MONOCLINOUS SPECIES.

A. *With dichogamous (protandrous) flowers.*

1. Nutation successively places the dehiscent anthers at the point which the receptive stigma occupies later.

a. Style undeveloped in the staminate stage.

a. The filaments rise from their original horizontal position, place themselves against the ovary, resume their original position, and again become erect, but without lengthening; petals plane; self-pollination usually impossible: *Ruta.*

β. The originally short, erect filaments lengthen, curve inwards, and again straighten; petals united below in a tube; close pollination possible by gravitation: *Coleonema.*

b. Style developed in the staminate stage, though not always to its full length; so placed as to oppose self-pollination.

÷ Flowers zygomorphic.

a. The stamens which lie on the lower lip successively bend upward, and, after dehiscence, resume their original position; the end of the style likewise bends up at maturity: *Dictamnus.*

β. The stamens, originally bent upwards, successively straighten at maturity, then bend outward; the style, bent downward when young, straightens when the stigma becomes receptive: *Calodendron.*

= Flowers actinomorphic. The filaments successively elongate after dehiscence.

a. In the staminate stage the style is bent horizontally across the ovary; the stamens bend over the pistil successively at maturity, then lengthen, and turn outward between the finally erect petals: *Diosma tenuifolia.*

β. Similar to the last; but the staminodia, and not the petals, become erect, the stamens bending outward but little: *Adenandra.*

γ. After flowering, the style bends outward and downward between the staminodia, the petals remain horizontal, the staminodia lie against the ovary, and, after dehiscence, the fertile stamens resume their original horizontal position: *Barosma.*

2. The stamens nutate but once, and simultaneously. In the staminate stage they are perpendicular, or incline but little toward each other, so that the anthers are in contact at their margin; in the pistillate stage they have bent outward.

a. The anthers fall away when the filaments curve outward: *Ravenia.*

b. Anthers persistent on the bent filaments.

÷ Pollen may fall on the unreceptive stigma, and so effect self-fertilization. Even later this is not impossible, as the wind or gravitation may carry pollen from the reflexed stamens to the mature stigma.

a. In the pistillate stage the style elongates: *Zieria* and *Eriostemon.*

β. With normally developed stigma: *Boronia* (ex parte).

γ. When the style lengthens, the stigma may encounter the anthers of the still erect stamens: *Erythrochiton.*

= The viscidity of the pollen, and the situation of the anthers, prevent self-pollination: *Metrodorea.*

3. The stamens do not nutate at all.

a. Self-pollination possible in the pendant flowers after the separation of the lobes of the stigma: *Correa.*

b. The style is surrounded by staminodia in the first stage; in the second stage spontaneous pollination by neighboring flowers may occur if insect-crossing has not been effected: *Agathosma* (ex parte).

B. *With synacmic flowers.*

1. Self-fertilization impossible.

a. With viscid pollen: *Boronia* (ex parte).

b. The stigma surpassing the anthers: *Triphasia.*

2. Spontaneous self-pollination impossible because of the situation of the filaments, but spontaneous crossing between neighboring flowers favored: *Agathosma* (ex parte).

3. Spontaneous pollination of either sort opposed; crossing by insects inevitable: *Crowea.*

4. Spontaneous close fertilization possible; crossing favored: *Cusparia, Choisya, Skimmia* (ex parte), *Murraya, Citrus.*

II. DICLINOUS SPECIES.

Self-fertilization impossible; crossing necessary: *Ptelea, Skimmia* (ex parte). — (*Jahrbuch bot. gart. Berlin*, ii.) W. T. [57

ZOÖLOGY.

Mollusks.

Credit to an American naturalist. — In an official report by M. Bouchen-Brandely, secretary of the college of France, the author states that he has learned by two years of study that the sexes of the Portuguese oyster are confined to separate individuals ; that after this discovery he conceived that it might be possible to artificially fertilize the eggs of this mollusk ; and that, after two years more of experimenting, this attempt has been successful. Americans will be interested to learn that in 1879 an American naval officer, Lieut. Francis Winslow, who was stationed at Gibraltar for a few weeks, determined the unisexuality of the Portuguese oyster, and reared it from artificially fertilized eggs. His results were printed in the *American naturalist* in 1879 or 1880 ; but, as I have no opportunity for reference at present, I cannot give the exact date. — W. K. B. [58

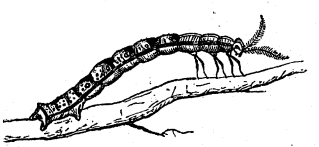
Notes. — In the year-book of the Verein für vaterländische naturkunde in Württemberg, published lately at Stuttgart, Weinland has a paper on the mollusk fauna of the Württembergisch Franken, and Wundt one on the zone of Ammonites transversarius in the Suabian white Jura. —— The second part of the *Quarterly journal of microscopical science* contains a paper by Lankester on the existence of Spengel's olfactory organ and of paired genital ducts in Nautilus pompilius. —— Heude's 'Conchyliologie fluviatile' of Nanking and Central China approaches completion. The ninth and concluding fasciculus will appear during the present year. It is luxuriously illustrated, and printed in large quarto. —— Kuster's continuation of Martini and Chemnitz Conchylien cabinet bids fair to go on, like Tennyson's brook, forever. Lieferung 322 is announced. This work would be much benefited by the total exclusion of the frightful engravings which illustrated the earlier editions and are still pressed into the service. —— J. B. Gassiés, known by his concho-

logical researches in New Caledonia and Southern France, has recently died. — W. H. D. [59

Insects.

American paleozoic insects. — R. D. Lacoe, whose collection of these objects must be one of the largest, if not the largest, in the country, has prepared a list of those hitherto published, including twenty-six genera and forty-eight species of hexapods, five genera and species of arachnids, and nine genera and nineteen species of myriapods, — a total of forty genera and seventy-two species. This embraces, however, three genera and fourteen species still unpublished. The list is purely bibliographical, excepting that it contains careful statements of the place of discovery of the fossils, the name of the finder, and the place of present deposit. About half of the described species have been published within the last five years. — (*Wyom. hist. geol. soc., publ.* 5.) [60

A monstrous caterpillar. — E. H. Jones figures a curious larva of the geometrid moth Melanippe montanata of Europe, which he exhibited at an entomological reunion at the Royal aquarium on March 5. It has the antennae and legs of the perfect insect fully developed, while in other respects a normal larva. It was reared from the egg with a dozen others. Last November this one, then normal, was considerably larger than the rest of the brood,



Abnormal larva of *Melanippe montanata*.

and was noticed as a constant feeder. "On Feb. 15 I was astonished to find that this forward individual had developed the antennae of the imago, but without in any other way altering its larval appearance. For a space of two or three days the antennae were beautifully pectinated, and then the prolegs [thoracic legs ?] of the imago became perfect. . . . Both antennae and legs then gradually shrank and dried until the 20th." — (*Entom.*, xvi. 121.) [61

VERTEBRATES.

Temperature and pulse rate. — By means of his new method of isolating the mammalian heart, Prof. Martin has been able to make an accurate study of the effect of variations of temperature on the rate of beat of the dog's heart when completely separated physiologically from all the rest of the body except the lungs. In the brief abstract of his work which has been published, a short description of the method of operating is given, together with some of the more important results which have been obtained. He finds that in the mammalian heart, as in that of the frog, the rate of beat is gradually increased as the temperature of the blood is raised from 27° to 42° C. The quick pulse of fever can therefore be explained by the direct action of the heated blood on the heart itself, without assuming any special action upon the extrinsic inhibitory or accelerator nerve-centres.

The rate of beat of the heart is found to bear a much more direct relation to the temperature of the blood in the coronary arteries than to the temperature of the blood in the right auricle or ventricle.

An interesting point which comes out of the method of work is, that, although the defibrinated calf's blood used to nourish the heart was repeatedly circulated through the heart and lungs for several hours, it gave no evidence of clotting at the end of an experiment, showing that fibrinogen is not formed in these organs. — (*Proc. roy. soc.*, no. 223, 1883.) W. H. H. [62

Lymphatics of periosteum. — George Hoggan and Frances Hoggan criticise the previous writings on this subject, and give the results of their own studies. They assert that what Budge described as the lymphatics are really capillary blood-vessels. Their own conclusions they summarize as follows: —

1. The lymphatics of the periosteum exist only on the outer surface, or within the outer gelatinous (white fibrous) stratum of the membrane. They never ramify upon the inner or bony surface. 2. When the periosteum is thin, more especially when the animal is old, the whole lymphatic plexus lies free upon the outer surface; but when the periosteum is thick, lymphatic twigs may pass part way through, but they never reach the inner surface. 3. The lymphatics accompany the blood-vessels, as if arranged to drain them. 4. No lymphatics exist on the surface of the great cavities of the bone. "There is thus every reason to believe that the lymphatics never come in contact with the bone itself, and that bone possesses no lymphatics apart from those found within the periosteum, which may be physiologically considered, therefore, as the lymphatics of bone." — (*Journ. anat. physiol.*, xvii. 308.) C. S. M. [63

Fish.

Classification of the Petromyzontids. — The Lampreys have been systematically considered by Gill, and are differentiated into two sub-families: 1. The Petromyzontinae, 'with the suproral lamina median and undivided;' and 2. The Caragolinae, 'with two lateral suproral laminae.' The former embraces six genera, one of which is named for the first time Exomegas, and is intended for the Petromyzon macrostomus of Buenos Aires: the Caragolinae are confined to the southern hemisphere; i.e., Australia and Pacific South America. — (*Proc. U. S. nat. mus.*, iv. 521.) [64

Characters of the Ephippiids. — The family of Ephippiids is distinguished by T. Gill from the Chaetodontids by the bifurcation of the post-temporal bones, and the wide, scaly isthmus extending from the pectoral region to the chin, and separating the branchial apertures.—(*Proc. U. S. nat. mus.*, iv. 557.) [65

Extinct fauna of Idaho and Oregon. — Professor E. D. Cope, referring to the remains of

fishes from the middle valley of the Snake River in Idaho and eastern Oregon, stated that bones collected from sections now dry, but which had formerly been portions of lake-basins in the Oregon district, indicated a close relationship with the fishes now found in the remaining lakes and rivers. The number of species of fishes collected from the Idaho beds amounts to twenty-two. They are all distinct from those found in the Oregon basin, and cannot be identified with existing forms, although, with two exceptions, they belong to existing genera. Four of the families of fishes obtained from these beds are not now found west of the Rocky Mountains, except a single species of one of them (Percidae) in California. Of even greater interest was the fact that this fauna includes representatives of the Cobitidae, — a family of fishes entirely absent in the living fauna of North America. The presence of their remains in the Idaho beds indicates a probable former connection between North America and Asia. The names 'Idaho Lake' and 'Idaho deposits' were proposed for the lake and deposits now first described. The formation is distinct from any previously known, and is older than the Oregon lake-deposit. With the exception of fishes, the remains of but few vertebrates were found in the Idaho beds, although the Oregon deposits are full of the bones of mammals and birds. The means of indicating the exact geological position of these pliocene beds, as compared with those of Europe, was as yet wanting. — (*Acad. nat. sc. Philad.; meeting* June 19.) [66

Reptiles and batrachians.

Spermatozoon of newt. — Dowdeswell describes a very minute barb at the tip of the head of the spermatozoon of the newt: it measures 1.5 μ in breadth by 2 μ in length. He looked for it in other animals, but did not find it. — (*Quart. journ. micr. sc.*, 1883, 336.) C. S. M. [67

Nerves of the frog's palate. — Stirling and Macdonald describe fully the palatine nerves of the frog, their origin, and their general and minute distribution. There is a coarse plexus of medullated fibres and a finer plexus of naked fibres, which last innervate the blood-vessels and the glands, besides forming the ultimate ramifications of the nerves. In the course of the former plexus are scattered unipolar cells, each with a straight and a spiral fibre. There are, besides, many details given. This well illustrated and admirably written paper may be specially commended to histologists engaged in laboratory practice. — (*Journ. anat. physiol.*, xvii. 293.) C. S. M. [68

ANTHROPOLOGY.

Australian class systems. — In the Australian division of the tribe the communes are represented by two primary classes, each of which has a group of totem names, which are chiefly names of things animate or inanimate. The two primary intermarrying classes are over a large part of south-eastern Australia called Eaglehawk and Crow. Each group of totem names is a representation of its primary; and, as a general rule, any one of the group may marry with any other of the complementary group. If the primaries are A and B, and the groups, 1, 2, 3, etc., and i, ii, iii, etc., in certain localities, A 1 must marry B i only, and so on. The next change is the subdivision of A and B as in the Kamilaroi, thus : —

$$\mathrm{A}\left\{\begin{matrix}a\\ \\ a\end{matrix}\right\}\ 1,\ 2,\ 3,\ \text{etc.}$$

$$\mathrm{B}\left\{\begin{matrix}b\\ \\ \beta\end{matrix}\right\}\ \text{i, ii, iii, etc.}$$

The effect of this is to remove the woman of the second generation from the possibility of marrying her father. Were this not so, the law 'A (male) marries B (female)' would permit A to take his daughter to wife, the simpler law forbidding the marriage of brothers and sisters only.

Under the form $a + \alpha = \mathrm{A}$ and $b + \beta = \mathrm{B}$, each half of an original class has marital rights over the women of one particular half of the other class, whose children do not take the class name of the mother, but of the sister class. For example: $a + \beta = b$, who must marry a; and the children of the third generation, by mother right, will be again a and β. Mr. Howitt, who has worked out these systems with great patience, is of the opinion that this subdivision into classes was designed to render impossible those unions which were considered, and are now considered, as deep pollution. He has certainly given the most rational explanation of aversion to mothers-in-law. Under the old *régime* a daughter was of the clan of her mother, and B could marry any A. The law against looking at a mother-in-law, therefore, was to prevent the possibility of marrying her.

Mr. Howitt sums up his labors in the following conclusions : 1. The primary division prevented brother and sister marriage; 2. The secondary, intermarriage between parents and children; 3. The prohibition of intercourse between a woman and her son-in-law prevented connections not to be reached by class rules; 4. These changes were all reformatory in the community. — (*Journ. anthrop. inst.*, xii. 496.) J. W. P. [69

Region of man's evolution. — Mr. W. S. Duncan is the author of a paper upon the probable region of man's evolution, in which the following points are made. Man formed one of a set of families of man-like animals, somewhat similar to the present apes. Since only the lowest members of the Primates have been distributed to the eastern and the western continent, it is probable that the Primates originated within the arctic circle, while the higher groups sprang from the eastern continent : man, therefore, did not originate within the arctic circle, nor in the new world. The Cynopithecidae, since tertiary time, have been spread over nearly the entire eastern continent. The Semnopithecidae have been dispersed over central and western Europe to southern Europe and south-eastern Asia, as far south as Ethiopia. The anthropoid apes have been more circumscribed, but all the genera of living apes are derived from southern Europe and subtropical Asia. As apes existed

in Europe and Asia before they reached the tropics, so we may infer that man existed in Europe and Africa before the low types, the Akkas and the Aetas, occupied tropical Asia and Malasia. The present habitat of the apes is not conducive to change: we must look to some region where apes were compelled to change their food and modes of locomotion. The stoppage of the southern migration by vast sheets of water shut up the apes in temperate regions. The crowding of other animals in the same locations sharpened the intelligence of the precursor of man. Here, then, Mr. Duncan supposes the great conflict and transition from man-like apes to ape-like men took place. — (*Journ. anthrop. inst.*, xii. 513-525.) J. W. P. [70

Tylor's lectures at Oxford. — The concluding portion of Dr. Tylor's lectures on anthropology, delivered in the Oxford museum in February (see i. **1055**), is devoted to the history of the growth of practical art. "In considering the claims of anthropology as a practical means of understanding ourselves, we have to form an opinion how the ideas and arts of any people are to be accounted for as developed from preceding stages. To work out the lines along which the process of organization has actually moved, is a task needing caution. A tribe may have some art which plainly shows progress from a ruder state of things: and yet it may be wrong to suppose this development to have taken place among themselves; it may be an item of higher culture, that they have learned from sight of a more advanced nation. It is essential, in studying even savage and barbaric culture, to allow for borrowing." Illustrations are given by Dr. Tylor of this borrowing, one of which is quite amusing. The later Danish travellers among the Eskimo enter very minutely into the description of the tools and dress of these people, before contact with Europeans, meaning the post-Columbian voyagers; but, unwittingly in many instances, they are describing fashions and forms borrowed from the Skraelling ancestors of these very writers a thousand years ago. Another very important point discussed in the lectures is the possibility of national degradation. Dr. Tylor was the first to discover, after the battle between the advocates of 'degradation' and those of evolution, that both were right, and that a proper view of human history must include both vicissitudes over and over again, and the commingling of both in every degree of complexity. Mr. Tylor gives a succinct account of the formation of the Pitt-Rivers collection, now housed at Oxford, and, in commenting upon the evolution of gesture-speech, pays this tribute to our country: "The labor and expense which anthropologists in the United States are now bestowing on the study of the indigenous tribes contrasts, I am sorry to say, with the indifference shown to such observations in Canada, where the habits of yet more interesting native tribes are allowed to die out without even a record." With very great shrewdness the speaker discussed the subject of magic and the benefit derived from even such useless search as that for the 'lost tribes of Israel.' — (*Nature*, May 17.) J. W. P. [71

The North-American Indians and the horse. — Professor Hovelacque, in his recent work Les races humaines, gives as one of the important characterizations of the North-American Indians the statement that they do not breed horses, leaving it to be inferred from the context that they obtain their supply from wild herds. It may be remarked, that, however general the use of horses is at this time among the Indian tribes of the great plains, an ethnologic distinction based upon any treatment of that animal — a European importation and intrusion — is hardly legitimate. For centuries after the Columbian discovery but a small proportion of the tribes of North America ever saw a horse. The fact that the horse was not known to or used by them in their prehistoric condition constitutes an important element in establishing their position in the ethnic scale, their rise from savagery and barbarism having been retarded by that deprivation. Further, it must be suggested that there is little evidence, apart from the novels of Capt. Mayne Reid and similar authorities, of the existence in North America of herds of wild horses similar to those in South America, sufficiently large to supply the Plains tribes. There were, doubtless, some wild horses, the descendants of those imported by the Spaniards, in a condition to be captured by a past generation; but probably no living Indian has relied upon recruiting his stock from such herds, and his horses have been obtained by the civilized method of purchase or the more convenient process of stealing. The latter expedient has of late years been stopped by the powers of the United States authorities: so some of the tribes have learned to breed from their horses, though as yet the practice is limited by the same want of prudence as is shown in their neglect to provide food and shelter for their ponies. The whole connection of the tribes with the horse simply shows a course of education to a certain extent by a foreign civilization. The statement of M. Hovelacque is therefore as untrue in fact as it is unphilosophic as an ethnic characterization. — J. W. P. [72

EARLY INSTITUTIONS.

Land-holding in South Africa. — Sir H. Bartle Frere gives us an account of the systems of land-tenure among the aboriginal tribes of South Africa, — Bushmen, Hottentots, Kaffirs. Among the Kaffirs, if a man wishes to leave the paternal kraal, he seeks a tract of unoccupied land, and builds a kraal for himself. His wives proceed to cultivate as much land as they please, and the live-stock is turned out to pasture. The settlement descends from father to sons, unless, as often happens, this is prevented by the chief or an enemy. Titles rest simply on force. A man owns the land he occupies as long as he can hold it by his own might, or with the aid of the chief, or the tribe, if this is given. Authority of the chief or elders to resume or recognize possession has not been discovered by Sir Bartle Frere; but he says that it may, perhaps, be discovered by future investigators. — (*Journ. anthrop. inst.*, Feb.) D. W. B. [73