also on Heat; and Mr. Shaw (Emmanuel), on Conservation of Energy.

The followin g are advanced lectures :—Organic Chemistry, Prof. Dewar; Physical Optics, Mr. Trotter (Trinity); Electricity and Magnetism, Mr. Garnett (St. John's).

Practical Chemistry at the University, St. John's, Caius, and Sidney Laboratories. Practical Physics at the Cavendish Laboratory; also advanced demonstrations by Messrs. Shaw and Glazebrook.

In geology Prof. Hughes is lecturing on Stratigraphical Geology; Mr. Tawney, on Fossil Echinoderms and Crustaceans, and on Petrology. Dr. Roberts (Clare College) is also taking a class in Petrology; and Prof. Hughes makes periodical field excursions.

Dr. Vines (Christ's) lectures on the Anatomy of Plants, with practical work; Mr. Hicks (Sidney), on Elementary Botany, chiefly Morphology; Mr. Saunders (Downing), on Elementary Botany; and Mr. Hillhouse, on the Anatomy and Physiology of Plants, at the Museums.

Prof. Newton takes Vertebrata this term (lectures on Geographical Distribution once a week). Mr. Balfour gives elementary and advanced lectures on Morphology, with practical work, as usual. Dr. Foster's elementary course of Physiology is continued; and the advanced lectures are Dr. Gaskell's, on Respiration; Mr. Langley's, on the Digestive System; and Mr. Hill's, on the Central Nervous System.

Prof, Humphry lectures on the nervous system and the Organs of Special Sense, and takes a class for Tripos and 2nd M.B. work in Anatomy and Physiology. Dr. Creighton has a class for Osteology, and Practical Human Anatomy commenced on January 20.

Prof. Stuart is lecturing on the Theory of Strictures. The Demonstrator of Mechanism will form classes in elementary and advanced mathematics applicable to engineering.

The last Senior Wrangler under the old regulations is Mr. R. A. Herman, of Trinity College, educated at King Edward's School, Bath; his private tutor was Mr. Routh. The second wrangler is Mr. J. S. Yeo, of St. John's College, educated at Blundell's School, Tiverton; his private tutor was Mr. R. R. Webb, of St. John's. The third wrangler is Mr. S. S. Loney, of Sidney College, educated at Maidstone Grammar School and Tonbridge School: private tutor, Mr. Routh. St. John's has four wranglers of the first eight; Trinity has only one wrangler besides the Senior.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 8, 1881.—"On the Development of the Skull in *Lepidosteus osseous*," by W. K. Parker, F.R.S.

The materials for the present paper were kindly sent to me by Prof. A. Agassiz; they were for the use of Mr. Balfour and myself, and consisted of fifty-four small bottles of eggs and embryos in various stages. These very valuable materials were obtained from Black Lake by Mr. S. W. Garman and Prof. Agassiz, and many of the embryos were described and figured by the latter in the *Proceedings* of the American Academy of Arts and Sciences, October 8, 1878.

We have had additional materials from Prof. Burt G. Wilder; Mr. Balfour has obtained from Prof. Agassiz several adult fishes in spirit; and I am indebted to Prof. Flower for an adult in the dry state.

Mr. Balfour's part of the work has been done with the assistance of my son, Mr. W. N. Parker, and their joint labour will include the anatomy of various organs of the adult fish.

My observations on the skull and visceral arches have been made on embryos and young, varying from one-third of an inch to 4½ inches in length; I have (artificially) divided these into six stages. Cartilage was being formed in the smallest examined by me, but in my second stage, embryos five-twelfths of an inch long, this tissue was quite consistent, and I succeeded in dissecting out all the parts. The large notochord at this stage bends downwards under the swelling hind-brain, and turning up a little at its free end, and passing into the lower part of the fissure between the mid- and hind-brain, it reaches beyond the middle of the cranium, and just touches the infundibulum and *distinct* pituitary body. Between the trabeculæ, in front, there is a small wedge of younger cartilage, the rudiment of the "intertrabecula."

As in the Batrachia, the fore part of the palato-quadrate cartilage is continuous with the trabeculæ in front; but the pedicle is free behind. The free articulo-Meckelian rod is quite in front of the eye-balls, and is nearly as long as the hind suspensorium, or proper quadrate region; this forward position of the hinge of the mandible is not temporary, as in the frog, but permanent. The uppermost element of the hyoid arch is an anvil-shaped cartilage from the first, and ossifies afterwards, as the hyo-mandibular and symplectic bones. As pointed out to me by Mr. Balfour, its dorsal end is continuous, *as cartilage*, with the auditory capsule above. The basi-hyal is not yet ossified, but distinct inter-, cerato-, and hypo-hyal segments are already marked out. Four larger and one small rod of cartilage are seen on each side, articulating with a median band; these are the branchial arches, which chondrify before they undergo segmentation. In this stage there are no osseous laminæ as yet formed.

Here, in this stage, in connection with a large pre-nasal suctorial disk, we have three important generalised characters, namely, the continuity of the distal end of the mandibular pier and of the proximal end of the hyoid pier with the skull, and the forward position of the hinge of the jaw coupled with the horizontal direction of the suspensorium. The hyoid arch has its segments formed much earlier than in the Teleostei, and the "pharyngo-branchials" are not independent cartilages, as in the *Skate*.

The third stage—embryos two-thirds of an inch long—show a considerable advance in the development of the skull; the cartilage, generally, is more solid and more extensive, and new tracts have appeared. The apex of the notochord is now in the middle of the basis cranii, for the pro-chordal tracts have grown faster than the para-chordals. The trabeculæ swell out where they are confluent, and then are narrower in front again. At their fore end each band passes insensibly into the corresponding palato-quadrate bar outside, whilst inside they are separated by a large pyriform wedge of cartilage, the intertrabecula. The thick, rounded, free fore end of this median cartilage is the rudiment of the great "nasal rostrum," and the rounded fore ends of the trabeculæ are the rudiments of their "cornua."

There is only a floor in the occipital region, but the wall-plate of the chondrocranium has begun as a styloid cartilage running forward from the fore end of each auditory capsule into the superorbital region. The palato-pterygoid bar—continuous in front with the trabeculæ—is now longer than the proximal part of the suspensorium, the spatulate quadrate region whose dorsal end is the free pedicle. The wide proximal part of each trabecula is now already forming an oblong facet, the basipterygoid, for articulation with the facet of the pedicle.

In this stage the skull is a curious compromise between that of a salmon at the same stage and that of a tadpole just beginning its transformation. The hind-skull is quite like that of a young salmon, the fore-skull, with its non-segmented palatoquadrate, and its forwardly placed quadrate condyles and horizontal suspensorium, is very much like what is seen in the suctorial skull of the Anurous larva. A splint bone, the parasphenoid, as in the tadpole, has now made its appearance.

The largest embryos reared by Messrs. Agassiz and Gorman, which are about one inch in length, form my *fourth* stage; these are rapidly acquiring the character of the adult.

This is the stage in which the chondrocranium of this Holostean type corresponds most closely with that of the Chondrostean sturgeon, whose adult skull is similar to that of garpike just as the latter begins to show its own special characters. This important difference is already evident, namely, that whilst in *Acipenser* the olfactory capsules remain in the *antorbital* position, those of *Lepidosteus* are already carried forwards by the growing intertrabecula, and are even now in front of the relatively huge cornua trabeculæ. Thus these regions are now well grown in front of the ethmoidal territory, which, instead of being, as in the last stage, in the front margin of the skull, is now fairly in its middle, and this change has taken place whilst the embryo has only become one-half larger—from two-thirds of an inch to an inch in length. It is the hypertrophy of cartilage in the three trabecular tracts that makes the rostrum of the sturgeon so massive, even whilst only a few inches in length, and this state of things exists temporarily in the garpike.

Above, the sphenotic, epiotic, and opisthotic projections of the auditory capsule are more evident, but are not ossified. Some slight bony deposit has appeared in the pro-otic regions. The "cephalostyle" is the first *endo*-cranial bone, and the parasphenoid the first *ecto*-cranial centre; but the exoccipitals are just appearing also.

The superficial bones can now be seen as fine films in the transverse sections, and the parosteal palatine and pterygoid are large leaves of bone applied to the pterygopalatine bar; the mesopterygoid is only half as large as them, but is relatively much larger than in the adult.

While doubling its length, the young *Lepidosteus* gains a cranium much more like that of the adult; this is my *fifth* stage. The general form is now intensely modified by the foregrowth of the rostrum, which is two-thirds the length of the entire skull. The cornua trabeculæ now reach only two-fifths of the distance to the end of the beak, and the pterygo-palatine arcade reaches but little further forwards. The bony matter of the "cephalostyle" is now aggregated towards the hinder half of the notochord; it is now the basi-occipital bone. The exoccipitals and pro-otics are growing larger, and there are both sphenotics and alisphenoids. Also, below, the quadrate, metapterygoid, and articular centres have appeared; and behind the jaw there are the hyomandibular, symplectic, epihyal, cerato-hyal, and hypo-hyal centres; and the epi-, cerato-, and hypo-branchials have acquired a bony sheath.

In a young *Lepidosteus* $4\frac{1}{2}$ inches long (nearly), the approach to the adult state of the skull has been very great; the supercial bones can all be determined. The most remarkable of these are the small distal nasals and premaxillaries: the long *maxillary chain*, ending in an os mystaceum and jugal; the extremely long and slender "ethmo-nasals" and vomers; the small pre-opercular; and the huge angulated inter-opercular, which carries the large opercular and the sub-opercular. The five mandibular splints are all present (as in most Sauropsida), the branchiostegals are only three in number, as in the Carp tribe.

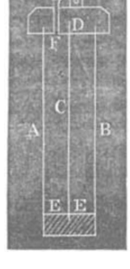
The intertrabecula, which was at first merely a small tract of cells binding the trabeculæ together in front, is now three-fourths the length of the entire skull; to it is due the length of the beak. The cornua trabeculæ are now merely short lanceolate leafy growths on the sides of the rostrum at its hind part. In the last stage there was a fine bridge of cells running across behind the pituitary body; it is now a small cartilaginous post-clinoid bar. The opisthotic and epiotic form now a scarcely divided tract of bone, all the other centres are developing, and a pair of additional bones have appeared in the funnel-shaped fore-end of the chondrocranium; these are the "lateral ethmoids." The bony matter of the basi-occipital has now retired to the hinder third of the notochord, which is much shrunken.

There are now two centres (as in *Amia calva*) in the articular region of the mandible; the quadrate and metapterygoid centres are much larger; the hyo-mandibular and symplectic are together only half the size of the mandibular suspensorium; the basi-hyal is very large, is composed of two parallel pieces, and is very *Myxinoid*.

No clear understanding of the morphology of this type of skull can be had unless it be seen in the light derived from that of the Elasmobranchs, the Sturgeon, and the Anurous larva on one hand, and that of *Amia calva* and the Teleostei on the other.

Royal Society, January 12.—"On a New Electrical Storage Battery (Supplementary Note)." By Henry Sutton. Communicated by the President.

The new cell consists of a flat copper case, same shape as a Grove's cell; it has a lid of paraffined wood, from which hangs a plate of lead amalgamated with mercury, the lower part of lead plate being held in a groove in a slip of paraffined wood resting on bottom of copper case; through the lid a hole is bored for introduction of solution, which consists of a solution of cupric sulphate, to which is added one-twelfth of hydric sulphate; the presence of this free sulphuric acid improves the cell at once.



The sectional sketch shows the arrangement.

A B. The outer flat copper case.

C. Plate of amalgamated lead held in grooves in cap D and slip E.

F shows the hole in cap through which the solution is introduced, and by the introduction of a glass tube through this hole the state of the charge is seen by observing the colour; the interior surface of the case forms the negative electrode, and the amalgamated lead the positive.

Linnean Society, January 19.—Sir John Lubbock, Bart., F.R.S., President in the chair. Mr. R. Kippist's death was officially notified, and a valuable donation of books from the late treasurer (Mr. Currey) announced. There were exhibited, for Mr. Thomas Bruges Flower, three rare British plants, viz.: *Potentilla rupestris*, L., from Montgomeryshire, *Polygonum maritimum*, L., and *Senecio squalidus*, L., from North Devon; and, for Mr. W. Bancroft Espeut, an albino specimen of Bat., (*Molossus obscurus*, Geoff.) from Jamaica; albinism in the cheiroptera being said to be extremely rare. Dr. T. Spencer Cobbold called attention to living examples of *Leptodera* under the microscope. Mr. G. Maw read a communication on the Life History of a Crocus and classification and distribution of the genus. He says the corm tunic is the only permanent record of perennial existence, and even this in the living state lasts but a year. Minute papillæ stud the surface of the corm, these increase as bud-growth and ultimately secure the life cycle; the new corm is implanted on and finally absorbs the parent. The tunics are homologous with leaves, and their fibrous net-like structure has so many ornamental patterns that by a fragment a species can be determined. Certain *Croci* are constant in colour, others are exceedingly variable, and still others change in tint as found from east to west: *C. cancellatus* being purple in Asia Minor, lilac in Greece, and white in the Ionian Islands. The stigmata are so variable that Mr. Maw thinks that Mr. Baker's threefold classification, based thereon, fails. Grouping of the genus is necessarily to be founded on a combination of characters, for the overlapping and interlacing of single ones militate against the natural sequence of species. A modification of Dean Herbert's classification is, by the author, preferred to those of Haworth and Baker. The crocuses are geographically confined to the Old World and Northern Hemisphere, their chief area of distribution being around the Mediterranean and Black Sea. Mr. Maw divides their region of occupation into nine sub-districts. *C. biflorus* has the widest range of longitude, and extends from Italy into Georgia, and *C. sativus* follows, ranging from Italy to Kurdistan. Certain Mediterranean islands, on the other hand, present curious examples of quite a local distribution. The author expresses doubts of the existence of wild hybrids; and he points out the great tendency to morphosis of nearly every part of the plant.—Mr. W. Percy Sladen read a paper "On the Asteroidea of the 'Challenger' Expedition." The family Pterasteridæ, he remarks, has been heretofore but feebly represented in living forms; 8 species only being on record as belonging to the genera *Pteraster* and *Retaster*, and a 9th solitary representative to *Hymenaster*. From the *Challenger* collection 34 species of Pterasteridæ have been obtained, 2 only known previously. Of the 32 new species, 3 belong to *Pteraster*, 4 to *Retaster*, and 20 to *Hymenaster*—a genus now found to be world-wide in deep waters. The remaining 5 species are the representatives of 3 new genera, viz.: *Marsipaster* 2, *Benthaster* 2, and *Calyptraster* 1 species.—The Rev. G. Henslow read a note "On the Occurrence of a Staminiferous Corolla in the Foxglove and in the Potato"; staminody in these plants seldom having been recorded and figured.

Chemical Society, January 19.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the chemistry of Bast fibres by C. F. Cross and E. J. Bevan (we give a report of this elsewhere).—Dr. Carnelley then read a paper on the action of heat on mercuric chloride. About twelve months ago the author exhibited to the Society some experiments on the action of heat on ice and mercuric chloride under low pressures, and subsequently read a paper on the subject before the Royal Society. Two propositions were advanced—(1) that when the superincumbent pressure is maintained below a certain point called "the critical pressure," it is impossible to *melt* ice, mercuric chloride, and probably other substances, no matter how great the heat applied; (2) that under these circumstances ice and mercuric chloride attain temperatures considerably above their natural melting-points without melting. Subsequent observers have confirmed the first proposition, but have been unable to verify the second. The author has therefore repeated his previous experiments with mercuric chloride, and in addition has made determinations of the temperature of mercuric chloride, heated in a vacuum, by dropping the heated solid into a calorimeter containing turpentine, benzine, and petroleum. Some unexpected results were obtained. When the salt is pressed as a compact powder round the bulb of the thermometer, and heated in a vacuum, the thermometer rises 21° to 50° above the melting-point of the mercuric chloride, though still surrounded by the solid salt. When the salt is in the form of a solidified cylinder, the temperature rises 15° above the melting-point. When a turpentine calorimeter is used, the temperature of the mercuric chloride came out 100° above the ordinary melting-point; but with petroleum or benzine, temperatures above the ordinary melting-point could not be obtained. The author therefore withdraws his previous statement, and concludes that although mercuric chloride does not fuse when heated under diminished pressure, yet its temperature never rises appreciably above its ordinary melting-point. The high temperatures indicated by the thermometer being due to the diffusion of the superheated vapours of the mercuric chloride through the pores of the solid salt. The author also concludes that turpentine cannot be used in a calorimeter for the determination of the specific heat of bodies soluble in water, since some substances such as mercuric chloride, zinc chloride, &c., when heated, cause an evolution of heat, due probably to the polymerisation of the turpentine. Hence many of Regnault's specific heat determinations, in which turpentine was employed, are probably too high; they are, it may be remarked, in almost all cases higher than Kopp's numbers, that observer having used coal-tar naphtha. The specific heat of mercuric chloride is 0·06425, and of zinc chloride 0·14301, neither value being altered by a rise of temperature.—Contributions to the history of cerium compounds, including the analysis of Rhabdophane, a new British mineral containing Cerium, Lanthanum, Didymium, Yttrium, by W. N. Hartley.—On the reaction of chromic anhydride with sulphuric acid, by C. F. Cross and A. Higgin.—On dibenzoybanilin and its isomerides, by A. Higgin.

Entomological Society, January 18.—Annual Meeting.—An address was delivered by the president, H. T. Stainton, F.R.S., and the following gentlemen were elected to serve on the Council for 1882:—President, H. T. Stainton, F.R.S. Treasurer, E. Saunders, F.L.S. Librarian, F. Grut, F.L.S. Secretaries: E. A. Fitch, F.L.S., and W. F. Kirby. Other Members of Council: W. Cole, F. Du Cane Godman, F.L.S., F. P. Pascoe, F.L.S., O. Salvin, F.R.S., W. A. Forbes, B.A., F.L.S., F.G.S., Rev. H. S. Gorham, Lord Walsingham, M.A., F.Z.S., and C. O. Waterhouse.

PARIS

Academy of Sciences, January 23.—M. Jamin in the chair.—The following papers were read:—On the explosive wave, by M. Berthelot. It is not a sound-wave travelling with a velocity depending on the physical constitution of the medium, but a change of chemical constitution propagated. M. Berthelot recapitulates its properties. As to dependence of the velocity on the diameter, this becomes less and less as the increase of the diameter allows more freedom of motion to the molecules and diminishes friction. The total energy of the gas, at the moment of explosion, depends on its initial temperature and the heat liberated during combination. These two data determine the absolute temperature of the system, which, moreover, is proportional to the kinetic energy ($\frac{1}{2}mv^2$) of translation of the molecules. It follows that the velocity of translation is proportional to the square root of the ratio between the absolute temperature and the den ity of the gas referred to air. The result of experiments agrees closely with this.—*Résumé* of meteorological observations made during 1881 at four points of Haut-Rhin and the Vosges, by M. Hirn. The stations are—Thann (alt. 350 m.), Munster (alt. 388 m.), Col de la Schlucht (alt. 1154 m.), and Colmar (alt. 195 m.). *Inter alia*, the maximum difference between a black-bulb thermometer and an ordinary one at the same height in shade at Colmar was 27·6 (in January). The most violent winds at Colmar never exceeded 18 to 20 metres per second. The rainfall at Schlucht was 1310·8 mm., at Munster 664 mm., at Colmar 521 mm.—Spectroscopic observations with monochromatic light, by M. Zenger. Seeking combinations which should give strong dispersion with perfect transparency and total reflection of red or violet, he finds that benzine and benzylene, combined with quartz, eliminate the extreme red of an angle of about 75°, while pure anethol, at the same angle, eliminates the extreme violet. A parallelepiped thus formed is the best means of observing the solar protuberances or spots, or the reversed colours of the chromosphere. He commends it to the Transit of Venus Commisston. Irradiation is abolished or greatly reduced. Larger magnifying power may be used. The confusion arising from interference-bands at the edge of Venus' disc is obviated. And better photographs may be had.—Remarks on a note of MM. Mignon and Rouart, on processes of coppering, by M. Weil. He denies that he uses organic acid merely as an accessory.—On the spherical representation of surfaces, by M. Darboux.—On some transcendent equations, by M. Laguerre.—On Fuchsian functions, by M. Poincaré.—On a means of extending the theory of imaginaries, without making use of imaginaries, by M. Saltel.—New manner of employing the principle of least action, in questions of dynamics, by M. Brassinne.—Determination, by means of the microphone, of the nodes and ventral segments in vibrating columns of air, by M. Serro-Carpi. A small graphite microphone is applied to an elastic membrane on a ring, and this is brought into the sounding-pipe. The presence of a node is indicated by a roll (*roulement*) in the telephone, like that which the instrument gives with induced currents. In the ventral segments the sounds are more apart and rare. One does not hear the musical sound of the pipe.—On spermatogenesis in Annelids and Vertebrates, by M. Sabatier. In Annelids he has observed two generations of spermatoblasts formed on the inner surface of the spermatic pouches. The second, springing from the first, are transformed into spermatozoids (the nuclei forming the heads). M. Sabatier considers that spermatogenesis in Vertebrates may be similarly explained.—On the *rôle* of the amnios in the production of anomalies, by M. Daresti. In an anomalous fœtus of sheep he finds confirmation of his view that deviations, and especially congenital club-foot in man, are the consequence of compression of the body of the embryo by the amnios arrested in its development.—On the vegetation of aquatic plants in air, by M. Mer. He concludes, that if certain aquatic plants cannot form branches in free air, it is simply because their tissues are unable to resist active transpiration, and not, as in the case of aerial plants immersed, because they are incapable of development and nutrition in air. They can live in air, provided this is moist, and can produce starch in it sometimes more easily than in water. But there are very few in which the same leaf will act in both media.—On the concentric bands of felspars, by M. Lévy.—On the barometric height of January 17, 1882, by M. Renou. This on the parc de Saint Maur (alt. 49·30 m.) at 10 a.m. was 782·13 mm.; reduced to sea-level, 786·92 mm. During nearly a century, there has only been one height slightly exceeding this, at Paris Observatory. On February 6, 1821, at 9 a.m., the height was 780·90 mm., at sea-level, 787·52 mm. It would appear that at Paris during two centuries, with exception of the figures in 1821 and 1882, the barometer has never exceeded 778·5 mm. M. Renan gave an explanation of the recent high pressure. M. Faye attributed to the pressure a remarkable depression of the sea-level observed at Antibes (in the south of France), about which M. Naudin had written him. It lasted a fortnight.

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