It is also a well-ascertained fact that moist heat acts much more powerfully on seeds than dry heat. We may safely conclude therefore that when the physical and chemical conditions of the medium in which a seed is placed are unfavourable to its germination, water is the most powerful agent in rapidly destroying its vitality. My experiments on the action of liquids on seeds confirm this conclusion.

Moist seeds kept in oxygen and in nitrogen protoxide do not germinate. In some few cases I observed the commencement of sprouting in seeds kept in oxygen. My observations confirm those of Cossa, and are contrary to those of Borscow and Rischawi, who asserted that nitrogen protoxide can cause moistened seeds to germinate.

II. *Action of Liquids.*—The air-dry seeds were kept in the different liquids in well-stoppered bottles. In some liquids several kinds of seeds were put. The following are some of the results of experiments with the seeds of Lucerne or *Medicago sativa* :—

Liquids used.	Number of days in which the seeds remained in the liquid.	Percentage of seeds that retained the germinating power.
Methyl alcohol...	841	19
Ethyl ,, (absolute)	834	78
Amyl ,,	841	19
Ethyl ether	484	29
,, ,,	908	1·3
Chloroform	484	29·6
,,	841	6
,,	924	0
Carbon tetrachloride	350	57·4
,, disulphide	405	63·2
,, ,,	802	58·4
Ethyl iodide	350	65·4
,, ,,	792	52·5
Glycerine	157	24·2
,,	484	5·2
Benzol ...	397	20
,,	841	8·6
Nitrobenzol	397	17·4
,,	841	6·0
Aniline ...	397	20·1
,,	841	4·2
,, and alcohol (93°)	709	37

In the experiments with methyl alcohol and with glycerine the presence of small quantities of water must have contributed not a little in augmenting the action of the liquid on the vitality of the seeds.

Experiments were made to see the action of ethyl-alcohol when at different degrees of dilution. It was observed that, when the solution contained less than 50 per cent. of alcohol, the seeds easily got swollen, and were rapidly killed. The following are the results of experiments where Lucerne seeds, from the same sample, were kept for 834 days in different mixtures of alcohol and water :—

Degree of the alcoholic solution, Gay-Lussac's scale, per cent. in volume.	Percentage of seeds that retained the germinating power.
60°	0
70	0
80	23
90	62
100	63
100 *bis*	78

Absolute or nearly absolute, alcohol rapidly destroys the germinating power of some kinds of seeds, such as wheat, flax, &c.

In some cases seeds resist the action even of boiling liquids, when the temperature of the boiling point is not too high. Thus, of Lucerne seeds that had been for 160 hours in boiling ether (boiling point 36°) 31 per cent. were still capable of germinating. Seeds of the same plant were kept for 81 hours in boiling carbon disulphide (boiling point 43°): 75 per cent. of the seeds sprouted when sown in moist sand. After five hours boiling in absolute alcohol (boiling point 78°) only 9½ per cent. of the Lucerne seeds did germinate.

In all the experiments where seeds, previously swollen in water, were brought in contact with other liquids, such as absolute alcohol, ether, carbon disulphide, the germinative power was quickly destroyed.

The last series of experiments was made with solutions of solids and gases in liquids different from water. Great care had to be taken in washing the seeds, the germinative power of which had to be tested on the moist sand well with alcohol, and then with water ; the presence, even of traces, of the solution in which the seeds had been immersed was sufficient, in some cases, to entirely prevent germination. The following are experiments made with Lucerne seeds :—

Solutions used.			Number of days in which the seeds remained in the solution.	Percentage of seeds that retained the germinating power.
Alcoholic	solution	of iodine	382	1·5
,,	,,	potassium bromide	757	68·4
,,	,,	zinc chloride	757	34·6
,,	,,	,, ,,	376	83·6
,,	,,	mercuric chloride.	756	68·4
Glycerine	,,	copper sulphate ...	757	23·1
,,	,,	,, ,,	375	67·1
,,	,,	arsenic trioxide ...	758	1·3
,,	,,	,, ,,	322	70·2
Alcoholic	,,	potassium sulphide	223	8·2
,,	,,	ammonium ,,	223	0
Glycerine	,,	potassium cyanide	757	80
,,	,,	,, ,,	376	95·3
Alcoholic	,,	camphor ...	757	70·4
,,	,,	phenol	757	65
Ether	,,	,,	598	69·4

All these solutions easily destroyed the germinating power of wheat.

The following results show the action of saturated alcoholic solutions of gases on Lucerne seeds :—

Solution (alcohol at 97° Gay-Lussac).			Number of days in which the seeds remained in the solution.	Percentage of seeds that retained the germinating power.
Alcoholic	solution	of sulphuretted hydrogen ...	587	27
,,	,,	sulphur dioxide	587	3
,,	,,	nitric oxide ...	587	20

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Dr. Acland, Dr. Burdon Sanderson, and Mr. W. W. Fisher, having been appointed examiners for the Radcliffe Travelling Fellowship, give notice that an examination will be held for the purpose of electing a Travelling Fellow on Tuesday, February 14. Candidates are to send their names to Mr. Fisher before February 8.

There will be an examination at Christ Church on February 22 for at least one Junior Studentship in Natural Science ; papers will be set in Chemistry, Biology, and Physics ; but no candidate will be allowed to offer himself for examination in more than two of these subjects.

Candidates for the Natural Science Studentships who make Physics their principal subject are recommended to offer themselves for examination in Mathematics, at least in Algebra, Plane Trigonometry, and Pure Geometry, as great weight will be attached in their case to a knowledge of these subjects.

Candidates for the Natural Science Studentships will also have to show that they possess such a knowledge of Classics as will enable them to pass Responsions.

On February 7 Convocation will be asked to pass a decree authorising the Curators of the University Chest to pay to the Delegates of the Museum a sum not exceeding 250*l*., for the purpose of providing the Linacre Professor of Physiology with additional microscopes, diagrams, and drawings for the use of students in the Physiological Laboratory, as well as with additional cupboards for containing diagrams and drawings.

CAMBRIDGE.—The following elementary lectures on chemistry are being given :—Prof. Liveing's and Mr. Main's (St. John's College) General Courses ; Mr. Pattison Muir (Caius), Non-Metallic Elements ; Mr. Lewis (Downing), Catechetical Lectures ; Mr. Walker (Sidney), Organic Chemistry ; Mr. Garnett is lecturing on Heat at St. John's ; Mr. Glazebrook (Trinity), 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 para-