our system were incandescent bodies as well, just as the sun is still to-day. If we go backwards from these suns we get, by further conclusions, to accumulated masses of clouds, the embryos of the later suns, then to cloud-belts, and eventually to the gaseous mass distributed tolerably uniformly, and this is the original state beyond which, with our present insight, we cannot get.

All this proves distinctly that just as upon the earth an eternal change takes place, the heavens likewise are constantly changing. Each change consists of a sum of motions, and supposes a former change or sum of motions, from which it resulted with mechanical necessity, and further on a chain of changes from all eternity. Thus the gaseous state of our solar system must have been preceded by a continuous endless series of changes, and if our scientific insight does not lead us to this, does not even justify us in this supposition, it thus proves only its own inadequacy.

We must, on the contrary, conclude from the eternity of changes in the universe that the whole process of development of our solar system or of the whole starry heaven, from the original gaseous mass, through the ball-shaped nebulæ, fiery and dark globes, to the cold, solid, and dense mass, is only one of the numberless successive periods, and that analogous periods and occurrences have preceded and will follow endlessly. It is true that we perfectly understand, according to our present physical knowledge, how a mass of gas in a state of progressing condensation produces heat, and how the hot condensed mass again gives off this heat until its temperature and that of its surroundings, in our case that of universal space, have become equal. But we do not understand how the solid mass can again become gaseous, and how the necessary heat, distributed in universal space, can again be collected.

There is a gap in our knowledge at this point; and we may fill it by various suppositions. In the present state of almost complete ignorance among physicists and chemists of the properties of chemical elements and of ether, it is possible that, with sufficient condensation of matter and approach of its particles, forces become active of which we have no idea at present, and which may perhaps bring about an explosive dispersion of the solid mass into a gaseous state. It is also possible that the quantity of heat in the endless universe (not in our starry heaven) is distributed unequally, and that there are domains in it which are of a much higher, and others which are of a much lower, temperature than our starry heaven; that in the endless space of the universe heat currents exist, similar to the air currents in our atmosphere, and that we have perhaps for some billions of years been in one of these currents of lower temperature, in which the process of solidification continues on a large scale, just as on a small scale it occurs on the earth's surface during north winds, and that some hot current which sooner or later may pass through our starry heaven may again bring about a gaseous distribution of matter.

This example shows that we may use our experiences of the finite only for deductions within the finite. As soon as man wishes to overstep this domain, which is opened to him by his senses and which is accessible to his knowledge, and wants to form some conception of the whole, he falls into absurdities. Either he leaves unconsidered what he has gained by experience and meditation, and then he loses himself in arbitrary and empty fancies; or he proceeds logically from the laws fo the finite and then he finally arrives at perfectly ridiculous consequences.

The example mentioned before may again serve to illustrate this. The world known to us changes. If we follow these changes according to the laws of causality, backward into the past and forward into the future, and place ourselves upon the before-mentioned physical stand-point of the nebular theory, and adopt what is known to us there as a measure, then we find stages both in the past and the future which more and more approach perfect rest, without ever reaching it altogether. But if we assume a further point of view, and suppose that heavenly bodies and systems of heavenly bodies arise and perish without end in the universe, then we find two possibilities: either, according to the materialistic conception, the successive stages are of the same value; or, according to the philosophical conception, they continually change their relative value, becoming more perfect every time, in which case the universe would in the eternal past more and more approach absolute imperfection (therefore rest), and in the eternal future absolute perfection (therefore again rest). All three conceptions are equally irrational. The first (physical) and the third (philosophical) let the world awaken from dead rest and return to it. The second (materialistic) condemns it to eternal rest, because a change which always repeats itself, means for an eternity nothing else but rest.

With space we do not fare better than with time. We naturally wish to imagine the universe as of finite extent in space and thus make it accessible to our conception. But as the space filled with matter can but everywhere be limited by more space filled with matter, we arrive at the absurd deduction that the world in its circumference is bordered by itself. But if we allow infinity to universal space, and according to our ideas of space it must be infinite, then heavenly bodies follow upon heavenly bodies without end, in different sizes, different compositions, and different stages of development. Now as size, composition, and stages of development move within finite limits, the combinations which are possible constitute of course, to our ideas, an infinitely great, but yet not an endless number. If this number is exhausted the same combinations must repeat themselves. We cannot deny this, even with the conviction that centillions upon centillions of heavenly bodies or systems of heavenly bodies would not suffice to complete the number of possible combinations. Because centillions compared to endlessness are less than a drop of water compared to the ocean. We therefore arrive at the mathematically correct, but to our reason most absurd, deduction that our earth, just as it is now, must occur several times, indeed an infinite number of times in the universe, and that also the jubilee festival, which we celebrate to-day, is celebrated just in the same way upon many other earths.

The logical consequences of this kind may be multiplied. The examples suffice to show, that our finite reason is only accessible to finite conceptions, and that, when it wishes to raise itself to conceptions of the eternal in however logical a manner, its wings become paralysed, and, like a second Icarus, before the sunny heights are reached, it falls back into the depths of finite and obscure ideas.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The Physical Science Postmastership at Merton College, has been awarded to Mr. E. T. Milner, of Manchester Grammar School.

CAMBRIDGE.—Mr. J. N. Langley, B.A., of St. John's College, has been elected a Fellow of Trinity College. Mr. Langley was bracketed second in the first-class of Natural Science Tripos 1874.

EDINBURGH.—Mr. Thomas Annandale, who was assistant to the late Prof. Syme, has been appointed to the chair of Clinical Surgery in Edinburgh University, vacant by the removal of Mr. Lister to King's College, London.

UPSALA.—The *Scotsman* of Thursday last, contains a very full and interesting account of the recent Upsala celebration, evidently by one of the Edinburgh delegates. The writer, speaking of a visit he paid to one of the largest schools of Upsala, built for about 500 pupils, says:—"Here, as elsewhere in Sweden, the expense of education is wholly borne by the State. The pupils pay no fees. The building is spacious and airy, and the class-rooms and playgrounds furnished, almost to luxuriousness, with the requisites for the development of healthy minds in healthy bodies. The arrangements for the securing of the required heating and ventilation of the rooms during the long severe winters of Sweden are particularly good. Nearly every class-room is seated for about thirty pupils. Each pupil has his own little desk before him, and a chair with a back fitting comfortably to his body, and adjustable as to height so as to suit each pupil. This seat he retains during the session, so that there is no taking of places in the classes. There are several carefully-selected libraries for the pupils in the school—a marked feature of which is the number of books in English, French, and German; and there is the best proof everywhere that these volumes, which are mostly classic authors in these languages, do not lie idly on the shelves, in the number of Swedes one meets with who can converse tolerably well in one or all of these languages. But what struck us as deserving of the very warmest commendation, are the well-appointed and well-kept museums of apparatus illustrative of the simplest and most fundamental facts of natural philosophy and chemistry; well-dried mounted specimens of the common plants of the district; stuffed and otherwise prepared specimens of the Swedish fauna; large models of typical plants

and animals, showing the details of their structure ; and skeletons and plaster casts by which the fundamental facts of anatomy and human physiology can be successfully taught. Thus, with the aid of these admirable elementary museums and appliances, which Mr. Forster might well envy, the broad principles of physical, chemical, and biological science are taught to all whose education goes no further than the public schools ; and as regards the others, such instruction in the elements of science forms an admirable introduction to the University course."

SOCIETIES AND ACADEMIES

LONDON

Royal Microscopical Society, October 3.—Mr. H. C. Sorby, president, in the chair.—The president read a paper on an improved method for distinguishing the axes of double refracting substances which consisted of a wedge-shaped piece of quartz cut parallel to the positive axis of the crystal, and made to slide into the eye-piece of the microscope. When this passed across the field of view in polarised light every gradation of tint was successively produced by the varying thickness of the quartz, and by viewing crystals through this it was very easy at once to determine the position of their axes by noting the effect upon the series of coloured bands produced by the quartz scale.—A paper by Mr. F. H. Wenham on the aperture of object glasses was read by the secretary. The purport of Mr. Wenham's paper was further explained, and illustrations of the method proposed were drawn on the black-board by Mr. J. E. Ingpen.—Mr. Slack described some curious observations made as to the habit and power of offensive attack by the genus diglena upon anguillula and other species.

PHILADELPHIA

Academy of Natural Sciences, May 1.—On the Cambari (crayfishes) of Northern Indiana, by W. F. Bundy (*Proc.*, 1877, p. 171).—Synopsis of the fishes of Lake Nicaragua, by Drs. Gill and Bransford (pp. 175–191).—On lavendulite from Chili, by E. Goldsmith.

May 15.—Prof. Leidy, on gregarines.

May 22.—Prof. Leidy, on flukes infesting molluscs.—H. C. Yarrow, notes on the natural history of Fort Macon, N.C. (pp. 203–218).—On the brain of *Chimæra monstrosa*, by Dr. Wilder (pp. 219–250).

June 12.—Prof. Leidy, remarks on parasitic infusoria.

June 26.—Prof. Leidy, the birth of a rhizopod (*Euglypha*).

PARIS

Academy of Sciences, October 8.—M. Peligot in the chair.—On an incident mentioned at the congress of Stuttgart, by M. Faye. This relates to recent geodetic operations in the north-east of Spain, directed by Gen. Ibanez.—Apparatus for measuring the heat of vaporisation of liquids, by M. Berthelot. He aims at greater simplicity, while transmitting the vapour dry from generator to calorimeter. A phial with hermetically sealed neck is traversed by a wide vertical tube open at its inclosed top, passing down through the phial to a serpentine in a calorimeter, and (in its way) through a metallic disc, a circular lamp, another metallic plate, a sheet of paste-board, and a wooden plate (the last three forming the cover of the calorimeter). He finds on an average 636·2 as the total heat furnished by water between 100° and zero (Regnault 636·6).—On the determination of the heat of fusion, by M. Berthelot. The two phenomena of fusion and solidification in a body like hydrate of chloral are not reciprocal when one directly follows the other, and the heat absorbed in one case is not equal to that liberated in the other. To measure the calorific work in fusion the body should be brought to a certain final state, proved identical by thermal measurements, *e.g.*, dissolving hydrate of chloral at a given temperature and in a constant quantity of water, and comparing specimens recently fused, and others kept several months or years. Then a known weight of the substance is raised to different temperatures, sometimes above sometimes below the point of fusion, then immersed and dissolved suddenly in the water of the calorimeter. He finds the heat of fusion to be 33·2 cal. for 1 gramme.—On the variations of the heat liberated by union of water and sulphuric acid at different temperatures, by M. Berthelot.—On the relation which should exist between the diameter of magnetic cores of electro-magnets and their length, by M. Du Moncel. For equal resistances of circuit the diameters should be proportional to the electro-motive force for equal electromotive forces, in inverse ratio of the resistance of the circuit, including the battery resistance ; for equal diameters proportional to the square roots of the resistances of the circuits ; for given electro-motive force and with electro-magnets in their conditions of maximum the electro-motive forces of the batteries should be proportional to the square roots of the resistances of the circuits.—Programme of the expedition of next year (July, 1878) to the glacial sea of Siberia, by M. Nordenskjöld.—Observations of the planet 175 Palisa, and of the new comet of Tempel, with the garden equatorial, by MM. Paul and Prosper Henry.—On a general method of transformation of integrals depending on square roots ; application to a fundamental problem of geodesy, by M. Callandreau.—On the spectrum of the new metal davyum, by M. Kern. He indicates the principal lines.—Pyrogenous decomposition of chlorhydrate, bromhydrate, and iodhydrate of trimethylamine ; new characteristic of methylamines, by M. Vincent. The new characteristic is the production of chloride, bromide, and iodide of methyl from such decomposition.—On iodide of starch, by M. Bondonneau.—Synthesis of benzoic acid and of benzophenone, by MM. Friedel, Crafts, and Ador.—Experiments on the tape-like development of human cysticercus, by M. Redou. Man may, like swine, become completely infested by cysticerci. M. Redou caused some cysts from a human body to be ingested with tepid milk into young pigs and dogs ; he also swallowed some himself. It appeared that only man presents a favourable medium ; the pigs and dogs gave no trace of the tape-worms ; but the author after about three months discovered worms in his stools. This throws light on the nature of the development of the human cysticercus, and presents a striking exception to the law of parasitism with alternating generations.—Description of the meteoric stones of Rochester, Warrenton, and Cynthiana which fell respectively on December 21, 1876, and January 3 and 23, 1877, with some remarks on previous falls of meteorites in the same region, by Mr. Smith.—M. Bouvel called attention to an arrangement for compressing oxygen and hydrogen to considerable pressures. The wires from a battery are conducted into a thick metallic block containing a strong glass voltameter with one chamber double the other ; under the chambers are the terminal electrode immersed in acidulated water, the bottom of the reservoirs being closed by a strong screw. The reservoir communicates also with another cylinder in which a screw can be made to press on the liquid. Two narrow passages rise from the gas chamber and are closed by screws.

CONTENTS

ERRATUM.—In NATURE, vol xvi. p. 330, the reference to the *Astron. Nach.* should be to Nos. 1,663 and 1,733