but serving to promote the oxidation of the sulphurous oxide at a temperature considerably below that at which sulphuric oxide decomposes when heated. The action of surfaces generally may well be of this character, and the converse influence they so frequently exercise is probably an effect of the same order.

I have elsewhere raised the question whether there may not be a difference between actions taking place under the influence of low and of high electromotive forces—whether water, *per se*, may not be an electrolyte towards high, although not towards low, forces, in the case of high temperature changes, or those brought about under the influence of the electric spark, for example. More attentive consideration of the subject has led me to think that this is not the case, and that we must treat high temperature changes such as occur and are involved in gaseous explosions in the same way as those occurring under ordinary conditions and at low temperatures. From this point of view, Mr. Baker's statement that ammonia and hydrogen chloride do not combine is of extreme importance; the formation of ammonium chloride from these two compounds apparently involves no interchange, but a mere combination of two substances each endowed with considerable "residual affinity," and there is no reason why a distinction should be drawn between such a case and that afforded by, say, *atoms of hydrogen and oxygen*, the difference being, it would seem, one of degree only; in fact, I am no longer inclined to believe that atoms are capable of directly uniting. In all cases at least one function of the (composite) electrolyte would appear to be that of providing the necessary "mechanism" whereby the degradation or discharge of the energy is effected. If this argument be sound, its logical extension involves the conclusion that *pure* gases should be dielectrics, *i.e.* that the passage of an electric discharge through a gas like that of an explosive wave through, say, a mixture of hydrogen and oxygen, can only take place if an electrolyte be present. Hitherto but little attention has been paid to the electric discharge in gases which have been highly purified. The peculiar behaviour of Tesla tubes referred to by Mr. Crookes in the discussion on Mr. Shenstone's paper on the formation of ozone is, perhaps, explicable from this point of view—it may be that the atmosphere within the tube does not become conducting until sufficient moisture and "impurity" have been projected from its sides. It is conceivable that a similar explanation may hold good in the case of Prof. Schuster's observation, that it is possible to urge a current of low electromotive force across a gas subjected to a high electromotive force in itself insufficient to cause a discharge in the gas; the atomic dissociation hypothesis put forward in explanation of the phenomenon does not appear to me to be sufficient.

Finally, the question arises, Can no line be drawn; are no two pure substances capable of combining or interacting:—For example, water and sulphuric anhydride? There is little to guide us here, but it seems not unlikely that water has special properties which enable it to act directly; moreover—perhaps because—in such cases composite electrolytes would result. Ammonium chloride, so long as it remains solid, is clearly a compound of a different order, and it may well be that compounds of this type are in no case directly obtainable from their constituents, because, under the conditions under which they are formed, they cannot behave as electrolytes.

Apparently, in all cases in which molecular aggregates are formed—as in the case of solutions—we are dealing with dissociable and dissociating systems, and it is not improbable that we may ultimately find an explanation of the mechanism of such changes in this fact.

At present there is no information forthcoming whether simple electrolytes, such as fused silver chloride, for example, will condition chemical change in the way that water does—whether, for instance, silver chloride will condition the formation of hydrogen chloride from chlorine and hydrogen, so that a gas battery might be constructed of these three substances.

HENRY E. ARMSTRONG.

THE SUCCESSION OF TEETH IN MAMMALS.

PROF. H. F. OSBORN, in the *American Naturalist* for June, gives an account of recent researches upon the succession of the teeth in mammals. He says:—

"The recent studies of Kükenthal, Röse, and Taeker in the discovery of the complete double or milk dentition in the Marsupials, and in the discussion of its relation to that of the reptiles, also in the ontogenesis of the crowns of the teeth among the Cetaceans, Edentates, Primates, and Ungulates are of the greatest interest and importance. They involve a complete revolution in our ideas as to the interpretation of the dentition in the three orders first mentioned above."

After giving an account of the work done by the European observers, Prof. Osborn shows, by means of a table, the phylogenetic order as observed by Cope and Osborn, and the ontogenetic order as observed by Röse and Taeker. His researches indicate that the earliest forms of mammals were homodont, and had two or more series of successional teeth. Then within the mammalian stem the teeth were differentiated, and there arose a great heterodont group with teeth at least of three kinds—incisors, premolars, and molars, all successional. From the most anterior premolar arose the canine. Then came the division between the Marsupials and the Placentals, the former tending to suppress the development of the second series of teeth, the latter retaining the second series as far back as the first molar. There is an obvious advantage in the line of succession being drawn at the first molar,[1] for upon the molars rested the necessity of complex development, and such development was best effected in permanent crowns.

1. All the so-called "milk molars" plus the so-called "true molars" constitute the *first series*. Beneath one or more of the "true molars" in lower mammals are rudiments of a second series. The *second series* consists therefore of these submolar rudiments plus the successional or permanent premolars, incisors and canines.

2. In the stem Marsupials the entire first series persisted and became mainly permanent (non-deciduous); the second series became rudimentary and non-successional with the exception of the fourth upper and lower premolars, and possibly one or two other teeth which either replaced or were intercalated between members of the first series. One or more premolars were suppressed, and one more molar retained than typical in the Placentals. Thus is explained the apparently atypical dental formula of Marsupials.

3. In the stem heterodont Placentals (excepting the Cetacea and Edentata) the entire first series persisted, and all the incisors, canines, and premolars remained deciduous. The successional second series persisted as far back as the first molar.

4. In the stem Cetacea the entire first series persisted, and the second series became rudimentary and non-successional. The tooth form changed from a heterodont to a homodont type.

5. In the stem Edentates, which also transformed from the heterodont to the homodont type, the first series became rudimentary, and the second series persisted in the succession even behind the region of the first molar.

Finally, there is evidence that a primitive succession in the region of the molar teeth, lost in the Marsupials and in the Placentals, was more or less fully retained in the Cetacea and Edentates.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Governors of the Glasgow and West of Scotland Technical College have appointed Mr. W. H. Watkinson, lecturerer on engineering, Central Higher Grade School, Sheffield, to the Chair of steam, steam engines, and other prime movers, recently instituted in the college. By several important changes, the engineering department has been recently reorganised, Prof. Jamieson devoting his attention entirely to electrical engineering, Prof. Rowden to mechanics (theoretical and applied), Prof. MacSay to machine drawing, and Prof. Watkinson to the subjects stated above. With this addition and rearrangement the college now possesses an engineering staff worthy of one of the greatest engineering centres in the kingdom. Many additions are wanted, however, to bring the laboratories and general equipment to a position of equality with those even in many provincial towns.

[1] The law of molar evolution is that complication is most rapid in teeth which are longest in use. Thus the first molar is the most progressive tooth of the true molar series, and the last premolar is the most progressive of the premolar series. The apparent exception that the third milk premolar is always an advance type of the third permanent premolar is explained by the fact that the milk premolars are formed to assume the molar function

We have received from the Cambridge University Extension authorities the detailed programme of their summer meeting. Courses of study extending over a month (from July 29 to August 26 inclusive) have been arranged, intended primarily for those connected in some way with the University Extension Movement, though all members of the teaching profession and other students are also admitted. Though the full course extends over a month it has been arranged that those who can only spare a fortnight shall have a fairly complete course of work to go through. The subjects on which instruction is offered are extremely varied, including history, literature, and language, art, economics, and natural science. On the scientific side several courses of laboratory work are provided and in addition there are to be a set of lectures illustrating, from the history of several sciences, the progress and methods of natural science. The services of Sir Robert Ball, Sir Henry Roscoe, and a number of other well-known lecturers have been secured. Many intending visitors will be glad also to see that the authorities have not forgotten that August is a time for recreation as well as study and have made special arrangements for boating, for admission to college gardens, as well as for several excursions to places of historic, artistic, or scientific interest. Three colleges have agreed to board students at extremely moderate rates, and there is an abundance of lodgings. The total expense of the month for a student living economically need not exceed £6 or £7. There are probably not many other ways in which such a pleasant and profitable holiday can be spent for so small a sum.

THE following elections to natural science scholarships at Oxford have been announced :—Mr. H. C. H. Carpenter, of Eastbourne College, to a Natural Science Postmastership at Merton College. Mr. T. J. Garstang, of Manchester Grammar School, to a Natural Science Scholarship at Corpus Christi College. Mr. Richard Warren, of the Charterhouse, to an Open Natural Science Scholarship at New College. In each case the value gained is £80 per annum.

SUMMER courses seem to be the order of rhe day. The Marine Biological Laboratory at Woods Holl, Massachusetts, was opened on June 1, and will remain open until August 30. The Laboratory has aquaria supplied with running sea-water, boats, a steam launch, collecting apparatus, and dredges. There are thirty-three private laboratories for investigators, and five general laboratories. Short courses has also been arranged in zoology and botany, the laboratory work in each case being accompanied by lectures. Every facility is given for the obtain- of general knowledge, while those who are prepared to begin original work, under the guidance of instructors, are provided for as well as the practised investigator. This classification of workers into three grades is an excellent one and well worthy of imitation.

COL. SIR CHARLES W. WILSON, F.R.S., has been appointed Honorary Master of Engineering of the University of Dublin.

SCIENTIFIC SERIAL.

American Meteorological Journal, June.—The principal articles are : Note on the relation of solar spots to terrestrial anticyclones, by A. Searle. The relation considered is not one of cause and effect, but simply an analogy recently suggested in the *Astronomische Nachrichten*, by E. von Oppolzer, whose idea is to substitute the anticyclone instead of the cyclone as is usually done, as the terrestrial term of the comparison. The author considers the comparison to be both striking and plausible, but Prof. Davis thinks it should be limited to terrestrial anticyclones during winter nights.—A new series of isanomalous temperature charts, based on Buchan's isothermal charts, by S. F. Batchelder. The author has constructed a new set of isabnormal charts, based on the observations of the *Challenger* expedition, which are said to show more plainly than those of Humboldt and Dove the departures from the average temperature of a parallel of latitude. The cold area on the west coast of South America is found to be 10° too cool, instead of 6°·7 ; that on the west coast of Africa to be 6° instead of 4°·5. The excess of heat of Southern Alaska is given as 10° instead of 6°·7, and the south coast of Norway (under the influence of the Gulf Stream) is found to be 23° over the average for the latitude, instead of 20°·3, while the cold areas in the interior of North America and Asia, given as 11°·3 by Dove, are now shown to be 14° below the mean temperature of their latitude.—Proposed subjects for correlated study by State Weather Services, by W. M. Davis. The non-telegraphic records are almost entirely reduced in an arithmetical manner, suitable for the determination of climate, but not for the determination of unperiodic factors of the kind with which weather changes are concerned. The author suggests that all observers should make hourly records of the ordinary weather elements on certain days, that these observations should be charted for every hour, and afterwards consolidated on a single map for the whole country, by which means some extremely interesting illustrations of weather phenomena would be gained, and give a better knowledge of processes now imperfectly understood.—Meteorology as the physics of the atmosphere, by W. von Bezold. This concluding part deals more especially with observations made in balloons, and with thermometer exposure. The author thinks it probable that Dr. Assmann's aspirator will show that the temperatures hitherto made in balloons are affected by radiation to the extent of 10° at least. He also gives some valuable advice as to the observation of clouds, and draws especial attention to the importance of observing not only their outward appearance, but more particularly their formation and dissolution, so as to establish their classification and nomenclature upon a natural basis.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 8.—"The Experimental Proof that the Colours of certain Lepidopterous Larvæ are largely due to modified Plant Pigments, derived from Food." By E. B. Poulton, F.R.S.

The object of this investigation was to afford a conclusive test as to the theory, previously submitted by the author, that some of the colours of certain Lepidopterous larvæ are made up of modified chlorophyll derived from the food-plant.

Larvæ from one batch of eggs laid by a female *Tryphæna pronuba* were divided into three lots fed (in darkness) respectively throughout their whole life upon (1) green leaves, (2) yellow etiolated leaves, and (3) white mid-ribs of cabbage. The larvæ fed upon (1) and (2) became green or brown as in nature, thus proving that etiolin, no less than chlorophyll, can form the basis of the larval ground-colour. Those fed upon (3), in which neither chlorophyll nor etiolin was accessible, were entirely unable to form the green or brown ground colour. The production of dark superficial cuticular pigment was, however, unchecked. One of the larvæ fed in this way was perfectly healthy, and had become nearly mature when it was accidentally killed. Many others died early, but resembled that last described in the inability to form a ground-colour.

The experiment seems to leave no doubt as to the validity of the conclusions previously reached. Interesting questions as to the changes passed through by the derived pigments are suggested by this inquiry.

"The Menstruation of *Semnopithecus entellus*." By Walter Heape, Balfour Student at the University of Cambridge. Communicated by Prof. M. Foster, Sec.R.S.

"Researches on the Structure, Organisation, and Classification of the Fossil Reptilia. Part viii. On further Evidences of *Deuterosaurus* and *Rhopalodon* from the Permian Rocks of Russia." By H. G. Seeley, F.R.S.

Royal Meteorological Society, June 21.—Dr. C. Theodore Williams, President, in the chair.—Mr. R. H. Scott, F.R.S., read a paper on fifteen years' fogs in the British Islands, 1876–1890, which was a discussion of the fog observations made at the stations which appear in the *Daily Weather Report*. From the observations it appears that there is no trace of a regular increase either in the monthly or in the annual curve. All that can be said is that taking the three lustral periods of five years each, the last of these, 1886–90, comes out markedly the worst, the successive totals being 262, 250, 322.—A paper on upper currents of air over the Arabian Sea, by Mr. W. L. Dallas, of the Indian Meteorological Office, was also read, in which it is shown that there exists a regular arrangement in the vertical succession of the upper currents, and that the Doldrum region,