derivative $CH_2I\cdot O\cdot CH_2I$ is simultaneously formed. Incidentally M. Henry observed that phenol reacts in a most violent manner with formaldehyde, great heat being evolved, and a remarkable porcelain-like substance being produced which is insoluble in all the usual solvents.

THE additions to the Zoological Society's Gardens during the past week include a Black-handed Spider Monkey (*Ateles ater*, ♀) from Eastern Peru, presented by Mr. L. Clarke; a Coot (*Fulica atra*) European, presented by Mrs. L. Spender; two Wedge-tailed Eagles (*Aquila audax*) from Australia, presented by Mr. F. W. Burgess; a Long-billed Butcher Bird (*Barita destructor*) from New Holland, deposited; a Salvin's Amazon (*Chrysotis salvini*) from South America, two Purple-capped Lories (*Lorius domicella*) from Moluccas, purchased; a Yak (*Pœphagus grunniens*) born in the Gardens.

## OUR ASTRONOMICAL COLUMN.

HARVARD COLLEGE OBSERVATORY REPORT.—In this, the forty-eighth annual report to the President of the University, Prof. Pickering, the director of the Astronomical Observatory of Harvard College, has a fine record of work to refer to, which has been carried out during the twelve months ending October 31, 1893. We make the following brief extracts from the accounts given of the various branches of work done in the several departments. The East Equatorial was on the whole worked by Mr. O. C. Wendell, and employed for the systematic observation of variable stars upon the system lately adopted. Photometric observations of Jupiter's satellites (twenty-five in number) were made; forty-eight series of wedge photometer observations (3354 measurements) for determining the brightness of 1118 stars occurring in the Durchmusterung, were also made. Among other uses of this instrument were the observations of comets, measurements with the polarising photometer, &c. The Meridian Circle has been, as usual, at work under the direction of Prof. W. Rogers, while good progress has been made in the reductions of the observations of the southern stars with the meridian photometer. The observing list for the latter observations contains about 6000 stars, and excluding the 4000 already contained in the Harvard Photometry, three quarters have now been made. Mr. W. Reed, with the West Equatorial, on eighty-seven evenings has made observations on variable stars (489), comparison stars (1318), and ten on the brightness of Comet Holmes.

With regard to the Henry Draper Memorial, Mrs. Fleming has given us, as usual, her list of stars with peculiar spectra, and her examination has resulted in the discovery of the new star in Norma. In addition to a classification of the 20149 spectra of stars for the new catalogue, work has been done with the 8-inch and 11-inch, resulting in the production of 2424 and 1037 photographs respectively. A most interesting series (213 photographs) of $\beta$ Aurigæ has also been obtained.

In the Boyden Department, in addition to an expedition to observe the total solar eclipse in April last, important work was done by the 13-inch telescope, which was devoted to a study of the members of the solar system, an account of which has been previously referred to in this column. Prof. Bailey, the director of the third expedition, began work on April 4, and with an 8-inch and 13-inch telescope has obtained 1516 and 852 photographs with these two instruments respectively; some of these pictures show some very remarkable southern clusters. This observatory has also a meteorological station on Mount Chachani, 16,650 feet, the highest in the world; a second one has now been established on the volcano El Misti, at an elevation of 19,200 feet, with self-recording instruments. The Bruce photographic telescope will now be soon completed and ready for work, but the Bruce transit photometer has already made some progress towards the observations of tenth magnitude stars as standards for faint stellar magnitudes. Zodiacal phenomena have also been systematically observed. The new brick building for the thirty thousand glass photographic plates is finished, and the plates have been transferred. In his concluding remarks Prof. Pickering alludes to the difficulty, now becoming more and more significant every year, with regard to the observation of faint objects, owing to the increasing number of electric lights in the neighbourhood. An "electric tram" trouble seems also approaching a focus in the near future. We hope Prof. Pickering will successfully override these difficulties.

THE "GEGENSCHEIN."—In order to find out the origin of this peculiar phenomenon an effort has been made to obtain observations as nearly contemporaneous as practicable, and made at widely separated points. The distribution of light in the zodiac, and particularly of the slight maximum nearly opposite the sun, and known as "Gegenschein," or Counter-glow, has for some time past attracted the attention of astronomers, and we hope the present systematic attempt will be rewarded with successful results. Those cooperating in this work are Prof. Barnard, of the Lick, Prof. Bailey at Arequipa, Prof. Searle and Mr. Reed at Strafford, Vermont, and Mr. Douglass at Cambridge, U.S.A. Prof. Barnard, after describing the general appearance of this phenomenon (*Astr. Journal*, No. 308), besides noticing the change of form and its connection with a zodiacal band, finds that his observations show that the "Gegenschein" lags behind exactly opposite the sun, or, in other words, that its longitude is not quite 180° greater than that of the sun. His numbers are:—

| From | $\lambda-\odot$. | $\beta$. | No. obs. |
|---|---|---|---|
| 1883–1887 ... ... | 179·4 ... | +0°·4 ... | 16 |
| 1888–1891 ... ... | 179·4 ... | +1°·3 ... | 16 |
| Sept. and Oct. 1893 | 179·6 ... | +0°·5 ... | 22 |

His observations show no decided parallax to the object, but an appreciable north latitude, as seen from the value of $\beta$ in the table above, will be noticed.

Prof. Barnard believes that the latitude of the "Gegenschein" and the lagging in longitude to be due to "atmospheric absorption, and that the object is exactly opposite the sun, and that it lies in the ecliptic, and if its centre were a definite point the position of the sun could be accurately determined from observations of the 'Gegenschein' by changing the sign of the declination and subtracting twelve hours from the Right Ascension."

## GEOGRAPHICAL NOTES.

THE Arctic expedition planned by Dr. Stein, of the U.S. Geological Survey, as the first of a series for the gradual exploration of the Arctic regions from a base in Ellesmereland (see NATURE, vol. xlix. p. 18), is being actively prepared. According to Reuter's agency the command of the expedition has been offered to Baron Nordenskiöld, who has contributed £250 to its fund and has arranged by cable to keep a place open for a Swede on the staff. Dr. Stein has agreed to the latter proposal, and has stated that his first duty will be to search for the Swedish naturalists Björling and Kalstennius, whose tragic story has been briefly told in this column (p. 85). The possibility that the unfortunate party was able to reach the Eskimo of Ellesmereland and live with them for two years is very slight, but as long as the faintest chance remains it is satisfactory to find that arrangements are being made for a search and possible succour.

M. E. A. MARTEL, whose researches on the subterranean watercourses of France and Greece are well known, has been investigating the Adelsberg Grotto and other *karst* phenomena of Carniola, in company with Herr Putick. They were able to solve conclusively some points in the hydrology of the river Piuka, and found their way into parts of the Adelsberg cavern never before reached, proving that the whole length of the underground passages in connection with it is not less than 10 kilometres.

WITH the publication of vol. xix., dealing with South America, M. Elisée Reclus' great work, "Nouvelle Géographie Universelle: La Terre et les Hommes," has been completed. Twenty years have elapsed since the first volume was published, and these years have seen immense advances of geographical knowledge; but by the device of treating the less known continents at the end of the work, it has not fallen seriously out of date. Its great features are the philosophic grasp of the relation of man to his natural surroundings, and the working out of this relation for each continent and country. It is unfortunate that the state of public feeling on the continent makes it impossible for the University of Brussels to carry out the appointment of M. Reclus to a professorship there (see NATURE, vol. xlvii. p. 327 on account of his political views.

AT a meeting of the Royal Scottish Geographical Society, held last week at Edinburgh, with Prof. J. Geikie in the chair, to consider the question of Antarctic research, the following resolution by the council of the Society was read:—"That at this meeting, held for the discussion of Antarctic research, the Royal Scottish Geographical Society resolves to give its hearty support to the promotion of further exploration in the Antarctic. The Society's council is of opinion that at the present time a properly equipped Government expedition would, with the increased advantages of steam and modern appliances, have every prospect of successful explorations in the South Polar regions. The council is also convinced that the additions which might be made to our knowledge of climatology, terrestrial magnetism, geology, and natural history, would be of such practical scientific value as to fully justify the equipment of such an expedition at national expense. Towards the promotion of this object the council considers it desirable to submit a memorial on this subject to her Majesty's Government, and in this action they invite the cooperation of all the leading scientific societies of Scotland. To this end the Society appoints an Antarctic committee, consisting of Dr. John Murray, Prof. James Geikie, Dr. Buchan, and Mr. J. G. Bartholomew, together with the delegates of the other scientific societies, with instructions to draft such a memorial and take such steps towards the promotion of Antarctic exploration as is deemed desirable." A committee of the Royal Geographical Society was formed on the occasion of Dr. Murray's paper (NATURE, vol. xlix. p. 112), and has already been at work for some time with a view to bring the whole question of Antarctic exploration before Government. The course of action of this committee we understand to be the memorialisation of the Royal Society, requesting that body to take the lead in approaching the Government after ascertaining the feeling of all the leading scientific societies of the United Kingdom.

## *THE RISE OF THE MAMMALIA IN NORTH AMERICA.*[1]

### II.

### *Primitive Trituberculism.*

There is a very general tendency among the vertebrates as a whole, fishes and reptiles as well as mammals, to form what are called "triconodont" crowns by the addition of lateral cusps to simple cones. In the mammals alone, these three cusps pass into higher stages of evolution, through what is called "trituberculy," in which these cusps form a triangle. The discovery of primitive widespread trituberculy by Cope was a great step forward. In looking over the odontographies of Cuvier, Owen, Tomes, and Baume, we find there is no suspicion of this common type around which the highly diverse mammalian molars centre. The molars of the clawed and hoofed mammals can now be compared, as we compare the hand or foot of the horse with that of the cat, because they spring from a common type. All the specialised mammalian series—ungulates, primates, carnivores, insectivores, rodents, marsupials—are found playing similar yet independent adaptive variations upon one type. We thus have a clue to the comparison of all molars with each other and with the reptile cones; take the human grinders, for example. The anterior outer cusps in the upper jaw, and the anterior inner cusps in the lower jaw, are homologous with each other and with the reptilian cone. Leaving aside for the moment Multituberculates and Monotremes, every known triassic, jurassic, cretaceous and basal eocene mammal (excepting Dicrocynodon) is in some stage of trituberculy; all the known cretaceous molars are simple triangles above; all later fossil mammals also converge to trituberculy, until in the lowest eocene every molar is tritubercular, and the early stages of divergence are so similar that it requires a practised eye to distinguish the molar of a monkey from that of a horse. Embryology supports the evidence of these fossil series. Thanks to the recent admirable researches of Röse and Tæcker, we find in the primates, ungulates and marsupials, that in the calcification of its dental caps every molar is heralded by *three cones placed in a triangle*, and in the lower jaw these three cones invariably appear in the same order (protocone, paracone, and metacone) in which they arose during the remote geological periods.

Continued from p. 238.

It is necessary to mention this overwhelming palæontological evidence, because "trituberculy" is still not universally recognised; Fleischmann and others have questioned the homologies of the upper and lower triangles, and two able writers, Röse and Forsyth Major, have independently proposed an opposition theory that "multituberculy" or "polybuny" is the mammalian archetype, the latter author believing trituberculy has become a "dogma." So far, however, from there being any decline of evidence, I am now able to add the Cretaceous mammalia to the tritubercular lists and bring forward evidence that the multitubercular molar instead of being primitive was derived from the tritubercular; moreover, all the researches I have been quoting tend to draw the mammals without exception into one of three great primary forms. The haplodont form, from which Dromotherium is just emerging in the Trias, is the oldest and nearest the reptiles; the triconodont, or three cones in line, was a predominating lower Jurassic type; the tritubercular, or three cones in a triangle (trigonodont, Rütimeyer), was the prevailing upper Jurassic and later form. The final predominance of the tritubercular over the others was due to its possibilities of mechanical adaptation to work of every kind—its *potential* in evolution. Upon the polyphyletic theory of the origin of the mammals here advocated, we must admit, first, the independent evolution of trituberculy in different phyla; and second, the branching off of several great groups in the pretritubercular stages.

The tendency of late research is to show that all stem mammals were related in their diphyodontism, in their dental formula, and in their primitive molar form. These features point, not to a succession, but to a unity of ancestry of the Monotremes, Marsupials, and Placentals.

### *Divergence of the Three Groups.*

The discovery of the complete double series seems to have removed the last prop from the theory of the Marsupial ancestry of the placentals, for the peculiar mode of suppression of the second series in the Marsupials has been constant since the Purbeck; this difficulty is added to the structure of the jaw, the epipubic bones, the profoundly different mode of fœtal nutrition. None the less, any conclusion we can draw now as to the primary relations of the three great groups is more or less of a "Schwindelbau," and I put together the results of these later discoveries with a full realisation of the temporary character of present conclusions.

The Permian Sauro-Mammalia (Baur) with a multiple succession of simple conical teeth divided into: A, Theromorpha, which lost the succession and in some lines acquired a heterodont dentition and triconid single-fanged molars; B, Promammalia.

The hypothetical lower Triassic Pro-mammalia retained a double succession of the teeth; they became heterodont, with incipient triconid double-fanged molars; dental formula approximating 4. 1. 4–5. 8. They gave rise to three groups: I. The Prototheria which passed rapidly through the tritubercular into the multitubercular molars in the line of Multituberculates, and more slowly into trituberculy and its later stages in the ine of Monotremes. II. The Metatheria or Marsupials tended to suppress the second series of teeth, except those intercalated with the first; by this and by reduction the formula became 5. 1. 3. 4–6; the molars passed slowly through the triconodont into the typical triiubercular type. III. The Eutheria or Placentals divided early into a number of branches, in which there was heterodontism, but no uniform modification of succession.

We may distinguish four chief branches among these, as follows: (A) forms suppressing the second series in the molar region only, and acquiring a typical Eutherian dentition, 3. 1. 4. 3–4. 1. The Insectivores tended to partly suppress the anterior teeth of the second series or intercalate them with teeth of the first series; the molars became tritubercular. 2. The higher Placentals retained the succession of the first and second series as far back as the first molar; the molars entered rapidly into trituberculy and its higher stages. (B) forms retaining the double succession in part of the molar region, and retaining more of the primitive dentition, 4. 1. 4. 8. 3. The Edentates branched off from an early triconodont or tritubercular