have lost none of their value, notwithstanding subsequent exploration; and the whole gives a vivid description of the explored region, from the Caspian Sea, over the Ust-Urt plateau, to the mouth of the Amu-daria and to Samarkand. Of the many short notes scattered in the diary we may select one in which it is mentioned that Barbot de Marny has had the opportunity of finally ascertaining that the so-called *bugry* of the Caspian shore are simply due to denudation. The layers of clay and sand of which they consist are mostly horizontal, and, when they are not so, the stratification has no relation whatever to the exterior shape of these elongated low ridges. The next contribution to the same fascicule is by M. Andrusoff. It is full of geological data, and its conclusions are very interesting, the author never failing to discriminate between what is already proved and what still belongs to the domain of hypothesis. His remarks about the Caspian Sea and its present fauna being remains of a Miocene sea, and the enumeration of the geological problems in connection with that fact which remain yet unsettled, will be read by geologists with interest, the more so as the substance of this paper has been given in German in the *Jahrbuch der k.k. Geologischen Reichsanstalt*, vol. xxxviii.

THE following are the arrangements for Tuesday evening lectures at the Royal Victoria Hall during November:—November 4, Mr. Arnold Mitchell, "Old Buildings and the Story they tell"; November 11, Mr. A. H. Gilkes, "Columbus"; November 18, Mr. A. P. Laurie, "Air and Water," with experiments; November 25, Mr. Hilliard Atteridge, "The New Divisions of Africa." The oxyhydrogen lantern will be used with all these lectures.

In our note on the Rev. J. A. Galbraith, on October 23, the last three lines should have been printed as follows:—"In 1854 he was chosen Erasmus Smith Professor of Experimental Philosophy. Along with Dr. Haughton, Prof. Galbraith was the author of various excellent scientific manuals."

In a communication to the current number of the *Comptes rendus*, M. Moissan announces the result of his redetermination of the atomic weight of fluorine. The method adopted consisted in converting a known weight of sodium, calcium, or barium fluoride, prepared in a manner specially devised by M. Moissan in order to exclude impurities, into sulphate by repeated ignition with pure sulphuric acid in a small platinum retort. The process for obtaining pure sodium fluoride was as follows. An already fairly pure specimen of sodium chloride was freed from the last traces of potassium by a large number of fractional crystallizations. This was then converted into bicarbonate, of soda by saturating its aqueous solution successively with ammonium and carbon dioxide. The precipitated bicarbonate, after repeated washing, was converted into the normal carbonate by boiling its solution in water, and the crystals which separated on evaporation were freed from traces of chloride by repeated partial crystallization. The carbonate was next converted into fluoride by treatment with redistilled hydrofluoric acid originally prepared by distillation of hydrogen potassium fluoride, HF.KF. The sodium fluoride thus obtained, after ignition at a red heat, was probably the purest specimen which has ever been obtained. As the result of five ignitions with sulphuric acid, the values obtained for the atomic weight of fluorine ranged from 19.04 to 19.08, when Na = 23.05 (Stas), S = 32.07 (Stas), and O = 16. The calcium and barium fluorides employed in the second and third series of determinations were obtained in microscopic crystals by precipitating potassium fluoride with calcium or barium chloride in dilute solutions of particular strengths. The values obtained in the case of four experiments with calcium fluoride varied from 19.02 to 19.08, and as the result of five determinations with barium

fluoride, 19.05–19.09. As barium fluoride is not so regularly decomposed by sulphuric acid as sodium and calcium fluorides, M. Moissan considers that the nearest approximation to the truth is afforded by taking the mean of the experiments with the two latter fluorides. This value is 19.05. Hence the atomic weight of fluorine may be considered, as has previously been supposed, to be practically represented by the whole number 19.

THE additions to the Zoological Society's Gardens during the past week include a Diana Monkey (*Cercopithecus diana* ♀) from West Africa, presented by Mr. Howard V. Henry; a Spotted Ichneumon (*Herpestes nepalensis*) from Nepal, presented by Mr. J. Percy Leith, F.Z.S.; a Polecat (*Mustela putorius*), British, presented by Mr. F. D. Lea Smith; two Laughing Kingfishers (*Dacelo gigantea*) from Australia, presented by Mr. W. B. Phillips; two Pomatorhine Skuas (*Stercorarius pomatorhinus*), British, presented by Mr. T. E. Gunn; a Cashmere Monkey (*Macacus pelops* ♀) from Cashmere, deposited; two Common Squirrels (*Sciurus vulgaris*), two Reed Buntings (*Emberiza schenichus*), two Redpolls (*Linota rufescens*), British, purchased; an Angora Goat (*Capra hircus* ♀ var.), received in exchange; two Vinaceous Turtle Doves (*Turtur vinaceus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on October 30 = oh. 36m. 39s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ' "
(1) G.C. 105	—	—	0 34 23	+41 5
(2) G.C. 117	—	—	0 36 43	+40 16
(3) δ Piscium	4	Yellowish-red.	0 42 58	+6 59
(4) η Ceti	3	Yellowish-white.	1 2 31	—10 49
(5) θ Ceti	3	Whitish-yellow.	1 18 30	—8 45
(6) α Andromedæ ...	1	White.	0 2 42	+28 20
(7) 3 Schj.	8	Deep red.	0 14 5	+44 6
(8) R Vepuculæ ...	Var.	Yellowish-red.	20 59 30	+23 23

Remarks.

(1) The spectrum of this bright nebula has not yet been recorded. The G.C. description is: "Very bright; very large; much extended in the direction 165°; very gradually very much brighter in the middle."

(2) This is the companion to the Great Nebula in Andromeda, which is described by Herschel as "exceptionally bright; large; round; pretty suddenly much brighter in the middle to a nucleus." With reference to the spectrum, Dr. Huggins notes: "This small but very bright companion of the Great Nebula of Andromeda presents a spectrum exactly similar to that of 31 M (the Great Nebula). The spectrum appears to end abruptly in the orange, and throughout its length is not uniform, but is evidently crossed either by lines of absorption or by bright lines." Referring to the Great Nebula, the same observer wrote: "The spectrum could be traced from about D to F. The light appeared to cease very abruptly in the orange; . . . no indications of the bright lines." A comparison of the two descriptions would lead one to suppose that the spectrum of the companion is the more discontinuous of the two, and, if this be the case, measurements of the positions of the brightnesses in the spectrum may teach us a good deal about the nebulae which have so-called "continuous" spectra. After such a definite statement by Dr. Huggins as to the existence of irregularities, it is highly desirable that further observations and measurements should be made. Carbon comparisons (spirit-lamp flame) are suggested.

(3) A star of Group II., with bands 2, 3, 5, 7, 8 so narrow that Dunér describes them as "little more than lines." Narrow bands are common to both the early and late species of the

group, but in the former case the bright carbon flutings are strongly developed, whilst in the latter they are barely visible. Another characteristic of the later species is the addition of absorption-lines to the narrow bands. The observations of Mr. W. J. Lockyer and myself show that δ Piscium represents a late stage of the group, there being little or no carbon radiation.

(4, 5) Stars of the solar type. The usual differential observations are required.

(6) A star of Group IV. Observations of the relative thicknesses of the hydrogen and additional lines should be made, and the characters and positions of the latter noted. It appears that in some of these stars the added lines are similar to those seen in α Cygni, whilst others are solar.

(7) In this star of Group VI. the blue zone is very pale, the carbon band λ 564 is very wide and dark, and band 4 is suspected (Dunér).

(8) There will be a maximum of this variable on October 31. The period is about 138 days, and the range from 7.5-8.5 to 2.5-13.0. According to Dunér, the spectrum is one of Group I, but excessively weak. More details may possibly be obtained if the spectrum be observed at maximum. A. FOWLER.

SPECTROSCOPIC OBSERVATIONS (SAWERTHAL'S COMET 1881 I, AND β LYRÆ)—Dr. Nicolaus von Konkoly, the Director of the Astro-physical Observatory in O'Gyalla (Hungary) has issued the volumes containing his observations made during 1888-89. He notes, with respect to Sawerthal's comet (1881 I.):—

"I have observed the spectrum with a Merz universal spectro-scope having one prism in position. This gave a dispersion of 8° (H to D), which was more than sufficient for my purpose. I was obliged to use this instrument, because the deviation it gave suited the focussing arrangement of the Kartaler refractor. The telescope of the spectro-scope magnified seven times.

"The continuous spectrum was not very bright, and faded away slowly at each end. I thought that I could distinguish the D line (dark). It was so weak, however, that I could not fix its position with the micrometer. The continuous spectrum extended from 673μ to 435μ . Besides this I was able to recognize five hydrocarbon bands which I have located five times. From these measurements I have deduced the following mean values: I. 561.46μ , II. 546.25μ , III. 515.88μ , IV. 513.26μ , V. 472.56μ .

"The lines were not sharply defined on either side, and were much widened near the continuous spectrum. The measurements given above are of the middle of the maximum light-intensity of the bands, which could be easily distinguished."

β Lyræ was spectroscopically observed on January 1, 1889, and it is recorded:—"The C line was bright and could be easily seen, and a dark band was visible at a slight distance from it. D_3 was distinguished in a similar manner. Near it, in the green, some fine lines could be perceived. F was suspected, but it was almost invisible."

Dr. Konkoly gives an extended account of his observations of Jupiter from 1885 to 1889, and accompanies it with a series of fourteen drawings of the planet. Several drawings of Sawerthal's comet are also given.

SPECTROSCOPY AT PARIS OBSERVATORY.—M. Deslandres has charge of the spectroscopic section just created at Paris Observatory, and in the current number of *Comptes rendus* (October 20) he gives an account of the instruments to be used with the great equatorial (1.20 metres aperture). Those who have tried to obtain photographs of star spectra by means of a slit spectro-scope on a large telescope, know how difficult it is to adjust a star on the slit, and, when there, to keep it in position for a sufficiently long time. To enable this to be done during a long exposure, M. Deslandres has arranged a total reflecting prism near the dark slide, so that the red end of the spectrum may be seen whilst the blue end is being photographed. In this way he has obtained many photographs of stellar spectra in juxtaposition with comparison spectra. To adjust the instrument for observing, the spectrum of a star, a small mirror, having a hole in the centre about the same diameter as the length of the slit, has been fixed in front of the slit at an inclination of 45° . The image of a star is thus reflected to the side of the instrument, and after another reflection reaches a small telescope fixed at the spectro-scope. This telescope, therefore, gives the image of a star in the plane of the slit, and constitutes a veritable finder for use with the spectro-scope.

NO. 1096, VOL. 42]

ON THE LATER PHYSIOGRAPHICAL GEOLOGY OF THE ROCKY MOUNTAIN REGION IN CANADA, WITH SPECIAL REFERENCE TO CHANGES IN ELEVATION AND TO THE HISTORY OF THE GLACIAL PERIOD.¹

DR. G. M. DAWSON has been engaged continuously for seventeen years in geological exploration of the Western Territories of Canada, including the country from Lake Superior to the Pacific; and in the paper above named he summarizes the history of the successive deposits and earth-movements which have built up the mountain ranges of the West, and the relations of these to the geology of the great plains to the eastward. He devotes special attention to the Glacial age, and concludes that the drift phenomena of the plains belong to a period of submergence, and that in the extreme period of glaciation there were great glaciers on the Cordillera on the west, and the Laurentian axis on the east, with a vast internal sea between. He is thus entirely opposed, as far as North America is concerned, to the idea of a Polar ice-cap or a great continental glacier flowing down the interior plateau of the continent, and he resolves the phenomena of the ice age into the operation of huge mountain glaciers and floating ice.

The leading points of the memoir may be summarized, with the aid of a few extracts, in such a manner as to convey a general view of the history of the great Cordilleran belt, which stretches along the west coast of America from Behring Straits to Cape Horn, and more especially to indicate that of its more northern portion.

The general structure of the country may be defined as follows:—

"At the present day, the western border region of the continent is formed by a series of more or less nearly parallel mountain-systems, with an average breadth in British Columbia of about 400 miles. The trend of these systems is north-west and south-east, or similar to that of the corresponding portion of the Pacific shore-line, the position of which, in fact, depends upon that of these orographic features. This generally mountainous zone of country is often referred to as the Rocky Mountain region, but is more appropriately named the Cordillera belt, the Rocky Mountains proper constituting only its north-eastern marginal range. In traversing it from east to west, in the southern part of the province of British Columbia, four distinct mountain-systems are crossed: (1) the Rocky Mountains proper, (2) mountains which may be classed together as the Gold Ranges, (3) the Coast Ranges, (4) an irregular mountain-system which in its unsubmerged parts constitutes Vancouver Island and the Queen Charlotte Islands, and which may be designated the Vancouver system. Between the second and third of these mountain-systems is a region without important mountain ranges, which is referred to as the Interior Plateau of British Columbia.

"To simplify our conception of the main features of this part of the Cordillera for our present purpose, we may, however, regard it broadly as being outlined on the north-east and south-west sides by the Rocky Mountains proper and by the Coast Mountains, as dominant ranges. This view is justified by the remarkable constancy of these two ranges and their relative importance. The intervening region may then be described as comprising the Interior Plateau together with the various ranges which have been grouped together under the name of the Gold Ranges, as well as other detached mountains and irregular mountainous tracts."

The geological history of British Columbia begins, like that of many other parts of the world, with that primitive crumpling of the earth's crust which produced the Laurentian gneisses. These exist principally in the Gold Ranges, and are in this region neither greatly extended nor of great elevation. In the Palæozoic age there were sea-bottoms receiving sediment, but apparently little mountain-making.

"Omitting, then, from consideration the imperfectly-known progress of events in the earlier stages of the geological history of the region, we may endeavour to picture to ourselves its condition in the Triassic or first stage in the Mesozoic division of geological time. The central region of the continent was at this time occupied by a very extensive, though shallow, mediterranean sea, which was either entirely cut off from the ocean

¹ By Dr. G. M. Dawson, F.G.S., Assistant Director of the Geological Survey of Canada. Transactions of the Royal Society of Canada, 1892. 73 pages quarto, with 4 maps.