Ontario, by G. C. Hoffmann; sun-spots observed at McGill Observatory, by C. H. McLeod; a test of Ewing and MacGregor's method of measuring the electric resistance of electrolytes, by J. G. McGregor; the later physiographical geology of the Rocky Mountain region in Canada, by G. M. Dawson; fossil plants from the Similkameen Valley and other places in the southern interior of British Columbia, by Sir J. W. Dawson.

MESSRS. SWAN SONNENSCHEIN AND CO. will issue the following books during the autumn season:—"The Colours of Animals," by Prof. Beddard, with coloured and other plates and woodcuts; "Text-book of Embryology: Man and Mammals," by Dr. Oscar Hertwig, Professor of Comparative Anatomy in the University of Berlin, translated and edited from the third German edition (with the assistance of the author) by Dr. E. L. Mark, Professor of Anatomy in Harvard University, with 389 illustrations and 2 coloured plates; "Text-book of Embryology: Invertebrates," by Drs. Korschelt and Heider, of the University of Berlin, translated and edited by Dr. E. L. Mark, with several hundred illustrations; "Text-book of Animal Palæontology," by Dr. Thomas Roberts, designed as a supplement to Claus and Sedgwick's "Text book of Zoology," illustrated; "Text-book of Geology," adapted from the work of Dr. Emanuel Kayser, Professor in the University of Marburg, by Philip Lake, of St. John's College, Cambridge, with illustrations; "Text-book of Zoology," by Dr. C. Claus, of the University of Vienna, and Adam Sedgwick, F.R.S., Vol. II. "Mollusca to Man," third edition; "The Geographical Distribution of Disease in England and Wales," by Alfred Haviland, M.D., with several coloured maps; "Introductory Science Text-books"—Additions: Introductions to the study of "Physiography," by H. M. Hutchinson; "Zoology," by B. Lindsay; "Amphioxus," by Dr. B. Hatschek, of the University of Vienna, and James Tuckey; "Geology," by Dr. Edward Aveling; "Physiological Psychology," by Dr. Th. Ziehen, of the University of Jena, adapted by Dr. Otto Beyer, with 21 figures. "Young Collector Series"—Additions: "The Telescope," by J. W. Williams; "British Birds," by the Rev. H. C. Macpherson; "Flowering Plants," by James Britten; "Grasses," by W. Hutchinson; "Fishes," by the Rev. H. C. Macpherson; "Mammalia," by the Rev. H. C. Macpherson.

AN instrument for optical comparison of transparent liquids, named a *liquoscope*, has been recently devised by M. Sondén, of Stockholm. Two hollow prisms holding the liquids are separated by a partition at right angles to the refracting angle. The whole is placed in a vessel filled with glycerine, and which allows of vision in a horizontal direction through plane glass plates. The deflection of the light rays through the prisms is thus compensated. So long as the two liquids have the same optical action, one sees a distant mark (say a black paper strip on a window) as a straight connected line; but its halves are relatively displaced if the liquids have different refractive power. The amount of displacement gives a measure of the difference, the positive or negative nature of which also appears from the direction of displacement. The author recommends his apparatus for chemical purposes, especially comparison and testing of fats and oils, analysis of glycerine, &c., and detection of margarine in butter, margarine greatly lowering the index of refraction.

HERR HUFNER has lately pointed out some of the biological bearings of the fact (observed in experiment along with Herr Albrecht) that long light-waves are much more strongly absorbed by water than short ones. If the lower marine animals had, like man, the liveliest light perception with yellow rays, and a certain intensity of light were necessary to them, they must live at a less depth than if their visual organs were most strongly affected by short-waved rays. Thus, *e.g.*, if they needed as much yellow light as that of the full moon, they could not live deeper than 177 metres (say, 590 feet). Yet they are found at all depths where food, oxygen, and a suitable temperature exist. On the other hand, the existence of plants having chlorophyll depends on light, and we might expect that the distribution of non-parasitic plants would be very limited; which is the case, no plant-organisms being found under 200 fathoms. Green plants assimilate best in yellow light; and supposing plants to assimilate in moonlight they would find their limit at the above depth (177 metres). But while yellow is here weakened to 0·0000016 of its brightness, indigo blue has still 0·007829 of its original strength, and the assimilation with blue rays will be 660 times as strong as with yellow. Different coloured marine plants react differently according to the colour of light, and they have accordingly different distribution in depth.

THE additions to the Zoological Society's Gardens during the past week include two Pinche Monkeys (*Midas œdipus* ♂ ♀) from Granada, presented by Mr. A. Aitken; a Fallow Deer (*Dama vulgaris* ♂), British, presented by Mr. J. Johnston; a Persian Gazelle (*Gazella subgutturosa* ♀) from Persia, presented by Baron Ferdinand de Rothschild; a Common Cormorant (*Phalacrocorax carbo*), British, two Yellow-browed Buntings (*Emberiza chrysophrys*), two Red-backed Buntings (*Emberiza rutila*), a —— Bunting (*Emberiza cioides*), two Japanese Greenfinches (*Fringilla kawarahibi*, var.) from Japan, purchased; a Yellow-footed Rock Kangaroo (*Petrogale xanthopus* ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE LINEAR ARRANGEMENT OF STARS.—Although the arrangement of stars in curves has often been noted and studied, little attention has been paid to what is apparently a more striking and prevalent feature, viz. straight lines and parallel arrangement of pairs, lines, and bands of stars, and of irresolvable wisps. Our knowledge of the structure of the sidereal universe is therefore extended in the required direction by some results obtained by Mr. T. W. Backhouse from observations which he has made during the last nine years in Sunderland. The area of the sky selected for scrutiny is that portion of the Milky Way included between 15, 13, 8 Monocerotis, α Orionis, ζ Tauri, and 5, μ, ξ Geminorum; and the configurations in this portion have been examined chiefly with a binocular field-glass of 2·05 inches aperture. The observations have been divided into sections, referring respectively to lines and parallel arrangements of stars, to those in clusters, to nebulous wisps, to nebulæ, and to miscellaneous lines. In these are given the detailed structure in different parts of the area showing various systems of parallel lines and wisps, together with their position-angles referred to that portion of Gould's galactic equator which runs through the middle of the area in question. The parallel arrangement of the stars, and an arrangement in straight lines, is strikingly obvious from the maps which illustrate the tabulated results of the observations. Besides the maps, sixteen figures have been drawn to show the various angles of position of the lines and streams with reference to the central line or axis of the Milky Way. From these figures it is apparent that the angles of position are grouped more numerously in certain directions than in others, the principal directions being nearly parallel to the galactic equator. Also, there is a great deficiency of position-angles at right angles to this equator. A wonderful case of radiation of stars and wisps in a fan-shaped group has been found, 68 Orionis being approximately the centre. One conclusion derived from the investigation is, that the stars and wisps in parallel lines are probably in the same region of space; and therefore that the majority of the stars in extensive tracts of the area examined are really near one another.

WOLF'S PERIODIC COMET.—This object can now be fairly seen by means of a small telescope. It will pass through the Hyades about September 25, and be 3° south of Aldebaran on October 2. The following ephemeris, from one given by Herr

Thraen in *Astronomische Nachrichten*, No. 3054, shows that the comet crosses the equator near the end of October :—

Ephemeris for Berlin Midnight.

1891.	Right Ascension. h. m. s.	Declination. ° ′ ″	Brightness.
Sept. 19 ...	4 9 50·40 ...	19 5 59·0 ...	9·1
,, 21 ...	13 7·99 ...	18 17 29·3	
,, 23 ...	16 16·09 ...	17 27 4·4	
,, 25 ...	19 14·09 ...	16 34 48·7	
,, 27 ...	22 1·58 ...	15 40 44·3	
,, 29 ...	24 38·50 ...	14 44 57·2	
Oct. 1 ...	27 4·25 ...	13 47 32·4 ...	11·2
,, 3 ...	29 19·10 ...	12 48 36·5	
,, 5 ...	31 22·56 ...	11 48 16·6	
,, 7 ...	33 14·86 ...	10 46 39·8	
,, 9 ...	34 55·42 ...	9 43 57·5	
,, 11 ...	36 24·69 ...	8 40 16·9	
,, 13 ...	37 42·51 ...	7 35 49·0 ...	12·0
,, 15 ...	38 49·17 ...	6 30 45·1	
,, 17 ...	39 44·06 ...	5 25 18·0	
,, 19 ...	40 27·92 ...	4 19 38·1 ...	12·1
,, 21 ...	41 0·53 ...	3 13 58·7	
,, 23 ...	41 22·25 ...	2 8 33·2	
,, 25 ...	41 33·30 ...	+ 1 3 35·1 ...	12·0
,, 27 ...	41 33·97 ...	− 0 0 47·0	
,, 29 ...	41 24·46 ...	1 3 57·7	
,, 31 ...	41 5·38 ...	2 6 8·0	
Nov. 2 ...	40 37·33 ...	3 6 51·3	
,, 4 ...	40 0·67 ...	4 5 54·6	
,, 6 ...	39 16·50 ...	5 3 7·0 ...	11·2
,, 8 ...	38 25·07 ...	5 58 14·5	
,, 10 ...	37 27·44 ...	6 51 6·6	
,, 12 ...	36 24·07 ...	7 41 33·4 ...	10·4

It will be seen that the comet is now nine times brighter than at the date of discovery (May 4). The maximum brightness will be reached about October 19.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE Address of the President of the Geological Section having been devoted to the general questions involved in the origin, association, and working of coal, it was natural that other papers on the economic side of the science should claim considerable interest. Prof. Boyd Dawkins stated that the Channel Tunnel boring had been carried to a depth of 1500 feet, with the result of penetrating coal-measures dipping gently to the south at 1113 feet. Six seams, containing 10 feet of workable coal, had been pierced between that depth and the present bottom of the boring. The author endeavoured to show the probability that a thick series of coal-measures, with workable coals like those of Liége on one side and Somerset on the other, would be met with if the boring were continued, and pointed out the advantage possessed by the south-eastern coal-field in its moderate depth and the comparatively uncrushed character of the coal.

In an exhaustive paper Mr. Topley summarized the chief facts bearing on the origin of petroleum. He pointed out that, while the American oil was mainly derived from Palæozoic rocks, that in Europe and Asia came largely from Secondary beds, and the large Caucasian supply was drawn from rocks of Miocene age. The essential conditions for the supply of oil appeared to be, a porous rock, generally of sandstone or limestone, which served as a reservoir and was underlain by or contained beds largely consisting of organic remains, with an impervious cover of shale. In many cases the limestone had been dolomitized and transformed into a cavernous rock which was capable of storing the gas and oil. Such rocks can contain from one-eighth to one-tenth of their bulk of oil. The oil was driven to the surface by artesian pressure, and so gas was generally met with on the summits of anticlines and oil on their flanks. Where the rocks were very highly disturbed oil occurred, but not in very great abundance, while gas was rarely found.

Mr. Ross, in a paper on the same subject, endeavoured to prove that the oil was mainly generated by the action of solfataric volcanic energy upon beds of limestone, basing his conclusion on the occurrence of hydrocarbon and sulphurous vapours in solfataras, and the constant association of rock salt, dolomite, and gypsum with the rocks yielding petroleum. He exhibited equations to show that the action of sulphur dioxide and sulphuretted hydrogen on carbonate of lime, with or without water and peroxide of hydrogen, was capable of producing the ethylene and marsh gas derivatives, and he quoted experiments of Bischof to show that sulphur was formed by similar reactions, arguing that the hydrocarbons must be necessary by-products.

Sir Archibald Geikie communicated two most important papers on the results of Geological Survey work in the North-western Higlands. One of these papers, relating to the discovery of the *Olenellus* zone in the North-west Highlands, was as follows :—"Ever since the Geological Survey began the detailed investigation of the structure of the North-west Highlands of Scotland, the attention of its officers has been continuously given to the detection of any fossil evidence that would more clearly fix the geological horizons of the various sedimentary formations which overlie the Lewisian gneiss. A large collection of organic remains has been made from the Durness limestone, but it has not yet yielded materials for a satisfactory stratigraphical correlation. The study of this collection, however, has confirmed and extended Salter's original sagacious inference that the fauna of the Durness limestone shows a marked North American facies, though, according to our present terminology, we place this fauna in the Cambrian rather than in the Silurian system. Below the Durness limestone lies the dolomitic and calcareous shaly group known as the 'Fucoid beds,' which, though crowded with worm-castings, has hitherto proved singularly devoid of other recognizable organic remains. In following this group southwards through the Dundonnell Forest, in the west of Rosshire, my colleague, Mr. John Horne, found that, a few feet below where its upper limit is marked by the persistent band of 'Serpulite grit,' it includes a zone of blue or almost black shales. During a recent visit to him on his ground, when he pointed out to me this remarkable zone, I was struck with the singularly unaltered character of these shales, and agreed with him that if fossils were to be looked for anywhere among these ancient rocks, they should be found here, and that the fossil-collector, Mr. Arthur Macconochie, should be directed to search the locality with great care. The following week this exhaustive search was undertaken, and Mr. Macconochie was soon rewarded by the discovery of a number of fragmentary fossils, among which Mr. B. N. Peach, who was also stationed in the district, recognized what appeared to him to be undoubtedly portions of *Olenellus*. The importance of this discovery being obvious, the search was prosecuted vigorously, until the fossiliferous band could not be followed further without quarrying operations, which in that remote and sparsely inhabited region could not be at that time undertaken. The specimens were at once forwarded to me, and were placed in the hands of Messrs. Sharman and Newton, Palæontologists of the Geological Survey, who confirmed the reference to *Olenellus*. More recently Mr. Peach and Mr. Horne, in a renewed examination of the ground, have found, in another thin seam of black shale interleaved in the 'Serpulite grit,' additional pieces of *Olenellus*, including a fine head-shield with eyes complete. There may be more than one species of this trilobite in these Rosshire shales. The specific determinations and descriptions will shortly be given by Mr. Peach. The detection of *Olenellus* among the rocks of the North-west Highlands, and its association with the abundant *Salterella* of the 'Serpulite grit,' afford valuable materials for comparison with the oldest Palæozoic rocks of other regions, particularly of North America. The 'Fucoid beds' and 'Serpulite grit,' which intervene between the quartzite below and the Durness limestone above, are now demonstrated to belong to the lowest part of the Cambrian system. The quartzites are shown to form the arenaceous base of that system, while the Durness limestones may be Middle or Upper Cambrian. On the other hand, the Torridon sandstone, which Murchison placed in the Cambrian series, can now be proved to be of still higher antiquity. The marked unconformability which intervenes between it and the overlying quartzite points to a long interval having elapsed between the deposition of the two discordant formations. The Torridon sandstone must therefore be pre-Cambrian. Among the 8000 or 10,000 feet of strata in this group of sandstones and conglomerates, there occur, especially towards the base and the top, bands of grey and dark shales, so little altered that they may be confidently expected somewhere to yield recognizable fossils. Already my colleagues have detected traces of annelids and some more obscure remains of other organisms