F.R.S. has been even more potent in securing the majority against the proposal of the council. What we are quite certain about is that for a long time past the elections to the fellowship of the Royal Society have (largely through this influence of "vested interests") got far too much into a groove. The honor of being labelled F.R.S. has gradually come to be regarded more and more simply as a higher "degree" added to the academic distinctions of men who have passed through the regular scientific "mill" and have contributed a certain number of papers to the *Transactions*. The result is that the Royal Society is not as fully representative as it ought to be of the genius of the country, to which, as in earlier days, its fellowship should be extended. This is particularly true of "men distinguished in the scientific or educational service of the state," the importance and originality of whose work for the nation have secured much more adequate appreciation in consequence of the light thrown on it during war-time. A more elastic procedure in the recommendations to fellowships has for some time past been seen to be called for by the wisest heads in the society, and the proposal of the council was the outcome. We hope that it will still be pushed, with more persuasive effect, even though for the moment nothing further is done.

NOTES ON CANADIAN STRATIGRAPHY AND PALEONTOLOGY

CORDILLERAN PROVINCE

Graham Island.—The Queen Charlotte Islands form part of the outer, largely submerged ranges of the northwestern Cordillera and are generally considered to be the northern continuation of the Vancouver Range. Graham Island is the largest and one of the most northerly of the group. Its geology is the subject of a memoir by MacKenzie.[1] The oldest rocks exposed on the island belong to the Vancover group and are divided into two formations, the Maude and the Yakoun. The former consists of argillites, sandstones, and tuffs; it contains a marine fauna of early Jurassic age and at two localities in the lower beds are "probably Upper Triassic" forms. The Maude formation contains a large amount of pyroclastic material in its upper portion and grades upward into the Yakoun volcanic agglomerate, composed of rather massive water-laid beds. Its marine fauna, largely pelecypods and ammonites, suggests correlation with Middle Jurassic sandstones in Alaska. Both formations are moderately metamorphosed and considerably disturbed by folds and faults. They are cut by batholithic intrusions which may be correlated with the Upper Jurassic Coast Range batholith. The orogenic movements causing the deformation of the Vancouver group manifested themselves as compressive stresses acting in a direction north 60° east and were concomitant with these intrusions.

Erosion during Comanchean time reduced the mountain ranges thus formed to a subdued topography which was buried beneath the Queen Charlotte series in the Cretaceous period. That series consists of the Haida sandstones and coal-bearing shales, the Honna conglomerates and sandstones, and the Skidegate sandstones and shales, named in ascending order. It is probable that the Queen Charlotte series was formed in estuarine basins by the sudden influx of a large amount of sediment carried in by rapid streams, and that the series as a whole represents a delta deposit reassorted and modified by the waves and currents of a shallow sea. During the Laramide revolution the rocks of this district were slightly folded and upraised; dacite and andesite dikes and sills were extensively injected. Following this uplift, the Cretaceous sediments were largely stripped from the underlying rocks, remaining only in synclinal basins.

Shallow-water sediments forming the Skonun formation were deposited during the Miocene period. Sedimentation was cut short by the resumption of volcanic activity on a tremendous scale, by which the Masset formation was built up. This vulcanism is best placed in the early or mid-Pliocene, and the close of this epoch was marked by a recur-

[1] J. D. MacKenzie, "Geology of Graham Island, B. C.," Geol. Surv., Canada, Mem. 88, 1916.

rence of deforming forces which locally severely flexed the Tertiary formations but in general disposed them in broad open folds. Quaternary time has been marked by erosion, glacial as well as fluvial, and there are some suggestions of a recent, slight, negative movement of the strand line.

A valuable correlation table of formations of Graham Island and neighboring districts faces page 118 of this excellent report.

Flathead Valley.—The Flathead coal basin, occupying a portion of Flathead Valley in British Columbia near the international boundary, is described in another memoir by the same author.[2] Bedrock formations range from strata which are probably Devonian to those of Eocene age. At the base are black limy sandstones and shales which have not yet yielded identifiable fossils but are referred to as "Devono-Carboniferous." Grey and black limestones conformably overlie the shales and range in age from Upper Mississippian to Lower Pennsylvanian, according to Girty's interpretation of two lots of fossils obtained from the middle and near the top of the formation. Above these limestones a white, quartzose sandstone was found. It is provisionally referred to the Triassic because of its position beneath the Fernie shales which elsewhere have been proved to be of Jurassic age. (The lithologic similarity between this Triassic (?) sandstone and the Jurassic La Plata sandstone of Colorado is noteworthy.) The Fernie formation is conformably overlain by the coal-bearing Kootenay sandstones and shales. The Kootenay beds were "accumulated in a long lake of varying depth, or, more probably, in a chain of lakes and swamps extending along what is now the axis of the Rocky Mountains." They are of Lower Cretaceous (Comanchean) age. Upper Cretaceous conglomerates and sandstones are believed to represent the Dakota formation. Orogenic disturbance during the Laramide revolution was followed by the deposition of the Kishinena formation during Tertiary time. The Kishinena beds are of freshwater origin and may be of Eocene age.

[2] J. D. MacKenzie, "Geology of a Portion of the Flathead Coal Area, British Columbia," Geol. Surv., Canada, Mem. 87, 1916.

CAMBRIAN

Trilobites.—A recent number[3] of Walcott's memoirs on Cambrian Geology and Paleontology contains descriptions and figures of several trilobites, some of them new, from the Lower and Middle Cambrian of Newfoundland, Quebec, Alberta, and British Columbia. *Corynexochus senectus* serves to correlate the upper beds of the *Olenellus* series of Newfoundland with the top of the Mount Whyte formation in the Lower Cambrian of British Columbia. A new subgenus of *Corynexochus* is named *Bonnia,* and to it are referred two closely allied species, one from the Mount Whyte formation and the other from the Lower Cambrian of Labrador and Quebec. To the genus *Bathyuriscus* are referred a new species from the Stephen formation near Field, B. C., and a new subgenus, *Poliella,* which comprises several small-tailed trilobites. Most of them are of Middle Cambrian age, but one occurs in the Mount Whyte formation and lived near the close of Lower Cambrian time. *Dolichometopus* and *Ogygopsis* receive thorough treatment and *Olenellus gilberti* is transferred to the genus *Mesonacis* on the basis of data derived from a Mount Whyte specimen. A new genus, *Pagetia,* is founded upon material from the Burgess shale member of the Stephen formation near Field.

New Brunswick.—A brief but important paper by G. F. Matthew[4] contributes to knowledge of the paleogeography of eastern Canada in early Cambrian time. The relations of Cambrian rocks in New Brunswick are presented in tabular form. At the base is found the non-fossiliferous Coldbrookian terrane, composed largely of volcanic rocks, overlain by the Etchiminian slates and sandstones with a scanty fauna of *Hyolithes* and *Obolus.* The overlying Acadian division of the St. John group is much more extensive because

[3] C. D. Walcott, "Cambrian Trilobites," Smithsonian Misc. Coll., Vol. 64, pp. 303–456, 1916.

[4] G. F. Matthew, "Notes on Cambrian Faunas," No. 12, *Trans. Roy. Soc. Canada.,* Ser. 3, Vol. 10, Sec. 4, pp 45–54, 1916.

of sea transgression. The lower fifty feet of this division contains the *Protolenus* fauna which Walcott interprets as marking the passage beds between Lower and Middle Cambrian. Above are shales and slates, 200 feet thick, carrying the *Paradoxides* fauna. The middle division, Johannian, of the St. John group consists of coarse clastics characterized by the presence of *Lingulella,* while the upper one, Bretonian, is largely dark gray to black shale which is in part of Ordovician age.

Emphasis is laid upon the complete separation of the Atlantic coastal seas from those of the interior of North America during early Cambrian time, and "the presence of a deep and broad abyss off the Atlantic coast in this early time" is postulated.

Ontario.—The Potsdam sandstones which outcrop in the vicinity of Kingston are described by M. B. Baker[5] in a report which in the main treats of pre-Cambrian geology. Two members, a lower buff, and an upper red sandstone, are recognized as forming the Potsdam formation. Both were deposited in the basins and hollows between low rounded hills of pre-Cambrian rock. Basal and other conglomerates are common. Cross-bedding is frequently observed and the strata are non-fossiliferous. The so-called "tree concretions" are interpreted as structural accumulations resulting from whirlpools and eddies.

ORDOVICIAN

Ontario.—Fossils from the Trenton limestone in the the Balsam Lake region are described by Ruedemann.[6] A new species of graptolite is referred to the genus *Inocaulis.* Unusualy well-preserved specimens of *Stenaster salteri* confirm the suspicion that this

Faunal Relations	Manitoulin Island	Toronto-Hamilton	Kingston	Ottawa Valley
	Whitewater, Saluda, Waynesvillle } Richmond	Queenston / Richmond		Queenston
				Richmond
	Wekwemikongsing	Pulaski } Lorraine		Lorraine
	Sheguiandah	Eden } Lorraine		
		Utica		Gloucester
	Collingwoood	Collingwood		Collingwood
				Upper Picton
Minnesota Prosser				Lower Picton
	Prasopora zone		Trenton	Trenton
Kentucky Curdsville	Stromatocerium zone			Hull
	Curdsville Trenton			
Watertown, N. Y. | Decorah, Minn.	Black River		Decorah zone	Rockland
	Leray		Leray	Leray
	Lowville		Lowville	Lowville
			Pamelia / Rideau	Pamelia
				Aylmer

Fig. 1. Correlation chart of Ordovician strata in Ontario. Compiled from papers by Foerste, Parks, Kindle and Raymond.

[5] M. B. Baker, "The Geology of Kingston and Vicinity," Ontario Bur. Mines, Ann. Rept., Vol. 25, Pt. 3, pp. 1–36, 1916.

[6] R. Ruedemann, "Paleontologic Contributions from the New York State Museum," New York State Mus. Bull. 189, 1916.

remarkable stelleroid belongs to the subclass Auluroidea. It is believed to be a primitive ophiuroid, which was still very close to the ancestral asterozoans.

The Ordovician strata of Ottawa Valley are described in summary style by Raymond.[7] The formational nomenclature and relationships are indicated in the accompanying table. Gloucester is a new formation name applied to the carbonaceous shales between the Collingwood and Cincinnatian strata. In correlating the Ottawa formations with those of New York, Kentucky, and Minnesota, Raymond makes a number of radical departures from the conclusions of Ulrich and Bassler. In certain details, the correlation chart[8] is not in complete harmony with the statements made on the accompanying pages of text, as, for example, in regard to the faunal relations of the Kentucky Curdsville.

The limestones of the Kingston district are described by Kindle.[9] The formations recognized are indicated in Fig. 1, which departs from Kindle's usage only in the separation of the Decorah zone as a distinct stratigraphic unit above the Lowville-Leray. The term, "Rideau," originally proposed by Ami[10] in terms which, in the reviewer's opinion, include the Potsdam sandstone described by Baker as noted above, is applied to the green-tinged, arkosic and generally conglomeratic, shaly beds at the base of the Pamelia formation. Accompanying the description of Ordovician strata is a report upon their faunas by Miss Wilson and K. F. Mather.[11] Faunal lists and descriptive keys to the common fossils are aranged in two parts, one for the Black River and the other for the Trenton rocks.

Quebec.—The district about Lake St. John at the head of Saguenay River in Quebec is of interest to the stratigrapher because of the occurrence of Paleozoic sediments far within the limits of the Pre-Cambrian "shield" of northern Canada. These outliers, described by Dresser,[12] are preserved in a basin formed by normal faulting which may have occurred at the close of the Paleozoic Era. The sediments include Trenton limestone, Utica shale, and Richmond limestone, said to be "deposited in conformable succession."

Fossils from the Trenton and Utica were identified by Raymond. The Trenton fauna is preponderantly molluscan and is probably basal Trenton, "about the horizon of the Rockland beds of the Ottawa district." The Utica fauna is small and not distinctive. According to Foerste, the Richmond faunas correspond to those of the Waynesville member of the Ohio Richmond.

SILURIAN

A star-fish from the Arisaig series at the mouth of Stonehouse brook, Nova Scotia, is described by Ruedemann[13] as a new variety of *Urasterella ruthveni* of the Upper Ludlow in England.

DEVONIAN

E. M. Kindle[14] records the occurrence of limestones containing a Devonian coral at Gull Lake, in the lower MacKenzie Valley, where published data show only Cretaceous and pre-Cambrian terranes. Two other small collections of Devonian fossils from MacKenzie Valley, one from within the Arctic circle, are commented upon.

[7] P. E. Raymond, "The Correlation of the Ordovician Strata of the Baltic Basin with those of Eastern North America," Harvard College Mus. Comp. Zool., Bull., Vol. 56, pp. 179–286, 1916.

[8] Raymond, *op. cit.*, p. 257.

[9] E. M. Kindle, "The Ordovician Limestones of the Kingston Area," Ontario Bur. Mines, Ann. Rept., Vol. 25, Pt. 3, pp. 37–44, 1916.

[10] H. M. Ami, "Ordovician Succession in Eastern Ontario," Geol. Soc America, Bull., Vol. 13, pp. 517–518, 1902.

[11] Alice E. Wilson and Kirtley F. Mather, "Synopsis of the Common Fossils of the Kingston Area," Ontario Bur. Mines, Ann. Rept., Vol. 25, Pt. 3, pp. 45–66, 1916.

[12] J. A. Dresser, "Geological Structure of the Basin of Lake St. John, Quebec," *Trans. Roy Soc. Canada*, Ser. 3, Vol. 10, Sec. 4, pp. 125–130, 1916; "Part of the District of Lake St. John, Quebec," Geol. Surv., Canada, Memoir 92, 1916.

[13] *Op. cit.*, p. 46.

[14] E. M. Kindle, "Notes on Devonian Faunas of the MacKenzie River Valley," *Am. Jour. Sci.* (4), Vol. 42, pp. 246–48, 1916.

CARBONIFEROUS

R. L. Moodie[15] reprints, in his monograph of Pennsylvanian amphibia, descriptions and figures of the remarkable microsaurs from the Joggins coal fields in Nova Scotia, which were published by Dawson between 1860 and 1895.

TRIASSIC

L. M. Lambe[16] has published descriptions of three new fishes, two Paleoniscids and one Crossopterygian, from localities west of Banff. The strata have heretofore been assigned to the Jurassic period[17] but are more correctly correlated with the Upper Banff shale on the basis of invertebrates associated with the fish remains. The Upper Banff fauna, according to Girty and Kindle, represents the horizon of the Lower Triassic Meekoceras beds of Idaho and Wyoming. It should no longer be referred to the Permian.

CRETACEOUS-EOCENE

The geology of the region about Wood Mountain and Willowbunch, adjoining the international boundary south of Moosejaw, Sask., is described by Bruce Rose.[18] The strata exposed range from the Fox Hills and Pierre Cretaceous through the Lance formation to the Fort Union Eocene. The latter contains lignitic coal of value. An excellent description of the Prairie Plains of Saskatchewan and their Quaternary history forms the second chapter of the report.

New types of duck-bill dinosaurs from the Cretaceous of Alberta are described by Brown.[19]

[15] R. L. Moodie, "The Coal Measures Amphibia of North America," Carnegie Inst. Washington, Pub. 238, 1916.

[16] L. M. Lambe, "Ganoid Fishes from near Banff, Alberta," *Trans. Roy. Soc. Canada*, Ser. 3, Vol. 10, Sec. 4, pp. 35–44, 1916.

[17] J. A. Allan, "Bankhead to Golden," Cong. géol. internat., Guide Book 8, Pt. 2, p. 191, 1913.

[18] Bruce Rose, "Wood Mountain-Willowbunch Coal Area, Saskatchewan," Geol. Surv., Canada, Mem. 89, 1916.

[19] Barnum Brown, American Mus. Nat. Hist., Bull., Vol. 35, pp. 701–708, 1916.

MIOCENE

A new species of cyprinid fish, based upon four specimens discovered by Bruce Rose of the Canadian Geological Survey near Kamloops Lake, B. C., is described by Hussakof.[20] It has considerable resemblance to *Leuciscus balteatus* living to-day in the Columbia basin.

Kirtley F. Mather

Queen's University,
Kingston, Canada,
March 5, 1917

SPECIAL ARTICLES

THE VITALITY OF CYSTS OF THE PROTOZOON, DIDINIUM NASUTUM

It is well known that many of the unicellular forms encyst under certain conditions, *i. e.*, become inactive and form a heavy wall about themselves, and that in this state they can endure environmental conditions which are otherwise fatal. For example, the loss of water readily kills didinia when they are in the active state, but when they are encysted desiccation such as is produced by exposure even for months to ordinary atmospheric conditions does not necessarily kill them. This is also true of many other forms. When they are thus dried they may be widely scattered by the wind; encystment consequently may have a twofold function, protection and distribution. Whether or not it functions still further in rejuvenescence in accord with the contention of Fermor (1913) and Calkins (1915) is a question which will be considered at some length in a later paper.

The degree of protection and the extent of distribution that organisms secure by encystment depends upon the vitality of the cysts. The longer they live the greater the protection and the wider the distribution. It is consequently important to know how long organisms can live in the encysted state. This is especially true regarding pathogenic forms, and these forms are the only ones, with the exception of the rotifers, in which the problem has been seriously investigated. Knowledge regarding the endurance of cysts

[20] L. Hussakof, "A New Cyprinid Fish, *Leuciscus rosei*, from the Miocene of British Columbia," *Am. Jour. Sci.* (4), Vol. 42, pp. 18–20, 1916.