The deviation of one of these persons was $-1°.4$. The settings of the other were always positive when made from the positive side and negative when made from the negative side. The average deviation of a single setting made by this person was in absolute amount $1°.5$.

When settings are made by a person while standing squarely before the instrument with his head *much* inclined to one side, the deviations are always clockwise when the inclination is to the right, and counter-clockwise when the inclination is to the left. When the inclination is small it is, of course, not possible to predict the signs of the deviations. The settings of one observer, and of only one among several who were examined, were exceptions to the rule when the head was inclined as much as 20°. In Table VI. the first line gives the deviations of an observer fairly representative of the average, and the second line those of the exceptional person just mentioned. The inclinations were very nearly 20° in all cases.

TABLE VI.

Observer.	Horizontal settings made, when the head was inclined to the						Vertical settings made when the head was inclined to the					
	Left,			Right,			Left,			Right,		
	using the left eye.	using the right eye.	using both eyes.	using the left eye.	using the right eye.	using both eyes.	using the left eye.	using the right eye.	using both eyes.	using the left eye.	using the right eye.	using both eyes.
1	$-2°.3$	$-0°.9$	$-2°.0$	$+2°.1$	$+1°.4$	$+1°.9$	$-1°.9$	$-2°.2$	$-1°.9$	$+0°.7$	$+1°.5$	$+1°.4$
2	$+1\ .3$	$+3\ .4$	$+2\ .1$	$-0\ .6$	$+0\ .9$	$+1\ .4$	$+1\ .1$	$+2\ .2$	$+1\ .2$	$-0\ .6$	$-1\ .0$	$-2\ .4$

When the observer lay on one side on a horizontal shelf, with the line joining his eyes vertical, and with head well screened for some time before he made his settings, the deviations were in all cases clockwise if he lay on his right side and counter-clockwise if he lay on his left side, whether he used one eye or both. The magnitudes of the deviations, though very different with different people, were often as great as 20°.

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THE DEVONIAN SYSTEM IN CANADA.

II.

2. ONTARIO AND KEEWATIN (HUDSON BAY).

While Logan was exploring the Gaspé sandstones in 1843, Mr. A. Murray, then Assistant Geologist to the Canadian Survey, was engaged in a "geological examination of the district lying in a general line between Georgian Bay, on Lake Huron, and the lower extremity of Lake Erie." In his report on that year's operations, published in 1845, Mr. Murray correctly, and for the first time, regards the rocks at Port Colborne, Cayuga, etc., which he calls the Upper Limestones, as the equivalents of the Corniferous limestone of the State of New York. The black bituminous shales at Kettle Point, Lake Huron and on the Sydenham River, that he examined in 1848, he at first thought to be part of the Hamilton formation, but in 1855 he re-examined these shales and some of the exposures on the Sable River and in the township of Bosanquet, in company with James Hall, upon whose authority the former were decided to represent the lowest member of the Portage and Chemung group and the latter the Hamilton formation. But this statement was not published until 1857.

The discovery of the Oriskany sandstone at Cayuga would seem to have been made, or rather first recorded, by E. Billings, in May, 1860. For, in the preface to his now classical paper 'On the Devonian Fossils of Canada West,' Mr. Billings says that the "Devonian rocks of Canada West consist of portions of the Oriskany sandstone,

Schoharie grit, Onondaga limestone, Corniferous limestone, Hamilton, Portage and Chemung groups." This paper was originally published in four parts, and in the third and fourth parts, fourteen of the species of brachiopoda therein enumerated or described are said to occur in the Oriskany. The 'Geology of Canada,' published in 1863, contains a list of thirty species of fossils from the Ontario Oriskany, most of which, in the Museum of the Geological Survey at Ottawa, are labelled as having been collected by J. De Cew. In that publication it is stated that only the lowest of the three divisions of this formation extends into Ontario; that it occupies only a few small areas in the townships of Dunn, Oneida and Cayuga, as a 'very narrow border' to the Corniferous, and that it 'seldom exceeds about six feet in thickness.' A 'list of the fossils occurring in the Oriskany sandstone of Maryland, New York and Ontario,' by Mr. Charles Schuchert, published in 1889, in the 'Eighth Annual Report of the Geologist of the State of New York,' contains the names of seventy-six species from Cayuga. Most of the Ontario material from which this list was made was probably obtained from Mr. De Cew. But Mr. Schuchert, who made additional collections of the fossils of the Ontario Oriskany for the United States National Museum in 1895, says, in a recent letter to the writer, that he then saw how easy it is to mix Oriskany and Corniferous fossils while collecting, and believes that the collections made by Mr. De Cew are mixed. Mr. Schuchert thinks that near Cayuga there is a transition zone between the Oriskany and the true Corniferous, and that many of the fossils recorded in the 'Geology of Canada' as from the Oriskany may be from this zone. Further, he is of the opinion that it is only the uppermost portion of the Oriskany that is represented near Cayuga.

The fossils of the Corniferous formation or Upper Helderberg group of Ontario have been determined or described, either separately or together with those of the Hamilton formation, by E. Billings and Professor H. A. Nicholson, in Canadian publications ranging from 1857 to 1895. Incidentally they have been described or enumerated by James Hall in the thirty-fifth regents' report of the New York State Cabinet of Natural History, and in volumes four to eight of the Paleontology of that State, also by Dr. Carl Rominger in his 'Fossil Corals' of Michigan.

Tabulating the information obtainable from these and other sources, and omitting names that have long been known to be synonyms, the number of species of fossils that have been recorded from this formation in Ontario would seem to be 258, as follows:

Corals (inclusive of Stromatoporoids)	100
Vermes	1
Polyzoa (= Bryozoa)	40
Brachiopoda	60
Pelecypoda (=Lamellibranchiata)	10
Gasteropoda	17
Cephalopoda	8
Ostracoda	1
Trilobita	17
Fishes	4
	258

In addition to these, there are in the Museum of the Canadian Survey, a few fragmentary crinoids, several species of polyzoa, a few brachiopoda, pelecypoda and gasteropoda, and one pteropod (an undetermined species of *Tentaculites*) from the Corniferous of Ontario, that have yet to be studied.

From this list it would appear that corals form by far the most conspicuous feature in the fauna of the Ontario Corniferous. But, although in places this formation is mainly a large coral reef, it is obvious that quite a number of the species that have been proposed therefrom are based upon very insufficient characters. For some time past the writer's friend and colleague, Mr. L. M.

Lambe, has been engaged in a much-needed revision of the Canadian paleozoic corals, and when this revision is completed, as it is hoped it soon will be, it will doubtless materially reduce the number of species from the Corniferous of the province. On the other hand, the number of species of polyzoa, brachiopoda and mollusca from that formation, in collections that have yet to be studied, will be quite largely increased.

The fossils of the Hamilton formation of Ontario have been reported on by Billings, Nicholson, Hall, and more recently by the writer, who has published two small monographs upon them. In the latter of these, published in November, 1898, 219 species are recognized and recorded, as follows:

Sponges	2
Corals (inclusive of Stromatoporoids)	40
Echinodermata	16
Vermes	14
Polyzoa (= Bryozoa)	40
Brachiopoda	61
Pelecypoda (= Lamellibranchiata)	13
Gasteropoda	12
Pteropoda	3
Cephalopoda	8
Ostracoda	3
Phyllopoda	1
Trilobita	4
Fishes	2
	219

Several additional species of Fenestellidæ and Monticuliporidæ are indicated in the Canadian Survey and other collections by mere fragments that have not yet been critically examined. From a comparison between the foregoing lists it would appear that echinodermata and vermes are more numerous in genera and species in the Hamilton formation than in the Corniferous, but eight of the fourteen specimens of vermes from the Hamilton formation are jaws or teeth of conodonts that are very small and difficult to find.

The black shales at Kettle Point, which are supposed to represent the Genesee slates of the State of New York, have so far yielded only a still undetermined *Lingula*, and four species of fossil plants (*Calamites inornatus*, *Lepidodendrum primœvum*, macrospores of *Protosalvinia Huronense*, and a *Spirophyton*) that have been determined or described by Sir William Dawson.

The Tully limestone, the supposed representative of the Cuboides zone of the European Devonian, and the Naples beds, or Intumescens zone, of western New York, have not yet been recognized in Ontario.

One of the results of the explorations of Dr. R. Bell in 1871, 1875, 1877 and 1886, on behalf of the Geological Survey of Canada, was the discovery of a large area of Devonian rocks to the west and southwest of James Bay. In 1871 Dr. Bell collected a few fossils on the Albany River (which is now part of the dividing line between Ontario and the District of Keewatin) between Marten's Falls and the Forks; and in 1886 a much larger number on the same river below the Forks. Some of these fossils are from a yellowish gray limestone, and those obtained from this limestone in 1886 represent seventeen species. Twelve of these appear to be identical with Corniferous species from Ontario and New York State, and the remainder are either undeterminable or undescribed. Others are from small patches of red marl, and these fossils seem to indicate the Hamilton formation, the prevalent species being perfect and well preserved specimens of *Spirifera pennata* (Atwater), formerly known as *S. mucronata*, Conrad.

Collections of fossils that are obviously of Devonian age were made by Dr. Bell in 1875 and 1877 on the Moose River and two of its larger tributaries, the Missinaibi and Mattagami. Lists of these fossils, most of which are identical with well-known Corniferous species, were published in the 'Reports of Progress of the Geological Survey of Canada' for 1875–76 and 1877–78. For many years a number of fossils from

the Devonian rocks of the Albany River at Old Fort Henley and of the Moose River, collected by the late Mr. George Barnston about 1834 or 1835, have been in the Museum of the Canadian Survey, but nothing appears to have been published about them.

In Keewatin a few fossils that are probably of Devonian age were collected in 1886 by Dr. R. Bell at two localities on the Attawapishkat River, and by Mr. Low from the Limestone Rapids on the Fawn branch of the Severn River. These fossils have not yet been critically studied, but among those from the last-mentioned locality there is a recognizable fragment of *Sphærospongia tesselata*, which is one of the most characteristic species of the Stringocephalus zone of the Manitoba Devonian. The existence of Devonian rocks on Southampton Island has been quite recently inferred from the fact that a few fossils from that island lent to Dr. Bell by a missionary in 1898 are similar to those from the Attawapishkat River. Dr. Bell had previously stated that the limestone on Southampton Island is "evidently exactly the same as that of Mansfield Island."* If this be the case the limestone of Mansfield Island may possibly be Devonian, rather than Cambro-Silurian as previously supposed.

3. MANITOBA AND THE NORTH-WEST TERRITORIES.

The Devonian age of the limestones on Snake Island, Lake Winnipegosis, and Manitoba Island, in the lake of that name, was asserted by E. Billings in 1859, on the evidence of a few fossils collected therefrom in 1858. At that time Mr. Billings was under the impression that these limestones are, as he says, 'most probably about the age of the Hamilton group.'† In 1874 Dr. J. W. Spencer collected some fossils, which Mr. Billings pronounced to be also of Devonian age, from rocks on the islands and shore of Swan Lake and on the western shore of Dawson Bay, Lake Winnipegosis. Still more recently an almost exhaustive geological examination of the islands, shores and immediate vicinity of lakes Manitoba and Winnipegosis was made by Mr. J. B. Tyrrell in 1888 and 1889. Assisted by Mr. D. B. Dowling, Mr. Tyrrell also made an exceptionally large collection of the fossils of the Devonian rocks of this region. This collection, which has been reported on somewhat fully by the writer in two illustrated papers published in 1891,* and 1892,† was found to consist of 133 species, but about nineteen of these could not then be determined specifically. Two additional species of corals in this collection have since been determined, and an additional species of pteropoda from a collection made later has been described, making the total of identified or described species now known from these rocks to be 117, as follows:

Sponges (inclusive of Receptaculitidæ)	2
Corals (inclusive of Stromatoporoids)	17
Vermes	1
Polyzoa (= Bryozoa)	5
Brachiopoda	18
Pelecypoda	25
Gasteropoda	29
Pteropoda	2
Cephalopoda	9
Ostracoda	3
Trilobita	3
Fishes	3
	117

According to Mr. Tyrrell these fossils are exclusively from the Middle and Upper Devonian of the province, for the Lower Devonian has not yet been satisfactorily recognized in Manitoba, though it may be

* Geological and Natural History Survey of Canada, Report of Progress for 1882–83–84, p. 34 D.D.

† Hind's report on the Assiniboine and Saskatchewan Exploring Expedition, Toronto, p. 187.

* Transactions of the Royal Society of Canada, Vol. VIII., Sec. 4, p. 93.

† Geological Survey of Canada, Contributions to Canadian Paleontology, Vol. I., pt. 4.

represented by about 100 feet of red and other shales, from which no fossils have yet been collected. In any case they are of special interest as showing certain well marked and not altogether unexpected points of resemblance to those of the English and European Devonian. For, the upper half of the Manitoba Middle Devonian, or Winnipegosan formation of Mr. Tyrrell, consists of a tough white dolomitic limestone holding numerous examples of a large *Stringocephalus* which is apparently identical with the *S. Burtini* of Defrance and other European authors. Moreover, it is here associated with many fine specimens of *Sphærospongia tesselata*, Phillips, and with fossils that cannot at present be distinguished from the following well-known European species:

Cladopora cervicornis (De Blainville).
Spirorbis omphalodes, Goldfuss.
Productella productoides (Murchison).
Stropheodonta interstrialis (Phillips).
Atrypa reticularis, L.
Atrypa aspera, Schlotheim.
Pugnax pugnus (Martin).
Paracyclas antiqua (Goldfuss).
Murchisonia turbinata, Schlotheim.
Euomphalus annulatus, Phillips.
Loxonema priscum, Munster.
Macrochilina subcostata (Schlotheim).

The Stringocephalus limestone of Manitoba would seem to occupy much the same stratigraphical position as that of Devonshire, Rhenish Prussia and Belgium, and its fossils show that it is probably their homotaxial equivalent.

Immediately above the Stringocephalus zone in Manitoba there are beds which may possibly represent the Cuboides zone, although *Rhynchonella*, or, as it is now called, *Hypothyris cuboides*, has not yet been found in them. The prevalent fossils in these beds are *Cyathophyllum dianthus* and *C. vermiculare*, var. *præcursor* (teste Frech); *Chonetes Logani* var. *Aurora*, *Productella subaculeata*, *Orthis striatula*, *Stropheodonta arcuata*, and *Cyrtina Hamiltonensis*, which the Rev. G. F. Whidborne has recently asserted is the same as the European *C. heteroclita*.

Regarding the fossils of the Manitoba Devonian as a whole, it is to be noted that it is not the corals, nor the polyzoa (or bryozoa), nor the brachiopoda that have as yet yielded the largest number of species (as they have in Ontario), but the gasteropoda and pelecypoda.

From the northern end of Lake Winnipegosis the Devonian rocks extend into the immediately adjacent district of Saskatchewan.

It has long been known that the eastern ranges of the Rocky Mountains in Alberta are mainly composed of Carboniferous or Devonian, or perhaps of Carboniferous *and* Devonian, limestones and shales. These rocks were examined in 1858 and 1859 by Sir James Hector, who writes as follows in regard to them:

"These limestones are of dark and light blue colour, crystalline, compact or cherty, with fossils that are either of Carboniferous or Devonian age, the principal of which are *Spirifer*, *Orthis*, *Chonetes*, *Conularia*, *Lonsdalia*, *Cyathophyllum*, *Lithostrotion*, etc." * * * "Along with them are softer beds of gritty, sandy shale, generally of a dull red or purple colour." * * * "In the second range we have the same limestones and shales repeated as in the first, but at the base I observed traces of a magnesian limestone of a buff colour, containing *Atrypa reticularis*, a true Devonian fossil."† * * * "On the Kicking Horse River, in the third range, we have the mountains again formed of blue limestone, along with a compact blue schist with red bands, giving a curious striped aspect to the rocks." ‡

In reference to these remarks, Dr. G. M. Dawson, who made a geological examination of the South Kootanie Pass and its vicinity, in 1874, adds the following comments:

"Dr. Hector is not very clear as to the separation of the supposed Devonian and Carboniferous limestones, and they may indeed very probably belong to

* Palliser's Explorations in British North America, 1863, p. 239.

† Quarterly Journal of the Geological Society of London, Vol. XVII., 1861, p. 443.

‡ Palliser's Explorations in British North America, p. 239.

a single series. Professor Meek, in describing fossils from limestones occurring in the mountains south of the boundary line, which, from the general facies, he believed to be Carboniferous, mentions the fact that the forms, without exception, belong to genera which are common both to that formation and the Devonian, and of which a small number are represented in the Silurian." *

In 1881, 1883 and 1884 Dr. Dawson was engaged in an examination of the geological structure of parts of the Rocky Mountains in Alberta between Lat. 49° and Lat. 51° 30′, the results of which were published in the 'Annual Report of the Geological Survey of Canada' for 1885 (Vol. I., New Series). This report contains preliminary lists of a few supposed Devonian fossils, from the limestones on the summit of the North Kootanie Pass, on Crow Nest Lake, and from the lowest beds exposed at the west end of the cañon on the Cañon branch of the Elbow River.

Subsequently Mr. R. G. McConnell made a geological survey of the Rocky Mountains between the Canadian Pacific Railway and the North Saskatchewan in 1885, and a more detailed exploration than had yet been made, of the geology of those in the more immediate neighborhood of that railway, in 1886. He published in the 'Annual Report of the Geological Survey of Canada' for 1886 a geological section across the Rocky Mountains in the vicinity of the Canadian Pacific Railway, with a diagram showing the formations represented in the sections to the west of the Castle Mountain Range, and another of those represented in sections to the east of that range. In the latter only four geological systems or formations are recognized, namely, the Cambrian, which Mr. McConnell calls also the 'Castle Mountain Group'; the Devonian, which he designates also as the 'Intermediate Limestone'; the Devono-Carboniferous, which he calls the 'Banff Limestone'; and the Cretaceous. In the text it is stated that the Intermediate Limestone is "mainly composed of a great series of brownish dolomitic limestones and has a thickness of about 1500 feet." Its fossils are "usually badly preserved and consist mainly of almost structureless corals." The few that were collected, it may be added, have not yet been determined and indeed are scarcely determinable. According to Mr. McConnell, the Banff Limestone is the "principal constituent of all the longitudinal ranges east of Castle Mountain." It "has a total thickness of about 5,100 feet and is divisible into a lower and upper limestone and into lower and upper shales." Its fossils are better preserved than those of the Intermediate Limestone, and fairly large and representative collections of the former were made.

These collections have not yet been at all exhaustively studied, but most of the species represented in them are apparently of Carboniferous age. Among those collected in 1886 are two or three small species of *Productus;* a large *Syringothyris;* a *Pugnax* closely allied to if not identical with *P. Rockymontana*, Marcou; a *Hustedia* like *H. Mormoni* (Marcou); and two well-marked pygidia of *Prœtus peroccidens*, Hall and Whitfield. The specimens from the black fissile shales of the Bow River, collected by Mr. McConnell in 1885, that were provisionally referred to the Devonian genus *Clymenia* on page 18 D of his report, do not show clear indications of either septa or siphuncle, and may, therefore, be casts of a discoidal gasteropod. On the other hand, in 1885 Mr. McConnell obtained a few specimens, that are unquestionably referable to *Atrypa reticularis*, from the Rocky Mountains at the Pipestone Pass Falls, and from the first range on the North Saskatchewan. It was from the mountains at the source of the North Saskatchewan that

* 'Report on the Geology and Resources of the Region in the Vicinity of the Forty-ninth Parallel,' etc., 1875, p. 71.

the specimens were collected by Sir James Hector which Salter referred to *A. reticularis.*

In 1898 Mr. J. McEvoy collected a few fossils at several localities in the first foothill of the Rocky Mountains, in Alberta, where it intersects the valley of the Athabasca. These fossils have not yet been very critically examined, but those from two of these localities are probably Carboniferous, and the remainder either Carboniferous or Devonian.

In 1868 Mr. F. B. Meek published a paper entitled 'Remarks on the Geology of the Valley of the Mackenzie River, with figures and descriptions of Fossils from that region, in the Museum of the Smithsonian Institution, chiefly collected by the late Robert Kennicott, Esq.,' in the first volume of the Transactions of the Chicago Academy of Sciences. The paper consists of a concise history of the discovery of Devonian rocks at various localities in the Athabasca, Mackenzie River and Yukon districts by Sir John Franklin, Sir John Richardson, Mr. A. K. Isbister, Major R. Kennicott, Mr. R. W. McFarlane, Mr. B. R. Ross and the Rev. W. W. Kirby, followed by descriptions or identifications of thirty-two species of Devonian fossils. Of these species ten are corals, twenty-one are brachiopoda and the remaining one is a cephalopod. Mr. Meek expresses the opinion that the Devonian rocks exposed on the Clearwater, Athabasca, Slave, and Mackenzie Rivers, and on Great Slave Lake, are probably referable to the Hamilton formation.

Since 1868 Devonian rocks have been discovered or examined by officers of the Geological Survey of Canada, and their fossils collected at the following localities in this region. In the Athabasca district, at four different exposures on the Athabasca River and at one each of its tributaries, the Clearwater, Red and Pembina Rivers, by Professor Macoun in 1875, by A. S. Cochrane in 1881, by Dr. R. Bell in 1882 and by R. G. McConnell in 1890; also at three different exposures on the Peace River by Professor Macoun in 1875 and by Mr. McConnell in 1879. In the Mackenzie District, on the banks of the Long Reach of the Lower Liard River and on the Hay River forty miles above its mouth by Mr. McConnell in 1887, and at four different and rather widely distant exposures on the Mackenzie River by Mr. McConnell in 1888.

Most of the fossils from these localities that were collected before 1875 have been provisionally reported on in the Reports of Progress of the Canadian Survey for the years in which they were made. Those, however, that were collected between the years 1875 and 1890, both inclusive, form the subject of an illustrated paper, by the writer, on 'The Fossils of the Devonian Rocks of the Mackenzie River Basin,' published in 1891.* This publication, which is practically a continuation of Mr. Meek's paper on the same subject, already referred to, adds fifty-seven additional species of purely marine invertebrata to the previously known fauna of these rocks, as under:

Sponges	1
Corals (inclusive of Stromatoporoids)	10
Crinoidea	1
Vermes	3
Polyzoa (= Bryozoa)	7
Brachiopoda	20
Pelecypoda	7
Gasteropoda	3
Pteropoda	1
Ostracoda	3
Trilobita	1
Total	57

According to Mr. McConnell, a section of the Devonian rocks in the Mackenzie district, in descending order, would be somewhat as follows:

1. Upper limestone ..... (about) 300 feet
2. Greenish and bluish shales alternating with limestone (about) 500 feet

* Geological Survey of Canada, Contributions to Canadian Paleontology, Vol. I., part 3.

3. Grayish limestone, interstratified with dolomites, the lower part of which may be older than the Devonian..... 2,000 feet (or more)

The whole of the fossils collected by Mr. McConnell, Professor Macoun and Dr. Bell are from the upper part of the middle division of this section. Of the fifty-seven species of fossils in the foregoing list, twenty-two are apparently found also in the Hamilton formation of Ontario and the State of New York; ten (but only six additional ones) in the Devonian rocks of Iowa now referred to the Chemung; and seven in the Chemung of the States of New York and Pennsylvania. On the other hand, there are strong reasons for supposing that the whole of these fossils are from a horizon nearly corresponding to that of the 'Cuboides zone' of Europe. In the first place, three specimens of a brachiopod which the writer has identified with the *Rhynchonella* (now called *Hypothyris*), *cuboides* of Sowerby, were collected by Mr. McConnell, one at the Hay River in 1887, and two on the Peace River at Vermilion Falls in 1889. It is true that Mr. Schuchert thinks that these three specimens should be called *Hypothyris Emmonsi*, but Mr. Walcott had previously expressed the opinion (in 1884) that "there is little doubt but that *Rhynchonella intermedia*, *R. Emmonsi* and *R. venustula*, Hall, are varieties of *R. cuboides*,* of the Devonian of Europe." On the Hay and Peace Rivers the supposed *Hypothyris cuboides* is associated with *Spirifera disjuncta* (or *Verneuili*), and other fossils that are elsewhere supposed to be characteristic of the Cuboides zone are to be met with in the published lists of species from the Athabasca and its tributaries, or the Mackenzie. The discovery by Mr. McConnell, at the Ramparts on the Mackenzie River, of two large specimens of a *Stringocephalus* which cannot at present be distinguished from *S. Burtini* may indicate a northwestward extension of the Stringocephalus limestone of Manitoba. The still later recognition by Dr. John M. Clarke, in 1898, of *Manticoceras intumescens* in the cast of the interior of three chambers of the septate portion of a species of Goniatite from the Hay River, collected by Mr. McConnell and figured by the writer, would seem to indicate the existence of the equivalent of the 'Intumescens zone,' or Naples fauna at that locality.

* Monographs of the United States Geological Survey, Vol. VIII. (Paleontology of the Eureka District), page 157.

The present state of our knowledge of the Devonian rocks of the whole Dominion, from a purely paleontological standpoint, may be thus briefly summarized. We now possess a fairly satisfactory knowledge of the fossils of the Devonian rocks of Ontario, and of the relations which these rocks bear to the typical section in the State of New York. The fossil plants of the Gaspé sandstones have been described and figured by Sir William Dawson, and the remarkable assemblages of fossil fishes from the Upper Devonian of Scaumenac Bay and Lower Devonian near Campbellton have been worked out somewhat exhaustively, the earlier collections in Canada, and the later ones by the best ichthyological authorities in London and Edinburgh. We have now some idea of the fossil fauna of the Manitoba Devonian, and have added materially to our knowledge of the fossils of the Devonian rocks of the Athabasca and Mackenzie River districts. But, on the other hand, our knowledge of the organic remains of the Devonian of Nova Scotia is still in its infancy, and it would seem that the plant-bearing beds near St. John's, N. B., which have so long been regarded as Devonian, may possibly be Carboniferous. In the Rocky Mountain region of Alberta we have not always succeeded in distinguishing Devonian rocks

from Carboniferous, and we have yet to obtain a much fuller knowledge than we now possess of the Devonian fossils of Keewatin and the area to the southwest of James Bay.

J. F. Whiteaves.

Ottawa, June 28, 1899.

SECTION B—PHYSICS.

The work of this section at the Columbus meeting was extremely gratifying to those who were fortunate enough to attend; although no papers of an epoch making nature were presented, still all those which were read were of a good character, and seemed to represent a large part of the work in physics in this country, for the past year or more. Several of the papers were of considerable importance, and it is hoped that they will find their way into the columns of this Journal before long.

The meetings of the section were well attended and the discussions were intelligent, interesting and to the point. It should be a matter of congratulation that the Association succeeded in collecting at Columbus so large a number of working physicists and presented such a good series of papers. It seems that more and more such scientists and such papers as are found at the meetings of the British Association are coming to these meetings.

The address of the Vice-President, Dr. Elihu Thomson, 'On the Field of Experimental Research,' was published in Science for August 25th.

Professor Caldwell presented a number of interesting diagrams, which by appropriate super-position enable one to point out the constants of current and electromotive force in the rotary converter. These diagrams must be extremely useful in presenting the complex question of the operation of these machines.

Professor Eddy showed a simple and convenient method for constructing the entropy-temperature diagrams of a gas or oil engine from the indicator card; and showed how these diagrams enable one to readily detect the advantages or defects in the running of such engines.

Mr. Briggs' new variable condenser consists of a series of alternating plates of mica and spring brass. The capacity is increased by compressing the plates together by means of a thumb-screw.

In photometric operations we are accustomed to compare the relative illumination of two surfaces by looking at them, and guessing at their relative intensity, or by endeavoring to make the illumination of the two surfaces equal. In Professor Cattell's method, however, the difference between the two surfaces is measured by the time it requires for the observer to decide which of the two surfaces is the brighter; it being a fair assumption that the difference in the impressions is a function of the time required to distinguish between them. A considerable series of observations have confirmed the belief that this method is not only applicable but highly advantageous.

In Professor Cattell's other paper, he brought before the section an extremely interesting and novel observation, which must throw considerable light upon the relative importance of the retina and the brain in the operation of vision. He finds that if, by a motion of the eye, the images of black and white bars are made to pass over the retina at the rate of even a hundred or a thousand per second, still the eye or the brain perceives them as individual bars, and not as a fused gray surface; of course, when the eye is stationary, if light and dark images are caused to pass over the retina at a much less rate, we have perfect fusion. Thus it seems a matter of vital importance in distinct vision, when the image moves on the retina, whether the eye is moving and the object stationary, or the reverse. These experiments indicate that the phenomena of vision are chiefly cerebral